Ericksen Roed & Associates
Structural Engineers
2550 University Avenue West Ste 201-S
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Facsimile: 651-251-7578

December 2, 2005

Mr. Stanley Hamilton, President & C.E.O.
ReCon Retaining Wall Systems
2311 Wayzata Blvd.
Minneapolis, MN 55405

Re: Structural Analysis

Dear Mr. Hamilton,

This letter summarizes the results of an engineering analysis of ReCon Fence / Guardrail systems, made by Ericksen Roed & Associates, at your request.

Introduction

The purpose of the analysis was to determine the structural capacity of walls and vehicle barriers constructed of ReCon blocks, with respect to lateral forces applied above grade. The analysis did not consider lateral soil pressures from retained earth.

Two general cases were analyzed;

1. A straight, free-standing wall (fence), constructed with loose-stacked ReCon block.
2. A straight* vehicle barrier subject to:
   2.1 A horizontal load as prescribed in the International Building Code (IBC 2000).
   2.2 Impact from moving vehicles.

   *Note: The analysis also applies to curved walls with a convex alignment with respect to the roadway, but is not applicable to walls with a concave alignment.

1.0 Free-Standing Wall

A 6'-8" high free-standing wall, constructed of standard 24" wide blocks plus a cap block, was analyzed with respect to the following loads:

1. A continuous "pedestrian" load of 50 pounds / lineal foot, applied horizontally at a height of 42 inches, per IBC 1607.7.1.
2. A single "pedestrian" load of 200 pounds, applied at any point, per IBC 1607.7.1.1.
3. A wind pressure of 15 pounds / sq. ft., per IBC 1609.1.2.

The critical load combination was determined to be the 50 PLF continuous load acting with 80% of the prescribed wind pressure.

The configuration of the wall and related calculations are included in Exhibit "A".
The configuration of the individual blocks is shown in Exhibit "B".

The 6'-8" high wall was found to have a factor-of-safety of 3.6 against overturning.

Walls less than 6'-8" high will have a greater factor-of-safety against overturning.

The base block must be placed on a layer of compacted granular material (6-inch minimum thickness), to permit drainage beneath the wall. Suitable granular materials are; coarse sand, crushed rock or a stabilized base material typical for pavements. The drainage layer must be placed on engineered fill or competent natural soils with a minimum bearing capacity of 2000 pounds per sq. ft..

Walls constructed on frost susceptible or expansive soils may require special provisions, to avoid detrimental effects of volume changes in the soils. Generally, differential vertical movement of bearing surfaces, greater than 1-inch in 10 feet would be unacceptable.

Special provisions may include increased depth of embedment, installation of buried drain tile, positive surface drainage away from the wall, etc. A qualified Geotechnical Engineer should be engaged to confirm soil bearing capacity and other soil properties which may require special design considerations.

2.0 Vehicle Barrier Wall

A ReCon barrier wall was analyzed with respect to vehicle impact. Two cases were checked.

The wall configurations and related calculations are included in Exhibit "C".

The basic configuration of the barrier wall consists of two 24-inch wide blocks, with a cap block, placed upon two 45-inch wide base blocks, with vertical reinforcing in the block cores. The cap blocks should be bonded to the barrier wall with adhesive, to prevent them from dislodging and flying loose during a vehicle impact.

The vehicle barrier is assumed to be installed on a retaining wall constructed of 45-inch wide ReCon block.

Case 2.1

The structure was analyzed with respect to the standard for "Vehicle Barriers" set forth in the International Building Code (IBC 1607.7.3), which is intended to apply to parking structures or vehicle barriers protecting building elements. The standard is also generally accepted for parking lots, residential side streets or private drives where low vehicle speeds would be typical.

The IBC standard specifies resistance to " a single load of 6000 pounds applied horizontally in any direction to the barrier system"...at a height of 18 inches. It must be pointed out that the prescribed load is an arbitrary static load intended to provide nominal restraint to a slow moving vehicle, i.e. at the edge of parking decks. It is not intended to resist the impact from any specific combination of vehicle mass and velocity.

#4 bars in each core of the barrier wall (24-inches on-center) will resist the prescribed load and provide an approximate factor-of-safety of 1.8 with respect to allowable stresses.

A Geogrid or other tie-back system providing a minimum lateral resistance of 100 lbs. per linear foot, is required to resist sliding and overturning with a minimum factor-of-safety of 1.5

Case 2.2
The structure was also analyzed with respect to impact from moving vehicles.

