TETRA TECH

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Mr. Paul Kulpa, Project Manager
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Subject: Response to Comments,
90% Design Report, Replacement Stone Revetment, Site 09
Naval Station Newport, Newport RI

Dear Mr. Lim and Mr. Kulpa:

On behalf of Ms. Winoma Johnson, I am providing to you the responses to your comments to the 90% Design Report for the Replacement Stone Revetment at the Old Fire Fighting Training Area (OFFTA) (Site 09) at Naval Station Newport, in Newport Rhode Island. Your comments were dated August 1, 2008 and August 13, 2008, respectively.

Based on these responses the 100% design will be developed and submitted.

If you have any questions, please do not hesitate to contact me at 978-474-8434.

Very truly yours,

Stephen S. Parker, LSP
Project Manager

Enclosures

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RESPONSES TO COMMENTS FROM USEPA
STONE REVETMENT REPLACEMENT DESIGN (90% SUBMISSION)
OLD FIRE-FIGHTING TRAINING AREA NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND
Comments Dated August 1 2008

General Comments

1. ***Comment:*** *Clearly it makes sense not to design the revetment to prevent overtopping during a 100-year storm or even to prevent revetment damage during a 100-year storm. However, it appears that lesser storms would also create overtopping conditions that could potentially damage the revetment. While it should not be the intent to prevent overtopping even during these lesser storms, the effects of overtopping should be evaluated to determine how susceptible the proposed design will be to damage from overtopping during these more frequent lesser storms. It may be in the Navy's best interest to use somewhat heavier armor to prevent more frequent periodic revetment repair resulting from these lesser storms.*

   Response: The 100-year storm event includes both a storm surge and wind generated waves. The 100-year flood elevation based on the FEMA flood mapping will overtop the OFFTA site. The revetment has not been designed to prevent overtopping of the site; however, the revetment has been designed to withstand wind generated waves by a 100-year storm event without the maximum storm surge. This is a more severe design condition with respect to the size of the revetment stone because as the OFFTA site is flooded by the 100-yr storm, the waves will not be breaking on the revetment and the stone size would not need to be as large. The effects of overtopping of the revetment has been considered in the design and the back side of the revetment has been thickened to prevent undermining of the revetment from the landside as water which overtopped the revetment structure returns to the bay.

2. ***Comment:*** *Because the details of many of the construction activities of interest to EPA will only be addressed in the construction contractor's submittals and are not detailed in the project design documents, EPA requests copies of the following contractor's preconstruction plans in a timeframe that will allow EPA to review and comment on the plans and for comments to be resoled with the Navy prior to the initiation of any construction for this project:*

   - *Work Plan*
   - *Sampling and Analysis Plan for Excavated Materials*
   - *Solid Waste Management Plan*
   - *Environmental Management Plan*
   - *Stormwater Pollution Prevention Plan*
   - *Dirt and Dust Control Plan*
   - *Excavation and Fill Activities Plan*

   EPA notes that the recent removal action at OFFTA was initiated before the contractor had even completed the work plan and EPA did not have an opportunity to review the work plan until well after the removal action began. EPA does not want that to happen

for this work. If Navy cannot accommodate this request then please provide the details for these plans in the 100% design document.

Response: The Navy concurs with this comment. Through contractual agreement the Navy will require the contractor to submit the identified documents for regulatory review.

3. ***Comment:*** *Interrelationship Between Removal Action and Feasibility Study – EPA notes that the Feasibility Study for OFFTA continues on a parallel track with the design and replacement of the revetment wall. Given that sediments are a medium of interest in the feasibility study, EPA requests a figure with an overlay of current footprint of the 90% design for the stone revetment wall with past sediment samples to determine any impacts and/or reduction in potential contaminated sediment areas.*

Response: The Navy concurs with this comment. The past sediment sample locations have been added to the final grading plans and will be added to the design report as figures. The sediment sample locations were obtained from Figure 2-4 from the Draft Feasibility Study. The stations that exceed the unrestricted use recreational PRGs are shown highlighted. In addition a line has been added that shows the toe of the revetment stone (it should be noted that the toe of the revetment stone is buried with either restored beach or rocky shore material. The modified figures (Figures 3 and 4) have been appended to these responses to comments.

Specific Comments

1. ***Comment:*** *Page 4-6 §4.2.1 – Please correct the table at the end of this section to reflect the correct stone sizes as presented in the Construction Specifications. The nominal diameters should be 1.75 feet for the 4.33 foot wave and 1.0 foot for the 2.1 foot wave. (Note also that the nominal diameters were rounded up [e.g. 1.68 became 1.75] but in doing so the associated weights were not revised to correspond with the rounded diameters.) Also for consistency, make the weight in this table a range that is consistent with the Construction Specifications (after correcting the weights in the Construction Specifications for the rounded diameters)*

Response: The table referenced on page 4-6 presents the stone sizes and average weight required by design calculations and is consistent with the numbers presented in the calculation presented in Appendix D. The minimum sizes that were required by the calculations were then rounded up for the specifications. The calculations for sizing the revetment stone is based on weight and then converted to a diameter. Since the calculation is based on weight, the weight was not changed in developing the specifications. The information in the Table on page 4-6 will be clarified.

2. ***Comment:*** *Page 4-6, §4.2.2, 2nd Para – Determining additional excavation via visual inspection is not sufficient. EPA recommends making allowances for sampling and analysis with analytical parameters being consistent with contaminants of concern as identified in the RI/FS; and specifying a decision rule for additional excavation to which all parties including regulatory agencies can agree.*

Response: A sampling methodology will be added to the text of the design including a decision rule for additional excavation. The actual sampling plan, however will be developed and submitted as part of the contractors work plan.

3. ***Comment:*** *Page 4-11, §4.2.6 – Please clarify if the rocky shore areas negatively impact the ability of the port-a-dam to hold back the water.*

Response: Due to the long flap that extends into the water (23 feet from the base of the portable dam structure to the end of the geomembrane flap) the portable dam should have a sufficient amount of flat bottom to prevent water from flowing behind the portable dam. However, the contractor performing the construction will have to verify that their selected dewatering system is compatible with the surface conditions.

4. ***Comment:*** *Page 5-4, §5.6 – Please correct the reference in the second sentence of the second paragraph to refer to Section 5.4 (Erosion and Sediment Control Requirements).*

   Response: The reference will be corrected.

5. ***Comment:*** *Page 5-5, §5.7 – Please add a fifth bullet that requires that soil/material stockpile covers be checked during each inspection.*

   Response: The Navy agrees with the comment. A fifth bullet will be added this section.

6. ***Comment:*** *Table 3-5 – This table lists total petroleum hydrocarbon (TPH) concentrations in samples collected for the 2008 geotechnical investigation; however, because this investigation only analyzed samples for diesel range organics (DRO), TPH was not characterized. Please change the analyte listed from TPH to DRO because without an analysis for gasoline range organics (GRO) the analytical result cannot be identified as TPH. As had been agreed to previously, any further analyses for TPH at this site must include both DRO and GRO in order to characterize the result as TPH.*

   Response: It is agreed that DRO would more accurately describe the analysis completed. The analyte listed will be changed from TPH to DRO. However, past analysis has found that GRO makes up a minimal fraction (at most locations, less than 5% of the petroleum measured is GRO). Any further analyses for TPH at this site will included both the DRO and GRO fractions.

7. ***Comment:*** *Appendix B –*

   a. *In order to avoid any misunderstanding as to the intent for how the ends of the revetment will be constructed, please provide cross-sections and details sufficient to describe how both ends of the revetment will be constructed. The Construction Drawings do not call out the location of the eelgrass beds (a hatched area is shown but not identified). Please edit the drawings to identify the eelgrass beds.*

   b. *§ B, Drawing C-8 – At the eastern end of the revetment in the area between the revetment and the concrete boat ramp appears to be very vulnerable to washout and may warrant more substantial flank protection than currently proposed. Please review.*

   c. *§ B, Drawing C-9 – Correction/clarification for Section B-B' on this sheet is required because it is not consistent with the Stone Revetment East design shown on Sheet C-8. On Sheet C-8 the toe is 4 feet thick in Section B-B' the toe is shown as 3 feet thick. If the intent is to have the toe 3 feet thick at the location of the concrete culvert, please edit the section to show the bankrun sand and gravel some specified distance around the culvert and show the revetment stone continuing beyond this specified distance. Also, the toe design in Section A-A' is significantly different from the design on Sheet C-8 so it is not clear how the designer intends to transition from the standard toe design to the toe design shown on Sheet C-9. Finally, as shown in Section A-A' the culvert connection as well as the concrete encasement both intersect the geotextile beneath the*

revetment stone. While this detail is not to scale, if this is not the intention, please clarify the intent and revise Section A-A' as appropriate. Also, the culvert connection detail on Sheet C-9 is not consistent with the details shown in Section B-B'. Please review and correct as appropriate.

Response:

a. The detail titled "Stone Revetment East" on Drawing C-8 has been modified to show the flank protection. The modified detail is provided with theses responses to comments as Figure 5. Due to the configuration of the western flank, additional protection is not required (i.e., the toe protection in this portion of the revetment will also serve as the flank protection). The eelgrass symbol is defined in the General Legend provided on Drawing T-2.

b. The flank protection is shown on the modified detail referenced in Response to Comment 7A. Additionally, the Navy is currently constructing a new bridge in this area and the revetment structure construction in this area may need to be adjusted to account for the installed bridge abutments. The effects of the bridge abutment on the revetment will be addressed in the 100% design. Design and construction at OFFTA will be coordinated with the work occurring one the bridge contract.

c. It is agreed that Section B-B' of the Culvert and Concrete Encasement Detail shown on Drawing C-9 does not accurately show the upper limit of stabilization stone. The revetment stone should be shown to an elevation 3 feet. The revised Section B-B' will be incorporated into the 100% design. In addition, Section A-A' of that detail will be revised to match the Stone Revetment East Detail on Drawing C-8.

The culvert and the culvert encasement structure will penetrate the geotextile on the back slope of the shoreline stabilization structure. This is a standard construction penetration and does not require its own detail. The geotextiles will need to be cut and overlapped in the field (field fit). As for the culvert connection shown on Drawing C-9, section B-B' is not intended to show the culvert connection. No adjustments are needed in the details for this issue.

8. ***Comment:*** *Appendix C –*

a. *Specification Section 31 23 00.00 20, §1.6 – TPH must be characterized for both GRO and DRO; therefore, use EPA Method 8015 Modified (purge and trap, GC/FID). BTEX must be characterized using EPA Method 8260 (GCMS); 8020 (GC/PID) is not reliable. Please change this section accordingly.*

b. *Specification Section 35 31 19, §1.1 – This section states that a certificate attesting that the stone meets the specifications is required from the contractor. Is it the Navy's intent that gradation tests be run on the stone to verify that it meets the specifications? What quality control does the Navy intend to implement to verify that the stone satisfies the specifications?*

c. *Specification Section 35 31 19, §3.3.2.1 – This section discusses the placement of revetment stone. This specification allows stone to be dropped from a height of no more than one foot. The specification further discusses the use of dump trucks to place the stone. It does not appear that placing the stone with a dump truck would satisfy the restriction for a maximum drop of one foot and further it is not clear that the dump trucks would be able to access the placement locations closely enough to satisfy the specifications. Finally, refer to EM 1110-2-1100, Table VI-4-17 which states that stone in the weight range required for the western revetment must not be dropped at all but must be placed on the geotextile.*

Response:

a. The analytical methods referenced in the comment will be changed in the specification section.

b. The contractor can get the certification from the quarry that supplies the needed stone. This certification letter is required to be included with the contractor's construction reporting documents. Additional QA/QC on the rock used by for the stabilization structure comes from construction oversight.

c. Due to the size of rock required for both ends of the shoreline stabilization structure, the rock needs to be placed rather than dumped. A slightly less restrictive approach can be used on the eastern side because of the smaller rock size. The 100% design will indicate that revetment stone will be placed. It is agreed that dumping and dropping of revetment stone will not be permitted.

9. ***Comment:*** *Appendix D –*

a. *Calculations – Project Datums – The Calculations note on page 1 that the Naval Station Mean Low Water Datum has been revised based on input from the Naval Station. This change has been included in all the construction drawings but is not reflected in the DiOrio Drawing in Appendix A, Attachment A.4 which was prepared to document the field work completed in December 2007.*

b. *Design Wave Calculation for OFFTA – At the bottom of page 3 of 8, the Naval Station datum corrections have not been made for the mean low and high water elevations. Also, please check the elevations listed or the top of slope, which may also need to be corrected based on the revised Naval Station local datum.*

c. *Shoreline Stabilization Calculation – This section still indicates that a 3H:1V slope will be employed for the revetment construction; however, the drawings appear to indicate that the 3H;1V slope will no longer be used. Please review and correct as appropriate. On page 2 of 17, please correct the metric height of the waves – values should be 1.32 meters and 0.64 meters, respectively for the 4.33 foot and 2.1 foot waves.*

d. *Revetment Stone Gradation – On the bottom of page 3 of 6, please correct the typo for East Side minimum to read East Side $D_{15\,min}$.*

e. *Volume Calculations – Shoreline Stabilization Project – At the bottom of page 1 of 3, please correct the drawing numbers cited: the Interim Grades are actually presented on Drawings C-3 and C-4 and the Final Grades are presented on Drawings C-5 and C-6.*

On page 2 of 3 please correct the references to rocky shore material used in the calculation of the bankrun sand and gravel volume required.

Please also note that although the volume of excavated material available for backfill (see section 4.2.2 on page 4-7) is 90 CY, the available volume of rocky shore material has not been identified and may not be sufficient to satisfy the 650 CY requirement calculated here.

f. *Veneer Stability of Riprap Revetment, OFFTA – In the discussion of "Approach", it should be noted that if the gravel gets scoured and the toe collapses into the hole the buttress effect would be lost and this conservative factor would no longer exist.*

On page 3 of 8, there are two solutions to this quadratic equation, so how was it determined that the safety factor was 1.46 and not 0.29?

g. *<u>Global Slope Stability, OFFTA Revetment</u> – The analysis has not included loads from construction equipment burdened by the armor stone loads. The haul road is within approximately 10 feet of the top of slope which may be close enough to be problematic. Please address the potential impact from construction equipment live loads.*

This analysis has not included the pressure differential loads on the revetment from the waves which can be substantial and contribute to slip circle failure. Please review the global slope stability calculations in consideration of the wave loads.

<u>Response:</u>

a. The Comment is correct the elevations on the referenced figure prepared by the coastal zone delineation subcontractor were not updated. However, since this document was prepared by a third party and is only providing support information, the document will not be revised.

b. The elevation references will be checked against the Navy Datum provided and modified accordingly.

c. The shoreline stabilization calculation includes rock sizing for both a 3H:1V and 2H;1V slopes. This was originally completed during the preliminary phases of design because at that time, it had not yet been decided which slopes would finally be used. Leaving the 3H:1V information in the report does not detract from the calculation and could possibly be useful during construction if conditions were to change.

The heights of the design waves given in metric units will be corrected. All calculations were completed using English units; therefore, this typo did not affect any other portions of the calculation.

d. It is agreed that a typo exists in this calculation and will be modified.

e. The Navy agrees that identified references in the volume calculation are not accurate and will be modified.

f. It is acknowledged that if the toe of the revetment is scoured out that some of the conservativeness of the analysis will no longer exist, this will be noted in the calculation.

With regard to the two solutions to the quadratic equation, the selection of the positive expression rather than the negative before the square root was based on the examples in the referenced text that the equations were taken from.

g. The construction live loads have been evaluated by simulating a 60,000 lb hydraulic excavator on top of the slope. This is largest piece of equipment that the construction contractor has indicated that he is planning on using. The evaluation indicates that the excavator should not operate closer than 5 feet from the edge of the excavation slope and should be placed on a crane mat to help distribute the load at the critical section on the eastern portion of the site. The supplemental stability analysis is attached to this response to comment document.

An additional supplemental stability analysis was conducted which evaluated the differential loads due to waves. This supplemental analysis is also attached to these responses to comments. The factor of safety for the "end of construction" case including

the effects of waves on the revetment was 2.3. A factor of safety of 1.5 is generally considered acceptable for end of construction conditions, therefore the configuration of the revetment is considered acceptable with respect to slip circle failures and wave loadings.

RESPONSES TO COMMENTS FROM RIDEM
STONE REVETMENT REPLACEMENT DESIGN (90% SUBMISSION)
OLD FIRE-FIGHTING TRAINING AREA NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND
Comments Dated August 13, 2008

General Comments

1. ***Comment:*** *Installation of the revetment will entail the removal of contaminated soils. This will necessitate the submission of a sampling and analysis plan, a soil management plan, a storm water management plan and a dust control plan. The 90 % Design implies that these documents will be submitted as part of the contractors preconstruction plans. Please be advised that these primary documents are subject to review and approval by the regulatory agencies. Therefore, please either submit these documents as part of the 90 % design for review and approval, or note in the 90 % Design they will be submitted as primary documents to the regulatory agencies for review and approval.*

   Response: The Navy agrees that contractor' work plan should include the preconstruction plans. The construction contractor will be scoped to provide these documents for regulator review and approval.

2. ***Comment:*** *The proposal calls for the installation of a stone revetment along an area of contaminated shoreline. Installation of the revetment in this area will not allow for subsequent remedial actions. Therefore, all soils above the Rhode Island Site Remediation Residential Direct Exposure Standards and contaminated sediments at and in the vicinity of the revetment must be removed prior to the installation of the revetment. In regards to the soils/sediments in the vicinity of the revetment the extent of the soils/sediments to be removed must be of sufficient width and depth, such that any subsequent removal action can occur without compromising the revetment and/or require the installation of sheet piling or other techniques to protect the revetment.*

   Response: Figures showing the sediment sample locations and the footprint of the revetment are attached to these responses to comments. As these figures show, few sediment sample locations that exceed the PRGs will be covered with the revetment. It is not the intent of the revetment to cover all the contaminated sediments. As discussed in the response to EPA Specific Comment Number 2, a sampling methodology will be added to the 100% design, however the actual sampling plan will be included in the contractors work plan It should be noted that physical constrains at the site may preclude digging deeper that what is required for the revetment due to water table elevations and the decreased stability of the excavation slopes the deeper the excavation progresses. The need for excavation, or any other remediation outside the footprint of the revetment is being discussed in the development of the feasibility study for this site. Additionally, it is our understanding that the RIDEM Residential Direct Exposure Criteria apply only to vadose zone soils, which would negate their applicability to soil under the revetment or to sediment.

   The comments within this response summary of the FS suggest removal of sediment as a media of concern from the FS. While the Navy would concur with this, the logic is that there is risk measured from the sediment, but the uncertainty of the source of the contaminants and the level of the risk posed by those contaminants suggests that the sediment PRGs should not be selected for a remedial action. Thus the PRGs for sediment and the sediments should not be considered "actionable". This is a topic of discussion that needs to be addressed in accordance with the FS.

3. ***Comment:*** *The work plan notes that a Portadam will be installed during the installation of the stone revetment. A review of the proposed limits of excavation identified in the 90% Design report and the extent of sediment contamination exceeding PRGs identified in the Feasibility Study reveals that extending the excavation at certain locations, beyond that outlined in the 90% Design Report, but still within the working limits of the Portadam system will allow for the removal of the contaminated sediments exceeding PRGs. Addressing the contaminated sediments now will avoid the need to perform a dredging action as identified in the Feasibility Study, and allow for the removal of contaminated sediments under dry conditions. This will greatly reduced both the time and cost of the removal action and allow for this portion of the site to be addressed. Please revise the work plan to include removal of these sediments.*

Response: There are constraints to protect resource areas and prevent damage to eelgrass beds. Excavation of sediment or soil outside the revetment footprint is a subject for the FS. Refer to Response to Comment 2.

