

**10 MWe Solar Thermal
Central Receiver Pilot Plant
Solar Facilities Design Integration**

**PSS FINAL DESIGN CALCULATIONS
BOOK 7 OF 26--RECEIVER TOWER FOUNDATIONS
CONSTRUCTION PACKAGE 7A (RADL ITEM 7-8)**

September 1980

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**PREPARED FOR THE
U.S. DEPARTMENT OF ENERGY
SOLAR ENERGY
UNDER CONTRACT DE-AC-03-79SF10499**

PREFACE

This document is provided by McDonnell Douglas Astro-nautics Company (MDAC) in accordance with Department of Energy Contract Number DE-AC03-79SF10499, Reports and Deliverables List (RADL Item 7-8). The report was prepared by Stearns-Roger Engineering Corporation under MDAC Subcontract Number 78012035.

The Plant Support Subsystem Final Design Calculations (RADL Item 7-8) are arranged in a twenty-six book volume as shown on the master Table of Contents.

Book 7 of this document is provided in support of the Receiver Tower Foundation, Construction Package No. 5A and includes structural design calculations, and reference sheets for trade study and drilled pier alternate. The calculations are supplemented by the design criteria and engineering data previously submitted by RADL 7-1, Final Soils Report.

Questions concerning this report should be directed to R.J. Perkins at (714) 896-3073.

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BOOK 4 - RECEIVER TOWER
STRUCTURAL, CONSTRUCTION
PACKAGE 5A (RADL ITEM 7-21)

Note: This document includes design calculation for the receiver tower steel (Construction Package 5A) which was previously submitted by MDAC letter A3-228-EP-RJP-46, dated 16 January 1980, and therefore, is not included in this submittal. Please transfer your copy to your RADL ITEM 7-8 file, marking it as BOOK 4 of 25.

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Note: This document was previously submitted by MDAC Letter A3-228-EP-RJP-262, dated 7 March 1980 and therefore is not included in this submittal. Please transfer your copy to your RADL ITEM 7-8 file, marking it as BOOK 25 of 25.

BOOK-26-MDAC GENERAL ANALYSIS AND
BACKGROUND DATA

- 1 Plant Process and Preliminary Component Requirements
- 2 Receiver Subsystem Calculations
- 3 Thermal Storage Subsystems Calculations
- 4 Analysis of Plant Cost Reduction Options
- 5 Collector Field Design and Plant Power Calculations
- 6 Miscellaneous Plant Calculations

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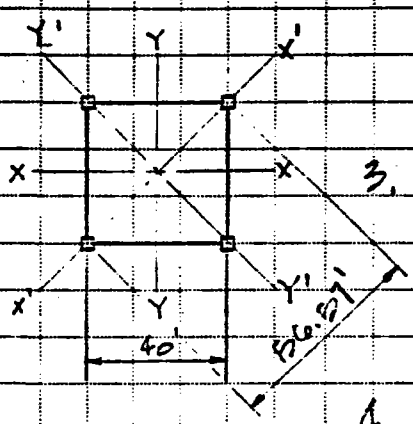
FORM 62.114
REV. 4.75

JOB NO. C-21700 DATE 7-23-79 PAGE 1
 BY RCR CHK HJM
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER - SPREAD FOOTING

REF. H.I.M.'S STEEL CALCULATION SHEETS P. 279 THRU. P. 285

DATA: 1. TOTAL D.L. = 1049^K, OR 1049/4 = 262^K/col.
 " L.L. = 243^K, OR 243/4 = 61^K/col.

2. WIND FORCE NORMAL TO X-X OR Y-Y AXIS:



$H = 357.2^K$ TOTAL, OR $357.2/4 = 89.3^K$ /col.
 $V = \pm M/2 = 50498/40 \times 2 = \pm 631^K$ /col.

3. WIND FORCE NORMAL TO X'-X' OR Y'-Y' AXIS (DIAGONAL):

$H = 371.2^K$ TOTAL, OR $371.2/4 = 92.8^K$ /col.
 $V = \pm M/2 = \pm 50951/56.57 = 401^K$

4. SEISMIC FORCE NORMAL TO X-X OR Y-Y AXIS:

$H = 212^K$ TOTAL, OR $212/4 = 53^K$ /col.
 $V = \pm 488^K$ /col.

5. SEISMIC FORCE NORMAL TO X'-X' OR Y'-Y' AXIS (DIAGONAL):

$H = 212^K$ TOTAL, OR $212/4 = 53^K$ /col.
 $V = \pm 682^K$ /col.

(SEISMIC NOT GOVERNING!)

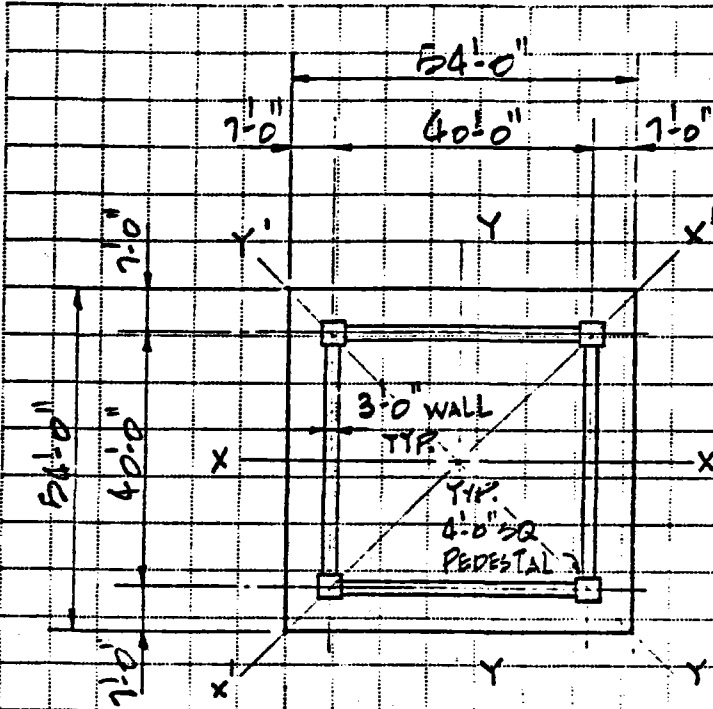
MATERIALS: $f_c = 3000$ PSI
 $f_y = 60,000$ PSI

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PAGE

2

JOB NO. C-21700 DATE 7-23-79 BY CS [Signature] CHK HJM
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER - MAT FOUNDATION



$$I_x = I_y = I_{x'} = I_{y'} = \frac{54^4}{12} = 708588 \text{ FT}^4$$

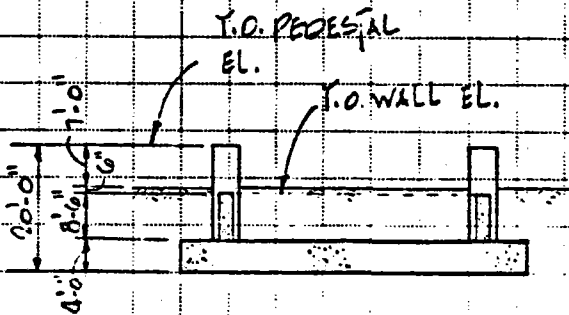
$$S_x = S_y = \frac{708588}{27} = 26244 \text{ FT}^3$$

$$S_{x'} = S_{y'} = \frac{708588}{27\sqrt{2}} = 18560 \text{ FT}^3$$

PLAN

WT. OF FDN.:

- PEDESTALS $4 \times 4 \times 16 \times 4 \times 0.15 = 154^k$
 - WALLS $3 \times 36 \times 53 \times 4 \times 0.15 = 231^k$
 - FDN. MAT $54^2 \times 4 \times 0.15 = 1750^k$
- $S = 2455^k$



WT. OF BACKFILL: (SOIL WT. = 110[#]/CF)

$$W = (54^2 \times 9 - 4^2 \times 4 \times 9 - 3 \times 36 \times 3.5 \times 4) \times 0.11$$

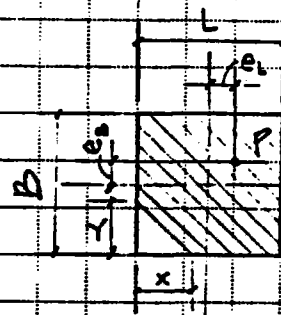
$$= 2420^k$$

SECTION

$$\text{TOTAL WT.} = 2455 + 2420 = 4875^k$$

JOB NO. C-21700 DATE 7-23-79 BY CS Chang CH'K HJM PAGE 3
 CUSTOMER MDAC PROJECT SOLAR A/E
 SUBJECT FOUNDATION FOR RECEIVER TOWER

CASE (I): DIAGONAL WIND + D.L. + L.L.



$$P = 1049 + 4875 + 243 = 6167 \text{ K}$$

$$M_o = 50921 + 3712 \times 20 = 58375 \text{ IK}$$

$$M_x = 6167 \times 27\sqrt{2} = 235479 \text{ IK}$$

Factor of safety = $235479 / 58375 = 4.03715$ O.K.!

$$M_x = M_y = 58375 \times 0.707 = 41271$$

REF. "FDN. DESIGN" BY WAYNE C. JENK 1962
 P. 133 FIG. G-14

$$e_b = e_L = 41271 / 6167 = 6.69'$$

$$e_b / B = e_L / L = 6.69 / 54 = 0.124$$

$$\therefore K = 2.6, \quad x = y = 0.3L = 0.3B$$

$$p_{max} = KP / BL = 2.6 \times 6167 / 54^2 = 5.50 \text{ KSF}$$

$$p_{net} = 5.50 - 13 \times 0.11 = 4.07 \text{ KSF} < 5 \times 1.33 = 6.65 \text{ KSF O.K.}$$

(WINDWARD - CLYDE SOIL REPORT P. 7)

CASE (Ia): DIAGONAL WIND + 75% D.L.

$$P = 0.75 \times 1049 + 2655 = 3242 \text{ K}$$

$$M_x = 3242 \times 27\sqrt{2} = 123792 \text{ IK}$$

Factor of safety = $123792 / 58375 = 2.1 > 1.5$ O.K.

