VAN DEURZEN AND ASSOCIATES, P.A.

CONSULTING STRUCTURAL ENGINEERS
11011 KING STREET, SUITE 130
COMMERCE TERRACE BUILDING D
OVERLAND PARK, KANSAS 66210
(913) 451 - 6305   FAX (913) 451 - 1021

July 13, 2021

Mr. Kevin Brock
Brock Walls
P.O. Box 860114
Shawnee, Kansas 66286

RE: Retaining Wall Evaluation
4709 NE Saratoga Ct.
Lee's Summit, Missouri

Dear Mr. Brock:

Per your request, Van Deurzen and Associates, P.A. performed an inspection of the retaining wall on the above referenced site on July 9, 2021. The purpose of the inspection was to observe the construction of the retaining and to identify any problems. The services rendered are in accordance with the standard of care exercised by other professional structural engineers in this community under the same or similar circumstances.

The retaining wall inspected is located along the northwest corner of the house. The wall provides the grade separation between the higher back yard and the lower side yard. The retaining walls consist of Recon retaining wall units measuring 16" tall, 24" wide with a maximum exposed height of 4'-0" with clean gravel backfill.

Our inspection consisted of viewing the finished retaining wall and the grades around the retaining wall. Based on our inspection, the wall has been constructed in accordance with the enclosed retaining wall detail and calculations provided by this office, the applicable provisions of the building code and good construction practices. Based on our inspection, we believe that the wall is performing and no corrective actions are required to the retaining wall.

STRUCTURAL DESIGN   INVESTIGATIONS   REPORTS   INSPECTION

Mr. Kevin Brock   July 12, 2021
RE: 4709 NE Saratoga Ct.

We trust this report meets with your needs, if you need any additional information please do not hesitate to contact this office.

Sincerely,
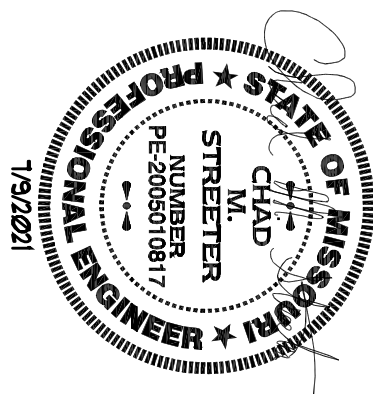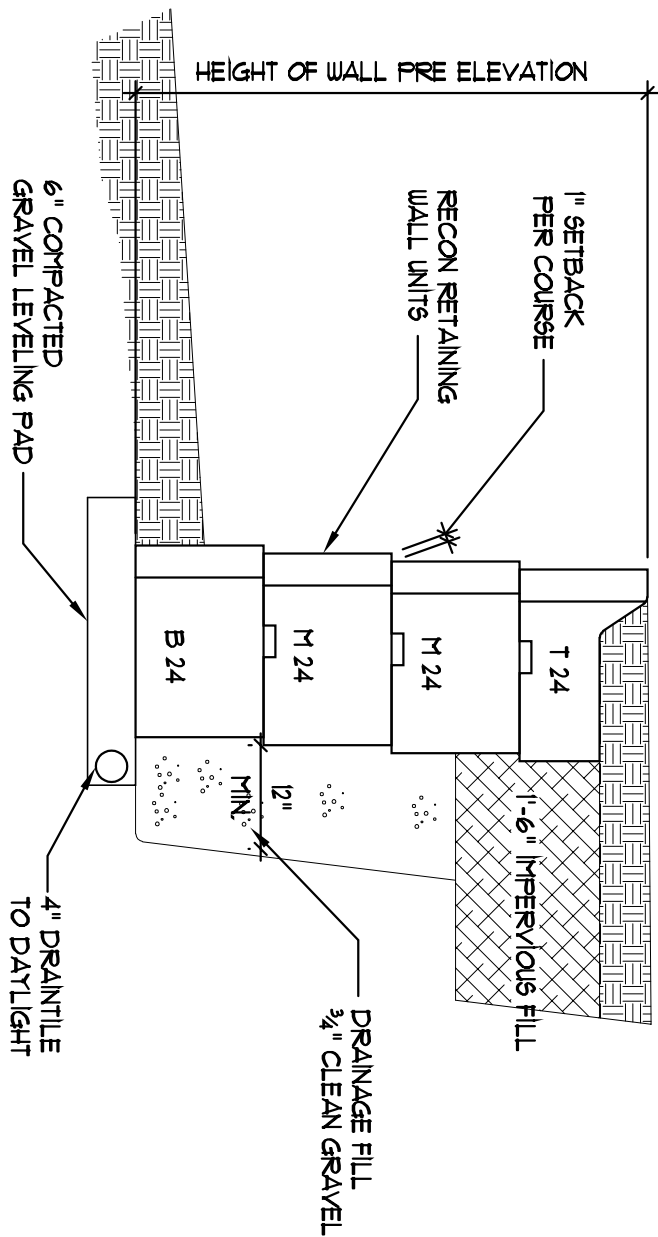
VAN DEURZEN AND ASSOCIATES, P.A.