4. ***Comment:*** *The proposed excavation to install the revetment will extend into the water table. Contaminated groundwater, including free product exist at the site. It is recommended that the Navy employ crushed stone in the backfill in the water table and the smear zone along with PVC stand pipes. This will allow for, if needed, removal of contaminated groundwater and/or injection of oxygen or oxidants to avoid contamination of the revetment and the newly installed clean beach sand.*

Response: This was discussed at the meeting held 11/14/07. It was determined at that time that passive recovery wells could not be installed within the revetment trench. It was suggested that the soil removal under way at that time at the site be completed with passive recovery wells as planned, and determine if NAPL collects within these wells.

As a part of the soil removal action, small quantities of NAPL were found in some excavations, and pumped in accordance with the work plan. It was found that NAPL did not re-accumulate or re-form on the standing water table in test excavations after pumping. Therefore, installation of recovery wells is not recommended. However, at any time in the future, if necessary, recovery wells can be installed along the landward edge of the revetment structure.

5. ***Comment:*** *Please be advised that at all locations the toe of the revetment cannot extend onto the existing beach, (i.e. there must be no loss of the beach environment, be advised that the beach extends beyond the high tide mark). Further, in areas where the toe stabilization will be placed beneath the beach the Navy must create and maintain a beach, which has a minimal thickness of two feet, which is also similar in nature to what is or was at the site. Please clearly state these requirements in the document (Due to the information presented in the figures and the nature of the legends it is not clear where these requirements are being met at all locations).*

Response: The design intent was to maintain a two foot thickness over the proposed revetment toe where ever the toe extends under the coastal beach as shown on Figure 3-2 of the 90% design and as documented in Appendix A.4. Note that coastal beaches as defined in CRMP Section 210.1 as including "expanses of unconsolidated, usually unvegetated sediment commonly subject to wave actions, but may include a vegetated beach berm. Beaches extend from the mean low water landward to an upland rise, usually the base of a dune, headland bluff, or costal protection structure, pilings or foundation." Figures 1 and 2 have been attached to this response to comments submission to identify the limits of existing coastal beach before and after construction of the stone revetment structure. As indicated in this figure the area of coastal beach has increased from 0.62 acres to 0.83 acres. These figures will be added to the design report.

6. ***Comment:*** *One function of the revetment is to eliminate the migration of contaminated soils into the adjacent sediments. Considering the cost of the revetment it is strongly recommended that the Navy considering removing the contaminated soils at the site and install a simple, less costly, revetment.*

Response: Comment noted.

7. ***Comment:*** ***Section 3.2, 2008 Geotechnical Investigation, Visual Survey Rocky Shore Page 3-4.***

The report notes that a visual survey was conducted of the rocky shore to ascertain the characteristics of the beach, (rock size, etc). A review of historical aerial photographs indicates that in the past this beach did not reflect the current composition. In addition, similarly located beaches elsewhere on the island and the base also do not reflect the aforementioned composition. The current beach conditions may be due to erosion of the mounds which were created when the fire fighter was dismantled and/or erosion of materials placed along the embankment. As the revetment will solve the erosion problem, the beach to be installed should reflect preerosion conditions, i.e. be similar in nature to other beaches located in the same environment. Please modify the document to state that the beach to be installed in this area will reflect preerosion conditions.

Response: The revetment design will replace the shoreline at OFFTA to match the current conditions. The current shoreline consists of a rocky shoreline on the western portion of the site and a coastal beach on the eastern site of the site. The coastal beach will be replaced (see response to RIDEM Comment 5). Given the higher wave energy expected on the western portion of the site, it is likely that sands and gravels placed in front of the revetment on this portion to establish a coastal beach would be subject frequent erosion, causing sedimentation problems elsewhere (burial of the eelgrass beds, or shellfish beds in the inner harbor). Therefore replacement of the existing rocky shore material is appropriate to maintaining the current conditions.

8. ***Comment:*** ***Section 4.2.1, Structural Protection Requirements, Page 4-6, General***

The stabilization for the toe trench of the revetment extends into the beach area. At McAllister Point Landfill a gravity wall was installed which did not extend into the beach area. A gravity wall at this location was found sufficient even though the revetment height and size was considerable larger then that at the OFFTA. Further, the McAllister Point site is exposed to a greater wave fetch, and storm conditions. Considering the location of eel grass at the western end of the site, at a minimum the Design should considered a gravity wall at this location (it is also recommended that a gravity wall be considered at the eastern end of the site). Finally, please be advised that the Navy will have to maintain the beach environment above the proposed toe stabilization structure.

Response: As stated in the response to this comment on the 30% design submittal, the gravity wall installed at McAllister was installed into the intertidal area on the west-facing side of the site. This is the same approach as is to be used at the OFFTA site.

9. ***Comment:*** ***Section 4.2.1, Structural Protection Requirements, Page 4-6, Table***

This table notes that a nominal diameter stone of 1.68 feet has a weight of 779 lbs. Based on the last paragraph of page 4-5 it is noted that a stone has a density of 165 lb/ft^3. Assuming a sphere which has a volume of $4/3\pi r^3$ the weight of the stone would equal 4/3(3.1415)(0.84ft^3)(165 lb/ft^3) = 409 lbs. This is significantly different than the 779 lbs stated. Please explain how this weight was obtained.

Response: The design of the shoreline revetment structure follows the accepted approach for sizing shoreline revetment structures established by the Army Corps of Engineers. The procedures published by the Army Corps of Engineers for the development of shoreline stabilization revetment structures recognizes that the rock used for shoreline stabilization structures are not spherical in nature, rather they are angular in nature. Therefore to account for this the average stone weights are based on nominal diameters (average stone width) rather than diameters of spheres. No changes will be made to the document as a result of this comment.

10. ***Comment:* Section 4.2.2, Excavation Requirements, Page 4-6**

Contaminated soil and sediment, which exceed regulatory requirements, is present within the footprint of the revetment. Accordingly, the 90 % Design must include a stipulation for the sampling and removing of any soils/ sediment, which exceed regulatory requirements. Please modify the document accordingly.

Response: Refer to Response to Specific USEPA Comment 2, and the response to RIDEM Comment No. 2 above.

11. ***Comment:* Section 4.2.2, Excavation Requirements, Page 4-6**

There are two-discharge pipes, which contain oil sludge on the beach and in the embankment where the revetment is to be installed. The design must stipulate that the entire length of these pipes, and any other similar pipes, and any associated contaminated soils/sediments in the vicinity of the pipe will be removed.

Response: These pipes have been removed during the 2007-2008 removal action. Any pipes encountered during the construction of the shoreline stabilization revetment will be removed, appropriately capped, or extended.

12. ***Comment:* Section 4.2.3, Shoreline Stabilization, Page 4-7, Paragraph 1**

To protect the geotextile the stone revetment provisions should be made to place the stones on this material rather than dropping the stones.

Response: Agreed, the placement of the revetement stones on the geotextile will be limited to placement rather than dropping. See response to specific EPA Comment 8c.

13. ***Comment:* Section 5.5, Permanent Stabilization, Page 5-4**

Whatever grass seed mixture is selected, one of the requirements should be that it could withstand a salt-water environment.

Response: The identified permanent seed mixture presented in Section 5 of the design will be reviewed for survivability in brackish water conditions. Changes will be included in the 100% design if needed.

14. ***Comment:* Section 5.6 Stormwater Management Consideration, Page 5-5**

The temporary storage structures will have an impermeable liner. Please state where the overflow will be pumped if the 110% capacity is exceeded.

Response: The size of the temporary storage structure was established to avoid the need to pump accumulated surface water runoff. However, if needed this water will be pumped through the sediment removal system and allowed to discharge to the bay.

15. ***Comment:* Section 5.7, Inspection and Maintenance of Erosion and sediment Controls, Third Bullet, Page 5-5**

This bullet notes that seeded areas will be checked and reseeded if necessary. In the event of soil erosion please state if new soil, in addition to reseeding will take place (i.e. soil erodes prior to grass growing).

Response: The section cited describes the responsibilities of the construction contractor. The area that falls under the contractors requirements to establish a permanent stand of the grass for stabilization is equal to the area of disturbance. Areas outside of the limits of disturbance are not the responsibility of the construction contractor. Concerns on erosion of the areas outside the project limits and for the long term should be addressed in the FS and the contractor's work plan.

16. ***Comment:* Section 5.6, Response Procedures for Spill Mitigation, Page 5-6**

Please note that if a spill occurs the regulators must also be notified.

Response: Regulator notification will be added to the construction contractor's work plan where appropriate.

17. ***Comment:* Figure C-7**

In this figure and others a dashed line is used to depict the existing grade and the final grade. This does not allow one to distinguish between the two and ascertain whether regulatory requirements are being met. Please employ an alternate line scheme.

Response: The line types on Drawing C-7 will be reviewed and clarified.

18. ***Comment:* Figure**

Please produce an overhead figure clearly delineating the current toe of the existing revetment/end of embankment and the proposed toe/end of embankment. Also, this overhead figure should clearly delineate the portions of the toe stabilization, which is to be placed under the beach. Without this information it is not possible to confirm that the revetment as designed will not extend beyond the existing foot print of the site.

Response: The landward extent of the buried toe of the revetment has been added to the final grade drawings which are attached as Figures 3 and 4 to these responses to comments. In addition, the sediment sample locations have been added to Figures 3 and 4. These figures will be added to the 100% design document.

CLIENT: NAVAL STATION NEWPORT		JOB NUMBER: 00632	
SUBJECT: Supplemental Global Slope Stability with construction loads, OFFTA Revetment			
BASED ON: As noted below		DRAWING NUMBER:	
BY: DCW Date: 09/26/08	CHECKED BY: RCM Date: 10/30/08	APPROVED BY:	DATE:

OBJECTIVE

The objective of this calculation is to determine the effect of construction loads on the slope stability of the revetment at OFFTA.

REFERENCES

1 Calculation titled "Global Slope Stability, OFFTA Revetment" prepared by RCM 5/30/08, Tetra Tech NUS.

2 Day, Robert, Foundation Engineering Handbook, McGraw-Hill, 2005.

APPROACH

This analysis will take the critical sections from the 'during construction' condition from Reference 1 and add a surcharge (i.e. boundary) load to account for a hydraulic long reach excavator located at the top of the slope during construction. Both the eastern and western critical cross-sections will be evaluated.

The construction contractor has indicated that a 60,000-lb long reach hydraulic excavator will be used. Standard dimensions of hydraulic excavators will be used to determine a ground pressure (boundary load) that will be placed at the top of the slope to simulate the excavator in the STABL model. The excavator is assumed to be eccentrically loaded with the center of gravity of the excavator being 1/3 of the distance from the front of the excavator. Given the existing low factor of safety for the 'during construction' condition without a construction loading it is assumed that the excavator will be placed on a crane mat to distribute the load thereby increasing the contact area and reducing the ground pressure.

The analysis will yield conservative results because the STABL program is only a two dimensional analysis so that any load placed at the top of the slope is in effect being simulated as a load perpendicular to the cross section along the entire top of the slope. In reality, the load of the excavator perpendicular to the slope is only equal to the width of the excavator or crane mat. Any real slope failure would occur in three dimensions and areas that are not loaded with the excavator (which would have a higher factor of safety) would also have to fail. By using this simplified analysis of the excavator loading a level of conservativeness is inherent in the analysis.

ANALYSES

The calculation of the excavator loadings are provided on sheets 8 to 18. The 'end of construction' condition critical cross-sections from reference 1 were modified by adding an eccentrically loaded excavator. It was assumed that the excavator would be placed on a crane mat. Preliminary stability analyses without the crane mat resulted in factors of safety less than 1.0 for the eastern portion of the site. The crane mat was conservatively assumed to be small with the size equal to the overall footprint of the excavator. In reality the crane mat would be larger to allow some movement of the excavator on the crane mat. A larger crane mat would distribute the load over a larger area and result in lower ground pressures which would result in a higher factor of safety. Since it is not known what size crane mat that will be used, a crane mat equal to the size of the excavator was used as a conservative assumption.

The load was initially set at the edge of the slope, however that resulted in an unacceptable factor of safety (less than 1.0), therefore the load was moved back from the edge of the slope until an acceptable factor of safety was achieved. For the eastern portion the factor of safety was 1.1 when the excavator is 5 feet from the edge of the slope (i.e., 5 feet back from the crest of slope) and placed on a crane mat that matches the footprint of the excavator. For the western portion this same set of conditions produced a factor of safety of 1.4.

CLIENT: NAVAL STATION NEWPORT		JOB NUMBER: 00632	
SUBJECT: Supplemental Global Slope Stability with construction loads, OFFTA Revetment			
BASED ON: As noted below		DRAWING NUMBER:	
BY: DCW Date: 09/26/08	CHECKED BY: Date: RCM 10/30/08	APPROVED BY:	DATE:

CONCLUSIONS

Based on these analyses, the critical factors of safety for the 'during construction' condition with the proposed surcharge (i.e. boundary) load applied to account for a 60k load hydraulic long reach excavator located 5-feet from the top of the slope for the eastern and western critical cross-sections are 1.1 and 1.4, respectively. The proposed hydraulic excavator should be located no closer than 5 feet from the top of the slope. The excavator should be placed on a crane mat sized and oriented to reduce the ground contact pressure.

CLIENT	Naval Station Newport	JOB NUMBER	00632
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY RCM 10/30/08	APPROVED BY	DATE

ESTIMATE EXCAVATOR LOADING

CONSTRUCTION CONTRACTOR INDICATED THEY WILL USE A 60,000 lb HYDRAULIC LONG REACH EXCAVATOR.

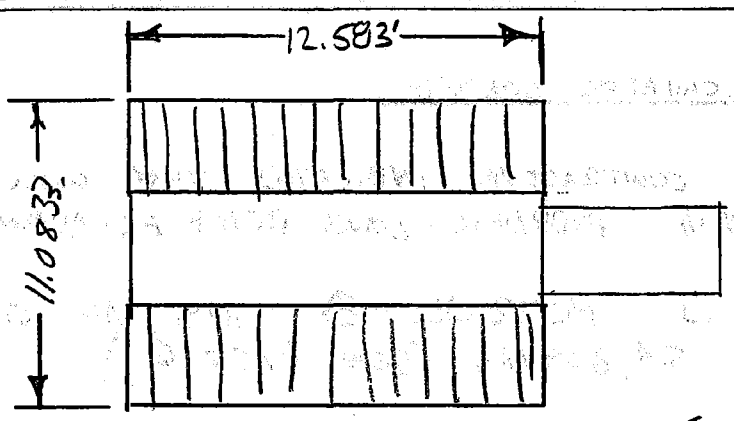
A KOMATSU PC220LC-8 HAS AN OPERATING WEIGHT OF 54,309 lbs (SEE PAGE 6.)

ASSUME IF FITTED OUT WITH LONG REACH STICK THE WEIGHT WOULD GO UP TO 60,000 lbs. USE THE DIMENSIONS OF THE KOMATSU AND 60,000 lbs TO SIMULATE THE LOADING IN THE STABILITY MODEL

THE TRACK LENGTH ON THE GROUND IS 12-7" or 12.583'
WIDTH OF CRAWLER IS 11'-1" or 11.083'

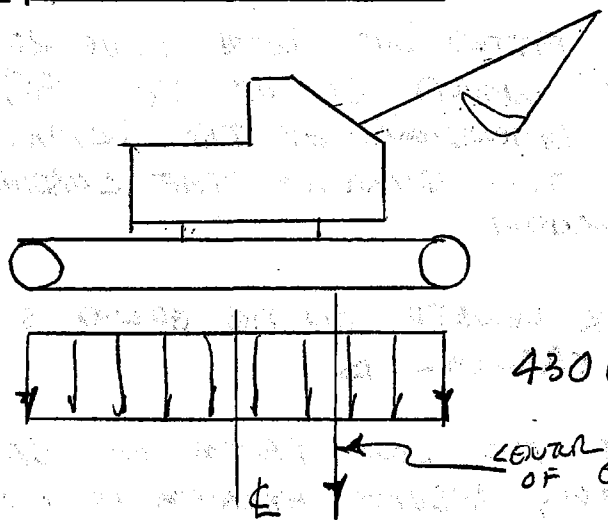
BECAUSE OF THE LOW FACTOR OF SAFETY WITHOUT (1.1 REF 1) THE EXCAVATOR, ASSUME EXCAVATOR IS ON A CRANE MAT EQUAL IN DIMENSIONS TO THE OVERALL FOOTPRINT OF THE EXCAVATOR.