FOR SOIL PRESSURE SEE p_1 on 3

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FORM 62-114
REV. 4-75

JOB NO. 21700 DATE 8-16-79 BY HJM CH'K 3a
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FDN. RECEIVER TOWER

$$(I) \quad \frac{P}{A} = \frac{6167K}{54^2} = 2.11 \text{ Ksf}$$

$$\frac{M_x}{S} = \frac{41,271 \times 6}{54^3} = \pm 1.57 \text{ "}$$

$$\frac{M_y}{S} = \pm 1.57 \text{ "}$$

$$P_{max} \approx 5.25 \text{ Ksf} \sim 5.5 \quad (OK)$$

$$(P_{min} = -1.03 \text{ Ksf}) \rightarrow (N/A)$$

$$(Ia) \quad \frac{P}{A} = \frac{3,242}{54^2} = 1.11 \text{ Ksf}$$

$$\frac{M_x}{S} = \pm 1.57 \text{ "}$$

$$\frac{M_y}{S} = \pm 1.57 \text{ "}$$

$$E_p = 4.25 \text{ Ksf} \quad [\text{or } -2.03 \text{ Ksf}] (N/A)$$

$$e_B = e_C = \frac{41,271}{3,242} = 12.73 \text{ '};$$

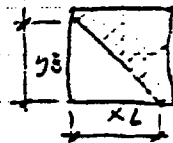
$$e_B/B = \frac{12.73}{54} = 0.24$$

$$\therefore K = 5.5$$

$$x = 0.95L; \quad y = 0.95B$$

$$P_{max} = 5.5 (3,242) \frac{1}{54^2} = 6.11 \text{ Ksf}$$

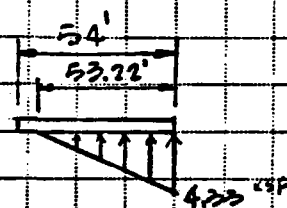
$$P_{net} = 6.11 - 13(.11) = 4.68 \text{ Ksf} < 6.65 \quad (OK)$$



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JOB NO. C-21700 DATE 7-23-79 BY G. Chang CHK AM
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

PAGE 4

CASE (I): NORMAL WIND + D.L. + L.L.

$$P = 6167 \text{ K} \quad (\text{P.3})$$

$$M_o = 50498 + 357.2 \times 20 = 57642 \text{ K}$$

$$M_R = 6167 \times 27 = 166509 \text{ K}$$

$$\text{FACTOR OF SAFETY} = 166509 / 57642 = 2.89 > 1.5 \quad \text{O.K.}$$

$$e = M_o / P = 57642 / 6167 = 9.35' > \frac{1}{6} \times 54 = 9' \quad \text{RESULTANT OUTSIDE MID } \frac{1}{2}$$

$$p_{\text{max}} = \frac{P}{A} \left(\frac{4e}{3b - 6e} \right) = \frac{6167}{54^2} \left(\frac{4 \times 9.35}{3 \times 54 - 6 \times 9.35} \right) = 4.31 \text{ KSF}$$

$$p_{\text{net}} = 4.31 - 13 \times 0.11 = 2.88 \text{ KSF} < 6.65 \text{ KSF} \quad \text{O.K.}!$$

CASE (Ia): NORMAL WIND + 75% D.L. (SEE P.4a)CASE (I): D.L. + L.L.

$$p_{\text{max}} = 6167 / 54^2 = 2.11 \text{ KSF}$$

$$p_{\text{net}} = 2.11 - 13 \times 0.11 = 0.68 \text{ KSF} < 6.0 \text{ KSF} \quad \text{O.K.}!$$

COMPARE TO ABOVE THREE CASES, CASE (I) IS FOR CHECKING OF SOIL BEARING PRESSURE ONLY, NOT PRACTICAL FOR DESIGN OF FON. \therefore USE CASE (I) FOR FOUNDATION MAT DESIGN.

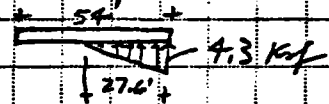
JOB NO. 21700 DATE 8-17-79 BY HJM CH'K. fa
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FDN. f. RECEIVER TOWER

(IIa) : NORMAL WIND + DL (.75) :

$P = 3,242^k$ (Pg. 3 CK. PRINT)

$e = \frac{M_{OT}}{P} = \frac{57,642}{3,242} = 17.8' > \frac{54'}{6} = 9' \therefore R \rightarrow 0.5 \text{ MID. } \frac{1}{3}$

$a = \frac{54'}{2} - 17.8 = 9.2'$



$\text{max } P = \frac{2 \times 3,242}{3 \times 9.2 \times 54} = 4.3 \text{ krf} < 5 \times 1.33 = 6.65$ (OK)

$M_{ST.} = 3,242 \times 27' = 87,534^k$

$S.F. = \frac{87,534}{57,642} = 1.52 > 1.5$ (OK)

JOB NO. C-21700 DATE 7-23-79 PAGE 5
 BY CS (Camp) CHK. HJM
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

FDN. DESIGN

CASE (I)

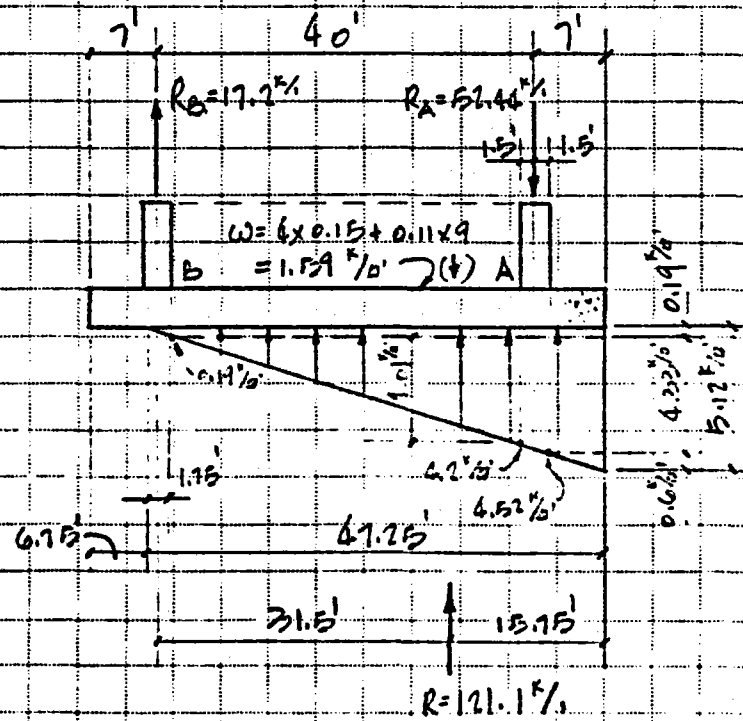
$$P_u = [(1049 + 4875) \times 1.4 + 243 \times 1.7] \times 0.75 = 6530^k$$

$$M_u = 57642 \times 1.7 \times 0.75 = 73494^k$$

$$e = M_u / P_u = 73494 / 6530 = 11.25' > \frac{1}{6} \times 54 = 9'$$

$$p_u \text{ max} = \frac{6530}{54^2} \left(\frac{4 \times 54}{3 \times 4 - 6 \times 11.25} \right) = 5.12 \text{ KSF}$$

$$a = \left(\frac{54}{2} - 11.25 \right) \times 2 = 47.25'$$



$$R = 5.12 \times 47.25 / 2 = 121.1^k$$

$$R_A = \frac{121.1 \times 31.5 - 1.59 \times 54 \times 20}{40} = 52.44^k$$

$$R_B = 52.44 + 1.59 \times 54 - 121.1 = 17.2^k$$

0.625'
4.375'
0.195'
5.12 KSF

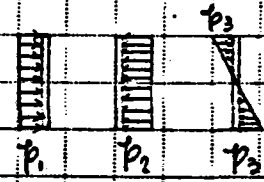
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JOB NO. C-21700 DATE 7-23-79 BY OS Chang CH'K HJM PAGE 6
 CUSTOMER MOAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

