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Creative Engineering Options INC.

CEO

Geotechnical Engineers, Geologists & Environmental Scientists

September 16, 1991 **91-1192**

Mr. Boon Woo
Seaspect Inc.
Island Office Plaza
2737 - 77th Avenue S.E.
Suite 100
Mercer Island, Washington 98040-2834

Subject: **Geotechnical Monitoring of Rockery Construction**
Emergency Protective System Repair
7709 West Mercer Way
Mercer Island, Washington

(Permit No. 91-0673)

Reference: CEO Inc. letter regarding Rockery Construction Guidelines, Emergency Protective System Repair, dated August 1, 1991.

Gentlemen:

Introduction

As requested, we have periodically examined the construction of a rockery recently constructed along the eastern side of the subject site. This rockery was to replace a failed timber wall in the same location. The purpose of our services was to verify that the rockery was built in general accordance with the construction recommendations contained in the referenced letter and the ARC Standard Rockery Construction Guidelines attached thereto.

We visited the site on September 5, 1991 during rockery construction and again on September 11, 1991 after rockery construction was completed. Copies of our Rockery Examination Records are attached for your information.

5418 159th Place NE • Redmond, WA 98052 • (206) 883-6889 • (206) 953-1173 • FAX 881-3592

Rockery Construction

At the time of our first visit to the site on September 5, 1991 to observe the progress of rockery construction, the previously failed timber wall had been removed, the exposed face of the soil bluff excavated to provide space for rockery construction, and the rockery had been partially built. The soil faced exposed consisted of a very dense and partially cemented-in-place silty sand with gravel, a glacial till. At that time, the rockery was approximately eighty (80) feet long and extended to a maximum height of fourteen (14) feet.

By our second visit on September 11, 1991 the rockery had been completed and all the earlier excavated soil removed from the site and disposed. At that time the wall measured approximately eighty-four (84) feet in length and had a maximum height of twenty (20) feet. This height is slightly in excess of the height originally estimated in the referenced letter.

In our professional opinion this height increase does not detrimentally affect the structural integrity of the rockery. The increase in height was made to better accommodate the re-construction of a relatively shallow slope above the rockery. In our opinion, this will reduce the potential for surface erosion, particularly after the surface has been re-vegetated.

The basal row of rock was set into a keyway excavation which varied between about twelve (12) and sixteen (16) inches in depth. The individual rocks were placed in reasonably close proximity to each other so far as the rock shapes would allow. The larger void spaces were subsequently hand chinked with smaller rocks. In general, the rocks were placed in a manner that allowed for flat-to-flat rock contact and, where possible, they are supported on the underlying two rocks.

Because of the specific size and shape of the individual rocks, and the need to obtain a tight fit between the rocks, it was not always possible to achieve a very close rock-to-rock contact. Nevertheless, this does not detrimentally affect the structural integrity of the rockery. The majority of the rocks have been placed with the longest dimension of the individual rock laid back towards the soil face being protected. This tends to result in the placement of a greater mass per foot of rockery.

On the basis of our in-place measurement of a randomly selected fifteen (15) rocks we have estimated that the average individual rock weight is on the order of five thousand two hundred and eighty (5,280) pounds. This is indicative that the rocks are four-man sized rocks. The individual rock weights range between approximately two thousand one hundred and seventy-six (2,176) pounds to eight thousand two hundred and sixty-three (8,263) pounds. The rock face was laid back at a batter of between 1:5 and 1:6 (horizontal:vertical) and presents a clean and aesthetically pleasing product.

A drain rock layer was placed between the rear of the rockery rock and the soil face being protected. Typically, this drain rock layer measured between approximately one and one and one-half feet in thickness. The rock consists predominantly of coarse, angular rock, approximately two to four inches in size.

A four inch diameter, perforated, rigid plastic drain line was installed at the back edge of the keyway to collect any groundwater seepage that might make its way to the base of the rockery. This line, which was placed with sufficient gradient to initiate gravity flow, and an outfall line has been extended beneath the rockery at the lowest point, about twenty (20) feet north of the southern end of the wall.

The rockery contractor explained to us that he was only required to install the outfall line for this drain. Connection to a drainage system will require cutting through a section of the concrete driveway and this, apparently, was not part of the contractor's scope of services. We understand that the owner will make the appropriate connection to a positive and permanent discharge system.

On completion of the rockery a small amount of soil was re-placed along the top of the rockery to re-generate a slope between the rockery and the excavated bluff. This soil must be re-vegetated before the winter to help reduce the potential for surficial erosion. We recommend that a rapid growth, deep rooted, broad leafed vegetation be sown. It might also prove appropriate to use a pegged in-place jute matting to help keep the seed and mulch in-place until the vegetation has an opportunity to germinate and the root mat can take hold. If the re-vegetation is not performed, it is possible that some of the surficial soil could be eroded from the top of the rockery and flushed down onto the driveway. This should be avoided.

Summary

In summary, this rockery has been built of appropriate materials and in general accordance with the recommendations contained in the referenced letter and the ARC Standard Rockery Construction Guidelines attached thereto. It is our professional opinion that the rockery we monitored has been constructed in a competent and professional manner.

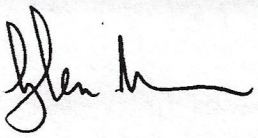
Providing the precautions outlined in the referenced letter are closely followed, this rockery should perform as originally intended throughout the lifetime of the project.

Closure

We appreciate the opportunity to have been of service to you on this project. Our observations and conclusions were made or derived in a manner consistent with that level of skill, care and competence

ordinarily exercised by other members of the profession in good standing currently practicing under similar conditions in this area. No other warranty, express or implied, is made. Should you have any questions regarding any point raised in this letter, or the attachments, or if we can be of further assistance, please call.