CLIENT	Naval Station Newport	JOB NUMBER	00632
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY RCM 10/30/08	APPROVED BY	DATE



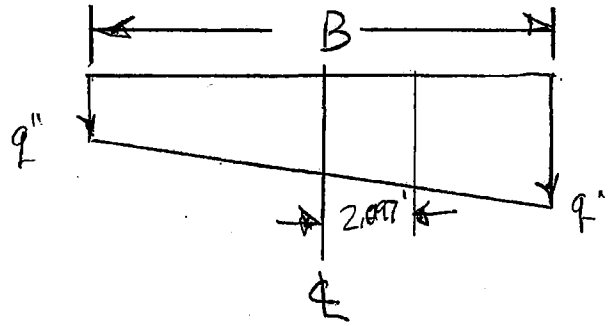
WEIGHT = 60,000 lbs
AREA = 12.583' x 11.0833'
= 139.464 ft²

CONTACT PRESSURE
$\frac{60{,}000 \text{ lb}}{139.461 \text{ ft}^2} = 430.2 \text{ PSF}$
(WITH CRANE MAT)



430 PSF IF WEIGHT IS IN CENTER

CALCULATE WEIGHT DISTRIBUTION IF EXCAVATOR CENTER OF GRAVITY IS 1/3 DISTANCE FROM THE FRONT EDGE OF EXCAVATOR



CLIENT	Naval Station Newport		JOB NUMBER	
SUBJECT				
BASED ON			DRAWING NUMBER	
BY DCW 9/26/08		CHECKED BY RCM 10/30/08	APPROVED BY	DATE

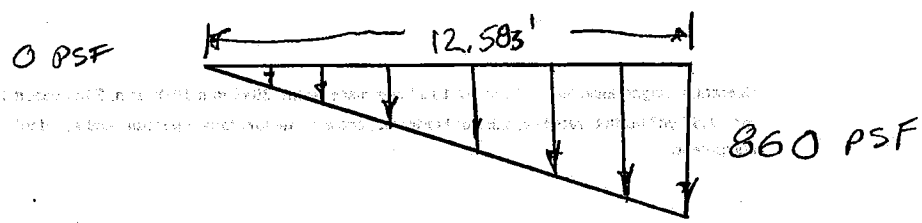
$$q' = \frac{Q(B+6e)}{B^2}$$

$$q'' = \frac{Q(B-6e)}{B^2}$$

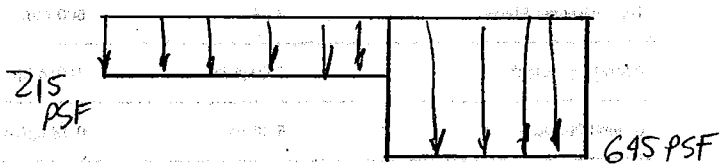
FROM REF 2 P. 614
$Q = 60{,}000$ lb
$q = 430$ PSF
$B = 12.583$ ft
$e = 2.097$ ft

$q' = 9{,}536$ lb/ft OVER A WIDTH OF 11.083 ft $= 860$ lb/ft^2
$q'' = 0$ lb/ft " " " " " $= 0$ lb/ft^2

THE LOADING IS THEN



BUT STABL CAN ONLY ACCEPT UNIFORM LOADS TO ASSUME TWO STEP LOADS THAT EQUAL THE TRIANGULAR LOAD



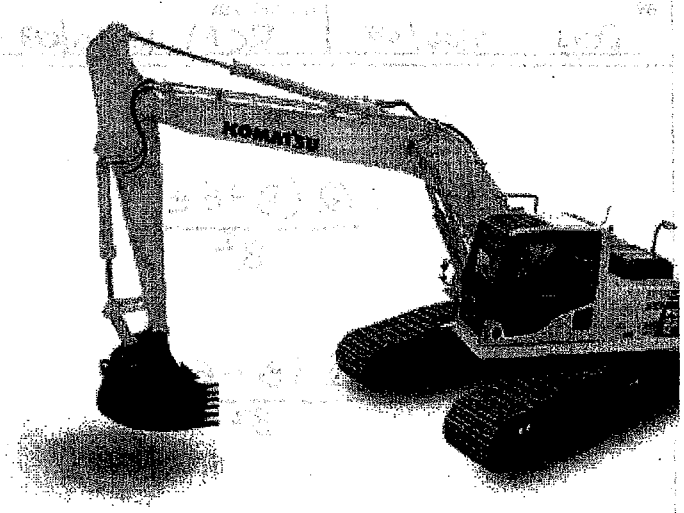
$$\frac{430+860}{2} = 645 \text{ PSF}$$

$$\frac{0+430}{2} = 215 \text{ PSF}$$

TRACK LENGTH IS 12'-7" BUT TO MAKE INPUT INTO THE MODEL SIMPLER ASSUME TRACK LENGTH IS 13 FT AND EACH STEP LOAD IS 6.5' IN LENGTH (THIS WILL ACTUALLY INCREASE THE TOTAL LOAD SLIGHTLY ABOVE 60,000 LBS SO IT IS CONSERVATIVE)

[redacted]

PC220LC-8



PC220LC-8

walkaround video

KOMTRAX standard

Print Brochure

Specifications | Features | Charts | Standard Equipment | Optional Equipment | Bid Specs

Engine

Hydraulics

Drives & Brakes

Swing System

Undercarriage

Coolant and Lubricant Capacity (refilling)

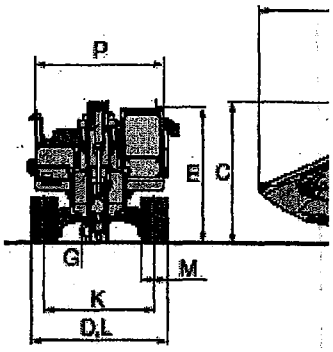
Operating Weight (approximate)

Operating weight, including 5850 mm / 19'2" one-piece boom, 3045 mm 10'0" arm, SAE heaped 1.2 m^3 / 1.57 yd^3 bucket, rated capacity of lubricants, coolant, full fuel tank, operator, and standard equipment.

Triple-Grouser Shoes	28"	700 mm
Operating Weight	54,309 lb	24634 kg
Ground Pressure	6.08 psi	0.43 kg/cm²
Triple-Grouser Shoes	31.5"	800 mm
Operating Weight:	54,926 lb	24914 kg
Ground Pressure	5.38 psi	0.38 kg/cm²

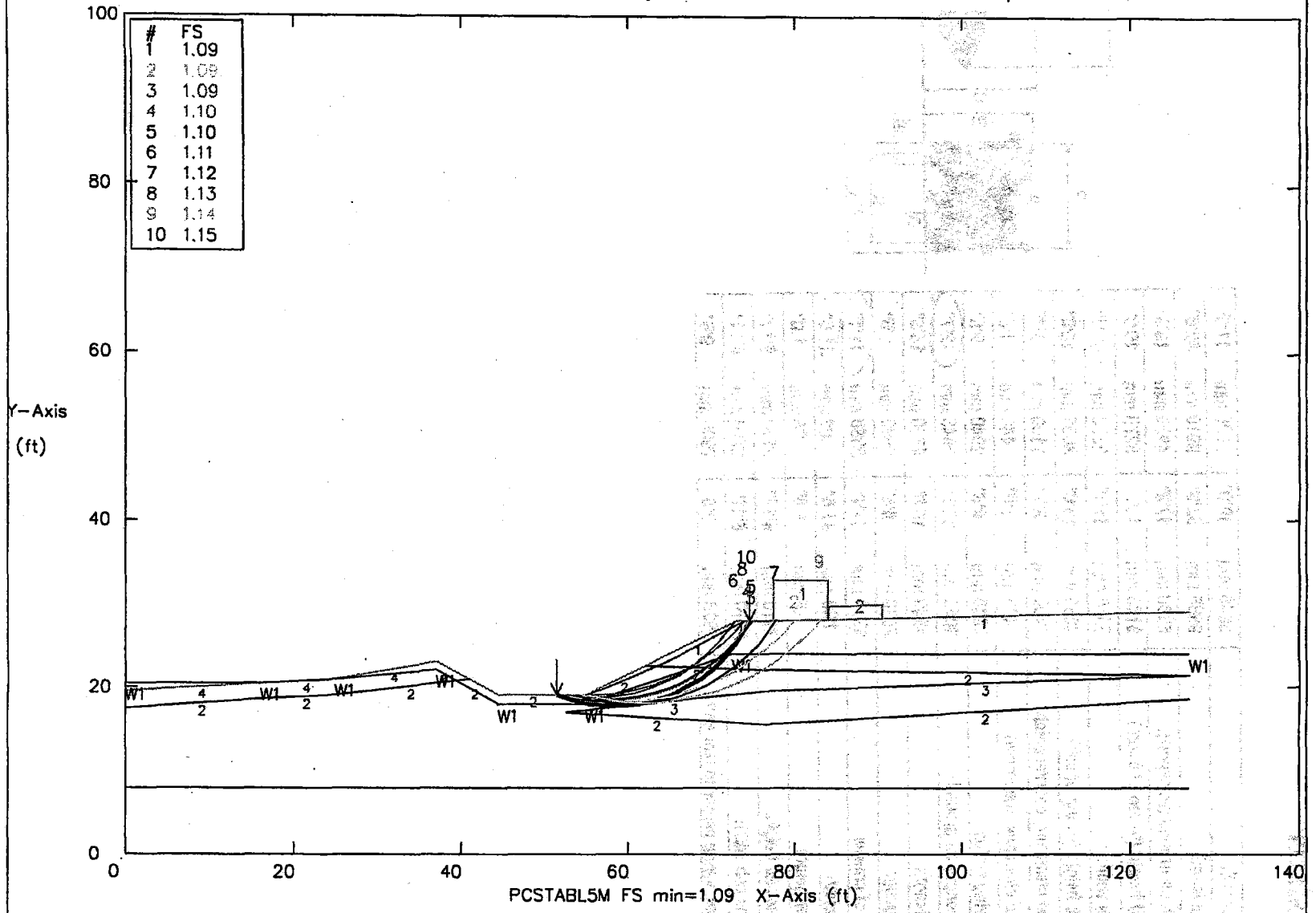
Dimensions

	Arm Length	3045 mm	10'0"	3505 mm	11'6"
A	Overall length	9885 mm	32'5"	9910 mm	32'6"
B	Length on ground (transport):	5990 mm	17'6"	4950 mm	16'3"
C	Overall height (to top of boom)	3185 mm	10'5"	3270 mm	10'9"
D	Overall width	3380 mm	11'1"	3380 mm	11'1"
E	Overall height (to top of cab)	3055 mm	10'0"	3055 mm	10'0"
F	Ground clearance, counterweight	1100 mm	3'7"	1100 mm	3'7"
G	Ground clearance (minimum)	440 mm	1'5"	440 mm	1'5"
H	Tail swing radius	2940 mm	9'8"	2940 mm	9'8"
I	Track length on ground	3845 mm	12'7"	3845 mm	12'7"
J	Track length	4640 mm	15'3"	4640 mm	15'3"
K	Track gauge	2580 mm	8'6"	2580 mm	8'6"
L	Width of crawler	3380 mm	11'1"	3380 mm	11'1"
M	Shoe width	800 mm	31.5"	800 mm	31.5"
N	Grouser height	25 mm	1.0"	25 mm	1.0"
O	Machine cab height	2110 mm	6'11"	2110 mm	6'11"
P	Machine cab width	2710 mm	8'11"	2710 mm	8'11"
Q	Distance, swing center to rear end	2905 mm	9'6"	2905 mm	9'6"



SECTION EAST OFFTA CONST COND EAST

Ten Most Critical. C:CELOAD6.PLT By: DCW 08-28-08 1:42pm



Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	1
2	110	116	0	27	0	0	1
3	50	68	446	24.9	0	0	1
4	120	130	0	33	0	0	1

C:\STABLE\CELOAD6.DXF 9/25/2008 2:30:19 PM

CELOAD6.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 08-28-08
Time of Run: 1:42pm
Run By: DCW
Input Data Filename: C:CELOAD6.IN
Output Filename: C:CELOAD6.OUT
Plotted Output Filename: C:CELOAD6.PLT

V'd by: RCM 10/30/08

PROBLEM DESCRIPTION SECTION EAST
OFFTA CONST COND EAST

BOUNDARY COORDINATES

10 Top Boundaries
19 Total Boundaries

(73.00, 28.00) is crest of slope

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	19.50	16.00	20.50	4
2	16.00	20.50	25.00	21.00	4
3	25.00	21.00	37.00	23.00	4
4	37.00	23.00	41.00	21.00	4
5	41.00	21.00	44.50	19.00	2
6	44.50	19.00	55.00	19.00	2
7	55.00	19.00	62.00	22.50	2
8	62.00	22.50	73.00	28.00	1
9	73.00	28.00	76.50	28.00	1
10	76.50	28.00	127.00	29.00	1
11	.00	17.50	16.00	18.50	2
12	16.00	18.50	25.00	19.00	2
13	25.00	19.00	41.00	21.00	2
14	62.00	22.50	76.50	22.00	2
15	76.50	22.00	127.00	21.50	2
16	52.50	17.00	76.50	19.50	3
17	76.50	19.50	127.00	21.50	3
18	52.50	17.00	76.50	15.50	2
19	76.50	15.50	127.00	18.50	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	130.0	.0	30.0	.00	.0	1
2	110.0	116.0	.0	27.0	.00	.0	1
3	50.0	68.0	446.0	24.9	.00	.0	1
4	120.0	130.0	.0	33.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	16.00	20.50
3	25.00	21.00
4	37.00	22.00
5	44.50	18.00
6	55.00	18.00
7	72.50	24.00
8	127.00	24.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	77.50	84.00	645.0	.0
2	84.10	90.50	215.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	127.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 44.50 ft.
and X = 55.00 ft.

Each Surface Terminates Between X = 72.50 ft.
and X = 92.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.50	19.00
2	53.40	18.37
3	55.35	17.95
4	57.34	17.75
5	59.34	17.76
6	61.33	18.00
7	63.28	18.45
8	65.17	19.10
9	66.97	19.97
10	68.67	21.02
11	70.25	22.25
12	71.68	23.65
13	72.95	25.19
14	74.04	26.87
15	74.62	28.00

Circle Center At X = 58.2 ; Y = 36.0 and Radius, 18.3

*** 1.086 ***

Individual data on the 21 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.9	65.8	.0	.0	.0	.0	.0	.0	.0
2	1.6	141.2	.0	.0	.0	.0	.0	.0	.0
3	.0	5.3	.0	.0	.0	.0	.0	.0	.0
4	.3	37.7	.0	1.6	.0	.0	.0	.0	.0
5	2.0	406.4	.0	72.5	.0	.0	.0	.0	.0
6	2.0	657.4	.0	164.5	.0	.0	.0	.0	.0
7	2.0	849.8	.0	230.5	.0	.0	.0	.0	.0
8	.7	322.2	.0	89.8	.0	.0	.0	.0	.0
9	1.3	657.5	.0	180.1	.0	.0	.0	.0	.0
10	1.9	1052.7	.0	282.3	.0	.0	.0	.0	.0
11	1.8	1055.3	.0	267.3	.0	.0	.0	.0	.0
12	.6	348.6	.0	84.8	.0	.0	.0	.0	.0
13	1.1	643.4	.0	140.4	.0	.0	.0	.0	.0
14	1.5	851.9	.0	153.3	.0	.0	.0	.0	.0
15	.0	23.1	.0	3.2	.0	.0	.0	.0	.0
16	1.4	699.8	.0	62.0	.0	.0	.0	.0	.0
17	.1	35.8	.0	.3	.0	.0	.0	.0	.0
18	1.2	457.7	.0	.0	.0	.0	.0	.0	.0
19	.0	16.5	.0	.0	.0	.0	.0	.0	.0
20	1.0	242.2	.0	.0	.0	.0	.0	.0	.0
21	.6	39.1	.0	.0	.0	.0	.0	.0	.0

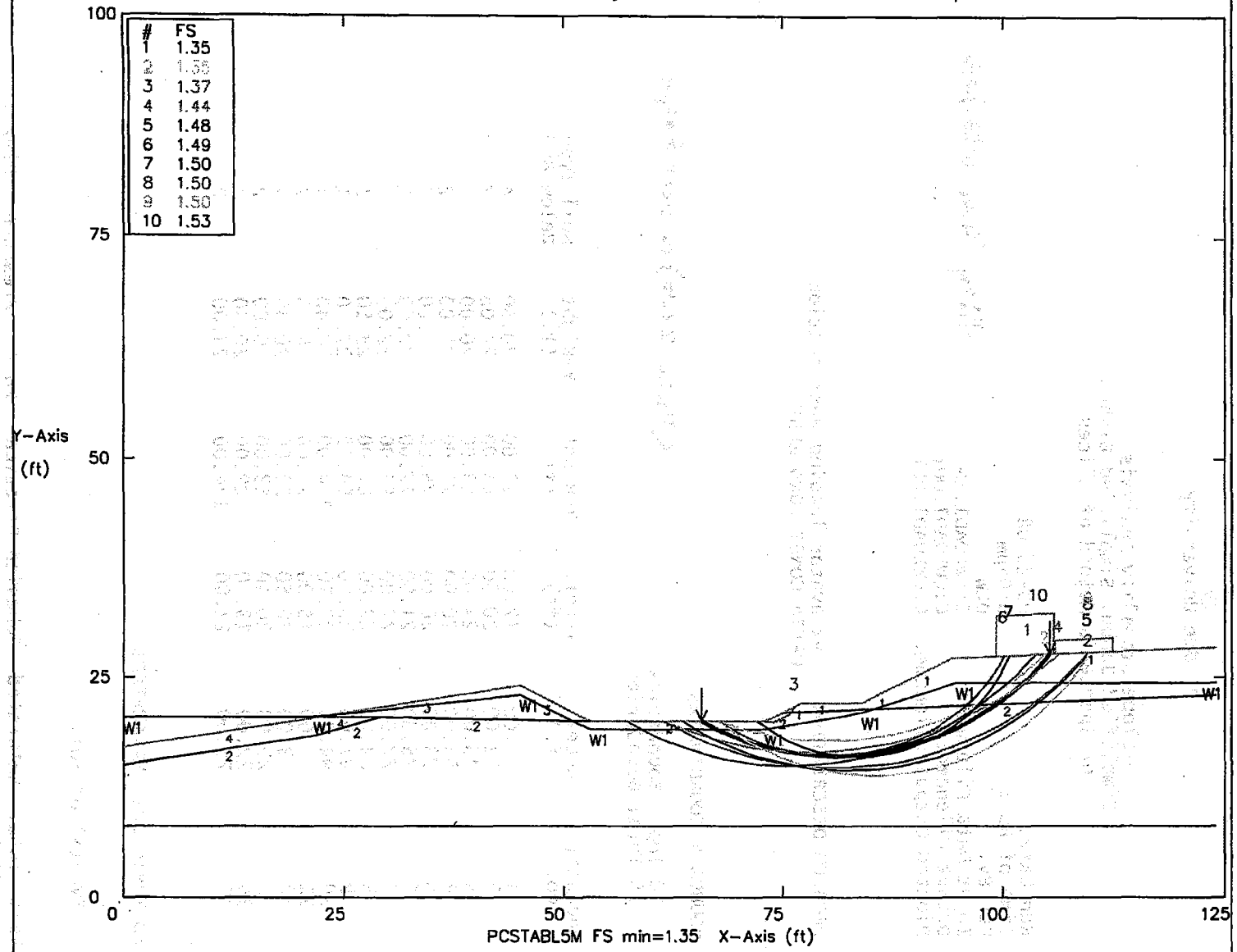
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.50	19.00
2	53.46	18.58
3	55.43	18.29
4	57.43	18.14
5	59.43	18.14
6	61.42	18.27
7	63.41	18.54
8	65.36	18.95
9	67.29	19.50
10	69.17	20.18
11	71.00	20.99
12	72.76	21.92
13	74.46	22.98
14	76.08	24.15
15	77.61	25.44
16	79.05	26.83
17	80.18	28.07

Circle Center At X = 58.5 ; Y = 46.7 and Radius, 28.6

*** 1.087 ***

excavator loading west section OFFTA CONST COND WEST
Ten Most Critical. C:CWLOAD1.PLT By: DCW 09-25-08 3:05pm



Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	1
2	110	116	0	27	0	0	1
3	103	127	0	41	0	0	1
4	120	130	0	33	0	0	1

C:\STABLE\CWLOAD1.DXF 9/26/2008 10:19:28 AM

CWLOAD1.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 09-25-08
Time of Run: 3:05pm
Run By: DCW
Input Data Filename: C:CWLOAD1.IN
Output Filename: C:CWLOAD1.OUT
Plotted Output Filename: C:CWLOAD1.PLT

V'd by RCM 10/30/08

PROBLEM DESCRIPTION excavator loading west section
OFFTA CONST COND WEST

BOUNDARY COORDINATES

(94.20, 27.10) is crest of slope

10 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	17.00	22.00	20.50	4
2	22.00	20.50	45.00	24.00	3
3	45.00	24.00	53.00	20.00	3
4	53.00	20.00	73.00	20.00	2
5	73.00	20.00	75.00	21.00	2
6	75.00	21.00	77.00	22.00	1
7	77.00	22.00	84.00	22.00	1
8	84.00	22.00	87.00	23.50	1
9	87.00	23.50	94.20	27.10	1
10	94.20	27.10	124.00	28.40	1
11	.00	15.00	22.00	18.50	2
12	22.00	20.50	29.00	20.40	4
13	29.00	20.40	53.00	20.00	2
14	22.00	18.50	29.00	20.40	2
15	75.00	21.00	124.00	23.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	120.0	130.0	.0	30.0	.00	.0	1
2	110.0	116.0	.0	27.0	.00	.0	1
3	103.0	127.0	.0	41.0	.00	.0	1
4	120.0	130.0	.0	33.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	21.50	20.50
3	45.00	23.00
4	53.00	19.00
5	73.00	19.00
6	84.00	21.00
7	94.70	24.30
8	124.00	24.30

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	99.20	105.70	645.0	.0
2	105.80	112.30	215.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	124.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 53.00 ft.
and X = 72.00 ft.

