INLAND ENGINEERING & CONSULTING, INC.
Structural & Civil Engineering

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SHT. # 1 OF 8
JOB # 8124
DATE: 2/4/08

STRUCTURAL CALCULATIONS

PREPARED FOR: SUNTREK

PROJECT: SOLAR POOL HEATING ATTACHMENT

TRACY, CA. 95376

REGISTERED PROFESSIONAL ENGINEER
SHAWN NIKJOO
NO. 38969
EXP. 6-30-08
CIVIL
STATE OF CALIFORNIA

2-5-08

GENERAL INFORMATION:

BUILDING CODE: 2007 CBC

MATERIAL PROPERTIES

LUMBER: (STRUC. LUMBER DOUGLAS FIR LARCH)

	GRADE	Fb	Ft	Fv	E	Fc
2x AND 4x JOIST AND BEAM.....	No. 2	875	575	95	1.6x10^6	1300
	No. 1	1000	575	95	1.7x10^6	1300
	SELECT	1450	575	95	1.9x10^6	1300
6x BEAMS & THICKER.....	No. 1	1350	675	85	1.6x10^6	925
6x POSTS.....	No. 1	1350	825	85	1.6x10^6	1000
GLU-LAMINATED BEAMS.....	24-F-V4	2400	1100	165	1.8x10^6	1600
PSL-PARALLAM OR EQ.		2800	1850	285	2.0x10^6	2700

CONC.:	fc	wt.
SLAB ON GRADE.....	2500 psi	150pcf
FOOTING.....	2500 psi	150pcf

MASONRY:
CONC. BLOCK..... 1500 psi

REINF. STEEL: ..... # 4 BAR AND SMALLER GR. 40.
5 BAR AND LARGER GR. 60.

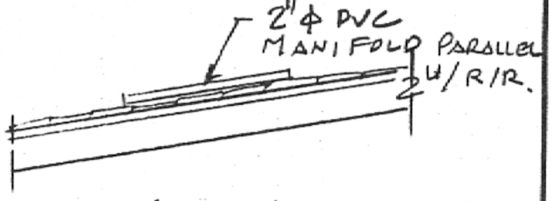
STRUC STEEL:
STRUC. PLATES..... Fy = 36 ksi
PIPE COLS..... Fy = 35 ksi
STL. TUBES..... Fy = 46 ksi

SCOPE OF WORK

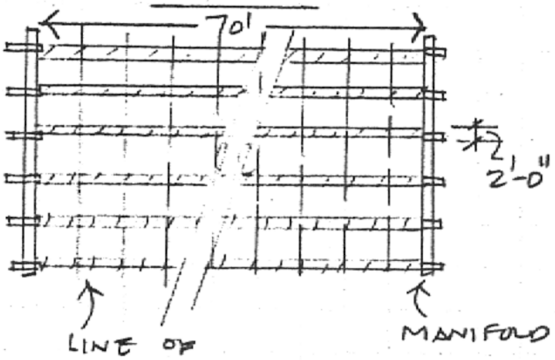
SUNTREK'S SOLAR SYSTEM ATTACHMENT ON ROOF

WEIGHT OF SYSTEM : 1.5 PSF FULL

MAX. COLLECTOR SPAN = 70 FT.



SECTION



PLAN

DESIGN LOADS:

WIND: 85 MPH EXP. C

ASSUMED HT. OF ROOF 20'

$K_z = .90$

$K_{zt} = 1.0$

$K_d = .85$

$I = 1.0$

$q_h = .00256\, K_z\, K_{zt}\, K_d\, V^2 I$

$= .00256\,(.9)(1.0)(.85)(85^2) I$

$= 14.15$ PSF

NEG. EXTERNAL PRESSURE COEFF. FOR $(GCp) = -0.9$

$P_w = q_h\,[GCp - GCpi]$

$P_w = 14.15\,[-0.9 - -.18] = 15.3$ PSF

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SEIS. LOAD:

$$F_p = \frac{.4 a_p S_{DS} W_p}{(R_p/I_p)}\left(1 + 2\frac{z}{h}\right) \begin{cases} < F_p = 1.6 S_{DS} I_p W_p \\ > .3 S_{DS} I_p W_p \end{cases}$$

$a_p = 2.5$, $R_p = 3.0$, $I_p = 1.0$ $S_{DS} = \frac{2}{3} S_{MS}$, $S_{MS} = F_a S_S$ } ZIP. CODE 95209

$F_a = 1.163$ $z = h = 20.'$ $S_S = .842$

$S_{MS} = (1.0)(.842) = .842$

$S_{DS} = \frac{2}{3}(.842) = .561$ } SITE CLASS "D"

$$F_p = \frac{(.4)(2.5)(.561) W_p}{(3./1.)}\left(1 + 2\frac{20}{20}\right) = .561 W$$

F_p MAX. $= 1.6(.561)(F_p) W_p = .897 W_p$

F_p MIN. $= .3(.561)(F_p) W_p = .168 W_p$ } OR

NOTE:

* COLLECTORS ARE 2'-0" WIDE
* COLLECTORS ARE ATTACHED TO ROOF @ 2'-0" O.C.

