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MEMORANDUM

SUBJECT: EPA Comments on "Assessment of Dam Safety of Coal Combustion Surface Impoundments: GenOn – Conemaugh Generating Station, New Florence, Pennsylvania"

**DATE: July 15, 2013**

1. In section 1.2.3 "Recommendations…" it may be advantageous to explicitly include in recommendations for supporting technical documentation that a liquefaction potential analysis be conducted if warranted by representative soil samples.
2. On page 4-1, Sections 4.1.1 and 4.1.2 – Section 4.1.1 indicates that the Pond cells for the Ash Filter Ponds were constructed in 1985-1986. However, in section 4.1.2, the report indicates that a fourth cell was added to the Ash Filter Ponds in 1983. Should the date in Section 4.1.2 be 1993? How can a pond be added prior to the construction of the original system?
3. On page 4-1, Section 4.2.1, please indicate that the "impoundment" is the Ash Filter Ponds Impoundment.
4. On pages 5-4 and 5-5, the font appears to have changed from caption under the photo "Figure 5.2.4-1" through the text of section 5.3.1.
5. Please include, in memo form, the informal analysis, performed by the contractor, that indicates that the structural stability of the impoundments is likely sufficient.

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| | |
|---|---|
| **From:** | Adams, Roger |
| **To:** | Englander, Jana; Cox, Ken; rogers, rick; Conover, Clark |
| **Cc:** | Hoffman, Stephen; Dufficy, Craig; Kelly, PatrickM; Caylor, Douglas |
| **Subject:** | RE: Comment Request on Coal Ash Site Assessment Round 12 Draft Report - GenOn - Conemaugh Generating Station |
| **Date:** | Tuesday, October 29, 2013 4:27:13 PM |

Dear All,

Pennsylvania DEP Dam Safety has reviewed the draft assessment report for the Conemaugh Generating Station Filter Ash Ponds & Desilting Basin. The Department concurs with the findings of the Dewberry & Davis, LLC report and offers the following additional comments:

Upon review of the information presented in the report, Pennsylvania DEP Dam Safety has determined that the Filter Ash Pond cells collectively comprise a jurisdictional dam under 25 PA Code §105.3(a)(3) - *Dams used for the storage of fluids or semifluids other than water, the escape of which may result in air, water, or land pollution or in danger to persons or property.* The Department will regulate this ring dike structure containing four cells and the appurtenant structures of the dam. The Department has preliminarily designated the structure as class "C-4" dam based on the size and hazard potential and will regulate the dam until it is no longer deemed a jurisdictional dam by the Department. The dam is now identified by the Department as D32-091 – Conemaugh Gen Station WWT Lagoon Dam. The dam will be periodically inspected by the Department and any deficiencies will be reported to the owner.

The Desilting Basin does not receive offsite runoff and is designed to only hold water for temporary storage and use as makeup water to the Flue Gas Desulfurization (FGD) system. Additionally It is noted that as the Desilting Basin has an effective height of only eight feet and a storage volume of less than 50 acre-feet, the Department does not consider it a jurisdictional dam under 25 PA Code §105.

Please let me know if you need additional information.
Roger

**Roger P. Adams, P.E.** | Chief, Division of Dam Safety
Department of Environmental Protection | Bureau of Waterways Engineering and Wetlands
Rachel Carson State Office Building
400 Market Street | Hbg PA 17101
Phone: 717.772.5951 | Fax: 717.772.0409
www.dep.state.pa.us

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**From:** Englander, Jana [mailto:Englander.Jana@epa.gov]
**Sent:** Monday, September 30, 2013 3:29 PM
**To:** Cox, Ken; rogers, rick; Conover, Clark; Adams, Roger; Reisinger, Richard; Berger, James; Maines, Heath; Kreider, Kirk; Hannigan, Lisa
**Cc:** Hoffman, Stephen; Dufficy, Craig; Kelly, PatrickM; Englander, Jana
**Subject:** FW: Comment Request on Coal Ash Site Assessment Round 12 Draft Report - GenOn –

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Conemaugh Generating Station

Dear All,

We would like to offer Pennsylvania and EPA Region 3 an opportunity to comment on the Draft Assessment Report on the Coal Combustion Residual Impoundment(s) located at the facility below. You can access the report by following the link below. Please let me know if you intend to comment or have any questions. Comments would be appreciated within 30 calendar days of receipt of this email. Thank you!
Regards,

Jana

**Jana Englander**
Office of Resource Conservation and Recovery,
Materials Recovery Waste Management Division
Energy Recovery and Waste Disposal Branch
U.S. Environmental Protection Agency
703-308-8711

---

**From:** Englander, Jana
**Sent:** Monday, September 30, 2013 3:10 PM
**To:** 'dbenson@kcpo.com'; 'amy.trojecki@exeloncorp.com'; 'vicky.will@exeloncorp.com'
**Cc:** Hoffman, Stephen; Dufficy, Craig; Kelly, PatrickM; Englander, Jana
**Subject:** Comment Request on Coal Ash Site Assessment Round 12 Draft Report - GenOn – Conemaugh Generating Station

Dear Mr. Benson,

The draft assessment report for GenOn – Conemaugh Generating Station is ready for review. EPA would appreciate it if you would review and submit your comments on this report to us within 30 calendar days of receipt of this email. **Please confirm receipt of this email and send your comments to:**

Mr. Stephen Hoffman
US Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

If you are using overnight of hand delivery mail, please use the following address:

Mr. Stephen Hoffman
US Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor, N-5237
Arlington, VA 22202-2733

You may also provide your comments by e-mail to hoffman.stephen@epa.gov and englander.jana@epa.gov.

You may assert a business confidentiality claim covering all or part of the information requested, in the manner described by 40 C. F. R. Part 2, Subpart B. Information covered by such a claim will be disclosed by EPA only to the extent and only by means of the procedures set forth in 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when EPA receives it, the information may be made available to the public by EPA without further notice to you. If you wish EPA to treat any of your response as "confidential" you must so advise EPA when you submit your response.

The draft report can be accessed at the secured link below. The secured link will expire on November 15, 2013.

Here is the link for the report:

http://www.hightail.com/download/OGhkeFVSZ1BCMTVESjhUQw

Please let me know if you have trouble accessing the reports or have any questions/requests.

Respectfully,

Jana Englander

**Jana Englander**
Office of Resource Conservation and Recovery,
Materials Recovery Waste Management Division
Energy Recovery and Waste Disposal Branch
U.S. Environmental Protection Agency
703-308-8711

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| | |
|---|---|
| **From:** | Frank, Stephen |
| **To:** | Hoffman, Stephen; Englander, Jana |
| **Subject:** | Comment Request on Coal Ash Site Assessment Round 12 Draft Report - Conemaugh Generating Station |
| **Date:** | Wednesday, November 27, 2013 9:45:52 AM |
| **Attachments:** | Conemaugh - Desilting Basin Ponds Inspection Report.pdf<br>Conemaugh - Ash Recycle Ponds Inspection Report.pdf<br>Con Desilting Basin Post Construction Certification 11-1-13.pdf<br>Desilting Basin DER.PDF<br>Desilting Basin Design Drawings.pdf<br>Final MD13352_Conemaugh 11.22.13.pdf<br>Conemaugh Ownership and other minor text revisions.pdf<br>Desilting Basin Photos 2013 prnt.pdf |

Dear Mr. Hoffman and Ms. Englander,

As requested, NRG has reviewed and is providing the following comments on the Draft Report for Conemaugh Generating Station:

- The station operator is GenOn Northeast Management Company (GenOn), a subsidiary of NRG Energy, Inc. (NRG).

- Since the site inspection by Dewberry personnel on September 14, 2012, the Cooling Tower Desilting Basin at the Conemaugh Generating Station was reconstructed in its entirety. As a result, a fair portion of the Draft Report will need to be updated to reflect this new construction. Construction was completed on November 1, 2013 (See attached Post Construction Certification). Copies of portions of the Design Engineer's Report, Design Drawings, and photographs are also attached for reference. Copies of the Hydraulics and Hydrology calculations referenced in the Design Engineer's Report can be provided if requested.

- Although the conclusions appear correct regarding hydrologic/hydraulic safety, the conclusions for the Ash Filters Ponds did not reflect the presence of a gravity emergency overflow outfall from the ponds that would also prevent overtopping of the embankments. Additional information regarding this outfall is included in the Geosyntec report, which is attached to this e-mail.

- Revised text reflecting the ownership in Section 2.1 and other minor changes are attached.

- The surveillance program has been formalized and expanded to include the Ash Filter Ponds by using a checklist format (Example Inspection Reports attached).

- Based on the assessment conducted by Geosyntec (attached), the embankments for the Ash Filter Ponds and Desilting Basin are sufficiently stable, and it is appropriate for the EPA to report a condition of "Satisfactory," instead of "Poor," for continued safe and

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reliable operations of the impoundments at the Conemaugh Generating Station.

Please do not hesitate to contact me with any questions or comments.

Thank you, Steve

NRG Energy

**Stephen M. Frank, PE**
Senior Environmental Specialist
NRG Energy Southpointe Operations Center
121 Champion Way, Suite 300
Canonsburg, PA 15317
P 724.597.8310
M 724.249.3610

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22 November 2013

NRG Energy Southpointe Operations Center
121 Champion Way, Suite 300
Canonsburg, PA 15317

Attention: Mr. Stephen Frank, P.E.
Senior Environmental Specialist

**Subject: Geotechnical and Hydraulic Assessment Report**
**Conemaugh Generating Station – Filter Ash Ponds and Desilting Basin**
**New Florence, Pennsylvania**

Dear Mr. Frank:

Geosyntec Consultants (Geosyntec) is pleased to submit this letter report presenting the findings of an assessment of the coal combustion waste (CCW) impoundments at the Conemaugh Generating Station (Site). The assessment was performed to address the recommendations of the draft report issued by the United States Environmental Protection Agency (EPA) regarding the condition of the impoundments. This report presents the results of the following activities: (i) field investigation of soil properties; (ii) general assessment of the geotechnical stability of pond embankments; and (iii) hydrologic/hydraulic evaluation of these ponds. This letter report was prepared by Dr. Chunling Li, P.E. and Mr. Wade Tyner, P.E., and it was reviewed by Dr. Lucas de Melo, P.E. and Mr. Michael Houlihan, P.E., in accordance with Geosyntec's peer review policy

## 1. BACKGROUND

The CCW management system at the site includes a cluster of four contiguous Filter Ash Ponds and a separate Cooling Tower Desilting Basin (Desilting Basin). These ponds were recently evaluated by the United States Environmental Protection Agency (EPA) as part of its ongoing national effort to assess the management of CCW. The draft EPA report dated November 2012, prepared by Dewberry & Davis, LLC (Dewberry) of Fairfax, Virginia, provided a Condition Assessment for each of the impoundments. According to EPA's guidelines, the Condition Assessment result can be "Satisfactory", "Fair", "Poor", or "Unsatisfactory" based on the availability of data, analysis, loading condition, and several other factors. The EPA draft report for Conemaugh site [Dewberry, 2012] provides a Condition Assessment result of "Poor" to both the Filter Ash Ponds and the Desilting Pond. The report states that the "rating is influenced by the lack of any formal documentation of hydrologic/hydraulic safety and slope stability for the Ash Filter Ponds and Desilting Basin dikes."

Section 1.2.3 of the EPA draft report provides the following recommendations for both the Filter Ash Ponds and Desilting Basin:

**Recommendation 1**: "Prepare and maintain on file formal documentation of slope stability analyses and safety factors."

**Recommendation 2**: "Prepare and maintain on file formal documentation of hydrologic/hydraulic safety showing the impoundments ability to hold design floods and precipitation."

After the draft report of the EPA inspection of the impoundments at Conemaugh was made available, NRG had thirty days from the receipt of this report to comment on the EPA's conclusions. On October 2013, NRG requested and was granted by EPA a 30-day extension to present EPA with responses to the EPA draft report; this extension postponed the due date of NRG's response to 30 November 2013. To support responding to comments presented in the EPA draft report, NRG retained Geosyntec to perform an assessment of the site's CCW impoundments. The purpose of this assessment is to:

- Evaluate the conditions that led to the assessment outcome of "Poor"; and
- Address the recommendations provided in the EPA report.

The findings of the assessment are presented in this letter report.

## 2. SUMMARY OF WORK

Geosyntec's work conducted in this assessment in response to EPA's comments is summarized in the following table.

**TABLE 1**
**SUMMARY OF WORK**

**Conemaugh Generating Station**
**New Florence, Pennsylvania**

| Impoundment | EPA Recommendation | Work Conducted | Where Addressed in this Report |
|---|---|---|---|
| Ash Filter Ponds/ Desilting Basin | 1 | • Field investigation and laboratory tests<br>• Slope stability analyses.<br>• Liquefaction potential evaluation | Section 3, Appendices B and C<br>Section 4, Appendix D<br>Section 5 |
| | 2 | • Hydrologic/hydraulic analysis | Section 6 |



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## 3. GEOTECHNICAL FIELD INVESTIGATION

On 15 October 2013, Geosyntec conducted a geotechnical field investigation at the Filter Ash Pond and Desilting Basin to collect the data needed to assess the characteristics and properties of the stratigraphy.

The geotechnical field investigation consisted of drilling six test borings, identified as B-1 through B-4 (located in the Filter Ash Ponds area), and NE-1/SE-1 (located in the Desilting Pond area). Boring locations are shown in Figure 1. These borings were advanced near the crest of the exterior slope of the Filter Ash Pond and Desilting Basin embankments. Borings were drilled to an approximate depth of 26 feet below the existing ground surface (ft-bgs) at the Filter Ash Pond and 10 to 16 ft-bgs at the Desilting Basin. Boring investigation has been previously conducted at the Desilting Basin area and the boring logs have been presented in the Permit Application for reconstructing the Desilting Basin [GAI, 2011].

A track-mounted hollow-stem auger was used to advance the test borings. The drill bit has an internal diameter of 3.25 inches and outside diameter of 6 inches. Soil samples were obtained using a split-spoon sampler in accordance with ASTM D 1586 [ASTM, 2009]. At each boring location, soil samples were obtained every 2 ft. Sampling was conducted continuously at each of the borings. The soil penetration resistance was measured at all sampling locations using the Standard Penetration Test (SPT) and recording blow counts (i.e., N-values). The N-value is the number of blows required for a 140-pound (lb.) hammer dropping 30 inches (in.) to drive the sampler through a 12-in. interval. Boring logs obtained as part of this work are included in Appendix B of this report. After completion, the geotechnical boreholes were backfilled to ground surface using a cement grout.

Based on the boring logs, the Filter Ash Ponds' embankments were constructed using clay or silt with varying amount of gravel. The SPT N-values varied between 8 and 40 blows/ft. The soils below the original ground surface prior to pond construction have similar appearance and generally higher SPT-N value; thus, they are considered to have similar physical properties as the fill material used for embankment construction. Indication of weathered rock formation was encountered at approximately near the bottom of the boring at B-1 through B-4. No sound bedrock was encountered at these boring locations.

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The Desilting Basin was constructed through excavation. The soils at the Desilting Basin were also identified as clay or silt with varying amount of gravel based on boring logs for SE-1 and NE-1. The SPT-N values varied from 3 to 27 blows/ft.

Laboratory test results were conducted to classify the soil samples collected during field investigation. The tests conducted include:

- Water content tests (ASTM D2216)
- Grain size distribution tests (ASTM D1140)
- Atterberg Limit tests (ASTM D4318)

The results of laboratory tests are shown in Appendix C.

Shear strength properties for the embankment and foundations soils were derived from data collected during the field investigation and from laboratory results. The soil properties derived from the field and laboratory tests are presented in Appendix D (i.e., Stability Analysis).

The groundwater table was not identified during drilling or after completion of the borings.

## 4. STABILITY EVALUATION

Geosyntec performed a stability analysis for both Filter Ash Ponds and Desilting Basin. Three representative cross sections, denoted as A-A, B-B, and C-C, were selected for the analysis based on review of subsurface conditions, visual inspection, and pond geometry. Cross Sections A-A and B-B are located at the Desilting Basin, and Cross Section C-C is at the Filter Ash Pond's Cell D. The locations of the selected cross sections are shown in Figures 1 and 2. These sections were selected either because the embankment height at this location is the highest or the slope is steepest. The weakest foundation condition identified by the boring investigation was conservatively assumed for the analyses of all analyzed cross sections. Thus, the selected cross sections represent the critical cross section and analysis results will likely represent the lowest expected factor of safety against failure for each evaluated impoundment.

The geometry of the embankment was obtained from the design plans, including design drawings of the Desilting Basin prepared by GAI dated August 2011 and design drawing of Filter Ash Ponds by Gilbert dated February 1980. Stability was analyzed under both static and seismic loading conditions. Both impoundments were considered to be at its high water elevation. No rapid drawdown analysis was found to be necessary because both the Filter Ash Ponds and the Desilting Basin are lined, and also because under this loading condition, the inner slope of the empty pond would represent the critical failure condition, which would not cause ash release or result in a hazard of the type that is contemplated in the EPA assessment. The major static load applied to the foundation soils is the gravity load exerted by the weight of the berm. A surcharge

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load of 250 psf was applied to the top of the embankment to model traffic loading on top of the embankment. This is a conservative assumption, because traffic loads are not permanent loads.

Based on the 2008 USGS Seismic Hazard Maps for Central and Eastern United States, the peak (horizontal) ground acceleration (PGA) with a 2-percent probability of exceedance in 50 years at this site is anticipated to be 0.050g (g is the gravitational acceleration). Seismic loading was modeled considering the maximum horizontal acceleration in bedrock for the Conemaugh site of 0.05g and seismic coefficient of 0.039. Details on the derivation of these parameters are included in Appendix D (i.e., Stability Analysis).

No phreatic surface would be expected to develop in the dike embankments if the liners at both the Ash Filter Ponds and the Desilting Basin perform as designed. To model the water pressure acting on the embankment, material inside the impoundments were represented by a no-shear strength material with unit weight of 62.4 lbs/ft$^3$. Based on the historical groundwater monitoring well results and Natural Resources Conservation Service (NRCS) Web Soil Survey [Dewberry, 2013], the groundwater level at the Ash Filter Ponds site is assumed to be at the bottom of both impoundments.

Geosyntec conducted the slope stability analyses using the computer program SLIDE version 6.0 [Rocscience, 2012]. Both circular and non-circular (block) slip surfaces were analyzed. The factors of safety are all above the minimum recommended values. A summary of stability analyses results are presented in Table 2. Complete analyses are included in Appendix C (i.e., Stability Analysis).

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**TABLE 2**
**RESULTING FACTOR OF SAFETY – SLOPE STABILITY ANALYSIS**

**Conemaugh Generating Station**
**New Florence, Pennsylvania**

| Cross Sections | Loading Conditions | Failure Mode | Calculated F.S. | Target F.S. |
|---|---|---|---|---|
| A-A (Desilting Basin) | Static (undrained) | Block | 1.30 | 1.30 |
| | | Circular | 1.30 | 1.30 |
| | Static (drained) | Block | 1.62 | 1.50 |
| | | Circular | 1.59 | 1.50 |
| | Seismic | Block | 1.21 | 1.20 |
| | | Circular | 1.20 | 1.20 |
| B-B (Desilting Basin) | Static (undrained) | Block | 1.63 | 1.30 |
| | | Circular | 1.56 | 1.30 |
| | Static (drained) | Block | 1.83 | 1.50 |
| | | Circular | 1.82 | 1.50 |
| | Seismic | Block | 1.40 | 1.20 |
| | | Circular | 1.33 | 1.20 |
| C-C (Filter Ash Pond) | Static (undrained) | Block | 2.57 | 1.30 |
| | | Circular | 2.61 | 1.30 |
| | Static (drained) | Block | 1.50 | 1.50 |
| | | Circular | 1.50 | 1.50 |
| | Seismic | Block | 2.30 | 1.20 |
| | | Circular | 2.29 | 1.20 |

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## 5. LIQUEFACTION POTENTIAL

Liquefaction is a phenomenon where soil substantially loses strength and stiffness in response to cyclic loads (e.g., earthquake) or change in stress state. Generally, liquefiable soils are saturated or nearly saturated loose sand with relatively low fines content. According to the boring logs, the soils present at the site are either cohesive or contains primarily relatively large gravel-size particles. Therefore, the soils at the site are not considered liquefiable. Additionally, the site is located in an area with low seismic activity. The potential for liquefaction in this site is considered negligible.

## 6. HYDROLOGIC/HYDRAULIC EVALUATION

Section 1.2.3 of the EPA report recommends the following with regard to the hydrologic/hydraulic evaluation of the impoundments: "Prepare and maintain on file formal documentation of hydrologic/hydraulic safety showing the impoundments [sic] ability to hold design floods and precipitation."

In response to this recommendation, Geosyntec has performed an evaluation of the hydrologic/hydraulic performance of these impoundments.

*Desilting Basin*

Stormwater from the area north of the offices and adjacent to the cooling towers flows by gravity to the Desilting Basin. GAI Consultants [2011] conducted a hydraulics and hydrology calculation as a part of the water quality management permit application. Their analysis assumed that the cooling tower yard area discharged to the basin, and both the FGD pumps and Cooling Tower Blowdown Treatment System are not operational, and that the Ash Valley Treatment System is operating. Considering that the pre-storm water surface elevation in the basin is at the crest of the riser (i.e., 1077.75 ft), the results of the modeling for 25-year and 100-year storm are summarized in Table 3 below:

**TABLE 3**
**SUMMARY OF HYDRAULIC AND HYDROLOGY MODELING RESULTS – DESILTING BASIN**

**Conemaugh Generating Station**
**New Florence, Pennsylvania**

| Peak Inflow (cfs) | | Riser Discharge (cfs) | | Peak Water Elevation (ft-msl) | | Freeboard (ft) | |
|---|---|---|---|---|---|---|---|
| 25-yr | 100-yr | 25-yr | 100-yr | 25-yr | 100-yr | 25-yr | 100-yr |
| 70.5 | 89.8 | 36.9 | 38.9 | 1079.32 | 1079.87 | 2.18 | 1.63 |



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As demonstrated by GAI [2011] and summarized in Table 3, a freeboard greater than 1 ft can be maintained during a 100-year storm event at the Desilting Basin. All influent pipes to the basin can be valved off; therefore the stormwater management system is equipped with means to by-pass stormwater away from the Desilting Basin and reduce the risk of embankment overtopping during an extreme storm event (i.e., larger than the 100-yr storm event).

*Ash Filter Ponds*

The Ash Filter Ponds currently are designed to receive outflow from Ash Water Recycle Sump (AWRS). The AWRS receives water from the following sources: (1) stormwater collected by the Ash Silo Sump at the Ash Silo Complex Area; (2) a small vegetated area located to the north of the four Ash Ponds, Limestone Pond (limestone pile drainage area), and FGD Building & Gypsum Area; (3) process water, and (4) Ash Filter Ponds Drainage area. These sources of stormwater could be pumped to the Desilting Basin, returned to the Ash Filter Ponds, or overflow through the NPDES permitted Internal Monitoring Point (IMP) 707 (i.e., Manhole #4) to the final Outfall 007. The delineated stormwater drainage area and hydraulic/hydrologic model prepared by GAI are shown in Figures 3 and 4, respectively.

Other than direct precipitations, flow into the Ash Filter Ponds can be controlled by pump during a storm event and the normal water elevation is maintained at 2 ft below the crest of the embankment. The design precipitation depth at the high end of the design range (100-year frequency) is 5.77 inches or 0.48 ft, which is considerably less than the available freeboard. Considering that water inflow into the Ash Filter Ponds can be controlled by the existing water management system installed at the site and/or diverted towards the Desilting Basin or Overflow through Manhole #4 during large storm events, the Ash Filter Ponds are considered to be sufficiently safe to avoid embankment overtopping in a 100-year design storm.

## 7. CONDITION ASSESSMENT

Condition Assessment definitions, as accepted by EPA, are as follows:

- *Satisfactory:* *No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.*

- *Fair:* *Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.*



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- *<u>Poor:</u> A management unit safety deficiency is recognized for a required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. "Poor" also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.*

- *<u>Unsatisfactory:</u> Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary."*

Based on the assessment conducted in this analysis, the embankments at the site is sufficiently stable. The Ash Filter Pond and Desilting Basin can safely contain a 100-year precipitation. It is our opinion that, with the additional information that is now available in this report, it would be appropriate for the EPA to report a condition of "Satisfactory", instead of "Poor", for both CCW impoundments at the site.

## 8. CONCLUSIONS

Based on the assessment described in this letter, Geosyntec believes that the appropriate Condition Assessment result is "Satisfactory". Other than routine maintenance, no other action is recommended at this time.

Geosyntec is confident that the findings discussed in this report address each of the EPA's comments provided in the Condition Assessment draft report for the Conemaugh facility. If EPA has additional comments or requests, we would be happy to address those.

Geosyntec appreciates the opportunity to be of assistance to NRG on this project. Please call any of the undersigned if you have any questions.

Sincerely,

Lucas de Melo, Ph.D., P.E.
Senior Engineer

Mike Houlihan, P.E.,
Principal



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Attachments: Appendix A – References
Appendix B – Boring Logs
Appendix C – Laboratory Test Results
Appendix D – Stability Analysis

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FIGURES

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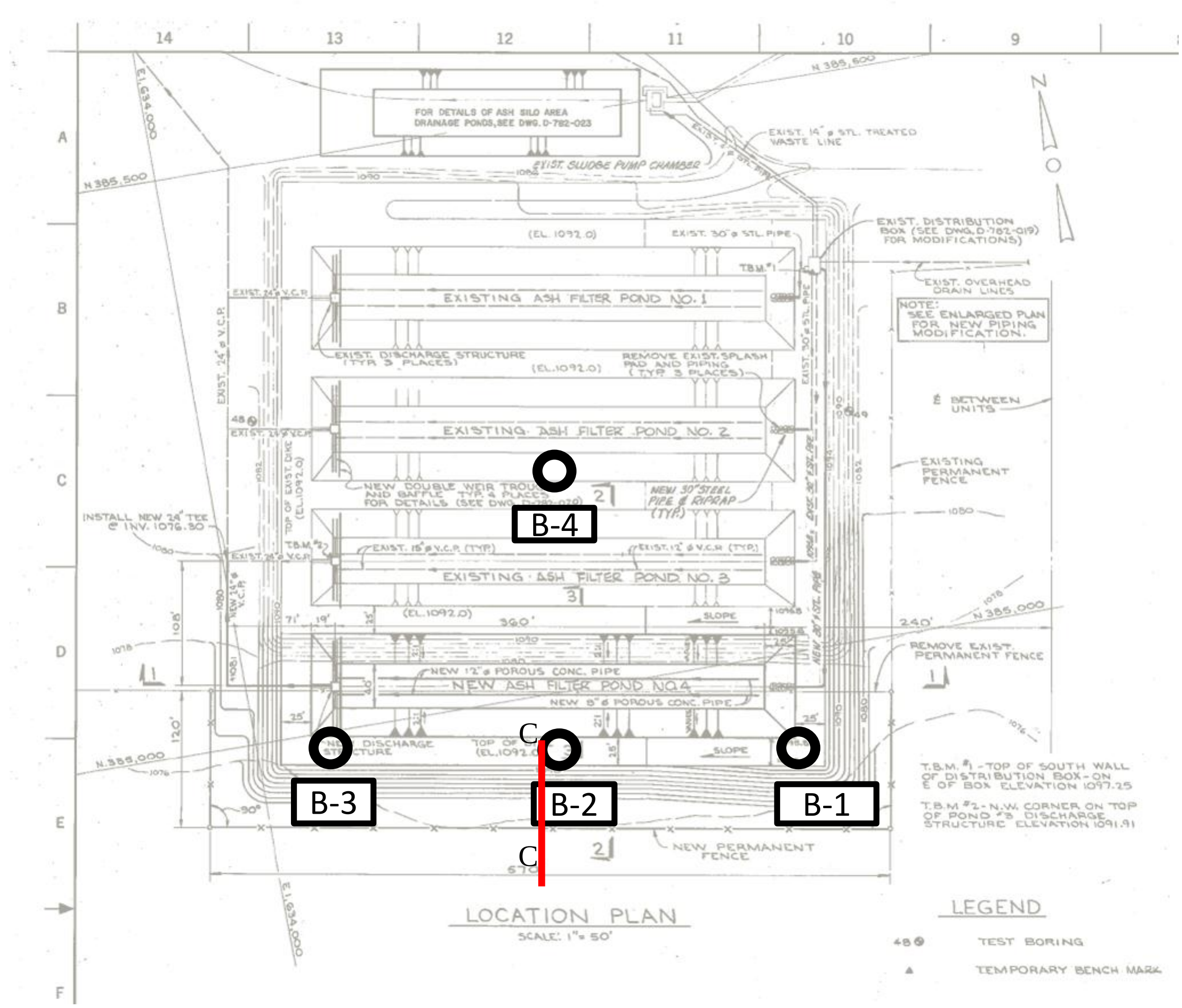


| **Legend** | **FIGURE 1 - SOIL BORING LOCATION**<br>**Conemaugh Power Station – Ash Filter Pond**<br>New Florence, PA | | |
|---|---|---|---|
| B-1 Approximate Boring Location | Geosyntec consultants<br><br>COLUMBIA, MARYLAND | DATE: | Oct 2013 |
| | | PROJECT NO. | ME1001 |
| | | DOCUMENT NO. | |
| | | FIGURE NO: | 1 |

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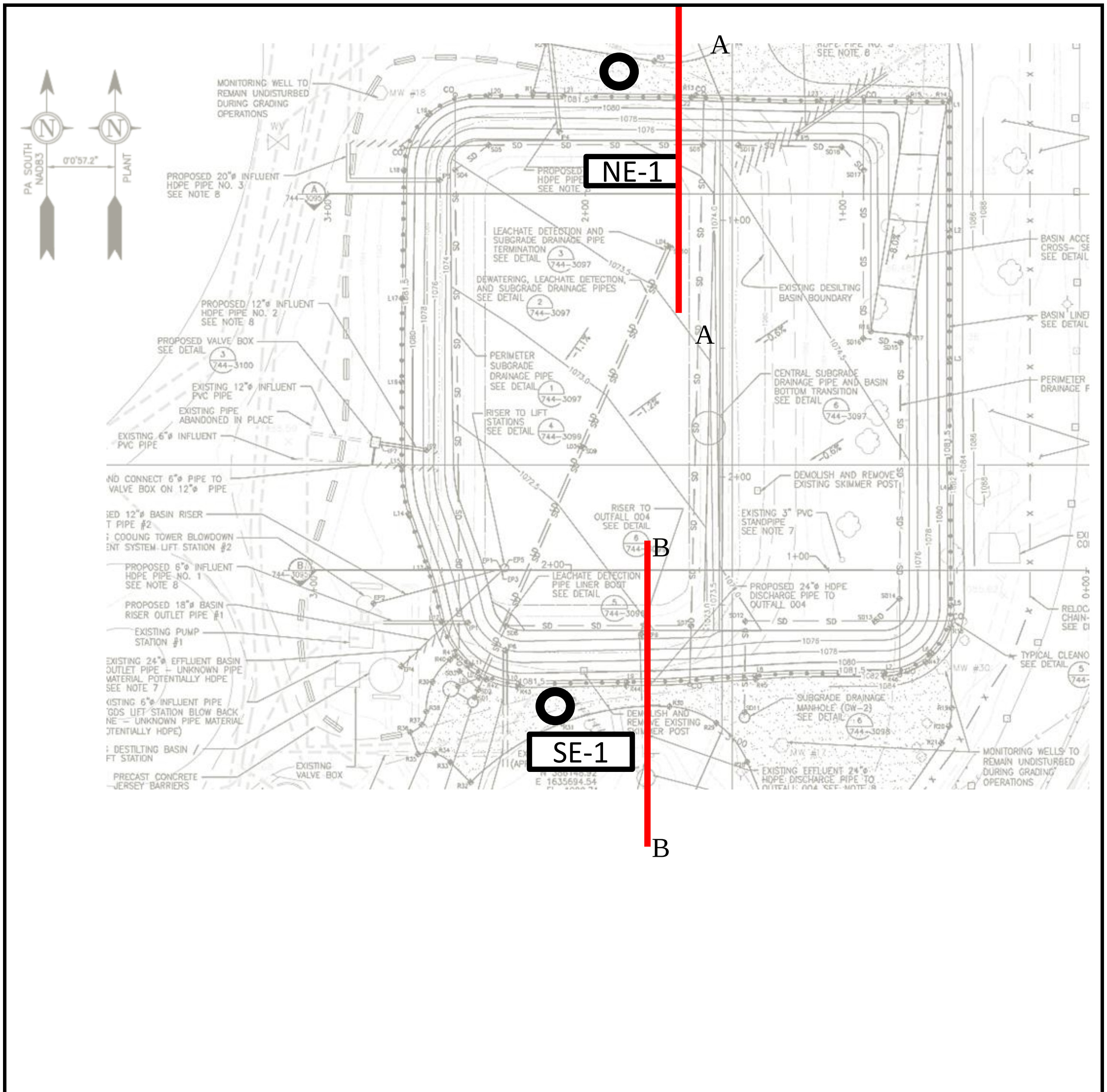


**Legend**

B-1 Approximate Boring Location

**FIGURE 2 - SOIL BORING LOCATION**

**Conemaugh Power Station – Desilting Basin**

New Florence, PA

| Geosyntec consultants | DATE: | Oct 2013 |
|---|---|---|
| | PROJECT NO. | ME1001 |
| | DOCUMENT NO. | |
| COLUMBIA, MARYLAND | FIGURE NO: | 2 |

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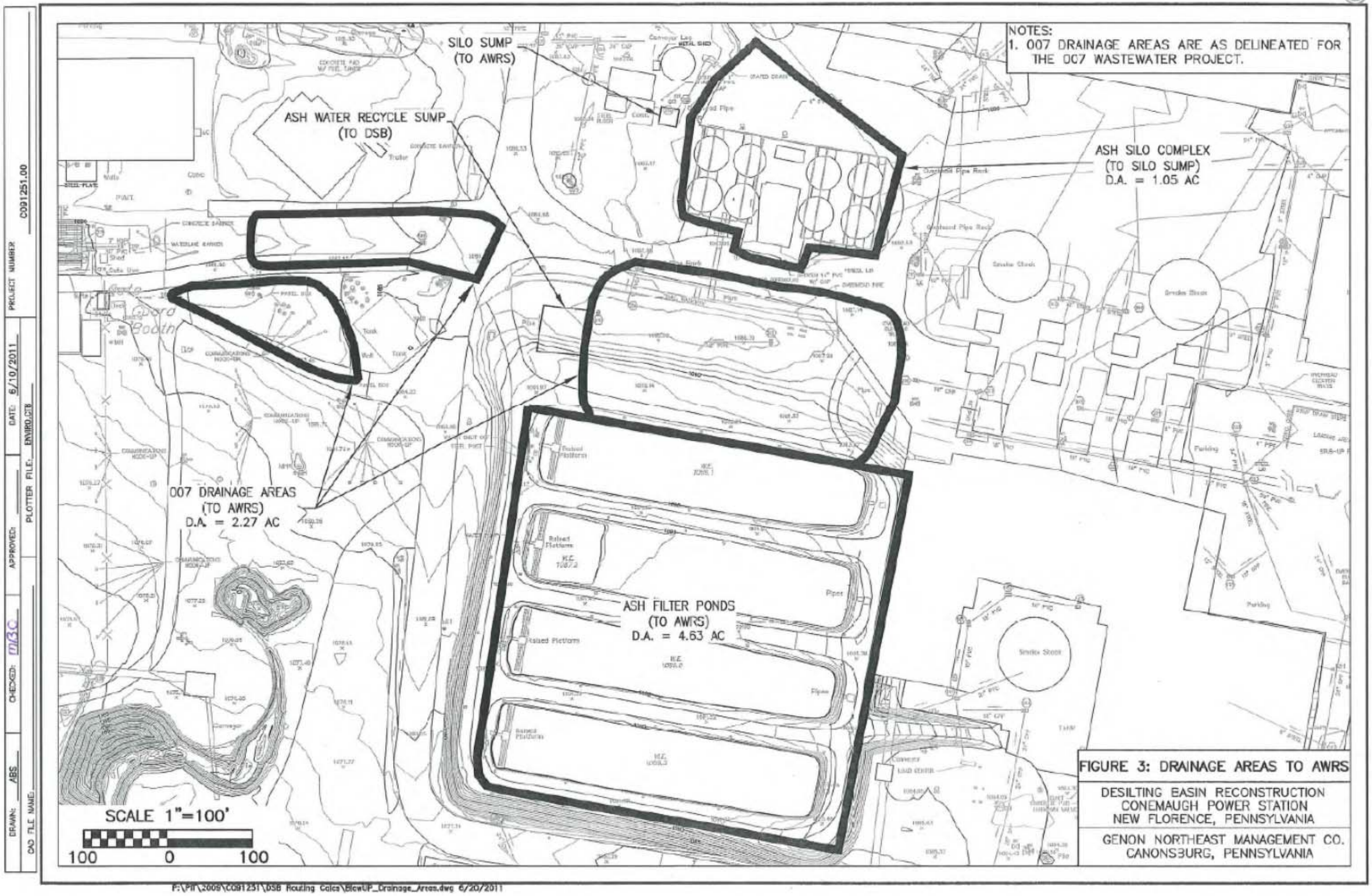
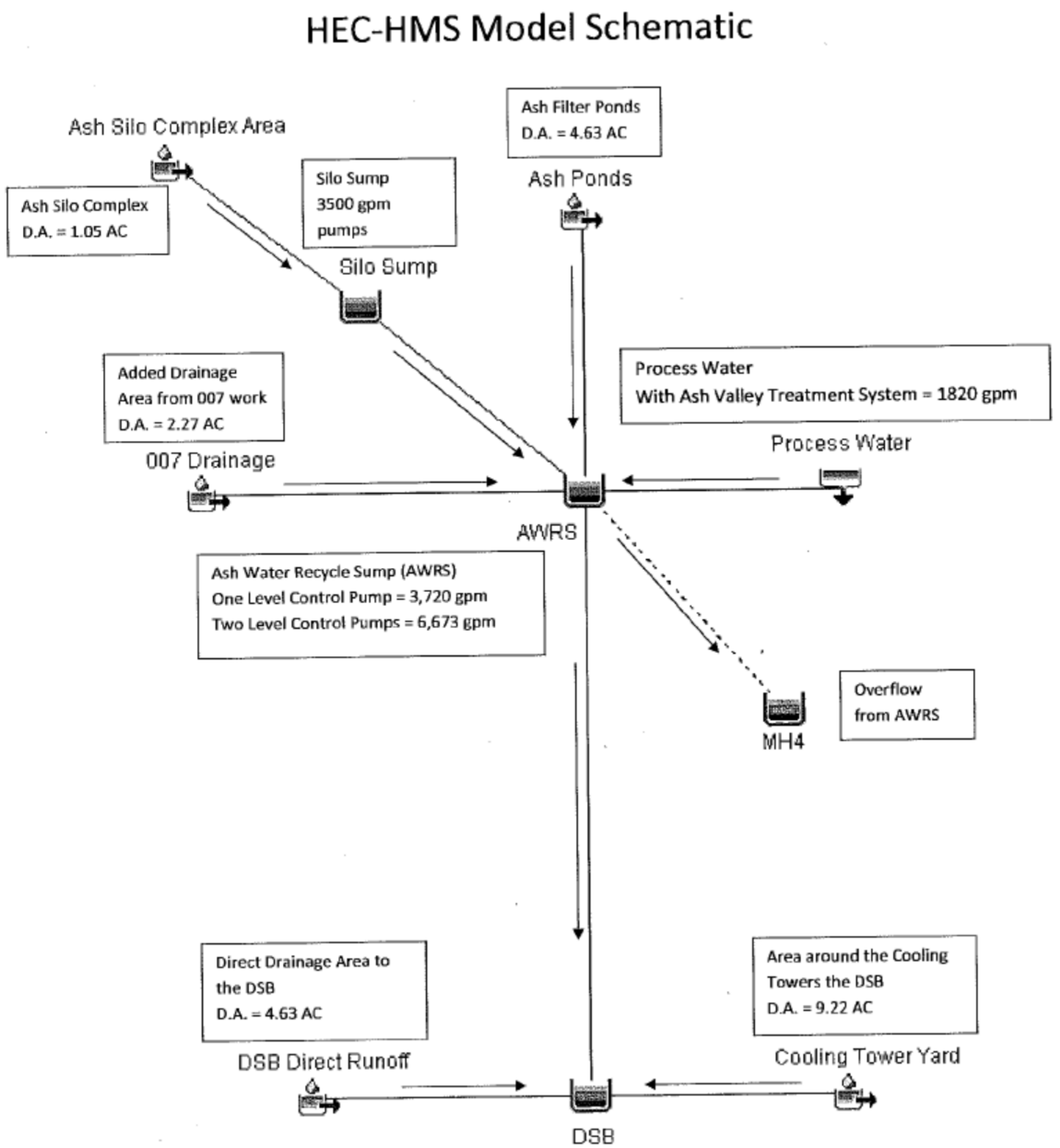



Source: GAI [2011]

**Figure 3. Drainage Area to Ash Water Recycling Sump**




Source: GAI [2011]

**Figure 4. Site Hydraulic/Hydrologic Model**

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# APPENDIX A

# REFERENCES

US EPA ARCHIVE DOCUMENT

**List of References:**

Dewberry & Davis, Inc. (2012)., “Coal Combustion Residue Impoundment Round 12 - Dam Assessment Report, Conemaugh Generating Station Filter Ash Ponds & CT Desilting Basin, GenOn Energy New Florence, PA.” prepared for United States Environmental Protection Agency, November, 2012 (draft).

