APPENDIX B
COMPUTER OUTPUT FILES

Table B.1 below summarizes the SAP2000 output file names for each analysis case:

Analysis Case Description	SAP2000N Model Name	Seismic Event	Direction of Vertical EQ	Coeff. of Frict. (μ)	Page Numbers
Hosgri Fixed Base	HEFB	Hosgri	NA	NA	B1-1 to B1-10
LTSP Fixed Base	LTSPFB	LTSP	NA	NA	B2-1 to B2-10
Validation	Sx=0.5g,u=1.19	Sine	NA	1.19	B3-1 to B3-11
Validation	Sx=1.5g,u=1.19	Sine	NA	1.19	B4-1 to B4-11
Validation	Sy=0.5g,u=1.19	Sine	NA	1.19	B5-1 to B5-11
Validation	Sy=1.5g,u=1.19	Sine	NA	1.19	B6-1 to B6-11
Validation	Pure Slide,u=1.19	Sine	NA	1.19	B7-1 to B7-9
Seismic Case 1	ISFSI Set 1,u=1.19	ISFSI	+Z	1.19	B8-1 to B8-11
Seismic Case 2	ISFSI Set 2a,u=1.19	ISFSI	+Z	1.19	B9-1 to B9-11
Seismic Case 3	ISFSI Set 3,u=1.19	ISFSI	+Z	1.19	B10-1 to B10-11
Seismic Case 4	ISFSI Set 5,u=1.19	ISFSI	+Z	1.19	B11-1 to B11-11
Seismic Case 5	ISFSI Set 6,u=1.19	ISFSI	+Z	1.19	B12-1 to B12-11
Seismic Case 6	ISFSI Set 1,u=0.73	ISFSI	+Z	0.73	B13-1 to B13-11
Seismic Case 7	ISFSI Set 2a,u=0.73	ISFSI	+Z	0.73	B14-1 to B14-11
Seismic Case 8	ISFSI Set 3,u=0.73	ISFSI	+Z	0.73	B15-1 to B15-11
Seismic Case 9	ISFSI Set 5,u=0.73	ISFSI	+Z	0.73	B16-1 to B16-11
Seismic Case 10	ISFSI Set 6,u=0.73	ISFSI	+Z	0.73	B17-1 to B17-11
Total Pages					183
Total Pages Including this page					184

Table B.1: Summary of Analyses Cases and S2K Output File Names

S A P 2 0 0 0 (R)

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```
Program SAP2000 Nonlinear Version 7.10                          File:HEFB.OUT
                                                                 Page
DCPP ISFSI PAD SLIDING (FB - Hosgri)                                    1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              -   -   -   -   -   -
    2              A   A   A   A   A   A
```

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page 2

DCPP ISFSI PAD SLIDING (FB - Hosgri)

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
2	18.633540	18.633540	18.633540	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	18.633540	18.633540	18.633540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	18.633540	18.633540	18.633540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	118.500000	118.500000	118.500000

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page
DCPP ISFSI PAD SLIDING (FB - Hosgri) 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.062955	15.884326	99.804161	9960.871
2	0.062955	15.884326	99.804161	9960.871
3	0.034130	29.299769	184.095881	33891.293

Program SAP2000 Nonlinear Version 7.10

File:HEFB.OUT
Page
4

DCPP ISFSI PAD SLIDING (FB - Hosgri)

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.062955	4.216793	0.923146	4.65E-16
2	0.062955	-0.923146	4.216793	-3.16E-16
3	0.034130	5.22E-16	-2.09E-16	-4.316658

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page
DCPP ISFSI PAD SLIDING (FB - Hosgri) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.062955	95.4265	4.5735	0.0000	95.4265	4.5735	0.0000
2	0.062955	4.5735	95.4265	0.0000	100.0000	100.0000	0.0000
3	0.034130	0.0000	0.0000	100.0000	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page 6

DCPP ISFSI PAD SLIDING (FB - Hosgri)

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	0.0000	0.0000	-INFINITY-
ACC	UX	100.0000	100.0000	0.062955
ACC	UY	100.0000	100.0000	0.062955
ACC	UZ	100.0000	100.0000	0.034130

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page
DCPP ISFSI PAD SLIDING (FB - Hosgri) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	.000000	.000000	.000000	.000000	.000000
2	0.039570	0.055609	0.006683	0.000635	0.000500	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	.000000	.000000	.000000	.000000	.000000
2	-0.056018	-0.050275	-0.005866	-0.000703	-0.000708	.000000

Program SAP2000 Nonlinear Version 7.10 File:HEFB.OUT
Page 8

DCPP ISFSI PAD SLIDING (FB - Hosgri)

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	42002.927	9195.340	4.64E-12	-1.0896E+06	4.9773E+06	.000000
REACTNS	-42002.927	-9195.340	-1.58E-11	1.0896E+06	-4.9773E+06	.000000
TOTAL	1.46E-11	5.46E-12	-1.11E-11	-6.98E-10	2.79E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	-9195.340	42002.927	-3.15E-12	-4.9773E+06	-1.0896E+06	.000000
REACTNS	9195.340	-42002.927	1.07E-11	4.9773E+06	1.0896E+06	.000000
TOTAL	.000000	2.91E-11	7.57E-12	-4.66E-09	-9.31E-10	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	1.77E-11	-7.10E-12	-146297.137	8.41E-10	2.10E-09	.000000
REACTNS	-2.92E-11	1.16E-11	146297.137	-6.21E-10	-1.56E-09	.000000
TOTAL	-1.15E-11	4.48E-12	-5.82E-11	2.21E-10	5.39E-10	.000000

```
Program SAP2000 Nonlinear Version 7.10                          File:HEFB.OUT
                                                                  Page
DCPP ISFSI PAD SLIDING (FB - Hosgri)                                   9

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P        V2        V3         T        M2        M3
0.00000   4220.421   7344.426  10321.313   .000000  1.2231E+06  870314.433
0.50000   4220.421   7344.426  10321.313   .000000  611537.779  435157.216
1.00000   4220.421   7344.426  10321.313   .000000   3.63E-10    5.08E-10

HIST SEISMIC ------------------ MIN

REL DIST        P        V2        V3         T        M2        M3
0.00000  -3704.555  -10397.243  -9331.444   .000000 -1.1058E+06 -1.2321E+06
0.50000  -3704.555  -10397.243  -9331.444   .000000 -552888.036 -616036.627
1.00000  -3704.555  -10397.243  -9331.444   .000000   -4.07E-10   -3.62E-10
```

S A P 2 0 0 0 (R)

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```
Program SAP2000 Nonlinear Version 7.10                    File:LTSPFB.OUT
                                                             Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP)                  1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             -   -   -   -   -   -
     2             A   A   A   A   A   A
```

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
2	18.633540	18.633540	18.633540	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	18.633540	18.633540	18.633540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	18.633540	18.633540	18.633540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	118.500000	118.500000	118.500000

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.062955	15.884326	99.804161	9960.871
2	0.062955	15.884326	99.804161	9960.871
3	0.034130	29.299769	184.095881	33891.293

Program SAP2000 Nonlinear Version 7.10

File:LTSPFB.OUT
Page 4

DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP)

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.062955	4.216793	0.923146	4.65E-16
2	0.062955	-0.923146	4.216793	-3.16E-16
3	0.034130	5.22E-16	-2.09E-16	-4.316658

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.062955	95.4265	4.5735	0.0000	95.4265	4.5735	0.0000
2	0.062955	4.5735	95.4265	0.0000	100.0000	100.0000	0.0000
3	0.034130	0.0000	0.0000	100.0000	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page 6

DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP)

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	0.0000	0.0000	-INFINITY-
ACC	UX	100.0000	100.0000	0.062955
ACC	UY	100.0000	100.0000	0.062955
ACC	UZ	100.0000	100.0000	0.034130