Chad M. Streeter

Chad M. Streeter, P.E.

7/12/2021

GRAVITY RETAINING WALL SECTION

SCALE: ½" = 1'-0"

HEIGHT OF WALL PRE ELEVATION

6" COMPACTED GRAVEL LEVELING PAD

RECON RETAINING WALL UNITS

1" SETBACK PER COURSE

B 24

M 24

M 24

T 24

12" MIN.

1'-6" IMPERVIOUS FILL

4" DRAINTILE TO DAYLIGHT

DRAINAGE FILL ¾" CLEAN GRAVEL

RETAINING WALL FOR:

4709 NE SARATOGA CT

LEE'S SUMMIT, MISSOURI

DATE:	7/9/2021
BY:	MEJ
JOB:	
SHEET NO.	RW1.1

4709 NE Saratoga Ct
Lee's Summit, Missouri

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Reinforced Soil Retaining Wall Design

VAN DEURZEN AND ASSOCIATES, P.A.
July 9, 2021

ReCon Wall

Project: 4709 NE Saratoga Ct
Location: Site Location
Designer: MEJ
Date: 7/9/2021
Section: Section 1
Design Method: NCMA_09_3rd_Ed, Ignore Vert. Force
Design Unit: ReCon

SOIL PARAMETERS	φ	coh	γ
Retained Soil:	26 deg	0psf	120pcf
Foundation Soil:	26 deg	0psf	120pcf
Leveling Pad: Crushed Stone			
	32 deg	0psf	135pcf

GEOMETRY

Design Height:	4.00ft	Live Load:	0psf
Wall Batter/Tilt:	3.60/ 0.00 deg	Live Load Offset:	0.00ft
Embedment:	0.50ft	Live Load Width:	0ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	0.0 deg	Dead Load Offset:	0.0ft
Slope Length:	0.0ft	Dead Load Width:	0ft
Slope Toe Offset:	0.0ft	Leveling Pad Width:	3.00ft
Vert δ on Single Dpth			

FACTORS OF SAFETY

Sliding:	1.50	Overturning:	1.50
Bearing:	2.00		
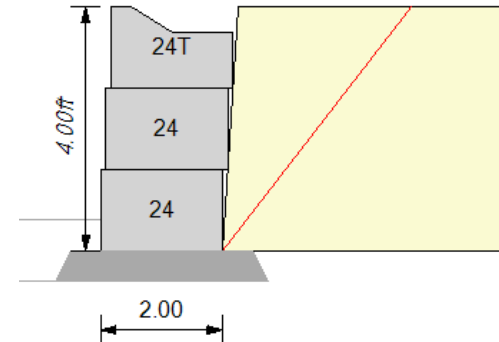
RESULTS

FoS Sliding:	2.01 (lvlpd)		FoS Overturning:	3.43
Bearing:	632.65		FoS Bearing:	4.76
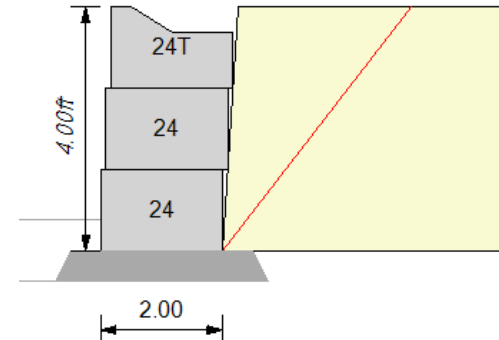
Name	Elev.[dpth]	ka	Pa	Paq	Paqd	(PaC)	PaT	FSsl	FoS OT	%D/H
24T	2.67[1.33]	0.322	34	0	0	0	34	--	25.66	150%
24	1.33[2.67]	0.322	138	0	0	0	138	54.54	7.10	75%
24	0.00[4.00]	0.322	309	0	0	0	309	2.01	3.43	50%

Column Descriptions:

ka: active earth pressure coefficient

Pa: active earth pressure

Paq: live surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(lvl Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.

%D/H: ratio of based depth to height (warning for narrow walls, < 35%)

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final
n or construction without the independent review, verification, and approval by a qualified professional engineer.

