A TR Engineering Inc.
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3/11/99

TO:
Masonry Heater Association / WSCPA
c/o Lopez Quarries Masonry Heaters / Firecrest Fireplace Corp.
111 Barbara Lane
Everett WA. 98203

Attention Mr. Jerry Frisch
Subject: Masonry Heater Stabilization / Supplemental to report dated 7/20/98

Dear Jerry,

I have revised the previous calculations to include the new Uniform Building Code lateral coefficients. I have also modified my previous calculations to include the resisting effect of the structures' dead load. As you can see in the attached calculation sheet the resistance to overturning is greater that the overturning caused by the lateral force, with a factor of safety (FS) greater than 1 .0 in all cases. This satisfies the code requirement for stability. Although stability of the stoves is shown, I would like to suggest that we still use the details shown on drawings M-4 and M-5 with these modifications: (1) use a 1/4" flat plate in lieu of the previous channel and (2) use 1/4" diameter rods instead of 3/8" diameter. This will provide an extra factor of safety against workmanship and varying unit dead load weights for each stove type.

If you have any questions regarding this information, please feel free to call.

Sincerely,

A.T. Rack

Arthur T. Rack P.E.
President

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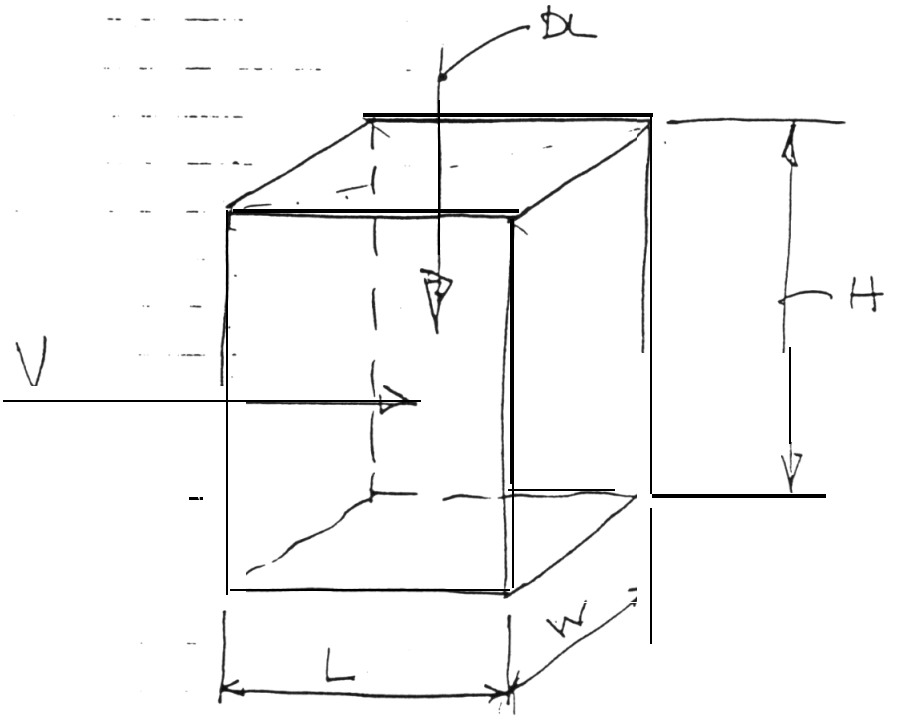
PROJECT

MASONRY HEATER ASSOCIATION

MASONRY STOVE STABILITY

Sheet No. M-1

Date 7/20/98



$$M_{OT} = V \times \frac{H}{2}$$

WHERE $V = .2W$
SEISMIC ZONE 4
NON-BUILDING STRUCTURE

$$M_R = DL \times \frac{W}{2}$$

$$T = \frac{M_{OT} - M_R}{W}$$

New M2

file: masonOT

For Masonry Heater Association I WSCPA
c/o Lopez Quarries Masonry Heaters / Firecrest Fireplace Copr.
111 Barbara Lane
Everett WA 98203

Masonry Stove Types
1. Russian Multi-Flue
2. German Austrian
3. Finnish
4. Swedish
5. Small Grundofen

STABILITY CHECK

Mark	Firebox Weights (lbs)	Height (ft)	Width (inches)	Length (inches)	Lateral Seismic (lbs) v=% of Gravity 0.252	Mot Overturning Moment #-A	Mr Resisting Moment #-ft	Factor of Safety FS= Mr/Mot
Type 1	20,000	7.25	36	72	5.040	18,270	30,000	1.64
Type 2	14,000	7.25	32	64	3,528	12.789	18.667	1.46
Type 3	12.500	7.25	36	48	3,150	11,419	18.750	1.64
Type 4	11,000	7.25	26	44	2,772	10.049	Il.917	1.19
Type 5	9,000	5.00	24	34	2.268	5,670	9 . m	1.59