FDN. MAT

REF. BOOK: "MOMENTS AND REACTIONS FOR RECTANGULAR PLATES"
 U.S. DEPT. OF THE INTERIOR, BUREAU OF RECLAMATION
 P. 40 & 41, FIGURES 34 & 35

$p_1 = 1.59 - 0.19 = 1.4 \text{ KSF}$
 $p_2 = p_3 = 4.01/2 = 2.01 \text{ KSF}$



FOR $a/b = 37/37 = 1$

$M_1 = -0.05 \times 1.4 \times 37^2 = -95.83 \text{ K}'$
 $V_1 = -0.4359 \times 1.4 \times 37 = -22.74 \text{ K}$

$M_2 = 0.05 \times 2.01 \times 37^2 = +137.58 \text{ K}'$
 $V_2 = 0.4389 \times 2.01 \times 37 = +32.64 \text{ K}$

$M_3 = 0.0148 \times 2.01 \times 37^2 = +40.73 \text{ K}'$
 $V_3 = 0.1974 \times 2.01 \times 37 = +14.83 \text{ K}$

$\Sigma M_u = 137.58 + 40.73 - 95.83 = 82.48 \text{ K}'$
 $\Sigma V_u = 32.64 + 14.83 - 22.74 = 24.73 \text{ K}$

@ CANTILEVER SIDE, M & V @ FACE OF WALL "A"

$M_u = 4.33 \times 5.5^2/2 + (0.6 \times 5.5/2) \times 2 \times 5.5/3 - 1.4 \times 5.5^2/2 = 55.37 \text{ K}'$
 $V_u = (5.12 + 4.53) \times 5.5^2/2 - 1.59 \times 5.5 = 17.77 \text{ K}$

@ CANTILEVER SIDE "B"

$M = 1.59 \times 5.5^2/2 = 24.05 \text{ K}'$

@ MID. OF SLAB:

$M_u = (0.01 - 1.4) \times 0.0212 \times 37^2 = 17.79 \text{ K}'$

JOB NO. C-21700 DATE 7-23-79 PAGE 7
 BY Ch. P. ... CHK HJM
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

FOUN. MAT (CONT.) - REBAR IN MAT:

$M_u = 82.48 \text{ k-ft}$ FOR $b=12$, $d=43$ $\therefore F=1.85$

$K_u = 82.48 / 1.85 = 45$ $\therefore Q_u = 4.45$

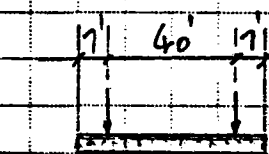
$A_s = 82.48 / 4.45 \times 43 = 0.4 \text{ in}^2$

USE # 8 @ 12" BOT. # # 8 @ 12" TOP SA WAY (OVER SIZE BAR FOR TEMPERATURE PURPOSE)

CHECK SHEAR:

$\phi V_c = 0.85 \times 2.1 \times 12 \times 43 = 9203 \text{ k}$
 $= 48.05 \text{ k} > 24.73 \text{ k}$ O.K. (SHEAR @ DISTANCE OUT O.K.)

GRADE WALL DEPTH 12'-0" ABOVE $d=12'-0"$ (144"), $b=36$, $d=10$



$w=52.44 \text{ k}$

TOP BAR $M_u = \frac{52.44 \times 40^2}{8} - \frac{52.44 \times 12^2}{2} = 9203 \text{ k}$

BOT. BAR $M_u = \frac{17.2 \times 40^2}{8} - \frac{17.2 \times 12^2}{2} = 3019 \text{ k}$

$F = \frac{b d^2}{12000} = \frac{36 \times 144^2}{12000} = 62.2$

$K_u = 9203 / 62.2 = 133.9$ (TOP) $\therefore Q_u = 4.35$ (ACI 10.5 USE)

$K_u = 3019 / 62.2 = 34.2$ (BOT) $\therefore Q_u = 4.45$ ($A_s = 14.7 \times 1.33 = 19.55 \text{ in}^2$)

TOP BAR $A_s = 9203 / 4.35 \times 144 = 14.7$ USE 13-#10, $A_s = 22.86 \text{ in}^2 > 19.55 \text{ in}^2$

BOT BAR $A_s = 3019 / 4.45 \times 144 = 4.71$ USE 6-#10, $A_s = 7.62 \text{ in}^2 > 4.71 \times 1.33 = 6.26 \text{ in}^2$

CHECK SHEAR @ "d" DISTANCE OUT. $V_u = 52.44 (21-12) = 420 \text{ k}$

$\phi V = 0.85 \times 2.1 \times 36 \times 144 / 1000 = 433 \text{ k} > 420 \text{ k}$ O.K.

Stearns-Roger

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

GRADE WALL (CONT.)

TRY #2 STIRRUPS @ 12"

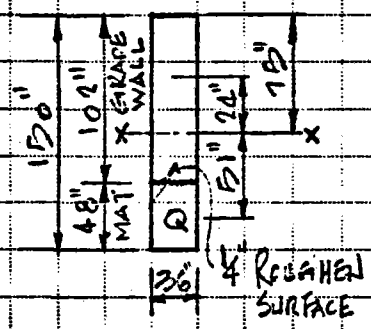
$$A_s = 0.31 \times 2 = 0.62 \text{ in}^2$$

$$A_s = F_{os} b_w s / f_y = 50 \times 36 \times 12 / 60000 = 0.36 < 0.62 \text{ (GRADE WALL)}$$

$$\text{OR} = 50 \times 36 \times 12 / 40000 = 0.54 < 0.62 \text{ (" " ")}$$

USE #2 STIRRUPS @ 12" —

GRADE WALL CONN. TO MAT:



HORIZ. SHEAR: $V_u = 52.4 \times 37/2 = 969 \text{ k}$

$$I_x = 36 \times 150^3 / 12 = 1.01 \times 10^7 \text{ in}^4$$

$$Q = 48 \times 36 \times 31 = 36 \times 102 \times 24 = 88128 \text{ in}^3$$

$$S_u = V_u Q / I_b = \frac{969000 \times 88128}{1.01 \times 10^7 \times 36} = 235 \text{ PSI}$$

ACI-318-77 17.5.4.3 $S_{allow} = 350 \text{ PSI} > 235 \text{ PSI}$ O.K.

ACI-318-71 $V_{de} = V_u / 4 \text{ bond} = 969000 / (0.55 \times 36 \times 144) = 220 \text{ PSI} < 350 \text{ PSI}$ O.K.

FOR MOMENT TRANSFERRED FROM PEDESTAL

$$M = 89.3 \times 13.75 = 1228 \text{ k} < 3019 \text{ k (P.7)}$$

(I.C. PEDESTAL TO E. OF GRADE WALL = 13'-7")

Bottom & Top BARS ARE ADEQUATE!

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

PEDESTAL

SIZE 4'-0" SQ. (48" SQ) , $A_2 = 48^2 = 2304 \text{ in}^2$

LOADING CONDITIONS:

1. DL+LL

$$P_u = 1.4 \times 262 + 1.7 \times 61 = 471 \text{ K}$$

$$H_u = 0$$

$$M_u = 0$$

2. DL+LL+WIND (DIAGONAL)

$$P_u = 0.75(1.4 \times 262 + 1.7 \times 61 + 1.7 \times 901) = 1502 \text{ K}$$

$$P_u = 0.75 \times 0.9 \times 262 - 1.3 \times 901 = -994 \text{ K (UPLIFT)}$$

$$H_u = 1.3 \times 92.8 = 121 \text{ K}$$

$$M_u = 92.8 \times 1.3 \times 7.5 = 905 \text{ K}$$

$$\therefore M_{ux} = M_{uy} = 905 \times 0.707 = 640 \text{ K}$$

CHECK CONC. BEARING:

SIZE OF PILE = 2'-8" SQ (32" SQ) , $A_1 = 32^2 = 1024 \text{ in}^2$

$$f_p = 0.85 \phi f_{c1} \sqrt{A_2/A_1} = 0.85 \times 0.7 \times 3000 \sqrt{2304/1024} = 2678 \text{ PSI}$$

$$f_p = (1502/1024) \times 1000 = 1467 \text{ PSI} < 2678 \text{ PSI} \text{ O.K. !}$$