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US EPA ARCHIVE DOCUMENT

APPENDIX B

BORING LOG

US EPA ARCHIVE DOCUMENT

# BORING LOG

Geosyntec consultants
engineers | scientists | innovators

| | | | |
|---|---|---|---|
| Boring ID | B-1 | | |
| Logged By | L. Chai | Elevation | N/A |
| Date | 10/15/2013 | Northing | N/A |
| Project No. | ME1001 | Easting | N/A |
| Project Name | Conemaugh Power Plant | | |
| | | Drilling Method | HSA |
| Drilling Co. | Eichelbergers, Inc. | Bore Hole Diameter | 6 inches |
| Driller(s) | Tom Growden | Cave Depth | N/A |
| Rig Type | Track Mounted HSA | Depth to Water | Not Encountered |

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | USCS | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 11 | 9 | 11 | 10 | 20 | Top 5" black top soil with vegetation. Coarse gravel with yellowish orange clay | GC | 1 | 95% |
| | 2-4 | 8 | 8 | 9 | 7 | 17 | Yellowish orange clay with little fine gravel | CL | 2 | 100% |
| | 4-6 | 6 | 7 | 7 | 6 | 14 | Subangular gravel with yellowish orange clay | GC | 3 | 100% |
| | 6-8 | 6 | 8 | 9 | 9 | 17 | Subangular gravel with yellowish orange clay | GC | 4 | 100% |
| | 8-10 | 7 | 10 | 10 | 10 | 20 | Top 1' light gray clay, bottom 1' Subangular gravel with yellowish orange clay | CL GC | 5 | 100% |
| | 10-12 | 5 | 7 | 5 | 7 | 12 | Yellowish orange clay with little coarse gravel | CL | 6 | 100% |
| | 12-14 | 7 | 7 | 7 | 7 | 14 | Yellowish orange clay with little coarse gravel | CL | 7 | 100% |
| | 14-16 | 4 | 6 | 9 | 12 | 15 | Yellowish orange clay with little coarse gravel | CL | 8 | 100% |
| | 16-18 | 9 | 11 | 11 | 10 | 22 | Yellowish orange clay with little coarse gravel | CL | 9 | 40% |
| | 18-20 | 6 | 6 | 8 | 7 | 14 | Yellowish orange clay with little coarse gravel | CL | 10 | 95% |
| | 20-22 | 5 | 8 | 9 | 12 | 17 | Sandy clay with gravel | CL | 11 | 70% |
| | 22-24 | 15 | 16 | 32 | 20 | 48 | Light brown clayey sand | SC | 12 | 65% |
| | 24-26 | 15 | 14 | 15 | 22 | 29 | Light brown clayey sand | SC | 13 | 95% |
| | | | | | | | BORING COMPELETE AT 26 FEET - BACKFILLED WITH CEMENT GROUT | | | |

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# BORING LOG

Boring ID: B-2
Logged By: L. Chai
Date: 10/14/2013
Elevation: N/A
Northing: N/A
Easting: N/A
Project No.: ME1001
Project Name: Conemaugh Power Plant
Drilling Method: HSA
Drilling Co.: Eichelbergers, Inc.
Bore Hole Diameter: 6 inches
Driller(s): Tom Growden
Cave Depth: N/A
Rig Type: Track Mounted HSA
Depth to Water: Not Encountered

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | USCS | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 15 | 23 | 15 | 17 | 38 | Fine (0.5") gravel with sand | GP | 1 | 90% |
| | 2-4 | 12 | 12 | 16 | 14 | 28 | Light gray silt with few subrounded coarse gravel | ML | 2 | 100% |
| | 4-6 | 9 | 7 | 9 | 8 | 16 | Light gray silt with few subrounded coarse gravel | ML | 3 | 85% |
| | 6-8 | 7 | 8 | 9 | 9 | 17 | Olive gray clayey sand with few sub angular gravel | SC | 4 | 85% |
| | 8-10 | 5 | 8 | 10 | 10 | 18 | Olive gray clayey sand with few sub angular gravel | SC | 5 | 90% |
| | 10-12 | 3 | 5 | 7 | 8 | 12 | Olive gray clayey sand with little angular gravel, fine to coarse | SC | 6 | 80% |
| | 12-14 | 3 | 5 | 6 | 6 | 11 | Olive gray clayey sand with little angular gravel, fine to coarse | SC | 7 | 75% |
| | 14-16 | 5 | 6 | 7 | 10 | 13 | Olive gray clayey sand with little angular gravel, fine to coarse | SC | 8 | 100% |
| | 16-18 | 6 | 16 | 12 | 21 | 28 | Olive gray clayey sand with little angular gravel, fine to coarse | SC | 9 | 100% |
| | 18-20 | 11 | 11 | 16 | 16 | 27 | top 1': same clayey sand continue<br>bottom 1': light brown clayey sand | SC<br>SC | 10 | 100% |
| | 20-22 | 7 | 8 | 8 | 8 | 16 | light brown clayey sand | SC | 11 | 100% |
| | 22-24 | 10 | 11 | 10 | 10 | 21 | light brown clayey sand | SC | 12 | 100% |
| | 24-26 | 9 | 9 | 12 | 15 | 21 | light brown clayey sand, wet clayey sand at 24.5' to 25'<br>bottom 1': yellowish orange silty clay | SC<br>CL | 13 | 100% |
| | | | | | | | BORING COMPLETE AT 26 FEET - BACKFILLED WITH CEMENT GROUT | | | |

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# BORING LOG

| | | | |
|---|---|---|---|
| Boring ID | B-3 | | |
| Logged By | L. Chai | Elevation | N/A |
| Date | 10/14/2013 | Northing | N/A |
| Project No. | ME1001 | Easting | N/A |
| Project Name | Conemaugh Power Plant | | |
| | | Drilling Method | HSA |
| Drilling Co. | Eichelbergers, Inc. | Bore Hole Diameter | 6 inches |
| Driller(s) | Tom Growden | Cave Depth | N/A |
| Rig Type | Track Mounted HSA | Depth to Water | Not Encountered |

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | USCS | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 18 | 17 | 17 | 18 | 34 | Light gray gravel with sand | SP | 1 | 55% |
| | 2-4 | 18 | 13 | 12 | 11 | 25 | Gray, fine to coarse, sub rounded gravel with yellowish orange clay | GC | 2 | 90% |
| | 4-6 | 10 | 6 | 6 | 6 | 12 | Gray, fine to coarse, sub rounded gravel with yellowish orange clay | GC | 3 | 95% |
| | 6-8 | 4 | 4 | 4 | 4 | 8 | Gray, fine to coarse, sub rounded gravel with yellowish orange clay | GC | 4 | 90% |
| | 8-10 | 6 | 8 | 9 | 11 | 17 | Gray coarse sub angular gravel width olive gray clay | GC | 5 | 95% |
| | 10-12 | 3 | 8 | 11 | 8 | 19 | Light brown clay with some coarse gravel | GC | 6 | 95% |
| | 12-14 | 9 | 9 | 12 | 14 | 21 | Gray, fine to coarse, sub rounded gravel with yellowish orange clay | GC | 7 | 85% |
| | 14-16 | 4 | 4 | 7 | 10 | 11 | Fine to coarse gravel with some clay | GC | 8 | 100% |
| | 16-18 | 12 | 14 | 20 | 17 | 34 | Gray, fine to coarse, sub rounded gravel with yellowish orange clay | GC | 9 | 100% |
| | 18-20 | 7 | 12 | 13 | 18 | 25 | Light brown clay with few fine gravel | CL | 10 | 60% |
| | 20-22 | 10 | 12 | 12 | 11 | 24 | Clayey sand with few fine gravel | SC | 11 | 100% |
| | 22-24 | 11 | 19 | 19 | 13 | 38 | Light brown clayey sand | SC | 12 | 100% |
| | 24-26 | 12 | 17 | 34 | 31 | 51 | Coarse gravel with light brown sand, wet clayey sand at 24.5' | GC | 13 | 80% |
| | | | | | | | BORING COMPLETE AT 26 FEET - BACKFILLED WITH CEMENT GROUT | | | |

# BORING LOG

Geosyntec consultants
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| | | | |
|---|---|---|---|
| Boring ID | B-4 | | |
| Logged By | L. Chai | Elevation | N/A |
| Date | 10/15/2013 | Northing | N/A |
| Project No. | ME1001 | Easting | N/A |
| Project Name | Conemaugh Power Plant | | |
| | | Drilling Method | HSA |
| Drilling Co. | Eichelbergers, Inc. | Bore Hole Diameter | 6 inches |
| Driller(s) | Tom Growden | Cave Depth | N/A |
| Rig Type | Track Mounted HSA | Depth to Water | Not Encountered |

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 12 | 10 | 16 | 15 | 26 | Top 0.1': black surface soil. Fine gravel with some yellowish orange clay and trace sand. | GC | 1 | 100% |
| | 2-4 | 12 | 17 | 17 | 20 | 34 | Fine gravel with some yellowish orange clay and trace sand. | GC | 2 | 85% |
| | 4-6 | 10 | 17 | 11 | 10 | 28 | Yellowish orange clay with trace coarse gravel | CL | 3 | 80% |
| | 6-8 | 8 | 5 | 9 | 9 | 14 | Shale type gravel with some yellowish orange clay | GC | 4 | 85% |
| | 8-10 | 9 | 8 | 13 | 10 | 21 | Shale type gravel with some yellowish orange clay | GC | 5 | 95% |
| | 10-12 | 7 | 8 | 6 | 7 | 14 | Shale type gravel with some yellowish orange clay | GC | 6 | 85% |
| | 12-14 | 6 | 21 | 19 | 16 | 40 | Olive gray clay with trace poor grade gravel | CL | 7 | 70% |
| | 14-16 | 5 | 8 | 12 | 11 | 20 | Variegated light brown and light gray silty clay | CL | 8 | 100% |
| | 16-18 | 10 | 14 | 22 | 28 | 36 | Mottled light brown and black (spot) silty clay | CL | 9 | 100% |
| | 18-20 | 31 | 34 | 25 | 19 | 59 | Coarse gravel with sandy clay | GC | 10 | 100% |
| | 20-22 | 8 | 9 | 9 | 9 | 18 | Light brown clayey sand with subrounded gravel | SC | 11 | 90% |
| | 22-24 | 7 | 10 | 16 | 14 | 26 | Light brown clayey sand with subrounded gravel | SC | 12 | 100% |
| | 24-26 | 10 | 11 | 12 | 12 | 23 | Light brown clayey sand with subrounded gravel, bottom 0.5' black sandy clay | SC | 13 | 90% |
| | | | | | | | BORING COMPLETE AT 26 FEET - BACKFILLED WITH CEMENT GROUT | | | |

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# BORING LOG

Geosyntec consultants

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Boring ID: NE-1 (North Embankment)

Logged By: L. Chai

Date: 10/14/2013

Project No.: ME1001

Project Name: Conemaugh Power Plant

Elevation: N/A

Northing: N/A

Easting: N/A

Drilling Method: HSA

Bore Hole Diameter: 6 inches

Cave Depth: N/A

Depth to Water: Not Encountered

Drilling Co.: Eichelbergers, Inc.

Driller(s): Tom Growden

Rig Type: Track Mounted HSA

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | USCS | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 10 | 16 | 10 | 14 | 26 | Yellowish orange silty clay with little coarse gravel | CL | 1 | 80% |
| | 2-4 | 9 | 6 | 6 | 7 | 12 | Yellowish orange silty clay with little coarse gravel, with gray sand at 3' | CL | 2 | 60% |
| | 4-6 | 4 | 4 | 3 | 4 | 7 | Yellowish orange silty clay with little coarse gravel, with gray sand at 3' | CL | 3 | 100% |
| | 6-8 | 3 | 4 | 5 | 6 | 9 | Silty clay with trace fine gravel | CL | 4 | 85% |
| | 8-10 | 5 | 6 | 5 | 5 | 11 | Silty clay | CL | 5 | 90% |
| | | | | | | | BORING COMPLETE AT 10 FEET | | | |
| | | | | | | | | | | |
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# BORING LOG

Geosyntec consultants
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Boring ID SE-1 (South Embankment)
Logged By L. Chai
Date 10/15/2013

Project No. ME1001
Project Name Conemaugh Power Plant

Elevation N/A
Northing N/A
Easting N/A

Drilling Method HSA
Bore Hole Diameter 6 inches
Cave Depth N/A
Depth to Water Not Encountered

Drilling Co. Eichelbergers, Inc.
Driller(s) Tom Growden
Rig Type Track Mounted HSA

| Elevation | Depth (ft) | Blow Counts | | | | N- Value | Material Description | USCS | Sample No. | Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-2 | 6 | 7 | 4 | 5 | 11 | Yellowish orange silty clay with little coarse gravel | CL | 1 | 95% |
| | 2-4 | 5 | 9 | 18 | 6 | 27 | Yellowish orange silty clay with little coarse gravel and grey sand<br>Soil sample inclued a piece of black pipe edge | CL | 2 | 75% |
| | 4-6 | 7 | 3 | 4 | 4 | 7 | Yellowish orange silty clay with little coarse gravel | CL | 3 | 85% |
| | 6-8 | 3 | 3 | 2 | 3 | 5 | Greenish gray silty clay with little gravel | CL | 4 | 10% |
| | 8-10 | 2 | 1 | 2 | 2 | 3 | Greenish gray silty clay with little gravel | CL | 5 | 5% |
| | 10-12 | 2 | 2 | 2 | 3 | 4 | No recovery | N/A | 6 | 0% |
| | 12-14 | 3 | 6 | 5 | 5 | 11 | No recovery | N/A | 7 | 0% |
| | 14-16 | 8 | 9 | 8 | 24 | 17 | Wet silty clay from 14' to 14.5', below 14.5': moist sility clay | CL | 8 | 80% |
| | | | | | | | BORING COMPLETE AT 16 FEET - BACKFILLED WITH CEMENT GROUT | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

US EPA ARCHIVE DOCUMENT

APPENDIX C

LABORATORY TEST RESULTS

US EPA ARCHIVE DOCUMENT

Client: Geosyntec Consultant
Project: NRG (Conemaugh): ME 1001

TRI Log No.: E2377-48-09
Test Methods: As-Noted

Jeffrey A. Kuhn, Ph.D., P.E., 10/25/13
Quality Review/Date

Tested by: Tierra Jackson and Kahlil Hart

| | ASTM Standard | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | D2216 | | | D1140 | D4318 | | | |
| Sample ID | w (%) | γ total (pcf) | γ dry (pcf) | Percent Fines | Liquid Limit | Plastic Limit | Plastic Index | USCS** |
| NE-1 (4-6)* | 18.2 | - | - | - | 37 | 20 | 17 | - |
| SE-1 (4-6)* | 15.4 | - | - | - | 28 | 17 | 11 | - |
| B-1 (12-14, 24-26) | 14.3 | - | - | 24.3 | 27 | 17 | 10 | SC |
| B-2 (10-12, 24-26) | 9.8 | - | - | 47.9 | 23 | 16 | 7 | SC-SM |
| B-3 (6-8)* | 20.1 | - | - | - | 33 | 20 | 13 | - |
| B-4 (6-8, 20-22) | 13.6 | - | - | 37.3 | 31 | 20 | 11 | SC |

*As per clients instructions, grain size analsis was not performed due to limited sample quantity.

**For full USCS classification/description, please refer to D422-D2216-D4318 reports.

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.



US EPA ARCHIVE DOCUMENT

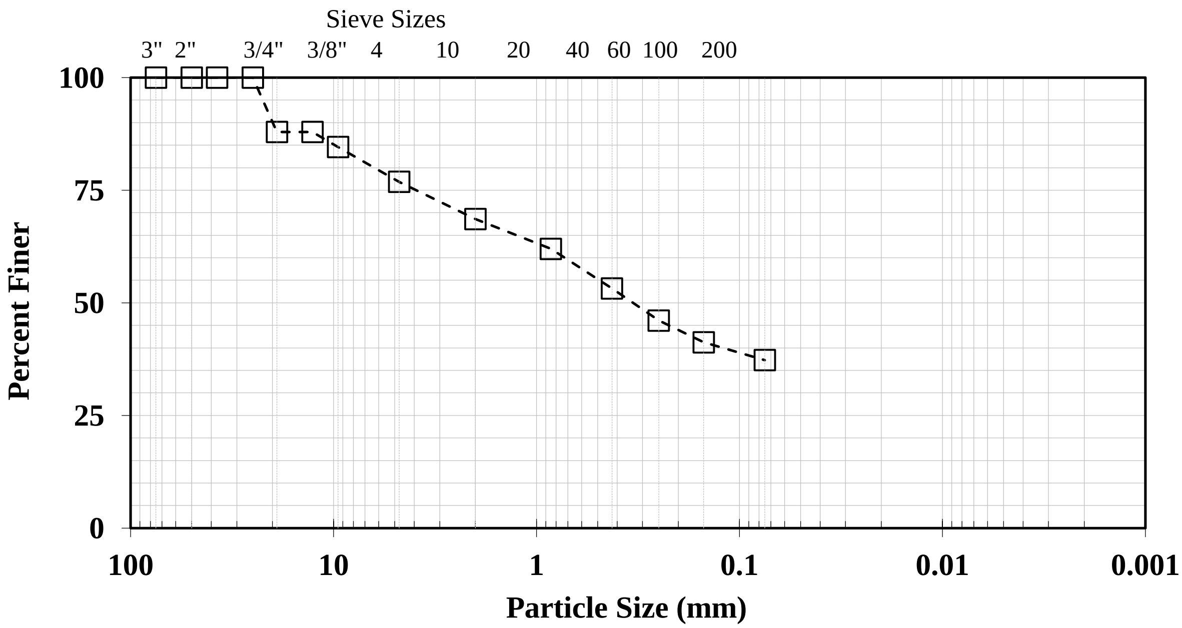
TRI/ENVIRONMENTAL, INC.

*A Texas Research International Company*

# Particle Size Analysis for Soils

Client: Geosyntec Consultant
Project: NRG (Conemaugh): ME 1001
Sample: B-4 (6-8, 20-22)

TRI Log#: E2377-48-09
Test Method: D422
Test Date: 10/22/13




| Sieve Analysis | |
|---|---|
| Sieve Size | Percent Passing |
| 3 in. | 100.0 |
| 2 in. | 100.0 |
| 1.5 in. | 100.0 |
| 1 in. | 100.0 |
| 3/4 in. | 87.9 |
| 1/2 in. | 87.9 |
| 3/8 in. | 84.6 |
| No. 4 (4.75 mm) | 76.9 |
| No. 10 (2.00 mm) | 68.6 |
| No. 20 (850 µm) | 62.0 |
| No. 40 (425 µm) | 53.2 |
| No. 60 (250 µm) | 46.1 |
| No. 100 (150 µm) | 41.2 |
| No. 200 (75 µm) | 37.3 |
| **Hydrometer Analysis** | |
| Particle Size | Percent Passing |
| 0.074 mm | - - |
| 0.005 mm | - - |
| 0.001 mm | - - |

| | | |
|---|---|---|
| **USCS Classification** (ASTM D2487) | Clayey Sand (SC) | |
| **As-Received Moisture Content (%)** | (ASTM D2216) | 13.6 |
| **Atterberg Limits** (ASTM D 4318, Method A : Multipoint) | Liquid Limit (3 pt) | 31 |
| | Plastic Limit | 20 |
| | Plastic Index | 11 |
| Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit) | | |
| **Specific Gravity** | (ASTM D854) | - - |
| **Organic Content (%)** | (ASTM D2974) | - - |
| **Carbonate Content (%)** | (ASTM 4373) | - - |

Jeffrey A. Kuhn, Ph.D., P.E., 10/25/2013
Quality Review/Date

Tested by: Kahlil Hart & Tierra Jackson

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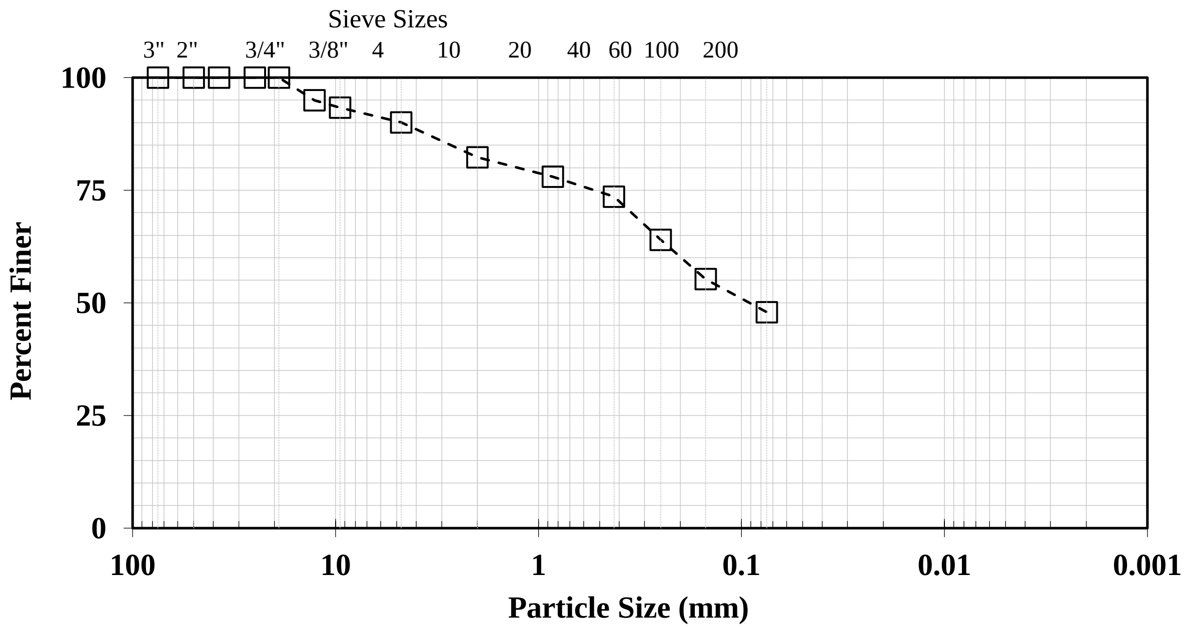
US EPA ARCHIVE DOCUMENT

# Particle Size Analysis for Soils

Client: Geosyntec Consultant
Project: NRG (Conemaugh): ME 1001
Sample: B-2 (10-12, 24-26)

TRI Log#: E2377-48-09
Test Method: D422
Test Date: 10/22/13




| Sieve Analysis | |
|---|---|
| Sieve Size | Percent Passing |
| 3 in. | 100.0 |
| 2 in. | 100.0 |
| 1.5 in. | 100.0 |
| 1 in. | 100.0 |
| 3/4 in. | 100.0 |
| 1/2 in. | 95.0 |
| 3/8 in. | 93.3 |
| No. 4 (4.75 mm) | 90.0 |
| No. 10 (2.00 mm) | 82.3 |
| No. 20 (850 µm) | 78.0 |
| No. 40 (425 µm) | 73.6 |
| No. 60 (250 µm) | 64.0 |
| No. 100 (150 µm) | 55.3 |
| No. 200 (75 µm) | 47.9 |
| **Hydrometer Analysis** | |
| Particle Size | Percent Passing |
| 0.074 mm | - - |
| 0.005 mm | - - |
| 0.001 mm | - - |

| | | |
|---|---|---|
| **USCS Classification** (ASTM D2487) | Silty, Clayey Sand (SC-SM) | |
| **As-Received Moisture Content (%)** | (ASTM D2216) | 9.8 |
| **Atterberg Limits** (ASTM D 4318, Method A : Multipoint) | Liquid Limit (3 pt) | 23 |
| | Plastic Limit | 16 |
| | Plastic Index | 7 |
| Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit) | | |
| **Specific Gravity** | (ASTM D854) | - - |
| **Organic Content (%)** | (ASTM D2974) | - - |
| **Carbonate Content (%)** | (ASTM 4373) | - - |

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Quality Review/Date
Tested by: Kahlil Hart & Tierra Jackson

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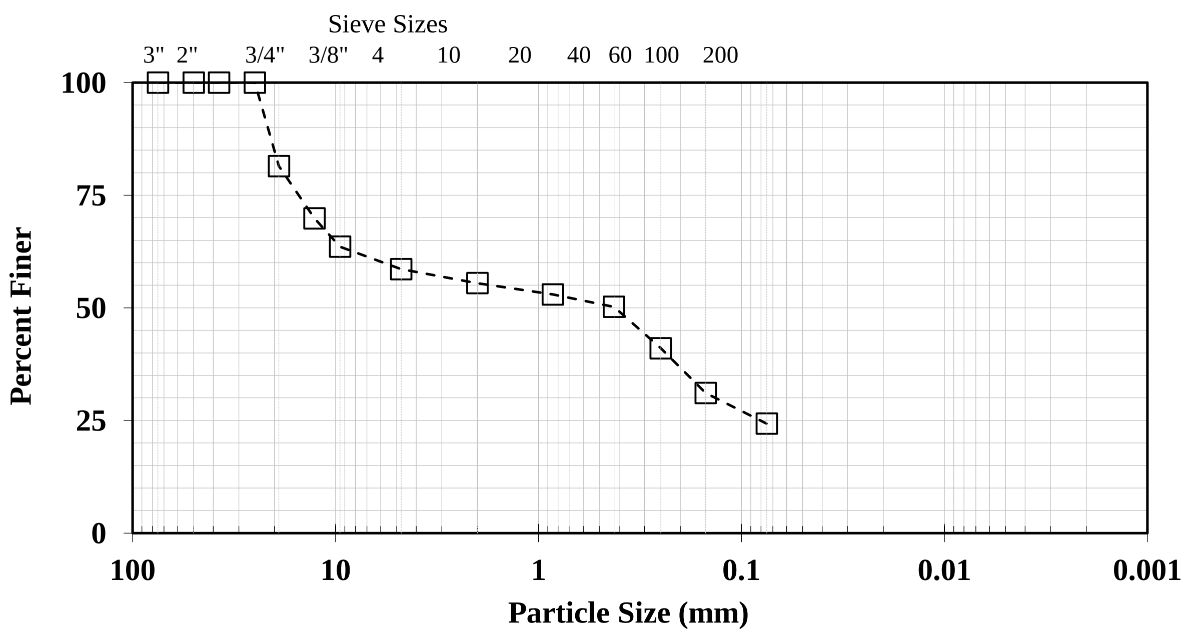
TRI/ENVIRONMENTAL, INC.

*A Texas Research International Company*

# Particle Size Analysis for Soils

Client: Geosyntec Consultant
Project: NRG (Conemaugh): ME 1001
Sample: B-1 (12-14, 24-26)

TRI Log#: E2377-48-09
Test Method: D422
Test Date: 10/22/13




| Sieve Analysis | |
|---|---|
| **Sieve Size** | **Percent Passing** |
| 3 in. | 100.0 |
| 2 in. | 100.0 |
| 1.5 in. | 100.0 |
| 1 in. | 100.0 |
| 3/4 in. | 81.5 |
| 1/2 in. | 69.9 |
| 3/8 in. | 63.6 |
| No. 4 (4.75 mm) | 58.6 |
| No. 10 (2.00 mm) | 55.5 |
| No. 20 (850 µm) | 53.0 |
| No. 40 (425 µm) | 50.2 |
| No. 60 (250 µm) | 41.0 |
| No. 100 (150 µm) | 31.1 |
| No. 200 (75 µm) | 24.3 |
| **Hydrometer Analysis** | |
| Particle Size | Percent Passing |
| 0.074 mm | - - |
| 0.005 mm | - - |
| 0.001 mm | - - |

| | | |
|---|---|---|
| **USCS Classification** (ASTM D2487) | Clayey Sand (SC) | |
| **As-Received Moisture Content (%)** | (ASTM D2216) | 14.3 |
| **Atterberg Limits** (ASTM D 4318, Method A : Multipoint) | Liquid Limit (3 pt) | 27 |
| | Plastic Limit | 17 |
| | Plastic Index | 10 |
| Notes: Specimen was air dried, 3 point Liquid Limit procedure was used. (NL = No Liquid Limit, NP = No Plastic Limit) | | |
| **Specific Gravity** | (ASTM D854) | - - |
| **Organic Content (%)** | (ASTM D2974) | - - |
| **Carbonate Content (%)** | (ASTM 4373) | - - |

Jeffrey A. Kuhn, Ph.D., P.E., 10/25/2013
Quality Review/Date
Tested by: Kahlil Hart & Tierra Jackson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US EPA ARCHIVE DOCUMENT

APPENDIX D

STABILITY ANALYSIS

US EPA ARCHIVE DOCUMENT

Geosyntec consultants

# COMPUTATION COVER SHEET

**Client:** NRG **Project:** Conemaugh Impoundment Evaluation **Project/Proposal #:** ME1001 **Task #:** ____

**TITLE OF COMPUTATIONS** Stability Analysis for CCW Impoundments at Conemaugh Power Station

COMPUTATIONS BY:
Signature [signature] 11/1/2013
DATE
Printed Name Chunling Li
and Title Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] 11/1/2013
DATE
Printed Name Lucas de Melo
and Title Senior Engineer

COMPUTATIONS CHECKED BY:
Signature [signature] 11/1/2013
DATE
Printed Name Lin Chai
and Title Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature [signature] 11/1/2013
DATE
Printed Name Chunling Li
and Title Project Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] 11/1/2013
DATE
Printed Name Michael Houlihan
and Title Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

| NO. | SHEET | DATE | BY | CHECKED BY | APPROVAL |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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US EPA ARCHIVE DOCUMENT

**STABILITY ANALYSIS FOR CCW IMPOUNDMENTS AT CONEMAUGH POWER STATION**

## 1. PURPOSE

As an ongoing national effort by the United States Environmental Protection Agency (EPA) to assess the management of coal combustion waste (CCW), the stability of CCW impoundment at the Conemaugh Power Station in New Florence, Pennsylvania was recently reviewed by EPA. The review was documented in a draft report by Dewberry & Davis, LLC dated November 2012. In response to the comments and recommendation in the report, Geosyntec was engaged by NRG Energy, Inc. (NRG) to review the stability condition of the CCW impounds at the Conemaugh Power Station. This calculation package presents the details of the slope stability analysis.

## 2. BACKGROUND

Currently, the Conemaugh has a CCW management complex known as the Ash Filter Ponds, which consists of four individual cells (Ponds A, B, C and D). The Ash Filter Ponds has a maximum capacity of 24.8 acre-ft and maximum embankment height of 13 ft. The Desilting Basin, which is part of cooling tower operations, has a maximum capacity of 4.2 acre-ft with a maximum height of 8 ft. Both the Ash Filter Ponds and the Desilting Basin have liner system installed. As a part of this impoundment stability assessment project, Geosyntec drilled six borings at the site, as shown in Figure 1 and 2. Additionally, historical borings are also available at the site. The geometry of the Desilting Basin was obtained from design drawing prepared by GAI dated August, 2011 and the geometry for the Ash Filter ponds were obtained from design drawings by Gilbert Associates, Inc. dated August 1980.

## 3. CROSS SECTIONS ANALYSED

Three critical cross sections, one at Filter Ash Pond D (C-C) and two at the Desilting Basin (A-A and B-B), were selected for the analysis based on review of subsurface condition and impoundment geometry. The locations of the selected cross sections are also shown in Figures 1 and 2.

These cross-sections were selected because the embankment height at these locations are the highest. As a conservative approach, the weakest foundation soil layer as identified from the subsurface investigation and review of construction data, was assumed to be present at these locations.



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## 4. STABILITY CRITERIA

According to the US Corps of Engineers [2003], the minimum recommended factor of safety (FS) against global slope stability failure for permanent conditions under static loading is 1.5 (EM 110-2-1902). For seismic condition, the minimum acceptable FS is selected to be 1.2, based on recommendation of presented by the Mine Safety and Health Administration document entitled Engineering and Design Manual: Coal Refuse Disposal Facilities [2009].

## 5. LOADING CONDITIONS

### 5.1 Static Loads

The major static load applied to the foundation soils is the gravity load exerted by the weight of the berm. A surcharge load of 250 pound per square feet (psf) is applied to the top of the embankment to represent traffic loading on top of the embankment.

### 5.2 Seismic Loads

The maximum horizontal acceleration in bedrock for the Conemaugh facility site is estimated to be 0.0488g (g is the gravitational acceleration), based on a seismic hazard map with contours of peak acceleration with 2% probability of exceedance in 50 years as indicated in Figure 3 [USGS, 2008]. This represents the peak ground acceleration in bedrock.

The peak ground acceleration at a soil site should be adjusted to account for the stiffness of soil material overlying the bedrock, which is represented by a site classification in the International Building Code. Using the International Building Code (IBC) 2006 soil classification table, the lithology at the Conemaugh facility site classifies as a site classification D (stiff soil profile). This classification is selected based on the average standard penetration resistance (N-value) within a upper 100 foot soil profile. An IBC 2006 site classification of D pertains to a soil profile with an average N-value between 15 and 50. This site classification table is attached as Figure 4. The bedrock at the site is located at approximately 20 to 30 ft below ground surface. Considering that the bedrock has high SPT blow counts, the average blow counts for the upper 100 ft shall be greater than 15. Using the site coefficient chart for site Class D the value of 1.6 is obtained as shown in Figure 5. Based on the site coefficient and the PGA in rock, the PGA in soil site is estimated to be 0.078g.

In slope stability analysis, the horizontal seismic loading is typically considered as the weight of the soil mass multiplied by seismic coefficient, *k*. Because the peak ground acceleration will only occur for a short duration, the seismic coefficient *k* used in the design analysis will be



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smaller than the PGA. A seismic design guidance provided by USEPA [Richardson et. al.,1995] recommends to use approximately half of PGA as seismic coefficient. For a design PGA of 0.078g, a seismic coefficient of 0.039 was used in this analysis.

## 6. STRATIGRAPHY

*Desilting Basin*

The Desilting Basin was constructed through excavating existing ground. Based on the log of borings conducted as part of this assessment, and historical boring logs, the soils at the Desilting Basin are generally medium stiff to stiff sandy silt or silty clay. The lowest SPT blow counts observed is approximately 3 blows/ft. The bedrock underlying the site was identified as Shale in the historical boring logs and as silt stone or sandstone in the MW-30 well log installed during the Desilting Basin reconstruction. This well log is included as Attachment I. The bedrock is generally located at approximately 20 to 30 ft below ground surface (ft-bgs). For this analysis, the bedrock is conservatively assumed to be located at 30 ft-bgs.

*Filter Ash Pond*

The borings conducted at the Filter Ash Ponds (B-1 through B-4) shows that the embankment soils are lean clays with varying amount of gravels. The lower bound of the SPT blow counts is 8 blows/ft. No bedrock was encountered during this boring investigation. The depth to bedrock is assumed to be 30 ft, based on historical boring results.

## 7. MATERIAL PARAMETERS

The selection for material parameters used for the slope stability analysis is described below:

*Embankment Fill (Filter Ash Pond)*

The embankment at the Filter Ash Pond was constructed using fill material. Based on the boring logs, the material used for the embankment construction is silt and clay mixed with varying amount of gravel or sand. For this analysis, the materials are conservatively assumed to have a clay type of behavior.



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For temporary undrained condition analysis, the undrained shear strength is selected based on the empirical correlation of the Standard Penetration Test blow counts (SPT-N) by Kulhawy and Mayne [1990]:

$$S_u/P_a = 0.06\ \mathrm{N} \qquad (1)$$

where: $S_u$ = undrained shear strength;
$P_a$ = atmospheric pressure (= 2,116 psf)
$N$ = SPT-N value (blows/ft)

The lower bound of the SPT-N is 8 blows/ft at the Filter Ash Pond. Using the empirical correlations in equation (1), the undrained shear strength of the embankment material at the Filter Ash Pond is assumed to be 1000 psf.

The drained shear strength of the embankment soil at the Filter Ash Pond is assumed based on the empirical correlations between friction angle and plasticity index (PI) for normally consolidated clay (see Figure 6). Laboratory test results shows that the upper bound of PI for soil samples collected within this area is 13, which yields to a friction angle of 34 degrees.

*Foundation Soil (Filter Ash Pond)*

The foundation soil at the filter ash pond was found to be similar to the soil used for the embankment construction. The undrained and drained shear strength was conservatively assumed to be the same as the embankment soil (i.e., undrained shear strength of 1000 psf and drained friction angle of 34 degrees).

*Foundation Soil (Desilting Basin)*

The Desilting Basin was constructed through excavation; Thus, the embankment and the foundation soils are considered to be the same material.

The undrained shear strength used for the analysis was 375 psf, assumed based on the lower bound of SPT-N of 3 blows/ft using Equation (1).

The drained shear strength used for the analysis was 32 degrees, conservatively assumed based on the upper bound value of PI for all soil samples collected (i.e., 17) using the empirical correlations shown in Figure 6. .



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*Bedrock*

The weathered bedrock (shale or sandstone/siltstone) present at the site was estimated to have high shear strength. For this analysis, the weathered bedrock was conservatively assumed to have a shear strength of 8000 psf.

Table 1 summaries the material properties used in the slope stability analysis.

Table 1. Material Properties Used in Slope Stability Analyses

| Material | Moist Unit Weight (lb/ft$^3$) | Saturated Unit Weight (lb/ft$^3$) | Drained Shear Strength | | Undrained Shear Strength (psf) |
|---|---|---|---|---|---|
| | | | Cohesion (psf) | Friction Angle (deg) | |
| Embankment Soil (Filter Ash Pond) | 120 | - | 0 | 34 | 1000 |
| Foundation Soil (Filter Ash Pond) | 135 | 135 | 0 | 34 | 1000 |
| Foundation Soil (Desilting Basin) | 135 | 135 | 0 | 32 | 375 |
| Weathered rock | 145 | 145 | 8000 | 0 | - |

## 8. GROUNDWATER CONDITION

Based on the information from Natural Resources Conservation Service (NRCS) Web Soil Survey and also confirmed by the groundwater monitoring well results, the groundwater table in the area is shallow.  Monitoring well results for the two wells (MW-17 and MW-18) located near the Desilting Basin showed a high groundwater elevation of 1075.3 ft-msl, based on the information presented in the Water Quality Management Permit Application for the Desilting Basin reconstruction [GAI, 2011].

For this analysis, the water level in the CCW impoundments area is assumed to be those of the high water table shown in the design drawings (Desilting basin drawing prepared by GAI Consultants[2011], and filter ash pond drawing by Gilbert [1980]).  Therefore, the elevations of the groundwater table are assumed to be, respectively, 1076 ft-msl in the Desilting Basin area, and 1090 ft-msl in the Filter Ash Pond area. The material in the lined pond is modeled as material with no shear strength in the analysis.



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## 9. METHOD OF SLOPE STABILITY ANALYSIS

The stability of the selected cross section was evaluated using the limit equilibrium method. The analyses were conducted using SLIDE [Rocscience, 2002], a two-dimensional (2D) slope stability computer program. The factors of safety for both circular and non-circular potential slip surface were evaluated. The Spencer's Method [Spencer, 1967], was used in the analysis. The interslice force assumption made in the Spencer's Method satisfies force equilibrium in horizontal and vertical directions as well as moment equilibrium. Therefore, Spencer's method is considered as a rigorous methods, which generally provide more precise results for factor of safety than non-rigorous method. The factors of safety reported herein are from Spencer's method.

Thousands of potential failure surfaces were analyzed to find the critical failure surface resulting in the minimum factor of safety for the slope. For the circular slip surface search, a search grid with 25 horizontal increments and 25 vertical increments was used. For the block failure analysis, two search windows were used for searching the most critical failure surface. SLIDE provides results graphically and as output text files. SLIDE graphical provides both the minimum factor of safety and contours of the calculated factors of safety. For each case analyzed, a figure and text are generated and presented in Attachment II of this calculation package.

## 10. RESULTS OF SLOPE STABILITY

The results of the SLIDE analyses using the material properties listed in Table 1 are summarized in Table 2.

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**Table 2. Summary of Slope Stability Results**

| Cross Sections | Loading Conditions | Failure Mode | Calculated F.S. | Target F.S. |
|---|---|---|---|---|
| A-A | Static (undrained) | Block | 1.30 | 1.30 |
| | | Circular | 1.30 | 1.30 |
| | Static (drained) | Block | 1.62 | 1.50 |
| | | Circular | 1.59 | 1.50 |
| | Seismic | Block | 1.21 | 1.20 |
| | | Circular | 1.20 | 1.20 |
| B-B | Static (undrained) | Block | 1.63 | 1.30 |
| | | Circular | 1.56 | 1.30 |
| | Static (drained) | Block | 1.83 | 1.50 |
| | | Circular | 1.82 | 1.50 |
| | Seismic | Block | 1.40 | 1.20 |
| | | Circular | 1.33 | 1.20 |
| C-C | Static (undrained) | Block | 2.57 | 1.30 |
| | | Circular | 2.61 | 1.30 |
| | Static (drained) | Block | 1.50 | 1.50 |
| | | Circular | 1.50 | 1.50 |
| | Seismic | Block | 2.30 | 1.20 |
| | | Circular | 2.29 | 1.20 |

## 11. SUMMARY

The stability of the both the Filter Ash Ponds and Desilting Basin of the Conemaugh facility was evaluated for several scenarios. The results of these analyses show factors of safety exceeding the minimum recommended factors of safety. Thus, the CCW impoundments at the Conemaugh facility are considered to be stable.



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## 12. REFERENCES


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# FIGURES

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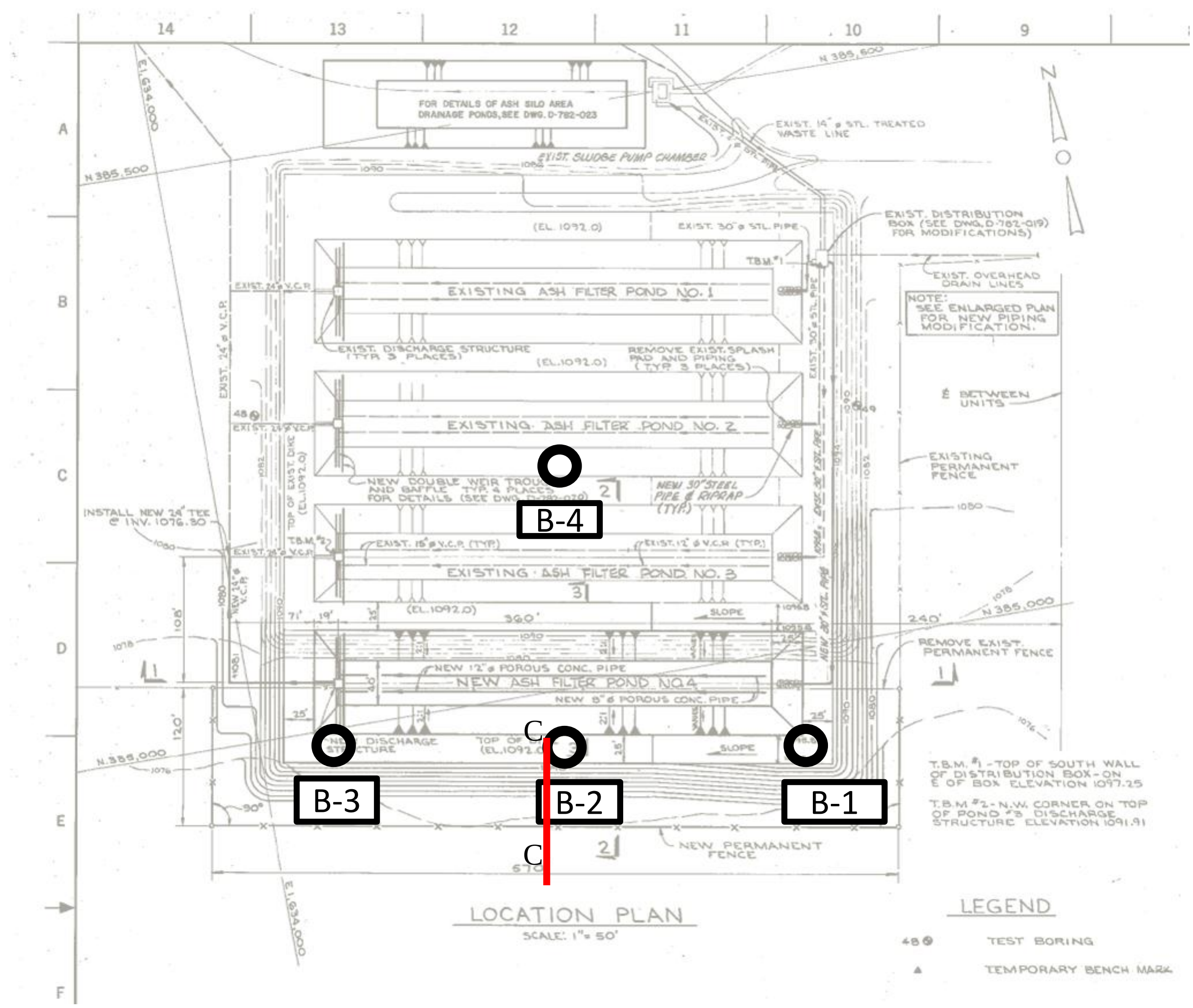


**Legend**

B-1 Approximate Boring Location

**FIGURE 1 - SOIL BORING LOCATION**
**Conemaugh Power Station – Ash Filter Pond**
New Florence, PA

Geosyntec consultants

COLUMBIA, MARYLAND

| | |
|---|---|
| DATE: | Oct 2013 |
| PROJECT NO. | ME1001 |
| DOCUMENT NO. | |
| FIGURE NO: | 1 |

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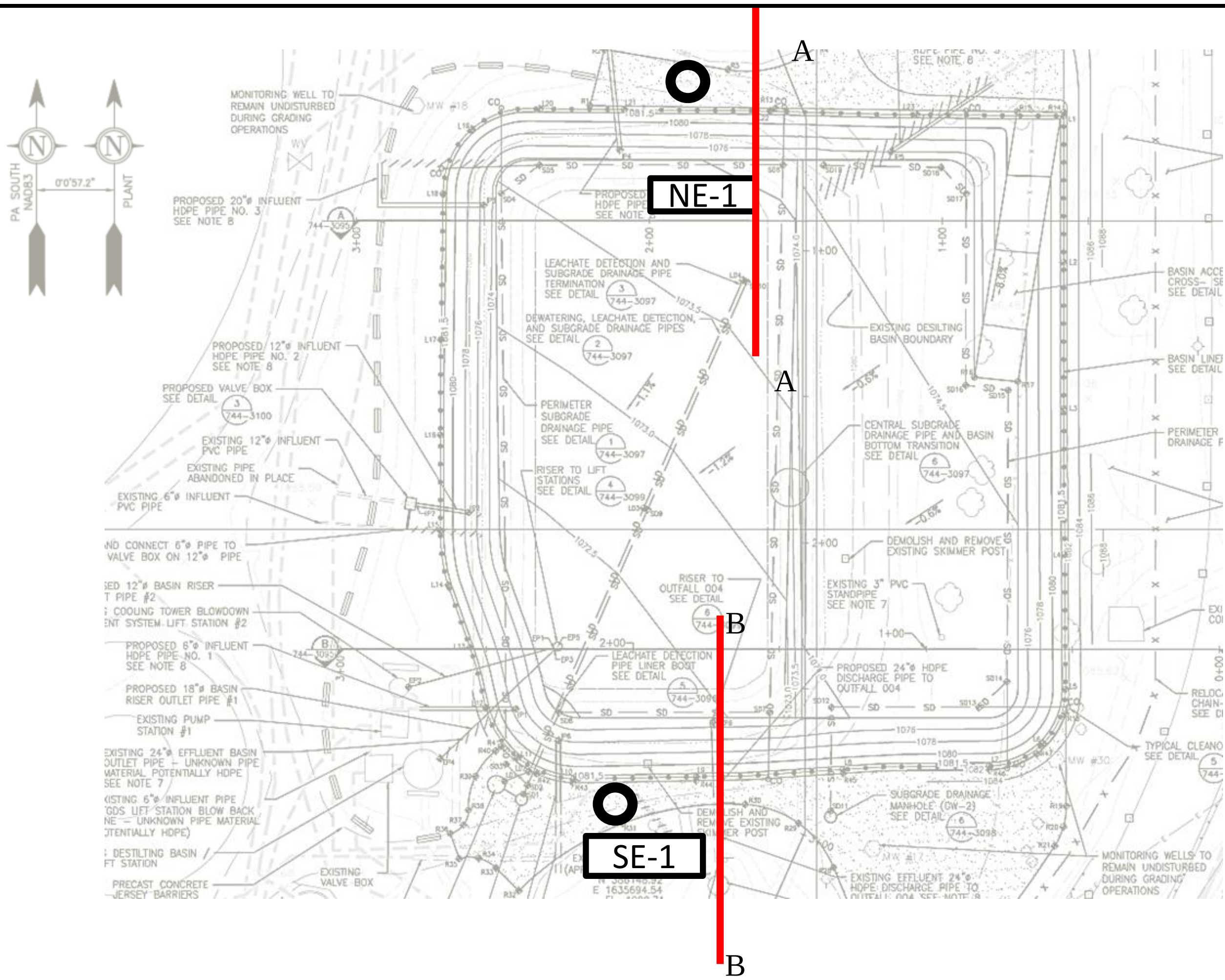
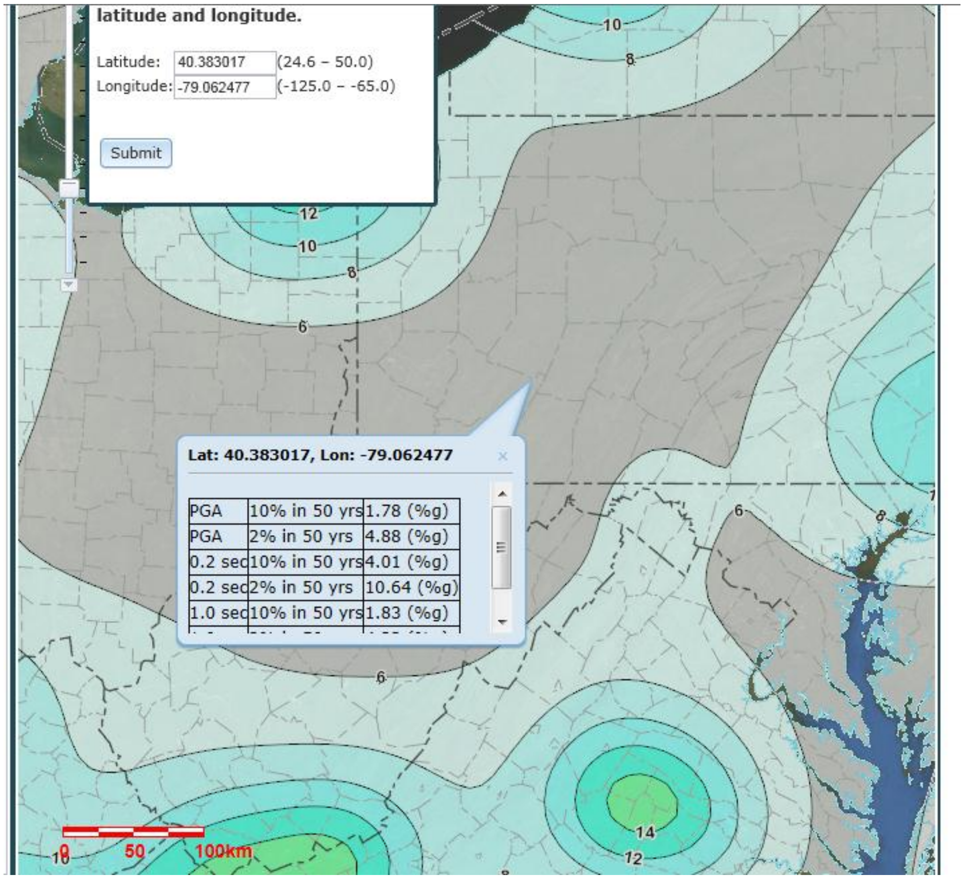



**Legend**

B-1 Approximate Boring Location

# FIGURE 2 - SOIL BORING LOCATION
## Conemaugh Power Station – Desilting Basin
New Florence, PA

| | | |
|---|---|---|
| Geosyntec consultants | DATE: | Oct 2013 |
| | PROJECT NO. | ME1001 |
| | DOCUMENT NO. | |
| COLUMBIA, MARYLAND | FIGURE NO: | 2 |




Source: USGS [2008]

**Figure 3. USGS Seismic Hazard Map**

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TABLE 1613.5.2
SITE CLASS DEFINITIONS

| SITE CLASS | SOIL PROFILE NAME | AVERAGE PROPERTIES IN TOP 100 feet, SEE SECTION 1613.5.5 | | |
|---|---|---|---|---|
| | | Soil shear wave velocity, $\bar{v}_s$, (ft/s) | Standard penetration resistance, $\bar{N}$ | Soil undrained shear strength, $\bar{s}_u$, (psf) |
| A | Hard rock | $\bar{v}_s > 5{,}000$ | N/A | N/A |
| B | Rock | $2{,}500 < \bar{v}_s \leq 5{,}000$ | N/A | N/A |
| C | Very dense soil and soft rock | $1{,}200 < \bar{v}_s \leq 2{,}500$ | $\bar{N} > 50$ | $\bar{s}_u \geq 2{,}000$ |
| D | Stiff soil profile | $600 \leq \bar{v}_s \leq 1{,}200$ | $15 \leq \bar{N} \leq 50$ | $1{,}000 \leq \bar{s}_u \leq 2{,}000$ |
| E | Soft soil profile | $\bar{v}_s < 600$ | $\bar{N} < 15$ | $\bar{s}_u < 1{,}000$ |
| E | — | Any profile with more than 10 feet of soil having the following characteristics:<br>1. Plasticity index $PI > 20$,<br>2. Moisture content $w \geq 40\%$, and<br>3. Undrained shear strength $\bar{s}_u < 500$ psf | | |
| F | — | Any profile containing soils having one or more of the following characteristics:<br>1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils.<br>2. Peats and/or highly organic clays ($H > 10$ feet of peat and/or highly organic clay where $H$ = thickness of soil)<br>3. Very high plasticity clays ($H > 25$ feet with plasticity index $PI > 75$)<br>4. Very thick soft/medium stiff clays ($H > 120$ feet) | | |

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m$^2$, 1 pound per square foot = 0.0479 kPa. N/A = Not applicable

Source: International Building Code 2006

**Figure 4. Site Classification**

TABLE 1613.5.3(1)
VALUES OF SITE COEFFICIENT $F_a$ [a]

| SITE CLASS | MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIOD | | | | |
|---|---|---|---|---|---|
| | $S_s \leq 0.25$ | $S_s = 0.50$ | $S_s = 0.75$ | $S_s = 1.00$ | $S_s \geq 1.25$ |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| D | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 |
| E | 2.5 | 1.7 | 1.2 | 0.9 | 0.9 |
| F | Note b | Note b | Note b | Note b | Note b |

a. Use straight-line interpolation for intermediate values of mapped spectral response acceleration at short period, $S_s$.
b. Values shall be determined in accordance with Section 11.4.7 of ASCE 7.