Each Surface Terminates Between X = 75.00 ft.
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.67	20.00
2	67.44	19.08
3	69.28	18.28
4	71.15	17.59
5	73.07	17.03
6	75.02	16.59
7	77.00	16.27
8	78.99	16.09
9	80.99	16.03
10	82.99	16.09
11	84.98	16.29
12	86.95	16.61
13	88.90	17.06
14	90.82	17.63
15	92.70	18.32
16	94.52	19.13
17	96.30	20.05
18	98.01	21.09
19	99.65	22.23
20	101.21	23.48
21	102.69	24.82
22	104.09	26.26
23	105.22	27.58

Circle Center At X = 80.9 ; Y = 47.3 and Radius, 31.3

*** 1.348 ***

Individual data on the 33 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.8	89.8	.0	.0	.0	.0	.0	.0	.0
2	.2	19.5	.0	.0	.0	.0	.0	.0	.0
3	1.6	250.1	.0	40.5	.0	.0	.0	.0	.0
4	1.9	438.8	.0	132.9	.0	.0	.0	.0	.0
5	1.8	562.5	.0	201.5	.0	.0	.0	.0	.0
6	.1	24.8	.0	9.2	.0	.0	.0	.0	.0
7	1.9	812.8	.0	288.3	.0	.0	.0	.0	.0
8	.0	12.0	.0	4.2	.0	.0	.0	.0	.0
9	2.0	1148.6	.0	382.9	.0	.0	.0	.0	.0
10	2.0	1335.4	.0	457.6	.0	.0	.0	.0	.0
11	2.0	1372.7	.0	517.6	.0	.0	.0	.0	.0
12	2.0	1374.4	.0	561.8	.0	.0	.0	.0	.0
13	1.0	687.0	.0	297.5	.0	.0	.0	.0	.0
14	1.0	682.4	.0	288.2	.0	.0	.0	.0	.0
15	.4	287.7	.0	120.2	.0	.0	.0	.0	.0
16	1.6	1219.7	.0	495.5	.0	.0	.0	.0	.0
17	.0	38.2	.0	15.4	.0	.0	.0	.0	.0
18	1.9	1602.0	.0	626.6	.0	.0	.0	.0	.0
19	1.9	1731.3	.0	652.5	.0	.0	.0	.0	.0
20	1.9	1780.1	.0	647.0	.0	.0	.0	.0	.0
21	1.5	1467.6	.0	516.8	.0	.0	.0	.0	.0
22	.3	316.7	.0	108.8	.0	.0	.0	.0	.0
23	.2	169.7	.0	60.3	.0	.0	.0	.0	.0
24	1.6	1466.6	.0	524.2	.0	.0	.0	.0	.0
25	1.7	1398.2	.0	465.2	.0	.0	.0	.0	.0
26	1.2	853.4	.0	253.3	.0	.0	.0	.0	.0
27	.1	67.4	.0	18.0	.0	.0	.0	.0	65.2
28	.3	225.2	.0	57.8	.0	.0	.0	.0	224.2
29	1.6	870.1	.0	180.1	.0	.0	.0	.0	1009.1
30	.9	387.4	.0	31.2	.0	.0	.0	.0	583.3
31	.6	200.7	.0	.0	.0	.0	.0	.0	372.4
32	1.4	327.6	.0	.0	.0	.0	.0	.0	898.5
33	1.1	86.2	.0	.0	.0	.0	.0	.0	727.9

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.78	20.00
2	69.67	19.35
3	71.60	18.81
4	73.55	18.38
5	75.52	18.06
6	77.51	17.85
7	79.51	17.75
8	81.51	17.76
9	83.50	17.89

10	85.49	18.13
11	87.46	18.48
12	89.40	18.95
13	91.32	19.52
14	93.20	20.20
15	95.04	20.98
16	96.84	21.86
17	98.58	22.85
18	100.26	23.93
19	101.88	25.11
20	103.43	26.37
21	104.73	27.56

Circle Center At X = 80.2 ; Y = 53.2 and Radius, 35.5

*** 1.352 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	72.00	20.00
2	73.99	19.81
3	75.78	20.71
4	76.38	21.69

Circle Center At X = 73.3 ; Y = 23.2 and Radius, 3.4

*** 1.373 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	61.44	20.00
2	63.29	19.24
3	65.18	18.56
4	67.09	17.98
5	69.03	17.49
6	70.99	17.10
7	72.97	16.80
8	74.96	16.60
9	76.96	16.50
10	78.96	16.49
11	80.95	16.58
12	82.94	16.76
13	84.92	17.05
14	86.89	17.42
15	88.83	17.90
16	90.75	18.46

CLIENT:	NAVAL STATION NEWPORT	JOB NUMBER:	00632
SUBJECT:	Supplemental Global Slope Stability with wave loads, OFFTA Revetment		
BASED ON:	As noted below	DRAWING NUMBER:	
BY: DCW Date: 09/25/08	CHECKED BY: Date: RCM 10/30/08	APPROVED BY:	DATE:

OBJECTIVE

The objective of this calculation is to determine the effect of wave induced loading on the overall slope stabilty of the revetment at OFFTA.

REFERENCES

1. *Coastal Engineering Manual Part VI*, U.S. Army Corps of Engineers, Engineering and Design Manual EM1110-2-1100, June 2006.
2. Calculation titled "Design Wave Calculation for OFFTA" prepared by DCW 08/07/07, Tetra Tech NUS.
3. Calculation titled "Global Slope Stability, OFFTA Revetment" prepared by RCM 5/30/08, Tetra Tech NUS.
4. Achilleos, E., User Guide for PC STABL 5M, Purdue University, West Lafayette, Indiana, 1988.

APPROACH

This analysis will evaluate the pressure differential loads on the revetment from wave action. The effect of wave action on the stone revetment itself is accounted for in the design of the revetment stone, however, the effect of wave action on the underlying soil and the potential for a slip circle failure is the focus of this evaluation.

The Coastal Engineering Manual (p. VI-5-210 of ref. 1) indicates that direct wave action on a permeable slope increases the destabilizing forces because the high uprush presents an extra load and creates fluctuating pore pressures and related destabilizing hydraulic gradient in the structure, in addition, both wave action and tides create a pressure gradient in porous seabeds.

The effect of wave action will be estimated by incorporating a conservative set of phreatic conditions within the PC STABL 5M limit equilibrium analyses conducted for the global slope stability. The STABL program uses the method of slices to calculate and sum the forces acting on the failure surface and calculate the factor of safety.

As the waves impact the revetment, water will run up the revetment (i.e., high uprush) and then quickly recede (i.e., deep downrush). Figure 1 (ref. 1) shows these two conditions and the corresponding flow nets for a homogeneous isotropic breakwater. The pore pressure in the PC STABL 5M program is estimated for each individual slice as the average of the vertical distance from the phreatic surface to the bottom of the slice and the perpendicular distance from the phreatic surface to the bottom of the slice (p. 10-12, ref. 4). This estimate of pore pressure along the failure surface is in effect an estimation of the pressure from a flow net within the soil at that point.

In order to evaluate a worst case scenario it is assumed that the pore pressure within the finer grained soil at OFFTA reflects the pressure associated with high uprush condition (this is assuming that the pore pressure within these soil types do not have time to dissipate when the wave is rushing out). In reality the pore pressure increase due to wave action would be attenuated the farther the point of interest is located from the surface of the revetment, however, as a conservative simplification, it is assumed that the high uprush pore pressure is seen throughout all of the finer grained soil layers. The coarse grained material (revetment stone and beach gravel) is assumed to dissipate the pore pressure rapidly. The analysis to account for wave action, will be similar to a traditional rapid drawdown analysis where the pore pressure in the slope does not have the time to dissipate, however, the surface water has receded. In this case the high uprush condition would be used for the pressure in the finer grained material and the downrush phreatic surface would be used for the coarse grained materials. This will create a condition where the built up pore pressure within the slope will have a tendency to lessen the factor of safety as the wave rushes back to the bay and there is not a countering downward weight of water on the toe of the slope.

CLIENT:	NAVAL STATION NEWPORT	JOB NUMBER:	00632
SUBJECT:	Supplemental Global Slope Stability with wave loads, OFFTA Revetment		
BASED ON:	As noted below	DRAWING NUMBER:	
BY: DCW Date: 09/25/08	CHECKED BY: Date: RCM 10/30/08	APPROVED BY:	DATE:

Wave Conditions

The design wave for the western portion of the site is 4.33 feet and the design wave for the eastern portion is 2.1 feet. Waves approaching a shoreline will break as the water depth gets shallower. The design wave for the western portion of the site assumed that there was some amount of storm surge accompanying the design wave so that the design wave would not be limited by the depth of water. The design wave is limited due to depth at the toe (d) by the following equation H = 0.6 x d (see ref. 2). The depth where the design wave breaks is assumed to be where the design wave would become depth limited 4.33 / 0.6 = 7.2 feet

Wave run-up was calculated using equations from ref. 1. The wave run-up is the elevation above the still water level (SWL) that the water will rise from the wave and the rundown is the minimum water surface elevation below the SWL. In some cases at OFFTA, the design wave will overtop the revetment and the actual run-up elevation will be lower that what is predicted using the formulas, however as a conservative assumption the calculated wave run-up elevation was used in the PC STABL 5M model to simulate the pore pressure (see Figure 2, part d from ref. 1). The deep downrush elevation was also calculated, however, to be conservative a lower convenient (matching a point already within the STABL model) elevation was used for the deep downrush elevation.

The stability of the both the eastern and western portion of the slopes were evaluated with a storm surge (SWL equal to 7.7 feet to match the elevation used in the design wave calculation (ref. 2) and with a SWL equal to the mean high water elevation. Performing a third set of calculations with a SWL equal to the mean low water was not performed since it would be unlikely for wind driven waves to occur without some water level rise in the bay.

ANALYSES

The calculation of the wave run-up and rundown is provided on sheets 3 through 7. Figures 3 and 4 show the phreatic surfaces used for the eastern and western portions of the site respectively. Each figure shows the high uprush and deep downrush phreatic surface for both the storm surge case and the mean high water case.

The 'end of construction' condition from the global slope stability analysis (ref. 3) was used as the starting PC STABL 5M model for the evaluation of the wave forces. The water table was then modified so that the high uprush condition was used for soil layers below the revetment stone and the beach gravel. The deep downrush condition was used for the revetment stone and the beach gravel. The outputs from these computer runs are shown on sheets 13 to 37. Sheet 8 presents a summary table of the minimum factors of safety for each case evaluation.

The revetment design uses the Naval Station MLW datum. The PC STABL 5M software does not recognize negative values for either the x- or y-axes. The geometry entered into the PC STABL 5M model therefore added 20 feet to the vertical axis.

CONCLUSIONS

The lowest factor of safety between the four scenarios evaluated (combinations of eastern cross-section, western cross-section, with a storm surge, or with mean high water) was 2.3. Generally for 'end of construction' conditions a factor of safety of 1.5 is considered acceptable, therefore the factors of safety are judged acceptable. As a comparision, the factor of safety from the original global stability calculation (ref. 3) was 2.5 for the east section and 2.4 for the west section.

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/25/08	CHECKED BY 10/30/08	APPROVED BY	DATE

WAVE RUNUP AND RUNDOWN

		EAST	WEST
WAVE HEIGHT:	H_{mo}	2.09 (FT)	4.33 (FT)
WAVE PERIOD	T_p	2.44 (SEC)	3.83 (SEC)

FROM DESIGN WAVE CALCULATION (REF 2)

RUNUP

$$\frac{R_{ui\%}}{H_s} = (A\xi + C)\gamma_r \gamma_b \gamma_h \gamma_\beta$$

EQUATION (VI-5-3) (REF 1)

$R_{ui\%}$ = RUNUP EXCEEDED by i PERCENT OF INCIDENT WAVES
H_s = SIGNIFICANT WAVE HEIGHT (IN OUR CASE = H_{mo})
ξ = SURF-SIMILARITY PARAMETER

$$\xi_{op} = \frac{\tan\alpha}{\sqrt{S_{op}}}$$

EQUATION VI-5-2

WHERE
$\tan\alpha$ = SLOPE ANGLE
S_{op} = WAVE STEEPNESS

WHERE

$$S_{op} = \frac{2\pi H_s}{g T_p^2}$$

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY 10/30/06	APPROVED BY	DATE

γ_r = REDUCTION FACTOR FOR INFLUENCE OF SURFACE ROUGHNESS
FROM TABLE VI-5-3 $\boxed{\gamma_r = 0.55}$
FOR ONE LAYER ROCK $H_s/D = 1.5-3.0$

$4.33/1.75 = 2.47$ OK

γ_b = REDUCTION FACTOR FOR BERM $\boxed{\gamma_b = 1}$ FOR NON-BERMED PROFILES

γ_h = REDUCTION FACTOR FOR SHALLOW WATER CONDITIONS
TO BE CONSERVATIVE ASSUME $\boxed{\gamma_h = 1}$ (NO REDUCTION)

γ_β = FACTOR FOR ANGLE OF WAVES HITTING (ASSUME WAVE HIT HEAD ON $\boxed{\gamma_\beta = 1}$

A, C COEFFICIENTS DEPENDENT ON ξ AND i FROM TABLE VI-5-2

WEST

$$S_{op} = \frac{2\pi H_s}{g T_p^2} = \frac{2\pi (4.33)}{32.2 (3.83)^2} = 0.05756$$

$\tan\alpha$ = FROM FIGURE 4 = 0.15

$$\xi_{op} = \frac{0.1515}{\sqrt{0.05756}}$$

$$\xi = 0.63$$

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY 10/30/08	APPROVED BY	DATE

A, C FROM TABLE VI-5-2 AND $R_{U2\%}$ $\xi < 2.5$

$A = 1.6 \quad C = 0$

$$R_{U2\%} = 4.33(1.6(0.63) + 0)0.55(1)(1)(1)$$

$$\boxed{= 2.40 \text{ ft}}$$ WEST RUNUP

EAST

$$S_o = \frac{2\pi(2.1)}{32.2(2.44)^2} = 0.068827$$

$\tan\alpha =$ (FROM FIGURE 3) $= 0.111$

$$\xi_{oEAST} = \frac{0.111}{\sqrt{0.068827}}$$

$$= 0.42$$

$$R_{U2\%EAST} = 2.1(1.6[0.42] + 0)0.55(1)(1)(1)$$

$$\boxed{R_{U2\%EAST} = 0.77 \text{ ft}}$$ EAST RUNUP

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY 10/30/08	APPROVED BY	DATE

RUN DOWN

$$\frac{R_{d2\%}}{H_s} = \begin{cases} 0.33\,\xi_{op} & \text{for } 0 < \xi_{op} < 4 \\ 1.5 & \text{for } \xi_{op} > 4 \end{cases}$$ EQUATION VI-5.4

WEST $R_{d2\% WEST} = 4.33\,(0.33)(0.63) = \boxed{0.9 \text{ ft}}$

EAST $R_{d2\% EAST} = 2.1\,(0.33)(0.42) = \boxed{0.3 \text{ ft}}$

SUMMARY.

	WEST	EAST
RUNUP	2.4 FT	0.77 FT
RUN DOWN	0.9 FT	0.3 FT

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY 10/30/08	APPROVED BY	DATE

WATER ELEVATIONS USED IN THE STABL MODEL

NOTE! 20' WAS ADDED TO ALL ELEVATIONS SO THAT THERE WOULD NOT BE ANY NEGATIVE NUMBERS IN STABL.

WEST (FIGURE 4)

CONDITION	STILL WATER ELEVATION	BREAK POINT	RUNUP ELEVATION	RUN DOWN ELEVATION
SURGE	27.7	4.33/0.6 = DEPTH = 7.2	27.7+2.4= 30.1	27.7-0.9= 26.8
	ELEVATION USED IN DESIGN WAVE CALC REF 2	WHERE GROUND SURFACE IS AT 27.7-7.2=20.5 (MODEL COORDINATES) (22, 27.7)	ASSUME MAX RUNUP IS OVER CREST (60, 30.1)	TO BE CONSERVATIVE PICK A LOWER POINT ALREADY IN MODEL (45, 24)
MEAN HIGH WATER	24.22	DEPTH=7.2 24.22-7.2= 17.02 (0, 24.22)	24.22+2.4 26.6 (59.6, 26.6)	24.22-0.9= 23.32 PICK A POINT LOWER ALREADY IN MODEL (37, 23.0)

EAST (FIGURE 3)

SURGE	27.7	2.1/0.6=3.5 DEPTH 27.7-3.5=24.2 (42, 27.7)	27.7+0.77 ≈28.5 PICK POINT OVER CREST (72.5, 28.5)	27.7-0.3 ≈27.4 TO BE CONSERVATIVE PICK (64, 26)
MHW	24.22	@ DEPTH 3.5 24.22-3.5=20.72 (16, 20.5)	24.22+0.77 24.99 (50, 25)	24.22-0.3= 23.9 TO BE CONSERVATIVE (37, 23)

CLIENT	Naval Station Newport	JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY RCM 10/30/08	APPROVED BY	DATE

SUMMARY OF FACTORS OF SAFETY DUE TO WAVE FORCES

FILE	CONDITION	FS
WEST		
WEWAV8.IN	SURGE	2.3
WEWAV10.IN	MEAN HIGH WATER	2.3
EAST		
EWAVSRG.IN	SURGE	3.8
EWAV MHW.IN	MEAN HIGH WATER	2.9

CLIENT	Naval Station Newport	JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 9/26/08	CHECKED BY RCM 10/30/08	APPROVED BY	DATE

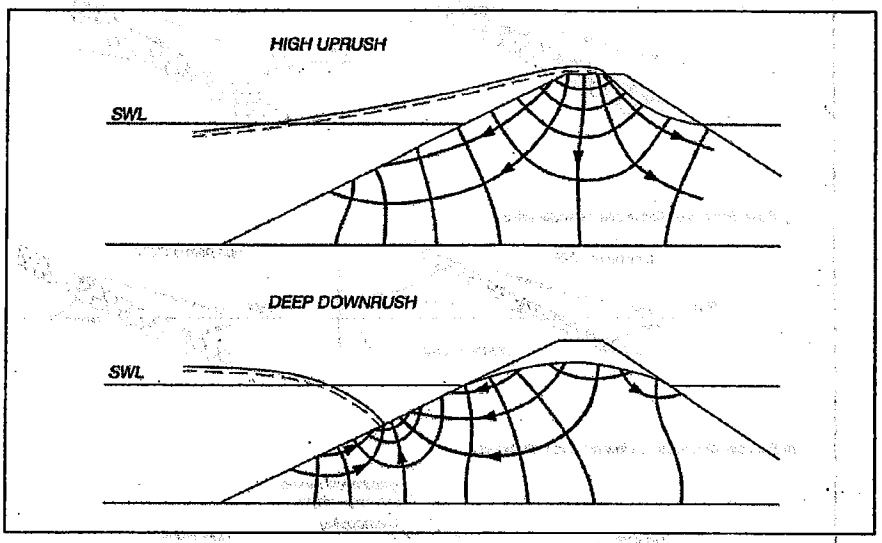


Figure VI-5-104. Illustration of flow nets in a homogeneous isotropic breakwater for two instantaneous wave load situations

FIGURE 1 (FROM REF 1)