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	.000000	.000000	.000000	.000000	.000000
2	0.040035	0.049138	0.009996	0.000533	0.000506	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	.000000	.000000	.000000	.000000	.000000
2	-0.047304	-0.042170	-0.010329	-0.000621	-0.000598	.000000

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT

DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	42002.927	9195.340	4.64E-12	-1.0896E+06	4.9773E+06	.000000
REACTNS	-42002.927	-9195.340	-1.58E-11	1.0896E+06	-4.9773E+06	.000000
TOTAL	1.46E-11	5.46E-12	-1.11E-11	-6.98E-10	2.79E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	-9195.340	42002.927	-3.15E-12	-4.9773E+06	-1.0896E+06	.000000
REACTNS	9195.340	-42002.927	1.07E-11	4.9773E+06	1.0896E+06	.000000
TOTAL	.000000	2.91E-11	7.57E-12	-4.66E-09	-9.31E-10	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	1.77E-11	-7.10E-12	-146297.137	8.41E-10	2.10E-09	.000000
REACTNS	-2.92E-11	1.16E-11	146297.137	-6.21E-10	-1.56E-09	.000000
TOTAL	-1.15E-11	4.48E-12	-5.82E-11	2.21E-10	5.39E-10	.000000

Program SAP2000 Nonlinear Version 7.10 File:LTSPFB.OUT
Page
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP) 9

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SEISMIC ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	6312.464	7430.791	9120.413	.000000	1.0808E+06	880548.723
0.50000	6312.464	7430.791	9120.413	.000000	540384.459	440274.362
1.00000	6312.464	7430.791	9120.413	.000000	3.22E-10	4.43E-10

HIST SEISMIC ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-6522.859	-8779.933	-7826.967	.000000	-927495.562	-1.0404E+06
0.50000	-6522.859	-8779.933	-7826.967	.000000	-463747.781	-520211.035
1.00000	-6522.859	-8779.933	-7826.967	.000000	-3.58E-10	-3.67E-10

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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```
Program SAP2000 Nonlinear Version 7.10                File:SX=0.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19)                1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT

Page

ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.010390	96.242289	604.708133	365671.927
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002757	362.700449	2278.914	5.1934E+06

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.010390	.000000	.000000	4.657681
4	0.008974	.000000	-4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002757	.000000	.000000	4.210409

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.010390	0.0000	0.0000	55.0308	49.2332	49.2332	55.0308
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	55.0308
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	55.0308
6	0.002757	0.0000	0.0000	44.9692	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) Page 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR NLLINK/DEF (TYPE)	(NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.010124
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.010124
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

```
Program SAP2000 Nonlinear Version 7.10                File:SX=0.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19)                 7

J O I N T   D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST    SINE ------------------ MAX

  JOINT        UX         UY         UZ         RX         RY         RZ
     1    0.025156    .000000   -0.001131    .000000   0.000308    .000000
     4    0.000887    .000000   -0.000152    .000000    .000000    .000000

HIST    SINE ------------------ MIN

  JOINT        UX         UY         UZ         RX         RY         RZ
     1   -0.027716    .000000   -0.001131    .000000  -0.000338    .000000
     4   -0.000983    .000000   -0.000152    .000000    .000000    .000000
```

```
Program SAP2000 Nonlinear Version 7.10                    File:SX=0.5G, U=1.19.OUT
                                                                     Page
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19)                    8

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000  -15232.500     .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000   15232.500     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE       1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE       2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000  -2.91E-11      .000000   -3.73E-09     .000000     .000000

MODE       3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  1.7032E+06     .000000     .000000     .000000
NLLINKS     .000000     .000000 -1.7032E+06     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    4.66E-10     .000000     .000000     .000000
```

```
Program SAP2000 Nonlinear Version 7.10                File:SX=0.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19)                 9

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE      4 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000 -2.1929E+06     .000000 -4.9320E+06     .000000     .000000
NLLINKS     .000000  2.1929E+06     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  4.9320E+06     .000000     .000000

  TOTAL     .000000    1.86E-09     .000000   -1.75E-07     .000000     .000000

MODE      5 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA  2.1929E+06     .000000     .000000     .000000 -4.9320E+06     .000000
NLLINKS -2.1929E+06     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000  4.9320E+06     .000000

  TOTAL   -4.66E-10     .000000     .000000     .000000   -2.05E-08     .000000

MODE      6 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  2.1867E+07     .000000     .000000     .000000
NLLINKS     .000000     .000000 -2.1867E+07     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000   -3.73E-09     .000000     .000000     .000000
```

Program SAP2000 Nonlinear Version 7.10 File:SX=0.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19) Page 10

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SINE ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	-7200.000	4970.552	.000000	.000000	.000000	1.18E-10
0.50000	-7200.000	4970.552	.000000	.000000	.000000	268455.990
1.00000	-7200.000	4970.552	.000000	.000000	.000000	536911.979

HIST SINE ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-7200.000	-4530.903	.000000	.000000	.000000	-1.30E-10
0.50000	-7200.000	-4530.903	.000000	.000000	.000000	-294505.235
1.00000	-7200.000	-4530.903	.000000	.000000	.000000	-589010.469

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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16 Nov 2001 09:10:13

ISFSI Pad Seismic Sliding Analyses – Output File

```
Program SAP2000 Nonlinear Version 7.10                    File:SX=1.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19)                    1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              A   A   A   A   A   A
    4              A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT

ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) Page 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.010390	96.242289	604.708133	365671.927
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002757	362.700449	2278.914	5.1934E+06

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT

ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.010390	.000000	.000000	4.657681
4	0.008974	.000000	-4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002757	.000000	.000000	4.210409

ISFSI Pad Seismic Sliding Analyses – Output File

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT

ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.010390	0.0000	0.0000	55.0308	49.2332	49.2332	55.0308
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	55.0308
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	55.0308
6	0.002757	0.0000	0.0000	44.9692	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.010124
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.010124
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT

ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) Page 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SINE ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.107916	.000000	-0.001131	.000000	0.000945	.000000
4	0.071626	.000000	-0.000152	.000000	.000000	.000000

HIST SINE ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.240963	.000000	-0.001131	.000000	-0.000843	.000000
4	-0.186154	.000000	-0.000152	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                    File:SX=1.5G, U=1.19.OUT
                                                                     Page
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19)                       8

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000   -15232.500    .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000    15232.500    .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE      1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE      2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000   -2.91E-11     .000000   -3.73E-09     .000000     .000000

MODE      3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  1.7032E+06     .000000     .000000     .000000
NLLINKS     .000000     .000000 -1.7032E+06     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    4.66E-10     .000000     .000000     .000000
```

Program SAP2000 Nonlinear Version 7.10 File:SX=1.5G, U=1.19.OUT

ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	-2.1929E+06	.000000	-4.9320E+06	.000000	.000000
NLLINKS	.000000	2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	4.9320E+06	.000000	.000000
TOTAL	.000000	1.86E-09	.000000	-1.75E-07	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1867E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1867E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	-3.73E-09	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                File:SX=1.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19)                   10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST    SINE ------------------ MAX

REL DIST        P         V2         V3         T         M2         M3
0.00000   -7200.000  12386.274    .000000    .000000    .000000    4.94E-10
0.50000   -7200.000  12386.274    .000000    .000000    .000000  823051.133
1.00000   -7200.000  12386.274    .000000    .000000    .000000  1.6461E+06

HIST    SINE ------------------ MIN

REL DIST        P         V2         V3         T         M2         M3
0.00000   -7200.000 -13891.158    .000000    .000000    .000000   -1.10E-09
0.50000   -7200.000 -13891.158    .000000    .000000    .000000 -733886.757
1.00000   -7200.000 -13891.158    .000000    .000000    .000000 -1.4678E+06
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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16 Nov 2001 09:17:53