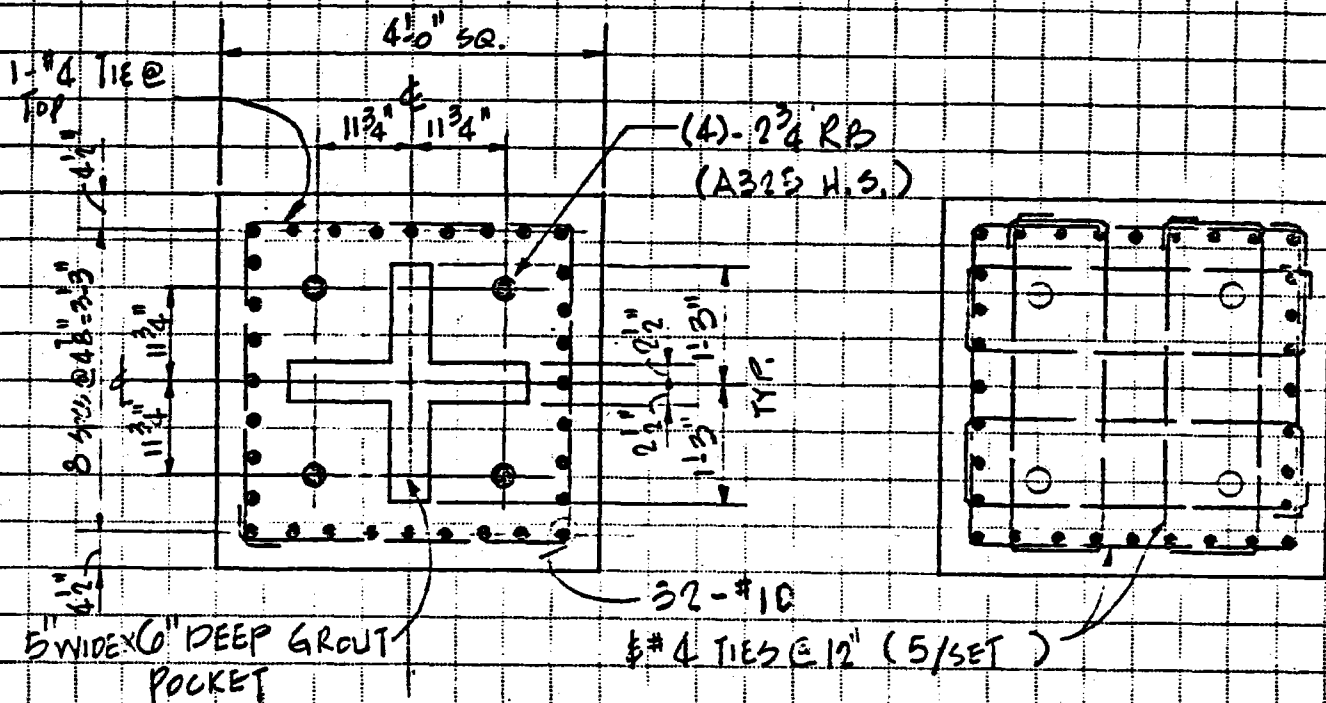
JOB NO. C-21700 DATE 7-26-79 BY CS [Signature] CHK HJM
 CUSTOMER NIDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

PAGE 10

PEDESTAL

CASE (I) = $M_u +$ UPLIFT FORCE

$P_u = -994^k$, $M_{ux} = M_{uy} = 640^{in-k}$, $\phi = 0.9$



$I_x = I_y = 18 \times 19.5^2 + 4 \times (11.63^2 + 9.75^2 + 4.88^2) = 8177$

$P_m = -994 / 0.9 = -1104^k$

(NEGLECT CONCRETE ACTION
SINCE TENSION IS HIGH!)

$M_{max} = M_{min} = 640 / 0.9 = 711^{in-k}$

$P_x = 1104 / 32 \pm \left(\frac{711 \times 12 \times 19.5}{8177} \right) \times 2$

$= 34.5^k \pm 40.7^k = 75.2^k$ (TENSION) MAX.

#10 BAR TENSION CAPACITY = $60 \times 1.27 = 76.2^k > 75.2^k$ O.K.!

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CUSTOMER _____ PROJECT _____
SUBJECT _____

PEDESTAL, ... $f_c' = 3.0 \text{ ksi}; f_y = 60 \text{ ksi}$
(I) ... $T_u = -994 \text{ K}$ up lift $H_{ux} = H_{uy} = \frac{121}{1.414} = 85.5 \text{ K}$
 $M_{ux} = M_{uy} = 640 \text{ K}$

(II) ... $P_u = 1502 \text{ K}$
 $M_{ux} = M_{uy} = 640 \text{ K}$ $H_{ux} = H_{uy} = 85.5 \text{ K}$

REF: SP-7

$g = \frac{39}{48} = 0.8$

req $d = \sqrt{\frac{640}{4.0(1.93)}} = 19" < 44" \text{ (OK)}$

(I) $K = \frac{1502}{3 \times 48 \times 48} = .217$

$K \frac{e}{t} = \frac{640(12) \cdot M_{ux}}{3 \times 48 \times 48^2} = .023$

$\therefore p_t = 0.00$; USE 0.01 min
 $A_s = 0.01 (48)^2 = 23.0 \text{ in}^2$

For Comp. only:

$\phi P_n (\text{max}) = 0.80 (0.9) \left[0.85 (3.0) \left(\frac{5748}{3000} (2304 - 50) + 60 (50) \right) \right]$
 $= 6,300 \text{ K}$ 32-#11

For one-way Bending only:

req $A_s = \frac{640}{4.2 \times 43.5} = 3.5 \text{ in}^2$ (small) \rightarrow 3-#11 (4.68 in²)

For (Comp. - Bending f. two-way) only:

$\phi P_n (\text{max}) = (0.80) 0.9 \left[5748 + 60 (50 - 4.68 \times 2) \right]$
 $= 5,894 \text{ K} > 1502 \text{ K} \text{ (OK)}$

I) $T_u = \frac{994}{32-3(2)} = 38.2 \text{ K/in.}$ #10: $f_{T_u} = \frac{38.2}{1.27} = 30.1 \text{ ksi}$ (OK)
26" For Bending above!

ET = 901 - 262(1.75) = 704 K; #10: $f_T = 30.1 \frac{704}{994} = 21.3 \text{ ksi}$ (OK)

USE 48" SQ. w/ 32-#10

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 SUBJECT FOUNDATION FOR RECEIVER TOWER

PEDESTAL

CASE (II) = Mu + DOWNWARD FORCE

$P_u = +1502^k$, $M_{ux} = M_{uy} = 640^k$, $\phi = 0.7$

USE ACI 318-77 HAND BOOK VOLUME 2 - COLUMNS (P.29)

$\gamma = (48-9)/48 \approx 0.8$, $h = 48''$

$e_x/r = e_y/r = M_u/P_u h = 640 \times 12 / 1502 \times 48 = 0.107$

32-#10 $A = 32 \times 1.56 = 40.69 \text{ in}^2$

$\rho_g = 40.69 / 48^2 = 0.0176$

For $f_c' = 3 \text{ ksi}$, $f_y = 60 \text{ ksi}$

COLUMN 7.3.3 R3-60.75 $\phi P_{nu}/A_g = \phi P_{ny}/A_g = 2.0$
 " 7.3.4 R3-60.90 " " = 2.0

COLUMN 8.3 R3-60 $\phi P_o/A_g = 2.0$

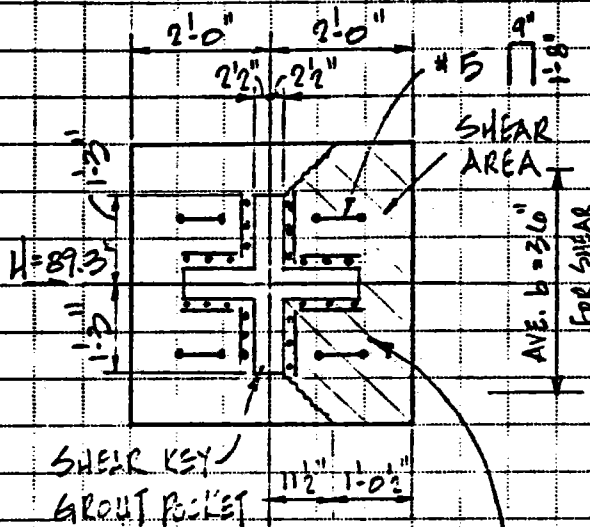
$\frac{1}{F_i/A_g} = \frac{1}{P_{nx}/A_g} + \frac{1}{P_{ny}/A_g} + \frac{1}{P_o/A_g} = \frac{1}{2.0} + \frac{1}{2.0} + \frac{1}{2.0} = 0.50$

$\therefore F_i = A_g / 0.50 = 48^2 / 0.50 = 4608^k > 1502^k \text{ O.K.}$

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

PEDESTAL (CONT.)