10 of 37

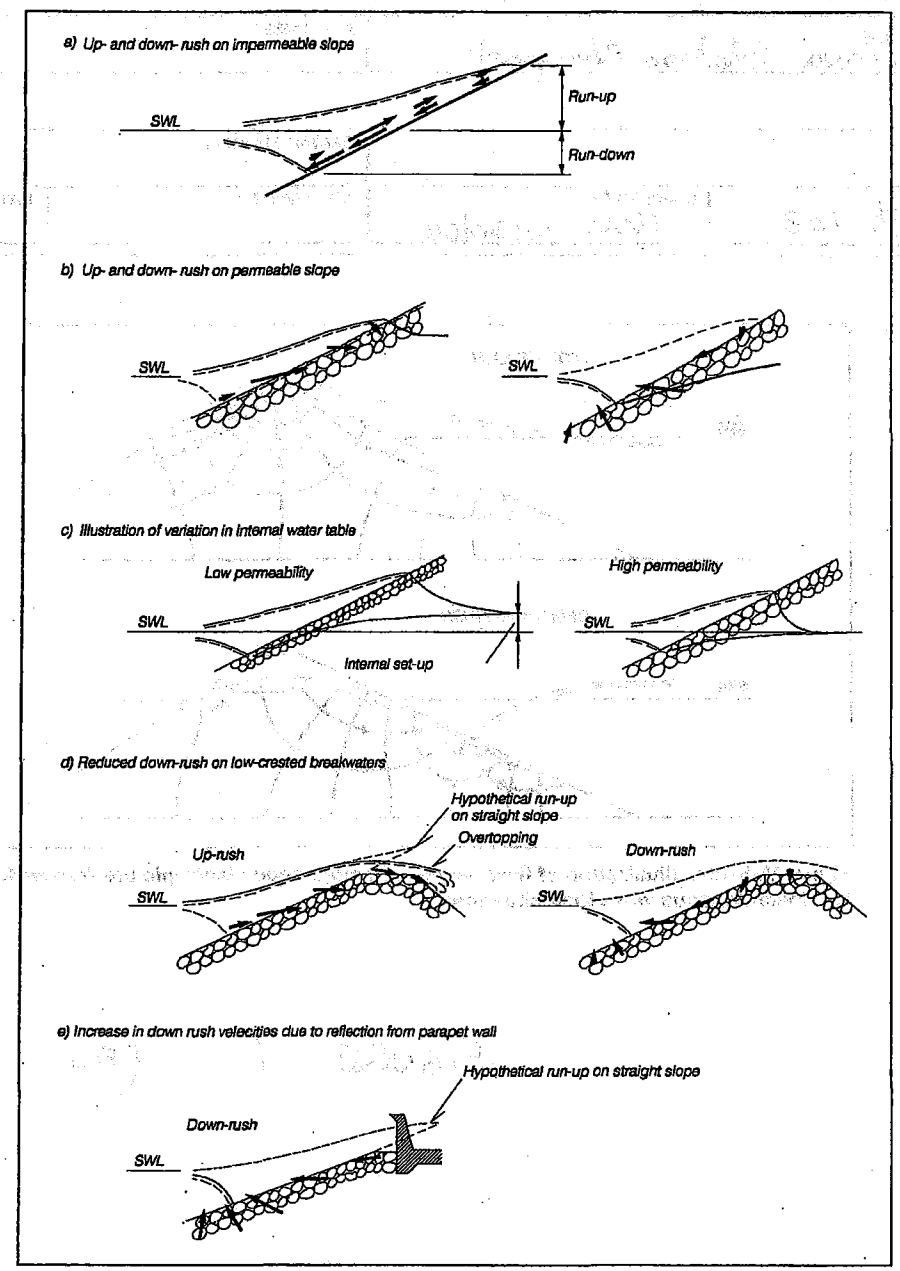
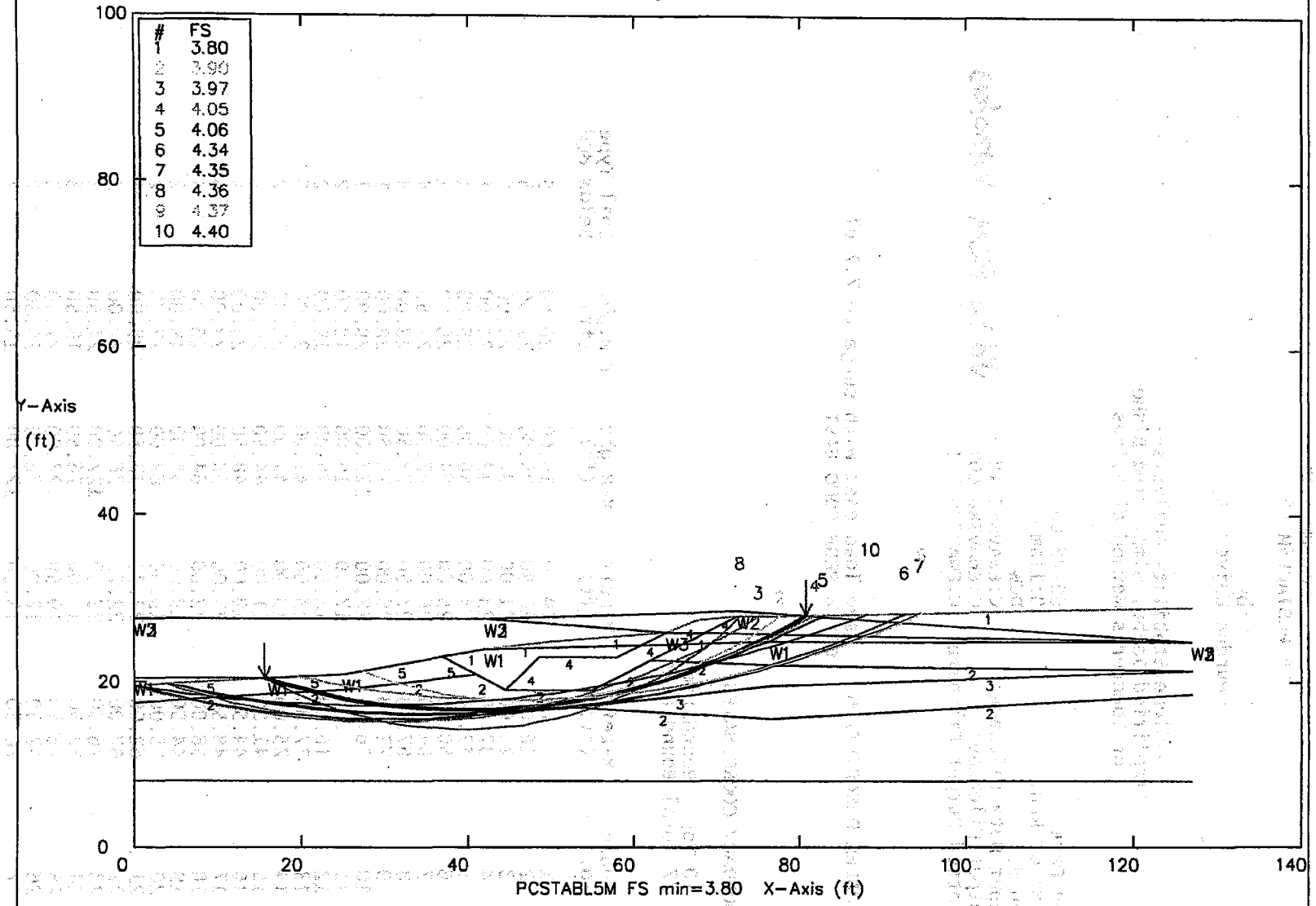


Figure VI-5-1. Illustration of runup and rundown (Burcharth 1993)

FIGURE 2 (FROM REF 1)

wave load east with surge to 7.7 el OFFTA PROP COND EAST
Ten Most Critical. C:EWAVSRG.PLT By: DCW 09-25-08 8:11am



#	FS
1	3.80
2	3.90
3	3.97
4	4.05
5	4.06
6	4.34
7	4.35
8	4.36
9	4.37
10	4.40

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	2
2	110	116	0	27	0	0	2
3	50	68	446	24.9	0	0	2
4	103	127	0	41	0	0	3
5	120	130	0	33	0	0	3

C:\STABLE\EWAVSRG.DXF 9/25/2008 8:16:08 AM

EWAVSRG.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 09-25-08
Time of Run: 8:11am
Run By: DCW
Input Data Filename: C:EWAVSRG.IN
Output Filename: C:EWAVSRG.OUT
Plotted Output Filename: C:EWAVSRG.PLT

V'd by RCM 10/30/08

PROBLEM DESCRIPTION wave load east with surge to 7.7 el
OFFTA PROP COND EAST

BOUNDARY COORDINATES

10 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	19.50	16.00	20.50	5
2	16.00	20.50	25.00	21.00	5
3	25.00	21.00	37.00	23.00	5
4	37.00	23.00	42.00	24.00	1
5	42.00	24.00	50.00	25.00	1
6	50.00	25.00	64.00	26.00	1
7	64.00	26.00	67.50	27.50	4
8	67.50	27.50	72.50	28.00	4
9	72.50	28.00	76.50	28.00	1
10	76.50	28.00	127.00	29.00	1
11	.00	17.50	16.00	18.50	2
12	16.00	18.50	25.00	19.00	2
13	37.00	23.00	41.00	21.00	5
14	25.00	19.00	41.00	21.00	2
15	41.00	21.00	44.50	19.00	2
16	44.50	19.00	48.50	23.00	4
17	48.50	23.00	58.00	23.00	4
18	58.00	23.00	64.00	26.00	4
19	44.50	19.00	55.00	19.00	2
20	55.00	19.00	62.00	22.75	2
21	62.00	22.75	72.50	28.00	1
22	62.00	22.75	76.50	22.00	2
23	76.50	22.00	127.00	21.50	2
24	52.50	17.00	76.50	19.50	3
25	76.50	19.50	127.00	21.50	3
26	52.50	17.00	76.50	15.50	2
27	76.50	15.50	127.00	18.50	2

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
FILL	1	120.0	130.0	.0	30.0	.00	.0	2
SILTY SAND	2	110.0	116.0	.0	27.0	.00	.0	2
PEAT	3	50.0	68.0	446.0	24.9	.00	.0	2
RIPRAP	4	103.0	127.0	.0	41.0	.00	.0	3
BEACH SAND	5	120.0	130.0	.0	33.0	.00	.0	3

1

3 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	16.00	20.50
3	25.00	21.00
4	42.00	24.00
5	76.50	24.90
6	127.00	24.90

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	27.70
2	42.00	27.70
3	72.50	28.50
4	127.00	24.90

1

Piezometric Surface No. 3 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)

1	.00	27.70
2	42.00	27.70
3	64.00	26.00
4	127.00	24.90

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	127.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 35.00 ft.

Each Surface Terminates Between X = 70.00 ft.
and X = 95.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.56	20.47
2	17.47	19.88
3	19.39	19.34
4	21.33	18.84
5	23.28	18.40

6	25.24	18.00
7	27.21	17.66
8	29.19	17.36
9	31.17	17.12
10	33.16	16.92
11	35.16	16.78
12	37.16	16.68
13	39.16	16.64
14	41.16	16.65
15	43.15	16.71
16	45.15	16.81
17	47.15	16.97
18	49.13	17.18
19	51.12	17.44
20	53.09	17.75
21	55.06	18.11
22	57.02	18.52
23	58.97	18.98
24	60.90	19.49
25	62.82	20.04
26	64.73	20.65
27	66.62	21.30
28	68.49	22.00
29	70.35	22.75
30	72.18	23.54
31	74.00	24.38
32	75.79	25.27
33	77.56	26.20
34	79.30	27.18
35	80.83	28.09

Circle Center At X = 39.9 ; Y = 95.7 and Radius, 79.0

*** 3.796 ***

Individual data on the 57 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	.4	4.8	200.2	211.6	.0	.0	.0	.0	.0
2	1.5	82.5	656.2	727.3	.0	.0	.0	.0	.0
3	1.9	256.6	849.9	1009.7	.0	.0	.0	.0	.0
4	1.9	416.0	842.7	1074.4	.0	.0	.0	.0	.0
5	.2	43.6	73.3	96.5	.0	.0	.0	.0	.0
6	1.8	514.9	761.5	1036.4	.0	.0	.0	.0	.0
7	1.7	592.2	725.5	1037.5	.0	.0	.0	.0	.0
8	.2	90.1	101.5	147.8	.0	.0	.0	.0	.0
9	2.0	827.2	809.5	1231.6	.0	.0	.0	.0	.0
10	2.0	981.9	771.7	1271.6	.0	.0	.0	.0	.0
11	2.0	1125.9	732.9	1305.3	.0	.0	.0	.0	.0
12	2.0	1258.7	693.2	1332.8	.0	.0	.0	.0	.0
13	2.0	1379.9	652.8	1354.0	.0	.0	.0	.0	.0
14	1.8	1369.1	565.5	1261.5	.0	.0	.0	.0	.0
15	.2	120.0	46.5	107.4	.0	.0	.0	.0	.0
16	2.0	1595.9	568.6	1377.4	.0	.0	.0	.0	.0
17	1.8	1562.0	479.4	1272.4	.0	.0	.0	.0	.0

18	.2	135.6	38.5	107.3	.0	.0	.0	.0	.0
19	.8	749.0	203.4	581.9	.0	.0	.0	.0	.0
20	1.2	1053.2	264.3	794.5	.0	.0	.0	.0	.0
21	1.3	1259.4	297.4	924.9	.0	.0	.0	.0	.0
22	.7	619.6	140.1	447.0	.0	.0	.0	.0	.0
23	2.0	1907.5	412.0	1361.7	.0	.0	.0	.0	.0
24	1.4	1302.4	265.9	918.3	.0	.0	.0	.0	.0
25	.6	611.3	120.6	427.0	.0	.0	.0	.0	.0
26	.9	835.4	160.5	580.4	.0	.0	.0	.0	.0
27	1.1	1075.6	201.4	742.2	.0	.0	.0	.0	.0
28	2.0	1877.7	347.5	1293.5	.0	.0	.0	.0	.0
29	1.9	1773.4	324.8	1219.9	.0	.0	.0	.0	.0
30	.1	55.9	10.2	38.4	.0	.0	.0	.0	.0
31	2.0	1756.7	322.5	1216.7	.0	.0	.0	.0	.0
32	1.0	849.1	157.6	595.7	.0	.0	.0	.0	.0
33	1.0	812.0	152.4	573.3	.0	.0	.0	.0	.0
34	1.9	1550.0	297.4	1115.0	.0	.0	.0	.0	.0
35	.1	70.3	13.7	51.4	.0	.0	.0	.0	.0
36	1.0	761.7	150.7	560.5	.0	.0	.0	.0	.0
37	.8	598.4	120.5	443.0	.0	.0	.0	.0	.0
38	1.2	829.7	169.7	619.8	.0	.0	.0	.0	.0
39	.7	502.5	.0	369.0	.0	.0	.0	.0	.0
40	1.0	705.4	.0	499.7	.0	.0	.0	.0	.0
41	.9	617.8	.0	416.8	.0	.0	.0	.0	.0
42	.9	623.6	.0	405.0	.0	.0	.0	.0	.0
43	.8	589.1	.0	372.3	.0	.0	.0	.0	.0
44	.1	96.9	.0	60.9	.0	.0	.0	.0	.0
45	.9	606.1	.0	379.4	.0	.0	.0	.0	.0
46	.9	611.5	.0	374.5	.0	.0	.0	.0	.0
47	1.8	1103.9	.0	663.8	.0	.0	.0	.0	.0
48	.3	180.5	.0	107.0	.0	.0	.0	.0	.0
49	1.5	770.3	41.2	452.9	.0	.0	.0	.0	.0
50	1.0	421.6	21.7	249.9	.0	.0	.0	.0	.0
51	.8	317.6	15.8	187.6	.0	.0	.0	.0	.0
52	.7	235.0	11.2	140.2	.0	.0	.0	.0	.0
53	.3	74.5	3.4	44.3	.0	.0	.0	.0	.0
54	.8	212.6	8.8	125.3	.0	.0	.0	.0	.0
55	1.7	305.8	7.3	176.5	.0	.0	.0	.0	.0
56	1.3	84.8	.0	41.7	.0	.0	.0	.0	.0
57	.2	1.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.22	21.37
2	29.10	20.68
3	31.00	20.05
4	32.92	19.50
5	34.86	19.02
6	36.82	18.62
7	38.79	18.29
8	40.78	18.03
9	42.77	17.85
10	44.77	17.75
11	46.77	17.72
12	48.77	17.77
13	50.76	17.90
14	52.75	18.10
15	54.73	18.37
16	56.70	18.72

17	58.66	19.14
18	60.59	19.64
19	62.51	20.21
20	64.40	20.86
21	66.27	21.57
22	68.11	22.36
23	69.92	23.21
24	71.70	24.13
25	73.43	25.12
26	75.13	26.18
27	76.79	27.29
28	77.79	28.03

Circle Center At X = 46.5 ; Y = 70.4 and Radius, 52.7

*** 3.895 ***

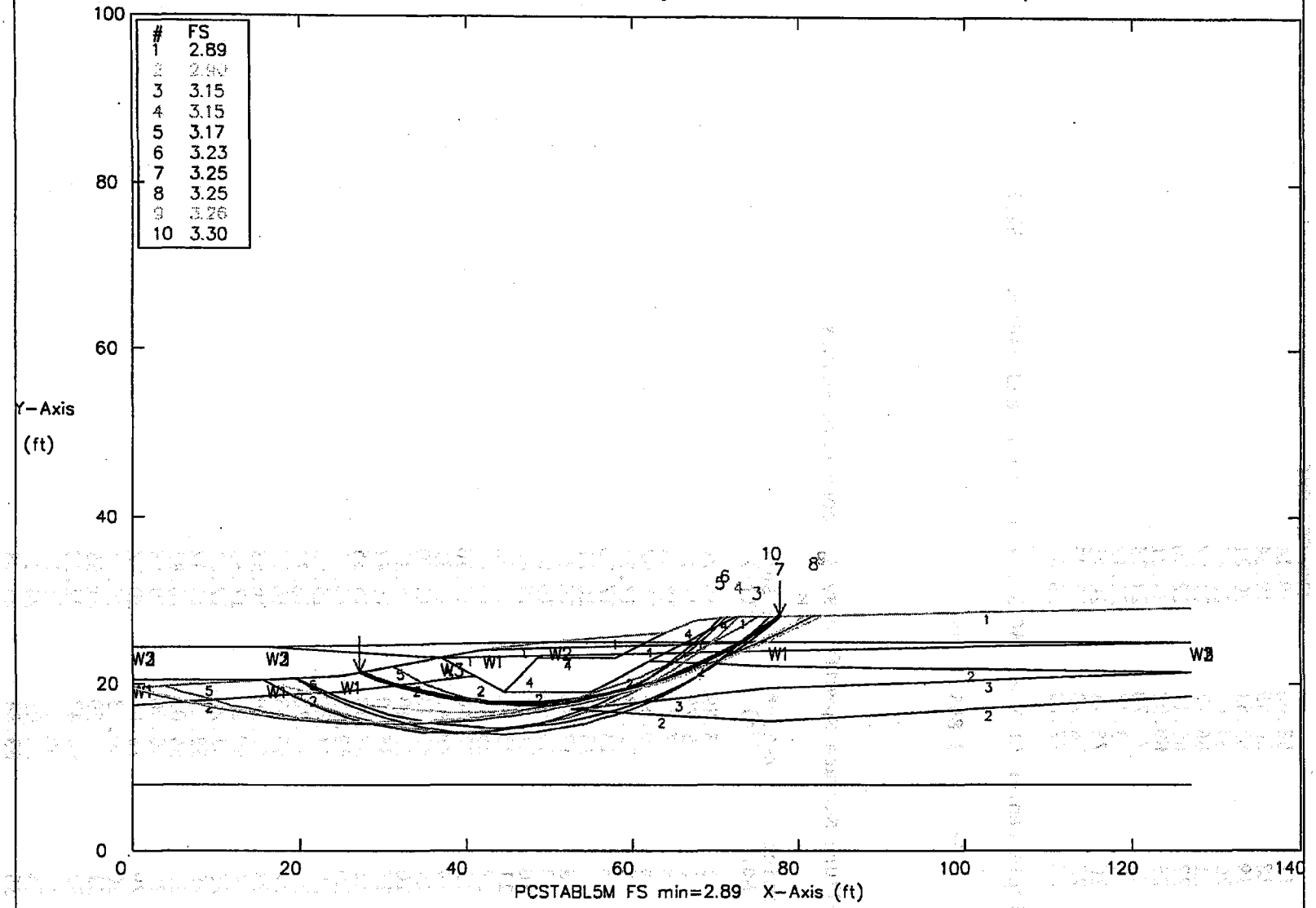
1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	3.89	19.74
2	5.79	19.12
3	7.71	18.55
4	9.64	18.02
5	11.58	17.54
6	13.53	17.10
7	15.49	16.71
8	17.46	16.37
9	19.44	16.07
10	21.42	15.82
11	23.41	15.62
12	25.41	15.47
13	27.40	15.36
14	29.40	15.31
15	31.40	15.30
16	33.40	15.33
17	35.40	15.42
18	37.40	15.55
19	39.39	15.73
20	41.37	15.96
21	43.36	16.24
22	45.33	16.56
23	47.30	16.93
24	49.25	17.35
25	51.20	17.81
26	53.13	18.32
27	55.05	18.87
28	56.96	19.48
29	58.85	20.12
30	60.73	20.81
31	62.59	21.55
32	64.43	22.33
33	66.25	23.15
34	68.05	24.02
35	69.84	24.93

wave load east OFFTA PROP COND EAST

Ten Most Critical. C:EWAVMHW.PLT By: DCW 09-24-08 2:36pm



Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	2
2	110	116	0	27	0	0	2
3	50	68	446	24.9	0	0	2
4	103	127	0	41	0	0	3
5	120	130	0	33	0	0	3