#5 bars in each block core of the barrier wall will provide an approximate factor–of-safety of 1.5, with respect to allowable steel stresses, due to a 90-degree impact from a mid-sized sedan weighing 3500 lb. and traveling at 15-mph. Minor cracking and dislocation of blocks may occur, but the wall will stop the vehicle and remain essentially intact.

A Geogrid or other tie-back system providing a minimum lateral resistance of 1200 lbs. per linear foot, is required to resist sliding and overturning with a minimum factor-of-safety of 1.5.

Higher velocity impacts can be resisted as the angle of incidence decreases. A 20-mph impact at 25-degrees or a 30 mph-impact at 15-degrees are nominally equivalent to the 15-mph impact at 90-degrees.

Please feel free to contact us if you have questions or concerns regarding our findings.

Sincerely,

Robert A. Curtis P.E. , Principal
MN Reg. No. 10125

Exhibit A

Ericksen Roed & Associates
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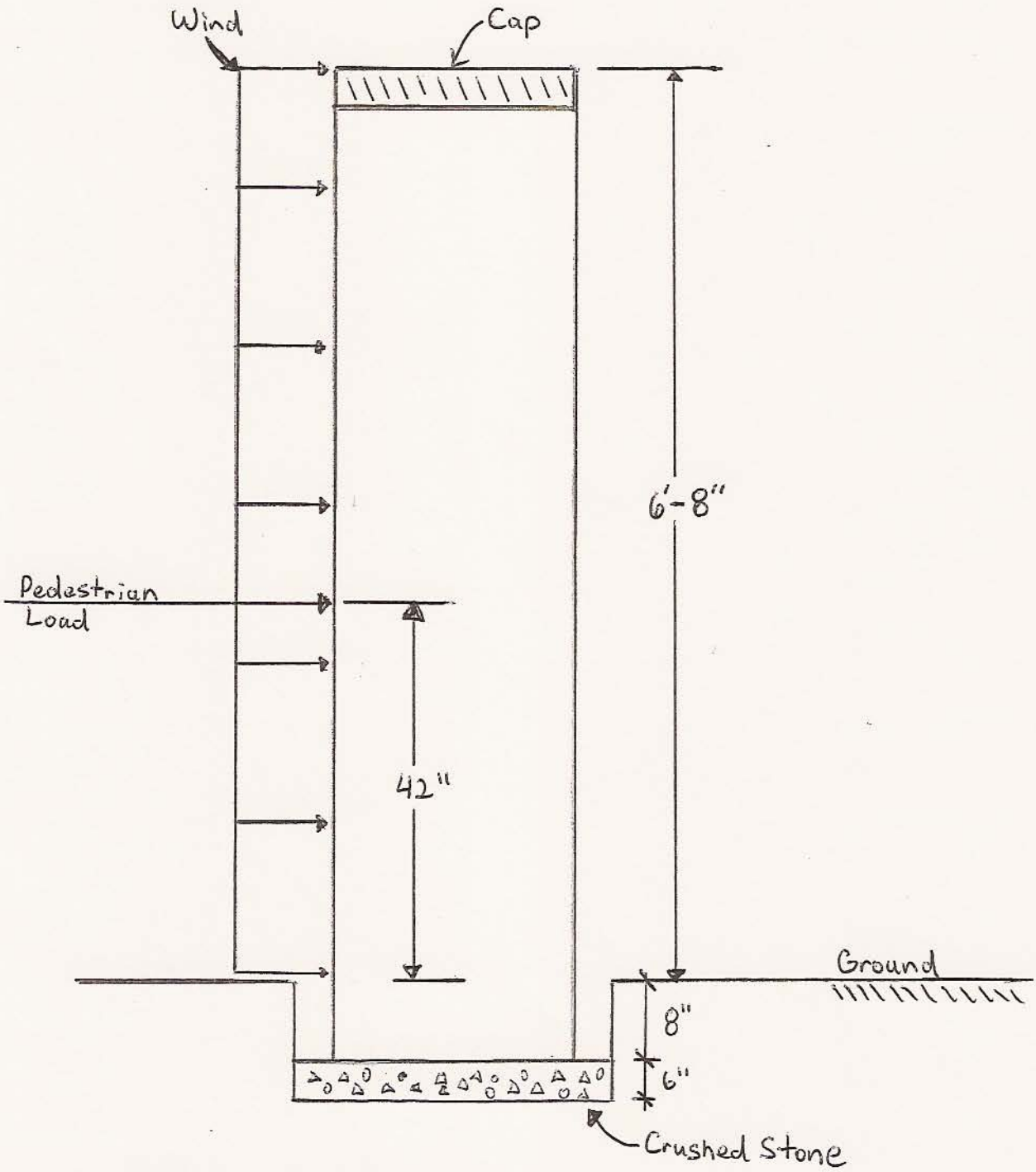
Comm. No. _____