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Program SAP2000 Nonlinear Version 7.10                    File:SY=0.5G, U=1.19.OUT
                                                                     Page
ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19)                        1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.010390	96.242289	604.708133	365671.927
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002757	362.700449	2278.914	5.1934E+06

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.010390	.000000	.000000	4.657681
4	0.008974	.000000	-4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002757	.000000	.000000	4.210409

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.010390	0.0000	0.0000	55.0308	49.2332	49.2332	55.0308
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	55.0308
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	55.0308
6	0.002757	0.0000	0.0000	44.9692	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.010124
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.010124
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

```
Program SAP2000 Nonlinear Version 7.10                    File:SY=0.5G, U=1.19.OUT
                                                                     Page
ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19)                        7

J O I N T   D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST    SINE ------------------ MAX

  JOINT         UX         UY         UZ         RX         RY         RZ
     1     .000000   0.025156  -0.001131   0.000338    .000000    .000000
     4     .000000   0.000887  -0.000152    .000000    .000000    .000000

HIST    SINE ------------------ MIN

  JOINT         UX         UY         UZ         RX         RY         RZ
     1     .000000  -0.027716  -0.001131  -0.000308    .000000    .000000
     4     .000000  -0.000983  -0.000152    .000000    .000000    .000000
```

Program SAP2000 Nonlinear Version 7.10 File:SY=0.5G, U=1.19.OUT

ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	-2.91E-11	.000000	-3.73E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	1.7032E+06	.000000	.000000	.000000
NLLINKS	.000000	.000000	-1.7032E+06	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	4.66E-10	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                    File:SY=0.5G, U=1.19.OUT
                                                                        Page
ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19)                          9

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE      4 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000 -2.1929E+06     .000000 -4.9320E+06     .000000     .000000
NLLINKS     .000000  2.1929E+06     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  4.9320E+06     .000000     .000000

  TOTAL     .000000    1.86E-09     .000000   -1.75E-07     .000000     .000000

MODE      5 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA  2.1929E+06     .000000     .000000     .000000 -4.9320E+06     .000000
NLLINKS -2.1929E+06     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000  4.9320E+06     .000000

  TOTAL   -4.66E-10     .000000     .000000     .000000   -2.05E-08     .000000

MODE      6 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  2.1867E+07     .000000     .000000     .000000
NLLINKS     .000000     .000000 -2.1867E+07     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000   -3.73E-09     .000000     .000000     .000000
```

```
Program SAP2000 Nonlinear Version 7.10                    File:SY=0.5G, U=1.19.OUT
                                                                    Page
ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19)                    10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST    SINE ------------------ MAX

REL DIST          P          V2          V3          T          M2          M3
0.00000   -7200.000    .000000    4530.903    .000000    2.29E-11    .000000
0.50000   -7200.000    .000000    4530.903    .000000  294505.235    .000000
1.00000   -7200.000    .000000    4530.903    .000000  589010.469    .000000

HIST    SINE ------------------ MIN

REL DIST          P          V2          V3          T          M2          M3
0.00000   -7200.000    .000000   -4970.552    .000000   -2.43E-11    .000000
0.50000   -7200.000    .000000   -4970.552    .000000 -268455.990    .000000
1.00000   -7200.000    .000000   -4970.552    .000000 -536911.979    .000000
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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```
Program SAP2000 Nonlinear Version 7.10                    File:SY=1.5G, U=1.19.OUT
                                                                     Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19)                1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              A   A   A   A   A   A
    4              A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) Page 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.010390	96.242289	604.708133	365671.927
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002757	362.700449	2278.914	5.1934E+06

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.010390	.000000	.000000	4.657681
4	0.008974	.000000	-4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002757	.000000	.000000	4.210409

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.010390	0.0000	0.0000	55.0308	49.2332	49.2332	55.0308
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	55.0308
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	55.0308
6	0.002757	0.0000	0.0000	44.9692	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.010124
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.010124
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SINE ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	0.107916	-0.001131	0.000843	.000000	.000000
4	.000000	0.071626	-0.000152	.000000	.000000	.000000

HIST SINE ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	.000000	-0.240963	-0.001131	-0.000945	.000000	.000000
4	.000000	-0.186154	-0.000152	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                File:SY=1.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19)                 8

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000   -15232.500    .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000    15232.500    .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE      1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE      2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000   -2.91E-11     .000000   -3.73E-09     .000000     .000000

MODE      3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  1.7032E+06     .000000     .000000     .000000
NLLINKS     .000000     .000000 -1.7032E+06     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    4.66E-10     .000000     .000000     .000000
```

Program SAP2000 Nonlinear Version 7.10 File:SY=1.5G, U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	-2.1929E+06	.000000	-4.9320E+06	.000000	.000000
NLLINKS	.000000	2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	4.9320E+06	.000000	.000000
TOTAL	.000000	1.86E-09	.000000	-1.75E-07	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1867E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1867E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	-3.73E-09	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                File:SY=1.5G, U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19)                10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================== LENGTH =  118.500000

HIST    SINE ------------------ MAX

REL DIST         P         V2         V3          T         M2         M3
0.00000   -7200.000    .000000   13891.158    .000000    1.34E-09    .000000
0.50000   -7200.000    .000000   13891.158    .000000  733886.757    .000000
1.00000   -7200.000    .000000   13891.158    .000000  1.4678E+06    .000000

HIST    SINE ------------------ MIN

REL DIST         P         V2         V3          T         M2         M3
0.00000   -7200.000    .000000  -12386.274    .000000   -5.25E-10    .000000
0.50000   -7200.000    .000000  -12386.274    .000000 -823051.133    .000000
1.00000   -7200.000    .000000  -12386.274    .000000 -1.6461E+06    .000000
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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16 Nov 2001 09:28:03