C:\STABLE\EWAVMHW.DXF 9/25/2008 8:17:00 AM

EWAVMHW.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 09-24-08
Time of Run: 2:36pm
Run By: DCW
Input Data Filename: C:EWAVMHW.IN
Output Filename: C:EWAVMHW.OUT
Plotted Output Filename: C:EWAVMHW.PLT

V'd by RCM 10/30/08

PROBLEM DESCRIPTION wave load east
OFFTA PROP COND EAST

BOUNDARY COORDINATES

10 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	19.50	16.00	20.50	5
2	16.00	20.50	25.00	21.00	5
3	25.00	21.00	37.00	23.00	5
4	37.00	23.00	42.00	24.00	1
5	42.00	24.00	50.00	25.00	1
6	50.00	25.00	64.00	26.00	1
7	64.00	26.00	67.50	27.50	4
8	67.50	27.50	72.50	28.00	4
9	72.50	28.00	76.50	28.00	1
10	76.50	28.00	127.00	29.00	1
11	.00	17.50	16.00	18.50	2
12	16.00	18.50	25.00	19.00	2
13	37.00	23.00	41.00	21.00	5
14	25.00	19.00	41.00	21.00	2
15	41.00	21.00	44.50	19.00	2
16	44.50	19.00	48.50	23.00	4
17	48.50	23.00	58.00	23.00	4
18	58.00	23.00	64.00	26.00	4
19	44.50	19.00	55.00	19.00	2
20	55.00	19.00	62.00	22.75	2
21	62.00	22.75	72.50	28.00	1
22	62.00	22.75	76.50	22.00	2
23	76.50	22.00	127.00	21.50	2
24	52.50	17.00	76.50	19.50	3
25	76.50	19.50	127.00	21.50	3
26	52.50	17.00	76.50	15.50	2
27	76.50	15.50	127.00	18.50	2

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	130.0	.0	30.0	.00	.0	2
2	110.0	116.0	.0	27.0	.00	.0	2
3	50.0	68.0	446.0	24.9	.00	.0	2
4	103.0	127.0	.0	41.0	.00	.0	3
5	120.0	130.0	.0	33.0	.00	.0	3

1

3 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	16.00	20.50
3	25.00	21.00
4	42.00	24.00
5	76.50	24.90
6	127.00	24.90

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	24.22
2	16.00	24.22
3	50.00	25.00
4	127.00	24.90

1

Piezometric Surface No. 3 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)

1	.00	24.22
2	16.00	24.22
3	37.00	23.00
4	127.00	24.90

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	127.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 35.00 ft.

Each Surface Terminates Between X = 70.00 ft.
and X = 95.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.22	21.37
2	29.10	20.68
3	31.00	20.05
4	32.92	19.50
5	34.86	19.02

6	36.82	18.62
7	38.79	18.29
8	40.78	18.03
9	42.77	17.85
10	44.77	17.75
11	46.77	17.72
12	48.77	17.77
13	50.76	17.90
14	52.75	18.10
15	54.73	18.37
16	56.70	18.72
17	58.66	19.14
18	60.59	19.64
19	62.51	20.21
20	64.40	20.86
21	66.27	21.57
22	68.11	22.36
23	69.92	23.21
24	71.70	24.13
25	73.43	25.12
26	75.13	26.18
27	76.79	27.29
28	77.79	28.03

Circle Center At X = 46.5 ; Y = 70.4 and Radius, 52.7

*** 2.885 ***

Individual data on the 51 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.9	122.9	235.2	310.3	.0	.0	.0	.0	.0
2	1.9	365.2	187.2	378.8	.0	.0	.0	.0	.0
3	.7	201.3	58.4	160.4	.0	.0	.0	.0	.0
4	1.2	390.6	78.7	380.4	.0	.0	.0	.0	.0
5	1.9	790.1	85.0	669.9	.0	.0	.0	.0	.0
6	2.0	973.2	31.4	730.5	.0	.0	.0	.0	.0
7	.2	97.0	.1	68.8	.0	.0	.0	.0	.0
8	1.8	1051.2	176.0	713.1	.0	.0	.0	.0	.0
9	2.0	1316.9	152.3	824.0	.0	.0	.0	.0	.0
10	.2	156.9	14.3	94.1	.0	.0	.0	.0	.0
11	1.0	732.6	57.5	428.2	.0	.0	.0	.0	.0
12	.8	591.4	37.5	334.4	.0	.0	.0	.0	.0
13	1.7	1397.4	70.5	761.3	.0	.0	.0	.0	.0
14	.3	223.5	9.2	118.8	.0	.0	.0	.0	.0
15	2.0	1707.5	54.1	894.0	.0	.0	.0	.0	.0
16	1.7	1521.2	26.1	778.7	.0	.0	.0	.0	.0
17	.3	236.7	2.3	119.7	.0	.0	.0	.0	.0
18	1.2	1105.3	4.7	553.3	.0	.0	.0	.0	.0
19	.8	687.9	.0	339.8	.0	.0	.0	.0	.0
20	2.0	1790.1	.0	873.8	.0	.0	.0	.0	.0
21	2.0	1761.1	.0	843.9	.0	.0	.0	.0	.0
22	.3	234.4	.0	111.4	.0	.0	.0	.0	.0
23	1.7	1469.6	.0	693.2	.0	.0	.0	.0	.0
24	1.3	1080.8	.0	507.7	.0	.0	.0	.0	.0

25	.7	532.8	.0	248.3	.0	.0	.0	.0	.0
26	.3	214.5	.0	100.5	.0	.0	.0	.0	.0
27	1.7	1270.7	.0	597.6	.0	.0	.0	.0	.0
28	.4	285.2	.0	136.4	.0	.0	.0	.0	.0
29	1.0	673.2	.0	323.4	.0	.0	.0	.0	.0
30	.0	20.7	.0	10.0	.0	.0	.0	.0	.0
31	.5	335.7	.0	161.3	.0	.0	.0	.0	.0
32	1.1	699.6	.0	336.0	.0	.0	.0	.0	.0
33	.4	226.8	.0	107.2	.0	.0	.0	.0	.0
34	.4	243.9	.0	111.8	.0	.0	.0	.0	.0
35	1.3	821.3	.0	344.7	.0	.0	.0	.0	.0
36	.5	335.8	.0	125.2	.0	.0	.0	.0	.0
37	.2	116.9	.0	42.2	.0	.0	.0	.0	.0
38	1.0	663.4	.0	219.7	.0	.0	.0	.0	.0
39	.6	385.0	.0	114.2	.0	.0	.0	.0	.0
40	.1	90.9	.0	26.3	.0	.0	.0	.0	.0
41	1.7	962.2	.0	247.2	.0	.0	.0	.0	.0
42	1.0	505.2	.0	103.1	.0	.0	.0	.0	.0
43	.8	383.2	.0	59.2	.0	.0	.0	.0	.0
44	.8	350.1	.0	35.2	.0	.0	.0	.0	.0
45	.4	150.7	.0	7.4	.0	.0	.0	.0	.0
46	.3	108.2	.0	1.7	.0	.0	.0	.0	.0
47	.3	94.6	.0	.0	.0	.0	.0	.0	.0
48	1.7	479.6	.0	.0	.0	.0	.0	.0	.0
49	1.4	223.6	.0	.0	.0	.0	.0	.0	.0
50	.3	28.3	.0	.0	.0	.0	.0	.0	.0
51	1.0	42.9	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.56	20.47
2	17.47	19.88
3	19.39	19.34
4	21.33	18.84
5	23.28	18.40
6	25.24	18.00
7	27.21	17.66
8	29.19	17.36
9	31.17	17.12
10	33.16	16.92
11	35.16	16.78
12	37.16	16.68
13	39.16	16.64
14	41.16	16.65
15	43.15	16.71
16	45.15	16.81
17	47.15	16.97
18	49.13	17.18
19	51.12	17.44
20	53.09	17.75
21	55.06	18.11
22	57.02	18.52
23	58.97	18.98
24	60.90	19.49
25	62.82	20.04
26	64.73	20.65
27	66.62	21.30
28	68.49	22.00
29	70.35	22.75

30	72.18	23.54
31	74.00	24.38
32	75.79	25.27
33	77.56	26.20
34	79.30	27.18
35	80.83	28.09

Circle Center At X = 39.9 ; Y = 95.7 and Radius, 79.0

*** 2.897 ***

1

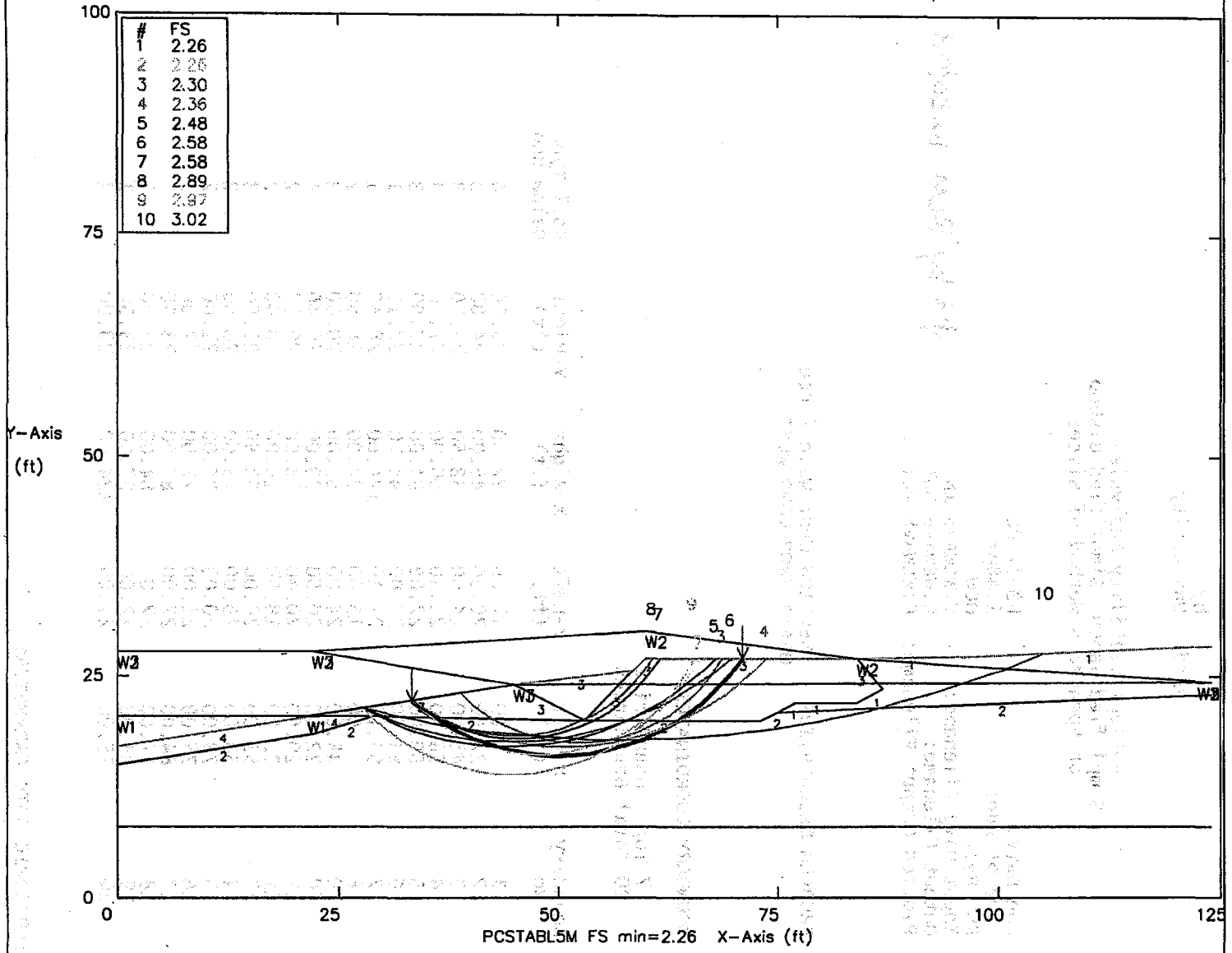
Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	3.89	19.74
2	5.79	19.12
3	7.71	18.55
4	9.64	18.02
5	11.58	17.54
6	13.53	17.10
7	15.49	16.71
8	17.46	16.37
9	19.44	16.07
10	21.42	15.82
11	23.41	15.62
12	25.41	15.47
13	27.40	15.36
14	29.40	15.31
15	31.40	15.30
16	33.40	15.33
17	35.40	15.42
18	37.40	15.55
19	39.39	15.73
20	41.37	15.96
21	43.36	16.24
22	45.33	16.56
23	47.30	16.93
24	49.25	17.35
25	51.20	17.81
26	53.13	18.32
27	55.05	18.87
28	56.96	19.48
29	58.85	20.12
30	60.73	20.81
31	62.59	21.55
32	64.43	22.33
33	66.25	23.15
34	68.05	24.02
35	69.84	24.93
36	71.59	25.88
37	73.33	26.88
38	75.04	27.91
39	75.17	28.00

Circle Center At X = 30.8 ; Y = 99.1 and Radius, 83.8

SECTION West Wave force OFFTA PROP COND WEST

Ten Most Critical. C:WEWAV8.PLT By: DCW 09-17-08 1:48pm



Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	2
2	110	116	0	27	0	0	2
3	103	127	0	41	0	0	3
4	120	130	0	33	0	0	3

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WEWAV8.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 09-17-08
Time of Run: 1:48pm
Run By: DCW
Input Data Filename: C:WEWAV8.IN
Output Filename: C:WEWAV8.OUT
Plotted Output Filename: C:WEWAV8.PLT

V'd by RCM 10/30/08

PROBLEM DESCRIPTION SECTION West Wave force
OFFTA PROP COND WEST

BOUNDARY COORDINATES

7 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	17.00	22.00	20.50	4
2	22.00	20.50	45.00	24.00	3
3	45.00	24.00	58.50	25.50	3
4	58.50	25.50	60.00	27.00	3
5	60.00	27.00	84.00	27.00	3
6	84.00	27.00	94.70	27.10	1
7	94.70	27.10	124.00	28.40	1
8	.00	15.00	22.00	18.50	2
9	45.00	24.00	53.00	20.00	3
10	22.00	20.50	29.00	20.40	4
11	29.00	20.40	53.00	20.00	2
12	22.00	18.50	29.00	20.40	2
13	53.00	20.00	58.50	25.50	3
14	53.00	20.00	73.00	20.00	2
15	73.00	20.00	75.00	21.00	2
16	75.00	21.00	77.00	22.00	1
17	84.00	27.00	87.00	23.50	3
18	77.00	22.00	84.00	22.00	1
19	84.00	22.00	87.00	23.50	1
20	75.00	21.00	124.00	23.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	130.0	.0	30.0	.00	.0	2
2	110.0	116.0	.0	27.0	.00	.0	2
3	103.0	127.0	.0	41.0	.00	.0	3
4	120.0	130.0	.0	33.0	.00	.0	3

1

3 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	21.50	20.50
3	45.00	24.00
4	124.00	24.30

Piezometric Surface No. 2 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	27.70
2	22.00	27.70
3	60.00	30.10
4	84.00	27.00
5	124.00	24.30

1

Piezometric Surface No. 3 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	27.70
2	22.00	27.70
3	45.00	24.00
4	124.00	24.30

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	124.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 50.00 ft.