CHECK SHEAR @ KEY

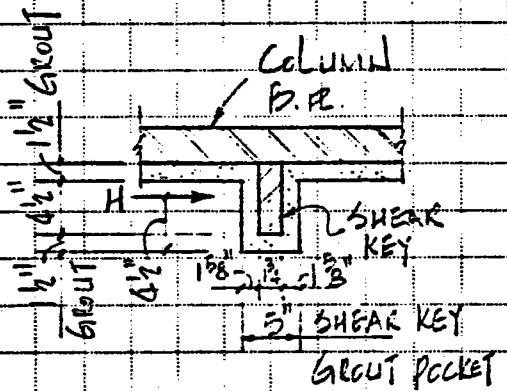
ASSUME SHEAR AREA = $(30 + 48) \times \frac{21.5}{2} = 12.5 \times 5 = 776 \text{ in}^2$

$H_u = 89.3 \times 1.7 \times 0.75 = 113.9 \text{ K}$

$V_u = 113900 / 0.85 \times 776 = 172.7 \text{ KSI} > 2.0 f_c' = 110 \text{ KSI}$

∴ SHEAR REINF. REQ'D

ALLOWABLE FRICTION SHEAR = $0.2 f_c' = 600 \text{ PSI} > 172.7 \text{ PSI}$

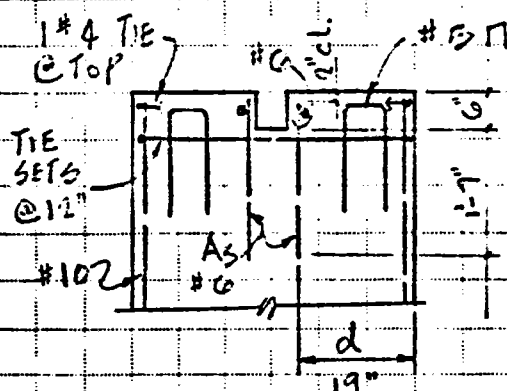


$A_{vf} = V_u / \phi f_y \mu$, $\mu = 1.4$, $\phi = 0.85$

∴ $A_{vf} = 113.9 / 0.85 \times 60 \times 1.4 = 1.6 \text{ in}^2$

$A_s = \frac{M_u}{\phi f_y j d} = \frac{113.9 \times 4.5}{0.9 \times 60 \times 0.9 \times 19} = 0.56 \text{ in}^2$ (ACI 11.9.7)

$A_s(\text{MIN.}) = \frac{0.04 \times f_c' b d}{f_y} = \frac{0.04 \times 36 \times 19}{60} = 1.37 \text{ in}^2$



#5 ∏ (A_n) BUT SINCE A_n = 0.54 A_s, A_n + A_s = A_{vf} (ACI 11.9.5)

∴ $A_s = \frac{2}{3} A_{vf} = 1.6 \times \frac{2}{3} = 1.07 \text{ in}^2 < 1.27 \text{ in}^2$

$A_n = \frac{1}{3} A_{vf} = 0.54 \text{ in}^2$

A_s: USE 6-#6 = 2.64 in² > 1.37 in²

A_n: USE 4-#5 = 1.24 in² > 0.54 in²

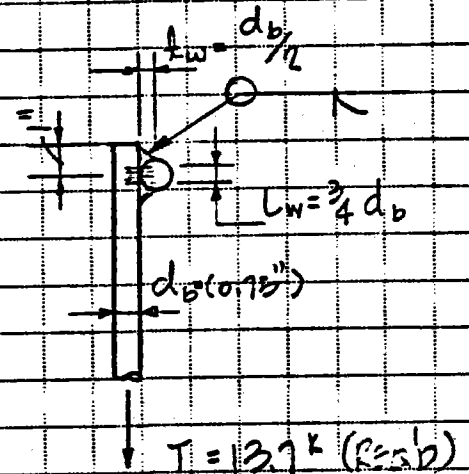
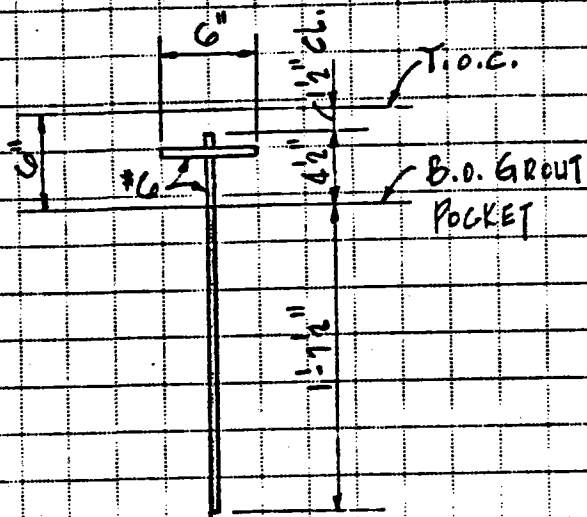
$P_v = (A_s + A_n) / b d = (2.64 + 1.24) / 36 \times 19 = 0.006$
 $< 0.2 f_c' / f_y = 0.01 \text{ MAX. (ACI 11.9.5)}$

BEARING: $P_u = \frac{113900}{(30-5)6} = 750 \text{ PSI}$
 O.K!

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FORM 62-114
REV. 4.75

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 SUBJECT FOUNDATION FOR RECEIVER TOWER



REF. BOOK "PCI DESIGN HANDBOOK" SECTION C.1.18

$$\text{ACTUAL AREA REQ'D} = 1.37 \text{ in}^2$$

$$\text{ACTUAL FORCE PER BAR (6 BARS)} T = 1.37 \times 60 / 6 = 13.7 \text{ k}$$

CAPACITY OF WELDED CONNECTION:

$$W_c = \phi \cdot 2.5 L_w t_w \quad \text{4 SIDES} \quad L_w = \text{LENGTH OF WELD} = 0.75 \times 0.75$$

$$= (0.7 \times 2.5 \times 0.75^2 / 2) \times 4 \quad t_w = \text{WELD SIZE} = 0.75 / 2$$

$$= 14.77 \text{ k} > 13.7 \text{ k} \quad \text{O.K.} \quad \phi = 0.7$$

CAPACITY OF "T" BAR BEARING

$$T_b = F_b \cdot \Sigma A$$

$$= 0.85 \times 0.7 \times 3.0 \times 2 \times 3.94$$

$$= 14.07 \text{ k} > 13.7 \text{ k}$$

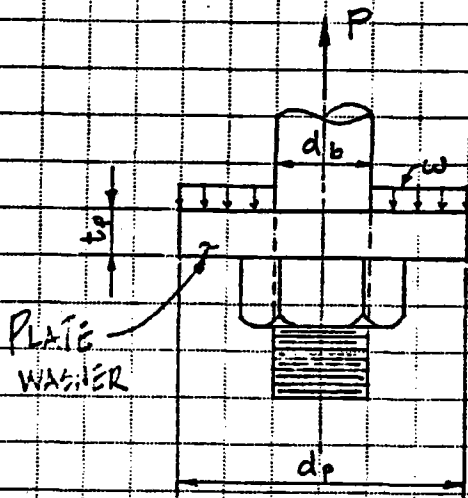
$$F_b = 0.85 \phi f'_c \sqrt{A_2/A_1} \quad (\sqrt{A_2/A_1} \geq 2)$$

$$\Sigma A = 0.75 \times (6 - 0.75) = 3.94 \text{ in}^2$$

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

DESIGN OF ANCHOR BOLT & WASHER

MATERIAL: 1. ANCHOR BOLT (2 3/4" A325 H.S. BOLTS) $F_t = 40 \text{ ksi}$
 2. PLATE WASHER A36 STEEL (PER B. OWEN) $F_b = 27 \text{ ksi}$



TENSILE STRESS AREA $A_{ts} = 4.93 \text{ in}^2$ (AISC 4-12.5)

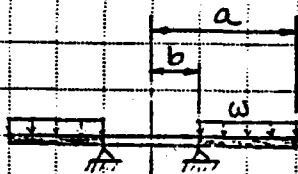
$P = 4.93 \times 40 = 197.2 \text{ k}$

ALLOWABLE BEARING STRESS FOR PLATE WASHER $= f'_c = 3.0 \text{ ksi}$ (CODE: ULTIMATE COMPRESSIVE STRESS)

$P = \frac{\pi}{4} (d_p^2 - d_b^2) f'_c$

$\therefore d_p = \sqrt{\frac{4P}{\pi f'_c} + d_b^2}$

$= \sqrt{\frac{4 \times 197.2}{\pi \times 3.0} + 2.75^2} = 9.56 \text{ in}$ (USE 9 3/4" DIA. OR ROUND)