ReConWall 5.0.20097

2

RETAINING WALL UNITS

STRUCTURAL PROPERTIES:
    N is the normal force [or factored normal load] on the base unit
    The default leveling pad to base unit shear is 0.8 tan(φ) [AASHTO 10.6.3.4] or
    may be the manufacturer supplied data. φ is assumed to be 40 degrees for a stone leveling pad.

Unit	Ht (in)	Width (in)	Depth (in)	Concr_Vol (cf/ft)	Concr_Density (pcf)	CG (in)
Cap 6.5	6.50	48.00	24.00	1.08	145.00	12.00, 3.25
Cap 8	8.00	48.00	24.00	1.33	145.00	12.00, 4.00
24Top Block	16.00	48.00	24.00	2.01	145.00	10.68, 8.00
39Top Block	16.00	48.00	39.00	2.25	145.00	16.00, 8.00
024(060cm)	16.00	48.00	24.00	2.50	145.00	11.64, 8.00
039(100cm)	16.00	48.00	39.00	3.88	145.00	18.60, 8.00
045(115cm)	16.00	48.00	45.00	4.38	145.00	21.26, 8.00
060(150cm)	16.00	48.00	60.00	5.52	145.00	27.64, 8.00
066(165cm)	16.00	48.00	66.00	5.93	145.00	30.10, 8.00
072(180cm)	16.00	48.00	72.00	6.35	145.00	32.70, 8.00
078(200cm)	16.00	48.00	78.00	6.78	145.00	35.30, 8.00
084(215cm)	16.00	48.00	84.00	7.20	145.00	38.00, 8.00

Unit	Aggr_Vol (cf)	Aggr_Density (pcf)	Aggr_CG (in)	Equiv_Density (pcf)	Equiv_CG (in)
Cap 6.5	0.00	120.00	0.00, 0.00	143.88	12.00
Cap 8	0.00	120.00	0.00, 0.00	144.09	12.00
24Top Block	0.66	120.00	16.01, 8.00	138.78	11.82
39Top Block	0.66	120.00	16.01, 8.00	93.57	16.00
024(060cm)	0.17	120.00	17.33, 8.00	143.48	11.94
039(100cm)	0.45	120.00	27.33, 8.00	142.13	19.37
045(115cm)	0.62	120.00	31.33, 8.00	141.70	22.31
060(150cm)	1.15	120.00	41.33, 8.00	140.65	29.65
066(165cm)	1.57	120.00	45.20, 8.00	142.89	32.82
072(180cm)	1.57	120.00	48.80, 8.00	138.68	35.44
078(200cm)	1.57	120.00	52.20, 8.00	135.12	38.02
084(215cm)	1.57	120.00	55.50, 8.00	132.08	40.68

Note: Calculations and quantities are for PRELIMINARY ANALYTICAL USE ONLY and MUST NOT be used for final
n or construction without the independent review, verification, and approval by a qualified professional engineer.

FORCE DETAILS

The details below shown how the forces are calculated for each force component. The values shown are not factored. All loads are based on a unit width (ppf / kNpm).

Layer	Block Wt	Soil Fill Wt	Soil Wt
1	290.88	79.20	0.00
2	362.50	20.10	0.00
3	362.50	20.10	

Block Weight (Force v (Block Wt + Infill Soil)) = 1135ppf X-Arm = 1.03ft
Soils Block Weight (Force v) = 0ppf   X-Arm = 0.00ft

Active Earth Pressure Pa = 309ppf
    Pa_h (Force H) = Pa cos(δ - batter) = 309 x cos(17.3 - (3.6)) = 301ppf
        Y-Arm = 1.33ft
    Pa_v (Force V) = Pa sin(δ - batter) = 309 x sin(17.3 - (3.6)) = 73ppf
        X-Arm = 2.08ft

CALCULATION RESULTS

OVERVIEW
    ReCon Wall Systems calculates stability assuming the wall is a rigid body. Forces and moments are
calculated about the base and the front toe of the wall. The base block width is used in the calculations. The concrete
units and granular fill over the blocks are used as resisting forces.

EARTH PRESSURES
    The method of analysis uses the Coulomb Earth Pressure equation (below) to calculate active earth
pressures. Wall friction is assumed to act at the back of the wall face. The component of earth pressure is assumed to
act perpendicular to the boundary surface. The effective δ angle is δ minus the wall batter at the back face. If the
slope breaks within the failure zone, a trial wedge method of analysis is used.