Each Surface Terminates Between X = 60.00 ft.
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	22.22
2	34.90	20.98
3	36.55	19.86
4	38.29	18.87
5	40.11	18.02
6	41.98	17.32
7	43.90	16.77
8	45.86	16.36
9	47.84	16.12
10	49.84	16.03
11	51.84	16.09
12	53.83	16.31
13	55.79	16.69
14	57.72	17.22

15	59.60	17.90
16	61.42	18.73
17	63.17	19.69
18	64.84	20.79
19	66.42	22.02
20	67.90	23.37
21	69.27	24.82
22	70.52	26.39
23	70.94	27.00

Circle Center At X = 50.0 ; Y = 41.5 and Radius, 25.5

*** 2.256 ***

Individual data on the 30 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	1.6	147.4	331.1	511.3	.0	.0	.0	.0	.0
2	1.0	248.6	190.3	374.5	.0	.0	.0	.0	.0
3	.6	206.7	106.6	404.9	.0	.0	.0	.0	.0
4	1.7	752.3	252.3	1159.6	.0	.0	.0	.0	.0
5	1.8	1039.0	198.3	1287.8	.0	.0	.0	.0	.0
6	1.9	1309.6	136.1	1398.9	.0	.0	.0	.0	.0
7	1.9	1555.4	67.1	1492.1	.0	.0	.0	.0	.0
8	1.1	973.2	5.5	872.3	.0	.0	.0	.0	.0
9	.9	792.5	.0	694.6	.0	.0	.0	.0	.0
10	2.0	1914.0	.0	1622.9	.0	.0	.0	.0	.0
11	2.0	2012.6	.0	1659.6	.0	.0	.0	.0	.0
12	2.0	2063.3	.0	1676.9	.0	.0	.0	.0	.0
13	1.2	1205.7	.0	978.8	.0	.0	.0	.0	.0
14	.8	859.0	.0	695.8	.0	.0	.0	.0	.0
15	2.0	2016.8	.0	1652.8	.0	.0	.0	.0	.0
16	1.3	1258.6	.0	1053.9	.0	.0	.0	.0	.0
17	.7	663.4	.0	557.7	.0	.0	.0	.0	.0
18	.8	752.8	.0	651.7	.0	.0	.0	.0	.0
19	1.1	1086.6	.0	899.4	.0	.0	.0	.0	.0
20	.4	411.4	.0	330.0	.0	.0	.0	.0	.0
21	1.4	1427.8	.0	1121.7	.0	.0	.0	.0	.0
22	1.8	1594.5	.0	1311.3	.0	.0	.0	.0	.0
23	.5	391.6	.0	340.3	.0	.0	.0	.0	.0
24	1.2	924.1	.0	330.3	.0	.0	.0	.0	.0
25	1.6	1011.4	.0	333.6	.0	.0	.0	.0	.0
26	1.5	705.2	.0	173.7	.0	.0	.0	.0	.0
27	.7	234.6	.0	22.3	.0	.0	.0	.0	.0
28	.7	180.6	.0	.0	.0	.0	.0	.0	.0
29	1.2	179.4	.0	.0	.0	.0	.0	.0	.0
30	.4	13.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	22.22

2	34.82	20.88
3	36.42	19.69
4	38.13	18.66
5	39.94	17.80
6	41.82	17.11
7	43.76	16.62
8	45.73	16.31
9	47.73	16.20
10	49.73	16.28
11	51.71	16.55
12	53.66	17.01
13	55.55	17.66
14	57.37	18.49
15	59.10	19.49
16	60.72	20.66
17	62.23	21.97
18	63.60	23.43
19	64.82	25.01
20	65.89	26.71
21	66.03	27.00

Circle Center At X = 47.9 ; Y = 36.8 and Radius, 20.6

*** 2.262 ***

1

Failure Surface Specified By 19 Coordinate Points

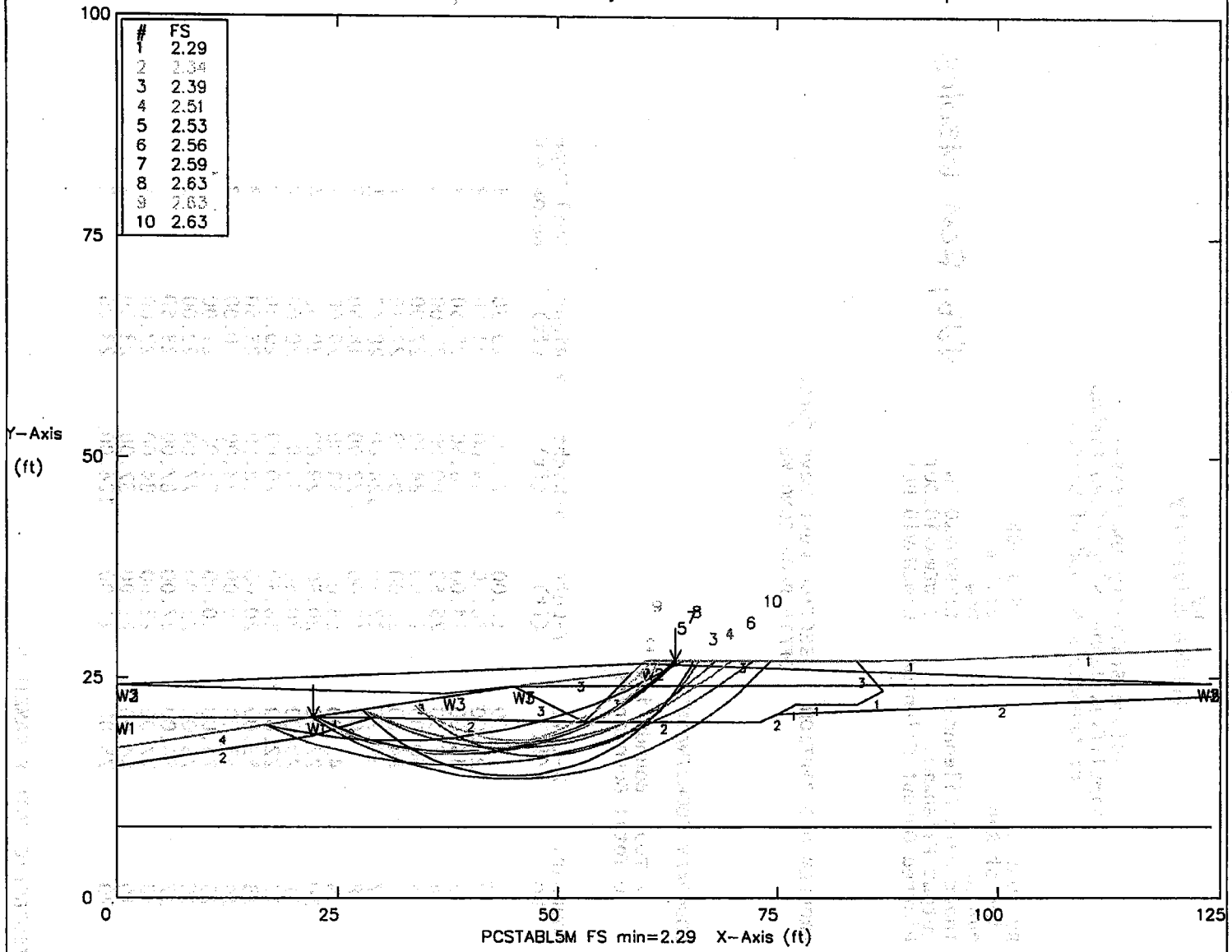
Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.89	23.07
2	40.37	21.72
3	41.98	20.54
4	43.71	19.53
5	45.53	18.71
6	47.43	18.10
7	49.39	17.68
8	51.38	17.48
9	53.38	17.49
10	55.37	17.71
11	57.32	18.14
12	59.22	18.78
13	61.03	19.62
14	62.75	20.64
15	64.35	21.84
16	65.82	23.20
17	67.13	24.71
18	68.27	26.36
19	68.62	27.00

Circle Center At X = 52.3 ; Y = 36.3 and Radius, 18.8

*** 2.299 ***

SECTION West Wave force OFFTA PROP COND WEST

Ten Most Critical. C:WEWAV10.PLT By: DCW 09-17-08 2:16pm



Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120	130	0	30	0	0	2
2	110	116	0	27	0	0	2
3	103	127	0	41	0	0	3
4	120	130	0	33	0	0	3

C:\STABLE\WEWAV10.DXF 9/25/2008 7:53:27 AM

WEWAV10.OUT
** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 09-17-08
Time of Run: 2:16pm
Run By: DCW
Input Data Filename: C:WEWAV10.IN
Output Filename: C:WEWAV10.OUT
Plotted Output Filename: C:WEWAV10.PLT

√'d by RCM 10/30/08

PROBLEM DESCRIPTION SECTION West Wave force
OFFTA PROP COND WEST

BOUNDARY COORDINATES

7 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	17.00	22.00	20.50	4
2	22.00	20.50	45.00	24.00	3
3	45.00	24.00	58.50	25.50	3
4	58.50	25.50	60.00	27.00	3
5	60.00	27.00	84.00	27.00	3
6	84.00	27.00	94.70	27.10	1
7	94.70	27.10	124.00	28.40	1
8	.00	15.00	22.00	18.50	2
9	45.00	24.00	53.00	20.00	3
10	22.00	20.50	29.00	20.40	4
11	29.00	20.40	53.00	20.00	2
12	22.00	18.50	29.00	20.40	2
13	53.00	20.00	58.50	25.50	3
14	53.00	20.00	73.00	20.00	2
15	73.00	20.00	75.00	21.00	2
16	75.00	21.00	77.00	22.00	1
17	84.00	27.00	87.00	23.50	3
18	77.00	22.00	84.00	22.00	1
19	84.00	22.00	87.00	23.50	1
20	75.00	21.00	124.00	23.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	130.0	.0	30.0	.00	.0	2
2	110.0	116.0	.0	27.0	.00	.0	2
3	103.0	127.0	.0	41.0	.00	.0	3
4	120.0	130.0	.0	33.0	.00	.0	3

1

3 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	20.50
2	21.50	20.50
3	45.00	24.00
4	124.00	24.30

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	24.22
2	59.60	26.60
3	124.00	24.30

1

Piezometric Surface No. 3 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	24.22
2	37.00	23.20
3	45.00	24.00
4	124.00	24.30

1

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	8.00	124.00	8.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 50.00 ft.

Each Surface Terminates Between X = 60.00 ft.
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 8.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.22	20.53
2	24.02	19.65
3	25.86	18.88
4	27.75	18.21
5	29.67	17.65
6	31.62	17.20
7	33.59	16.87
8	35.58	16.64
9	37.57	16.53
10	39.57	16.54
11	41.57	16.66
12	43.56	16.89
13	45.53	17.24
14	47.47	17.70
15	49.39	18.27
16	51.27	18.95

17	53.11	19.74
18	54.90	20.63
19	56.64	21.62
20	58.32	22.71
21	59.93	23.89
22	61.47	25.16
23	62.94	26.52
24	63.40	27.00

Circle Center At X = 38.5 ; Y = 51.4 and Radius, 34.9

*** 2.293 ***

Individual data on the 36 slices

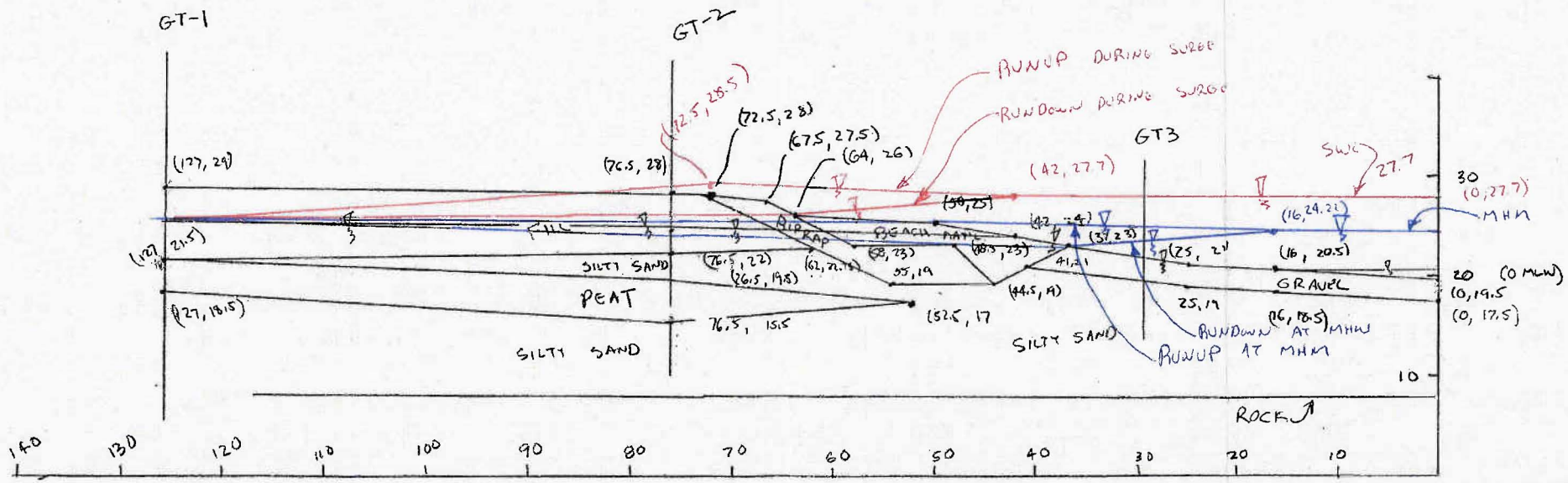
Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	.1	.2	15.1	16.7	.0	.0	.0	.0	.0
2	1.7	133.4	314.9	418.4	.0	.0	.0	.0	.0
3	.9	158.9	147.7	241.7	.0	.0	.0	.0	.0
4	1.0	236.7	152.9	402.4	.0	.0	.0	.0	.0
5	1.9	620.5	267.5	841.2	.0	.0	.0	.0	.0
6	1.3	517.8	155.4	595.8	.0	.0	.0	.0	.0
7	.7	308.5	75.6	331.4	.0	.0	.0	.0	.0
8	1.9	1023.0	191.7	999.7	.0	.0	.0	.0	.0
9	2.0	1200.0	150.0	1058.4	.0	.0	.0	.0	.0
10	2.0	1351.0	106.6	1103.1	.0	.0	.0	.0	.0
11	1.4	1040.3	48.8	806.1	.0	.0	.0	.0	.0
12	.6	433.2	13.4	327.6	.0	.0	.0	.0	.0
13	2.0	1565.6	38.1	1150.1	.0	.0	.0	.0	.0
14	2.0	1626.1	24.8	1152.2	.0	.0	.0	.0	.0
15	2.0	1654.2	11.6	1140.1	.0	.0	.0	.0	.0
16	1.4	1210.4	.3	820.0	.0	.0	.0	.0	.0
17	.5	438.4	.0	293.6	.0	.0	.0	.0	.0
18	1.9	1591.0	.0	1073.1	.0	.0	.0	.0	.0
19	1.9	1495.8	.0	1018.5	.0	.0	.0	.0	.0
20	1.9	1373.4	.0	950.0	.0	.0	.0	.0	.0
21	1.7	1157.6	.0	819.0	.0	.0	.0	.0	.0
22	.1	69.1	.0	48.9	.0	.0	.0	.0	.0
23	.5	329.0	.0	239.6	.0	.0	.0	.0	.0
24	1.3	725.0	.0	326.9	.0	.0	.0	.0	.0
25	1.7	851.0	.0	364.4	.0	.0	.0	.0	.0
26	.4	172.4	.0	69.7	.0	.0	.0	.0	.0
27	1.3	460.9	.0	165.7	.0	.0	.0	.0	.0
28	.2	57.3	.0	18.3	.0	.0	.0	.0	.0
29	1.1	339.3	.0	68.9	.0	.0	.0	.0	.0
30	.3	103.6	.0	7.3	.0	.0	.0	.0	.0
31	.1	22.8	.0	.8	.0	.0	.0	.0	.0
32	.1	41.5	.0	.6	.0	.0	.0	.0	.0
33	1.3	329.2	.0	.0	.0	.0	.0	.0	.0
34	1.4	173.1	.0	.0	.0	.0	.0	.0	.0
35	.0	2.1	.0	.0	.0	.0	.0	.0	.0
36	.5	11.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 23 Coordinate Points

OVERALL BEACH SLOPE

$$\frac{25 - 19.5}{50 - 0} = \frac{5.5}{50} \approx 0.11$$

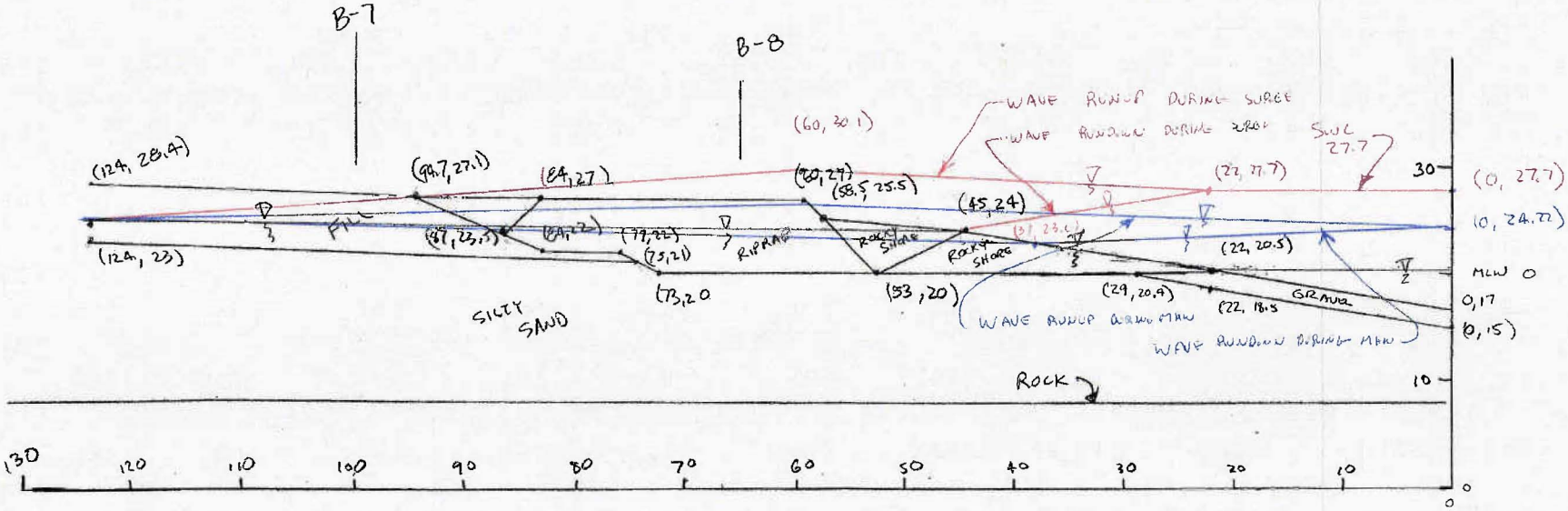
$$\approx 9H : 1V$$



EAST SECTION

SCALE 1"=10'

FIGURE 3



OVERALL BEACH SLOPE

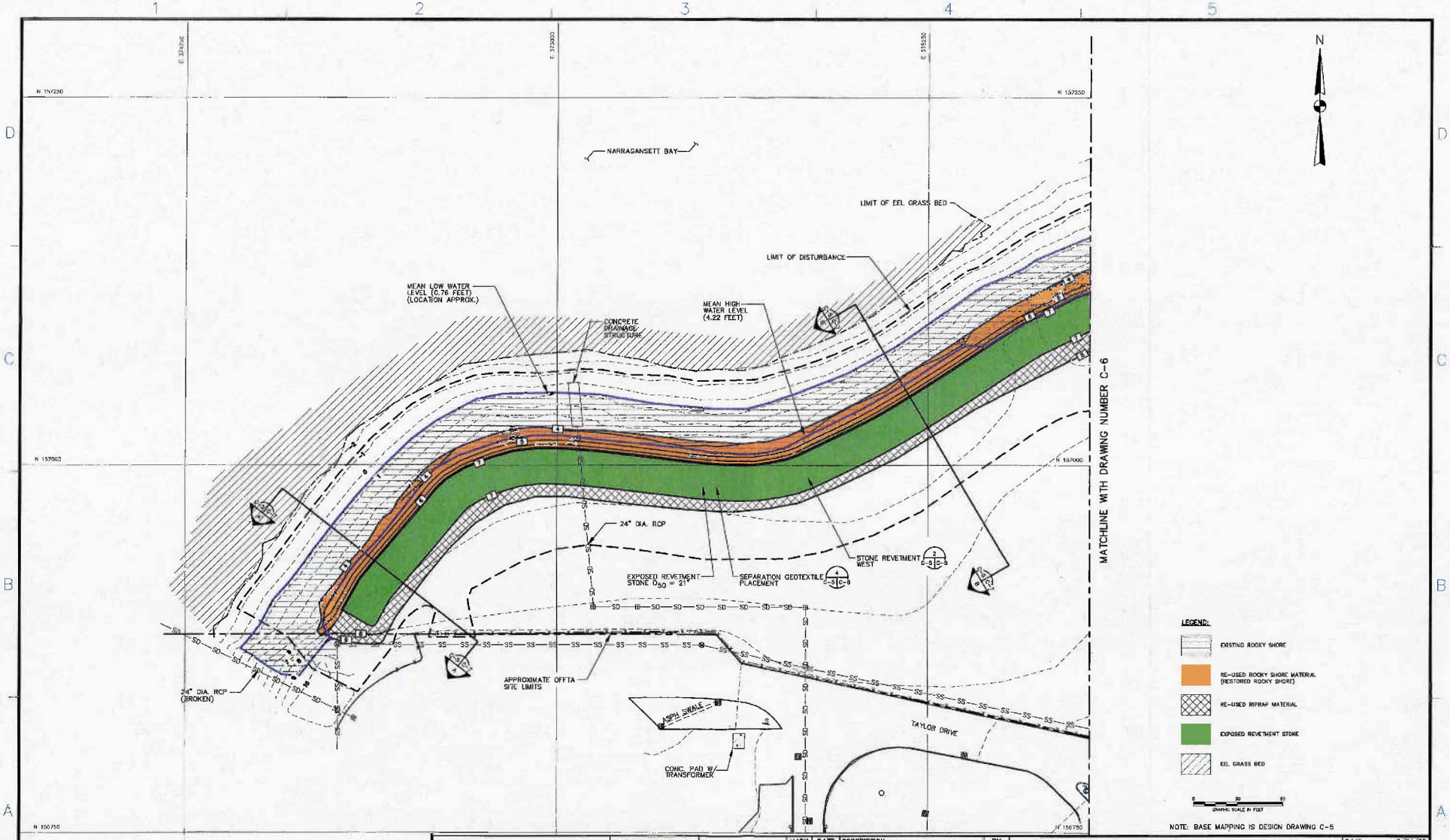
$$\frac{24-20.5}{45-22} = \frac{3.5}{23} = 0.15$$