Per 1997 Uniform Building Code / Seismic Zone 3
Lateral per 1629.6.8 for Non Building Structural Systems
Per 1634.3 for Rigid Structures
V=0.7 x Ca x I x W where Ca=0.36 / I=1.0

V= 0.252 W

Overturning and Stability Requirements Per 1605.2.2

REVISED TO (4) 1/4" RODS + 1/4" PLATE

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PROJECT: Masonry Heather Association

Sheet No.: M-3

MASONRY STONE STABILITY

Date 7/20/98

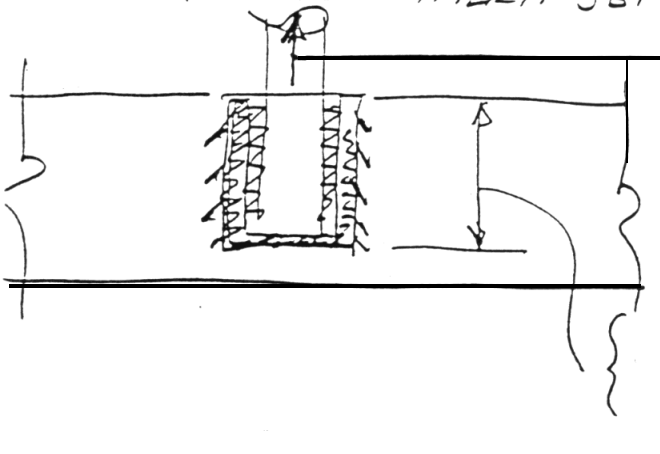
EMBEDMENT OF 3/8" ϕ INTO CONC PAD
ASSUME f'_c = 2500 psi min.

MINIMUM LOAD TO DEVELOP = 2500#/ROD.
Ld = 12d = 4 1/2" min. ⇒ IMPLIES 6" TK PAD.

MIN EDGE DISTANCE 5d OR 4" MIN.
5d = 1.875" USE 4" MIN

EPOXY GROUT
3/8" ϕ = 6580# ÷ 4 = 1645#/ROD = 3 REQ'D
1/2" ϕ = 12015# ÷ 4 = 3003#/ROD = 2 REQ'D

ALTERNATE MULTI SET ANCHOR TM RED HEAD



		N
3/8" ϕ	= 3300 ÷ 4 = 825	6
1/2" ϕ	= 5450 ÷ 4 = 1362	4
5/8" ϕ	= 7000 ÷ 4 = 1750#	3

SHEAR ACROSS HORIZONTAL PLANE

Assume Compression @ 50 psi
FOR 1. V = 4000#

TOTAL AREA = 2(36" + 72") x YY = 3.625" = 783 IN^2

COEFFICIENT OF FRICTION Masonry / MASONRY = 0.5 TO 0.7
TOTAL RESISTANCE = .5 x 783 x 50 psi = 19,575# > 4000#

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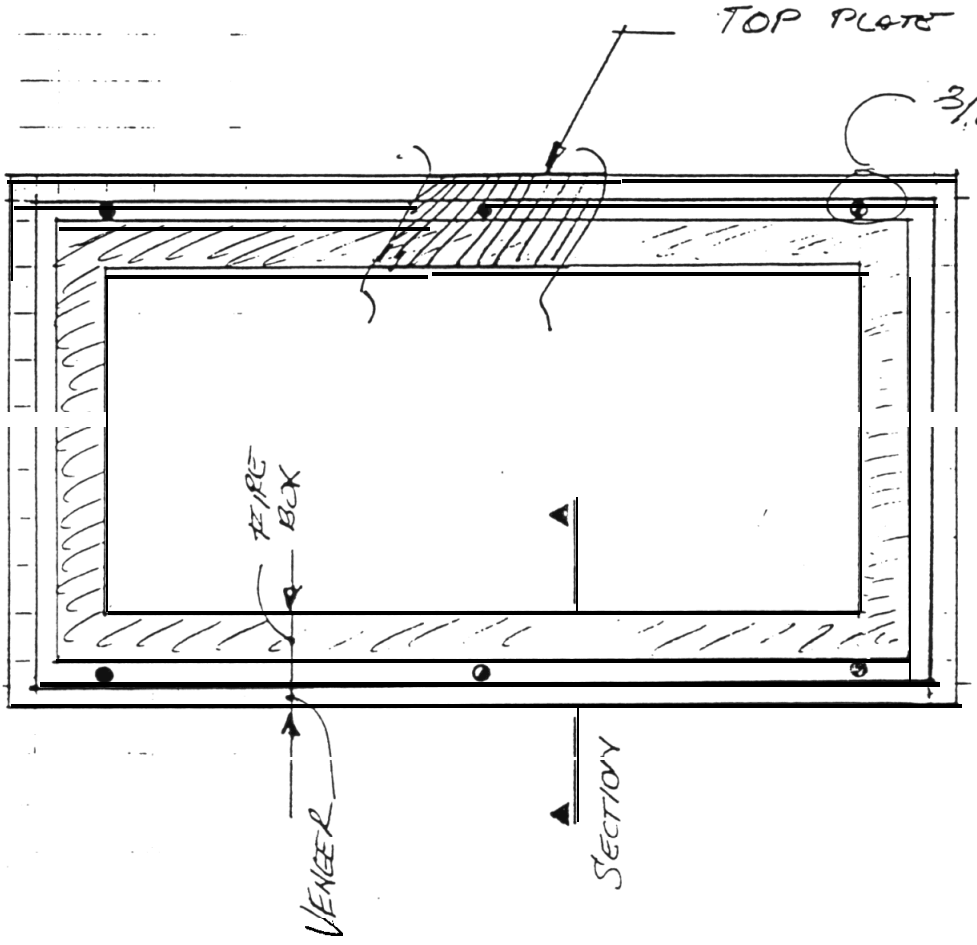
PROJECT