Date 11/14/05

Name SPD

Free Standing Fence Block



Self Weight = 7'-4" x 2 Ft Width x 145 pcf

= 2090 plf

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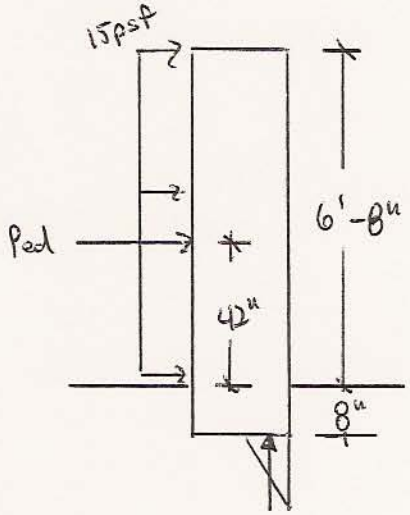
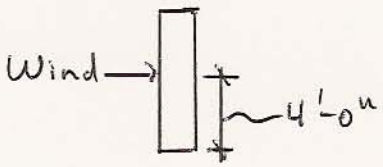
Wind + Pedestrian Load Case

Wind = 15 psf
Ped Load = 50 plf



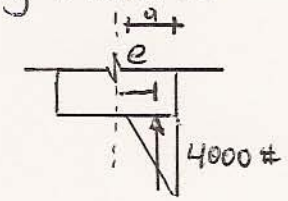
$\frac{M_R}{M_O} \geq 1.5$ Look @ 1ft of Wall



Wind = 15 psf × 6'-8" = 100 plf

$M_O = (100\ plf) \times (4'-0") + (50\ plf) \times (4'-2") = \underline{608\ lb \cdot ft}$ of wall

Assume 2000 psf Bearing Pressure



a = .9569 ft

$\frac{4000}{2} = 2090\,a \quad a = 11.5$ in

$e = \frac{2}{3}(11.5) + (12 - 11.5) = 8.17$ in

$M_R = 2090 \times \frac{8.17}{12} = \underline{1423\ lb \cdot ft}$

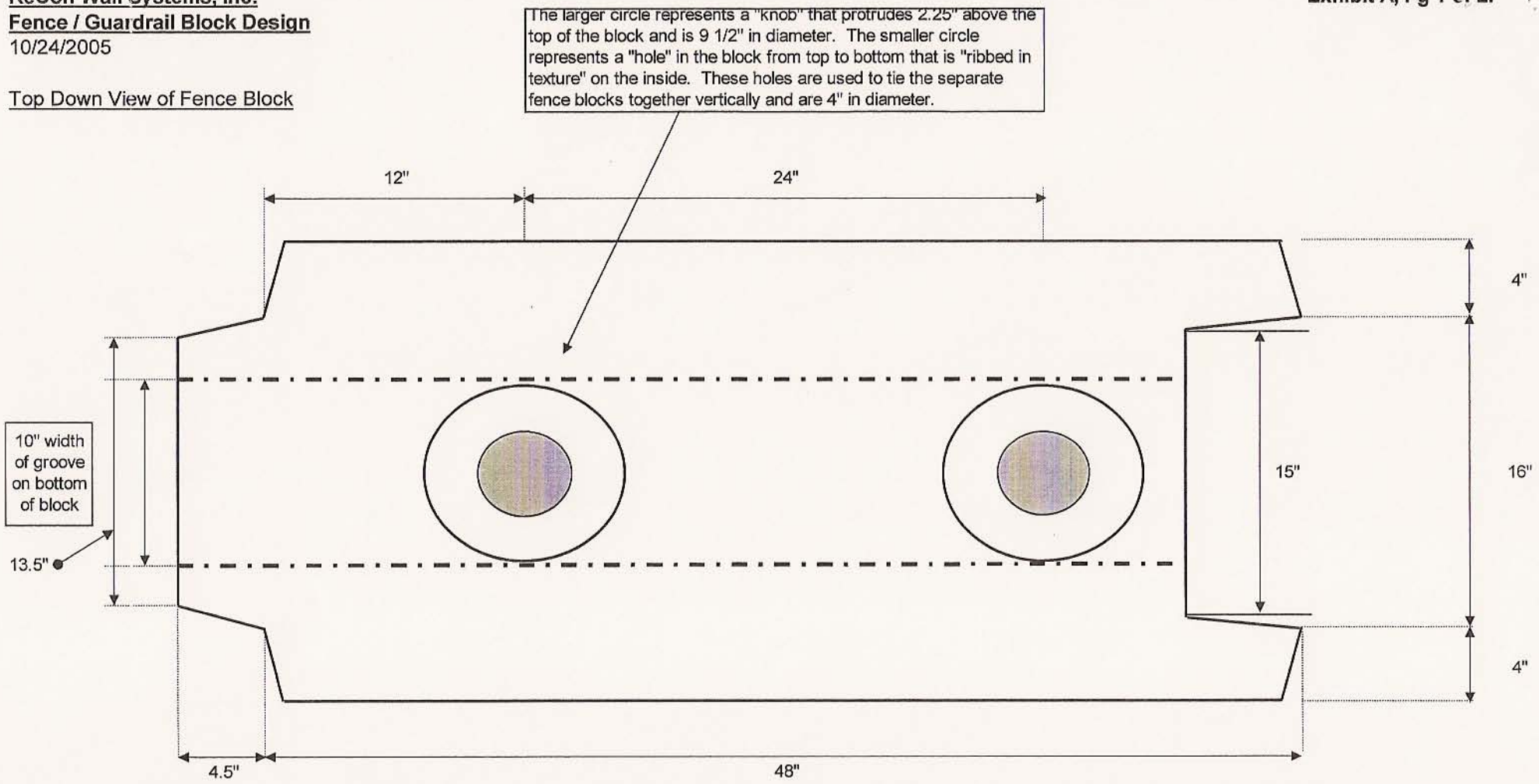
$\frac{M_O}{M_R} = \frac{1423}{608} = 2.3 \geq 1.5$ ✓