Very truly yours,
CREATIVE ENGINEERING OPTIONS, INC.



Glen Mann, P.E.
President

Attachments: Rockery Examination Record (2).

c.c.: City of Mercer Island Building Inspection Department

gm/boonwoo/eb1

EX. 1104
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CEO Creative Engineering Options INC.
Geotechnical Engineers, Geologists & Environmental Scientists

PROJECT NUMBER 91-1192
DATE 9/5/91
EXAMINED BY GM
CHECKED BY
SHEET 1 OF 1

ROCKERY EXAMINATION RECORD

Project Site Location 7709 W. Mercer Way, Mercer Island, WA
Wall Location East side of site.

Construction Status:
Rockery under construction (YES)/[redacted]
Age of completed rockery N/A
Stage of rockery being examined [redacted]/(LOWER)
Rockery completed [redacted]/(NO)
Staged rockery [redacted]/(NO)

Soil Features:
Condition of soil face to be protected Dense to very dense silty sand with gravel - cemented-in-place.
Inclination of excavated slope ~0.1 : 1 H:V
Depth of keyway cut 1 to 1.5 feet Width of keyway cut 5 to 6 feet
Condition and competency of keyway subgrade Very dense silty sand with gravel.

Rockery Slope:
Is there a slope above wall (YES)/[redacted] Gradient of slope 1 : 1 H:V([redacted]/estimated)
Vegetative cover (YES)/[redacted] Nature of cover berry vines, ferns, saplings.
Is there a slope below rockery [redacted]/(NO) Gradient of slope N/A H:V(measured/estimated)
Vegetative Cover [redacted]/(NO) Nature of cover concrete pavement.
Stability of slope(s) (visual evaluation) Stable.

Drainage Provisions:
Drainline is installed (YES)/[redacted] With gradient (YES)/[redacted] Drainline material Perforated plastic
Drainline pipe diameter 4 inches Drainline type (RIGID)/[redacted]
Width of drain filter rock behind wall 1 to 3 feet Average rock size 3 inches
Description of rock backfill Coarse, angular, 2 to 4 inch sized crushed rock.

Rock Wall:
Length of wall examined this visit from 0 feet to 80 feet
Height of wall examined this visit from 0 feet to 14 feet
Total length of completed rock wall 80 feet Max. height of completed rock wall 14 feet (to date)
Describe origin of wall measurement South end of wall at mud shanty.

Description of rock (type, hardness, etc.) Hard, durable, generally seam-free basalt.
Shape of rocks Generally tabular, rectangular and cubical.
Dimensions of largest and smallest rocks in section currently being examined
Largest - length 5.9 feet, width 3.2 feet, height 2.6 feet
Smallest - length 1.8 feet, width 1.4 feet, height 1.2 feet } Excluding chinking rocks
Relationship of rock of rock contact Generally flat-to-flat.
Angle of constructed wall face 1 : 6 H:V Reaction of rocks to hammer (sound) Ringing ping

Additional Comments:

Creative Engineering Options INC.
CEO
Geotechnical Engineers, Geologists & Environmental Scientists

PROJECT NUMBER 91-1192
DATE 9/11/91
EXAMINED BY GM
CHECKED BY
SHEET 1 OF 1

ROCKERY EXAMINATION RECORD

Project Site Location 7709 W. Mercer Way, Mercer Island, WA
Wall Location East side of driveway

Construction Status:
Rockery under construction [redacted] / (NO)
Age of completed rockery ~ 2 days
Stage of rockery being examined [redacted] / (LOWER)
Rockery completed (YES) / [redacted]
Staged rockery [redacted] / (NO)

Soil Features:
Condition of soil face to be protected Dense to very dense silty sand with gravel – cemented in-place.
Inclination of excavated slope ~0.1 : 1 H:V
Depth of keyway cut 1 to 1.5 feet Width of keyway cut 5 to 6 feet
Condition and competency of keyway subgrade very dense silty sand with gravel.

Rockery Slope:
Is there a slope above wall (YES) / [redacted] Gradient of slope 2 : 1 H:V(measured/[redacted])
Vegetative cover (YES) / [redacted] Nature of cover Vines, ferns, shrubs
Is there a slope below rockery [redacted] / (NO) Gradient of slope N/A H:V(measured/estimated)
Vegetative Cover [redacted] / (NO) Nature of cover Concrete driveway pavement.
Stability of slope(s) (visual evaluation) Stable. *

Drainage Provisions:
Drainline is installed (YES) / [redacted] With gradient (YES) / [redacted] Drainline material Perforated plastic
Drainline pipe diameter 4 inches Drainline type (RIGID) / [redacted]E
Width of drain filter rock behind wall 1 to 3 feet Average rock size 3 inches
Description of rock backfill Coarse, angular, 2 to 4 inch crushed rock.

Rock Wall:
Length of wall examined this visit from 0 feet to 84 feet
Height of wall examined this visit from 9 feet to 20 feet
Total length of completed rock wall 84 feet Max. height of completed rock wall 20 feet (~~to date~~)
Describe origin of wall measurement South end of rockery at junction with timber shoring wall.

Description of rock (type, hardness, etc.) Hard, durable and generally seam-free basalt
Shape of rocks Generally tabular, cubical or rectangular.
Dimensions of largest and smallest rocks in section currently being examined
Largest - length 5.9 feet, width 3.2 feet, height 2.6 feet
Smallest - length 1.8 feet, width 1.9 feet, height 1.2 feet } Excluding chinking rocks
Relationship of rock of rock contact Generally flat-to-flat
Angle of constructed wall face 1 : 6 H:V Reaction of rocks to hammer (sound) Ringing ping

Additional Comments: * Area of slope immediately above top-of-rockery should be seeded or sodded before winter to help reduce erosion potential