REF: ROARK, 4TH EDITION, TABLE X, CASE 10, P. 221

PLATE WASHER THICKNESS $= t_p$

$F_b = 27 \text{ ksi}$

$\bar{c} = \text{MAX. ALLOWABLE DEFLECTION} = 0.001 \text{ in}$

$R = d_p/2 = 9.56/2 = 4.58 \text{ in}$

$b = d_b/2 = 2.75/2 = 1.38 \text{ in}$

NOTE: THE FOLLOWING SOLUTION IS BASED ON THIN-PLATE THEORY. IN ORDER TO COMPENSATE FOR THE INACCURACY OF THE SOLUTION, THE PLATE IS CONSIDERED SUPPORTED ON THE FACE OF THE BOLT RATHER THAN AT THE CENTER OF THE BEARING SURFACE PROVIDED BY THE NUT. 17

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER

DESIGN OF ANCHOR BOLT & WASHER (CONT.)

$$w = \frac{P}{\pi(a^2 - b^2)} = \frac{197.2}{3.14(4.88^2 - 1.38^2)} = 2.87 \text{ ksi}$$

$$\nu = \text{POISSON'S RATIO} = 0.25$$

$$m = \frac{1}{\nu} = 4, \quad E = 29,000 \text{ ksi}$$

THICKNESS REQ'D TO SATISFY ALLOWABLE STRESS:

$$t = \left\{ \frac{3w \left[a^4 \left(20 \log \frac{a}{b} - 7 \right) + 4a^2b^2 + 3b^4 \right]}{16 F_b (a^2 - b^2)} \right\}^{1/2}$$

$$= \left\{ \frac{3 \times 2.87 \left[4.88^4 \left(20 \log \frac{4.88}{1.38} - 7 \right) + 4 \times 4.88^2 \times 1.38^2 + 3 \times 1.38^4 \right]}{16 \times 27 \times (4.88^2 - 1.38^2)} \right\}^{1/2}$$

$$= (2.22)^{1/2} = 1.5''$$

THICKNESS REQ'D TO SATISFY ALLOWABLE DEFLECTION:

$$t = \left\{ \frac{9w}{7.424 \times 10^6 \delta} \left[31a^4 + 21b^4 - 52a^2b^2 - \frac{260}{3}a^2b^2 \log \frac{a}{b} + \frac{400a^4b^2}{3(a^2 - b^2)} \left(\log \frac{a}{b} \right)^2 \right] \right\}^{1/3}$$

$$= \left\{ \frac{9 \times 2.87}{7.424 \times 10^6 \times 0.001} \left[31 \times 4.88^4 + 21 \times 1.38^4 - 52 \times 4.88^2 \times 1.38^2 - \frac{260}{3} \times 4.88^2 \times 1.38^2 \log \frac{4.88}{1.38} \right. \right. \\ \left. \left. + \frac{400}{3} \times \frac{4.88^4 \times 1.38^2}{(4.88^2 - 1.38^2)} \left(\log \frac{4.88}{1.38} \right)^2 \right] \right\}^{1/3}$$

$$= (52.61)^{1/3} = 3.75'' \quad \text{GOVERN}$$

USE $3\frac{3}{4}'' \times 9\frac{3}{4}'' \times 0\text{-}9\frac{3}{4}''$ WASHER

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 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER - TRADE STUDY

CONCRETE QUANTITIES:

1. FOR SPREAD FOOTING:

PEDESTAL :	$4 \times 4 \times 16 \times 4$	= 1024 CF.
GRADE BEAM :	$3 \times 8.5 \times 36 \times 4$	= 3672
MAT :	$54 \times 54 \times 4$	= 11664
	<u>Σ</u>	<u>= 16360 CF.</u>

OR $16360 / 27 = \underline{\underline{606 \text{ CY.}}}$

2. DRILLED PIER FOOTING:

PEDESTAL :	$4 \times 4 \times 7.5 \times 4$	= 480 CF.
PIER CAP :	$16 \times 16 \times 5 \times 4$	= 5120
GRADE BEAM :	$3 \times 5 \times 24 \times 4$	= 1440
PIER (48" dia) :	$\frac{3.14 \times 4^2}{4} \times 45 \times 16$	= 918
	<u>Σ</u>	<u>= 16088 CF.</u>

OR $16088 / 27 = \underline{\underline{596 \text{ CY.}}}$

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 BY PARKER CHK _____
 CUSTOMER MDM/DOE PROJECT SOLAR ONE
 SUBJECT RECOVER TOWER FOUNDATION TRADE STUDY

ESTIMATED CONSTRUCTION COST COMPARISON

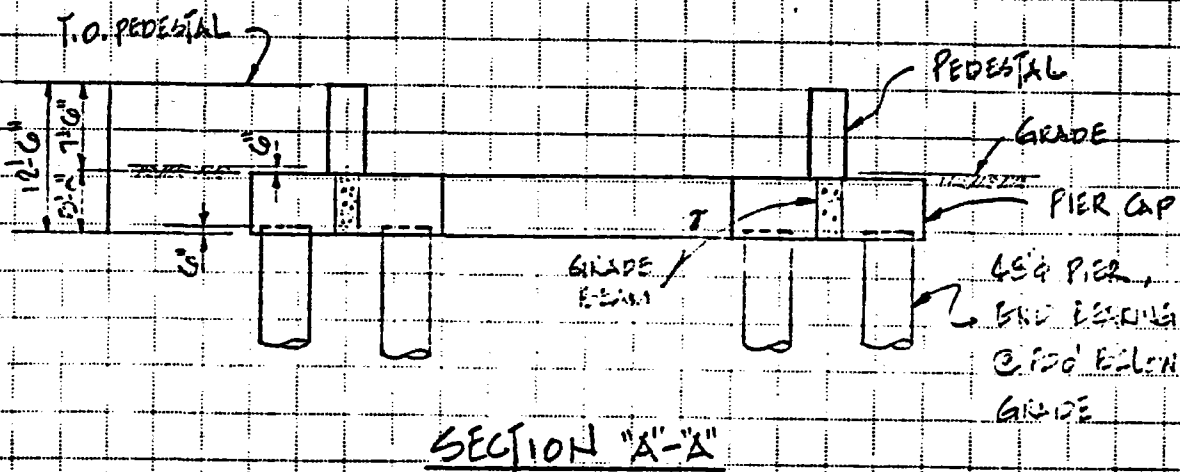
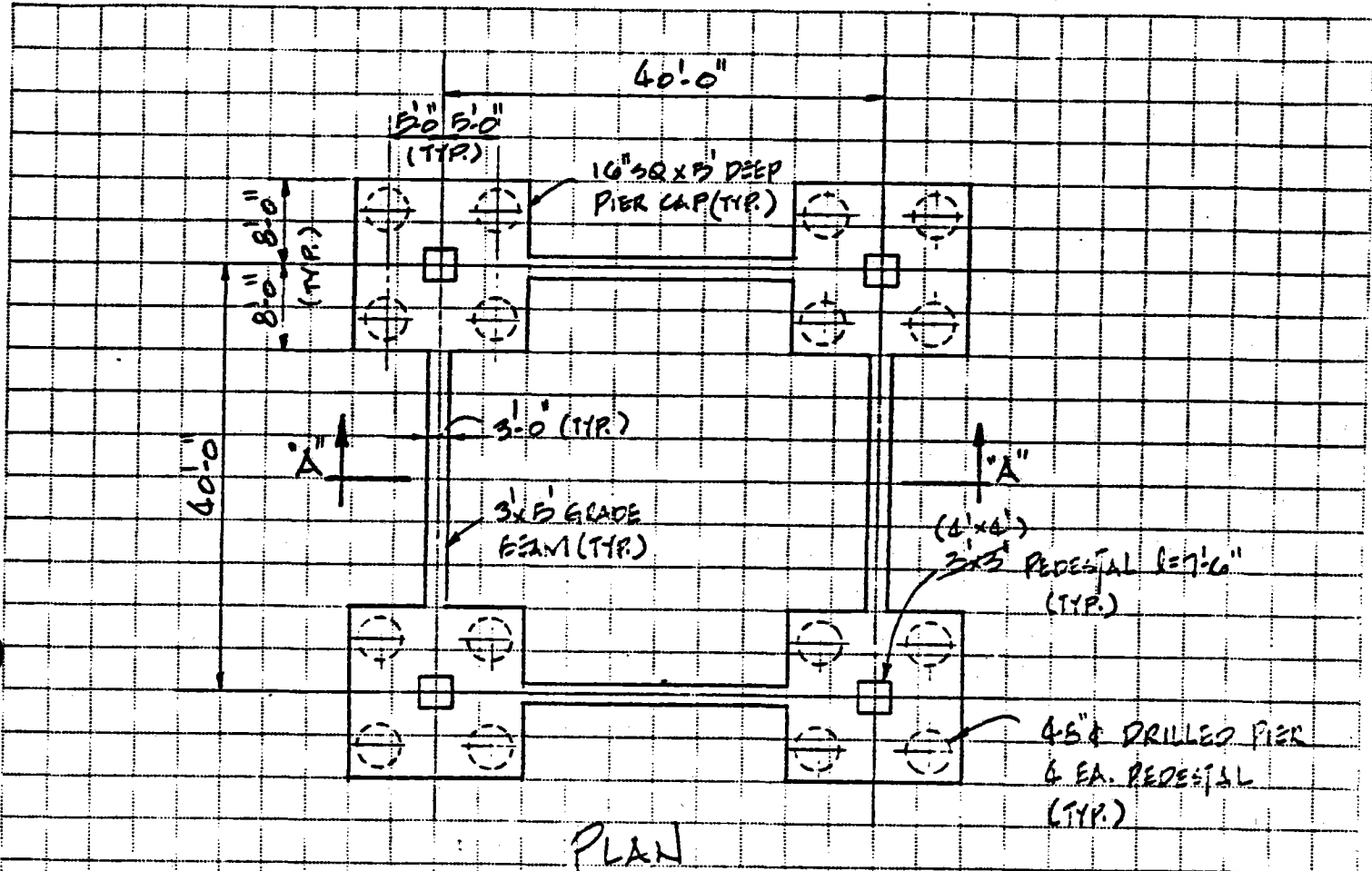
Ref: MEANS BUILDING CONSTRUCTION COST DATA-1975
 (Since we are only interested in relative costs - the date of this data should not be a problem)