FS = 1.5

Exhibit B

ReCon Wall Systems, Inc.
Fence / Guardrail Block Design
10/24/2005

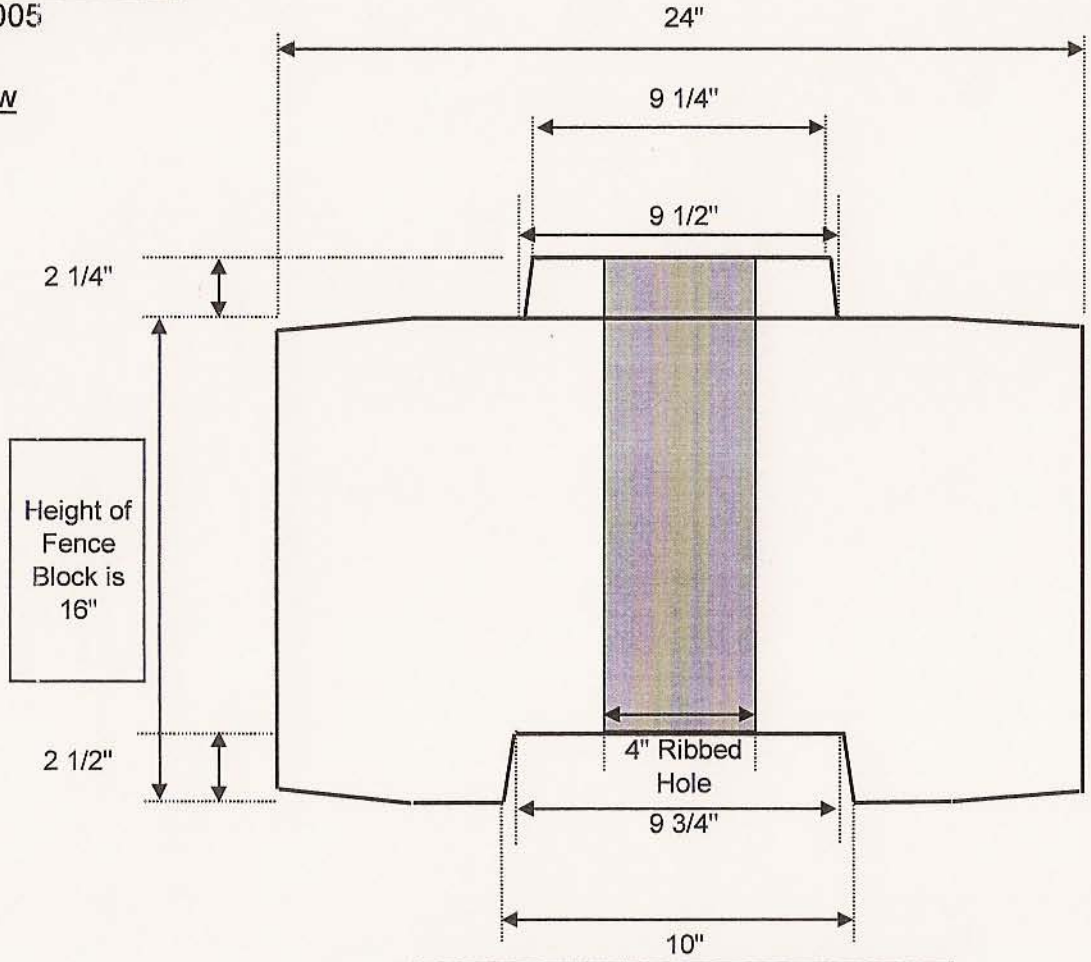
Top Down View of Fence Block



Note: This drawing is not to scale. Concrete shall be minimum 3000 psi with air entrainment (4.5 to 7.5 percent) with a minimum weight per cubic foot of 140 pounds.

ReCon Wall Systems, Inc.
Fence Block Design
10/24/2005

End View



This "groove" runs the entire length of the block. However, the Base Fence Block of a freestanding wall (not transitioning from a retaining wall) should not have the "groove" in it. Rather, it should have a smooth bottom surface.