```
Program SAP2000 Nonlinear Version 7.10          File:PURE SLIDE, U=1.19.OUT
                                                              Page
Client: PG&E     Project Number: 0104-0019                      1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    4              A   A   A   A   A   A
```

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page 2

Client: PG&E Project Number: 0104-0019

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
4	39.424000	39.424000	39.424000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.424000	39.424000	39.424000	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.424000	39.424000	39.424000
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page
Client: PG&E Project Number: 0104-0019 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.012476	80.156692	503.639353	253652.597
2	0.012476	80.156692	503.639353	253652.597
3	0.003945	253.477718	1592.647	2.5365E+06

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page 4

Client: PG&E Project Number: 0104-0019

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.012476	.000000	6.278853	.000000
2	0.012476	6.278853	.000000	.000000
3	0.003945	.000000	.000000	6.278853

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT

Page 5

Client: PG&E Project Number: 0104-0019

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.012476	0.0000	100.0000	0.0000	0.0000	100.0000	0.0000
2	0.012476	100.0000	0.0000	0.0000	100.0000	100.0000	0.0000
3	0.003945	0.0000	0.0000	100.0000	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page 6

Client: PG&E Project Number: 0104-0019

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.003945
ACC	UX	100.0000	100.0000	0.012476
ACC	UY	100.0000	100.0000	0.012476
ACC	UZ	100.0000	100.0000	0.003945
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012476
NLLINK/DEF	1/U3	100.0000	100.0000	0.012476

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page
Client: PG&E Project Number: 0104-0019 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SINE ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
4	0.032081	.000000	-0.000152	.000000	.000000	.000000

HIST SINE ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
4	-0.131621	.000000	-0.000152	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:PURE SLIDE, U=1.19.OUT
Page 8

Client: PG&E Project Number: 0104-0019

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	1.5926E+06	.000000	.000000	.000000	.000000
NLLINKS	.000000	-1.5926E+06	.000000	.000000	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	.000000	.000000	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	1.5926E+06	.000000	.000000	.000000	.000000	.000000
NLLINKS	-1.5926E+06	.000000	.000000	.000000	.000000	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	1.5926E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-1.5926E+07	.000000	.000000	.000000
TOTAL	.000000	.000000	-3.73E-09	.000000	.000000	.000000

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET1,U=1.19.OUT
                                                            Page
ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19)                    1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

Page

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	1.174023	0.030158	-0.001644	0.000631	0.000778	.000000
4	1.120628	0.001306	-3.86E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.027520	-1.143191	-0.022367	-0.000625	-0.000646	.000000
4	-0.000359	-1.111972	-0.000269	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

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Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET1,U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19)                   10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST         P         V2         V3          T         M2         M3
0.00000 -997.231774   9492.105   9183.313    .000000   5.16E-09   5.30E-09
0.50000 -997.231774   9492.105   9183.313    .000000  549365.155  677501.400
1.00000 -997.231774   9492.105   9183.313    .000000  1.0987E+06  1.3550E+06

HIST SEISMIC ------------------ MIN

REL DIST         P         V2         V3          T         M2         M3
0.00000  -13956.618  -11434.623  -9271.986    .000000  -1.41E-10  -1.29E-10
0.50000  -13956.618  -11434.623  -9271.986    .000000 -544111.318 -562407.228
1.00000  -13956.618  -11434.623  -9271.986    .000000 -1.0882E+06 -1.1248E+06
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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Program SAP2000 Nonlinear Version 7.10          File:ISFSI,SET2A,U=1.19.OUT
                                                              Page
ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19)                    1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

Page 5

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19)

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

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Program SAP2000 Nonlinear Version 7.10          File:ISFSI,SET2A,U=1.19.OUT
                                                              Page
ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19)                    7

J O I N T   D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ------------------ MAX

  JOINT        UX         UY         UZ         RX         RY         RZ
     1   0.038785   0.054463  -0.001799   0.000384   0.000510    .000000
     4   0.000733   0.010749  -3.47E-05    .000000    .000000    .000000

HIST SEISMIC ------------------ MIN

  JOINT        UX         UY         UZ         RX         RY         RZ
     1  -0.068949  -0.022042  -0.023688  -0.000661  -0.000643    .000000
     4  -0.020115  -0.001634  -0.000276    .000000    .000000    .000000
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19) Page 10

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SEISMIC ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	-1102.246	9453.163	9715.622	.000000	1.05E-10	1.83E-10
0.50000	-1102.246	9453.163	9715.622	.000000	334490.656	443887.551
1.00000	-1102.246	9453.163	9715.622	.000000	668981.312	887775.102

HIST SEISMIC ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-14791.442	-7491.773	-5645.412	.000000	-2.55E-10	-3.20E-10
0.50000	-14791.442	-7491.773	-5645.412	.000000	-575650.598	-560099.879
1.00000	-14791.442	-7491.773	-5645.412	.000000	-1.1513E+06	-1.1202E+06

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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16 Nov 2001 11:32:48

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Program SAP2000 Nonlinear Version 7.10                    File:ISFSI,SET3,U=1.19.OUT
                                                                    Page
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)                       1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              A   A   A   A   A   A
    4              A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT

Page 3

ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19) 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT

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ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT

Page 6

ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19) Page 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.148954	0.113930	-5.84E-05	0.000603	0.000652	.000000
4	0.113945	0.069673	-2.70E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.039028	-0.038632	-0.021886	-0.000560	-0.000658	.000000
4	-0.003008	-0.005863	-0.000279	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET3,U=1.19.OUT
                                                                     Page
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)                       8

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000  -15232.500     .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000   15232.500     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE      1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE      2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000    1.46E-11     .000000   -4.66E-09     .000000     .000000

MODE      3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  146411.283     .000000     .000000     .000000
NLLINKS     .000000     .000000 -146411.283     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    5.82E-11     .000000     .000000     .000000
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=1.19.OUT

ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

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Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET3,U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)                   10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================== LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P         V2         V3          T         M2         M3
0.00000  -19.866950   9672.563   8232.337    .000000   1.81E-10   6.78E-10
0.50000  -19.866950   9672.563   8232.337    .000000  524606.931  567793.339
1.00000  -19.866950   9672.563   8232.337    .000000  1.0492E+06  1.1356E+06

HIST SEISMIC ------------------ MIN

REL DIST        P         V2         V3          T         M2         M3
0.00000  -13646.287  -9583.010  -8854.125    .000000  -5.22E-10  -1.83E-10
0.50000  -13646.287  -9583.010  -8854.125    .000000 -487765.940 -573099.354
1.00000  -13646.287  -9583.010  -8854.125    .000000 -975531.879 -1.1462E+06
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET5,U=1.19.OUT
                                                              Page
ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)                        1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

Page 3

ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

Page

ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19) Page 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=1.19.OUT

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ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.061536	0.176868	0.000612	0.000673	0.000718	.000000
4	0.005754	0.138554	-2.32E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.105519	-0.042057	-0.022262	-0.000580	-0.000480	.000000
4	-0.067624	-0.001545	-0.000267	.000000	.000000	.000000

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Program SAP2000 Nonlinear Version 7.10                    File:ISFSI,SET5,U=1.19.OUT
                                                                     Page
ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)                       8

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000  -15232.500     .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000   15232.500     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE      1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE      2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000   1.46E-11      .000000   -4.66E-09     .000000     .000000

MODE      3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  146411.283     .000000     .000000     .000000
NLLINKS     .000000     .000000 -146411.283     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    5.82E-11     .000000     .000000     .000000
```

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET5,U=1.19.OUT
                                                                    Page
ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)                      9

G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE      4 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   2.1929E+06    .000000   4.9320E+06    .000000     .000000
NLLINKS     .000000  -2.1929E+06    .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  -4.9320E+06    .000000     .000000

  TOTAL     .000000   -4.66E-10     .000000    2.05E-08     .000000     .000000

MODE      5 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   2.1929E+06    .000000     .000000     .000000  -4.9320E+06    .000000
NLLINKS  -2.1929E+06    .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000   4.9320E+06    .000000

  TOTAL   -4.66E-10     .000000     .000000     .000000    -2.05E-08    .000000

MODE      6 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000   2.1932E+07    .000000     .000000     .000000
NLLINKS     .000000     .000000  -2.1932E+07    .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    7.45E-09     .000000     .000000     .000000
```

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET5,U=1.19.OUT
                                                            Page
ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)                    10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P         V2         V3          T         M2         M3
0.00000  401.481836   7048.921   8523.344    .000000   1.97E-10   2.88E-10
0.50000  401.481836   7048.921   8523.344    .000000  586265.507  624743.087
1.00000  401.481836   7048.921   8523.344    .000000  1.1725E+06  1.2495E+06

HIST SEISMIC ------------------ MIN

REL DIST        P         V2         V3          T         M2         M3
0.00000  -13892.340  -10544.187  -9894.776    .000000   -8.05E-10  -4.83E-10
0.50000  -13892.340  -10544.187  -9894.776    .000000 -505008.146 -417648.573
1.00000  -13892.340  -10544.187  -9894.776    .000000 -1.0100E+06 -835297.145
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET6,U=1.19.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19)                      1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

Page 3

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

Page 6

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19)

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) Page 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.049755	0.172512	0.000594	0.000598	0.000601	.000000
4	0.018351	0.125229	-2.11E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.151858	-0.031095	-0.023160	-0.000685	-0.000696	.000000
4	-0.116941	-0.002142	-0.000275	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=1.19.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET6,U=1.19.OUT
                                                            Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19)                    10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================= LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P         V2         V3          T         M2         M3
0.00000  388.816546  10221.097  10061.157    .000000   1.46E-10   2.33E-10
0.50000  388.816546  10221.097  10061.157    .000000  520719.324  523003.316
1.00000  388.816546  10221.097  10061.157    .000000  1.0414E+06  1.0460E+06

HIST SEISMIC ------------------ MIN

REL DIST        P         V2         V3          T         M2         M3
0.00000  -14453.523  -8827.060  -8788.512    .000000   -7.86E-10  -6.91E-10
0.50000  -14453.523  -8827.060  -8788.512    .000000 -596123.538 -605600.015
1.00000  -14453.523  -8827.060  -8788.512    .000000 -1.1922E+06 -1.2112E+06
```