**Source: International Building Code 2006**

**Figure 5. Site Coefficient**



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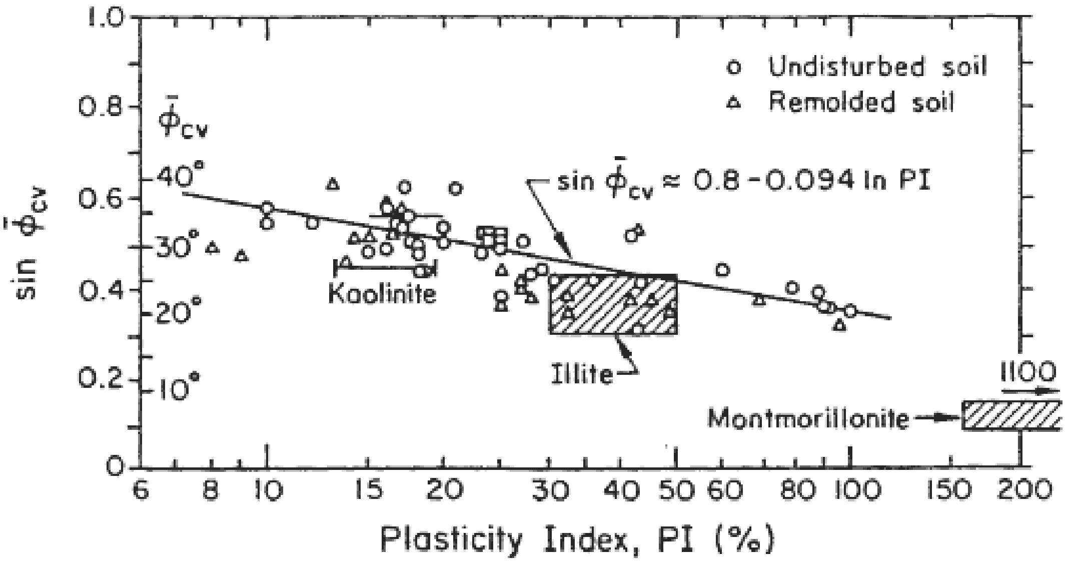


Figure 4-20. $\bar{\phi}_{cv}$ for NC Clays versus PI

Source: Mitchell (22), p. 284.

**Reproduced from Kulhawy and Mayne [1990]**

**Figure 6. Empirical Correlations between Critical Void Ratio Friction Angle and Plasticity Index**

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# Attachment I

# Boring Logs for Well MW-30

4. Describe below the proposed groundwater quality monitoring points for approval. (Monitoring point proposals are subject to final approval of the Engineering Design Plans. No wells are to be drilled until final approval of the Engineering Design Plans.) Use numbers only and number all monitoring points consecutively.

a. Wells (check one). For multiple wells indicate with monitoring point number (a) for existing and (b) for proposed.

☒ For existing wells complete the table below.

☒ For proposed new well construction, complete the table from your specifications.

| MONITORING POINT NUMBER | DRILLING METHOD | DEPTH | DIAMETER | CASING | | LOCATION | | SURFACE ELEVATION |
|---|---|---|---|---|---|---|---|---|
| | | | | SIZE & DEPTH | ZONES[1] PERFORATED | LATITUDE | LONGITUDE | |
| ***MW-30 (Existing)*** | ***Air knife, hollow-stem auger, and air hammer*** | ***39'*** | ***8" nominal*** | ***4" I.D., 18'*** | ***18' to 38'*** | ***40º23'09.96N*** | ***79º03'25.42W*** | ***1087.04*** |
| MW-17 (Existing) | Hollow-stem auger/tricone roller bit with air | 37.5' | 10" soil | 4" I.D., 35' | 17.5' to 37.5' | 40º23'09.4N | 79º03'27.1W | 1083.52 |
| MW-18 (Existing) | Hollow-stem auger/tricone roller bit with air | 37' | 10" soil | 4" I.D., 35' | 17' to 37' | 40º23'11.9N | 79º88'29.1W | 1088.76 |
| *Note: All depths measured from top of PVC | | | | | | | | |
| | | | | | | | | |

[1] *What zones or at what depth is the casing perforated?*

b. Springs

| MONITORING POINT NUMBER | ELEVATION | RATE OF FLOW (gpm) | DATE OF MEASUREMENT | LOCATION | |
|---|---|---|---|---|---|
| | | | | LATITUDE | LONGITUDE |
| NOT APPLICABLE | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

5. Do all springs listed have a continuous year-round flow? ☐ Yes ☐ No

If not, explain. NOT APPLICABLE

6. If there is a discharge or a potential discharge to groundwater, background water quality must be determined. Describe how background water quality was determined?

Existing background (crossgradient) wells are installed and have been monitored since October 1998

7. What is the background water quality? **(See Appendix V-J)**

| | | |
|---|---|---|
| a. | Temperature | Degrees C |
| b. | pH | |
| c. | Alkalinity | mg/L |
| d. | Total solids | mg/L |
| e. | Suspended solids | mg/L |
| f. | Settleable solids | mg/L |
| g. | MBAS | mg/L |
| h. | BOD 5-day | mg/L |
| i. | COD .25 w $K_2Cr_2O_8$ | mg/L |
| j. | Specific conductance | Micromhos/cm (Microsiemens/cm) |
| k. | Total iron | mg/L |
| l. | Manganese | mg/L |
| m. | Aluminum | mg/L |
| n. | Copper | mg/L |
| o. | Zinc | mg/L |
| p. | Nickel | mg/L |



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# ENGINEERS FIELD BORING LOG

BORING NO. MW-30
SHEET 1 OF 2
DATE: START 11/22/11
END 11/29/11
O.G. ELEV. 1087.0

PROJECT NAME GenOn - Conemaugh Desilting Exp. COUNTY C091251.01
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION ______ OFFSET FROM CENTERLINE ______
INSPECTOR (SIGNED) Raymond D. Glenn DRILLERS NAME/COMPANY Terra Testing
EQUIPMENT USED Diedrich D-50 Track
DRILLING METHODS Air Knife & 8 1/4" HSA & 7 7/8" Air Hammer
CASING: SIZE: ______ ; DEPTH: ______ ; WATER: DEPTH: 24.6' TIME: 0 DATE: ______
CHECKED BY: RJT ; DATE: 12/5/2011 DEPTH: 24.6' TIME: 12 DATE: ______

| DEPTH (FT) | SAMPLE NO./ TYPE/CORE RUN | BLOWS/0.5 FT. ON SAMPLER | RECOVERY (Ft.) | RECOVERY(%) / RQD (%) | POCKET PENT/ TORVANE (TSF) | USCS / AASHTO | $H_2O$ CONTENT | DESCRIPTION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Sandy SILT with Sandstone Cobbles, moist, stiff, light brown | 0' - 9' Air Knife<br>Alluvium |
| | | | | | | | | 5.0 Sandy SILT with Sandstone Cobbles and Gravels, moist, very stiff, gray/brown | |
| | | | | | | | | 9.0 SANDSTONE BOULDER, medium hard, gray | |
| 10.0 - 11.5 | S-1 | 11 13 26 | 1.5' | - | | SM | - | 10.0 Sandy SILT with Sandstone Cobbles, moist, very dense, light brown | 12.5 - 13.5 Boulder |
| 15.0 - 16.5 | S-2 | 6 7 5 | 1.5' | - | | SM | - | 15.0 Sandy SILT with Sandstone Cobbles and Gravels, moist, round and angular, dense, orange/brown | |
| | | | | | | | | 18.5 SANDSTONE GRAVEL, medium hard, light brown | Grinding on Rock at 18.5' |
| 20.0 - 20.4 | S-3 | 50/0.4 | 0.4' | - | | GP | - | -W/ Cobbles | |
| | | | | | | | | 23.0 SANDSTONE, hard, light brown | Top of Rock at 23.0'<br>Air Hammer |

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES FOR THIS BORING

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# ENGINEERS FIELD BORING LOG

BORING NO. MW-30
SHEET 2 OF 2
DATE: START 11/22/11
END 11/29/11
O.G. ELEV. 1087.0

PROJECT NAME GenOn - Conemaugh Desilting Exp. COUNTY C091251.01
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION ______ OFFSET FROM CENTERLINE ______
INSPECTOR (SIGNED) Raymond D. Glenn DRILLERS NAME/COMPANY Terra Testing
EQUIPMENT USED Diedrich D-50 Track
DRILLING METHODS Air Knife & 8 1/4" HSA & 7 7/8" Air Hammer
CASING: SIZE: ______ ; DEPTH: ______ ; WATER: DEPTH: 24.6' TIME: 0 DATE: ______
CHECKED BY: RJT ; DATE: 12/5/2011 DEPTH: 24.6' TIME: 12 DATE: ______

| DEPTH (FT) | SAMPLE NO./ TYPE/CORE RUN | BLOWS/0.5 FT. ON SAMPLER | RECOVERY (Ft.) | RECOVERY(%) / RQD (%) | POCKET PENT/ TORVANE (TSF) | USCS / AASHTO | $H_2O$ CONTENT | DESCRIPTION | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | SANDSTONE, hard, light brown *(continued)* | Air Hammer Continued |
| | | | | | | | | 28.0 SANDSTONE with Claystone Seams, medium hard, gray | |
| | | | | | | | | 35.0 SILTSTONE, very hard, gray | |
| | | | | | | | | 37.0 SANDSTONE, medium hard, gray | |
| | | | | | | | | 39.0 END OF BORING AT 39.0' | |
| | | | | | | | | Well Construction:<br>1.70' PCV Stick Up<br>0' - 3' Cement<br>3' - 12' Bentonite Chips<br>12' - 15' Bentonite Pellets<br>15' - 38' Sand<br>18' - 38' Screen (0.010' Slot)<br>38' - 39' Sand and Gravel<br>4" Thick, 4' Diameter Well Pad<br>Lock - Masterlock #2126 | |
| | | | | | | | | Development:<br>Purge for 2 hours<br>Brown to Clear | |

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES FOR THIS BORING

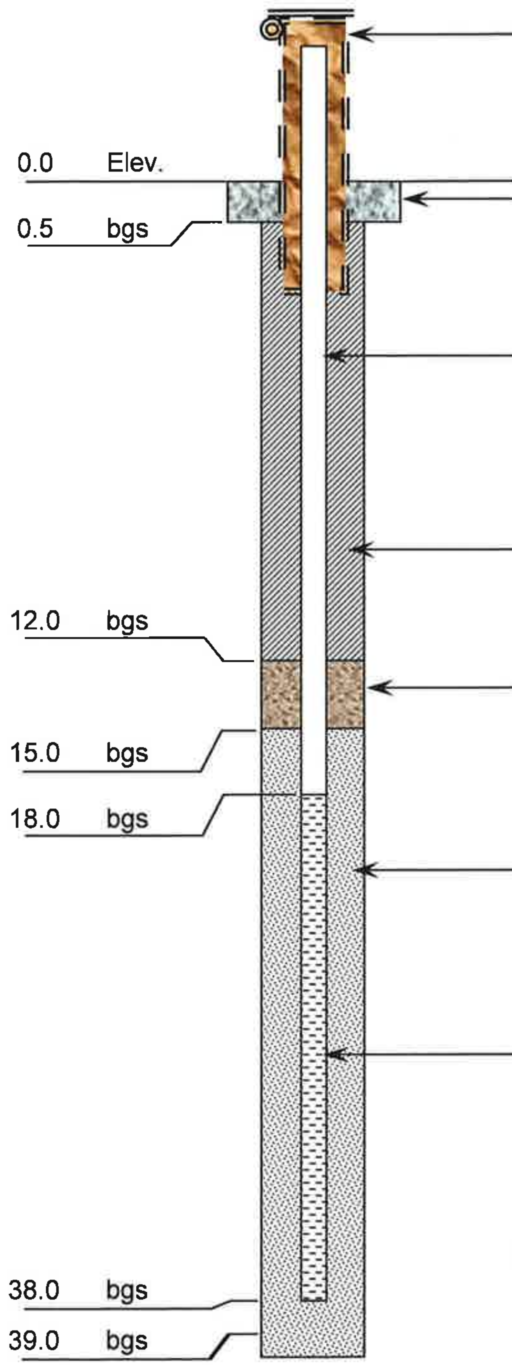
TERRA TESTING

# WELL / PIEZOMETER SCHEMATIC

*Geotechnical & Environmental Drilling*

**Well No:** MW-30
**Well Tag:**
**Date Installed:** 11/29/11
**GPS Location:** **Latitude:** 40.386086

**Project:** Conemaugh Power Plant, Fairfield, Westmoreland County, PA
**TTI Proj. No:** 11700
**Client:** GAI Consultants
**Longitude:** 79.057081




**STEEL PROTECTIVE COVER (Stick-up)**

| | | |
|---|---|---|
| Size: | 6" x 5' | |
| Riser Stick-up: | 2.5 | feet |

**CONCRETE PAD**

| | | |
|---|---|---|
| Size: | 4' round | |
| No. of Bags: | 10 | |
| Bags Size: | 50 | |

**Riser:**

| | | |
|---|---|---|
| Type: | Sch. 40 PVC | |
| Size: | 4 | inches I.D. |
| Length | 20 | feet |

**Grout Backfill**

| | | |
|---|---|---|
| Cement: | 3 | No. of Bags |
| Bags Size: | 94 | lbs. |
| Gran. Bentonite | - | lbs. |
| Bentonite Chips | 15 | lbs. |

| | | |
|---|---|---|
| **Bentonite** | 100 | lbs. |

**Sand Pack**

| | | |
|---|---|---|
| Type: | Best #430 | |
| Bags Size: | 50 | lbs. |
| No. of Bags | 21 | |

**Screen**

| | | |
|---|---|---|
| Type: | Sch. 40 PVC | |
| Size: | 4 | inches I.D. |
| Slot Size: | .010 | inches |
| Length: | 20 | feet |

**Additional Well Supplies**

| | |
|---|---|
| Expanding Locking Cap | Y |
| Locks | N |
| PVC Slip Cap | N |
| PVC Threaded Cap | Y |
| PVC Bottom Plug | N |
| Auger Plugs | N |
| No. of 55-gallon Drums Used | N |
| No of Guard Posts Used | N |

DEPARTMENT OF CONSERVATION & NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
WATER WELL LICENSING/WATER WELL INVENTORY SECTION
3240 Schoolhouse Rd
Middletown, PA 17057
717-702-2017

# WATER WELL COMPLETION REPORT

| | | | |
|---|---|---|---|
| Well Driller: | **TERRA TESTING, INC.** | Driller Well ID: | **11700 - MW - 30** |
| Driller License: | **2309** | Local Permit #: | |
| Type of Activity: | **New Well** | Original Well By: | **Current Driller** |
| Date Drilled: | **11/29/2011** | Drilling Method: | **BORED OR AUGERED** |

| | | | |
|---|---|---|---|
| Owner: | **Conemaugh Power Plant** | | |
| Address of Well: | | Zipcode: | |
| County: | **WESTMORELAND** | | |
| Municipality: | **FAIRFIELD** | Municipality Type: | **T** |
| Coordinate Method: | **GPS - Global Positioning System** | | |
| Quadrangle: | Latitude: **40.386086** | Longitude: | **-79.057081** |

| | | | |
|---|---|---|---|
| Well Depth (*ft*): | **38** | Well Finish: | **PERFORATED OR SLOTTED** |
| Depth to Bedrock (*ft*): | | Did Not Encounter Bedrock: | |
| Well Yield (*gpm*): | | Yield Measure Method: | |
| Static Water Level: (*ft below land surface*) | **24** | Water level after yield test: (*ft below land surface*) | |
| Length of Yield Test: (*minutes*) | | Saltwater Zone (*ft*): | |
| Use of Well: | **MONITORING** | Use of Water: | |

## DRILLER'S LOG

| UNIT TOP | UNIT BOTTOM | DESCRIPTION OF UNITS PENETRATED |
|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Unit Top 1: | **0** | Unit Bottom 1: | **10** | Unit 1: | **0.0 - 0.5 - Topsoil; 0.5 to 10.0 - Silty sand, light brown sandstone fragments, moist** |
| Unit Top 2: | **10** | Unit Bottom 2: | **23** | Unit 2: | **Medium course silty sand, sandstone fragments, wet** |
| Unit Top 3: | **23** | Unit Bottom 3: | **25** | Unit 3: | **Large gravel and cobbles** |
| Unit Top 4: | **25** | Unit Bottom 4: | **32** | Unit 4: | **Fractured sandstone, light brown, wet** |
| Unit Top 5: | **32** | Unit Bottom 5: | **39** | Unit 5: | **Hard gray siltstone** |

## BOREHOLE

**Section 1:** Top: **0** Bottom: **39** Diameter: **12**

## CASING

**Casing 1:**

Top: **0** Bottom: **18** Diameter: **4** Material: **PVC OR OTHER PLASTIC**

**Seal(Grout) 1:**

Top: **12** Bottom: **15** Type: **BENTONITE CHIPS/PELLETS**

## SCREEN/SLOT

**Screen 1:** Top: **18** Bottom: **38** Diameter: **4**

Type: **PERFORATED, POROUS, OR SLOTTED CASING**

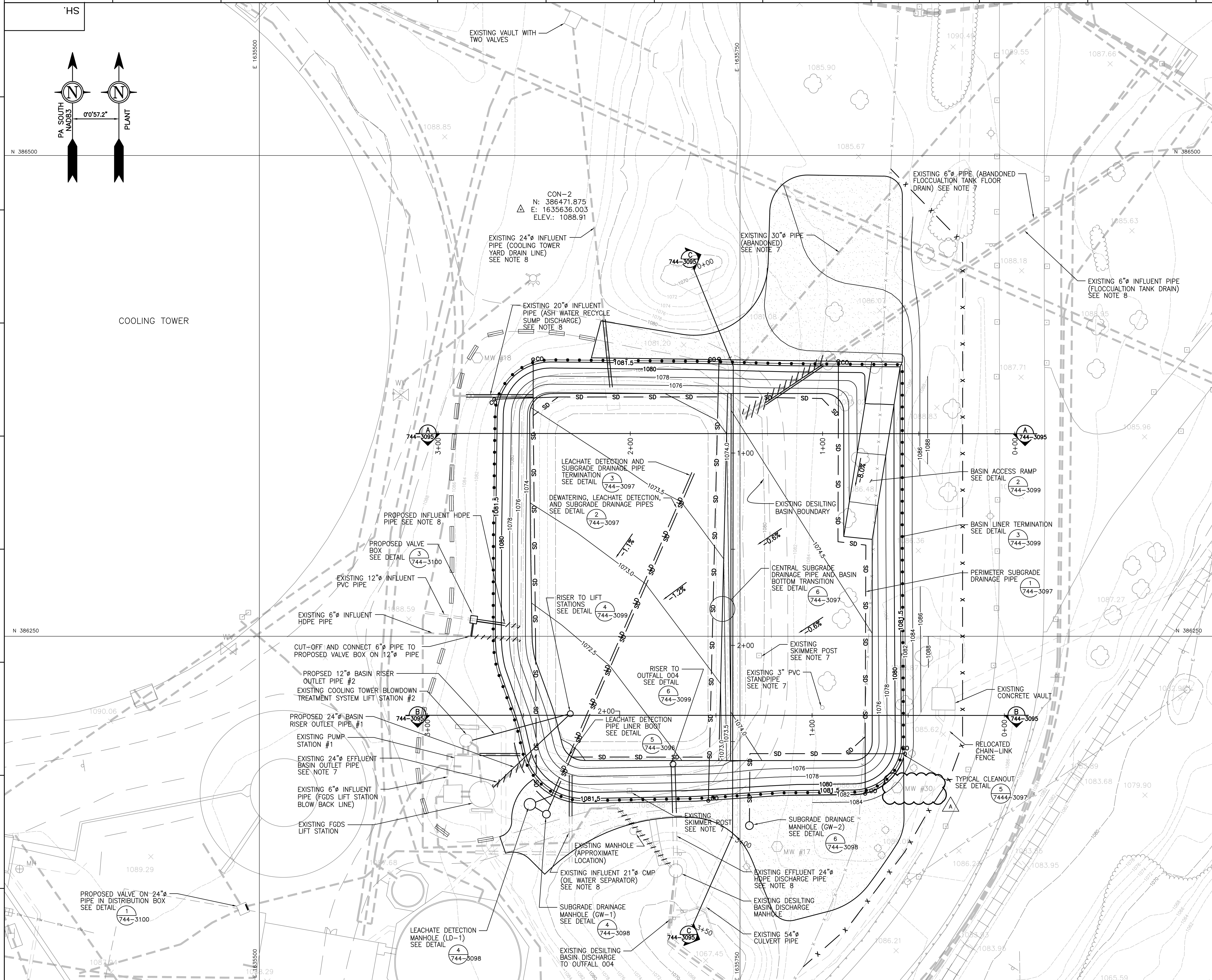
Material: **PLASTIC** Slot Size: **10**

Packing: **Screened Sand**

I hereby certify that the above information is true and complete to the best of my knowledge and belief.

Charlotte S Gurtel 12-14-11

Driller's Signature (required) Date




## GENERAL LEGEND

| EXISTING FEATURES | PROPOSED FEATURES | |
|---|---|---|
| ⬡ | ⬢ | MONITORING WELL LOCATION |
| | —SF—SF— | SILT FENCE |
| | ○ MH | MANHOLE |
| ---1200--- | —1200— | CONTOUR |
| | —SD— | SUBGRADE DRAINAGE PIPE |
| | —LD— | LEACHATE DETECTION PIPE |
| | | BURIED PIPE/CULVERT |
| | | PIPE (TO BE ABANDONED) |
| | | EXISTING DESILTING BASIN BOUNDARY |
| —x— | —x— | CHAIN LINK FENCE |
| | | TREE LINE |
| | | RAILROAD LINE |
| | | DECIDUOUS TREE |
| | | SHRUB |
| | | SURVEY CONTROL POINT |
| | CO | CLEANOUT |

## NOTES:

1. EROSION AND SEDIMENTATION CONTROL MEASURES ARE TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.
2. FOR GENERAL NOTES, SEE DRAWING D-744-3096.
3. CONTOUR ELEVATIONS SHOWN IN THE POND REPRESENT TOP OF FABRICFORM. THE TOP OF EMBANKMENT ELEVATIONS SHOWN REPRESENT THE PERIMETER ACCESS SUBGRADE.
4. SUBGRADE DRAINAGE PIPES SHALL BE SOLID WALL FROM THE BASIN BOTTOM PERIMETER TO MANHOLES GW-1 AND GW-2.
5. 8" THICK UNIFORM SECTION MAT SHALL BE INSTALLED ON THE BASIN FLOOR, ACCESS RAMP, AND THE LOWER SIDE SLOPES. TRANSITION FORM 8" UNIFORM SECTION MAT TO 4" UNIFORM SECTION MAT ON BASIN SIDESLOPES AT ELEVATION 1076.0. UNIFORM SECTION MAT IN ANCHOR TRENCH SHALL BE FILLED WITH GROUT FIRST AND BACKFILLED BEFORE FILLING UNIFORM SECTION MAT WITH GROUT ON SIDE SLOPES TO PREVENT PULL OUT AND ADD STABILITY, SEE DRAWING D-744-3099
6. FOR AN ENLARGED PLAN VIEW OF THE BASIN OUTLET PIPING, SEE DETAIL 1 744-3099
7. PIPE TO BE CUT OFF, GROUTED SHUT, OR REMOVED.
8. EXISTING PIPE TO BE CUT OFF MINIMUM 20'-0 OUTSIDE EDGE OF LINER AND EXTENDED WITH SMOOTH INTERIOR AND EXTERIOR SDR 17 HDPE PIPE TO PENETRATE THE NEW BASIN SYNTHETIC LINER SYSTEM. THE EXISTING PIPE AND NEW HDPE PIPE SHALL BE CONNECTED WITH A MECHANICAL WATERTIGHT CONNECTION.
9. FOR CROSS-SECTIONS A-A, B-B, AND C-C, SEE DRAWING D-744-3095.
10. MONITORING WELL MW#30 LOCATION WAS INSTALLED 11/29/2011, SURVEYED LOCATION BY GenOn.

gai consultants

## REFERENCES:

1. EXISTING TOPOGRAPHY AND FEATURES BASED ON AERIAL MAPPING PROVIDED BY GenOn – CONEMAUGH STATION BASE MAPPING. (DRAWING NO. E-744-3093-0, SHEETS 1 THROUGH 16) – DATE OF AERIAL PHOTOGRAPHY 3-17-2010.

   HORIZONTAL AND VERTICAL CONTROL IS BY A SURVEY TIE TO THE PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (1927 DATUM).

2. SUBSURFACE UTILITIES ARE BASED ON EXISTING DRAWINGS, SITE SPECIFIC SURVEYS, REMOTE SENSING SURVEYS, AND SITE OBSERVATIONS. THE INFORMATION SHOWN IS INTENDED TO PROVIDE GENERAL LOCATIONS OF UNDERGROUND UTILITIES AT THE CONEMAUGH POWER STATION. (DRAWING NO. C100963-001-00-E-E001, SHEETS 1 THROUGH 11 – DATED 10-29-2010).

# PLAN VIEW

SCALE: 1" = 20'

20 0 20 40

| A | 06/26/2012 | MW #30 RECORD LOCATION PER PaDEP COMMENT | EJM | MAG | KCC |
|---|---|---|---|---|---|
| NO. | DATE | REVISION | BY | CHK | APP |

GenOn.

CONEMAUGH
UNIT NO. 1 AND 2

DESILTING BASIN RECONSTRUCTION
PLAN VIEW

| DRAWN: 5-25-2011 | BY: DMM | DRAWING NUMBER |
|---|---|---|
| CHECKED 08-12-2011 | CHK BY: MSG | D-744-3094 |
| APPROVED 08-12-2011 | APP BY: KCC | SHEET: - |
| SIZE: 30x42 | | REV: A |
| DISCIPLINE: CIVIL | SCALE: AS NOTED | C091251-01-002-00-E-F009 |

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# Attachment II

# SLIDE Output

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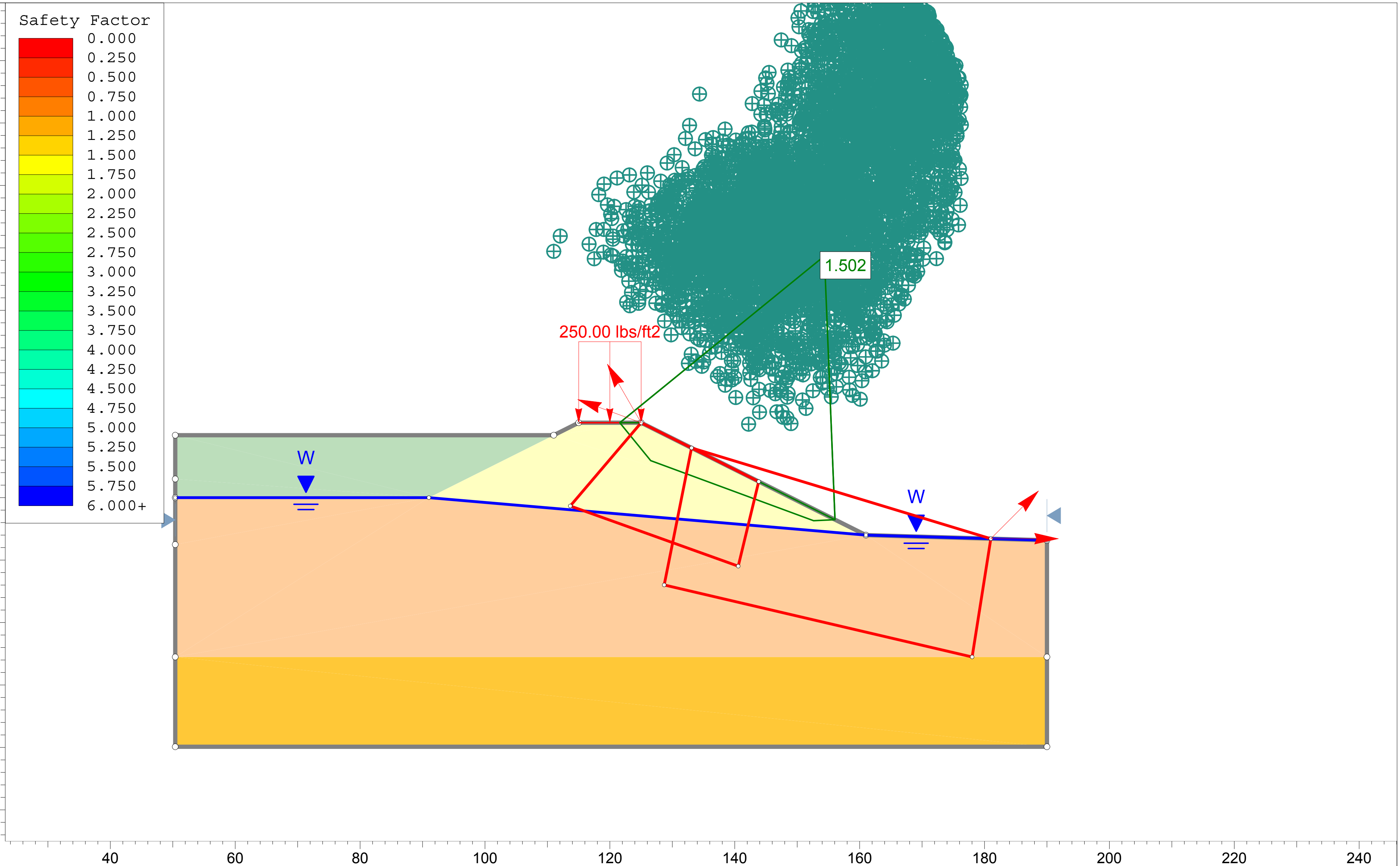


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:259 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* C-C_Conemaugh_drained block.slim | |

IDEINTERPRET 6.019

US EPA ARCHIVE DOCUMENT



# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_drained block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: 5

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Mohr-Coulomb | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | 120 | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | 120 | | 135 | 145 |
| Cohesion [psf] | 0 | | 0 | |
| Friction Angle [deg] | 34 | | 34 | |
| Cohesion Type | | | | 8000 |
| Water Surface | Water Table | None | Water Table | None |
| Hu Value | 1 | | 0 | |
| Ru Value | | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.502210
Axis Location: 154.349, 1118.706
Left Slip Surface Endpoint: 121.586, 1092.000
Right Slip Surface Endpoint: 156.056, 1076.472
Resisting Moment=363782 lb-ft

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Driving Moment=242165 lb-ft
Resisting Horizontal Force=7958.72 lb
Driving Horizontal Force=5298.02 lb
Total Slice Area=111.069 ft2

## *Global Minimum Coordinates*

### Method: spencer

| X | Y |
|---|---|
| 121.586 | 1092 |
| 126.542 | 1085.94 |
| 152.62 | 1076.32 |
| 156.056 | 1076.47 |

## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 3761
Number of Invalid Surfaces: 1239

#### Error Codes:

Error Code -105 reported for 140 surfaces
Error Code -107 reported for 23 surfaces
Error Code -108 reported for 503 surfaces
Error Code -111 reported for 397 surfaces
Error Code -112 reported for 176 surfaces

#### Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.50221

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base [psf] | Base Friction Angle [degrees] | Shear [psf] | Shear [psf] | Base Normal Stress [psf] | Pore [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.23891 | 112.705 | embankment soil | 0 | 34 | 80.2331 | 120.527 | 178.688 | 0 | 178.688 |
| 2 | 1.23891 | 338.115 | embankment soil | 0 | 34 | 123.045 | 184.839 | 274.036 | 0 | 274.036 |
| 3 | 1.23891 | 560.778 | embankment soil | 0 | 34 | 150.966 | 226.783 | 336.219 | 0 | 336.219 |
| 4 | 1.23891 | 720.392 | embankment soil | 0 | 34 | 136.824 | 205.539 | 304.724 | 0 | 304.724 |
| 5 | 1.37255 | 857.112 | embankment soil | 0 | 34 | 248.431 | 373.196 | 553.287 | 0 | 553.287 |
| 6 | 1.37255 | 827.437 | embankment soil | 0 | 34 | 239.831 | 360.276 | 534.131 | 0 | 534.131 |
| 7 | 1.37255 | 797.762 | embankment soil | 0 | 34 | 231.229 | 347.355 | 514.975 | 0 | 514.975 |
| 8 | 1.37255 | 768.087 | embankment soil | 0 | 34 | 222.628 | 334.434 | 495.819 | 0 | 495.819 |
| 9 | 1.37255 | 738.412 | embankment soil | 0 | 34 | 214.027 | 321.513 | 476.663 | 0 | 476.663 |
| 10 | 1.37255 | 708.737 | embankment soil | 0 | 34 | 205.425 | 308.592 | 457.506 | 0 | 457.506 |
| 11 | 1.37255 | 679.062 | embankment soil | 0 | 34 | 196.824 | 295.671 | 438.35 | 0 | 438.35 |
| 12 | 1.37255 | 649.386 | embankment soil | 0 | 34 | 188.223 | 282.75 | 419.194 | 0 | 419.194 |
| 13 | 1.37255 | 619.711 | embankment soil | 0 | 34 | 179.622 | 269.83 | 400.039 | 0 | 400.039 |
| 14 | 1.37255 | 590.036 | embankment soil | 0 | 34 | 171.021 | 256.909 | 380.883 | 0 | 380.883 |
| 15 | 1.37255 | 560.361 | embankment soil | 0 | 34 | 162.419 | 243.988 | 361.727 | 0 | 361.727 |
| 16 | 1.37255 | 530.686 | embankment soil | 0 | 34 | 153.818 | 231.067 | 342.571 | 0 | 342.571 |
| 17 | 1.37255 | 501.011 | embankment soil | 0 | 34 | 145.217 | 218.146 | 323.415 | 0 | 323.415 |
| 18 | 1.37255 | 471.336 | embankment soil | 0 | 34 | 136.615 | 205.225 | 304.259 | 0 | 304.259 |
| 19 | 1.37255 | 441.661 | embankment soil | 0 | 34 | 128.014 | 192.304 | 285.103 | 0 | 285.103 |
| 20 | 1.37255 | 411.986 | embankment soil | 0 | 34 | 119.413 | 179.383 | 265.947 | 0 | 265.947 |
| 21 | 1.37255 | 382.311 | embankment soil | 0 | 34 | 110.812 | 166.463 | 246.791 | 0 | 246.791 |
| 22 | 1.37255 | 352.636 | embankment soil | 0 | 34 | 102.211 | 153.542 | 227.635 | 0 | 227.635 |
| 23 | 1.37255 | 322.961 | embankment soil | 0 | 34 | 93.6094 | 140.621 | 208.479 | 0 | 208.479 |
| 24 | 1.71785 | 289.23 | embankment soil | 0 | 34 | 100.087 | 150.352 | 222.906 | 0 | 222.906 |
| | | | embankment | | | | | | | |

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| soil |
|---|

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.50221

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 121.586 | 1092 | 0 | 0 | 0 |
| 2 | 122.825 | 1090.48 | 171.368 | 78.632 | 24.648 |
| 3 | 124.064 | 1088.97 | 434.177 | 199.222 | 24.648 |
| 4 | 125.303 | 1087.45 | 756.623 | 347.176 | 24.648 |
| 5 | 126.542 | 1085.94 | 1048.86 | 481.271 | 24.6481 |
| 6 | 127.914 | 1085.43 | 987.37 | 453.054 | 24.648 |
| 7 | 129.287 | 1084.92 | 928.005 | 425.815 | 24.648 |
| 8 | 130.659 | 1084.42 | 870.77 | 399.552 | 24.648 |
| 9 | 132.032 | 1083.91 | 815.664 | 374.267 | 24.648 |
| 10 | 133.404 | 1083.4 | 762.686 | 349.958 | 24.648 |
| 11 | 134.777 | 1082.9 | 711.838 | 326.627 | 24.648 |
| 12 | 136.149 | 1082.39 | 663.119 | 304.272 | 24.648 |
| 13 | 137.522 | 1081.89 | 616.529 | 282.894 | 24.648 |
| 14 | 138.895 | 1081.38 | 572.068 | 262.493 | 24.648 |
| 15 | 140.267 | 1080.87 | 529.735 | 243.069 | 24.648 |
| 16 | 141.64 | 1080.37 | 489.532 | 224.622 | 24.648 |
| 17 | 143.012 | 1079.86 | 451.458 | 207.151 | 24.648 |
| 18 | 144.385 | 1079.36 | 415.513 | 190.658 | 24.648 |
| 19 | 145.757 | 1078.85 | 381.697 | 175.142 | 24.6481 |
| 20 | 147.13 | 1078.34 | 350.01 | 160.602 | 24.648 |
| 21 | 148.502 | 1077.84 | 320.452 | 147.039 | 24.648 |
| 22 | 149.875 | 1077.33 | 293.023 | 134.454 | 24.6481 |
| 23 | 151.247 | 1076.83 | 267.724 | 122.845 | 24.648 |
| 24 | 152.62 | 1076.32 | 244.553 | 112.213 | 24.648 |
| 25 | 154.338 | 1076.4 | 55.3102 | 25.3791 | 24.648 |
| 26 | 156.056 | 1076.47 | 0 | 0 | 0 |

## List Of Coordinates

### Water Table

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |





### Line Load

| X | Y |
|---|---|
| 125 | 1092 |
| 115 | 1092 |

### Block Search Window

| X | Y |
|---|---|
| 125 | 1092 |
| 113.647 | 1078.68 |
| 140.549 | 1069.03 |
| 143.841 | 1082.58 |

### Block Search Window

| X | Y |
|---|---|
| 133.074 | 1087.96 |
| 128.69 | 1066.02 |
| 178.01 | 1054.48 |
| 181.003 | 1073.44 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

### Material Boundary

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| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

## Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |

## Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |

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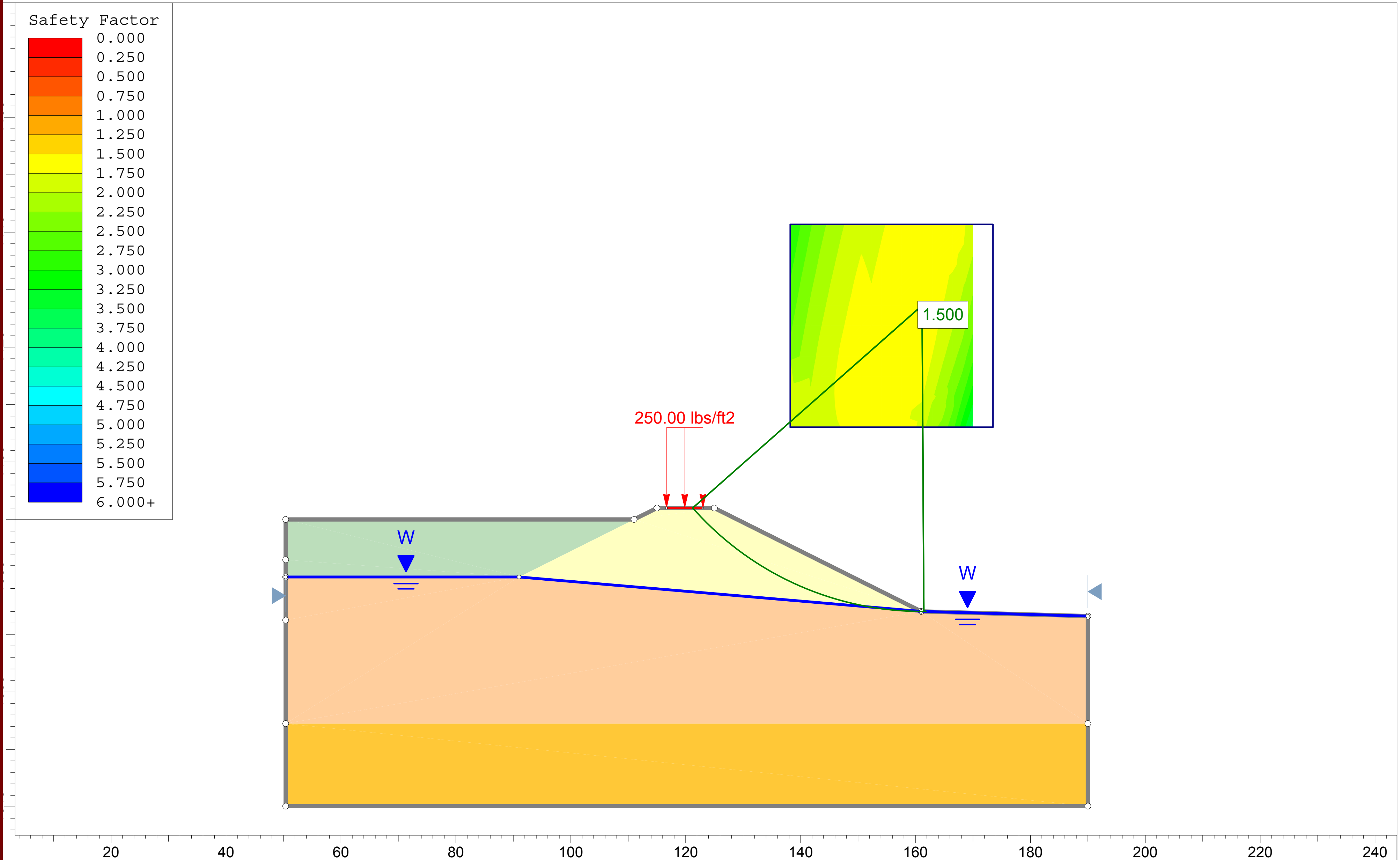


Project: SLIDE - An Interactive Slope Stability Program

Analysis Description

Drawn By

Scale: 1:280

Company

Date: 10/16/2013, 3:13:47 PM

File Name: C-C_Conemaugh_drained circular.slim

IDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_drained circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 6

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Mohr-Coulomb | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | 120 | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | 120 | | 135 | 145 |
| Cohesion [psf] | 0 | | 0 | |
| Friction Angle [deg] | 34 | | 32 | |
| Cohesion Type | | | | 8000 |
| Water Surface | Water Table | None | Water Table | None |
| Hu Value | 1 | | 0 | |
| Ru Value | | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.499510
Center: 161.143, 1127.255
Radius: 53.269
Left Slip Surface Endpoint: 121.210, 1092.000
Right Slip Surface Endpoint: 161.464, 1073.987
Resisting Moment=697287 lb-ft
Driving Moment=465009 lb-ft
Resisting Horizontal Force=11731.6 lb

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Driving Horizontal Force=7823.61 lb
Total Slice Area=171.737 ft2

## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 2909
Number of Invalid Surfaces: 1942

#### Error Codes:

Error Code -108 reported for 1 surface
Error Code -115 reported for 1941 surfaces

#### Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-115 = Surface too shallow, below the minimum depth.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.49951