CONCRETE IN PLACE	MAT FOUNDATION		DRILLED PIER FOUND.	
	QTY	COST	QTY	COST
A. PEDESTAL \$186/cy	38 cy	\$7,050	18 cy	\$3,310
B. GRADE WALLS \$109/cy	136 cy	14,140	53 cy	5,550
C. FOUND. MAT \$57/cy	432 cy	24,620	—	—
D. PIER CAP \$58/cy	—	—	190 cy	11,000
E. CASSION * \$ ⁴¹ 98/lf	—	—	800 lf	32,800
		\$45,810		\$52,660

USE → MAT FOUNDATION

* For Cassions, reduce figure of \$4200/ft by 15% since this figure from MEANS includes CIP, but the others do not.

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CUSTOMER MRAC PROJECT SOLAR ONE CHK
SUBJECT FOUNDATION FOR RECEIVER TOWER - DRILLED PIER



JOB NO. C-21700 DATE 5-24-79 BY C.S. Chang CHK
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER - DRILLED PIER

MAX. UPLIFT @ DIAGONAL WIND

$$P = 0.75 \text{ D.L.} + \text{WIND}$$

$$= 0.75 \times 977 / 4 + 993 = 67810^k$$

USE SAFETY FACTOR = 1.5 & NEGLECT ONE-THIRD INCREASE

$$\therefore \text{MAX. UPLIFT FORCE } P = 67810 \times 1.5 = 101715^k$$

MAX. DOWNWARD FORCE @ DIAGONAL WIND

$$P = \text{D.L.} + \text{L.L.} + \text{WIND}$$

$$= (977 + 196) / 4 + 993 = 1226^k$$

ALLOW ONE-THIRD INCREASE FOR COMBINE WT WIND

$$\therefore \text{MAX. DOWNWARD FORCE } P = 1226 \times 0.75 = 905^k$$

$$P = 905^k > \text{D.L.} + \text{L.L. ONLY} = (977 + 196) / 4 = 293^k$$

\therefore WIND LOAD GOVERNS!

TRY 4 - 48" PIER, SPACING @ 10' APART.

FROM WOODWARD-CLYDE CONSULTANTS' SOIL REPORT:

ALLOWABLE AXIAL PIER CAPACITY FIG. 1, USE INTERPOLATING VALUE FOR 48" PIER, SINCE THE FIG. GIVE VALUE ONLY FOR 36", 54" & 60" PIER.

* VALUE ON FIG. 1 NOT INCLUDED WT. OF PIER. (SEE TELEPHONE CONVERSATION FROM C.S. CHANG OF S-R TO DR. KUL KHUSHN OF WOODWARD-CLYDE CONSULTANTS DATE 5-23-79)

JOB NO. C-21700 DATE 5-24-79 PAGE 3
 CUSTOMER MDAC PROJECT SOLAR ONE
 SUBJECT FOUNDATION FOR RECEIVER TOWER - DRILLED PIER

WT OF 4.5" PIER $l = 50' - 3.5' = 44.5'$, $W = \frac{3.14 \times 4^2}{4} \times 44.5 \times 0.15 = 84^k$

DIFFERENT WT. BETWEEN CONC. & SOIL FOR THIS PIER $W = 84 \times \frac{150-110}{150} = 22^k$

WT. OF PIER CAP = $16^2 \times 5 \times 0.15 = 192^k$ / EA. COLUMN.

WT. OF GRADE BEAM = $24 \times 2 \times 5 \times 0.15 = 36^k$ / EA. COLUMN.

WT. OF PEDESTAL = $3^2 \times 7.5 \times 0.15 = 10^k$

ADDITIONAL WT. @ EA. COLUMN = $192 + 36 + 10 = 238^k$ (NOT INCL. PIER WT.)

ALLOWABLE AXIAL CAPACITY INTERPOLATED FROM FIG. 1 (PER EA. PIER)

UPLIFT FORCE = 280^k

COMPRESSION = 400^k

END BEARING = $400^k - 280^k = 120^k$

FIND EFFICIENCY OF FRICTION PIER GROUP:

REF. BOOK: "PILE FOUNDATION" BY R.D. CHELLIS SECOND EDITION

P. 137 CONVERSE-LABAREE METHOD

$$\text{EFFICIENCY} = 1 - \left[\frac{(m-1)\pi + (n-1)\pi}{90 \dots} \right] = 1 - 0.15 \left[\frac{2+2}{90 \times 2 \times 2} \right] = 0.76 \text{ (25\%)}$$

WHERE m = NUMBER OF ROWS = 2

n = NUMBER OF PIER IN A ROW = 2

ϕ = ARC TAN (d/s), IN DEGREES = $\tan^{-1}(4/10) = 21.5^\circ$

d = DIAMETER OF PIER = 4'

s = SPACING OF PIER CENTERS = 10'

JOB NO. C-21700 DATE 5-24-79 BY ABC/rauf PAGE 4 CHK
CUSTOMER MDAC PROJECT SOLAR ONE
SUBJECT FOUNDATION FOR RECEIVER TOWER - DRILLED PIER

ALLOWABLE AXIAL CAPACITY PER EA. PIER @ PIER GROUP:

UPLIFT: $280 \times 0.76 = 213^k$

COMPRESSION: $280 \times 0.76 + 120 = 333^k$

ACTUAL FORCE IN EA. PIER

UPLIFT: $(1215 - 238) / 4 - 84 = 160^k < 213^k$ O.K!

COMPRESSION: $(965 + 238) / 4 + 22 = 323^k < 333^k$ O.K!





Department of Energy
 San Francisco Operations Office
 1333 Broadway
 Oakland, California 94612

Reply To: DOE Solar One Project Office
 P.O. Box 366
 Daggett, CA 92327

SEP 28 1984

Mr. Robert L. Gervais
 Solar One Project Office
 McDonnell Douglas Astronautics Corp.
 P.O. Box 366
 Daggett, CA 92327

Subject: Contractor Clearance of Contract DE-AC03-79SF10499
 Solar One Reports for DOE/TIC Inclusion.

Dear Bob:

Enclosed are copies of covers and title pages of eight reports prepared by McDonnell Douglas Astronautics Corporation for the Solar One Project under the above referenced contract. In preparation for delivery of these documents to DOE/TIC, I have prepared a SAN form 70 "Request for Patent Clearance" and a DOE form RA-426 "Recommendations for Announcement and Distribution of Documents" for each document.

Please have the appropriate MDAC personnel complete and sign these forms. As agreed, SAN form 70 should be forwarded to SAN/OPC by your office with copies of the completed SAN form 70 and the transmittal letter being sent to me. The completed DOE form RA-426 should be sent directly back to me.

The documents covered by this letter are:

<u>Primary Document No.</u>	<u>Secondary No.</u>	<u>Brief Title</u>
DOE/SF/10499-T91	STMPO 176	PSS Design Calculations (Book 1 of 26)
DOE/SF/10499-T92	STMPO 177	PSS Design Calculations (Book 2 of 26)
DOE/SF/10499-T93	STMPO 178	PSS Design Calculations (Book 3 of 26)
DOE/SF/10499-T95	STMPO 180	PSS Design Calculations (Book 5 of 26)
DOE/SF/10499-T96	STMPO 181	PSS Design Calculations (Book 6 of 26)
DOE/SF/10499-T97	STMPO 182	PSS Design Calculations (Book 7 of 26)
DOE/SF/10499-T98	STMPO 183	PSS Design Calculations (Book 8 of 26)
DOE/SF/10499-T99	STMPO 184	PSS Design Calculations (Book 9 of 26)

If you should have any questions or concerns please do not hesitate to contact me by telephone at, (619) 254-2672.