The knob on the top of the fence block actually represents 2 circle knobs 9 1/2" in diameter at the base of the circle and positioned so that the center point of each knob is 24" apart from each other. See Top Down View for spacing details. Also, a smaller ribbed hole (4" in diameter) will be cast in the center of the knob to allow for vertical reinforcement of the wall.

Exhibit C

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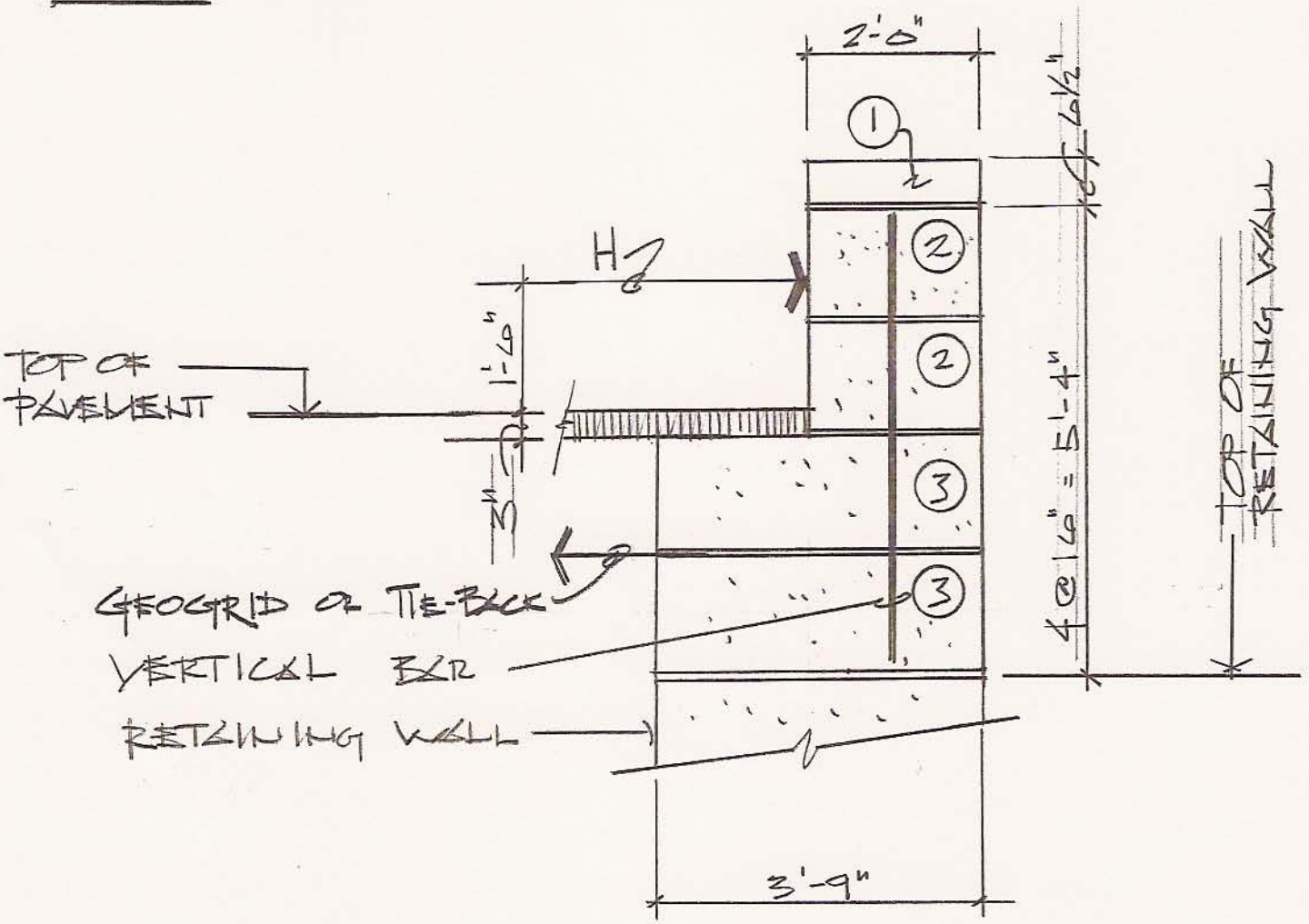
Job RETAIN BLOCK
Comm. No. 205257.00
Date Nov 20, '05
Name RLC