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.62358 | 171.239 | embankment soil | 0 | 34 | 90.8623 | 136.249 | 201.997 | 0 | 201.997 |
| 2 | 1.62358 | 499.302 | embankment soil | 0 | 34 | 89.4139 | 134.077 | 198.777 | 0 | 198.777 |
| 3 | 1.62358 | 765.246 | embankment soil | 0 | 34 | 131.492 | 197.174 | 292.323 | 0 | 292.323 |
| 4 | 1.62358 | 892.903 | embankment soil | 0 | 34 | 159.618 | 239.349 | 354.85 | 0 | 354.85 |
| 5 | 1.62358 | 990.155 | embankment soil | 0 | 34 | 183.756 | 275.544 | 408.511 | 0 | 408.511 |
| 6 | 1.62358 | 1067.81 | embankment soil | 0 | 34 | 205.371 | 307.956 | 456.564 | 0 | 456.564 |
| 7 | 1.62358 | 1127.49 | embankment soil | 0 | 34 | 224.405 | 336.498 | 498.879 | 0 | 498.879 |
| 8 | 1.62358 | 1170.5 | embankment soil | 0 | 34 | 240.797 | 361.078 | 535.321 | 0 | 535.321 |
| 9 | 1.62358 | 1197.98 | embankment soil | 0 | 34 | 254.48 | 381.596 | 565.741 | 0 | 565.741 |
| 10 | 1.62358 | 1210.86 | embankment soil | 0 | 34 | 265.379 | 397.938 | 589.968 | 0 | 589.968 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 1.62358 | 1209.93 | embankment soil | 0 | 34 | 273.409 | 409.979 | 607.82 | 0 | 607.82 |
| 12 | 1.62358 | 1195.9 | embankment soil | 0 | 34 | 278.476 | 417.578 | 619.087 | 0 | 619.087 |
| 13 | 1.62358 | 1169.34 | embankment soil | 0 | 34 | 280.475 | 420.575 | 623.526 | 0 | 623.526 |
| 14 | 1.62358 | 1130.76 | embankment soil | 0 | 34 | 279.286 | 418.792 | 620.884 | 0 | 620.884 |
| 15 | 1.62358 | 1080.6 | embankment soil | 0 | 34 | 274.773 | 412.025 | 610.854 | 0 | 610.854 |
| 16 | 1.62358 | 1019.24 | embankment soil | 0 | 34 | 266.785 | 400.047 | 593.093 | 0 | 593.093 |
| 17 | 1.62358 | 946.995 | embankment soil | 0 | 34 | 255.151 | 382.601 | 567.229 | 0 | 567.229 |
| 18 | 1.62358 | 864.15 | embankment soil | 0 | 34 | 239.674 | 359.394 | 532.824 | 0 | 532.824 |
| 19 | 1.62358 | 770.938 | embankment soil | 0 | 34 | 220.137 | 330.098 | 489.391 | 0 | 489.391 |
| 20 | 1.56776 | 647.812 | Foundation soil | 0 | 32 | 180.915 | 271.284 | 434.145 | 0 | 434.145 |
| 21 | 1.56776 | 544.501 | Foundation soil | 0 | 32 | 156.28 | 234.344 | 375.028 | 0 | 375.028 |
| 22 | 1.56776 | 431.179 | Foundation soil | 0 | 32 | 127.228 | 190.779 | 305.309 | 0 | 305.309 |
| 23 | 1.56776 | 307.947 | Foundation soil | 0 | 32 | 93.4512 | 140.131 | 224.256 | 0 | 224.256 |
| 24 | 1.56776 | 174.876 | Foundation soil | 0 | 32 | 54.6046 | 81.8801 | 131.036 | 0 | 131.036 |
| 25 | 1.56776 | 38.2132 | Foundation soil | 0 | 32 | 14.0667 | 21.0931 | 33.756 | 0 | 33.756 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.49951

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 121.21 | 1092 | 0 | 0 | 0 |
| 2 | 122.833 | 1090.24 | 207.623 | 92.0754 | 23.916 |
| 3 | 124.457 | 1088.63 | 382.524 | 169.639 | 23.916 |
| 4 | 126.081 | 1087.15 | 601.688 | 266.833 | 23.916 |
| 5 | 127.704 | 1085.79 | 826.494 | 366.528 | 23.916 |
| 6 | 129.328 | 1084.53 | 1042.37 | 462.262 | 23.9159 |
| 7 | 130.951 | 1083.37 | 1239.78 | 549.811 | 23.9161 |
| 8 | 132.575 | 1082.29 | 1411.3 | 625.874 | 23.916 |
| 9 | 134.198 | 1081.3 | 1551.24 | 687.935 | 23.9161 |
| 10 | 135.822 | 1080.39 | 1655.49 | 734.165 | 23.916 |
| 11 | 137.446 | 1079.55 | 1721.3 | 763.349 | 23.916 |
| 12 | 139.069 | 1078.77 | 1747.2 | 774.836 | 23.916 |
| 13 | 140.693 | 1078.07 | 1732.92 | 768.503 | 23.916 |
| 14 | 142.316 | 1077.42 | 1679.32 | 744.735 | 23.916 |
| 15 | 143.94 | 1076.84 | 1588.4 | 704.415 | 23.9161 |
| 16 | 145.564 | 1076.32 | 1463.28 | 648.926 | 23.916 |

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| | | | | | |
|---|---|---|---|---|---|
| 17 | 147.187 | 1075.85 | 1308.22 | 580.161 | 23.916 |
| 18 | 148.811 | 1075.43 | 1128.68 | 500.541 | 23.9161 |
| 19 | 150.434 | 1075.07 | 931.388 | 413.046 | 23.916 |
| 20 | 152.058 | 1074.77 | 724.405 | 321.254 | 23.916 |
| 21 | 153.626 | 1074.52 | 548.3 | 243.157 | 23.9161 |
| 22 | 155.193 | 1074.32 | 378.337 | 167.782 | 23.916 |
| 23 | 156.761 | 1074.17 | 225.611 | 100.053 | 23.9161 |
| 24 | 158.329 | 1074.06 | 102.976 | 45.6671 | 23.916 |
| 25 | 159.897 | 1074 | 25.2456 | 11.1958 | 23.9161 |
| 26 | 161.464 | 1073.99 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |

### Line Load

| X | Y |
|---|---|
| 123.007 | 1092 |
| 116.679 | 1092 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

### Material Boundary





| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

### Material Boundary

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |

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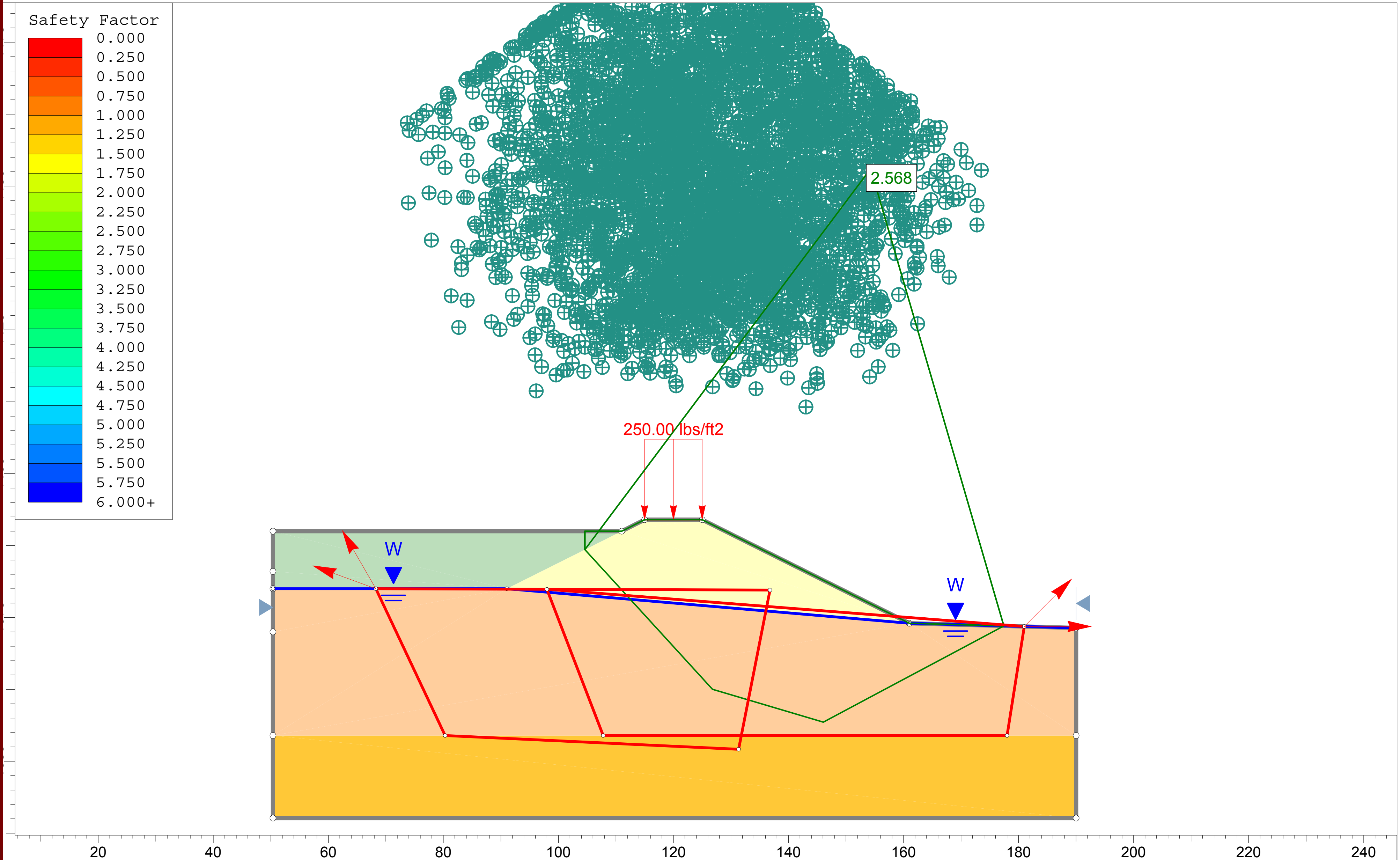


| | | | |
|---|---|---|---|
| Project | SLIDE - An Interactive Slope Stability Program | | |
| Analysis Description | | | |
| Drawn By | | Scale 1:280 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name C-C_Conemaugh_undrained block.slim | |

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_undrained block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Undrained | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Cohesion Type | 1000 | | 1000 | 8000 |
| Water Surface | None | None | None | None |
| Ru Value | 0 | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 2.568500
Axis Location: 154.285, 1153.016
Left Slip Surface Endpoint: 104.600, 1086.800
Right Slip Surface Endpoint: 177.447, 1073.538
Left Slope Intercept: 104.600 1090.004
Right Slope Intercept: 177.447 1073.538
Resisting Moment=7.46031e+006 lb-ft
Driving Moment=2.90453e+006 lb-ft
Resisting Horizontal Force=72846.8 lb

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Driving Horizontal Force=28361.6 lb
Total Slice Area=1209.32 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 104.6 | 1086.8 |
| 126.782 | 1062.52 |
| 146.057 | 1056.81 |
| 177.447 | 1073.54 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3113
Number of Invalid Surfaces: 1887

#### Error Codes:

Error Code -105 reported for 9 surfaces
Error Code -107 reported for 656 surfaces
Error Code -108 reported for 1163 surfaces
Error Code -111 reported for 22 surfaces
Error Code -112 reported for 37 surfaces

#### Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.5685

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6321 | 1080.89 | embankment soil | 1000 | 0 | 389.332 | 1000 | 11.8204 | 0 | 11.8204 |
| 2 | 2.6321 | 2190.35 | embankment soil | 1000 | 0 | 389.332 | 1000 | 395.902 | 0 | 395.902 |
| 3 | 2.6321 | 3334.4 | embankment soil | 1000 | 0 | 389.332 | 1000 | 791.26 | 0 | 791.26 |
| 4 | 2.85701 | 5155.56 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1304.82 | 0 | 1304.82 |
| 5 | 2.85701 | 6539.19 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1939.62 | 0 | 1939.62 |
| 6 | 2.85701 | 7734.78 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 2317.31 | 0 | 2317.31 |
| 7 | 2.85701 | 8930.37 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 2694.99 | 0 | 2694.99 |
| 8 | 2.85701 | 10030.8 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 2901.9 | 0 | 2901.9 |
| 9 | 3.21251 | 11605 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3433.89 | 0 | 3433.89 |
| 10 | 3.21251 | 11385.5 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3367.52 | 0 | 3367.52 |
| 11 | 3.21251 | 11165.9 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3301.17 | 0 | 3301.17 |
| 12 | 3.21251 | 10946.4 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3234.8 | 0 | 3234.8 |
| 13 | 3.21251 | 10726.9 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3168.42 | 0 | 3168.42 |
| 14 | 3.21251 | 10507.4 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3102.05 | 0 | 3102.05 |
| 15 | 2.85367 | 8693.73 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3478.21 | 0 | 3478.21 |
| 16 | 2.85367 | 7608.75 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 3076.65 | 0 | 3076.65 |
| 17 | 2.85367 | 6523.77 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 2675.11 | 0 | 2675.11 |
| 18 | 2.85367 | 5438.79 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 2273.56 | 0 | 2273.56 |
| 19 | 2.85367 | 4353.81 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1872.01 | 0 | 1872.01 |
| 20 | 2.85367 | 3405.28 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1520.96 | 0 | 1520.96 |
| 21 | 2.85367 | 2775.42 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1287.85 | 0 | 1287.85 |
| 22 | 2.85367 | 2158.66 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 1059.59 | 0 | 1059.59 |
| 23 | 2.85367 | 1541.9 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 831.332 | 0 | 831.332 |
| 24 | 2.85367 | 925.139 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 603.072 | 0 | 603.072 |
| 25 | 2.85367 | 308.38 | Foundation soil | 1000 | 0 | 389.332 | 1000 | 374.868 | 0 | 374.868 |





## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.5685

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 104.6 | 1086.8 | 320.196 | 0 | 0 |
| 2 | 107.232 | 1083.92 | -782.766 | -78.2766 | 5.71059 |
| 3 | 109.864 | 1081.04 | -567.119 | -56.7119 | 5.71059 |
| 4 | 112.496 | 1078.16 | 696.73 | 69.673 | 5.71059 |
| 5 | 115.353 | 1075.03 | 3663.43 | 366.343 | 5.71059 |
| 6 | 118.21 | 1071.9 | 8615.19 | 861.519 | 5.71059 |
| 7 | 121.067 | 1068.78 | 14748 | 1474.8 | 5.71059 |
| 8 | 123.924 | 1065.65 | 22061.8 | 2206.18 | 5.71059 |
| 9 | 126.782 | 1062.52 | 30022.7 | 3002.27 | 5.71059 |
| 10 | 129.994 | 1061.57 | 32040.4 | 3204.04 | 5.71059 |
| 11 | 133.207 | 1060.62 | 33995 | 3399.5 | 5.71059 |

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| | | | | | |
|---|---|---|---|---|---|
| 12 | 136.419 | 1059.67 | 35886.3 | 3588.63 | 5.71059 |
| 13 | 139.632 | 1058.71 | 37714.4 | 3771.44 | 5.71059 |
| 14 | 142.844 | 1057.76 | 39479.4 | 3947.94 | 5.71059 |
| 15 | 146.057 | 1056.81 | 41181.1 | 4118.11 | 5.71059 |
| 16 | 148.91 | 1058.33 | 34779.1 | 3477.91 | 5.71059 |
| 17 | 151.764 | 1059.85 | 28987.7 | 2898.77 | 5.71059 |
| 18 | 154.618 | 1061.37 | 23807.1 | 2380.71 | 5.71059 |
| 19 | 157.471 | 1062.89 | 19237.1 | 1923.71 | 5.71059 |
| 20 | 160.325 | 1064.41 | 15277.8 | 1527.78 | 5.71059 |
| 21 | 163.179 | 1065.93 | 11852.4 | 1185.24 | 5.71059 |
| 22 | 166.032 | 1067.45 | 8781.57 | 878.157 | 5.71059 |
| 23 | 168.886 | 1068.98 | 6057.86 | 605.786 | 5.71059 |
| 24 | 171.74 | 1070.5 | 3681.31 | 368.131 | 5.71059 |
| 25 | 174.593 | 1072.02 | 1651.91 | 165.191 | 5.71059 |
| 26 | 177.447 | 1073.54 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |

### Line Load

| X | Y |
|---|---|
| 125 | 1092 |
| 115 | 1092 |

### Block Search Window

| X | Y |
|---|---|
| 68.264 | 1080 |
| 80.3115 | 1054.48 |
| 131.325 | 1052.09 |
| 136.785 | 1079.76 |

### Block Search Window

| X | Y |
|---|---|
| 98.0043 | 1079.9 |
| 107.795 | 1054.48 |
| 178.01 | 1054.48 |





| | |
|---|---|
| 181.003 | 1073.44 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

### Material Boundary

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |

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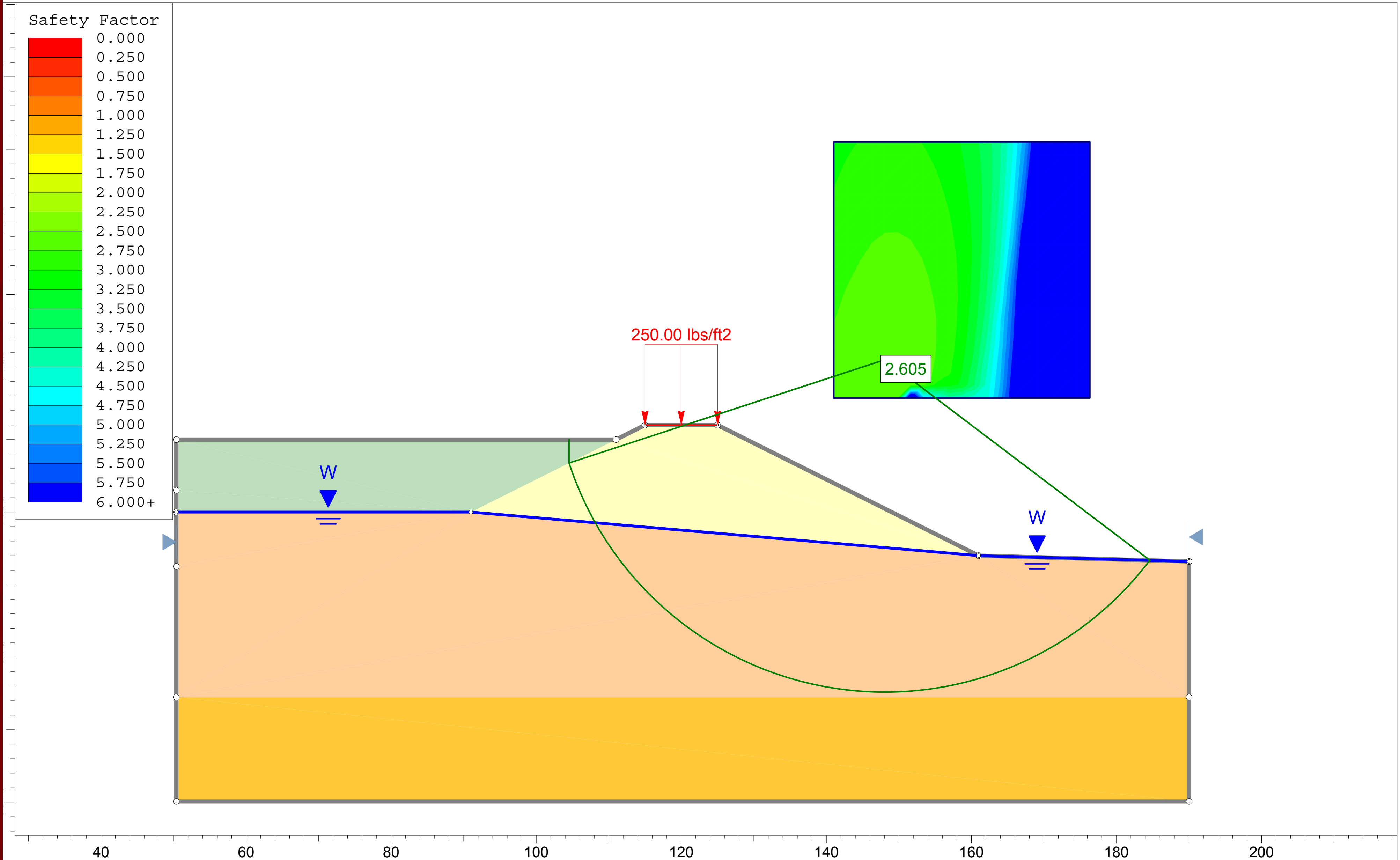


| | | | |
|---|---|---|---|
| Project | SLIDE - An Interactive Slope Stability Program | | |
| Analysis Description | | | |
| Drawn By | | Scale 1:222 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name C-C_Conemaugh_undrained circular.slim | |

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_undrained circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Undrained | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Cohesion Type | 1000 | | 1000 | 8000 |
| Water Surface | None | None | None | None |
| Ru Value | 0 | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 2.605340
Center: 148.084, 1101.017
Radius: 45.845
Left Slip Surface Endpoint: 104.513, 1086.756
Right Slip Surface Endpoint: 184.629, 1073.337
Left Slope Intercept: 104.513 1090.004
Right Slope Intercept: 184.629 1073.337
Resisting Moment=4.56855e+006 lb-ft
Driving Moment=1.75353e+006 lb-ft
Resisting Horizontal Force=80115.9 lb
Driving Horizontal Force=30750.6 lb
Total Slice Area=1603.82 ft2

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## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 4656
Number of Invalid Surfaces: 195

#### Error Codes:

Error Code -108 reported for 186 surfaces
Error Code -111 reported for 9 surfaces

#### Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.60534

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.61861 | 2707.53 | embankment soil | 1000 | 0 | 383.827 | 1000 | -94.3353 | 0 | -94.3353 |
| 2 | 3.18739 | 5320.04 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 1012.42 | 0 | 1012.42 |
| 3 | 3.18739 | 7665.5 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 1841.95 | 0 | 1841.95 |
| 4 | 3.18739 | 9536.76 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2702.06 | 0 | 2702.06 |
| 5 | 3.18739 | 10754.8 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3190.25 | 0 | 3190.25 |
| 6 | 3.18739 | 11758.6 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3566.43 | 0 | 3566.43 |
| 7 | 3.18739 | 12440.2 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3666.23 | 0 | 3666.23 |
| 8 | 3.18739 | 12545.8 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3684.09 | 0 | 3684.09 |
| 9 | 3.18739 | 12496.8 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3720.41 | 0 | 3720.41 |
| 10 | 3.18739 | 12331.2 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3716.88 | 0 | 3716.88 |
| 11 | 3.18739 | 12057.2 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3676.81 | 0 | 3676.81 |
| 12 | 3.18739 | 11680.7 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3602.46 | 0 | 3602.46 |
| 13 | 3.18739 | 11205.6 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3495.45 | 0 | 3495.45 |
| 14 | 3.18739 | 10634.1 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3356.69 | 0 | 3356.69 |
| 15 | 3.18739 | 9966.93 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 3186.69 | 0 | 3186.69 |
| 16 | 3.18739 | 9203.47 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2985.46 | 0 | 2985.46 |
| 17 | 3.18739 | 8341.59 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2752.49 | 0 | 2752.49 |
| 18 | 3.18739 | 7427.41 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2502.68 | 0 | 2502.68 |
| 19 | 3.18739 | 6839.06 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2357.64 | 0 | 2357.64 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 3.18739 | 6235.26 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2209.89 | 0 | 2209.89 |
| 21 | 3.18739 | 5503.93 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 2024.36 | 0 | 2024.36 |
| 22 | 3.18739 | 4628.76 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 1796.88 | 0 | 1796.88 |
| 23 | 3.18739 | 3586.04 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 1521.51 | 0 | 1521.51 |
| 24 | 3.18739 | 2339.59 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 1189.58 | 0 | 1189.58 |
| 25 | 3.18739 | 829.963 | Foundation soil | 1000 | 0 | 383.827 | 1000 | 787.823 | 0 | 787.823 |

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.60534

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 104.513 | 1086.76 | 328.973 | 0 | 0 |
| 2 | 108.132 | 1078.53 | -1897.85 | -107.491 | 3.24167 |
| 3 | 111.319 | 1073.63 | 1909.17 | 108.132 | 3.24167 |
| 4 | 114.506 | 1069.8 | 7735.01 | 438.099 | 3.24168 |
| 5 | 117.694 | 1066.69 | 14919.7 | 845.026 | 3.24167 |
| 6 | 120.881 | 1064.11 | 21920.4 | 1241.54 | 3.24169 |
| 7 | 124.068 | 1061.97 | 28364.6 | 1606.52 | 3.24167 |
| 8 | 127.256 | 1060.18 | 33702.4 | 1908.85 | 3.24168 |
| 9 | 130.443 | 1058.7 | 37913.3 | 2147.35 | 3.24168 |
| 10 | 133.631 | 1057.51 | 41126.5 | 2329.34 | 3.24168 |
| 11 | 136.818 | 1056.58 | 43369.8 | 2456.39 | 3.24167 |
| 12 | 140.005 | 1055.89 | 44679.6 | 2530.58 | 3.24168 |
| 13 | 143.193 | 1055.43 | 45100 | 2554.39 | 3.24168 |
| 14 | 146.38 | 1055.2 | 44682.6 | 2530.75 | 3.24168 |
| 15 | 149.568 | 1055.2 | 43487 | 2463.04 | 3.24169 |
| 16 | 152.755 | 1055.41 | 41582 | 2355.14 | 3.24168 |
| 17 | 155.942 | 1055.85 | 39047.2 | 2211.57 | 3.24168 |
| 18 | 159.13 | 1056.52 | 35976.2 | 2037.63 | 3.24167 |
| 19 | 162.317 | 1057.44 | 32465.3 | 1838.78 | 3.24167 |
| 20 | 165.504 | 1058.61 | 28477.7 | 1612.93 | 3.24168 |
| 21 | 168.692 | 1060.07 | 24043 | 1361.76 | 3.24168 |
| 22 | 171.879 | 1061.83 | 19246.5 | 1090.09 | 3.24168 |
| 23 | 175.067 | 1063.95 | 14211.1 | 804.896 | 3.24169 |
| 24 | 178.254 | 1066.5 | 9117.78 | 516.417 | 3.24168 |
| 25 | 181.441 | 1069.57 | 4245.09 | 240.435 | 3.24168 |
| 26 | 184.629 | 1073.34 | 0 | 0 | 0 |

## List Of Coordinates

### Water Table

| X | Y |
|---|---|

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| | |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |

**Line Load**

| X | Y |
|---|---|
| 125 | 1092 |
| 115 | 1092 |

**External Boundary**

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

**Material Boundary**

| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

**Material Boundary**

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

**Material Boundary**

| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |





**Material Boundary**

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |

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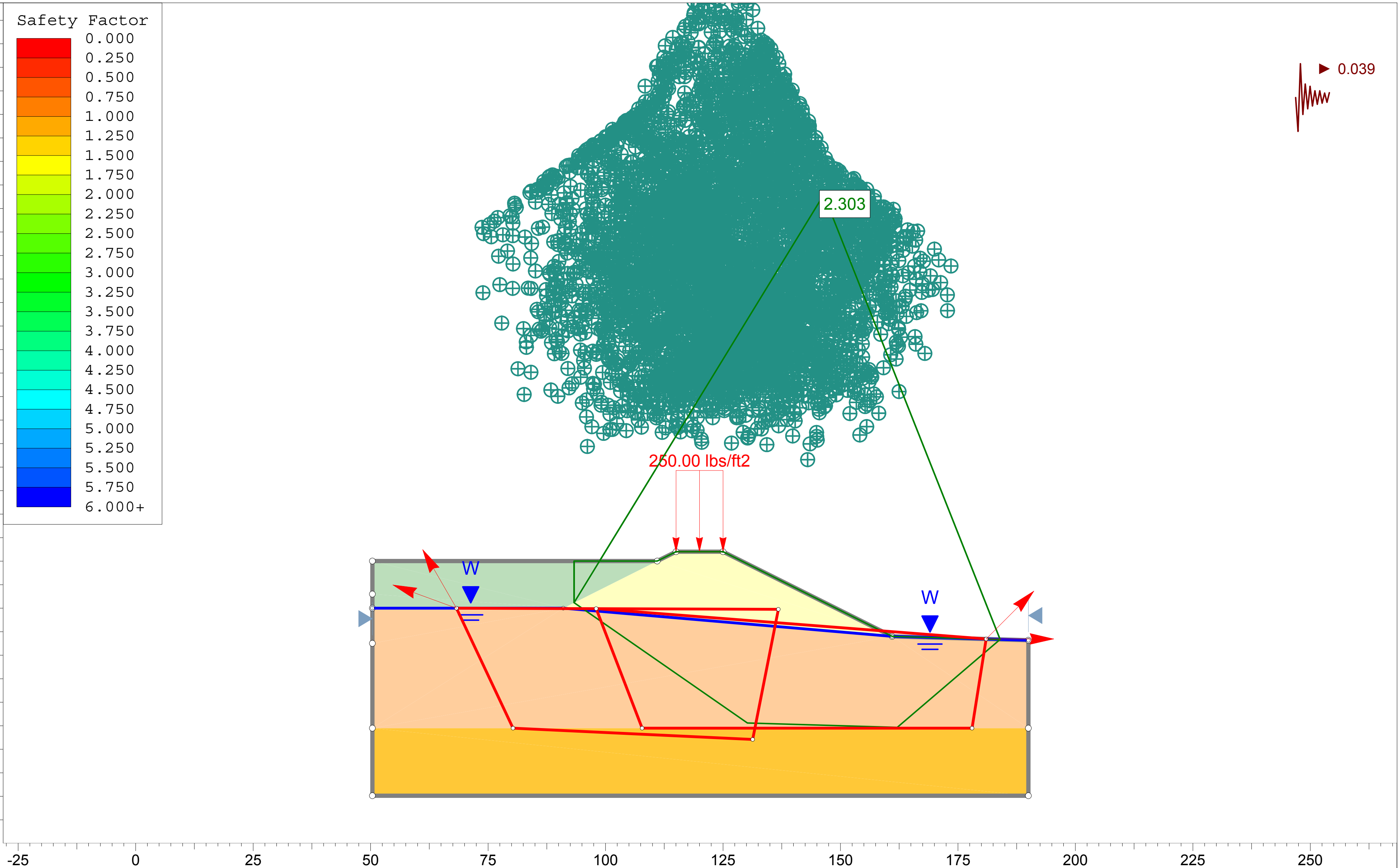


| Project | SLIDE - An Interactive Slope Stability Program | | |
|---|---|---|---|
| Analysis Description | | | |
| Drawn By | | Scale 1:345 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name C-C_Conemaugh_undrained block-seismic.slim | |

rocscience

SLIDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_undrained block-seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 0
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Undrained | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Cohesion Type | 1000 | | 1000 | 8000 |
| Water Surface | None | None | None | None |
| Ru Value | 0 | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 2.302960
Axis Location: 146.448, 1167.927
Left Slip Surface Endpoint: 93.311, 1081.156
Right Slip Surface Endpoint: 183.983, 1073.355
Left Slope Intercept: 93.311 1090.004
Right Slope Intercept: 183.983 1073.355
Resisting Moment=1.09143e+007 lb-ft
Driving Moment=4.73923e+006 lb-ft

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Resisting Horizontal Force=90672.1 lb
Driving Horizontal Force=39372.1 lb
Total Slice Area=1877.14 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 93.3112 | 1081.16 |
| 130.178 | 1055.57 |
| 162.075 | 1054.65 |
| 183.983 | 1073.35 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3384
Number of Invalid Surfaces: 1616

#### Error Codes:

Error Code -105 reported for 9 surfaces
Error Code -107 reported for 410 surfaces
Error Code -108 reported for 1093 surfaces
Error Code -111 reported for 62 surfaces
Error Code -112 reported for 42 surfaces

#### Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.30296

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion | Base Friction Angle | Shear Stress | Shear Strength | Base Normal Stress | Pore Pressure | Effective Normal Stress |
|---|---|---|---|---|---|---|---|---|---|---|





| | | | | | [degrees] | | | [psf] | | [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.22548 | 1506.27 | embankment soil | 1000 | 0 | 434.224 | 1000 | 366.379 | 0 | 366.379 |
| 2 | 3.84908 | 3983.05 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 703.102 | 0 | 703.102 |
| 3 | 3.84908 | 5778.73 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 1141.77 | 0 | 1141.77 |
| 4 | 3.84908 | 7574.41 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 1580.45 | 0 | 1580.45 |
| 5 | 3.84908 | 9370.09 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2019.12 | 0 | 2019.12 |
| 6 | 3.84908 | 11388.1 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2508.85 | 0 | 2508.85 |
| 7 | 3.84908 | 13250.3 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3178.15 | 0 | 3178.15 |
| 8 | 3.84908 | 14620.8 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3522.02 | 0 | 3522.02 |
| 9 | 3.84908 | 15936.7 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3759.04 | 0 | 3759.04 |
| 10 | 3.84908 | 16607.3 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3768.22 | 0 | 3768.22 |
| 11 | 3.54406 | 15151.9 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 4277.91 | 0 | 4277.91 |
| 12 | 3.54406 | 14431.2 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 4075.99 | 0 | 4075.99 |
| 13 | 3.54406 | 13710.5 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3874.1 | 0 | 3874.1 |
| 14 | 3.54406 | 12989.8 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3672.19 | 0 | 3672.19 |
| 15 | 3.54406 | 12269.1 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3470.27 | 0 | 3470.27 |
| 16 | 3.54406 | 11548.5 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3268.36 | 0 | 3268.36 |
| 17 | 3.54406 | 10827.8 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3066.44 | 0 | 3066.44 |
| 18 | 3.54406 | 10107.1 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2864.55 | 0 | 2864.55 |
| 19 | 3.54406 | 9419.59 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2671.94 | 0 | 2671.94 |
| 20 | 3.65141 | 8731.33 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 3071.12 | 0 | 3071.12 |
| 21 | 3.65141 | 7143.82 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2595.9 | 0 | 2595.9 |
| 22 | 3.65141 | 5556.3 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 2120.67 | 0 | 2120.67 |
| 23 | 3.65141 | 3968.79 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 1645.45 | 0 | 1645.45 |
| 24 | 3.65141 | 2381.27 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 1170.23 | 0 | 1170.23 |
| 25 | 3.65141 | 793.757 | Foundation soil | 1000 | 0 | 434.224 | 1000 | 693.357 | 0 | 693.357 |

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 2.30296

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 93.3112 | 1081.16 | 2442.56 | 0 | 0 |
| 2 | 95.5367 | 1079.61 | 189.92 | 19.9028 | 5.98252 |
| 3 | 99.3858 | 1076.94 | 1303.45 | 136.596 | 5.98252 |
| 4 | 103.235 | 1074.27 | 3445.72 | 361.097 | 5.98252 |
| 5 | 107.084 | 1071.6 | 6616.73 | 693.406 | 5.98252 |
| 6 | 110.933 | 1068.93 | 10816.5 | 1133.52 | 5.9825 |
| 7 | 114.782 | 1066.25 | 16292.5 | 1707.38 | 5.9825 |
| 8 | 118.631 | 1063.58 | 23628.9 | 2476.22 | 5.98255 |
| 9 | 122.48 | 1060.91 | 31937.4 | 3346.91 | 5.98253 |
| 10 | 126.329 | 1058.24 | 40930.4 | 4289.34 | 5.98253 |
| 11 | 130.178 | 1055.57 | 49974 | 5237.07 | 5.98253 |
| 12 | 133.722 | 1055.47 | 49466.2 | 5183.85 | 5.98252 |

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| | | | | | |
|---|---|---|---|---|---|
| 13 | 137.267 | 1055.36 | 48909.5 | 5125.52 | 5.98253 |
| 14 | 140.811 | 1055.26 | 48304.1 | 5062.07 | 5.98252 |
| 15 | 144.355 | 1055.16 | 47649.8 | 4993.5 | 5.98252 |
| 16 | 147.899 | 1055.06 | 46946.7 | 4919.82 | 5.98252 |
| 17 | 151.443 | 1054.95 | 46194.7 | 4841.02 | 5.98253 |
| 18 | 154.987 | 1054.85 | 45394 | 4757.1 | 5.98252 |
| 19 | 158.531 | 1054.75 | 44544.4 | 4668.07 | 5.98253 |
| 20 | 162.075 | 1054.65 | 43648.3 | 4574.16 | 5.98252 |
| 21 | 165.726 | 1057.76 | 32828.9 | 3440.33 | 5.98252 |
| 22 | 169.378 | 1060.88 | 23429.3 | 2455.3 | 5.98254 |
| 23 | 173.029 | 1064 | 15449.6 | 1619.06 | 5.98255 |
| 24 | 176.681 | 1067.12 | 8889.71 | 931.605 | 5.98253 |
| 25 | 180.332 | 1070.24 | 3749.64 | 392.947 | 5.98253 |
| 26 | 183.983 | 1073.35 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |

### Line Load

| X | Y |
|---|---|
| 125 | 1092 |
| 115 | 1092 |

### Block Search Window

| X | Y |
|---|---|
| 68.264 | 1080 |
| 80.3115 | 1054.48 |
| 131.325 | 1052.09 |
| 136.785 | 1079.76 |

### Block Search Window

| X | Y |
|---|---|
| 98.0043 | 1079.9 |
| 107.795 | 1054.48 |
| 178.01 | 1054.48 |
| 181.003 | 1073.44 |





### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

### Material Boundary

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |

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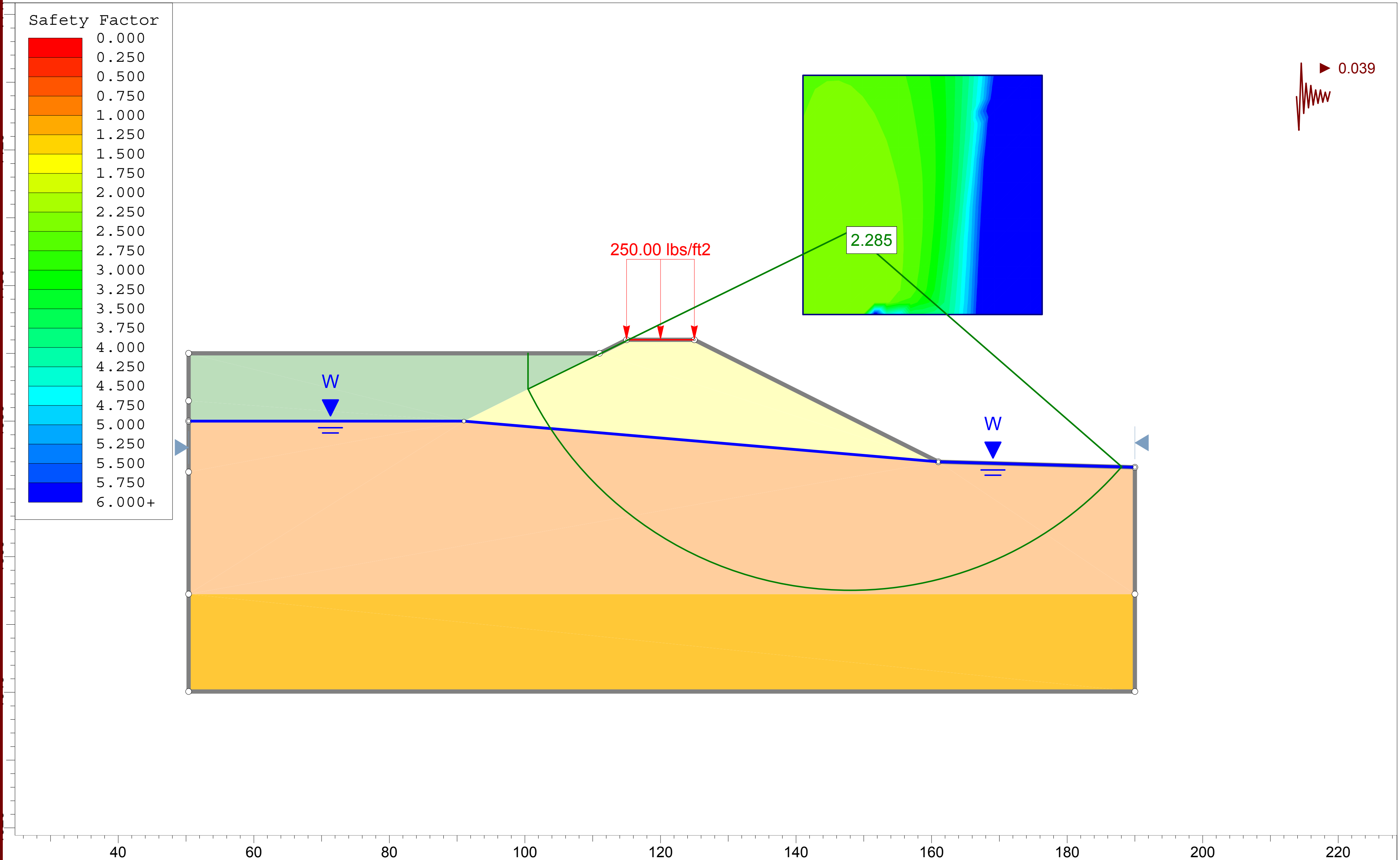


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | *Scale* 1:237 | *Company* | |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* C-C_Conemaugh_undrained circular-seismic.slim | |

SLIDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: C-C_Conemaugh_undrained circular-seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | embankment soil | water | Foundation soil | bedrock |
|---|---|---|---|---|
| Color | | | | |
| Strength Type | Undrained | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | | 135 | 145 |
| Cohesion Type | 1000 | | 1000 | 8000 |
| Water Surface | None | None | None | None |
| Ru Value | 0 | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 2.285320
Center: 148.084, 1108.077
Radius: 53.046
Left Slip Surface Endpoint: 100.453, 1084.727
Right Slip Surface Endpoint: 188.087, 1073.240
Left Slope Intercept: 100.453 1090.004
Right Slope Intercept: 188.087 1073.240
Resisting Moment=5.53309e+006 lb-ft
Driving Moment=2.42115e+006 lb-ft
Resisting Horizontal Force=87633.3 lb
Driving Horizontal Force=38346.3 lb

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Total Slice Area=1764.58 ft2

## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 4721
Number of Invalid Surfaces: 130

#### Error Codes:

Error Code -108 reported for 116 surfaces
Error Code -111 reported for 14 surfaces

#### Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 2.28532

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.32613 | 2416.44 | embankment soil | 1000 | 0 | 437.575 | 1000 | -16.0147 | 0 | -16.0147 |
| 2 | 3.5128 | 5240.75 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 828.087 | 0 | 828.087 |
| 3 | 3.5128 | 7611.43 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 1566.75 | 0 | 1566.75 |
| 4 | 3.5128 | 9781.9 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2238.61 | 0 | 2238.61 |
| 5 | 3.5128 | 11649 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3010.37 | 0 | 3010.37 |
| 6 | 3.5128 | 12809.3 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3447.93 | 0 | 3447.93 |
| 7 | 3.5128 | 13769.6 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3781.27 | 0 | 3781.27 |
| 8 | 3.5128 | 14227.3 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3743.55 | 0 | 3743.55 |
| 9 | 3.5128 | 14140.6 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3771.76 | 0 | 3771.76 |
| 10 | 3.5128 | 13920.1 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3768.75 | 0 | 3768.75 |
| 11 | 3.5128 | 13575.2 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3727.79 | 0 | 3727.79 |
| 12 | 3.5128 | 13112.3 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3650.89 | 0 | 3650.89 |
| 13 | 3.5128 | 12535.3 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3539.46 | 0 | 3539.46 |
| 14 | 3.5128 | 11846.8 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3394.32 | 0 | 3394.32 |
| 15 | 3.5128 | 11047.6 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3215.84 | 0 | 3215.84 |
| 16 | 3.5128 | 10137.3 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 3003.89 | 0 | 3003.89 |
| 17 | 3.5128 | 9113.65 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2757.86 | 0 | 2757.86 |
| 18 | 3.5128 | 8152.2 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2528.67 | 0 | 2528.67 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 3.5128 | 7568.58 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2409.71 | 0 | 2409.71 |
| 20 | 3.5128 | 6883.74 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2263.02 | 0 | 2263.02 |
| 21 | 3.5128 | 6056.74 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 2076.97 | 0 | 2076.97 |
| 22 | 3.5128 | 5071.94 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 1847.45 | 0 | 1847.45 |
| 23 | 3.5128 | 3907.26 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 1568.65 | 0 | 1568.65 |
| 24 | 3.5128 | 2530.51 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 1232.26 | 0 | 1232.26 |
| 25 | 3.5128 | 892.152 | Foundation soil | 1000 | 0 | 437.575 | 1000 | 824.657 | 0 | 824.657 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 2.28532

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 100.453 | 1084.73 | 868.803 | 0 | 0 |
| 2 | 103.779 | 1078.9 | -1031.43 | -91.8793 | 5.09045 |
| 3 | 107.292 | 1074.17 | 1833.78 | 163.352 | 5.09044 |
| 4 | 110.805 | 1070.34 | 6686.91 | 595.666 | 5.09044 |
| 5 | 114.318 | 1067.17 | 12632.4 | 1125.29 | 5.09045 |
| 6 | 117.831 | 1064.5 | 19560.3 | 1742.42 | 5.09044 |
| 7 | 121.343 | 1062.26 | 26242.8 | 2337.69 | 5.09043 |
| 8 | 124.856 | 1060.39 | 32338.5 | 2880.69 | 5.09043 |
| 9 | 128.369 | 1058.83 | 37179.2 | 3311.9 | 5.09044 |
| 10 | 131.882 | 1057.57 | 40961.4 | 3648.82 | 5.09044 |
| 11 | 135.395 | 1056.57 | 43713.8 | 3894 | 5.09044 |
| 12 | 138.907 | 1055.83 | 45463.3 | 4049.85 | 5.09045 |
| 13 | 142.42 | 1055.33 | 46247.8 | 4119.73 | 5.09044 |
| 14 | 145.933 | 1055.07 | 46115.8 | 4107.97 | 5.09044 |
| 15 | 149.446 | 1055.05 | 45126.9 | 4019.88 | 5.09044 |
| 16 | 152.959 | 1055.26 | 43352.5 | 3861.82 | 5.09044 |
| 17 | 156.471 | 1055.7 | 40877.9 | 3641.38 | 5.09044 |
| 18 | 159.984 | 1056.38 | 37805.2 | 3367.66 | 5.09043 |
| 19 | 163.497 | 1057.32 | 34215.3 | 3047.88 | 5.09044 |
| 20 | 167.01 | 1058.52 | 30073.1 | 2678.9 | 5.09045 |
| 21 | 170.523 | 1060.01 | 25433.5 | 2265.6 | 5.09044 |
| 22 | 174.035 | 1061.81 | 20387.3 | 1816.09 | 5.09044 |
| 23 | 177.548 | 1063.97 | 15066.1 | 1342.08 | 5.09044 |
| 24 | 181.061 | 1066.53 | 9662.02 | 860.687 | 5.09044 |
| 25 | 184.574 | 1069.58 | 4464.66 | 397.709 | 5.09043 |
| 26 | 188.087 | 1073.24 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

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| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |
| 161 | 1074 |
| 190 | 1073.19 |

### Line Load

| X | Y |
|---|---|
| 125 | 1092 |
| 115 | 1092 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1040.12 |
| 190 | 1040.12 |
| 190 | 1054.48 |
| 190 | 1073.19 |
| 161 | 1074 |
| 125 | 1092 |
| 115 | 1092 |
| 111.007 | 1090 |
| 50.3799 | 1090 |
| 50.3799 | 1083 |
| 50.38 | 1080 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.48 |