MASONRY HEATER ASSOCIATION

MASONRY STOVE STABILITY

Sheet No. M-4

Date 7/20/98



PLAN of ROD LAYOUT.

Revised To
4 - 1/4" RODS
w/ 1/4" FLAT PLATE ON TOP
See Cover Letter - 3/11/99

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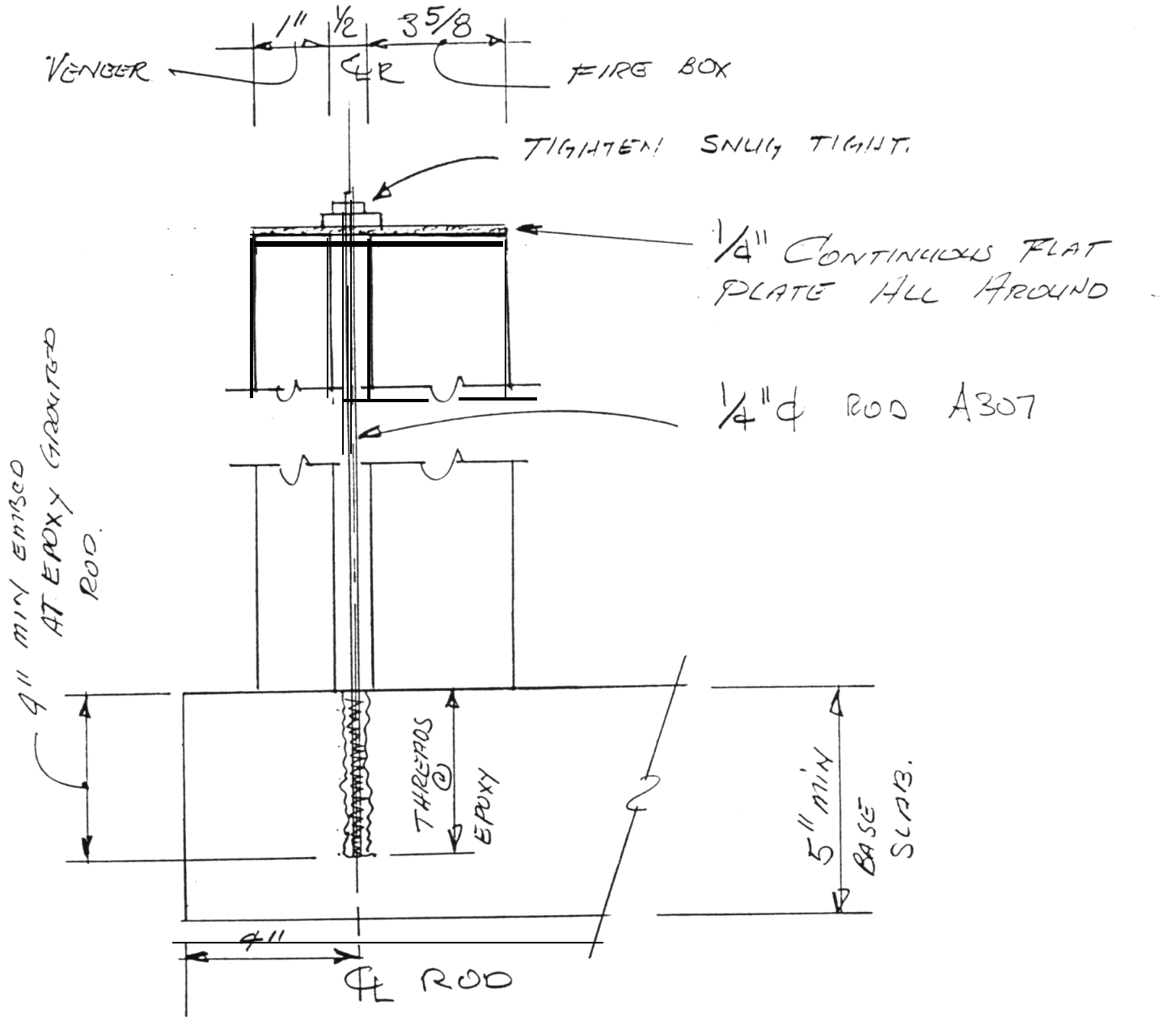
MASONRY HEATER ASSOCIATION