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET1,U=0.73.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73)                     1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              A   A   A   A   A   A
    4              A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

Page

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT
Page 6

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73)

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR NLLINK/DEF (TYPE)	(NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	2.354341	0.031277	-0.001644	0.000480	0.000713	.000000
4	2.337530	0.002656	-3.86E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.025745	-2.001354	-0.022367	-0.000635	-0.000600	.000000
4	-0.001433	-1.996918	-0.000269	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

ISFSI Pad Seismic Sliding Analyses – Output File

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET1,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73) Page 10

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SEISMIC ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	-997.231774	8811.775	9330.501	.000000	9.01E-09	1.06E-08
0.50000	-997.231774	8811.775	9330.501	.000000	417804.989	620762.831
1.00000	-997.231774	8811.775	9330.501	.000000	835609.979	1.2415E+06

HIST SEISMIC ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-13956.618	-10477.010	-7051.561	.000000	-1.47E-10	-1.21E-10
0.50000	-13956.618	-10477.010	-7051.561	.000000	-552832.173	-522097.642
1.00000	-13956.618	-10477.010	-7051.561	.000000	-1.1057E+06	-1.0442E+06

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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16 Nov 2001 12:42:24

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET2A,U=0.73.OUT
                                                                    Page
ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73)                      1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT

Page 3

ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73) 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT

ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73)

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

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J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.015126	0.268779	-0.001799	0.000348	0.000545	.000000
4	0.000766	0.249226	-3.47E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.292444	-0.021366	-0.023688	-0.000589	-0.000684	.000000
4	-0.266873	-0.002570	-0.000276	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET2A,U=0.73.OUT
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G L O B A L   F O R C E   B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000  -15232.500     .000000     .000000     .000000
INERTIA     .000000     .000000     .000000     .000000     .000000     .000000
NLLINKS     .000000     .000000   15232.500     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000     .000000     .000000     .000000     .000000

MODE      1 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA   43141.866     .000000     .000000     .000000  5.0082E+06     .000000
NLLINKS  -43141.866     .000000     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000 -5.0082E+06     .000000

  TOTAL   1.46E-11      .000000     .000000     .000000    4.66E-09     .000000

MODE      2 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000   43141.866     .000000 -5.0082E+06     .000000     .000000
NLLINKS     .000000  -43141.866     .000000     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000  5.0082E+06     .000000     .000000

  TOTAL     .000000    1.46E-11     .000000   -4.66E-09     .000000     .000000

MODE      3 ------------------

                FX          FY          FZ          MX          MY          MZ
APPLIED     .000000     .000000     .000000     .000000     .000000     .000000
INERTIA     .000000     .000000  146411.283     .000000     .000000     .000000
NLLINKS     .000000     .000000 -146411.283     .000000     .000000     .000000
REACTNS     .000000     .000000     .000000     .000000     .000000     .000000

  TOTAL     .000000     .000000    5.82E-11     .000000     .000000     .000000
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET2A,U=0.73.OUT

ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10          File:ISFSI,SET2A,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73)                  10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================== LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P         V2         V3         T         M2         M3
0.00000   -1102.246   10048.825   8651.313   .000000   1.00E-10   7.11E-11
0.50000   -1102.246   10048.825   8651.313   .000000  303226.775  474695.878
1.00000   -1102.246   10048.825   8651.313   .000000  606453.551  949391.755

HIST SEISMIC ------------------ MIN

REL DIST        P         V2         V3         T         M2         M3
0.00000  -14791.442   -8011.745  -5117.751   .000000   -1.21E-09  -1.32E-09
0.50000  -14791.442   -8011.745  -5117.751   .000000 -512590.294 -595392.887
1.00000  -14791.442   -8011.745  -5117.751   .000000 -1.0252E+06 -1.1908E+06
```

```
Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET3,U=0.73.OUT
                                                            Page
ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73)                          1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

       (A) = Active DOF, equilibrium equation
       (-) = Restrained DOF, reaction computed
       (+) = Constrained DOF
       ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT

Page 3

ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT

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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73)

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT

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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.857895	0.454117	-5.84E-05	0.000543	0.000602	.000000
4	0.824331	0.453318	-2.70E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.139137	-0.110887	-0.021886	-0.000528	-0.000601	.000000
4	-0.117698	-0.079972	-0.000279	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET3,U=0.73.OUT

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ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73) 10

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SEISMIC ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	-19.866950	8830.053	7750.105	.000000	5.06E-10	3.87E-09
0.50000	-19.866950	8830.053	7750.105	.000000	472750.946	523764.451
1.00000	-19.866950	8830.053	7750.105	.000000	945501.892	1.0475E+06

HIST SEISMIC ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-13646.287	-8839.906	-7978.919	.000000	-2.05E-09	-6.31E-10
0.50000	-13646.287	-8839.906	-7978.919	.000000	-459193.706	-523180.626
1.00000	-13646.287	-8839.906	-7978.919	.000000	-918387.411	-1.0464E+06

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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results produced by this program

16 Nov 2001 13:15:21

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET5,U=0.73.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73)                      1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
     1             A   A   A   A   A   A
     4             A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT
Page 3

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73)

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 4

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR NLLINK/DEF (TYPE)	(NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.398179	1.020633	0.000612	0.000632	0.000545	.000000
4	0.371487	0.982576	-2.32E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.075583	-0.109772	-0.022262	-0.000712	-0.000458	.000000
4	-0.055173	-0.094859	-0.000267	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET5,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73) Page 10

F R A M E E L E M E N T I N T E R N A L F O R C E S

ELEM 1 ========== LENGTH = 118.500000

HIST SEISMIC ---------- MAX

REL DIST	P	V2	V3	T	M2	M3
0.00000	401.481836	6725.070	10458.873	.000000	4.98E-10	1.80E-09
0.50000	401.481836	6725.070	10458.873	.000000	549858.599	474568.316
1.00000	401.481836	6725.070	10458.873	.000000	1.0997E+06	949136.632

HIST SEISMIC ---------- MIN

REL DIST	P	V2	V3	T	M2	M3
0.00000	-13892.340	-8009.592	-9280.314	.000000	-4.60E-09	-3.44E-10
0.50000	-13892.340	-8009.592	-9280.314	.000000	-619688.246	-398460.401
1.00000	-13892.340	-8009.592	-9280.314	.000000	-1.2394E+06	-796920.802

S A P 2 0 0 0 (R)

Structural Analysis Programs

Nonlinear Version 7.10

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It is the responsibility of the user to verify all
results produced by this program

16 Nov 2001 13:25:59

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Program SAP2000 Nonlinear Version 7.10                File:ISFSI,SET6,U=0.73.OUT
                                                            Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73)                    1

D I S P L A C E M E N T   D E G R E E S   O F   F R E E D O M

      (A) = Active DOF, equilibrium equation
      (-) = Restrained DOF, reaction computed
      (+) = Constrained DOF
      ( ) = Null DOF