Sincerely,



S.D. Elliott, Jr., Director
DOE Solar One Project Office

SDE/aks

Project File: CCC008.RNO(SA3:)

Encl: Eight Document Covers W/forms 70 and RA-426

cc: Roger Gaither, SAN/OPC
W.D. Matheny, DOE/TIC
Mike Lopez, DOE/SAN (FGS)
Mary Soderstrum, B&McD



**DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE**

**CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT**

TO: Roger S. Gaither, Asst. Chief for Prosecution
Office of Patent Counsel/Livermore Office
P.O. Box 808, L-376
Livermore, California 94550

FROM: McDonnell Douglas Corporation
3855 Lakewood Blvd.
Long Beach, CA 90846

Prime Contract No. DE-AC03-79SF10499
Subcontract No. (N/A)
Report No. (STMP0 182) DOE/SF/10499-T97
Date of Report September 1980
Name & Phone No. of DOE Technical Representative S.D. Elliott, Jr. (619) 254-2672

- Document Title: Plant Support Subsystem Final Design Calculations
(Book 7 of 26)
- Type of Document: Technical Report, Conference Paper, Journal Article, Abstract or Summary,
 Copy of Oral Presentation, Other (please specify): _____
(Routine)
- In order to meet a publication schedule or submission deadline, patent clearance by _____
would be desired.

SENDER IS TO CHECK BOX #4 OR #5 BELOW.

- I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:
 - Attention should be directed to pages _____ of this document.
 - This document describes matter relating to an invention:
 - Contractor Invention Docket No. _____.
 - A disclosure of the invention was submitted to DOE on _____ (date)
 - A disclosure of the invention will be submitted shortly _____ (approximate date)
 - A waiver of DOE's patent rights to the contractor:
 has been granted, has been applied for; or will be applied for _____ (date)
- This document is being submitted, but no review has been made of this document for possible inventive subject matter.
Provide copy of clearance to: Solar One Project Office
P.O. Box 366, Daggett, CA 92327

Reviewing/Submitting Official: Name (Print/Type) _____
Title _____
Signature _____ Date _____

TO: INITIATOR OF REQUEST
FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office

- No patent objection to above-identified release.
- Please defer release until advised by this office.

Signed _____ Date Mailed _____

DOE AND MAJOR CONTRACTOR RECOMMENDATIONS FOR
ANNOUNCEMENT AND DISTRIBUTION OF DOCUMENTS

See Instructions on Reverse Side

1. DOE Report No. <u>DOE/SF/10499-T97 (SIMPO 182)</u>	2. Contract No. <u>DE-AC03-79SF10499</u>	3. Subject Category No. <u>UC-62, 62c, 62d</u>
----------------------------------------------------------	---------------------------------------------	---------------------------------------------------

4. Title

Plant Support Subsystem Final Design Calculations (Book 7 of 26)

5. Type of Document ("x" one)

a. Scientific and technical report

b. Conference paper: Title of conference _____

_____ Date of conference _____

Exact location of conference _____ Sponsoring organization _____

c. Other (specify planning, educational, impact, market, social, economic, thesis, translations, journal article manuscript, etc.)

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d. within DOE.

e. to those listed in item 13 below.

f. Other (Specify) Archive/Issue on request

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a. Normal procedure may be followed.

b. Recommend the following announcement limitations:

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("x" one a. DOE patent clearance has been granted by responsible DOE patent group.

b. Document has been sent to responsible DOE patent group for clearance.

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14. Submitted by (Name and Position) (Please print or type)

S.D. Elliott, Jr., Director, DOE Solar One Project Office

Organization

P.O. Box 366, Daggett, CA 92327 (619) 254-2672

Signature

Date

10 MWe Solar Thermal
Central Receiver Pilot Plant

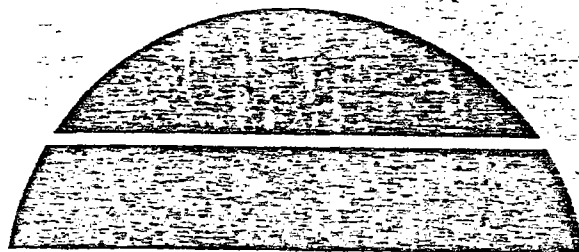
SOLAR FACILITIES DESIGN INTEGRATION

PSS FINAL DESIGN CALCULATIONS
BOOK 7 OF 26--RECEIVER TOWER FOUNDATIONS
CONSTRUCTION PACKAGE 7A (RADL ITEM 7-8)

September 1980

WORK PERFORMED UNDER CONTRACT
DE-AC03-79SF10499

STEARNS-ROGER ENGINEERING CORP.
4500 CHERRY CREEK DRIVE
P.O. BOX 5888
DENVER, CO 80217



U.S. Department of Energy



Solar Energy

**10 MWe Solar Thermal
Central Receiver Pilot Plant
Solar Facilities Design Integration**

**PSS FINAL DESIGN CALCULATIONS
BOOK 7 OF 26--RECEIVER TOWER FOUNDATIONS
CONSTRUCTION PACKAGE 7A (RADL ITEM 7-8)**

September 1980

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**STEARNS-ROGER ENGINEERING CORP
4500 CHERRY DRIVE
P.O. BOX 5888
DENVER, CO 80217**

**PREPARED FOR THE
U.S. DEPARTMENT OF ENERGY
SOLAR ENERGY
UNDER CONTRACT DE-AC-03-79SF10499**

U.S. DEPARTMENT OF ENERGY

DOE AND MAJOR CONTRACTOR RECOMMENDATIONS FOR
ANNOUNCEMENT AND DISTRIBUTION OF DOCUMENTS

See Instructions on Reverse Side

1. DOE Report No. DOE/SF/10499-T97 (STIMPO 182)	2. Contract No. DE-AC03-79SF10499	3. Subject Category No. UC-62, 62c, 62d
----------------------------------------------------	--------------------------------------	--------------------------------------------

4. Title
Plant Support Subsystem Final Design Calculations (Book 7 of 26)

5. Type of Document ("x" one)
 a. Scientific and technical report
 b. Conference paper: Title of conference _____
Date of conference _____

Exact location of conference _____ Sponsoring organization _____
 c. Other (specify planning, educational, impact, market, social, economic, thesis, translations, journal article manuscript, etc.)

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 d. Twenty-seven copies being transmitted to DOE-TIC for TIC processing and NTIS sales.

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 a. Normal handling (after patent clearance): no restraints on distribution except as may be required by the security classification. Make available only
 b. To U.S. Government agencies and their contractors. c. within DOE and to DOE contractors.
 d. within DOE. e. to those listed in item 13 below.
 f. Other (Specify) Archive/Issue on request

8. Recommended Announcement ("x" one)
 a. Normal procedure may be followed. b. Recommend the following announcement limitations:

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 a. Preliminary information. b. Prepared primarily for internal use. c. Other (Explain)

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Does this information product disclose any new equipment, process or material? No Yes If so, identify page nos. _____
Has an invention disclosure been submitted to DOE covering any aspect of this information product? No Yes
If so, identify the DOE (or other) disclosure number and to whom the disclosure was submitted.
Are there any patent-related objections to the release of this information product? No Yes If so, state these objections.
Does this information product contain copyrighted material? No Yes
If so, identify the page number _____ and attach the license or other authority for the government to reproduce.
Does this information product contain proprietary information? No Yes If so, identify the page numbers _____.
("x" one) a. DOE patent clearance has been granted by responsible DOE patent group.
 b. Document has been sent to responsible DOE patent group for clearance.

11. National Security Information (For classified document only; "x" one)
Document a. does b. does not contain national security information

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13. Additional Information or Remarks (Continue on separate sheet, if necessary)

14. Submitted by (Name and Position) (Please print or type)
S.D. Elliott, Jr., Director, DOE Solar One Project Office

Organization
P.O. Box 366, Daggett, CA 92327 (619) 254-2672

Signature _____ Date _____



DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT

TO: Roger S. Gaither, Asst. Chief for Prosecution
Office of Patent Counsel/Livermore Office
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Livermore, California 94550

FROM: McDonnell Douglas Corporation
3855 Lakewood Blvd.
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Prime Contract No. DE-AC03-79SF10499
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(Routine)
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- Attention should be directed to pages _____ of this document.
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5. This document is being submitted, but no review has been made of this document for possible inventive subject matter.

Provide copy of clearance to: Solar One Project Office
P.O. Box 366, Daggett, CA 92327

Reviewing/Submitting Official: Name (Print/Type) John P. Scholl
Title Asst. Chief Patent Counsel, MDC (MS 122-23)
Signature [Signature] Date 8 Nov 84

TO: INITIATOR OF REQUEST
FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office

- No patent objection to above-identified release.
- Please defer release until advised by this office.