MASONRY STOVE STABILITY

Sheet No. M-5

Date 7/20/98



SECTION @ TENSION ROAD

NTS

REVISED 3/11/99

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PROJECT

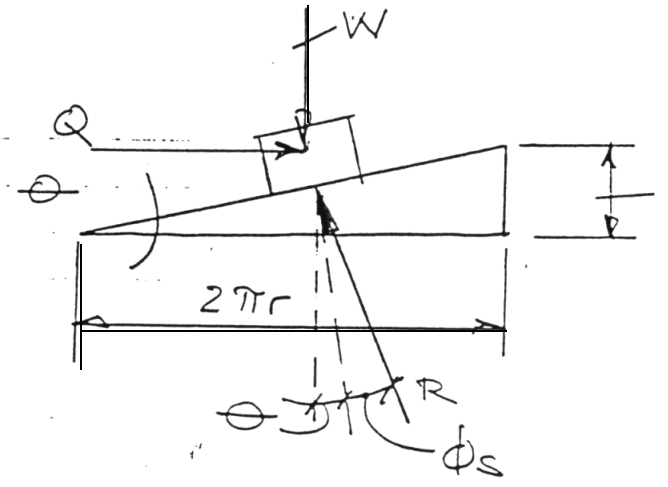
MASONRY HEATERS ASSOCIATION

TORQUE CALCULATIONS

Sheet No. MC

Date 7/20/98

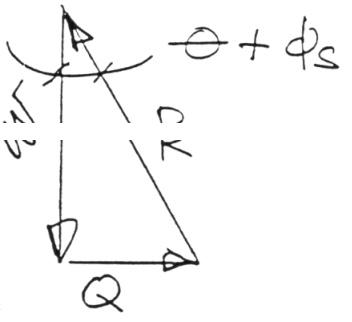
FREE BODY DIAGRAM



L = LEAD ON BOLT

SEE CALCULATIONS

THEN



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MASONRY HEATER ASSOCIATION

TORQUE CALCULATIONS ON ROD

Sheet No; MM

Date 7/20/98

TORQUE ON RODS

@ 50 psi
WITH A = 783 in²

R = 19,575# > 4000#

REDUCTION FACTOR = $\frac{4000^{\#}\ \text{REQ'D}}{19\,575^{\#}\ \text{PROVIDED}} = 0.204$

THEN 50 psi × .204 = MIN psi Rqd = 10.2 psi

MIN CLAMPING FORCE ≥ 10.2 psi × A = 8,000#

EACH 3/8" ϕ ROD = 2376#/ROD

$\frac{8000^{\#}}{2376} = 3.4$ MIN USE 4 MIN. RODS.

CONVERT TORQUE TO CLAMPING FORCE

3/8" ϕ 16 THREADS / IN
SINGLE THREADED.

SEE ⇨ DIAGRAM

PITCH = 1/16 = 0.063
LEAD = L = 1 × PITCH = 0.063
COEFFICIENT BETWEEN THREADS = μ_s = 0.30

LEAD ϴ $\tan\theta = \frac{L}{2\pi r} = \frac{0.063\ \text{in}}{2\pi(3/16)} = 0.053$ ϴ = 3°

$\tan\phi_s = \mu_s = 0.30$ = $\phi_s = 16.7°$

FORCE Q ← ASSUMED
Q(3/16 in) = 30 #-ft.

$Q = \frac{30 \times 12}{3/16} = 1920^{\#}$

$W = \frac{Q}{\tan(\phi + \phi_s)} = \frac{1920^{\#}}{\tan 19.7°} = 5362^{\#}$

REDUCE TORQUE TO $\frac{2376^{\#}}{5362^{\#}} \times 30^{\#}\text{-ft} = 13^{\#}\text{-ft}$ use