 JOINTS            UX  UY  UZ  RX  RY  RZ
    1              A   A   A   A   A   A
    4              A   A   A   -   -   -
```

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) 2

A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

JOINT	UX	UY	UZ	RX	RY	RZ
1	18.633540	18.633540	18.633540	.000000	.000000	.000000
4	20.788000	20.788000	20.788000	.000000	.000000	.000000

T O T A L A S S E M B L E D J O I N T M A S S E S

IN GLOBAL COORDINATES

	UX	UY	UZ	RX	RY	RZ
TOTAL	39.421540	39.421540	39.421540	.000000	.000000	.000000

T O T A L A C C E L E R A T E D M A S S A N D L O C A T I O N

TOTAL MASS ACTIVATED BY ACCELERATION LOADS, IN GLOBAL COORDINATES

	UX	UY	UZ
MASS	39.421540	39.421540	39.421540
X-LOC	.000000	.000000	.000000
Y-LOC	.000000	.000000	.000000
Z-LOC	56.011878	56.011878	56.011878

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) 3

M O D A L P E R I O D S A N D F R E Q U E N C I E S

MODE	PERIOD (TIME)	FREQUENCY (CYC/TIME)	FREQUENCY (RAD/TIME)	EIGENVALUE (RAD/TIME)**2
1	0.063493	15.749677	98.958142	9792.714
2	0.063493	15.749677	98.958142	9792.714
3	0.034236	29.208730	183.523863	33681.008
4	0.008974	111.428583	700.126437	490177.027
5	0.008974	111.428583	700.126437	490177.027
6	0.002856	350.179365	2200.242	4.8411E+06

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
Page 4

ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73)

M O D A L P A R T I C I P A T I O N F A C T O R S

FOR UNIT ACCELERATION LOADS IN GLOBAL COORDINATES

MODE	PERIOD	UX	UY	UZ
1	0.063493	4.405507	.000000	.000000
2	0.063493	.000000	4.405507	.000000
3	0.034236	.000000	.000000	4.346998
4	0.008974	.000000	4.473595	.000000
5	0.008974	4.473595	.000000	.000000
6	0.002856	.000000	.000000	4.530469

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) 5

M O D A L P A R T I C I P A T I N G M A S S R A T I O S

MODE	PERIOD	INDIVIDUAL MODE (PERCENT)			CUMULATIVE SUM (PERCENT)		
		UX	UY	UZ	UX	UY	UZ
1	0.063493	49.2332	0.0000	0.0000	49.2332	0.0000	0.0000
2	0.063493	0.0000	49.2332	0.0000	49.2332	49.2332	0.0000
3	0.034236	0.0000	0.0000	47.9342	49.2332	49.2332	47.9342
4	0.008974	0.0000	50.7668	0.0000	49.2332	100.0000	47.9342
5	0.008974	50.7668	0.0000	0.0000	100.0000	100.0000	47.9342
6	0.002856	0.0000	0.0000	52.0658	100.0000	100.0000	100.0000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
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ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) 6

M O D A L L O A D P A R T I C I P A T I O N R A T I O S

LOAD, ACC, OR (TYPE)	NLLINK/DEF (NAME)	STATIC (PERCENT)	DYNAMIC (PERCENT)	EFFECTIVE PERIOD
LOAD	GRAVITY	100.0000	100.0000	0.034109
ACC	UX	100.0000	100.0000	0.062862
ACC	UY	100.0000	100.0000	0.062862
ACC	UZ	100.0000	100.0000	0.034109
NLLINK/DEF	1/U1	100.0000	100.0000	0.003945
NLLINK/DEF	1/U2	100.0000	100.0000	0.012475
NLLINK/DEF	1/U3	100.0000	100.0000	0.012475

(*) NOTE: DYNAMIC LOAD PARTICIPATION RATIO EXCLUDES LOAD APPLIED
TO NON-MASS DEGREES OF FREEDOM

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) Page 7

J O I N T D I S P L A C E M E N T S

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

HIST SEISMIC ---------- MAX

JOINT	UX	UY	UZ	RX	RY	RZ
1	0.291803	0.569992	0.000594	0.000697	0.000595	.000000
4	0.262330	0.546219	-2.11E-05	.000000	.000000	.000000

HIST SEISMIC ---------- MIN

JOINT	UX	UY	UZ	RX	RY	RZ
1	-0.138699	-0.035478	-0.023160	-0.000636	-0.000634	.000000
4	-0.100099	-0.006796	-0.000275	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT
Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) 8

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD GRAVITY ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	-15232.500	.000000	.000000	.000000
INERTIA	.000000	.000000	.000000	.000000	.000000	.000000
NLLINKS	.000000	.000000	15232.500	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000

MODE 1 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	43141.866	.000000	.000000	.000000	5.0082E+06	.000000
NLLINKS	-43141.866	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	-5.0082E+06	.000000
TOTAL	1.46E-11	.000000	.000000	.000000	4.66E-09	.000000

MODE 2 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	43141.866	.000000	-5.0082E+06	.000000	.000000
NLLINKS	.000000	-43141.866	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	5.0082E+06	.000000	.000000
TOTAL	.000000	1.46E-11	.000000	-4.66E-09	.000000	.000000

MODE 3 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	146411.283	.000000	.000000	.000000
NLLINKS	.000000	.000000	-146411.283	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	5.82E-11	.000000	.000000	.000000

Program SAP2000 Nonlinear Version 7.10 File:ISFSI,SET6,U=0.73.OUT

ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73) Page 9

G L O B A L F O R C E B A L A N C E

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

MODE 4 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	2.1929E+06	.000000	4.9320E+06	.000000	.000000
NLLINKS	.000000	-2.1929E+06	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	-4.9320E+06	.000000	.000000
TOTAL	.000000	-4.66E-10	.000000	2.05E-08	.000000	.000000

MODE 5 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	2.1929E+06	.000000	.000000	.000000	-4.9320E+06	.000000
NLLINKS	-2.1929E+06	.000000	.000000	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	4.9320E+06	.000000
TOTAL	-4.66E-10	.000000	.000000	.000000	-2.05E-08	.000000

MODE 6 ----------

	FX	FY	FZ	MX	MY	MZ
APPLIED	.000000	.000000	.000000	.000000	.000000	.000000
INERTIA	.000000	.000000	2.1932E+07	.000000	.000000	.000000
NLLINKS	.000000	.000000	-2.1932E+07	.000000	.000000	.000000
REACTNS	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	7.45E-09	.000000	.000000	.000000

```
Program SAP2000 Nonlinear Version 7.10              File:ISFSI,SET6,U=0.73.OUT
                                                                   Page
ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73)                    10

F R A M E   E L E M E N T   I N T E R N A L   F O R C E S

ELEM      1 ================== LENGTH =  118.500000

HIST SEISMIC ------------------ MAX

REL DIST        P         V2         V3          T         M2         M3
0.00000  388.816546   9312.153   9346.167    .000000   1.65E-10   1.32E-09
0.50000  388.816546   9312.153   9346.167    .000000  606444.805  518009.939
1.00000  388.816546   9312.153   9346.167    .000000  1.2129E+06  1.0360E+06