CASE 2: VEHICLE BARRIER



① CAP BLOCK: WT = 580#
② 24" WIDE BLOCK: 1411#
③ 45" WIDE BLOCK: 2491#

SECTION

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CASE 2.1

- 6000# POINT LOAD PER IBC 1607.7.3
- DISTRIBUTE 2/3 OF LOAD TO TWO ADJACENT VERT. BARS

$H = 2/3 \times 1/2 \times 6000\# = 2000\#$

- DL BLOCKS: $\frac{1}{2}[580 + (2 \times 141)] = 1701\#$ (2' OF WALL)
- RESISTING MOMENT WITH #4 @ 24"

$M_R = 0.95 \times 12" \left[1701 + (0.20 kN^2 \times 2400 PSI)\right]$ (g)

$= 74,111$ IN·lbs

$\frac{74,111}{21} = 3529\#$

$S.F. = \frac{3529}{2000} = 1.77$ SAY 1.8

CHECK OVERTURNING FOR 12' LENGTH OF WALL

O.T.M. $= 6000\# \times 53" = 318,000$ IN·lbs

DL. BLOCKS: $3[580 + (2 \times 141\#)] = 10206\#, \times 12" = 122,472$

$6 \times 249\# \longrightarrow 1494\#, \times 22.5" = 336,285$

$\Sigma 25,152\#$ $\Sigma = 458,757$

$\frac{(318,000 \times 1.5) - 458,757}{10" \times 12'} = 95$ PLF

SAY 100 PLF

$25,152\# \times 0.3 = 7,546\# > 6000\#$ OK

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CASE 2.2

90° IMPACT BY 3500# SEDAN @ 15 MPH = 22 FPS

ASSUME CRUSHING DISTANCE = 2.0'

$F_V = \frac{3500^{\#} \times 22^2}{9 \times 2 \times 2.0} = 13,152^{\#}$

$\frac{2}{\frac{1}{2} \times 22} = .182$ MS

DISTRIBUTE ½ OF IMPACT FORCE TO TWO ADJACENT BLKS

$H = \frac{1}{2} \times \frac{1}{2} \times 13152^{\#} = 3288^{\#}$

DL BLOCKS → 1701#

RESISTING MOMENT WITH #5 @ 24"

$M_R = 0.95 \times 12" \left[1701 + (0.31 \times 24,000)\right]$

$= 104207$ IN·LBS

$\frac{104207}{21"} = 4962^{\#}$

$S.F. = \frac{4962}{3288} = 1.51$ > 1.3

CHECK OVERTURNING FOR 16' LENGTH OF WALL

O.T.M = $13,152^{\#} \times 53" = 697,056$ IN·LBS

D.L. BLOCK: $4\left[580 + (2 \times 141^{\#})\right] = 13,608^{\#} \times 12 = 163,296$

$8 \times 2491^{\#} \longrightarrow 19928^{\#} \times 22.5 = 448,380$

$\Sigma = 33,536^{\#}$ $\Sigma = 611,676$

$\frac{697,056 \times 1.5 - 611,676}{16" \times 12'} = 1094^{\#}$

$\frac{697,056 \times 1.33 - 611,676}{16 \times 16} = 1232^{\#}$ < 1200#