### Material Boundary

| X | Y |
|---|---|
| 91 | 1080 |
| 111.007 | 1090 |

### Material Boundary

| X | Y |
|---|---|
| 50.38 | 1080 |
| 91 | 1080 |

### Material Boundary

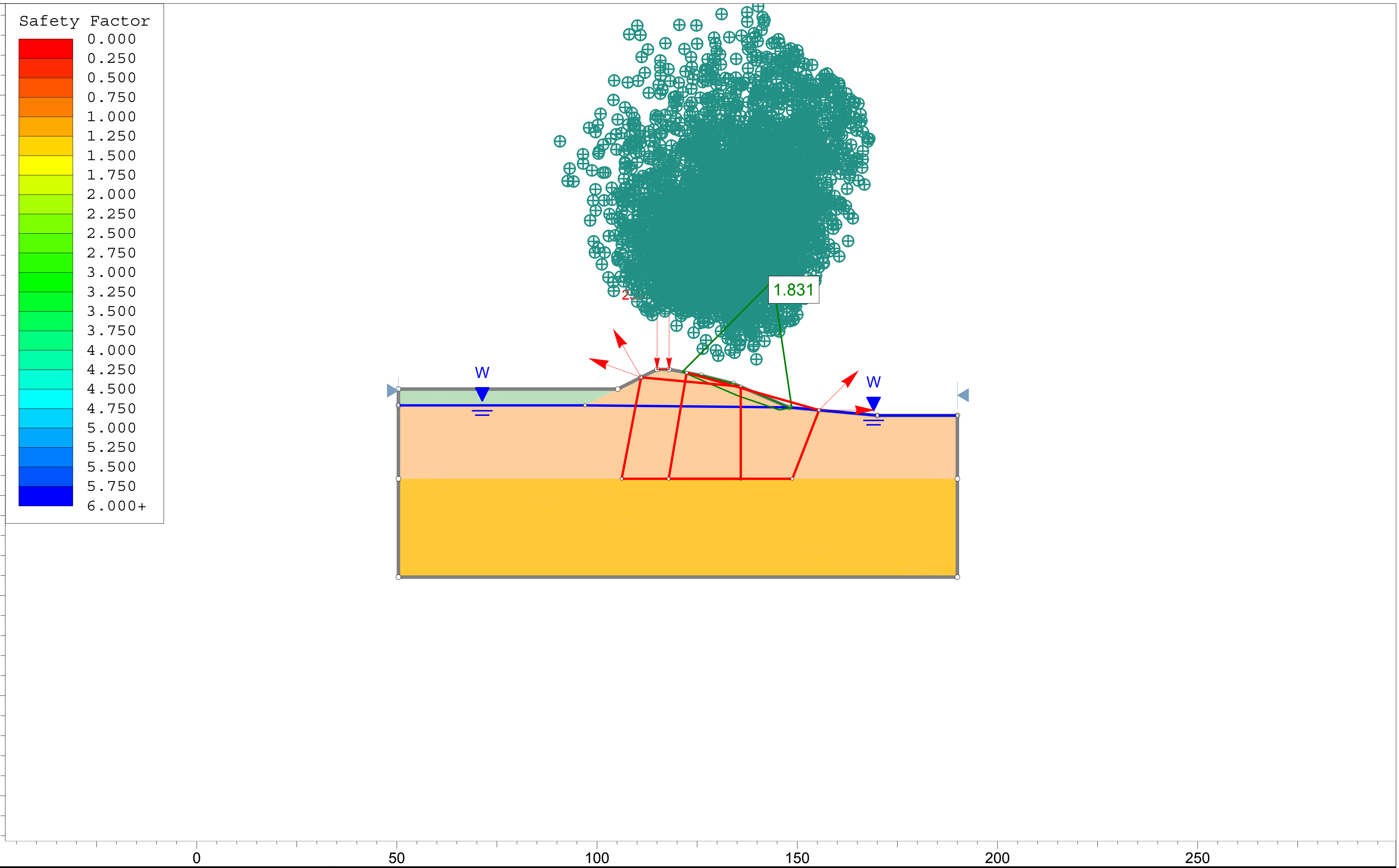
| X | Y |
|---|---|
| 91 | 1080 |
| 161 | 1074 |





### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.48 |
| 190 | 1054.48 |




| Project | SLIDE - An Interactive Slope Stability Program | | |
|---|---|---|---|
| Analysis Description | | | |
| Drawn By | | Scale 1:404 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name B-B_Conemaugh_drained block.slim | |

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_drained block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion [psf] | | 0 | |
| Friction Angle [deg] | | 32 | |
| Cohesion Type | | | 8000 |
| Water Surface | None | Water Table | None |
| Hu Value | | 0 | |
| Ru Value | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.830950
Axis Location: 143.898, 1103.734
Left Slip Surface Endpoint: 121.299, 1080.881
Right Slip Surface Endpoint: 148.621, 1071.944
Resisting Moment=109697 lb-ft

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Driving Moment=59912.3 lb-ft
Resisting Horizontal Force=3412.97 lb
Driving Horizontal Force=1864.04 lb
Total Slice Area=45.183 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 121.299 | 1080.88 |
| 135.27 | 1074.86 |
| 145.58 | 1071.37 |
| 148.621 | 1071.94 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3043
Number of Invalid Surfaces: 1957

#### Error Codes:

Error Code -105 reported for 6 surfaces
Error Code -107 reported for 576 surfaces
Error Code -108 reported for 1016 surfaces
Error Code -111 reported for 213 surfaces
Error Code -112 reported for 146 surfaces

#### Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.83095

| Slice | Width | Weight | Base | Base | Base Friction | Shear | Shear | Base Normal | Pore | Effective Normal |
|---|---|---|---|---|---|---|---|---|---|---|





| Number | [ft] | [lbs] | Material | [psf] | Angle [degrees] | [psf] | [psf] | Stress [psf] | [psf] | Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.07468 | 18.9856 | Foundation soil | 0 | 32 | 5.13645 | 9.40459 | 15.0505 | 0 | 15.0505 |
| 2 | 1.07468 | 56.9568 | Foundation soil | 0 | 32 | 15.4094 | 28.2138 | 45.1514 | 0 | 45.1514 |
| 3 | 1.07468 | 94.928 | Foundation soil | 0 | 32 | 25.6823 | 47.023 | 75.2525 | 0 | 75.2525 |
| 4 | 1.07468 | 132.899 | Foundation soil | 0 | 32 | 35.9552 | 65.8321 | 105.354 | 0 | 105.354 |
| 5 | 1.07468 | 168.963 | Foundation soil | 0 | 32 | 45.712 | 83.6963 | 133.942 | 0 | 133.942 |
| 6 | 1.07468 | 197.872 | Foundation soil | 0 | 32 | 53.5331 | 98.0165 | 156.859 | 0 | 156.859 |
| 7 | 1.07468 | 226.098 | Foundation soil | 0 | 32 | 61.1699 | 111.999 | 179.235 | 0 | 179.235 |
| 8 | 1.07468 | 254.324 | Foundation soil | 0 | 32 | 68.8064 | 125.981 | 201.611 | 0 | 201.611 |
| 9 | 1.07468 | 282.551 | Foundation soil | 0 | 32 | 76.4428 | 139.963 | 223.987 | 0 | 223.987 |
| 10 | 1.07468 | 310.777 | Foundation soil | 0 | 32 | 84.0793 | 153.945 | 246.363 | 0 | 246.363 |
| 11 | 1.07468 | 339.003 | Foundation soil | 0 | 32 | 91.7158 | 167.927 | 268.739 | 0 | 268.739 |
| 12 | 1.07468 | 366.77 | Foundation soil | 0 | 32 | 99.2277 | 181.681 | 290.75 | 0 | 290.75 |
| 13 | 1.07468 | 376.477 | Foundation soil | 0 | 32 | 101.854 | 186.489 | 298.445 | 0 | 298.445 |
| 14 | 1.14557 | 393.512 | Foundation soil | 0 | 32 | 105.177 | 192.574 | 308.184 | 0 | 308.184 |
| 15 | 1.14557 | 377.511 | Foundation soil | 0 | 32 | 100.901 | 184.744 | 295.653 | 0 | 295.653 |
| 16 | 1.14557 | 361.511 | Foundation soil | 0 | 32 | 96.6242 | 176.914 | 283.121 | 0 | 283.121 |
| 17 | 1.14557 | 345.51 | Foundation soil | 0 | 32 | 92.3477 | 169.084 | 270.59 | 0 | 270.59 |
| 18 | 1.14557 | 329.509 | Foundation soil | 0 | 32 | 88.0707 | 161.253 | 258.059 | 0 | 258.059 |
| 19 | 1.14557 | 313.509 | Foundation soil | 0 | 32 | 83.7942 | 153.423 | 245.528 | 0 | 245.528 |
| 20 | 1.14557 | 297.508 | Foundation soil | 0 | 32 | 79.5177 | 145.593 | 232.997 | 0 | 232.997 |
| 21 | 1.14557 | 281.507 | Foundation soil | 0 | 32 | 75.2407 | 137.762 | 220.466 | 0 | 220.466 |
| 22 | 1.14557 | 265.507 | Foundation soil | 0 | 32 | 70.9643 | 129.932 | 207.935 | 0 | 207.935 |
| 23 | 1.01361 | 185.09 | Foundation soil | 0 | 32 | 79.6264 | 145.792 | 233.316 | 0 | 233.316 |
| 24 | 1.01361 | 99.5793 | Foundation soil | 0 | 32 | 42.8396 | 78.4371 | 125.526 | 0 | 125.526 |
| | | | Foundation | | | | | | | |

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| soil |
|---|

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.83095

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 121.299 | 1080.88 | 0 | 0 | 0 |
| 2 | 122.374 | 1080.42 | 1.4373 | 0.424352 | 16.4488 |
| 3 | 123.448 | 1079.95 | 5.7492 | 1.69741 | 16.4489 |
| 4 | 124.523 | 1079.49 | 12.9357 | 3.81917 | 16.4488 |
| 5 | 125.598 | 1079.03 | 22.9968 | 6.78963 | 16.4488 |
| 6 | 126.672 | 1078.57 | 35.7881 | 10.5662 | 16.4489 |
| 7 | 127.747 | 1078.1 | 50.7679 | 14.9888 | 16.4488 |
| 8 | 128.822 | 1077.64 | 67.8846 | 20.0424 | 16.4488 |
| 9 | 129.897 | 1077.18 | 87.1381 | 25.7269 | 16.4489 |
| 10 | 130.971 | 1076.71 | 108.529 | 32.0422 | 16.4488 |
| 11 | 132.046 | 1076.25 | 132.056 | 38.9885 | 16.4488 |
| 12 | 133.121 | 1075.79 | 157.72 | 46.5656 | 16.4488 |
| 13 | 134.195 | 1075.32 | 185.486 | 54.7634 | 16.4489 |
| 14 | 135.27 | 1074.86 | 213.987 | 63.1782 | 16.4489 |
| 15 | 136.415 | 1074.47 | 212.605 | 62.77 | 16.4488 |
| 16 | 137.561 | 1074.08 | 211.279 | 62.3784 | 16.4488 |
| 17 | 138.707 | 1073.7 | 210.008 | 62.0034 | 16.4489 |
| 18 | 139.852 | 1073.31 | 208.795 | 61.645 | 16.4488 |
| 19 | 140.998 | 1072.92 | 207.637 | 61.3032 | 16.4488 |
| 20 | 142.143 | 1072.53 | 206.535 | 60.978 | 16.4489 |
| 21 | 143.289 | 1072.15 | 205.49 | 60.6695 | 16.4489 |
| 22 | 144.434 | 1071.76 | 204.501 | 60.3775 | 16.4489 |
| 23 | 145.58 | 1071.37 | 203.568 | 60.1021 | 16.4489 |
| 24 | 146.594 | 1071.56 | 78.2009 | 23.0882 | 16.4488 |
| 25 | 147.607 | 1071.75 | 10.7524 | 3.17456 | 16.4488 |
| 26 | 148.621 | 1071.94 | 0 | 0 | 0 |

## List Of Coordinates

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 170 | 1070 |
| 190 | 1070 |





### Line Load

| X | Y |
|---|---|
| 118 | 1081.5 |
| 115 | 1081.5 |

### Block Search Window

| X | Y |
|---|---|
| 111.007 | 1079.5 |
| 106.138 | 1054.17 |
| 135.877 | 1054.17 |
| 135.877 | 1077.2 |

### Block Search Window

| X | Y |
|---|---|
| 122.363 | 1080.68 |
| 117.871 | 1054.17 |
| 148.772 | 1054.17 |
| 155.453 | 1071.32 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |

| | |
|---|---|
| 105.176 | 1076.59 |

## Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

## Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

## Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |



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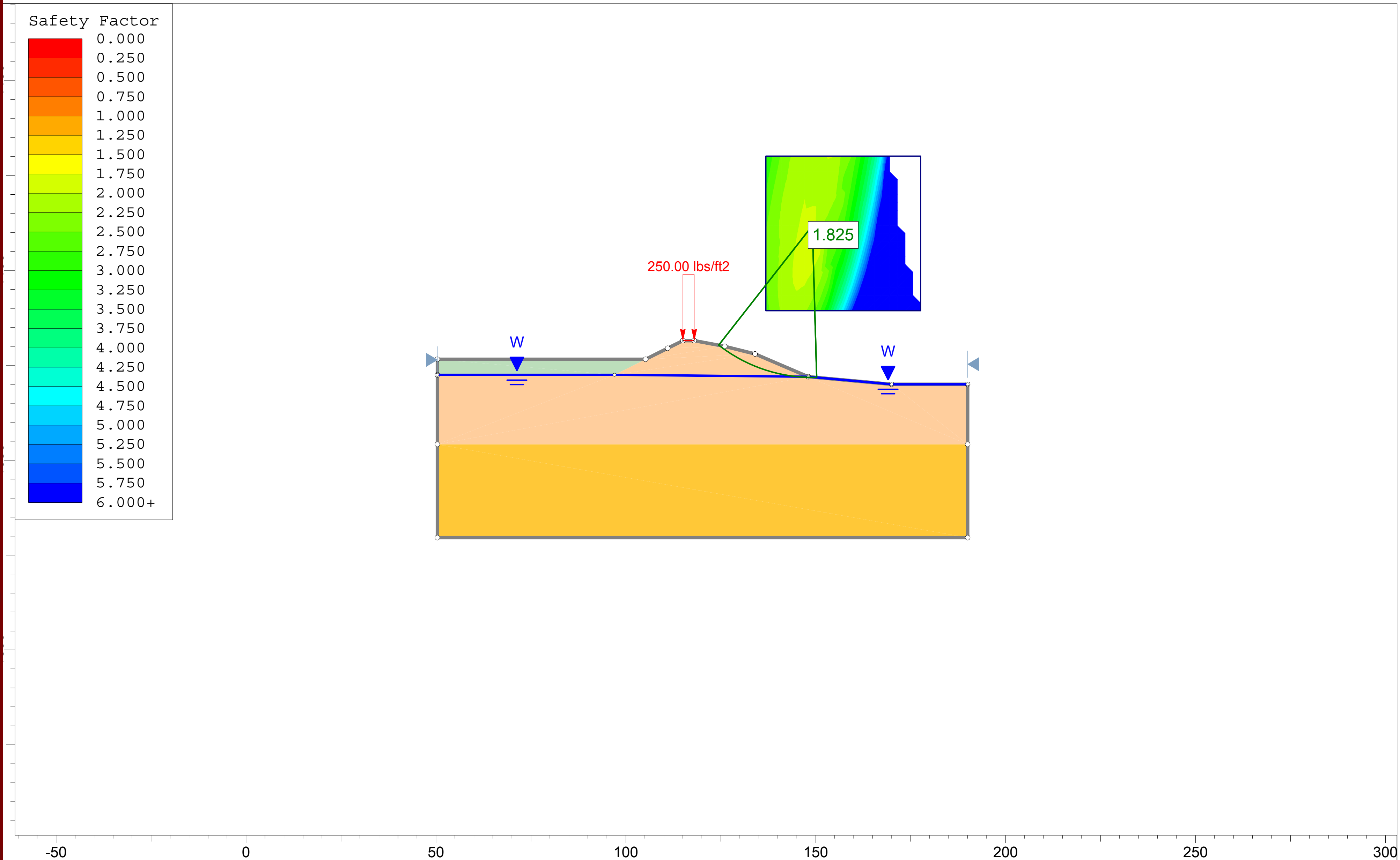


SLIDEINTERPRET 6.019

| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:424 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* B-B_Conemaugh_drained circular.slim | |

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_drained circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 3

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion [psf] | | 0 | |
| Friction Angle [deg] | | 32 | |
| Cohesion Type | | | 8000 |
| Water Surface | None | Water Table | None |
| Hu Value | | 0 | |
| Ru Value | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.825170
Center: 149.098, 1111.785
Radius: 40.007
Left Slip Surface Endpoint: 124.420, 1080.296
Right Slip Surface Endpoint: 150.254, 1071.795
Resisting Moment=159413 lb-ft
Driving Moment=87341.3 lb-ft
Resisting Horizontal Force=3738.07 lb

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Driving Horizontal Force=2048.06 lb
Total Slice Area=49.5063 ft2

## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 3195
Number of Invalid Surfaces: 1656

#### Error Codes:

Error Code -108 reported for 8 surfaces
Error Code -115 reported for 1648 surfaces

#### Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-115 = Surface too shallow, below the minimum depth.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.82517

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.03334 | 41.1096 | Foundation soil | 0 | 32 | 9.81295 | 17.9103 | 28.6625 | 0 | 28.6625 |
| 2 | 1.03334 | 118.78 | Foundation soil | 0 | 32 | 29.0183 | 52.9634 | 84.7595 | 0 | 84.7595 |
| 3 | 1.03334 | 182.831 | Foundation soil | 0 | 32 | 45.6713 | 83.3579 | 133.4 | 0 | 133.4 |
| 4 | 1.03334 | 239.184 | Foundation soil | 0 | 32 | 61.0425 | 111.413 | 178.298 | 0 | 178.298 |
| 5 | 1.03334 | 289.468 | Foundation soil | 0 | 32 | 75.4226 | 137.659 | 220.301 | 0 | 220.301 |
| 6 | 1.03334 | 334.004 | Foundation soil | 0 | 32 | 88.795 | 162.066 | 259.361 | 0 | 259.361 |
| 7 | 1.03334 | 373.071 | Foundation soil | 0 | 32 | 101.144 | 184.605 | 295.43 | 0 | 295.43 |
| 8 | 1.03334 | 406.913 | Foundation soil | 0 | 32 | 112.452 | 205.244 | 328.459 | 0 | 328.459 |
| 9 | 1.03334 | 435.744 | Foundation soil | 0 | 32 | 122.7 | 223.949 | 358.394 | 0 | 358.394 |
| 10 | 1.03334 | 452.911 | Foundation soil | 0 | 32 | 129.908 | 237.105 | 379.447 | 0 | 379.447 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 1.03334 | 447.467 | Foundation soil | 0 | 32 | 130.7 | 238.55 | 381.76 | 0 | 381.76 |
| 12 | 1.03334 | 436.568 | Foundation soil | 0 | 32 | 129.826 | 236.955 | 379.208 | 0 | 379.208 |
| 13 | 1.03334 | 421.289 | Foundation soil | 0 | 32 | 127.529 | 232.763 | 372.498 | 0 | 372.498 |
| 14 | 1.03334 | 401.743 | Foundation soil | 0 | 32 | 123.777 | 225.914 | 361.537 | 0 | 361.537 |
| 15 | 1.03334 | 378.03 | Foundation soil | 0 | 32 | 118.533 | 216.342 | 346.221 | 0 | 346.221 |
| 16 | 1.03334 | 350.238 | Foundation soil | 0 | 32 | 111.756 | 203.974 | 326.427 | 0 | 326.427 |
| 17 | 1.03334 | 318.442 | Foundation soil | 0 | 32 | 103.402 | 188.727 | 302.026 | 0 | 302.026 |
| 18 | 1.03334 | 282.708 | Foundation soil | 0 | 32 | 93.4192 | 170.506 | 272.866 | 0 | 272.866 |
| 19 | 1.03334 | 243.091 | Foundation soil | 0 | 32 | 81.7507 | 149.209 | 238.784 | 0 | 238.784 |
| 20 | 1.03334 | 199.639 | Foundation soil | 0 | 32 | 68.3334 | 124.72 | 199.593 | 0 | 199.593 |
| 21 | 1.03334 | 152.39 | Foundation soil | 0 | 32 | 53.0957 | 96.9087 | 155.086 | 0 | 155.086 |
| 22 | 1.03334 | 101.372 | Foundation soil | 0 | 32 | 35.9594 | 65.632 | 105.033 | 0 | 105.033 |
| 23 | 1.03334 | 47.4037 | Foundation soil | 0 | 32 | 17.1233 | 31.2529 | 50.0151 | 0 | 50.0151 |
| 24 | 1.03334 | 21.2508 | Foundation soil | 0 | 32 | 7.81872 | 14.2705 | 22.8375 | 0 | 22.8375 |
| 25 | 1.03334 | 7.70428 | Foundation soil | 0 | 32 | 2.99102 | 5.45912 | 8.73642 | 0 | 8.73642 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.82517

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 124.42 | 1080.3 | 0 | 0 | 0 |
| 2 | 125.453 | 1079.51 | 12.3062 | 3.83893 | 17.3254 |
| 3 | 126.487 | 1078.78 | 44.3836 | 13.8455 | 17.3254 |
| 4 | 127.52 | 1078.1 | 88.5226 | 27.6146 | 17.3253 |
| 5 | 128.553 | 1077.46 | 139.542 | 43.5299 | 17.3252 |
| 6 | 129.587 | 1076.86 | 193.267 | 60.2895 | 17.3253 |
| 7 | 130.62 | 1076.3 | 246.108 | 76.7734 | 17.3253 |
| 8 | 131.653 | 1075.78 | 294.992 | 92.0226 | 17.3253 |
| 9 | 132.687 | 1075.3 | 337.307 | 105.223 | 17.3253 |
| 10 | 133.72 | 1074.85 | 370.862 | 115.69 | 17.3253 |
| 11 | 134.753 | 1074.44 | 393.512 | 122.756 | 17.3253 |

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| | | | | | |
|---|---|---|---|---|---|
| 12 | 135.787 | 1074.06 | 403.771 | 125.956 | 17.3253 |
| 13 | 136.82 | 1073.71 | 401.888 | 125.369 | 17.3253 |
| 14 | 137.853 | 1073.39 | 388.504 | 121.194 | 17.3253 |
| 15 | 138.887 | 1073.1 | 364.593 | 113.735 | 17.3253 |
| 16 | 139.92 | 1072.85 | 331.469 | 103.402 | 17.3253 |
| 17 | 140.953 | 1072.62 | 290.788 | 90.7113 | 17.3253 |
| 18 | 141.987 | 1072.42 | 244.557 | 76.2896 | 17.3253 |
| 19 | 143.02 | 1072.24 | 195.146 | 60.8757 | 17.3253 |
| 20 | 144.053 | 1072.1 | 145.305 | 45.3278 | 17.3253 |
| 21 | 145.087 | 1071.98 | 98.186 | 30.6291 | 17.3253 |
| 22 | 146.12 | 1071.89 | 57.3709 | 17.8968 | 17.3253 |
| 23 | 147.154 | 1071.83 | 26.9013 | 8.39183 | 17.3253 |
| 24 | 148.187 | 1071.79 | 11.0522 | 3.44774 | 17.3253 |
| 25 | 149.22 | 1071.78 | 3.20525 | 0.999876 | 17.3253 |
| 26 | 150.254 | 1071.8 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 170 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 118 | 1081.5 |
| 115 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |





| | |
|---|---|
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 105.176 | 1076.59 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |

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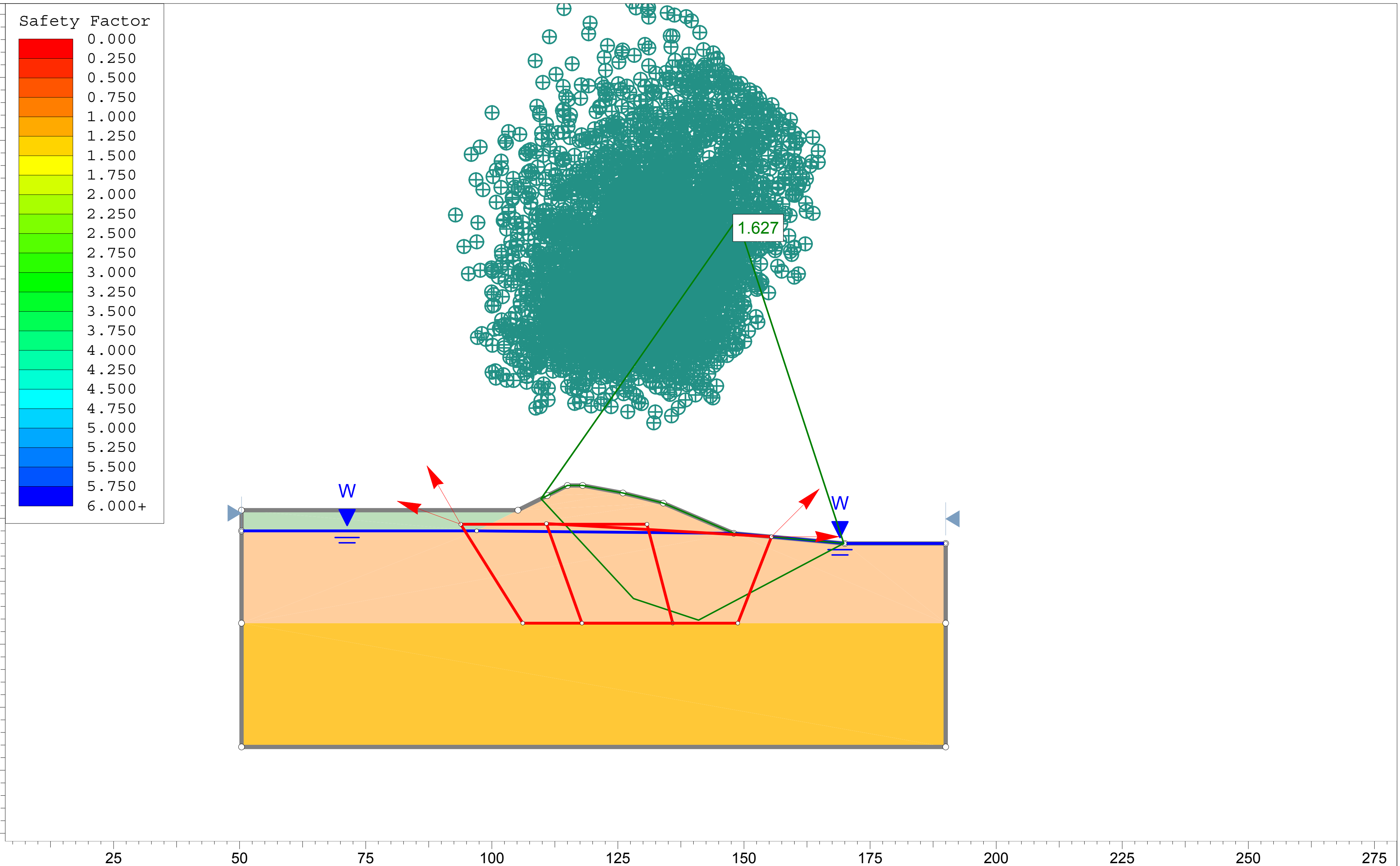


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:321 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* B-B_Conemaugh_undrained block.slim | |

IDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_undrained block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.626850
Axis Location: 148.633, 1134.468
Left Slip Surface Endpoint: 109.763, 1078.881
Right Slip Surface Endpoint: 169.781, 1070.020
Resisting Moment=1.8801e+006 lb-ft
Driving Moment=1.15567e+006 lb-ft
Resisting Horizontal Force=22506.6 lb
Driving Horizontal Force=13834.5 lb
Total Slice Area=743.897 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 109.763 | 1078.88 |
| 128.098 | 1059.07 |
| 140.994 | 1054.79 |
| 169.781 | 1070.02 |

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## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 3026
Number of Invalid Surfaces: 1974

#### Error Codes:

Error Code -107 reported for 776 surfaces
Error Code -108 reported for 1105 surfaces
Error Code -111 reported for 42 surfaces
Error Code -112 reported for 51 surfaces

#### Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.62685

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.29193 | 560.47 | Foundation soil | 375 | 0 | 230.507 | 375 | 12.2057 | 0 | 12.2057 |
| 2 | 2.29193 | 1681.41 | Foundation soil | 375 | 0 | 230.507 | 375 | 463.504 | 0 | 463.504 |
| 3 | 2.29193 | 2711.71 | Foundation soil | 375 | 0 | 230.507 | 375 | 878.309 | 0 | 878.309 |
| 4 | 2.29193 | 3481.51 | Foundation soil | 375 | 0 | 230.507 | 375 | 1188.24 | 0 | 1188.24 |
| 5 | 2.29193 | 4138.36 | Foundation soil | 375 | 0 | 230.507 | 375 | 1452.69 | 0 | 1452.69 |
| 6 | 2.29193 | 4771.76 | Foundation soil | 375 | 0 | 230.507 | 375 | 1707.7 | 0 | 1707.7 |
| 7 | 2.29193 | 5405.16 | Foundation soil | 375 | 0 | 230.507 | 375 | 1962.71 | 0 | 1962.71 |
| 8 | 2.29193 | 6019.99 | Foundation soil | 375 | 0 | 230.507 | 375 | 2210.24 | 0 | 2210.24 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 2.57907 | 7142.49 | Foundation soil | 375 | 0 | 230.507 | 375 | 2642.57 | 0 | 2642.57 |
| 10 | 2.57907 | 7215.87 | Foundation soil | 375 | 0 | 230.507 | 375 | 2670.3 | 0 | 2670.3 |
| 11 | 2.57907 | 7248.63 | Foundation soil | 375 | 0 | 230.507 | 375 | 2682.69 | 0 | 2682.69 |
| 12 | 2.57907 | 7168.31 | Foundation soil | 375 | 0 | 230.507 | 375 | 2652.33 | 0 | 2652.33 |
| 13 | 2.57907 | 7081.34 | Foundation soil | 375 | 0 | 230.507 | 375 | 2619.46 | 0 | 2619.46 |
| 14 | 2.3989 | 6174.2 | Foundation soil | 375 | 0 | 230.507 | 375 | 2830.26 | 0 | 2830.26 |
| 15 | 2.3989 | 5430.2 | Foundation soil | 375 | 0 | 230.507 | 375 | 2506.78 | 0 | 2506.78 |
| 16 | 2.3989 | 4687.03 | Foundation soil | 375 | 0 | 230.507 | 375 | 2183.65 | 0 | 2183.65 |
| 17 | 2.3989 | 4094.2 | Foundation soil | 375 | 0 | 230.507 | 375 | 1925.9 | 0 | 1925.9 |
| 18 | 2.3989 | 3612.53 | Foundation soil | 375 | 0 | 230.507 | 375 | 1716.48 | 0 | 1716.48 |
| 19 | 2.3989 | 3130.86 | Foundation soil | 375 | 0 | 230.507 | 375 | 1507.05 | 0 | 1507.05 |
| 20 | 2.3989 | 2649.19 | Foundation soil | 375 | 0 | 230.507 | 375 | 1297.63 | 0 | 1297.63 |
| 21 | 2.3989 | 2167.52 | Foundation soil | 375 | 0 | 230.507 | 375 | 1088.2 | 0 | 1088.2 |
| 22 | 2.3989 | 1685.85 | Foundation soil | 375 | 0 | 230.507 | 375 | 878.779 | 0 | 878.779 |
| 23 | 2.3989 | 1204.18 | Foundation soil | 375 | 0 | 230.507 | 375 | 669.352 | 0 | 669.352 |
| 24 | 2.3989 | 722.507 | Foundation soil | 375 | 0 | 230.507 | 375 | 459.929 | 0 | 459.929 |
| 25 | 2.3989 | 240.836 | Foundation soil | 375 | 0 | 230.507 | 375 | 250.529 | 0 | 250.529 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.62685

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 109.763 | 1078.88 | 0 | 0 | 0 |
| 2 | 112.055 | 1076.4 | -497.01 | -38.8032 | 4.46421 |
| 3 | 114.347 | 1073.93 | 123.778 | 9.66376 | 4.46422 |
| 4 | 116.639 | 1071.45 | 1771.98 | 138.344 | 4.4642 |
| 5 | 118.931 | 1068.97 | 4187.82 | 326.957 | 4.46422 |
| 6 | 121.223 | 1066.5 | 7258.67 | 566.708 | 4.46421 |
| 7 | 123.515 | 1064.02 | 10961.1 | 855.773 | 4.46423 |
| 8 | 125.807 | 1061.54 | 15295.2 | 1194.15 | 4.46423 |

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| | | | | | |
|---|---|---|---|---|---|
| 9 | 128.098 | 1059.07 | 20242.4 | 1580.39 | 4.46421 |
| 10 | 130.678 | 1058.21 | 21909.9 | 1710.58 | 4.46422 |
| 11 | 133.257 | 1057.36 | 23601.1 | 1842.61 | 4.4642 |
| 12 | 135.836 | 1056.5 | 25302.9 | 1975.48 | 4.46421 |
| 13 | 138.415 | 1055.64 | 26978.7 | 2106.31 | 4.4642 |
| 14 | 140.994 | 1054.79 | 28626.3 | 2234.95 | 4.46422 |
| 15 | 143.393 | 1056.06 | 24482.2 | 1911.41 | 4.46422 |
| 16 | 145.792 | 1057.33 | 20748.7 | 1619.92 | 4.46422 |
| 17 | 148.191 | 1058.6 | 17425.3 | 1360.45 | 4.46421 |
| 18 | 150.589 | 1059.87 | 14429 | 1126.52 | 4.46422 |
| 19 | 152.988 | 1061.14 | 11698.5 | 913.342 | 4.46422 |
| 20 | 155.387 | 1062.4 | 9233.87 | 720.918 | 4.46421 |
| 21 | 157.786 | 1063.67 | 7035.02 | 549.247 | 4.46421 |
| 22 | 160.185 | 1064.94 | 5101.99 | 398.329 | 4.46421 |
| 23 | 162.584 | 1066.21 | 3434.76 | 268.163 | 4.46421 |
| 24 | 164.983 | 1067.48 | 2033.35 | 158.75 | 4.46421 |
| 25 | 167.382 | 1068.75 | 897.738 | 70.0893 | 4.46421 |
| 26 | 169.781 | 1070.02 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 155.453 | 1071.32 |
| 170 | 1070 |
| 190 | 1070 |

### Block Search Window

| X | Y |
|---|---|
| 93.824 | 1073.8 |
| 106.138 | 1054.17 |
| 135.877 | 1054.17 |
| 130.766 | 1073.8 |

### Block Search Window

| X | Y |
|---|---|
| 110.824 | 1073.95 |
| 117.871 | 1054.17 |
| 148.772 | 1054.17 |
| 155.453 | 1071.32 |





### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 105.176 | 1076.59 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |

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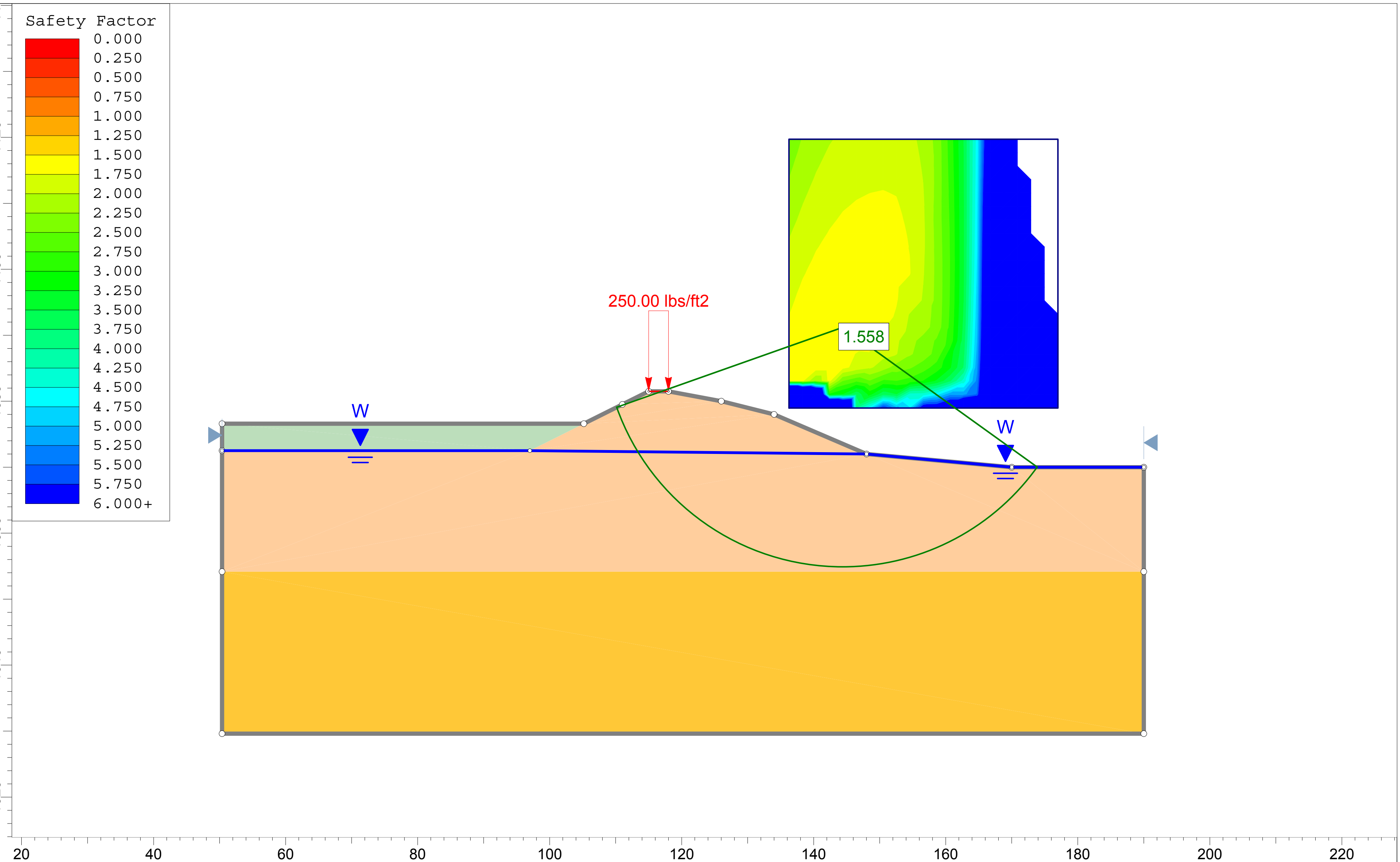


| | | | |
|---|---|---|---|
| *Project* SLIDE - An Interactive Slope Stability Program | | | |
| *Analysis Description* | | | |
| *Drawn By* | *Scale* 1:244 | *Company* | |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* B-B_Conemaugh_undrained circular.slim | |

SLIDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_undrained circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 3

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.558120
Center: 144.399, 1091.196
Radius: 36.321
Left Slip Surface Endpoint: 110.159, 1079.079
Right Slip Surface Endpoint: 173.895, 1070.000
Resisting Moment=1.07835e+006 lb-ft
Driving Moment=692082 lb-ft
Resisting Horizontal Force=23900.9 lb
Driving Horizontal Force=15339.5 lb
Total Slice Area=938.017 ft2

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## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3360
Number of Invalid Surfaces: 1491

#### Error Codes:

Error Code -103 reported for 3 surfaces
Error Code -108 reported for 86 surfaces
Error Code -111 reported for 1 surface
Error Code -112 reported for 68 surfaces
Error Code -115 reported for 1333 surfaces

#### Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-115 = Surface too shallow, below the minimum depth.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.55812

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.54943 | 1188 | Foundation soil | 375 | 0 | 240.675 | 375 | -47.7241 | 0 | -47.7241 |
| 2 | 2.54943 | 3270.06 | Foundation soil | 375 | 0 | 240.675 | 375 | 869.907 | 0 | 869.907 |
| 3 | 2.54943 | 4651.03 | Foundation soil | 375 | 0 | 240.675 | 375 | 1678.88 | 0 | 1678.88 |
| 4 | 2.54943 | 5535 | Foundation soil | 375 | 0 | 240.675 | 375 | 1861.06 | 0 | 1861.06 |
| 5 | 2.54943 | 6152.01 | Foundation soil | 375 | 0 | 240.675 | 375 | 2130.53 | 0 | 2130.53 |
| 6 | 2.54943 | 6635.42 | Foundation soil | 375 | 0 | 240.675 | 375 | 2360.61 | 0 | 2360.61 |
| 7 | 2.54943 | 6992.85 | Foundation soil | 375 | 0 | 240.675 | 375 | 2538.29 | 0 | 2538.29 |
| 8 | 2.54943 | 7220.32 | Foundation soil | 375 | 0 | 240.675 | 375 | 2663.04 | 0 | 2663.04 |
| 9 | 2.54943 | 7363.97 | Foundation soil | 375 | 0 | 240.675 | 375 | 2753.06 | 0 | 2753.06 |
| 10 | 2.54943 | 7399.66 | Foundation soil | 375 | 0 | 240.675 | 375 | 2799.51 | 0 | 2799.51 |
| 11 | 2.54943 | 7251.61 | Foundation soil | 375 | 0 | 240.675 | 375 | 2773.19 | 0 | 2773.19 |
| 12 | 2.54943 | 7027.89 | Foundation soil | 375 | 0 | 240.675 | 375 | 2715.82 | 0 | 2715.82 |
| 13 | 2.54943 | 6740.63 | Foundation soil | 375 | 0 | 240.675 | 375 | 2632.28 | 0 | 2632.28 |
| 14 | 2.54943 | 6391.18 | Foundation soil | 375 | 0 | 240.675 | 375 | 2523.24 | 0 | 2523.24 |
| 15 | 2.54943 | 5983.61 | Foundation soil | 375 | 0 | 240.675 | 375 | 2390.4 | 0 | 2390.4 |
| 16 | 2.54943 | 5701.08 | Foundation soil | 375 | 0 | 240.675 | 375 | 2306.34 | 0 | 2306.34 |
| 17 | 2.54943 | 5460.01 | Foundation soil | 375 | 0 | 240.675 | 375 | 2238.9 | 0 | 2238.9 |
| 18 | 2.54943 | 5152.53 | Foundation soil | 375 | 0 | 240.675 | 375 | 2145.7 | 0 | 2145.7 |
| 19 | 2.54943 | 4774.74 | Foundation soil | 375 | 0 | 240.675 | 375 | 2025.36 | 0 | 2025.36 |
| 20 | 2.54943 | 4321.03 | Foundation soil | 375 | 0 | 240.675 | 375 | 1875.89 | 0 | 1875.89 |
| 21 | 2.54943 | 3783.47 | Foundation soil | 375 | 0 | 240.675 | 375 | 1694.45 | 0 | 1694.45 |
| 22 | 2.54943 | 3150.78 | Foundation soil | 375 | 0 | 240.675 | 375 | 1477.08 | 0 | 1477.08 |
| 23 | 2.54943 | 2406.32 | Foundation soil | 375 | 0 | 240.675 | 375 | 1217.96 | 0 | 1217.96 |
| 24 | 2.54943 | 1535.5 | Foundation soil | 375 | 0 | 240.675 | 375 | 912.983 | 0 | 912.983 |
| 25 | 2.54943 | 543.602 | Foundation soil | 375 | 0 | 240.675 | 375 | 568.673 | 0 | 568.673 |





## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.55812

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 110.159 | 1079.08 | 0 | 0 | 0 |
| 2 | 112.708 | 1073.45 | -883.97 | -52.8115 | 3.41899 |
| 3 | 115.258 | 1069.52 | 1922.72 | 114.87 | 3.41899 |
| 4 | 117.807 | 1066.46 | 6446.41 | 385.131 | 3.41899 |
| 5 | 120.357 | 1063.97 | 10454.3 | 624.577 | 3.41899 |
| 6 | 122.906 | 1061.92 | 14216.3 | 849.333 | 3.41899 |

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| | | | | | |
|---|---|---|---|---|---|
| 7 | 125.455 | 1060.21 | 17638.9 | 1053.81 | 3.41899 |
| 8 | 128.005 | 1058.79 | 20630.6 | 1232.54 | 3.41897 |
| 9 | 130.554 | 1057.62 | 23126.4 | 1381.65 | 3.41898 |
| 10 | 133.104 | 1056.68 | 25102.2 | 1499.7 | 3.419 |
| 11 | 135.653 | 1055.94 | 26537 | 1585.42 | 3.419 |
| 12 | 138.203 | 1055.41 | 27408.8 | 1637.5 | 3.41899 |
| 13 | 140.752 | 1055.06 | 27741.2 | 1657.35 | 3.41897 |
| 14 | 143.301 | 1054.89 | 27565.4 | 1646.85 | 3.41898 |
| 15 | 145.851 | 1054.9 | 26918.8 | 1608.22 | 3.41898 |
| 16 | 148.4 | 1055.1 | 25844.5 | 1544.04 | 3.41898 |
| 17 | 150.95 | 1055.47 | 24365.4 | 1455.67 | 3.41898 |
| 18 | 153.499 | 1056.03 | 22489.9 | 1343.63 | 3.419 |
| 19 | 156.049 | 1056.79 | 20243 | 1209.39 | 3.41899 |
| 20 | 158.598 | 1057.77 | 17660.1 | 1055.08 | 3.419 |
| 21 | 161.147 | 1058.97 | 14790.8 | 883.654 | 3.41899 |
| 22 | 163.697 | 1060.43 | 11703.9 | 699.229 | 3.41897 |
| 23 | 166.246 | 1062.18 | 8497.06 | 507.644 | 3.41899 |
| 24 | 168.796 | 1064.29 | 5314.18 | 317.488 | 3.41899 |
| 25 | 171.345 | 1066.84 | 2367.7 | 141.455 | 3.41899 |
| 26 | 173.895 | 1070 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 170 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 118 | 1081.5 |
| 115 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |





| | |
|---|---|
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 105.176 | 1076.59 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |

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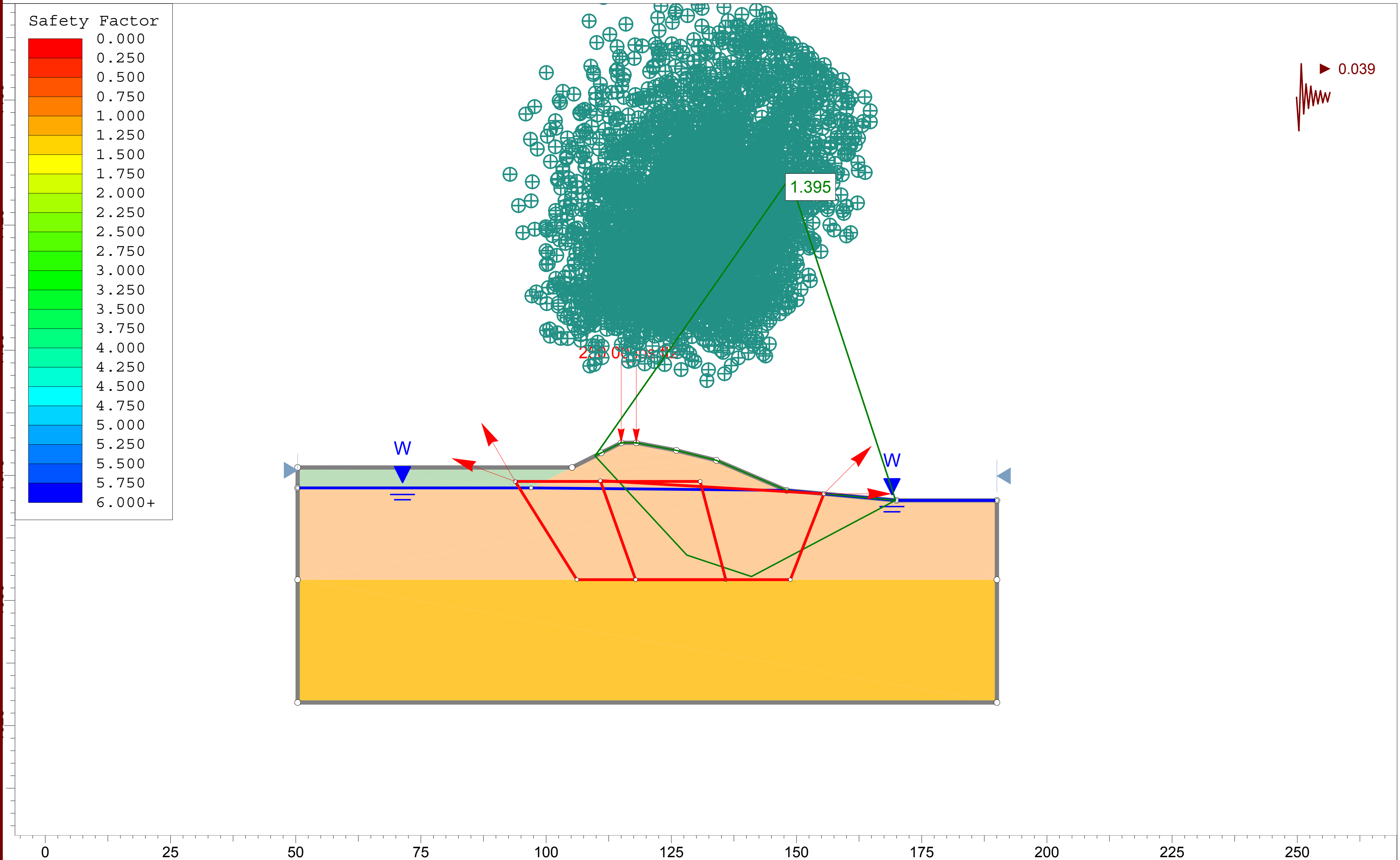


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:321 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* B-B_Conemaugh_undrained block_seismic.slim | |

IDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_undrained block_seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.395060
Axis Location: 148.633, 1134.468
Left Slip Surface Endpoint: 109.763, 1078.881
Right Slip Surface Endpoint: 169.781, 1070.020
Resisting Moment=1.88007e+006 lb-ft
Driving Moment=1.34766e+006 lb-ft
Resisting Horizontal Force=22506.6 lb
Driving Horizontal Force=16133.1 lb

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Total Slice Area=743.897 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 109.763 | 1078.88 |
| 128.098 | 1059.07 |
| 140.994 | 1054.79 |
| 169.781 | 1070.02 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3321
Number of Invalid Surfaces: 1679

#### Error Codes:

Error Code -107 reported for 448 surfaces
Error Code -108 reported for 1083 surfaces
Error Code -111 reported for 83 surfaces
Error Code -112 reported for 65 surfaces

#### Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.39506

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.29193 | 560.47 | Foundation soil | 375 | 0 | 268.806 | 375 | -16.8927 | 0 | -16.8927 |
| | | | Foundation | | | | | | | |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | soil | | | | | | | |
| 3 | 2.29193 | 2711.71 | Foundation soil | 375 | 0 | 268.806 | 375 | 980.849 | 0 | 980.849 |
| 4 | 2.29193 | 3481.51 | Foundation soil | 375 | 0 | 268.806 | 375 | 1253.43 | 0 | 1253.43 |
| 5 | 2.29193 | 4138.36 | Foundation soil | 375 | 0 | 268.806 | 375 | 1376.12 | 0 | 1376.12 |
| 6 | 2.29193 | 4771.76 | Foundation soil | 375 | 0 | 268.806 | 375 | 1622.72 | 0 | 1622.72 |
| 7 | 2.29193 | 5405.16 | Foundation soil | 375 | 0 | 268.806 | 375 | 1869.33 | 0 | 1869.33 |
| 8 | 2.29193 | 6019.99 | Foundation soil | 375 | 0 | 268.806 | 375 | 2108.7 | 0 | 2108.7 |
| 9 | 2.57907 | 7142.49 | Foundation soil | 375 | 0 | 268.806 | 375 | 2603.69 | 0 | 2603.69 |
| 10 | 2.57907 | 7215.87 | Foundation soil | 375 | 0 | 268.806 | 375 | 2631.03 | 0 | 2631.03 |
| 11 | 2.57907 | 7248.63 | Foundation soil | 375 | 0 | 268.806 | 375 | 2643.24 | 0 | 2643.24 |
| 12 | 2.57907 | 7168.31 | Foundation soil | 375 | 0 | 268.806 | 375 | 2613.31 | 0 | 2613.31 |
| 13 | 2.57907 | 7081.34 | Foundation soil | 375 | 0 | 268.806 | 375 | 2580.9 | 0 | 2580.9 |
| 14 | 2.3989 | 6174.2 | Foundation soil | 375 | 0 | 268.806 | 375 | 2900.89 | 0 | 2900.89 |
| 15 | 2.3989 | 5430.2 | Foundation soil | 375 | 0 | 268.806 | 375 | 2573.23 | 0 | 2573.23 |
| 16 | 2.3989 | 4687.03 | Foundation soil | 375 | 0 | 268.806 | 375 | 2245.93 | 0 | 2245.93 |
| 17 | 2.3989 | 4094.2 | Foundation soil | 375 | 0 | 268.806 | 375 | 1984.85 | 0 | 1984.85 |
| 18 | 2.3989 | 3612.53 | Foundation soil | 375 | 0 | 268.806 | 375 | 1772.72 | 0 | 1772.72 |
| 19 | 2.3989 | 3130.86 | Foundation soil | 375 | 0 | 268.806 | 375 | 1560.58 | 0 | 1560.58 |
| 20 | 2.3989 | 2649.19 | Foundation soil | 375 | 0 | 268.806 | 375 | 1348.45 | 0 | 1348.45 |
| 21 | 2.3989 | 2167.52 | Foundation soil | 375 | 0 | 268.806 | 375 | 1136.32 | 0 | 1136.32 |
| 22 | 2.3989 | 1685.85 | Foundation soil | 375 | 0 | 268.806 | 375 | 924.188 | 0 | 924.188 |
| 23 | 2.3989 | 1204.18 | Foundation soil | 375 | 0 | 268.806 | 375 | 712.053 | 0 | 712.053 |
| 24 | 2.3989 | 722.507 | Foundation soil | 375 | 0 | 268.806 | 375 | 499.922 | 0 | 499.922 |
| 25 | 2.3989 | 240.836 | Foundation soil | 375 | 0 | 268.806 | 375 | 287.815 | 0 | 287.815 |

## Interslice Data

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**Global Minimum Query (spencer) - Safety Factor**: 1.39506

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 109.763 | 1078.88 | 0 | 0 | 0 |
| 2 | 112.055 | 1076.4 | -634.209 | -69.1247 | 6.22032 |
| 3 | 114.347 | 1073.93 | -143.742 | -15.667 | 6.22034 |
| 4 | 116.639 | 1071.45 | 1777.2 | 193.704 | 6.22034 |
| 5 | 118.931 | 1068.97 | 4403.32 | 479.933 | 6.22031 |
| 6 | 121.223 | 1066.5 | 7358.92 | 802.075 | 6.22032 |
| 7 | 123.515 | 1064.02 | 10950 | 1193.48 | 6.22032 |
| 8 | 125.807 | 1061.54 | 15176.7 | 1654.16 | 6.22031 |
| 9 | 128.098 | 1059.07 | 20020.2 | 2182.07 | 6.22031 |
| 10 | 130.678 | 1058.21 | 21835 | 2379.88 | 6.22033 |
| 11 | 133.257 | 1057.36 | 23676.2 | 2580.55 | 6.22031 |
| 12 | 135.836 | 1056.5 | 25529 | 2782.5 | 6.22032 |
| 13 | 138.415 | 1055.64 | 27353.1 | 2981.31 | 6.22031 |
| 14 | 140.994 | 1054.79 | 29146.1 | 3176.73 | 6.2203 |
| 15 | 143.393 | 1056.06 | 25062.1 | 2731.6 | 6.2203 |
| 16 | 145.792 | 1057.33 | 21364.9 | 2328.64 | 6.22033 |
| 17 | 148.191 | 1058.6 | 18054.2 | 1967.79 | 6.22031 |
| 18 | 150.589 | 1059.87 | 15051.7 | 1640.54 | 6.22032 |
| 19 | 152.988 | 1061.14 | 12299.7 | 1340.59 | 6.22033 |
| 20 | 155.387 | 1062.4 | 9798.2 | 1067.94 | 6.22031 |
| 21 | 157.786 | 1063.67 | 7547.12 | 822.587 | 6.22031 |
| 22 | 160.185 | 1064.94 | 5546.5 | 604.533 | 6.22032 |
| 23 | 162.584 | 1066.21 | 3796.35 | 413.777 | 6.22031 |
| 24 | 164.983 | 1067.48 | 2296.65 | 250.32 | 6.22032 |
| 25 | 167.382 | 1068.75 | 1047.41 | 114.161 | 6.22032 |
| 26 | 169.781 | 1070.02 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 155.453 | 1071.32 |
| 170 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|





| | |
|---|---|
| 118 | 1081.5 |
| 115 | 1081.5 |

### Block Search Window

| X | Y |
|---|---|
| 93.824 | 1073.8 |
| 106.138 | 1054.17 |
| 135.877 | 1054.17 |
| 130.766 | 1073.8 |

### Block Search Window

| X | Y |
|---|---|
| 110.824 | 1073.95 |
| 117.871 | 1054.17 |
| 148.772 | 1054.17 |
| 155.453 | 1071.32 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 105.176 | 1076.59 |

### Material Boundary

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| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |

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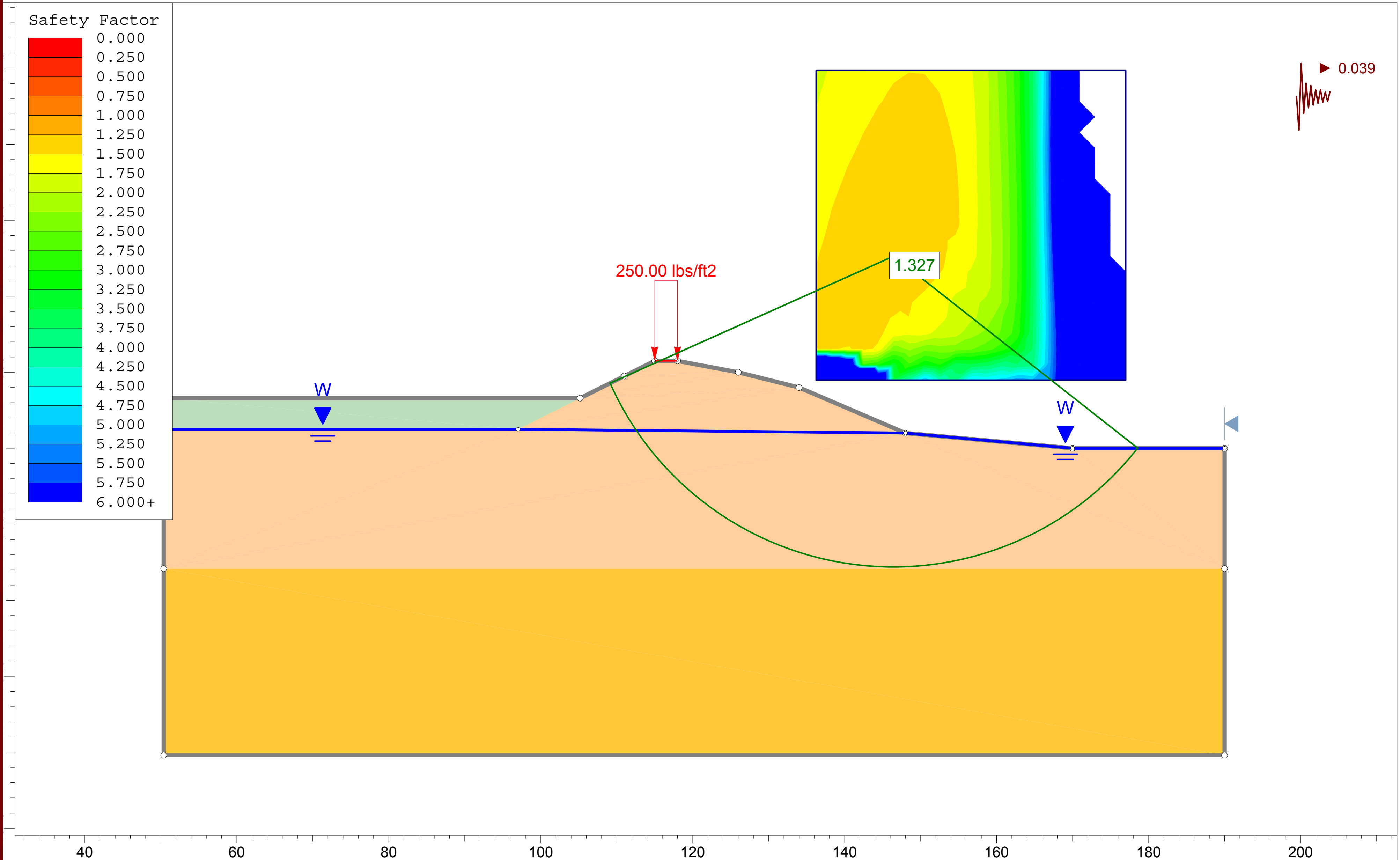


| | | | |
|---|---|---|---|
| Project | SLIDE - An Interactive Slope Stability Program | | |
| Analysis Description | | | |
| Drawn By | | Scale 1:212 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name | B-B_Conemaugh_undrained circular_seismic.slim |

IDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: B-B_Conemaugh_undrained circular_seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 3

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.327350
Center: 146.436, 1095.269
Radius: 40.893
Left Slip Surface Endpoint: 109.114, 1078.557
Right Slip Surface Endpoint: 178.588, 1070.000
Resisting Moment=1.28887e+006 lb-ft
Driving Moment=971005 lb-ft
Resisting Horizontal Force=26052.7 lb
Driving Horizontal Force=19627.5 lb
Total Slice Area=1021.63 ft2

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## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3362
Number of Invalid Surfaces: 1489

#### Error Codes:

Error Code -103 reported for 3 surfaces
Error Code -108 reported for 83 surfaces
Error Code -111 reported for 2 surfaces
Error Code -112 reported for 68 surfaces
Error Code -115 reported for 1333 surfaces

#### Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-115 = Surface too shallow, below the minimum depth.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.32735

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.77896 | 1231.17 | Foundation soil | 375 | 0 | 282.518 | 375 | -56.3558 | 0 | -56.3558 |
| 2 | 2.77896 | 3448.51 | Foundation soil | 375 | 0 | 282.518 | 375 | 779.725 | 0 | 779.725 |
| 3 | 2.77896 | 5072.61 | Foundation soil | 375 | 0 | 282.518 | 375 | 1606.32 | 0 | 1606.32 |
| 4 | 2.77896 | 6070.93 | Foundation soil | 375 | 0 | 282.518 | 375 | 1855.66 | 0 | 1855.66 |
| 5 | 2.77896 | 6755.47 | Foundation soil | 375 | 0 | 282.518 | 375 | 2101.91 | 0 | 2101.91 |
| 6 | 2.77896 | 7292.47 | Foundation soil | 375 | 0 | 282.518 | 375 | 2338.29 | 0 | 2338.29 |
| 7 | 2.77896 | 7681.65 | Foundation soil | 375 | 0 | 282.518 | 375 | 2519.88 | 0 | 2519.88 |
| 8 | 2.77896 | 7929.49 | Foundation soil | 375 | 0 | 282.518 | 375 | 2649.48 | 0 | 2649.48 |
| 9 | 2.77896 | 8083.9 | Foundation soil | 375 | 0 | 282.518 | 375 | 2744.07 | 0 | 2744.07 |
| 10 | 2.77896 | 8052.11 | Foundation soil | 375 | 0 | 282.518 | 375 | 2771.42 | 0 | 2771.42 |
| 11 | 2.77896 | 7855.87 | Foundation soil | 375 | 0 | 282.518 | 375 | 2738.81 | 0 | 2738.81 |
| 12 | 2.77896 | 7584.07 | Foundation soil | 375 | 0 | 282.518 | 375 | 2677.5 | 0 | 2677.5 |
| 13 | 2.77896 | 7239.32 | Foundation soil | 375 | 0 | 282.518 | 375 | 2588.53 | 0 | 2588.53 |
| 14 | 2.77896 | 6823.1 | Foundation soil | 375 | 0 | 282.518 | 375 | 2472.49 | 0 | 2472.49 |
| 15 | 2.77896 | 6514.23 | Foundation soil | 375 | 0 | 282.518 | 375 | 2393.96 | 0 | 2393.96 |
| 16 | 2.77896 | 6307.35 | Foundation soil | 375 | 0 | 282.518 | 375 | 2352.06 | 0 | 2352.06 |
| 17 | 2.77896 | 6027.22 | Foundation soil | 375 | 0 | 282.518 | 375 | 2283.93 | 0 | 2283.93 |
| 18 | 2.77896 | 5671.07 | Foundation soil | 375 | 0 | 282.518 | 375 | 2188.63 | 0 | 2188.63 |
| 19 | 2.77896 | 5234.74 | Foundation soil | 375 | 0 | 282.518 | 375 | 2064.71 | 0 | 2064.71 |
| 20 | 2.77896 | 4712.3 | Foundation soil | 375 | 0 | 282.518 | 375 | 1910.13 | 0 | 1910.13 |
| 21 | 2.77896 | 4095.47 | Foundation soil | 375 | 0 | 282.518 | 375 | 1722.01 | 0 | 1722.01 |
| 22 | 2.77896 | 3373 | Foundation soil | 375 | 0 | 282.518 | 375 | 1496.47 | 0 | 1496.47 |
| 23 | 2.77896 | 2582.93 | Foundation soil | 375 | 0 | 282.518 | 375 | 1248.72 | 0 | 1248.72 |
| 24 | 2.77896 | 1684.15 | Foundation soil | 375 | 0 | 282.518 | 375 | 964.839 | 0 | 964.839 |
| 25 | 2.77896 | 596.989 | Foundation soil | 375 | 0 | 282.518 | 375 | 615.711 | 0 | 615.711 |





## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.32735

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 109.114 | 1078.56 | 0 | 0 | 0 |
| 2 | 111.893 | 1073.38 | -1029.8 | -81.9903 | 4.55216 |
| 3 | 114.672 | 1069.52 | 1334.3 | 106.234 | 4.55216 |
| 4 | 117.451 | 1066.42 | 5712.54 | 454.821 | 4.55217 |
| 5 | 120.23 | 1063.88 | 9887.83 | 787.249 | 4.55217 |
| 6 | 123.008 | 1061.75 | 13831.6 | 1101.24 | 4.55215 |

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| | | | | | |
|---|---|---|---|---|---|
| 7 | 125.787 | 1059.97 | 17491.7 | 1392.66 | 4.55219 |
| 8 | 128.566 | 1058.49 | 20747.2 | 1651.85 | 4.55217 |
| 9 | 131.345 | 1057.26 | 23515.1 | 1872.22 | 4.55216 |
| 10 | 134.124 | 1056.27 | 25757.8 | 2050.78 | 4.55216 |
| 11 | 136.903 | 1055.5 | 27421.6 | 2183.25 | 4.55217 |
| 12 | 139.682 | 1054.94 | 28489.3 | 2268.26 | 4.55217 |
| 13 | 142.461 | 1054.57 | 28984 | 2307.65 | 4.55218 |
| 14 | 145.24 | 1054.39 | 28936.1 | 2303.83 | 4.55216 |
| 15 | 148.019 | 1054.41 | 28383.4 | 2259.83 | 4.55217 |
| 16 | 150.798 | 1054.61 | 27366.1 | 2178.83 | 4.55216 |
| 17 | 153.577 | 1055 | 25896.8 | 2061.85 | 4.55217 |
| 18 | 156.356 | 1055.6 | 23991 | 1910.11 | 4.55216 |
| 19 | 159.135 | 1056.4 | 21674.4 | 1725.67 | 4.55217 |
| 20 | 161.914 | 1057.42 | 18985.1 | 1511.56 | 4.55219 |
| 21 | 164.693 | 1058.68 | 15977.2 | 1272.08 | 4.5522 |
| 22 | 167.472 | 1060.2 | 12726.8 | 1013.28 | 4.55216 |
| 23 | 170.251 | 1062.03 | 9341.76 | 743.772 | 4.55217 |
| 24 | 173.03 | 1064.2 | 5936.2 | 472.628 | 4.55217 |
| 25 | 175.809 | 1066.82 | 2694.37 | 214.52 | 4.55217 |
| 26 | 178.588 | 1070 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |
| 148 | 1072 |
| 170 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 118 | 1081.5 |
| 115 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.17 |
| 190 | 1070 |
| 170 | 1070 |





| | |
|---|---|
| 148 | 1072 |
| 134 | 1078 |
| 126 | 1080 |
| 118 | 1081.5 |
| 115 | 1081.5 |
| 111.007 | 1079.5 |
| 105.176 | 1076.59 |
| 50.3799 | 1076.59 |
| 50.3799 | 1072.5 |
| 50.3799 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 105.176 | 1076.59 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1072.5 |
| 97.0003 | 1072.5 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.17 |
| 190 | 1054.17 |

### Material Boundary

| X | Y |
|---|---|
| 97.0003 | 1072.5 |
| 148 | 1072 |

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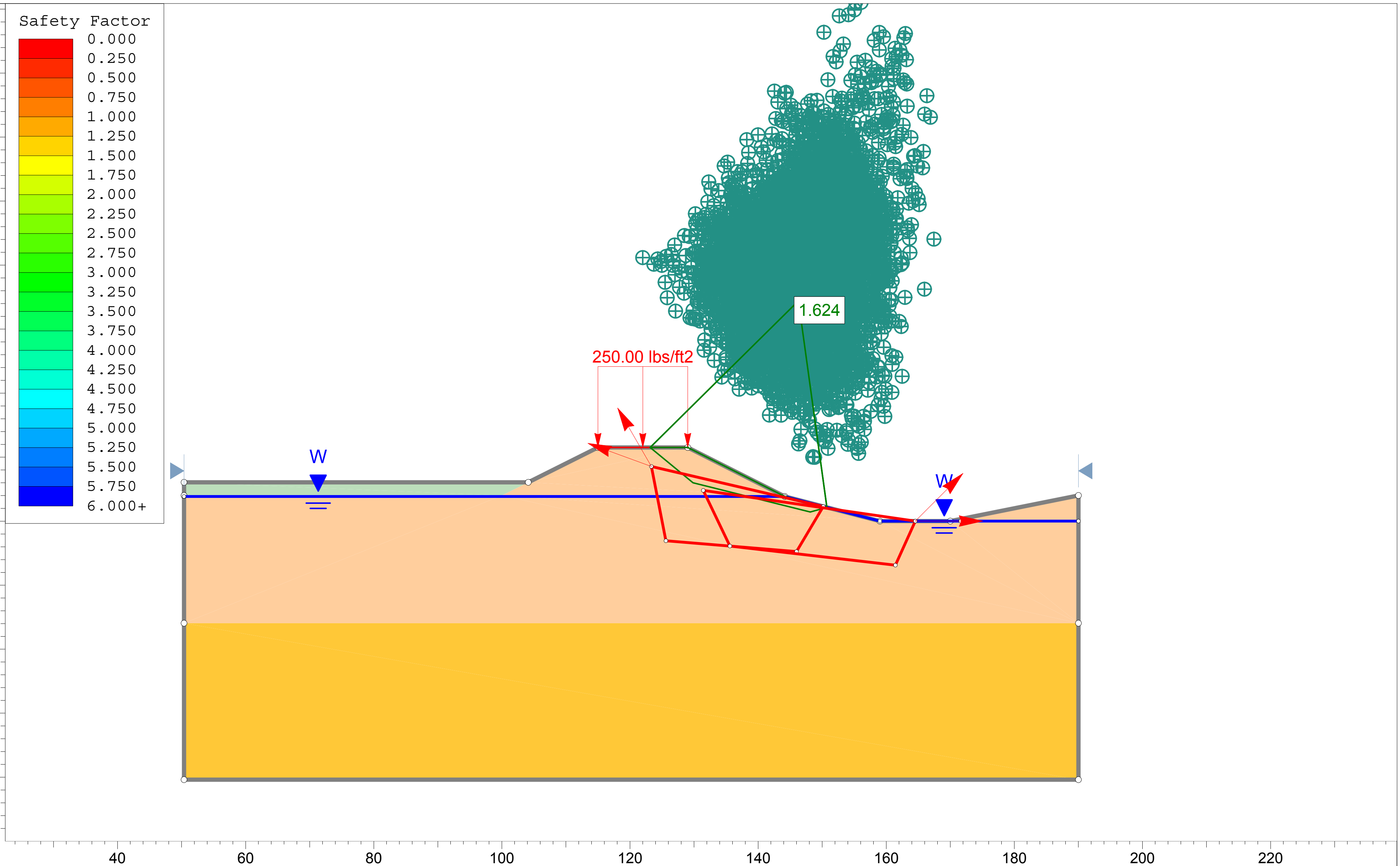


| | |
|---|---|
| Project | SLIDE - An Interactive Slope Stability Program |
| Analysis Description | |
| Drawn By | Scale 1:253 |
| Company | |
| Date 10/16/2013, 3:13:47 PM | File Name A-A_Conemaugh_Drained_Block.slim |

DEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_Drained_Block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: 5

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion [psf] | | 0 | |
| Friction Angle [deg] | | 32 | |
| Cohesion Type | | | 8000 |
| Water Surface | None | Water Table | None |
| Hu Value | | 0 | |
| Ru Value | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.624100
Axis Location: 146.289, 1104.410
Left Slip Surface Endpoint: 123.144, 1081.500
Right Slip Surface Endpoint: 150.730, 1072.148
Resisting Moment=214481 lb-ft

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Driving Moment=132061 lb-ft
Resisting Horizontal Force=6107.31 lb
Driving Horizontal Force=3760.42 lb
Total Slice Area=72.2684 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 123.144 | 1081.5 |
| 129.831 | 1076 |
| 148.141 | 1071.43 |
| 150.73 | 1072.15 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 4359
Number of Invalid Surfaces: 641

#### Error Codes:

Error Code -105 reported for 21 surfaces
Error Code -107 reported for 1 surface
Error Code -108 reported for 243 surfaces
Error Code -111 reported for 237 surfaces
Error Code -112 reported for 139 surfaces

#### Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.6241

| Slice | Width | Weight | Base | Base | Base Friction | Shear | Shear | Base Normal | Pore | Effective Normal |
|---|---|---|---|---|---|---|---|---|---|---|





| Number | [ft] | [lbs] | Material | [psf] | Angle [degrees] | [psf] | [psf] | Stress [psf] | [psf] | Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.11456 | 68.9796 | Foundation soil | 0 | 32 | 80.9722 | 131.507 | 210.456 | 0 | 210.456 |
| 2 | 1.11456 | 206.939 | Foundation soil | 0 | 32 | 113.108 | 183.698 | 293.979 | 0 | 293.979 |
| 3 | 1.11456 | 344.898 | Foundation soil | 0 | 32 | 145.244 | 235.89 | 377.502 | 0 | 377.502 |
| 4 | 1.11456 | 482.857 | Foundation soil | 0 | 32 | 177.379 | 288.081 | 461.025 | 0 | 461.025 |
| 5 | 1.11456 | 620.816 | Foundation soil | 0 | 32 | 209.514 | 340.272 | 544.549 | 0 | 544.549 |
| 6 | 1.11456 | 735.251 | Foundation soil | 0 | 32 | 187.764 | 304.948 | 488.019 | 0 | 488.019 |
| 7 | 1.07702 | 718.953 | Foundation soil | 0 | 32 | 245.963 | 399.468 | 639.283 | 0 | 639.283 |
| 8 | 1.07702 | 679.023 | Foundation soil | 0 | 32 | 232.303 | 377.283 | 603.778 | 0 | 603.778 |
| 9 | 1.07702 | 639.094 | Foundation soil | 0 | 32 | 218.642 | 355.097 | 568.273 | 0 | 568.273 |
| 10 | 1.07702 | 599.164 | Foundation soil | 0 | 32 | 204.982 | 332.911 | 532.768 | 0 | 532.768 |
| 11 | 1.07702 | 559.235 | Foundation soil | 0 | 32 | 191.321 | 310.725 | 497.264 | 0 | 497.264 |
| 12 | 1.07702 | 519.305 | Foundation soil | 0 | 32 | 177.661 | 288.539 | 461.759 | 0 | 461.759 |
| 13 | 1.07702 | 479.376 | Foundation soil | 0 | 32 | 164 | 266.353 | 426.255 | 0 | 426.255 |
| 14 | 1.07702 | 439.447 | Foundation soil | 0 | 32 | 150.34 | 244.168 | 390.75 | 0 | 390.75 |
| 15 | 1.07702 | 399.517 | Foundation soil | 0 | 32 | 136.68 | 221.982 | 355.245 | 0 | 355.245 |
| 16 | 1.07702 | 359.588 | Foundation soil | 0 | 32 | 123.02 | 199.796 | 319.741 | 0 | 319.741 |
| 17 | 1.07702 | 319.658 | Foundation soil | 0 | 32 | 109.359 | 177.61 | 284.236 | 0 | 284.236 |
| 18 | 1.07702 | 279.729 | Foundation soil | 0 | 32 | 95.6985 | 155.424 | 248.731 | 0 | 248.731 |
| 19 | 1.07702 | 239.799 | Foundation soil | 0 | 32 | 82.0381 | 133.238 | 213.226 | 0 | 213.226 |
| 20 | 1.07702 | 209.223 | Foundation soil | 0 | 32 | 71.5781 | 116.25 | 186.038 | 0 | 186.038 |
| 21 | 1.07702 | 205.869 | Foundation soil | 0 | 32 | 70.4304 | 114.386 | 183.056 | 0 | 183.056 |
| 22 | 1.07702 | 204.254 | Foundation soil | 0 | 32 | 69.8781 | 113.489 | 181.62 | 0 | 181.62 |
| 23 | 1.07702 | 202.639 | Foundation soil | 0 | 32 | 69.3252 | 112.591 | 180.184 | 0 | 180.184 |
| 24 | 1.29465 | 181.961 | Foundation soil | 0 | 32 | 82.5485 | 134.067 | 214.553 | 0 | 214.553 |
| | | | Foundation | | | | | | | |

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| soil |
|---|

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.6241

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 123.144 | 1081.5 | 0 | 0 | 0 |
| 2 | 124.258 | 1080.58 | 102.733 | 39.0902 | 20.832 |
| 3 | 125.373 | 1079.67 | 246.237 | 93.6941 | 20.832 |
| 4 | 126.488 | 1078.75 | 430.513 | 163.812 | 20.832 |
| 5 | 127.602 | 1077.83 | 655.561 | 249.443 | 20.832 |
| 6 | 128.717 | 1076.92 | 921.38 | 350.588 | 20.832 |
| 7 | 129.831 | 1076 | 1159.6 | 441.233 | 20.832 |
| 8 | 130.908 | 1075.73 | 1066.47 | 405.796 | 20.832 |
| 9 | 131.985 | 1075.46 | 978.511 | 372.327 | 20.832 |
| 10 | 133.062 | 1075.19 | 895.724 | 340.826 | 20.832 |
| 11 | 134.139 | 1074.92 | 818.109 | 311.293 | 20.832 |
| 12 | 135.216 | 1074.66 | 745.666 | 283.728 | 20.832 |
| 13 | 136.293 | 1074.39 | 678.396 | 258.132 | 20.832 |
| 14 | 137.37 | 1074.12 | 616.298 | 234.503 | 20.832 |
| 15 | 138.447 | 1073.85 | 559.373 | 212.843 | 20.832 |
| 16 | 139.524 | 1073.58 | 507.62 | 193.151 | 20.832 |
| 17 | 140.601 | 1073.31 | 461.039 | 175.427 | 20.832 |
| 18 | 141.678 | 1073.04 | 419.631 | 159.671 | 20.832 |
| 19 | 142.756 | 1072.78 | 383.396 | 145.883 | 20.8319 |
| 20 | 143.833 | 1072.51 | 352.332 | 134.064 | 20.8321 |
| 21 | 144.91 | 1072.24 | 325.23 | 123.751 | 20.832 |
| 22 | 145.987 | 1071.97 | 298.562 | 113.604 | 20.832 |
| 23 | 147.064 | 1071.7 | 272.103 | 103.536 | 20.832 |
| 24 | 148.141 | 1071.43 | 245.853 | 93.548 | 20.832 |
| 25 | 149.435 | 1071.79 | 62.2322 | 23.6795 | 20.8319 |
| 26 | 150.73 | 1072.15 | 0 | 0 | 0 |

## List Of Coordinates

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |





### Line Load

| X | Y |
|---|---|
| 129 | 1081.5 |
| 115 | 1081.5 |

### Block Search Window

| X | Y |
|---|---|
| 123.336 | 1078.54 |
| 125.602 | 1066.93 |
| 145.991 | 1065.23 |
| 150.176 | 1072.29 |

### Block Search Window

| X | Y |
|---|---|
| 131.427 | 1074.8 |
| 135.597 | 1066.1 |
| 161.425 | 1063.11 |
| 164.54 | 1070 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |
| 190 | 1074 |
| 170 | 1070 |
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

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## Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.06 |
| 190 | 1054.06 |

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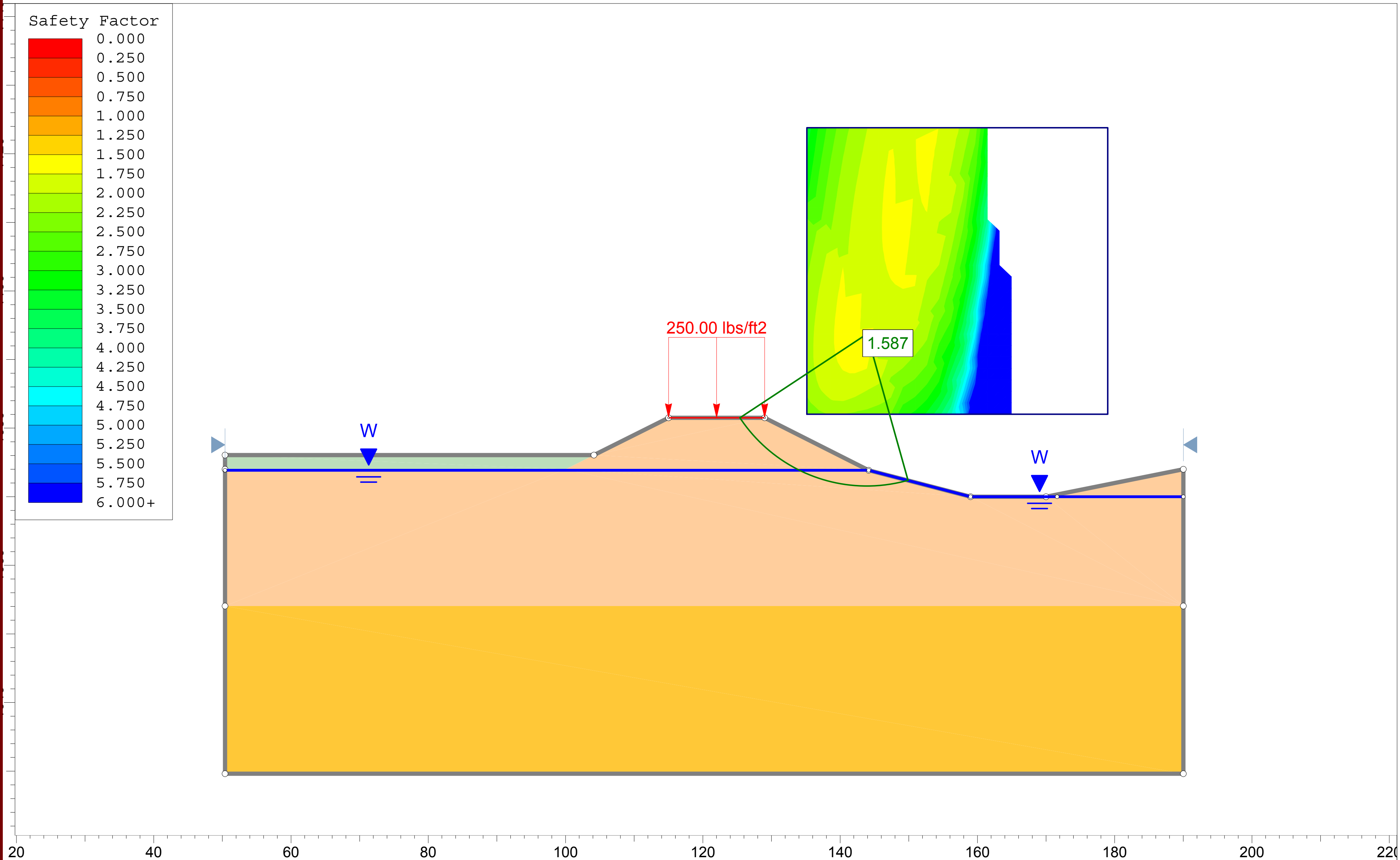


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* | 1:234 |
| *Company* | | | |
| *Date* | 10/16/2013, 3:13:47 PM | *File Name* | A-A_Conemaugh_Drained_circular.slim |

IDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_Drained_circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 5

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Mohr-Coulomb | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion [psf] | | 0 | |
| Friction Angle [deg] | | 32 | |
| Cohesion Type | | | 8000 |
| Water Surface | None | Water Table | None |
| Hu Value | | 0 | |
| Ru Value | 0 | | 0 |

## Global Minimums

### Method: spencer

FS: 1.586580
Center: 143.913, 1093.724
Radius: 22.181
Left Slip Surface Endpoint: 125.405, 1081.500
Right Slip Surface Endpoint: 149.893, 1072.365
Resisting Moment=160483 lb-ft
Driving Moment=101151 lb-ft
Resisting Horizontal Force=6431.24 lb

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Driving Horizontal Force=4053.53 lb
Total Slice Area=81.3942 ft2

## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 3583
Number of Invalid Surfaces: 3853

#### Error Codes:

Error Code -103 reported for 1 surface
Error Code -107 reported for 119 surfaces
Error Code -108 reported for 3 surfaces
Error Code -111 reported for 2 surfaces
Error Code -115 reported for 3728 surfaces

#### Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-115 = Surface too shallow, below the minimum depth.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.58658

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.979525 | 90.4034 | Foundation soil | 0 | 32 | 69.6334 | 110.479 | 176.803 | 0 | 176.803 |
| 2 | 0.979525 | 258.626 | Foundation soil | 0 | 32 | 112.985 | 179.259 | 286.875 | 0 | 286.875 |
| 3 | 0.979525 | 404.497 | Foundation soil | 0 | 32 | 155.692 | 247.018 | 395.311 | 0 | 395.311 |
| 4 | 0.979525 | 529.083 | Foundation soil | 0 | 32 | 176.198 | 279.553 | 447.378 | 0 | 447.378 |
| 5 | 0.979525 | 591.874 | Foundation soil | 0 | 32 | 158.631 | 251.68 | 402.773 | 0 | 402.773 |
| 6 | 0.979525 | 627.454 | Foundation soil | 0 | 32 | 176.57 | 280.142 | 448.322 | 0 | 448.322 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 0.979525 | 652.043 | Foundation soil | 0 | 32 | 192.051 | 304.704 | 487.628 | 0 | 487.628 |
| 8 | 0.979525 | 666.82 | Foundation soil | 0 | 32 | 205.068 | 325.357 | 520.68 | 0 | 520.68 |
| 9 | 0.979525 | 672.694 | Foundation soil | 0 | 32 | 215.599 | 342.065 | 547.419 | 0 | 547.419 |
| 10 | 0.979525 | 670.381 | Foundation soil | 0 | 32 | 223.602 | 354.762 | 567.738 | 0 | 567.738 |
| 11 | 0.979525 | 660.45 | Foundation soil | 0 | 32 | 229.015 | 363.351 | 581.482 | 0 | 581.482 |
| 12 | 0.979525 | 643.362 | Foundation soil | 0 | 32 | 231.755 | 367.698 | 588.441 | 0 | 588.441 |
| 13 | 0.979525 | 619.483 | Foundation soil | 0 | 32 | 231.715 | 367.635 | 588.339 | 0 | 588.339 |
| 14 | 0.979525 | 589.113 | Foundation soil | 0 | 32 | 228.762 | 362.95 | 580.84 | 0 | 580.84 |
| 15 | 0.979525 | 552.488 | Foundation soil | 0 | 32 | 222.73 | 353.379 | 565.524 | 0 | 565.524 |
| 16 | 0.979525 | 509.795 | Foundation soil | 0 | 32 | 213.418 | 338.604 | 541.879 | 0 | 541.879 |
| 17 | 0.979525 | 461.175 | Foundation soil | 0 | 32 | 200.579 | 318.234 | 509.281 | 0 | 509.281 |
| 18 | 0.979525 | 406.73 | Foundation soil | 0 | 32 | 183.915 | 291.796 | 466.97 | 0 | 466.97 |
| 19 | 0.979525 | 346.525 | Foundation soil | 0 | 32 | 163.061 | 258.709 | 414.022 | 0 | 414.022 |
| 20 | 0.979525 | 292.206 | Foundation soil | 0 | 32 | 143.265 | 227.301 | 363.758 | 0 | 363.758 |
| 21 | 0.979525 | 251.901 | Foundation soil | 0 | 32 | 128.877 | 204.473 | 327.225 | 0 | 327.225 |
| 22 | 0.979525 | 206.154 | Foundation soil | 0 | 32 | 110.264 | 174.942 | 279.965 | 0 | 279.965 |
| 23 | 0.979525 | 154.563 | Foundation soil | 0 | 32 | 86.619 | 137.428 | 219.931 | 0 | 219.931 |
| 24 | 0.979525 | 97.0191 | Foundation soil | 0 | 32 | 57.1225 | 90.6294 | 145.038 | 0 | 145.038 |
| 25 | 0.979525 | 33.3713 | Foundation soil | 0 | 32 | 21.1256 | 33.5175 | 53.6392 | 0 | 53.6392 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.58658

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 125.405 | 1081.5 | 0 | 0 | 0 |
| 2 | 126.385 | 1080.13 | 173.608 | 70.9145 | 22.2188 |
| 3 | 127.364 | 1078.96 | 400.698 | 163.675 | 22.2188 |
| 4 | 128.344 | 1077.93 | 655.226 | 267.644 | 22.2188 |

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| | | | | | |
|---|---|---|---|---|---|
| 5 | 129.323 | 1077.02 | 889.412 | 363.303 | 22.2188 |
| 6 | 130.303 | 1076.21 | 1059.31 | 432.701 | 22.2188 |
| 7 | 131.282 | 1075.49 | 1208.9 | 493.805 | 22.2188 |
| 8 | 132.262 | 1074.85 | 1333.54 | 544.717 | 22.2188 |
| 9 | 133.241 | 1074.28 | 1430 | 584.118 | 22.2187 |
| 10 | 134.221 | 1073.77 | 1496.2 | 611.162 | 22.2188 |
| 11 | 135.2 | 1073.33 | 1531.08 | 625.408 | 22.2188 |
| 12 | 136.18 | 1072.94 | 1534.42 | 626.772 | 22.2188 |
| 13 | 137.159 | 1072.6 | 1506.86 | 615.513 | 22.2187 |
| 14 | 138.139 | 1072.31 | 1449.82 | 592.217 | 22.2188 |
| 15 | 139.119 | 1072.07 | 1365.58 | 557.807 | 22.2188 |
| 16 | 140.098 | 1071.87 | 1257.26 | 513.561 | 22.2189 |
| 17 | 141.078 | 1071.73 | 1128.94 | 461.144 | 22.2188 |
| 18 | 142.057 | 1071.62 | 985.743 | 402.651 | 22.2188 |
| 19 | 143.037 | 1071.56 | 834.017 | 340.675 | 22.2188 |
| 20 | 144.016 | 1071.54 | 681.535 | 278.39 | 22.2188 |
| 21 | 144.996 | 1071.57 | 531.822 | 217.236 | 22.2188 |
| 22 | 145.975 | 1071.64 | 382.932 | 156.418 | 22.2188 |
| 23 | 146.955 | 1071.75 | 243.27 | 99.3697 | 22.2188 |
| 24 | 147.934 | 1071.91 | 123.762 | 50.5539 | 22.2189 |
| 25 | 148.914 | 1072.11 | 38.3509 | 15.6654 | 22.2188 |
| 26 | 149.893 | 1072.37 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 129 | 1081.5 |
| 115 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |





| | |
|---|---|
| 190 | 1074 |
| 170 | 1070 |
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.06 |
| 190 | 1054.06 |