EXTERNAL EARTH PRESSURES
         Effective δ angle (2/3 retained phi)   δ =17.3 deg
         Coefficient of active earth pressure   ka =0.322

         External failure plane   ρ = 52 deg
         Effective Angle from horizontal   α =93.60 deg
         Coefficient of passive earth pressure: kp = (1 + sin(φ)) / (1 - sin(φ)) kp =2.56

$$Ka := \frac{\cos(\phi_i + i)^2}{\cos(i)^2 \cdot \cos(\delta_i - i)\left(1 + \sqrt{\frac{\sin(\phi_i + \delta_i) \cdot \sin(\phi_i - \beta)}{\cos(\delta_i - i) \cdot \cos(i + \beta)}}\right)^2}$$

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FORCES AND MOMENTS

The program resolves all the geometry into simple geometric shapes to make checking easier. All x and y coordinates are referenced to a zero point at the middle of the base block for eccentricity calculations.

UNFACTORED LOADS

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.00	1016	--	1.03	--	--	1041
Soil Fill(W0)	1.00	119	--	1.50	--	--	179
Pa_h	1.00	--	301	--	1.33	401	--
Pa_v	1.00	73	--	2.08	--	--	153
Sum V / H	1.00	1209	301		Sum Mom	401	1373

X-Len: is measured from the center of the base

BEARING LOADS: NCMA

Name	Factor γ	Force (V)	Force (H)	X-len	Y-len	Mo	Mr
Face Blocks(W1)	1.00	1016	--	-0.03	--	--	-25
Soil Fill(W0)	1.00	119	--	-0.50	--	--	-59
Pa_h	1.00	--	301	--	1.33	401	--
Pa_v	1.00	73	--	-1.08	--	--	-80
Sum V / H	1.00	1209	301		Sum Mom	401	-164
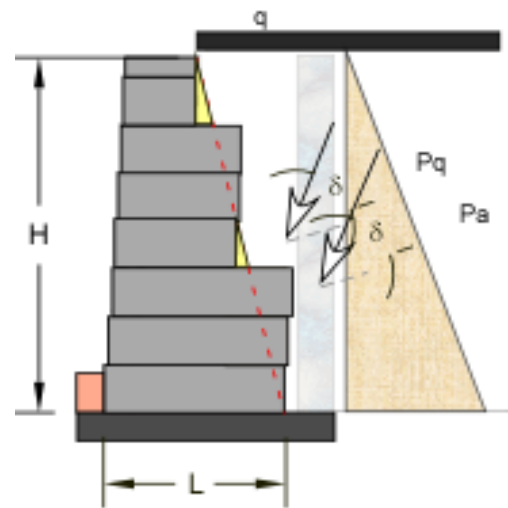
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BASE SLIDING

Sliding at the base is checked at the block to leveling pad interface between the base block and the leveling pad.

Forces Resisting sliding = W0 + W1 + Pav

119 + 1016 + 73   N =1209ppf

Resisting force at pad = (N * 0.8 * tan(slope) + intercept x L)

1209 x0.8 x tan(32.0) + 0.0   Rf =604

Driving force is the horizontal component of
Pah

301 Df =301

FSsl = Rf / Df   FSsl =2.01

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n or construction without the independent review, verification, and approval by a qualified professional engineer.

OVERTURNING ABOUT THE TOE

    Overturning at the base is checked by assuming rotation about the front toe by the block mass and the soil retained on the blocks. Allowable overturning can be defined by eccentricity (e/L). For concrete leveling pads eccentricity is checked at the base of the pad.

    Moments Resisting Overturning = M0 + M1 + MPav

179 + 1041 + 153   Mr =1373ft-lbs

    Moments causing Overturning = MPah

401 Mo =401ft-lbs

        FSot = Mr / Mo

        FSot =1373 / 401   FSot =3.43

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ECCENTRICITY AND BEARING

Eccentricity is the calculation of the distance of the resultant away from the centroid of mass. In wall design the eccentricity is used to calculate an effective footing width.

Calculation of Eccentricity

$SumV = W0 + W1 + Pav$

    $119 + 1016 + 73$ SumV = 1209

Moment Resisting   Mr = -164

Moment Driving   Md = 401

    $e = (SumMr + SumMd)/(SumV)$

    $e = (236 / 1208.73)$ e =0.196ft

Calculation of Bearing Pressures

    $Qult = c * Nc + q * Nq + 0.5 * \gamma * (B') * Ng$

      where:

        $Nc = 22.25$

        $Nq = 11.85$

        $Ng = 12.54$

        $c = 0.00psf$

        $q = 120.00psf$(soil weight above base of leveling pad)

        $B' = B - 2e + lvlpad = 2.11ft$

        $Gamma = 120pcf$

    Calculate Ultimate Bearing, Qult   Qult =3009psf

    Bearing Pressure = (SumVert / B') + (LP width * gamma)   sigma = 632.65psf

    Calculated Factors of Safety for Bearing   Qult/sigma =4.76