HIST SEISMIC ------------------ MIN

REL DIST        P         V2         V3          T         M2         M3
0.00000  -14453.523  -8742.784  -10235.355    .000000   -2.57E-09   -6.32E-10
0.50000  -14453.523  -8742.784  -10235.355    .000000 -553760.380 -551745.082
1.00000  -14453.523  -8742.784  -10235.355    .000000 -1.1075E+06 -1.1035E+06
```

NUCLEAR POWER GENERATION
CF3.ID4
ATTACHMENT 7.2

Index No. 402_____
Binder No. _____

TITLE: CALCULATION COVER SHEET

Unit(s): 1 & 2 File No.: 52.27

Responsible Group: Civil Calculation No.: 52.27.100.718

No. of Pages 3 pages + Index (4 pages) + 1 Attachment (34 pages) Design Calculation YES [x] NO [ ]

System No. 42C Quality Classification Q (Safety-Related)

Structure, System or Component: Independent Spent Fuel Storage Facility

Subject: Determination of Rock Anchor Design Parameters for DCPP ISFSI Cutslope (GEO.DCPP.01.08, Rev. 1)

Electronic calculation YES [ ] NO [x]

Computer Model	Computer ID	Program Location	Date of Last Change

Registered Engineer Stamp: Complete A or B

A. Insert PE Stamp or Seal Below	B. Insert stamp directing to the PE stamp or seal
Expiration Date:	***REGISTERED ENGINEERS' STAMPS AND EXPIRATION DATES ARE SHOWN ON DWG 063618***

NOTE 1: Update DCI promptly after approval.
NOTE 2: Forward electronic calculation file to CCTG for uploading to EDMS.

TITLE: CALCULATION COVER SHEET

CALC No. 52.27.100.718, R0

RECORD OF REVISIONS

Rev No.	Status	Reason for Revision	Prepared By:	LBIE Screen	LBIE	Check Method*	LBIE Approval		Checked	Supervisor	Registered Engineer
		Remarks	Initials/ LAN ID/ Date	Yes/ No/ NA	Yes/ No/ NA		PSRC Mtg. No.	PSRC Mtg. Date	Initials/ LAN ID/ Date	Initials/ LAN ID/ Date	Signature/ LAN ID/ Date
0	F	Acceptance of Geosciences Calc. No. GEO.DCPP.01.08, Rev. 1. Calc. supports current edition of 10CFR72 DCPP License Application to be reviewed by NRC prior to implementation. Prepared per CF3.ID17.	AFT2 MT 12/13/01	[ ] Yes [ ] No [x] NA	[ ] Yes [ ] No [x] NA	[ ] A [ ] B [x] C	N/A	N/A	N/A	LJS2 12/13/01	LJS4 12/13/01
				[ ] Yes [ ] No [ ] NA	[ ] Yes [ ] No [ ] NA	[ ] A [ ] B [ ] C					
				[ ] Yes [ ] No [ ] NA	[ ] Yes [ ] No [ ] NA	[ ] A [ ] B [ ] C					

*Check Method: A: Detailed Check, B: Alternate Method (note added pages), C: Critical Point Check

Table of Contents:

Item	Type	Title	Page Numbers
1	Index	Cross-Index (For Information Only)	1 - 4
2	Attachment A	Determination of Rock Anchor Design Parameters for DCPP ISFSI Cutslope	1 – 34

1- This table cross references between Geosciences calculation numbers and DCPP (Civil Group's) calculation numbers. This section is For Information Only.

Cross-Index
(For Information Only)

Item No.	Geoscience Calc. No.	Title	PG&E Calc. No.	Comments
1	GEO.DCPP.01.01	Development of Young's Modulus and Poisson's Ratios for DCPP ISFSI Based on Field Data	52.27.100.711	
2	GEO.DCPP.01.02	Determination of Probabilistically Reduced Peak Bedrock Accelerations for DCPP ISFSI Transporter Analyses	52.27.100.712	
3	GEO.DCPP.01.03	Development of Allowable Bearing Capacity for DCPP ISFSI Pad and CTF Stability Analyses	52.27.100.713	
4	GEO.DCPP.01.04 .	Methodology for Determining Sliding Resistance Along Base of DCPP ISFSI Pads	52.27.100.714	
5	GEO.DCPP.01.05	Determination of Pseudostatic Acceleration Coefficient for use in DCPP ISFSI Cutslope Stability Analyses	52.27.100.715	
6	GEO.DCPP.01.06	Development of Lateral Bearing Capacity for DCPP CTF Stability Analyses	52.27.100.716	
7	GEO.DCPP.01.07	Development of Coefficient of Subgrade Reaction for DCPP ISFSI Pad Stability Checks	52.27.100.717	
8	GEO.DCPP.01.08	Determination of Rock Anchor Design Parameters for DCPP ISFSI Cutslope	52.27.100.718	
9	GEO.DCPP.01.09	Determination of Applicability of Rock Elastic Stress-Strain Values to Calculated Strains Under	52.27.100.719	Calculation to be replaced by letter

Cross-Index
(For Information Only)

Item No.	Geoscience Calc. No.	Title	PG&E Calc. No.	Comments
		DCPP ISFSI Pad		
10	GEO.DCPP.01.10	Determination of SSER 34 Long Period Spectral Values	52.27.100.720	
11	GEO.DCPP.01.11	Development of ISFSI Spectra	52.27.100.721	
12	GEO.DCPP.01.12	Development of Fling Model for Diablo Canyon ISFSI	52.27.100.722	
13	GEO.DCPP.01.13	Development of Spectrum Compatible Time Histories	52.27.100.723	
14	GEO.DCPP.01.14	Development of Time Histories with Fling	52.27.100.724	
15	GEO.DCPP.01.15	Development of Young's Modulus and Poisson's Ratio Values for DCPP ISFSI Based on Laboratory Data	52.27.100.725	
16	GEO.DCPP.01.16	Development of Strength Envelopes for Non-jointed Rock at DCPP ISFSI Based on Laboratory Data	52.27.100.726	
17	GEO.DCPP.01.17	Determination of Mean and Standard Deviation of Unconfined Compression Strengths for Hard Rock at DCPP ISFSI Based on Laboratory Tests	52.27.100.727	
18	GEO.DCPP.01.18	Determination of Basic Friction Angle Along Rock Discontinuities at DCPP ISFSI Based on Laboratory Tests	52.27.100.728	
19	GEO.DCPP.01.19	Development of Strength Envelopes for Jointed Rock Mass at DCPP ISFSI Using Hoek-Brown Equations	52.27.100.729	

Cross-Index
(For Information Only)

Item No.	Geoscience Calc. No.	Title	PG&E Calc. No.	Comments
20	GEO.DCPP.01.20	Development of Strength Envelopes for Shallow Discontinuities at DCPP ISFSI Using Barton Equations	52.27.100.730	
21	GEO.DCPP.01.21	Analysis of Bedrock Stratigraphy and Geologic Structure at the DCPP ISFSI Site	52.27.100.731	
22	GEO.DCPP.01.22	Kinematic Stability Analysis for Cutslopes at DCPP ISFSI Site	52.27.100.732	
23	GEO.DCPP.01.23	Pseudostatic Wedge Analyses of DCPP ISFSI Cutslopes (SWEDGE Analysis)	52.27.100.733	
24	GEO.DCPP.01.24	Stability and Yield Acceleration Analysis of Cross Section I-I'	52.27.100.734	
25	GEO.DCPP.01.25	Determination of Seismic Coefficient Time Histories for Potential Siding Masses Above Cut Slopes Behind ISFSI Pad	52.27.100.735	
26	GEO.DCPP.01.26	Determination of Potential Earthquake-Induced Displacements of Potential Sliding Masses on DCPP ISFSI Slope	52.27.100.736	
27	GEO.DCPP.01.27	Cold Machine Shop Retaining Wall Stability	52.27.100.737	
28	GEO.DCPP.01.28	Stability and Yield Acceleration Analysis of Potential Sliding Masses Along DCPP ISFSI Transport Route	52.27.100.738	
29	GEO.DCPP.01.29	Determination of Seismic Coefficient Time Histories for Potential Sliding	52.27.100.739	

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(For Information Only)

Item No.	Geoscience Calc. No.	Title	PG&E Calc. No.	Comments
		Masses on DCPP ISFSI Transport Route		
30	GEO.DCPP.01.30	Determination of Potential Earthquake-Induced Displacements of Potential Sliding Masses Along DCPP ISFSI Transport Route	52.27.100.740	
31	GEO.DCPP.01.31	Development of Strength Envelopes for Clay Beds at DCPP ISFSI	52.27.100.741	
32	GEO.DCPP.01.32	Verification of Computer Program SPCTLR.EXE	52.27.100.742	
33	GEO.DCPP.01.33	Verification of Program UTEXAS3	52.27.100.743	
34	GEO.DCPP.01.34	Verification of Computer Code - QUAD4M	52.27.100.744	
35	GEO.DCPP.01.35	Verification of Computer Code DEFORMP	52.27.100.745	
36	GEO.DCPP.01.36	Reserved	52.27.100.746	
37	GEO.DCPP.01.37	Development of Freefield Ground Motion Storage Cask Spectra and Time Histories for the Used Fuel Storage Project	52.27.100.747	

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PG&E
Geosciences Department
Departmental Calculation Procedure
Attachment 5.2

Number: GEO.001
Revision: 04
Page: 1 of 1

Title: Design Calculation Cover Sheet

PACIFIC GAS AND ELECTRIC COMPANY
GEOSCIENCES DEPARTMENT
CALCULATION DOCUMENT

Calc Number GEO.DCPP.01.08
Revision: 1
Date: 11/6/01
Calc Pages: 32