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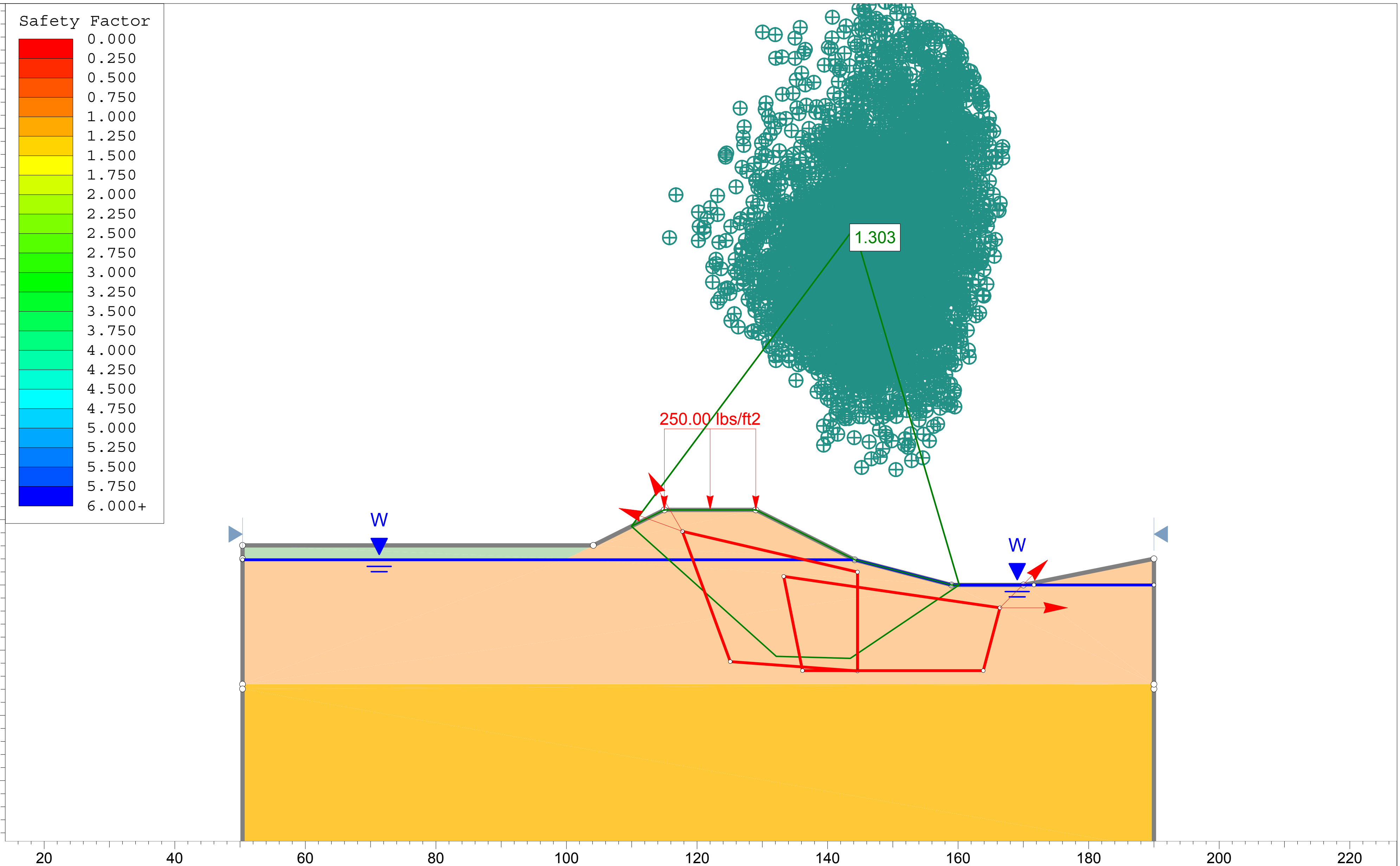


| | | | |
|---|---|---|---|
| *Project* SLIDE - An Interactive Slope Stability Program | | | |
| *Analysis Description* | | | |
| *Drawn By* | *Scale* 1:248 | *Company* | |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* A-A_Conemaugh_UnDrained_Block.slim | |

rocscience

SLIDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_UnDrained_Block
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.303400
Axis Location: 144.044, 1124.697
Left Slip Surface Endpoint: 109.960, 1078.980
Right Slip Surface Endpoint: 160.167, 1070.000
Resisting Moment=1.32246e+006 lb-ft
Driving Moment=1.01463e+006 lb-ft
Resisting Horizontal Force=18827.5 lb
Driving Horizontal Force=14445 lb
Total Slice Area=599.437 ft2

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## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 109.96 | 1078.98 |
| 132.139 | 1059.05 |
| 143.487 | 1058.73 |
| 160.167 | 1070 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 4280
Number of Invalid Surfaces: 720

#### Error Codes:

Error Code -107 reported for 18 surfaces
Error Code -108 reported for 459 surfaces
Error Code -111 reported for 164 surfaces
Error Code -112 reported for 79 surfaces

#### Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.3034

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.01626 | 383.789 | Foundation soil | 375 | 0 | 287.709 | 375 | -37.8626 | 0 | -37.8626 |
| 2 | 2.01626 | 1151.37 | Foundation soil | 375 | 0 | 287.709 | 375 | 312.434 | 0 | 312.434 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2.01626 | 1884.57 | Foundation soil | 375 | 0 | 287.709 | 375 | 762.181 | 0 | 762.181 |
| 4 | 2.01626 | 2411.97 | Foundation soil | 375 | 0 | 287.709 | 375 | 1117.77 | 0 | 1117.77 |
| 5 | 2.01626 | 2905.14 | Foundation soil | 375 | 0 | 287.709 | 375 | 1342.84 | 0 | 1342.84 |
| 6 | 2.01626 | 3398.31 | Foundation soil | 375 | 0 | 287.709 | 375 | 1567.9 | 0 | 1567.9 |
| 7 | 2.01626 | 3891.48 | Foundation soil | 375 | 0 | 287.709 | 375 | 1792.97 | 0 | 1792.97 |
| 8 | 2.01626 | 4384.65 | Foundation soil | 375 | 0 | 287.709 | 375 | 2018.04 | 0 | 2018.04 |
| 9 | 2.01626 | 4877.82 | Foundation soil | 375 | 0 | 287.709 | 375 | 2243.1 | 0 | 2243.1 |
| 10 | 2.01626 | 5328.05 | Foundation soil | 375 | 0 | 287.709 | 375 | 2320.44 | 0 | 2320.44 |
| 11 | 2.01626 | 5571.56 | Foundation soil | 375 | 0 | 287.709 | 375 | 2329.67 | 0 | 2329.67 |
| 12 | 1.89121 | 5212.43 | Foundation soil | 375 | 0 | 287.709 | 375 | 2768.59 | 0 | 2768.59 |
| 13 | 1.89121 | 4982.36 | Foundation soil | 375 | 0 | 287.709 | 375 | 2647.27 | 0 | 2647.27 |
| 14 | 1.89121 | 4752.29 | Foundation soil | 375 | 0 | 287.709 | 375 | 2525.94 | 0 | 2525.94 |
| 15 | 1.89121 | 4522.21 | Foundation soil | 375 | 0 | 287.709 | 375 | 2404.62 | 0 | 2404.62 |
| 16 | 1.89121 | 4292.14 | Foundation soil | 375 | 0 | 287.709 | 375 | 2283.29 | 0 | 2283.29 |
| 17 | 1.89121 | 4062.06 | Foundation soil | 375 | 0 | 287.709 | 375 | 2161.97 | 0 | 2161.97 |
| 18 | 2.08507 | 4038.45 | Foundation soil | 375 | 0 | 287.709 | 375 | 2310.82 | 0 | 2310.82 |
| 19 | 2.08507 | 3482.18 | Foundation soil | 375 | 0 | 287.709 | 375 | 2025.33 | 0 | 2025.33 |
| 20 | 2.08507 | 2933.33 | Foundation soil | 375 | 0 | 287.709 | 375 | 1743.66 | 0 | 1743.66 |
| 21 | 2.08507 | 2384.49 | Foundation soil | 375 | 0 | 287.709 | 375 | 1461.98 | 0 | 1461.98 |
| 22 | 2.08507 | 1835.64 | Foundation soil | 375 | 0 | 287.709 | 375 | 1180.3 | 0 | 1180.3 |
| 23 | 2.08507 | 1286.79 | Foundation soil | 375 | 0 | 287.709 | 375 | 898.624 | 0 | 898.624 |
| 24 | 2.08507 | 737.945 | Foundation soil | 375 | 0 | 287.709 | 375 | 616.948 | 0 | 616.948 |
| 25 | 2.08507 | 212.979 | Foundation soil | 375 | 0 | 287.709 | 375 | 347.35 | 0 | 347.35 |

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.3034

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| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 109.96 | 1078.98 | 0 | 0 | 0 |
| 2 | 111.977 | 1077.17 | -648.734 | -63.1701 | 5.56161 |
| 3 | 113.993 | 1075.36 | -662.795 | -64.5393 | 5.56161 |
| 4 | 116.009 | 1073.54 | 138.005 | 13.4382 | 5.56163 |
| 5 | 118.025 | 1071.73 | 1583.07 | 154.15 | 5.56159 |
| 6 | 120.042 | 1069.92 | 3435.91 | 334.57 | 5.56161 |
| 7 | 122.058 | 1068.11 | 5696.53 | 554.696 | 5.56161 |
| 8 | 124.074 | 1066.3 | 8364.92 | 814.53 | 5.56161 |
| 9 | 126.09 | 1064.49 | 11441.1 | 1114.07 | 5.56161 |
| 10 | 128.107 | 1062.67 | 14925.1 | 1453.32 | 5.5616 |
| 11 | 130.123 | 1060.86 | 18549.1 | 1806.21 | 5.56162 |
| 12 | 132.139 | 1059.05 | 22189.9 | 2160.73 | 5.56161 |
| 13 | 134.03 | 1059 | 21791.8 | 2121.97 | 5.56163 |
| 14 | 135.922 | 1058.94 | 21387.4 | 2082.58 | 5.56159 |
| 15 | 137.813 | 1058.89 | 20976.5 | 2042.57 | 5.5616 |
| 16 | 139.704 | 1058.84 | 20559.2 | 2001.94 | 5.56161 |
| 17 | 141.595 | 1058.79 | 20135.5 | 1960.68 | 5.5616 |
| 18 | 143.487 | 1058.73 | 19705.4 | 1918.81 | 5.56163 |
| 19 | 145.572 | 1060.14 | 15851.2 | 1543.5 | 5.5616 |
| 20 | 147.657 | 1061.55 | 12399 | 1207.34 | 5.56158 |
| 21 | 149.742 | 1062.96 | 9343.47 | 909.815 | 5.56161 |
| 22 | 151.827 | 1064.37 | 6684.64 | 650.913 | 5.56161 |
| 23 | 153.912 | 1065.78 | 4422.49 | 430.638 | 5.56162 |
| 24 | 155.997 | 1067.18 | 2557.03 | 248.989 | 5.5616 |
| 25 | 158.082 | 1068.59 | 1088.25 | 105.968 | 5.56162 |
| 26 | 160.167 | 1070 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 129 | 1081.5 |
| 115 | 1081.5 |





### Block Search Window

| X | Y |
|---|---|
| 117.742 | 1078.22 |
| 125.087 | 1058.24 |
| 144.582 | 1056.81 |
| 144.582 | 1071.97 |

### Block Search Window

| X | Y |
|---|---|
| 133.284 | 1071.3 |
| 136.163 | 1056.86 |
| 163.847 | 1056.86 |
| 166.398 | 1066.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |
| 190 | 1054.77 |
| 190 | 1074 |
| 170 | 1070 |
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.77 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

### Material Boundary

| X | Y |
|---|---|

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| | |
|---|---|
| 50.3799 | 1054.77 |
| 190 | 1054.77 |

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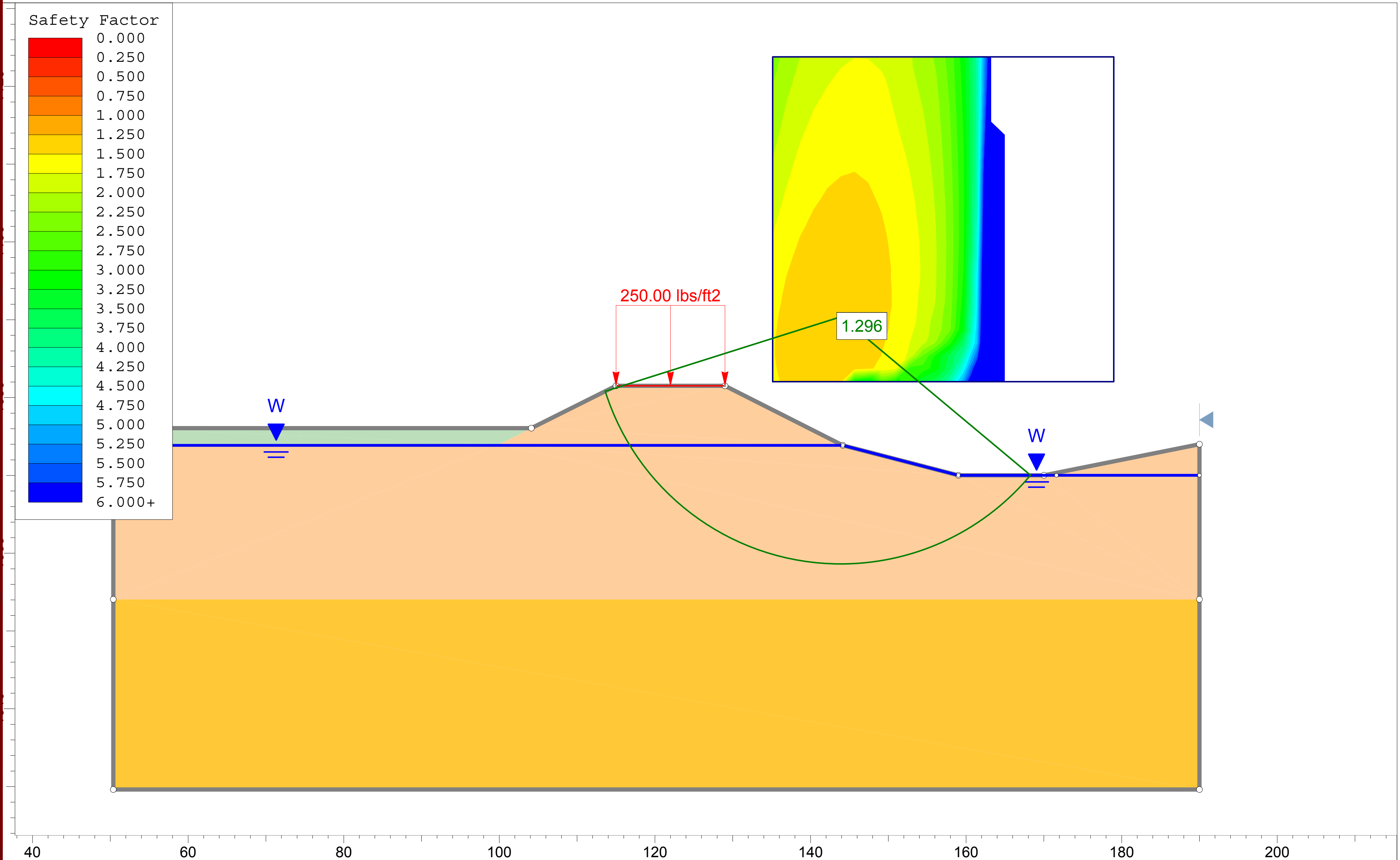


| | | | |
|---|---|---|---|
| Project | SLIDE - An Interactive Slope Stability Program | | |
| Analysis Description | | | |
| Drawn By | | Scale 1:207 | Company |
| Date 10/16/2013, 3:13:47 PM | | File Name A-A_Conemaugh_UnDrained_Circular.slim | |

SLIDEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_UnDrained_Circular
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 3

## Loading

1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.295650
Center: 143.913, 1090.384
Radius: 31.780
Left Slip Surface Endpoint: 113.611, 1080.805
Right Slip Surface Endpoint: 168.295, 1070.000
Resisting Moment=807275 lb-ft
Driving Moment=623065 lb-ft
Resisting Horizontal Force=20506.7 lb
Driving Horizontal Force=15827.3 lb
Total Slice Area=678.943 ft2

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## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 4072
Number of Invalid Surfaces: 3364

#### Error Codes:

Error Code -103 reported for 1 surface
Error Code -107 reported for 323 surfaces
Error Code -108 reported for 85 surfaces
Error Code -112 reported for 2 surfaces
Error Code -115 reported for 2953 surfaces

#### Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-115 = Surface too shallow, below the minimum depth.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.29565

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.18738 | 913.363 | Foundation soil | 375 | 0 | 289.43 | 375 | -135.609 | 0 | -135.609 |
| 2 | 2.18738 | 2277.69 | Foundation soil | 375 | 0 | 289.43 | 375 | 749.185 | 0 | 749.185 |
| 3 | 2.18738 | 3209.54 | Foundation soil | 375 | 0 | 289.43 | 375 | 1254.93 | 0 | 1254.93 |
| 4 | 2.18738 | 3944.42 | Foundation soil | 375 | 0 | 289.43 | 375 | 1652 | 0 | 1652 |
| 5 | 2.18738 | 4545.45 | Foundation soil | 375 | 0 | 289.43 | 375 | 1978.63 | 0 | 1978.63 |
| 6 | 2.18738 | 5044.87 | Foundation soil | 375 | 0 | 289.43 | 375 | 2253.46 | 0 | 2253.46 |
| 7 | 2.18738 | 5461.84 | Foundation soil | 375 | 0 | 289.43 | 375 | 2487.22 | 0 | 2487.22 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 2.18738 | 5657.22 | Foundation soil | 375 | 0 | 289.43 | 375 | 2387.52 | 0 | 2387.52 |
| 9 | 2.18738 | 5616.91 | Foundation soil | 375 | 0 | 289.43 | 375 | 2402.27 | 0 | 2402.27 |
| 10 | 2.18738 | 5520.72 | Foundation soil | 375 | 0 | 289.43 | 375 | 2397.41 | 0 | 2397.41 |
| 11 | 2.18738 | 5373.09 | Foundation soil | 375 | 0 | 289.43 | 375 | 2366.86 | 0 | 2366.86 |
| 12 | 2.18738 | 5177 | Foundation soil | 375 | 0 | 289.43 | 375 | 2312.31 | 0 | 2312.31 |
| 13 | 2.18738 | 4934.48 | Foundation soil | 375 | 0 | 289.43 | 375 | 2234.95 | 0 | 2234.95 |
| 14 | 2.18738 | 4646.87 | Foundation soil | 375 | 0 | 289.43 | 375 | 2135.56 | 0 | 2135.56 |
| 15 | 2.18738 | 4399.02 | Foundation soil | 375 | 0 | 289.43 | 375 | 2053.18 | 0 | 2053.18 |
| 16 | 2.18738 | 4180 | Foundation soil | 375 | 0 | 289.43 | 375 | 1983.51 | 0 | 1983.51 |
| 17 | 2.18738 | 3915.5 | Foundation soil | 375 | 0 | 289.43 | 375 | 1892.73 | 0 | 1892.73 |
| 18 | 2.18738 | 3604.07 | Foundation soil | 375 | 0 | 289.43 | 375 | 1780.29 | 0 | 1780.29 |
| 19 | 2.18738 | 3243.42 | Foundation soil | 375 | 0 | 289.43 | 375 | 1645.26 | 0 | 1645.26 |
| 20 | 2.18738 | 2830.22 | Foundation soil | 375 | 0 | 289.43 | 375 | 1486.24 | 0 | 1486.24 |
| 21 | 2.18738 | 2365.03 | Foundation soil | 375 | 0 | 289.43 | 375 | 1303.77 | 0 | 1303.77 |
| 22 | 2.18738 | 1951.33 | Foundation soil | 375 | 0 | 289.43 | 375 | 1147.97 | 0 | 1147.97 |
| 23 | 2.18738 | 1511.68 | Foundation soil | 375 | 0 | 289.43 | 375 | 983.622 | 0 | 983.622 |
| 24 | 2.18738 | 984.855 | Foundation soil | 375 | 0 | 289.43 | 375 | 783.031 | 0 | 783.031 |
| 25 | 2.18738 | 348.771 | Foundation soil | 375 | 0 | 289.43 | 375 | 538.583 | 0 | 538.583 |

## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.29565

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 113.611 | 1080.81 | 0 | 0 | 0 |
| 2 | 115.798 | 1075.57 | -1342.63 | -103.018 | 4.38762 |
| 3 | 117.985 | 1072.01 | 693.06 | 53.1777 | 4.38764 |
| 4 | 120.173 | 1069.26 | 3511.86 | 269.461 | 4.38764 |
| 5 | 122.36 | 1067.03 | 6558.93 | 503.259 | 4.38764 |
| 6 | 124.548 | 1065.19 | 9574.05 | 734.605 | 4.38764 |

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| | | | | | |
|---|---|---|---|---|---|
| 7 | 126.735 | 1063.65 | 12410 | 952.207 | 4.38765 |
| 8 | 128.922 | 1062.36 | 14973.8 | 1148.92 | 4.38763 |
| 9 | 131.11 | 1061.3 | 16883.1 | 1295.42 | 4.38764 |
| 10 | 133.297 | 1060.43 | 18335.1 | 1406.83 | 4.38764 |
| 11 | 135.484 | 1059.74 | 19350.9 | 1484.77 | 4.38764 |
| 12 | 137.672 | 1059.22 | 19947.5 | 1530.55 | 4.38765 |
| 13 | 139.859 | 1058.86 | 20145.9 | 1545.77 | 4.38764 |
| 14 | 142.047 | 1058.66 | 19971.2 | 1532.37 | 4.38765 |
| 15 | 144.234 | 1058.61 | 19452.6 | 1492.57 | 4.38763 |
| 16 | 146.421 | 1058.7 | 18620.1 | 1428.7 | 4.38765 |
| 17 | 148.609 | 1058.95 | 17492.5 | 1342.18 | 4.38764 |
| 18 | 150.796 | 1059.36 | 16092.7 | 1234.77 | 4.38763 |
| 19 | 152.983 | 1059.93 | 14450 | 1108.73 | 4.38763 |
| 20 | 155.171 | 1060.66 | 12602 | 966.935 | 4.38763 |
| 21 | 157.358 | 1061.59 | 10597.3 | 813.114 | 4.38762 |
| 22 | 159.546 | 1062.71 | 8496.36 | 651.915 | 4.38764 |
| 23 | 161.733 | 1064.07 | 6308.01 | 484.006 | 4.38764 |
| 24 | 163.92 | 1065.69 | 4080.07 | 313.059 | 4.38764 |
| 25 | 166.108 | 1067.64 | 1924.04 | 147.629 | 4.38763 |
| 26 | 168.295 | 1070 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 129 | 1081.5 |
| 115 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |
| 190 | 1074 |
| 170 | 1070 |





| | |
|---|---|
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.06 |
| 190 | 1054.06 |

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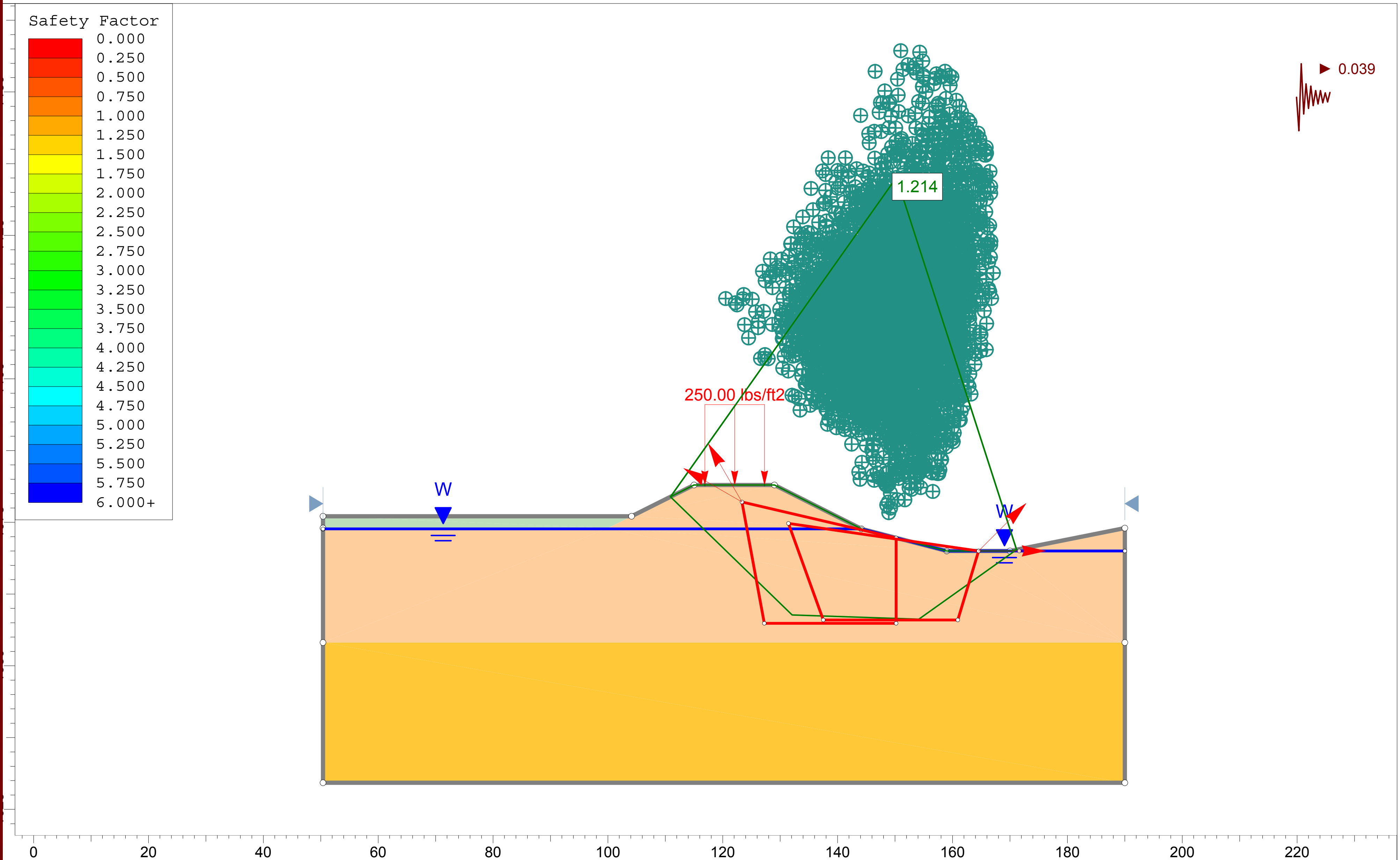


IDEINTERPRET 6.019

| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:280 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* A-A_Conemaugh_UnDrained_Block_seismic.slim | |

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_UnDrained_Block_seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 120
Left Projection Angle (End Angle): 150
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 0
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.214080
Axis Location: 150.240, 1135.107
Left Slip Surface Endpoint: 110.892, 1079.446
Right Slip Surface Endpoint: 171.160, 1070.232
Resisting Moment=1.89245e+006 lb-ft
Driving Moment=1.55876e+006 lb-ft
Resisting Horizontal Force=22600.7 lb
Driving Horizontal Force=18615.5 lb

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Total Slice Area=719.897 ft2

## Global Minimum Coordinates

### Method: spencer

| X | Y |
|---|---|
| 110.892 | 1079.45 |
| 132.067 | 1058.87 |
| 154.129 | 1058.12 |
| 171.16 | 1070.23 |

## Valid / Invalid Surfaces

### Method: spencer

Number of Valid Surfaces: 3682
Number of Invalid Surfaces: 1318

**Error Codes:**

Error Code -105 reported for 19 surfaces
Error Code -108 reported for 939 surfaces
Error Code -111 reported for 292 surfaces
Error Code -112 reported for 68 surfaces

**Error Codes**

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

## Slice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.21408

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.35285 | 549.922 | Foundation soil | 375 | 0 | 308.876 | 375 | -30.0369 | 0 | -30.0369 |
| 2 | 2.35285 | 1637.72 | Foundation soil | 375 | 0 | 308.876 | 375 | 383.338 | 0 | 383.338 |
| 3 | 2.35285 | 2467.91 | Foundation soil | 375 | 0 | 308.876 | 375 | 800.236 | 0 | 800.236 |
| 4 | 2.35285 | 3194.08 | Foundation soil | 375 | 0 | 308.876 | 375 | 1199.32 | 0 | 1199.32 |
| 5 | 2.35285 | 3920.25 | Foundation soil | 375 | 0 | 308.876 | 375 | 1475.27 | 0 | 1475.27 |
| 6 | 2.35285 | 4646.42 | Foundation soil | 375 | 0 | 308.876 | 375 | 1751.22 | 0 | 1751.22 |
| 7 | 2.35285 | 5372.59 | Foundation soil | 375 | 0 | 308.876 | 375 | 2018.82 | 0 | 2018.82 |
| 8 | 2.35285 | 6081.39 | Foundation soil | 375 | 0 | 308.876 | 375 | 2071.97 | 0 | 2071.97 |
| 9 | 2.35285 | 6522 | Foundation soil | 375 | 0 | 308.876 | 375 | 2239.41 | 0 | 2239.41 |
| 10 | 2.45134 | 6786.07 | Foundation soil | 375 | 0 | 308.876 | 375 | 2770.55 | 0 | 2770.55 |
| 11 | 2.45134 | 6404.33 | Foundation soil | 375 | 0 | 308.876 | 375 | 2616.16 | 0 | 2616.16 |
| 12 | 2.45134 | 6022.59 | Foundation soil | 375 | 0 | 308.876 | 375 | 2461.77 | 0 | 2461.77 |
| 13 | 2.45134 | 5640.84 | Foundation soil | 375 | 0 | 308.876 | 375 | 2307.38 | 0 | 2307.38 |
| 14 | 2.45134 | 5259.56 | Foundation soil | 375 | 0 | 308.876 | 375 | 2153.18 | 0 | 2153.18 |
| 15 | 2.45134 | 4990.12 | Foundation soil | 375 | 0 | 308.876 | 375 | 2044.21 | 0 | 2044.21 |
| 16 | 2.45134 | 4806.86 | Foundation soil | 375 | 0 | 308.876 | 375 | 1970.09 | 0 | 1970.09 |
| 17 | 2.45134 | 4623.6 | Foundation soil | 375 | 0 | 308.876 | 375 | 1895.97 | 0 | 1895.97 |
| 18 | 2.45134 | 4440.34 | Foundation soil | 375 | 0 | 308.876 | 375 | 1821.86 | 0 | 1821.86 |
| 19 | 2.43296 | 3928.27 | Foundation soil | 375 | 0 | 308.876 | 375 | 2034.4 | 0 | 2034.4 |
| 20 | 2.43296 | 3152.61 | Foundation soil | 375 | 0 | 308.876 | 375 | 1688.08 | 0 | 1688.08 |
| 21 | 2.43296 | 2480.32 | Foundation soil | 375 | 0 | 308.876 | 375 | 1387.93 | 0 | 1387.93 |
| 22 | 2.43296 | 1912.2 | Foundation soil | 375 | 0 | 308.876 | 375 | 1134.27 | 0 | 1134.27 |
| 23 | 2.43296 | 1344.09 | Foundation soil | 375 | 0 | 308.876 | 375 | 880.625 | 0 | 880.625 |
| 24 | 2.43296 | 775.969 | Foundation soil | 375 | 0 | 308.876 | 375 | 626.976 | 0 | 626.976 |
| 25 | 2.43296 | 226.021 | Foundation soil | 375 | 0 | 308.876 | 375 | 378.252 | 0 | 378.252 |





## Interslice Data

**Global Minimum Query (spencer) - Safety Factor**: 1.21408

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| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 110.892 | 1079.45 | 0 | 0 | 0 |
| 2 | 113.244 | 1077.16 | -775.589 | -91.8284 | 6.75229 |
| 3 | 115.597 | 1074.87 | -563.701 | -66.7413 | 6.75229 |
| 4 | 117.95 | 1072.59 | 633.667 | 75.0251 | 6.75229 |
| 5 | 120.303 | 1070.3 | 2771.73 | 328.168 | 6.75229 |
| 6 | 122.656 | 1068.01 | 5568.99 | 659.358 | 6.75228 |
| 7 | 125.009 | 1065.73 | 9025.44 | 1068.6 | 6.75231 |
| 8 | 127.362 | 1063.44 | 13122 | 1553.62 | 6.75228 |
| 9 | 129.714 | 1061.16 | 17367.7 | 2056.31 | 6.7523 |
| 10 | 132.067 | 1058.87 | 22013.4 | 2606.35 | 6.75229 |
| 11 | 134.519 | 1058.79 | 21748.9 | 2575.03 | 6.75228 |
| 12 | 136.97 | 1058.7 | 21456.6 | 2540.43 | 6.7523 |
| 13 | 139.421 | 1058.62 | 21136.7 | 2502.55 | 6.75229 |
| 14 | 141.873 | 1058.54 | 20789.1 | 2461.39 | 6.75228 |
| 15 | 144.324 | 1058.46 | 20413.8 | 2416.96 | 6.75229 |
| 16 | 146.775 | 1058.37 | 20019 | 2370.22 | 6.7523 |
| 17 | 149.227 | 1058.29 | 19610.9 | 2321.9 | 6.7523 |
| 18 | 151.678 | 1058.21 | 19189.6 | 2272.01 | 6.75227 |
| 19 | 154.129 | 1058.12 | 18754.9 | 2220.55 | 6.75229 |
| 20 | 156.562 | 1059.85 | 14636 | 1732.88 | 6.7523 |
| 21 | 158.995 | 1061.58 | 11086 | 1312.56 | 6.75227 |
| 22 | 161.428 | 1063.31 | 8028.84 | 950.601 | 6.75229 |
| 23 | 163.861 | 1065.04 | 5388.3 | 637.966 | 6.75229 |
| 24 | 166.294 | 1066.77 | 3164.35 | 374.653 | 6.75228 |
| 25 | 168.727 | 1068.5 | 1356.97 | 160.663 | 6.75229 |
| 26 | 171.16 | 1070.23 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 127.274 | 1081.5 |
| 116.887 | 1081.5 |





### Block Search Window

| X | Y |
|---|---|
| 123.336 | 1078.54 |
| 127.23 | 1057.41 |
| 150.176 | 1057.41 |
| 150.176 | 1072.29 |

### Block Search Window

| X | Y |
|---|---|
| 131.427 | 1074.8 |
| 137.502 | 1057.98 |
| 160.929 | 1057.98 |
| 164.54 | 1070 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |
| 190 | 1074 |
| 170 | 1070 |
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.06 |
| 190 | 1054.06 |

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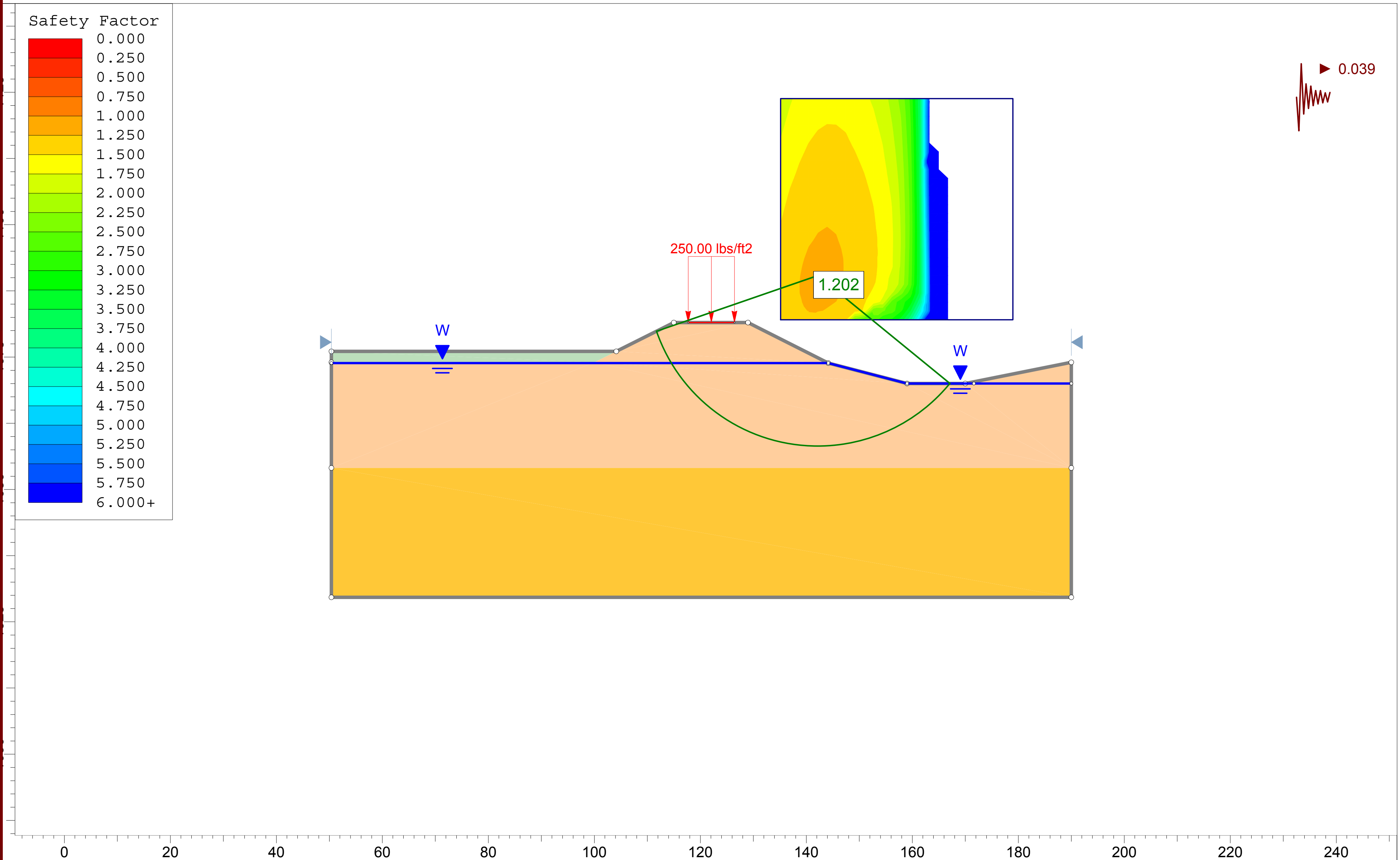


| | | | |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:304 | *Company* |
| *Date* 10/16/2013, 3:13:47 PM | | *File Name* A-A_Conemaugh_UnDrained_Circular_seismic.slim | |

DEINTERPRET 6.019

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# Slide Analysis Information

# SLIDE - An Interactive Slope Stability Program

## Project Summary

File Name: A-A_Conemaugh_UnDrained_Circular_seismic
Slide Modeler Version: 6.019
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 10/16/2013, 3:13:47 PM

## General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

## Analysis Options

### Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

## Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

## Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3





## Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 3

## Loading

Seismic Load Coefficient (Horizontal): 0.039
1 Distributed Load present

### Distributed Load 1

Distribution: Constant
Magnitude [psf]: 250
Orientation: Normal to boundary

## Material Properties

| Property | water | Foundation soil | bedrock |
|---|---|---|---|
| Color | | | |
| Strength Type | No strength | Undrained | Undrained |
| Unsaturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Saturated Unit Weight [lbs/ft3] | | 135 | 145 |
| Cohesion Type | | 375 | 8000 |
| Water Surface | None | None | None |
| Ru Value | 0 | 0 | 0 |

## Global Minimums

### Method: spencer

FS: 1.201750
Center: 142.160, 1090.384
Radius: 32.213
Left Slip Surface Endpoint: 111.715, 1079.857
Right Slip Surface Endpoint: 167.103, 1070.000
Resisting Moment=824162 lb-ft
Driving Moment=685802 lb-ft
Resisting Horizontal Force=20770.7 lb
Driving Horizontal Force=17283.7 lb
Total Slice Area=726.632 ft2

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## *Valid / Invalid Surfaces*

### Method: spencer

Number of Valid Surfaces: 4142
Number of Invalid Surfaces: 3294

#### Error Codes:

Error Code -103 reported for 1 surface
Error Code -107 reported for 243 surfaces
Error Code -108 reported for 92 surfaces
Error Code -111 reported for 3 surfaces
Error Code -112 reported for 2 surfaces
Error Code -115 reported for 2953 surfaces

#### Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-115 = Surface too shallow, below the minimum depth.

## *Slice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.20175

| Slice Number | Width [ft] | Weight [lbs] | Base Material | Base Cohesion [psf] | Base Friction Angle [degrees] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.21554 | 912.106 | Foundation soil | 375 | 0 | 312.045 | 375 | -224.108 | 0 | -224.108 |
| 2 | 2.21554 | 2466.25 | Foundation soil | 375 | 0 | 312.045 | 375 | 571.783 | 0 | 571.783 |
| 3 | 2.21554 | 3430.96 | Foundation soil | 375 | 0 | 312.045 | 375 | 1145.59 | 0 | 1145.59 |
| 4 | 2.21554 | 4165.94 | Foundation soil | 375 | 0 | 312.045 | 375 | 1701.32 | 0 | 1701.32 |
| 5 | 2.21554 | 4768.75 | Foundation soil | 375 | 0 | 312.045 | 375 | 2027.21 | 0 | 2027.21 |
| 6 | 2.21554 | 5270.25 | Foundation soil | 375 | 0 | 312.045 | 375 | 2302.18 | 0 | 2302.18 |





| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 2.21554 | 5689.01 | Foundation soil | 375 | 0 | 312.045 | 375 | 2452.46 | 0 | 2452.46 |
| 8 | 2.21554 | 6030.57 | Foundation soil | 375 | 0 | 312.045 | 375 | 2493.44 | 0 | 2493.44 |
| 9 | 2.21554 | 6089.55 | Foundation soil | 375 | 0 | 312.045 | 375 | 2563.62 | 0 | 2563.62 |
| 10 | 2.21554 | 5984.59 | Foundation soil | 375 | 0 | 312.045 | 375 | 2559.04 | 0 | 2559.04 |
| 11 | 2.21554 | 5827.29 | Foundation soil | 375 | 0 | 312.045 | 375 | 2528.63 | 0 | 2528.63 |
| 12 | 2.21554 | 5620.61 | Foundation soil | 375 | 0 | 312.045 | 375 | 2474.04 | 0 | 2474.04 |
| 13 | 2.21554 | 5366.51 | Foundation soil | 375 | 0 | 312.045 | 375 | 2396.44 | 0 | 2396.44 |
| 14 | 2.21554 | 5066.18 | Foundation soil | 375 | 0 | 312.045 | 375 | 2296.55 | 0 | 2296.55 |
| 15 | 2.21554 | 4730.46 | Foundation soil | 375 | 0 | 312.045 | 375 | 2179.42 | 0 | 2179.42 |
| 16 | 2.21554 | 4467.12 | Foundation soil | 375 | 0 | 312.045 | 375 | 2094.21 | 0 | 2094.21 |
| 17 | 2.21554 | 4190.55 | Foundation soil | 375 | 0 | 312.045 | 375 | 2002.84 | 0 | 2002.84 |
| 18 | 2.21554 | 3865.66 | Foundation soil | 375 | 0 | 312.045 | 375 | 1889.57 | 0 | 1889.57 |
| 19 | 2.21554 | 3489.98 | Foundation soil | 375 | 0 | 312.045 | 375 | 1753.45 | 0 | 1753.45 |
| 20 | 2.21554 | 3060 | Foundation soil | 375 | 0 | 312.045 | 375 | 1593.05 | 0 | 1593.05 |
| 21 | 2.21554 | 2570.74 | Foundation soil | 375 | 0 | 312.045 | 375 | 1406.36 | 0 | 1406.36 |
| 22 | 2.21554 | 2052.42 | Foundation soil | 375 | 0 | 312.045 | 375 | 1208.23 | 0 | 1208.23 |
| 23 | 2.21554 | 1582.62 | Foundation soil | 375 | 0 | 312.045 | 375 | 1037.22 | 0 | 1037.22 |
| 24 | 2.21554 | 1031.63 | Foundation soil | 375 | 0 | 312.045 | 375 | 834.283 | 0 | 834.283 |
| 25 | 2.21554 | 365.529 | Foundation soil | 375 | 0 | 312.045 | 375 | 586.913 | 0 | 586.913 |

## *Interslice Data*

**Global Minimum Query (spencer) - Safety Factor**: 1.20175

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [degrees] |
|---|---|---|---|---|---|
| 1 | 111.715 | 1079.86 | 0 | 0 | 0 |
| 2 | 113.93 | 1074.87 | -1773.53 | -145.092 | 4.67694 |
| 3 | 116.146 | 1071.38 | -377.113 | -30.8514 | 4.67692 |
| 4 | 118.361 | 1068.67 | 2171.76 | 177.671 | 4.67693 |

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| | | | | | |
|---|---|---|---|---|---|
| 5 | 120.577 | 1066.47 | 5392.93 | 441.194 | 4.67694 |
| 6 | 122.792 | 1064.64 | 8592.33 | 702.935 | 4.67693 |
| 7 | 125.008 | 1063.12 | 11621.2 | 950.729 | 4.67695 |
| 8 | 127.223 | 1061.84 | 14276.6 | 1167.97 | 4.67696 |
| 9 | 129.439 | 1060.79 | 16449.3 | 1345.71 | 4.67693 |
| 10 | 131.655 | 1059.93 | 18193.1 | 1488.37 | 4.67693 |
| 11 | 133.87 | 1059.26 | 19466.4 | 1592.54 | 4.67693 |
| 12 | 136.086 | 1058.75 | 20285.2 | 1659.52 | 4.67692 |
| 13 | 138.301 | 1058.4 | 20669.7 | 1690.98 | 4.67693 |
| 14 | 140.517 | 1058.21 | 20643.7 | 1688.85 | 4.67692 |
| 15 | 142.732 | 1058.18 | 20235.3 | 1655.44 | 4.67692 |
| 16 | 144.948 | 1058.29 | 19476.9 | 1593.4 | 4.67694 |
| 17 | 147.163 | 1058.56 | 18394.9 | 1504.88 | 4.67693 |
| 18 | 149.379 | 1058.99 | 17009.9 | 1391.57 | 4.67692 |
| 19 | 151.594 | 1059.58 | 15349.1 | 1255.7 | 4.67692 |
| 20 | 153.81 | 1060.35 | 13448.1 | 1100.19 | 4.67696 |
| 21 | 156.026 | 1061.31 | 11353.3 | 928.812 | 4.67694 |
| 22 | 158.241 | 1062.47 | 9125.69 | 746.569 | 4.67693 |
| 23 | 160.457 | 1063.87 | 6824.29 | 558.293 | 4.67693 |
| 24 | 162.672 | 1065.55 | 4458.7 | 364.765 | 4.67694 |
| 25 | 164.888 | 1067.56 | 2131.63 | 174.388 | 4.67693 |
| 26 | 167.103 | 1070 | 0 | 0 | 0 |

## *List Of Coordinates*

### Water Table

| X | Y |
|---|---|
| 50.3799 | 1073.86 |
| 144.157 | 1073.86 |
| 159 | 1070 |
| 171.616 | 1070 |
| 190 | 1070 |

### Line Load

| X | Y |
|---|---|
| 126.443 | 1081.5 |
| 117.718 | 1081.5 |

### External Boundary

| X | Y |
|---|---|
| 50.3799 | 1029.62 |
| 190 | 1029.62 |
| 190 | 1054.06 |





| | |
|---|---|
| 190 | 1074 |
| 170 | 1070 |
| 159 | 1070 |
| 144.157 | 1073.86 |
| 129 | 1081.5 |
| 115 | 1081.5 |
| 104.125 | 1076.06 |
| 50.3799 | 1076.06 |
| 50.3799 | 1074 |
| 50.3799 | 1054.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1074 |
| 100 | 1074 |
| 104.125 | 1076.06 |

### Material Boundary

| X | Y |
|---|---|
| 50.3799 | 1054.06 |
| 190 | 1054.06 |

3800-PM-WSFR0179a 9/2005
Post Construction Certification

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER STANDARDS AND FACILITY REGULATION

# WATER QUALITY MANAGEMENT
# POST CONSTRUCTION CERTIFICATION

| PERMITTEE IDENTIFIER | |
|---|---|
| Permittee | Genon Energy NE Management Co. |
| Municipality | West Wheatfield Township |
| County | Indiana |
| WQM Permit No. | 3211201 |
| Facility Type | Industrial Waste |

**All of the above information should be taken directly from the Water Quality Management Permit.**

## CERTIFICATION

This certification must be completed and returned to the permits section of the DEP's regional office issuing the WQM permit within 30 days of completion of the project and received by DEP prior to operation, and if requested, as-built drawings, photographs (if available) and a discussion of any DEP-approved deviations from the design plans during construction.

I, being a Registered Professional Engineer in Pennsylvania, do hereby certify to the best of my knowledge and belief, based upon personal observation and interviews, that the above facility approved under the Water Quality Management Permit has been constructed in accordance with the plans, specifications and modifications approved by DEP.