T.A. OF COLLECTOR = 2' x 2' = 4.0 S.F.

WT. = 4.0 (1.5 PSF) = 6.0 LB./FT.

WIND LOAD: $F_W = 15.3$ PSF (6) = 91.8 LBS./FT.

SEIS. LOAD: $F_S = .561(6) = 3.37$ LBS./FT.

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CHK. ADHESIVE STRENGTH (SUNTREK SEALANT)

BASED ON TEST RESULTS PROVIDED BELOW

AVERAGE TENSILE STRENGTH IS GIVEN AS 8.04 #/IN

$F_t = 24" (8.04) = 193^{\#} > 91.8^{\#}$ $F.S. = 2.1$ OK

The following table is a summary of the data collected during our testing:

Substrates (Adherents)	Average Peel Strength (Pounds Per Linear Inch)
Suntrek Rubber Tubing / Ceramic Tile	12.156
Suntrek Rubber Tubing / Composition Roofing	10.996
Suntrek Rubber Tubing / Wood (maple)	8.045

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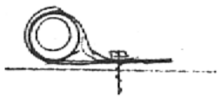
CHK. CONNECTION OF 2"ϕ MANIFOLD:

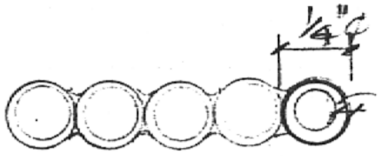
2"ϕ PVC MANIFOLD ATTACHED EVERY 28" o.c. TO EXIST'G. ROOF TILES FOR TILE ROOFS.

2"ϕ PVC MANIFOLD ATTACHED EVERY 28" o.c. TO EXIST'G. ROOF RAFTERS FOR SHAKE OR SHINGLE ROOFS.

EA. 2"ϕ PVC WRAPED W/ SOLAR PANEL TUBING CONSISTS OF 1/4"ϕ PLASTIC TUBING (TOTAL OF 5 - 1/4"ϕ TUBING)



ALLOW. TENSILE STRENGTH = 1479 psi FOR 1 - 1/4"ϕ TUBE



$A = \pi D^2/4 = \pi(.25^2 - .125^2)/4 = .036\ in^2$ $\Sigma A = 5(.036) = .184\ in^2$

$T_{ALLOW} = 1479\ psi\ (.184) = 272\ \# > 91.8\ \#$ OK

PHYSICALS OF SUNTREK SOLAR TUBE

SAMPLE	SLAB-DUMBBELL	TUBE
DURO, A	80	80
TENSILE STRENGTH, psi	1728	1479
ELONGATION, %	247	224
MOD@25%, psi	355	281
MOD@50%, psi	370	473
MOD@75%, psi	807	686
MOD@100%, psi	1001	899
MOD@200%, psi	1562	1448

2" ϕ PVC PIPE SCH. 40 FILLED W/ WATER.

PIPE #/1 WATER #/1

$EWT. = (3.653 + 1.453)\frac{28"}{12} = 12.^{\#}$ $\quad \frac{28"}{12} = 2.33^{FT.}$

$F_S = .561(12) = 6.73^{\#}$

$F_W = (2.33)(2)15.3 = 71.3^{\#}$ ← CONTROLS

1/4" ϕ LAG SC INTO WOOD RAFTERS MIN. 2" EMB.

$T_{ALL} = 225^{\#}/IN\,(2") = 450.^{\#} > 71.3^{\#}$ OK

USE 1/4" ϕ WOOD-SC 2" MIN. EMB. INTO ROOF RAFTERS

CONN. TO ROOF TILES (CONC. TILES)

W/ 1/4" ϕ LAG-SC W/ 5ϕT" EPOXY TO CONC. TILES

$T_{ALL} = 90.^{\#} > 71.3^{\#}$ OK

USE 1/4" ϕ LAGS W/ SHIELD EPOXY INTO CONC TILE

COVER HOLES TO PREVENT LEAKAGE

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