$\approx$ 6.6 H TO 1V

WEST SECTION

SCALE 1" = 10'

FIGURE 4



NOTE: BASE MAPPING IS DESIGN DRAWING C-5

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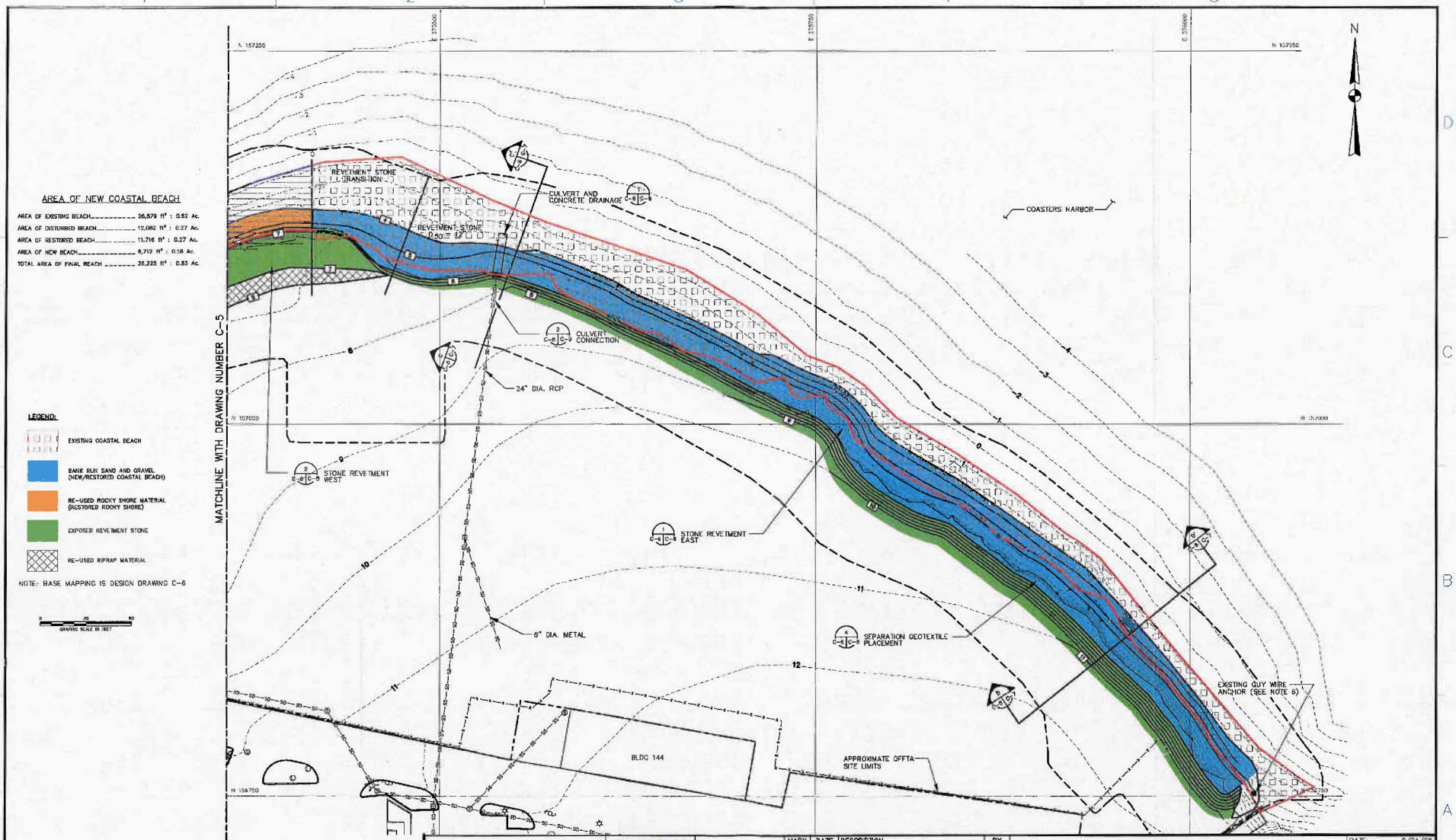
NAVFAC

MARK	DATE	DESCRIPTION	BY

LIMIT OF EXISTING AND FINAL LIMITS OF COASTAL BEACH – WEST OFFTA
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

DATE:	9/24/08
PROJECT NO.:	112200532
DESIGNED BY:	TWS
DRAWN BY:	BH
CHECKED BY:	DCW
SHEET:	1 OF 5

FIGURE 1



AREA OF NEW COASTAL BEACH

AREA OF EXISTING BEACH..... 26,579 ft² : 0.82 Ac.
AREA OF DISTURBED BEACH..... 12,082 ft² : 0.27 Ac.
AREA OF RESTORED BEACH..... 11,716 ft² : 0.27 Ac.
AREA OF NEW BEACH..... 8,712 ft² : 0.18 Ac.
TOTAL AREA OF FINAL BEACH ..... 36,225 ft² : 0.83 Ac.

LEGEND:

- EXISTING COASTAL BEACH
- BANK RUN SAND AND GRAVEL (NEW/RESTORED COASTAL BEACH)
- RE-USED ROCKY SHORE MATERIAL (RESTORED ROCKY SHORE)
- EXPOSED REVETMENT STONE
- RE-USED RIPRAP MATERIAL

NOTE: BASE MAPPING IS DESIGN DRAWING C-6

0 30 60
GRAPHIC SCALE IN FEET

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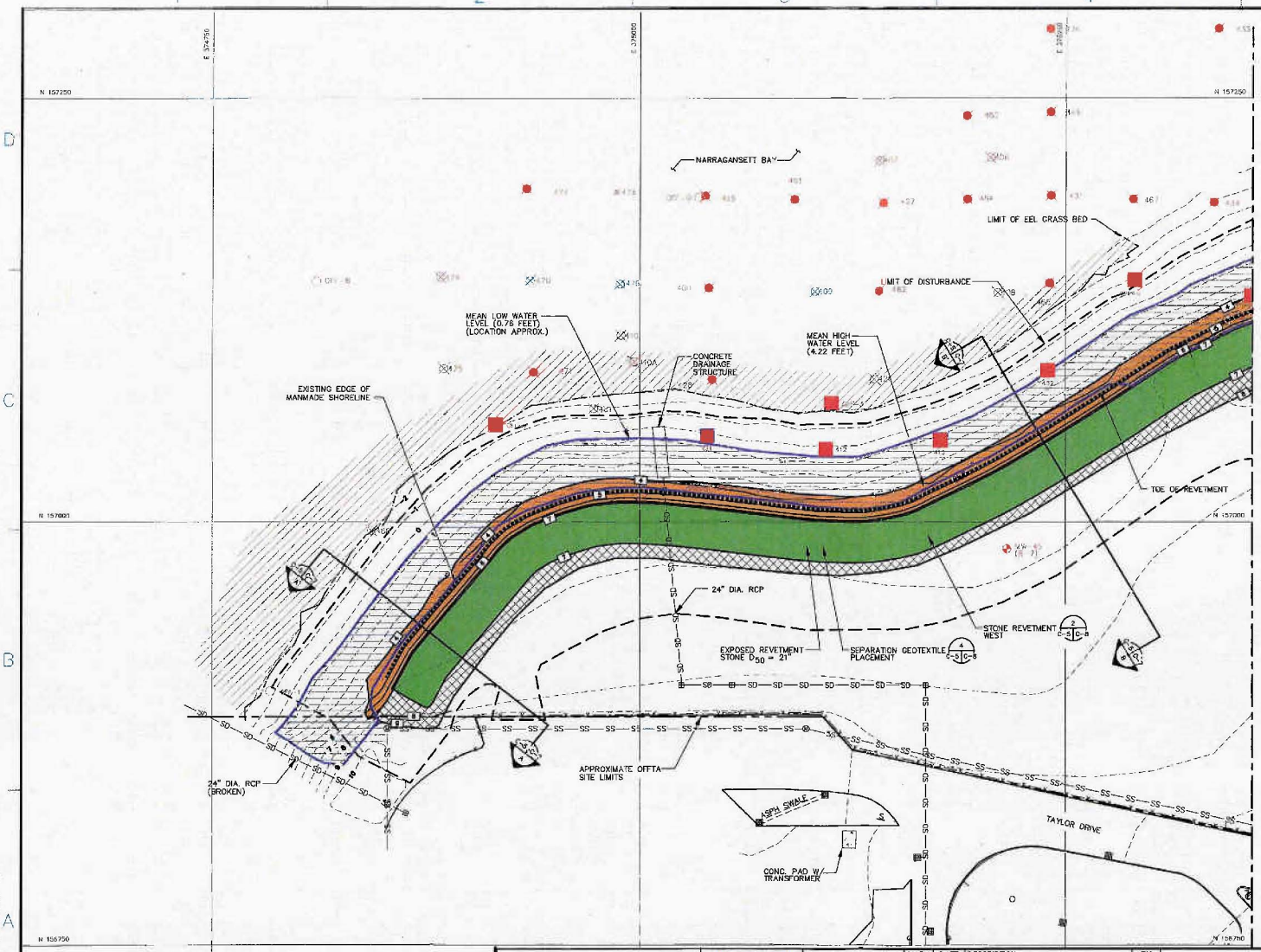
MARK	DATE	DESCRIPTION	BY

LIMIT OF EXISTING AND FINAL LIMITS OF COASTAL BEACH – EAST OFFTA
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

DATE:	9/24/08
PROJECT NO.:	112006632
DESIGNED BY:	TWS
DRAWN BY:	BH
CHECKED BY:	DCW
SHEET:	2 OF 5

FIGURE 2



NOTE: BASE MAPPING IS DESIGN DRAWING C-5

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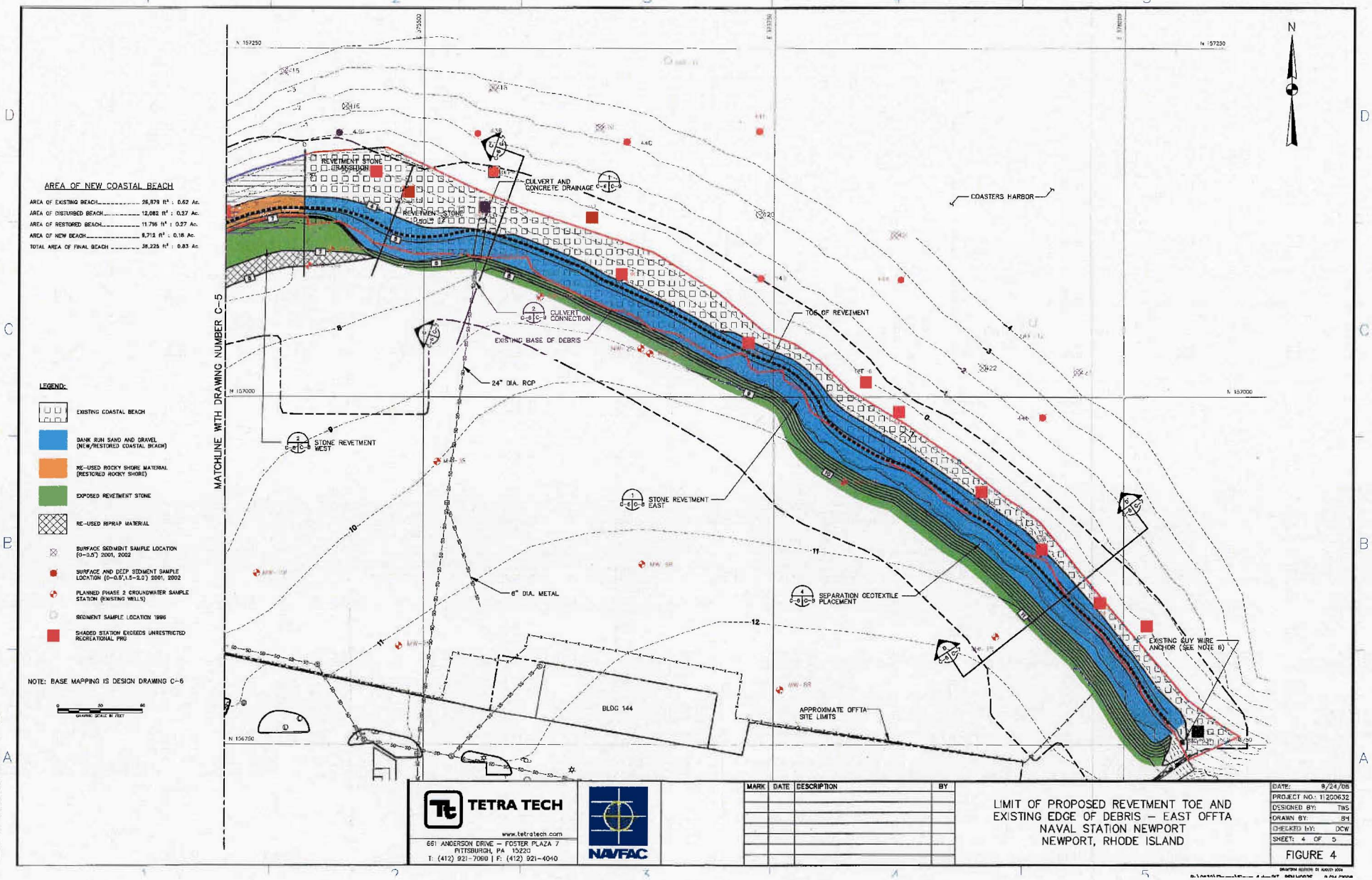
MARK	DATE	DESCRIPTION	BY

LIMIT OF PROPOSED REVETMENT TOE AND EXISTING EDGE OF DEBRIS – WEST OFFTA
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

DATE:	9/24/08
PROJECT NO.:	112G0532
DESIGNED BY:	TWS
DRAWN BY:	BH
CHECKED BY:	DCW
SHEET:	3 OF 5

FIGURE 3



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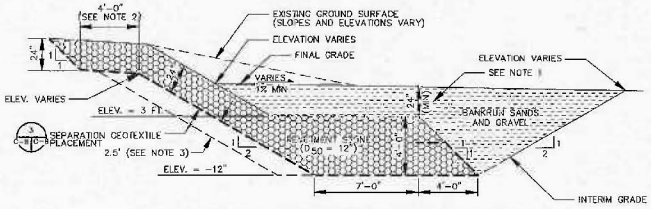
MARK	DATE	DESCRIPTION	BY

LIMIT OF PROPOSED REVETMENT TOE AND EXISTING EDGE OF DEBRIS – EAST OFFTA
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

DATE:	9/24/08
PROJECT NO.:	112G0632
DESIGNED BY:	TWS
DRAWN BY:	BH
CHECKED BY:	DCW
SHEET:	4 OF 5

FIGURE 4



NOTES:

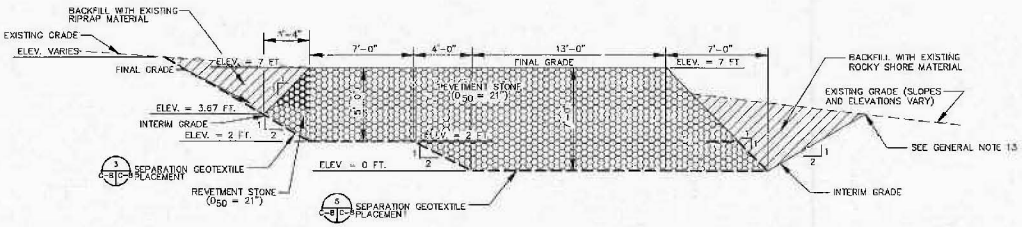
1.) BACKFILL TO EXISTING GRADES TO PROVIDE A MINIMUM OF 2 FEET OF FILL OVER ENTIRE STONE REVETMENT TOE STRUCTURE. AT WATERWARD EDGE OF TOE STRUCTURE CONTINUE FILLING OVER TOE STRUCTURE PROVIDING A MINIMUM SLOPE TOWARD THE WATER OF 1%.

2.) FLANK PROTECTION NOT SHOWN ON C-4 INTERIM GRADES.

3.) REVETMENT WORK IS INCREASED FROM 2.0' TO 2.5' ON EASTERN END OF THE REVETMENT TO PROVIDE FLANK PROTECTION. FULL THICKNESS OF FLANK PROTECTION MUST EXTEND A MINIMUM OF 2.5 FEET ALONG REVETMENT LENGTH PRIOR TO TRANSITION TO REVETMENT THICKNESS OF 2.0 FEET.

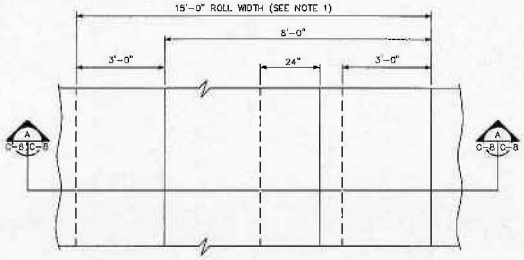
STONE REVETMENT EAST

NOT TO SCALE

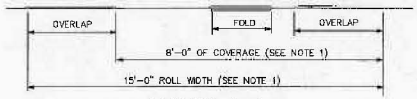


STONE REVETMENT WEST

NOT TO SCALE



PLAN



SECTION A-A

NOTE:

1) ROLL WIDTH MAY VARY.

SEPARATION GEOTEXTILE PLACEMENT DETAIL

NOT TO SCALE

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MARK	DATE	DESCRIPTION	BY

CONSTRUCTION DETAILS
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

DATE:	9/24/08
PROJECT NO.:	112G0632
DESIGNED BY:	WS
DRAWN BY:	BH
CHECKED BY:	DGW
SHEET:	5 OF 5

FIGURE 5