Construction Completion Date (MM/DD/YYYY): 11/01/2013

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
Kent C. Cockley
ENGINEER
PE-053618E

| Professional Engineer | |
|---|---|
| Name | Kent C. Cockley (Please Print or Type) |
| Signature | K. C. Cockley |
| Date | 11/01/2013 |
| License Expiration Date | 09/30/2015 |
| Firm or Agency | GAI Consultants, Inc. |
| Telephone | 724-387-2170 |

| Permittee or Authorized Representative | |
|---|---|
| Name | John Balog (Please Print or Type) |
| Signature | John A. Balog |
| Title | GENERAL MANAGER CONEMAUGH |
| Telephone | 724-235-4424 |

QUARTERLY ASH RECYCLE PONDS INSPECTION CHECKLIST
NRG ENERGY - OPERATIONS TECHNICAL SUPPORT
CONEMAUGH STATION

**NAME OF IMPOUNDMENT:** Ash Recycle Ponds

**LOCATION:** West Wheatfield Township, Indiana County

**PERSONS PRESENT AT INSPECTION:**

| NAME | TITLE/POSITION | REPRESENTING |
|---|---|---|
| | | NRG Energy |

**DATE OF INSPECTION:** **TIME:**
**WEATHER:**
**TEMPERATURE:**

This is to certify that the above ponds have been inspected and the following are the results of this inspection.

| EMBANKMENT | | | | |
|---|---|---|---|---|
| CREST AND INTERIOR SLOPES | | CHECK ( ) ACTION NEEDED | | |
| CONDITION/ITEMS | OBSERVATIONS | Monitor | Investigate | Repair |
| SURFACE CRACKING | | | | |
| LOW AREA(S) | | | | |
| HORIZONTAL ALIGNMENT | | | | |
| RUTS AND/OR PUDDLES | | | | |
| VEGETATION GROWTH | | | | |
| ADDITIONAL COMMENTS: | | | | |

| EMBANKMENT | | | | |
|---|---|---|---|---|
| EXTERIOR SLOPES | | CHECK ( ) ACTION NEEDED | | |
| CONDITION/ITEMS | OBSERVATIONS | Monitor | Investigate | Repair |
| WET AREA(S) | | | | |
| SEEPAGE | | | | |
| SLIDE, SLOUGH, SCARP | | | | |
| SINKHOLE, ANIMAL BURROW | | | | |
| EROSION | | | | |
| UNUSUAL MOVEMENT | | | | |
| VEGETATION CONDITION | | | | |
| ADDITIONAL COMMENTS: | | | | |

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## QUARTERLY DESILTING BASIN INSPECTION CHECKLIST
## NRG ENERGY - OPERATIONS TECHNICAL SUPPORT
## CONEMAUGH STATION

**NAME OF IMPOUNDMENT:** Desilting Basin

**LOCATION:** West Wheatfield Township, Indiana County

**PERSONS PRESENT AT INSPECTION:**

| NAME | TITLE/POSITION | REPRESENTING |
|---|---|---|
| | | NRG Energy |

**DATE OF INSPECTION:** **TIME:**
**WEATHER:**
**TEMPERATURE:**

This is to certify that the above ponds have been inspected and the following are the results of this inspection.

| EMBANKMENT | | | | |
|---|---|---|---|---|
| CREST AND INTERIOR SLOPES | | CHECK ( ) ACTION NEEDED | | |
| CONDITION/ITEMS | OBSERVATIONS | Monitor | Investigate | Repair |
| SURFACE CRACKING | | | | |
| LOW AREA(S) | | | | |
| HORIZONTAL ALIGNMENT | | | | |
| RUTS AND/OR PUDDLES | | | | |
| CONCRETE REVETMENT | | | | |
| ADDITIONAL COMMENTS: | | | | |

| EMBANKMENT | | | | |
|---|---|---|---|---|
| EXTERIOR SLOPES | | CHECK ( ) ACTION NEEDED | | |
| CONDITION/ITEMS | OBSERVATIONS | Monitor | Investigate | Repair |
| WET AREA(S) | | | | |
| SEEPAGE | | | | |
| SLIDE, SLOUGH, SCARP | | | | |
| SINKHOLE, ANIMAL BURROW | | | | |
| EROSION | | | | |
| UNUSUAL MOVEMENT | | | | |
| VEGETATION CONDITION | | | | |
| ADDITIONAL COMMENTS: | | | | |

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GENON NORTHEAST MANAGEMENT COMPANY
CANONSBURG, PENNSLYLVANIA

DRAFT
DESIGN ENGINEER'S REPORT
AS PART OF THE WATER QUALITY MANAGEMENT PERMIT APPLICATION
DESILTING BASIN RECONSTRUCTION
CONEMAUGH POWER STATION

K. C. Cockley

Date: 8-12-11

Kent C. Cockley
Registered Professional Engineer

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
Kent C. Cockley
ENGINEER
PE-0539155

GAI CONSULTANTS, INC.
385 EAST WATERFRONT DRIVE
HOMESTEAD, PENNSYLVANIA 15120-5005

GAI PROJECT: C091251.01

AUGUST 2011

# Table of Contents

# 1.0 GENERAL INFORMATION

## 1.1 Site Description

Conemaugh Power Station is a coal-fired, steam electric generating station located on the Conemaugh River in West Wheatfield Township, Indiana County, Pennsylvania (see Figure 1 for the Site Location Map). The station is operated by the GenOn Northeast Management Company (GenOn). The Station is owned by a group of eight co-owners and GenOn owns a 16.45-percent undivided interest in the station and operates the station on behalf of the owners through its wholly owned subsidiary, GenOn Northeast Management Company. The station commenced operation in 1970. The electric generating capacity of the station is 1,700 megawatts (MW) from two identical 850 MW units. Coal combustion by-products (CCBs) from the Conemaugh Power Station are disposed of in a lined disposal facility located north of the station. The disposal facility is a captive site owned as an undivided interest by the Conemaugh Owners Group and operated by GenOn. The station has flue gas desulfurization (FGD) scrubbers on both generating units, which produce a gypsum by-product that is primarily disposed on-site and also shipped off-site for beneficial use in wallboard production.

## 1.2 General Facility Description

The desilting basin (basin) was originally built in 1969 to allow for gravity settling of sediment from water discharged from the cooling towers during a complete tower drainage event. Settling of solids and equalization are the forms of treatment that takes place in this basin. Over the years, miscellaneous wastewater streams throughout the plant have been routed to the basin. In response to changing Residual Waste Regulations, in 1994 the basin was rebuilt in-place and lined with a synthetic liner system and an asphalt protective layer. The basin has been operated and reported to the Pennsylvania Department of Environmental Protection (PaDEP) as a residual waste storage impoundment since 1994. The basin is currently permitted to discharge to the Conemaugh River via Outfall 004 in accordance with Permit No. PA0005011. A groundwater monitoring system was added in 1998 to meet regulatory requirements. The basin presently or is planned to collect flows from the following sources:

- storm drains from plant areas around cooling towers and yard drains;
- cooling tower water during maintenance draining events;
- storm drains from an oil/water separator;
- drain from the River Intake Clarifier Flocculation Tank; and
- ash recycle sump discharge.

Currently, the basin water is either recycled as make-up water to the FGD system or is discharged by gravity through NPDES Outfall 004 (NPDES Permit No. PA0005011) to the Conemaugh River. A modification to the existing permit submitted in 2010 will provide treatment of some of the desilting basin water through the Cooling Tower Blowdown Treatment System (CTBTS) which will result in basin discharge through NPDES Outfall 003 (NPDES Permit No. PA0005011). Flow will continue to gravity discharge through NPDES Outfall 004.

In accordance with Residual Waste Regulation, sediment is currently removed from the basin on an annual basis. The basin is not designed to drain by gravity so it is dewatered with a pump through Outfall 004 until suspended solid levels approach the NPDES discharge limits. The remainder of the material is removed via vacuum truck and/or collected using a bobcat lowered into the basin. This sediment removal process results in the basin being off-line for approximately one week.

The current discharge point (outfall 004) is sampled and monitored in accordance with Permit No. PA0005011. The proposed Reconstructed Desilting Basin will be re-graded as described in this Report and shown on the Drawings and will have a dewatering drain to aid in sediment removal. New subsurface drainage facilities and a geosynthetic liner system will be constructed in accordance with PaDEP Solid Waste Regulations as specified within this Report and as shown on the Drawings.

Based on a conceptual study by GAI Consultants, Inc. in 2009/2010 to evaluate the condition of the desilting basin, it was determined that reconstruction of the desilting basin would be the preferred option.

## 1.3 General Project Description

### 1.3.1 Facility Reconstruction

The purpose of this project is to reconstruct the existing desilting basin to improve its function with regard to PaDEP regulations. This will be accomplished by reconstructing the existing desilting basin with a Class I double-composite liner system, constructing a shallower bottom elevation to improve vertical separation from the current groundwater table and existing facilities, providing an access ramp and a basin dewatering drain to aid in sediment removal, and improving the protective cover. Storm runoff and process water which are collected in the desilting basin will be discharged in a manner similar to the current basin with the exception of the CTBTS which is currently in the permit review process.

The desilting basin will have a Class I double composite liner system and a subgrade drainage system to manage seasonal levels. Hydrogeologic Data and Information is provided as Appendix V-J of the Form V Narrative. The desilting basin will provide two (2) feet of freeboard for the 25-year, 24-hour storm event when routed through the riser to Outfall 004. The 100-year, 24-hour event was also investigated and will be routed through the riser to Outfall 004 without overtopping the crest of the Reconstructed Desilting Basin as specified in Attachment 2. Discharge from the Reconstructed Desilting Basin will continue to be monitored as NPDES Outfall 004. Storm runoff from local yard drains and process water from the ash pond water recycle sump, oil/water separator, cooling tower drains, and the intake clarifier flocculation tank drain will continue to enter the desilting basin via the existing piping system. During construction, discharge to the desilting basin will be diverted as specified in Attachment 4. See Module 15 attached to this Water Quality Management (WQM) Permit Application for a summary of the wastewater flow information. As with the existing basin, settling of solids and equalization will be the type of treatment occurring in the desilting basin.

There are several advantages of reconstructing the desilting basin which primarily include increased separation from the regional groundwater table, installation of a groundwater drainage system, improvements to maintenance and cleaning operations and a more durable protective cover system.

### 1.3.2 Construction Sequencing

The existing desilting basin will be taken out of service during reconstruction. Process water and stormwater currently directed to the basin will be rerouted or collected by alternative methods. Reconstruction of the desilting basin has been scheduled to occur in 2012 when no plant outages are scheduled. The desilting basin will be constructed at the approximate location of the existing basin, and will also extend further to the east as shown on the Drawings. After the desilting basin reconstruction is completed, process water and yard drains will again be routed to the basin. The temporary diversion of water during construction is included within this Report in Attachment 4. In general, process water will be diverted to other in plant facilities for re-use or treatment and discharge. As part of the plan, stormwater will also be diverted to other existing permitted NPDES stormwater outfalls or other inplant process facilities for reuse or treatment and discharge.

GenOn also is submitting a request for authorization to test the facilities for the proposed diversion of water included in Attachment 4. GenOn specifically will plan to test the valves associated with Item 1 on Attachment 4 and the connection of the Ash Valley Treatment System discharge and Ash Water Recycle System discharge to the Cooling Towers indicated by Items 5 and 7, respectively in Attachment 4. The test for the diversion of water to the cooling tower will be performed to not only test the connection but also to allow operations to balance the system flows, chemistry, and controls in coordination with the make-up water from the river and blowdown.

#### 1.3.3 Wastewater Characteristics

The chemical composition of the storm runoff to the basin will be the same for the reconstructed desilting basin as it is for the existing basin. The volume of runoff entering the desilting basin under normal operating conditions will be almost identical to the volume entering the existing basin. Any difference in the influent volume will be the result of a larger basin footprint. The chemical composition for process water entering the desilting basin will be the same for the reconstructed basin as it is for the existing basin. As before, discharges from the desilting basin riser will be monitored by NPDES Outfall 004. See Module 15 for a summary of the wastewater characteristics. Representative wastewater sampling data is also attached to Module 15, which was previously reported in the Conemaugh Power Plant NPDES Permit No. PA0005011 Permit Renewal Application, dated 2006.

### 1.4 Schematics: Wastewater and Sediment Flow Diagrams

A wastewater and sediment flow diagram is included as Figures 3. Figure 3 illustrates the existing and reconstructed facility operation.

### 1.5 Treatment Facility Size, Capacity and Dimensions

Capacity and size information for the desilting basin is summarized on the following page and in the Attachment 2 calculations.

## SECTION E. SEDIMENTATION PONDS

Sedimentation ponds and other impoundments must be constructed in accordance with the requirements of Chapter 102 and this permit before any earthmoving activities start in the drainage area. Each impoundment must be inspected during construction by or under the supervision of a registered professional engineer, licensed in Pennsylvania, and certified by the Department upon completion of construction.

Any enlargement, reduction in size, reconstruction, or other modification that may affect the stability or operation must be approved by the Department. Ponds must be certified and approved by the Department prior to the start of disposal activities.

Identification Proposed Reconstructed Desilting Basin

U.S.G.S. Quadrangle New Florence, PA Location: Latitude 40 deg 23 min 15 sec ; Longitude 79 deg 3 min 27 sec

Or Location from Bottom Right corner of U.S.G.S. Quadrangle; inches North: ______ inches West: ______

HYDROLOGY: Drainage area 21.8 acres acres; Design Storm 25-yr, 24-hr Average Watershed Slope less than 1 %

Land Use Industrial Soil Type C/D Curve Number 84 - 100 Peak Discharge 70.5 cfs (25-yr, 24-hr storm)

| | | |
|---|---|---|
| Embankment | Top Width (Minimum) | 12 feet |
| | Outside Slope (Maximum) | 2H : 1V |
| | Inside Slope (Maximum) | 2H : 1V |
| | Top Elevation | 1081.50 feet |
| | Upstream Toe Elevation | 1074.00 feet |
| | Liner Material (earthen, synthetic, etc.) | Synthetic |
| Impoundment Dimensions and Capacities | Length at Bottom | 235 feet maximum |
| | Width at Bottom | 98 feet maximum |
| | Length at Crest of ~~Principal Spillway~~ Riser to Lift Stations | 0 |
| | Width at Crest of ~~Principal Spillway~~ Riser to Lift Stations | 0 |
| | Depth from Crest of ~~Principal Spillway~~ Riser to Lift Stations | 0 |
| | Length at Crest of ~~Emergency Spillway~~ Riser to Outfall 004 | 0 |
| | Width at Crest of ~~Emergency Spillway~~ Riser to Outfall 004 | 0 |
| | Volume at Crest of ~~Principle Spillway~~ Riser to Lift Stations | 495 cubic yards , |
| ~~Principal Spillway~~ Riser to Lift Stations | Time of Detention | Not Applicable |
| | Maximum Sediment Storage Volume | 495 cubic yards |
| | Shape (Circular, semi-circular, trapezoid, etc.) | Circular |
| | Dimensions (W x H x L) | 36" dia. riser, 1-12" & 1-18" dia. outlet pipes |
| | Inlet Elevation | 1073.75 feet |
| | Slope and Length | +6.4%, 48 feet - 0%, 55 feet |
| | Discharge Elevation | Not Applicable |
| | ~~Spillway~~ Capacity | Not Applicable |
| | Construction Material | HDPE |
| Dewatering Device | Type/Size | 4" Perforated HDPE, Lift Stations |
| | Inlet Elevation | Not Applicable |
| | Discharge Controls (i.e. self draining or valved) | Valved |
| | Discharge Capacity (maximum) | 1800 gallons per minute |
| | Time to Dewater Full Pond | 9.3 hours (from 1077.75 to 1073.75 feet) |
| ~~Emergency Spillway~~ Riser to Outfall 004 | Shape | Circular |
| | Dimensions (W x H x L) | 36 inch dia riser, 24 inch dia. outlet pipe |
| | Slope | 0.7 % |
| | Discharge Elevation | Inlet = 1077.75 feet |
| | Type of Lining/Protection | HDPE Pipes to Concrete Manhole |
| | ~~Spillway~~ Capacity (provide design calculations) | 36.9 cfs (25-yr storm), 38.9 cfs (100-yr storm) |

# 2.0 DETAILED DESCRIPTION OF THE WASTEWATER TREATMENT FACILITY

## 2.1 System Parameters and Design Considerations

The design and layout of the reconstructed desilting basin is based on several considerations. These considerations include: setting the bottom elevation of the desilting basin to improve the separation of groundwater and existing facilities; installing a subgrade drainage system; and improving dewatering and cleaning facilities, improving the protective cover, handling the 25-year, 24-hour storm event with two feet of freeboard.

The proposed Reconstructed Desilting Basin will be a double-composite lined Class I storage impoundment. Details of the synthetic and composite liners are comprehensively described on the following page and in Attachment 3, which is a residual waste Form V-Storage Impoundment Application Form. The basin will be mostly excavated on the east side, and have an embankment on the north and south sides, as the existing basin does.

**Applicant Name:** GenOn Energy Northeast Mangement Company

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER STANDARDS AND FACILITY REGULATION

# IMPOUNDMENTS
# MODULE 20

**APPLICANT NAME** GenOn Energy Northeast Mangement Company

**NOTE: Module 19 must be completed along with this module. The construction inspection plan must be prepared and attached to this module.**

**TYPE OF WASTE (Check one.)**

☐ Sewage ☒ Residual (refer to requirements of Title 25 Pa. Code 299.141) ☐ Manure

**GENERAL REQUIREMENTS**

1. Is the bottom of the subbase within 4 feet of the seasonal high water table? ☒ Yes (drainage system required) ☐ No
2. Describe the drainage system and how it will prevent seasonal high water table coming within 4 feet of the subbase. Geocomposite Drainage Net and 4" SDR17 HDPE piping

**SUBBASE**

1. The subbase material is hard, uniform, smooth and free of debris, rock fragments, plant materials and other foreign material. ☐ Yes ☐ No
2. Design Data
   a. Material Enhanced Geocomposite Clay Liner
   b. Depth N/A inches (minimum 6 inches)
   c. Permeability of upper 6 inches $1 \times 10^{-6}$ cm/sec (maximum $1 \times 10^{-5}$)
   d. Slope 0.5 percent (2 to 25 percent)
   e. Compaction N/A percent (Standard Proctor Density) (minimum 90 percent)

**LEAK DETECTION ZONE**

1. Design Data Geocomposite Drainage Net
   a. Thickness N/A inches (minimum 12 inches)
   b. Particle size N/A inches (maximum 0.5 inch)
   c. Permeability N/A cm/sec (minimum $1 \times 10^{-2}$)
   d. Slope 0.5 percent (minimum 2 percent)
2. Piping System
   a. Slope 0.5 percent (minimum 2 percent)
   b. Diameter 4 inches (minimum 4 inches)
   c. Wall Thickness Schedule SDR 17 (minimum Schedule 40)

**LINER**

1. Geosynthetic Design Data
   a. Material Textured HDPE Geomembrane
   b. Thickness 60 mils (minimum 30 mils)
   c. Permeability $1 \times 10^{-7}$ cm/sec (maximum $1 \times 10^{-7}$)
2. Geotextile material used between leak detection zone and liner. ☒ Yes ☐ No
3. An assurance and quality control program is attached for installation of the liner. ☒ Yes ☐ No

**NOTE: Upon completion of construction, a written completion certification that the liner has been adequately constructed and tested in accordance with project specifications shall be submitted by the engineer to DEP.**

The desilting basin bottom elevation was designed based on historical regional groundwater levels from the groundwater monitoring wells at the location of the existing basin. See Drawing D-744-3094 for existing monitoring well locations, and in Form V, Appendix V - J for historical groundwater elevations.

A subgrade drainage system consisting of a groundwater underdrain pipe system and geocomposite drainage net (GDN) will be placed underneath the entire desilting basin footprint, including underneath the sideslopes. Any seasonal high groundwater that is intercepted and collected by the GDN layer will be collected in manholes GW-1 and GW-2 and pumped into the desilting basin. The proposed geosynthetic liner system for the reconstructed desilting basin is shown on Drawing D-744-3096 and will consist of a contaminate resistance (enhanced) geosynthetic clay liner (EGCL) which will meet the regulatory subbase permeability requirement of $1\times10^{-5}$ cm/sec. Above the subbase will be a 60 mil textured high density polyethylene (HDPE) geomembrane that will function as a secondary liner. Above the secondary liner will be the leachate detection zone (LDZ), which will consist of a GDN and a perforated pipe collection system. The LDZ will drain to leachate detection manhole LD-1. This manhole will be used to monitor the LDZ, and if necessary, used to obtain water samples for analysis. Leachate detection manhole LD-1 will be valved to drain to manhole GW-1, so that any water collected in the leachate detection manhole can also be pumped to the desilting basin pump station and will discharge above the normal pool elevation of the basin. Immediately above the LDZ will be a composite primary liner. The composite primary liner will consist of a 60 mil textured HDPE geomembrane underlain by a GCL. The entire liner system will be protected above with a non-woven geotextile and a fabricform revetment lining, filled with 3,000 psi (compressive strength) grout and anchored at the top of the basin. Eight-inch thick uniform section mat fabricform will cover the bottom of the basin, the lower portion of the sideslopes and the entrance ramp, while four-inch thick uniform section mat fabricform will cover the upper portion of the sideslopes.

Stormwater will enter the desilting basin from various locations similar to existing conditions.

1. from the discharge line from oil/water separator 1;
2. from yard drains around the cooling tower;
3. from areas directly adjacent to the desilting basin; and
4. direct rainfall inside the desilting basin.

If necessary for emergency purposes, all gravity piped stormwater into the basin either presently are valved or are proposed to be valved as part of this reconstruction project. If inlets to the basin are closed, storm runoff will need to be handled as follows:

1. From oil/water separator 1 – stormwater will back up into two existing 20,000 gallon underground concrete tanks. Water would need to either be temporarily stored and rerouted to the desilting basin after the emergency is over or pumped to other plant facilities for reuse or pumped out and transported offsite for disposal at a permitted facility.
2. Water from yard drains would need to be pumped directly to other plant facilities for reuse or treatment such as one of the existing pump stations from the desilting basin or to a cooling tower.

The Reconstructed Desilting Basin is designed to store the anticipated sediment volume for more than five (5) years of operation. The estimated sediment volume for the five (5) year period is approximately 430 tons (360 cubic yards). For a factor of safety, the basin was sized to store approximately 600 tons (495 cubic yards) of sediment. The main source of flow to the desilting basin is from the Ash Pond Water Recycle System that is operated at a total suspended solids level to meet a discharge level of 30 mg/L. The ash water recycle sump does not flow continuously to the desilting basin. For the sediment volume estimate, a continuous annual flow of 1,300 gallons per minute was used. The Waste Filter Pond (Ash Pond) "A" that ash recycle water is routed through also operates under a variance to be cleaned once every five (5) years. The basin will be monitored as part of routine plant operations and will be cleaned out more frequently than once every five years, if needed. For example, the basin will be cleaned out in response to plant operations that are not part of usual basin operation, such as a tower drain event.

The basin will be able to handle the approximately 70 cfs of peak storm discharge from the 25-year, 24-hour storm. For the 25-year storm scenario where no water is being pumped out of the basin, peak discharge will flow through the riser to Outfall 004 with a minimum of two (2) feet of freeboard provided. The desilting basin sizing calculations are included in Attachment 2.

The outlets for the desilting basin will consist of two riser structures located at the south end of the basin. One riser will gravity flow to the existing pump stations located outside the basin embankment on the west and southwest side. The location of the riser to the pump stations, the pump stations, and the riser to Outfall 004 are shown on Drawing D-744-3094. As discussed above, any water collected from the subgrade drainage system and the LDZ will also be pumped to new pump stations GW-1 and GW-2. The pump station will consist of a wet well, pumps, motors, and station housing for the electrical system and pump controls. Specifics of the proposed and existing pumping station equipment and operation are discussed in detail in Section 2.2.

The desilting basin risers will consist of a short section of upright HDPE pipe. The risers will be sealed and connected to each component of the basin's double liner system with an HDPE flange system. The riser will be attached to the pump stations beneath the basin with dual-containment, solid-wall HDPE pipes. At the bottom of the inside of the basin a corrugated polyethylene (PE) sediment dewatering pipe will also be attached to the riser that is connected to the pump station. The perforated corrugated PE pipe within an envelope of bottom ash will be extended along the bottom centerline of the basin for dewatering of accumulated sediments during sediment cleanout operations.

## 2.2 Pumping Equipment

### 2.2.1 Subgrade Drainage System Manholes

The Reconstructed Desilting Basin is proposed to have two (2) subgrade concrete drainage manholes identified as GW-1 and GW-2 located at the downstream end of the subgrade drainage system. The manholes GW-1 and GW-2 will each contain an automatic submersible pump that will pump any accumulated ground water into the desilting basin. Leachate detection manhole LD-1 will have a pipe and valve so it can be drained to manhole GW-1 and be pumped as well.

### 2.2.2 Existing Pump Stations

There are two existing lift stations that can pump water out of the desilting basin. There is an FGDS lift station (also referred to as the existing desilting basin lift station) and the Cooling Tower Blowdown Treatment System lift station. The FGDS lift station can pump water to the flue gas desulfurization system as make up water due to evaporation or water that is blown down from the system for treatment. The FGDS lift station consists of two 77 horsepower, 2000 gallon per minute FLYGT pumps. A recirculation line to prevent pump overheating will direct water back to the desilting basin to prevent damage to the pumps.

The Cooling Tower Blowdown Treatment System (CTBTS) is designed to transfer waters from the desilting basin to the treatment system. The piping to connect the lift station to the treatment system is installed, but is "blanked off," so that no water can be pumped from the desilting basin to the treatment system. If an NPDES Permit amendment under review is granted to allow GenOn to treat water from the desilting basin and discharge the treated effluent through the existing Outfall 003, the "blanks" can be removed, and pumping can occur.

A pair of 30 horsepower, 600 gallon per minute FLYGT submersible centrifugal pumps are installed to transfer water from the lift station to the flocculation tank located within the CTBTS wastewater treatment facility at a maximum rate of approximately 1,000 gallons per minute. A recirculation line from the lift station back to the cooling towers is installed so water can be diverted around the treatment facility during maintenance activities, if the lift station is placed into service.

#### 2.2.3 Pumps for Contingency Procedures

As discussed in Section 2.1, if the inlets to the Reconstructed Desilting Basin are ever closed for maintenance, basin repair, or emergency conditions, stormwater stored in the inlet pipes can be accessed and pumped through the top of the shutoff valve box with a temporary submersible pump to other plant facilities. The station has multiple types of portable pumps, which could be used for this purpose.

### 2.3 Monitoring of Facility

The desilting basin will be monitored several different ways. The basin has a LDZ to monitor for liner leakage. Any leakage through the liner will be collected by the GDN that comprises the LDZ, and conveyed to LDZ manhole LD-1, where it can be collected and sampled (per 289.435 referenced from 299.144(11)(iv)).

The groundwater around the basin will continue to be sampled on a quarterly basis. Currently, monitoring well MW-17 (upgradient) and MW-18 (downgradient) are positioned around the existing basin. An additional monitoring well (identified as MW-27 (downgradient) will be installed, as described in Form V Appendix V-K.

The 004 Outfall from the Desilting Basin will continue to be monitored according to the existing NPDES permit for the Station. The monitoring will continue through the existing Parshall Flume and sampling or any future sampling, and monitoring equipment.

### 2.4 Sediment Removal

The current DEP Regulations require sediment removal at least once every 12 months, unless the DEP approves in writing a longer period of time (299.113(2)). Since the existing desilting basin has no dewatering pipe, the history of sediment removal could not be used for design as materials have historically been removed in a high moisture state. Therefore design for sediment removal is based on the water quality from the main source of flow to the basin. As such, this permitting application requests variance regarding the annual frequency of sediment removal based on the provided sediment storage dewatering capacity of the reconstructed desilting basin. The main flow of water to the desilting basin flows through the

"A" pond for the waste filter beds (ash ponds) to the Ash Pond Water Recycle Sump. The "A" pond is approved to be cleaned once per 5 years and this has historically been adequate for the pond operation. Therefore the desilting basin is also requested to be cleaned every five (5) years. A design capacity of approximately 495 cubic yards has been provided for sediment. The sediment will continue to be hauled to the on-site disposal facility. The actual sediment removal frequency will be based on sediment accumulation inside the reconstructed desilting basin at no greater than a five-year frequency. Dewatered sediments will be removed with a front-end loader, tracked skid loader, or backhoe in combination with highway trucks. If the perforated, corrugated PE sediment dewatering pipe begins to drain poorly, it will be removed during basin cleaning and replaced as necessary.

# 3.0 OPERATIONAL FLEXIBILITY AND RELIABILITY

## 3.1 Alarms and Sensing Devices

As specified on the Drawings, each subgrade manhole will be constructed with an automated alarm in the event of a power outage. Each structure may be equipped with a combination of float controls and/or pump controls to control pumping. Station personnel will be required to inspect the reservoir depth inside each structure and may be required to manually place submersible pumps with a backup power source inside in order to eliminate the potential for uncontrolled discharge. Any type of uncontrolled discharge is not anticipated for the subgrade and leachate detection manholes. If water is found flowing in the leachate detection manhole, station personnel will immediately notify the PaDEP in writing. The volume of water will be estimated on a weekly basis and sampled on a quarterly basis (per 289.435 by reference from 299.144(11)(iv). During periods of power loss, the pump station will discharge to the desilting basin and flow to Outfall 004 so long that water quality requirements are met.

## 3.2 Contingency Plan During Wastewater Facility Closure

The procedures to follow in the event that the FGD system and CTBTS can no longer accept discharges from the desilting basin are outlined herein. The basin is operated to meet the discharge requirements of Outfall 004 and will discharge through Outfall 004 when the facilities to pump water out of the desilting basin are off line. If the desilting basin cannot temporarily receive stormwater or process water, then the inlet pipes can be blocked and pumped to other plant facilities as described in Section 2.1 herein.

## 3.3 Personnel Training

Personnel training for operators of the desilting basin and subgrade manholes will include training in specific procedures and features of the system, as well as training in the emergency response procedures developed for all station personnel under that station's Preparedness, Prevention, and Contingency (PPC) Plan. Operator training will occur prior to system operation and new personnel will be trained prior to receiving operating responsibility. Outside contractor training personnel will be used as required.

Information is continually developed and periodically distributed to emergency coordinators, supervisors, and others as appropriate. Such information includes company directories, procedures, regulations, inventories, and background material. In addition, training seminars are scheduled periodically for supervisory personnel.

The objectives of the training program are to enable employees to understand the materials with which they are working, the practices for preventing spills, and the procedures for responding properly and rapidly to any spills or alarms which occur.

### 3.4 Operation and Maintenance Instructions

Operating manuals will be available on-site at all times, and will be used extensively in the personnel training program, as well as for a continuing reference source. The operating manual will include a schedule for routine maintenance. Detailed maintenance instructions will be obtained from all equipment vendors and maintained at the site.

### 3.5 Site Security

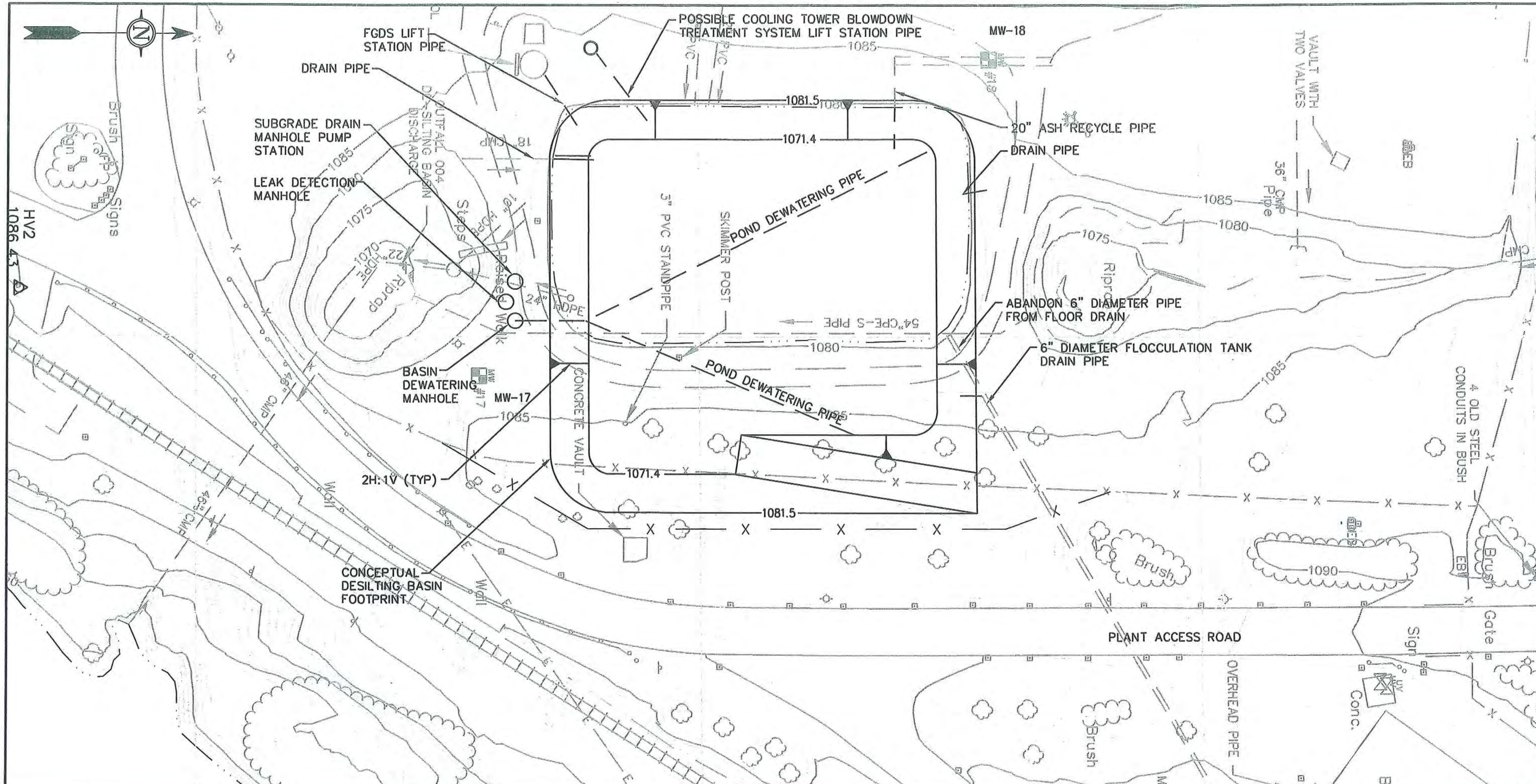
The site is wholly within the station grounds, and security measures are addressed in the station's PPC Plan. General site security includes a chain-link fence and locked gate. Entrance to the site by visitors is controlled by the guard at the main gate. All visitors must have a valid business purpose to gain access or be pre-authorized for a visit. Entrance of employees is controlled by the use of proper identification. Proper identification is also required of all visitors, and visitors are not permitted unrestricted movement through the plant.

## 4.0 SOIL EROSION AND SEDIMENT CONTROL PLAN AND STORMWATER DISCHARGES

Reconstruction of the existing desilting basin with a synthetically lined, replacement basin which will essentially be located in the same location will require specific erosion and sediment (E&S) measures. The anticipated E&S measures and an abbreviated sequence for pre- construction and post-construction are provided below. The finalized Erosion and Sedimentation Control Plan will be coordinated with the Indiana County Conservation District during the Chapter 102 permit process and prior to construction.

### 4.1 Erosion and Sediment Control Sequence

- Pre-construction activities:
  - Follow the Temporary Water Control Guidelines, as defined in Attachment 4, prior to earth disturbance.
  - Install rock construction entrances (if needed).
  - Install silt fence (or similar sediment containment product) around contractor staging area.
  - Install silt fence (or similar sediment containment product) along north, south and east sides of the work area.
  - Pump accumulated excavation water to pump water filter bags, as needed.
- Reconstruct desilting basin.
- Post-construction activities:
  - Permanently stabilize outer embankments, and other disturbed areas.
  - Restore/finalize the contractor staging area as desired.
  - Remove the silt fence (or similar sediment containment product, as applicable) from around the former contractor staging area.
  - Remove the rock construction entrances.
  - Restore diverted flows back into the basin.




PLAN VIEW SCALE 1"=50'

50 0 50 100

NOTE:
1. NEW DOWNGRADIENT GROUNDWATER MONITORING WELL TO BE ADDED.

REFERENCE: EXISTING TOPOGRAPHY AND FEATURES BASED ON AERIAL MAPPING PROVIDED BY GENON ENERGY, INC. - CONEMAUGH STATION BASE MAPPING. (DRAWING NO. E-744-3093-0, SHEETS 1 THROUGH 16)-DATE OF AERIAL PHOTOGRAPHY 3-17-10.

GAI CAD FILE: P:\PIT\2009\C091251\CAD DEPARTMENT\PRODUCTION DRAWINGS\PHASE 2\C091251-00-000-00-E-B002.DWG

PLOTTER FILE: ENVIRONMENTAL.CTB

**FIGURE 4**

| | | | | |
|---|---|---|---|---|
| gai consultants<br>Pittsburgh Office<br>385 East Waterfront Drive<br>Homestead, PA 15120-5005<br>412-476-2000 | CONEMAUGH COOLING TOWER DESILTING BASIN<br>CONCEPTUAL PLAN | DWN. JCN | CHKD. LGL | SCALE: |
| | | APPD. | DATE | AS NOTED |
| | GENON ENERGY NORTHEAST MANAGEMENT COMPANY<br>CANONSBURG, PENNSYLVANIA | DRAWING NUMBER<br>C091251-00-000-00-E-B002 | | REV 1 |

PLOTTER FILE: ENVIRONMENTAL.CTB

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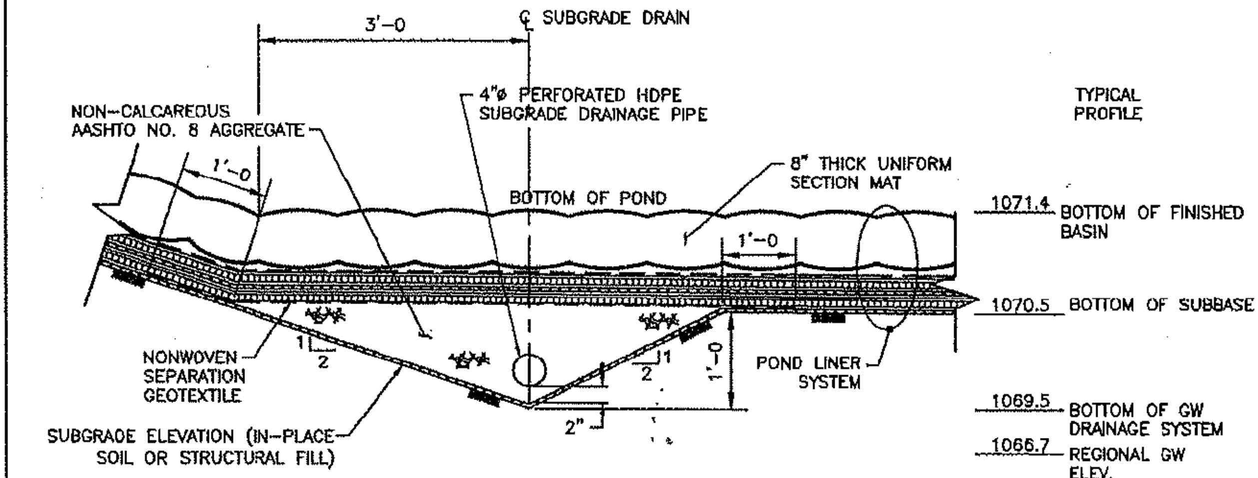
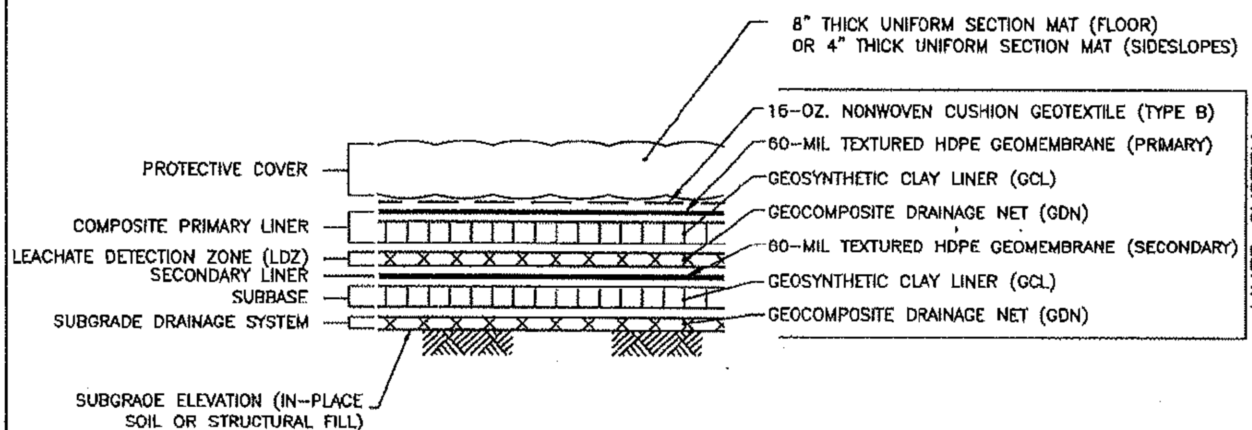



TYPICAL PERIMETER SUBGRADE DRAINAGE PIPE

SCALE: NTS

NOTE: PROFILE ELEVATIONS REPORTED AT DOWN GRADIENT END (SOUTH SIDE) OF BASIN



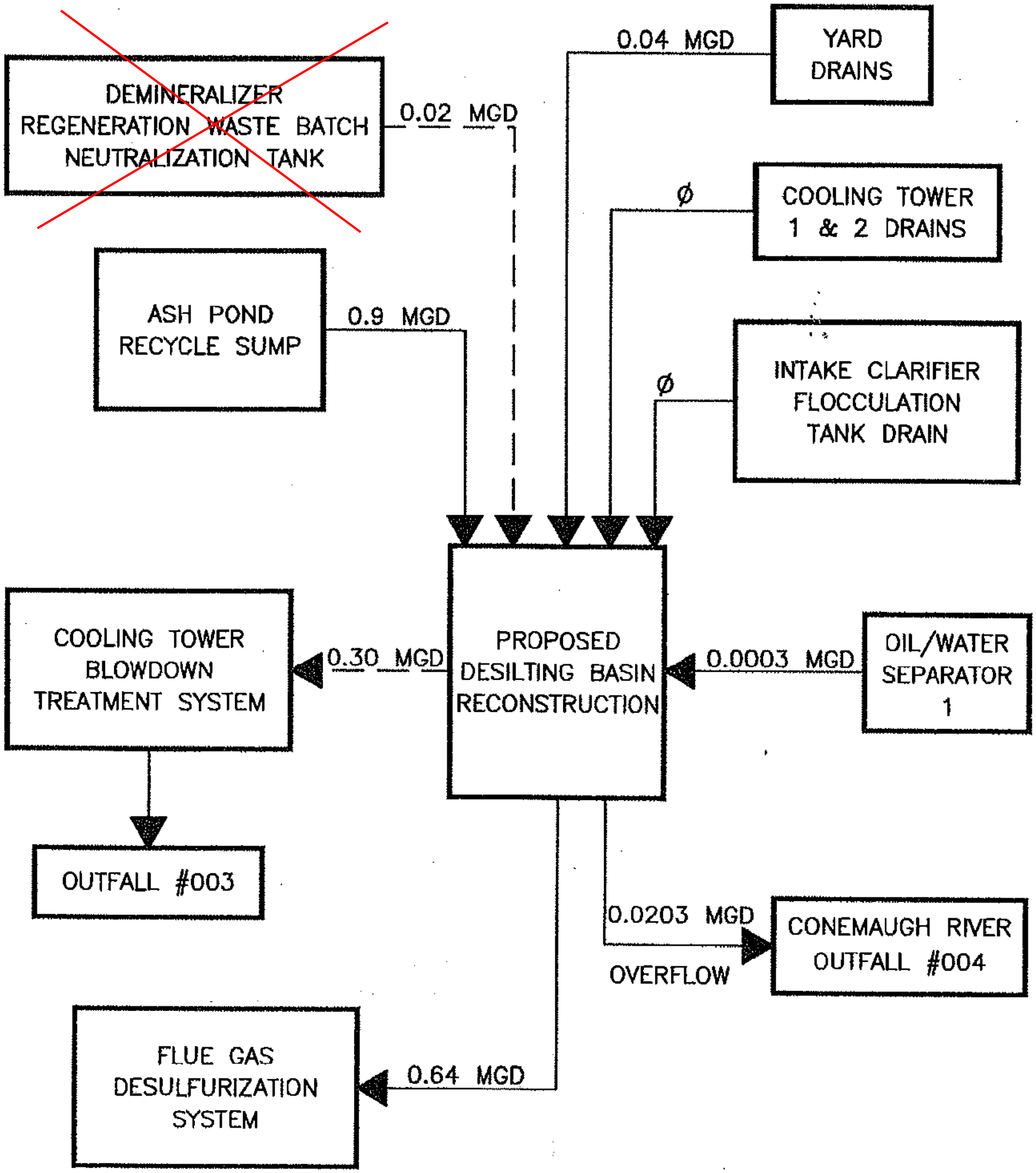

TYPICAL POND LINER SYSTEM

N.T.S.

gai consultants

FIGURE 5

| | | | |
|---|---|---|---|
| DESILTING BASIN PROPOSED LINER SYSTEM<br>CONEMAUGH POWER STATION<br>NEW FLORENCE, PENNSYLVANIA | DWN. JCN | CHKD. LGL | SCALE: |
| | APPD. | DATE | AS NOTED |
| GENON ENERGY, INC.<br>CANONSBURG, PENNSYLVANIA | DRAWING NUMBER<br>C091251-00-000-00-E-A003 | | REV 0 |




LEGEND:

EXISTING

~~SUBMITTED IN PERMIT AMENDMENT~~

REFERENCES:

AVERAGE MONTHLY FLOWS FROM WATER BALANCE DIAGRAM, RRI ENERGY DRAWING: 1942-SK-M-113-SH2 REV.11

gai consultants

C091251-00-000-00-E-A001

PROCESS FLOW DIAGRAM
CONEMAUGH POWER STATION
PROPOSED DESILTING BASIN
RECONSTRUCTION

GAI CAD FILE: P:\PIT\2009\C091251\CAD Department\Production Drawings\Phase 1\C091251-00-000-00-E-A001.dwg

DRAWN: JCN CHECKED: LGL APPROVED: - DATE: 02-11-2011 TASK NO. 00

CAD FILE NAME: C091251-00-000-00-E-A001 PLOTTER FILE: ENV COLOR PROJ. NO./DASH NO. C091251.01 DRAWING NO. A-001