Verification Method: A
Verification Pages: 4 | NOT ATTACHED A7/12/13/03

TITLE: Determination of rock anchor design parameters for DCPP ISFSI cutslope

PREPARED BY: Robert K. White DATE 11/6/01

Robert K. White — Geosciences
Printed Name — Organization

VERIFIED BY: Joseph I. Sun DATE 11/6/01

Joseph I. Sun — Geosciences
Printed Name — Organization

APPROVED BY: L S Cluff DATE 11/7/01

Lloyd S. Cluff — Geosciences
Printed Name — Organization

REGISTERED GEOLOGIST
LLOYD S. CLUFF
No. EG567
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Expires 12/31/02

PG&E
Geosciences Department
Departmental Calculation Procedure
Attachment 5.3

Number: GEO.001
Revision: 04
Page: 1 of 1

Title: Record of Revisions

Title: Determination of rock anchor design parameters for DCPP ISFSI cutslope

Calc No.: GEO.DCPP.01.08

Rev. No.	Reason for Revision	Revision Date
00	Initial Issue	10/25/01
01	Revise transmittals for Data report and some minor editorial changes.	11/6/01

DCPP ISFSI GEOTECHNICAL CALCULATION PACKAGE

Title:	Determination of rock anchor design parameters for DCPP ISFSI cutslope
Calc Number:	GEO.DCPP.01.08
Revision:	Rev. 1
Author:	Robert K. White
Date:	11/6/01
Verifier:	Joseph I. Sun

PURPOSE

This calculation package documents development of recommended design parameters for rock anchors to be used at the DCPP ISFSI site for support of the cutslopes. These parameters include the ultimate bond stress between anchor and rock, length of anchor including bonded and unbonded lengths, anchor type, and resulting capacity, per Geosciences Work Plan 2001-03, Appendix F.

ASSUMPTIONS

1. The anchor design procedure is assumed to be appropriately described in the Post Tensioning Institute (PTI) manual (1996) and the Army Corps Manual EM 1110-1-2908 (as adapted by ASCE, 1996). This is a reasonable assumption, as these two manuals are industry standards.
2. It is assumed that the anchors will be installed grouted full length in rock and fully stressed and field tested to determine actual capacity as per PTI (1996) guidelines.

DESIGN INPUTS

1. Rock mass types behind ISFSI cutslopes are presented in Figure 21-41 from Geosciences calculation GEO.DCPP.01.21.
2. Assumed pattern bolt spacing of 5 feet by 5 feet, orientation of 15 degrees from horizontal, unbonded length of 20 feet, and maximum dynamic load of 17 metric tonnes per anchor in cutslope as per Geosciences calculation GEO.DCPP.01.23.

3. Ultimate bond stress of 180 psi from anchor pullout tests performed for Vital Tanks as per Klimczak, 10/9/01 (VSL Corporation layouts and calculations, page 13, attached).
4. Anchor properties as per Con-Tech Services (CTS) data off website (pages 14 through 17, attached).
5. Rock friction angle of 50 degrees for altered sandstone from Geosciences calculation package GEO.DCPP.01.16.
6. Rock unit weight of 140 pcf based on Witter, 11/5/01 Data Report I.
7. Bearing capacity factor of 569 from Geosciences calculation GEO.DCPP.01.03.

METHODOLOGY

1. Determine rock types to be anchored in cutslope.
2. Determine rock properties applicable for design anchor bond stress between anchor grout and rock.
3. Determine design anchor bond strength at ISFSI site.
4. Determine applicable anchor formulas for design length.
5. Determine design anchor configuration.
6. Determine design anchor loads.
7. Determine minimum required anchor bond length.
8. Determine appropriate anchors for load conditions.
9. Determine bearing pads required to transfer loads to surface rock.

ANALYSIS

1. Determine rock types to be anchored in cutslope. The ISFSI site is primarily within the same rock types as the powerblock area (see Figure 21-41 from GEO.DCPP.01.21), including dolomite, sandstone, and altered sandstone.

2. Determine rock properties applicable for design anchor bond stress between anchor grout and rock. Dolomite and sandstone are described as sound, hard, and well-cemented, with bedding planes that are generally tight and well bonded (GEO.DCPP.01.21). In these cases, rock strength properties are not a factor in the initial design, as will be shown in (3) below. Altered rock is described as similar to a dense sand in consistency (GEO.DCPP.01.21) and a friction angle of 50 degrees has

been assigned to this material based on laboratory tests (GEO.DCPP.01.16). In this case, soil-like consistency is used as a factor in the initial design as discussed in (3) below.

3. Determine design anchor bond stress. Because rock types at the powerblock and ISFSI site are similar as described in (1) above, anchor properties developed at the powerblock are applicable to the ISFSI site. Tests on anchors installed in the rock formation beneath the Vital Tanks at the powerblock area were performed in 1979. The arrangement of the test anchors was provided in Kilmczak, 10/9/01 (page 11, attached, showing VSL Corporation test anchor layout). While the tests were performed with strand anchors, test results are equally applicable to bar anchors, as the bond stress between grout surrounding the anchor and rock interface, not anchor type, controls anchor capacity in both cases (Section 6.7.1 of PTI, 1996, page 22, attached). Anchor pullout test results were also provided in Klimczak, 10/9/01 (pages 12 and 13, attached, showing VSL Corporation calculation sheets and test data) and the failure bond stress chosen for design of 180 psi is shown to be the near-lower bound of all accepted test results. Typical anchor bond stresses for various rock types are also provided in section 6.7.1 of PTI (1996) (page 23, attached), including a range of 120 to 250 psi for "sandstones." Based on these inputs, an ultimate anchor bond stress, τ_{ult}, of 150 psi is recommended for use in preliminary design of rock anchors in both dolomite and sandstone in the cutslope site.

   As described in (1) above, some locations of the ISFSI cutslope will likely include altered sandstone. It is unknown, however, how far this material extends into the hillside beyond the cutslope face. As described in (2) above, this rock is reportedly soil-like in consistency and has been assigned a friction angle of 50 degrees, equivalent to a dense sand or gravel (Lambe and Whitman, 1969, page 19, attached). Recommendations for average ultimate anchor bond stresses for soils are provided in section 6.7.2.3 of PTI (1996) (page 26, attached), including a range of 31 to 200 psi for pressure-grouted anchors in dense sandy gravels. Because the wide range of values includes the value of 150 psi assigned to the unaltered rock, it is recommended that this value of τ_{ult} also be used for purposes of preliminary design of rock anchors in the altered sandstone. It is noted that to achieve this value in the field, some pressure grouting of the formation may be needed, depending on the extent of the altered rock determined as drilling for the anchors progresses. Other procedures that

could be incorporated include (1) increase the bonded length; (2) apply phase 2 and/or phase 3 post-grouting in the bonded zone; (3) reducing the anchor spacing; or (4) extend the anchor deeper to establish the bonded zone below the altered sandstone zone in the more competent bedrock. The most appropriate procedure to install anchor in the anchor should be selected based on an on-site testing program.

4. Determine applicable anchor formulas for design length. The minimum design length is determined as follows:

   $L_b = (FS \cdot P) / (\pi \cdot d \cdot \tau_{ult})$ (1)

   (adapted from section 6.7.1 of PTI, 1996, page 22 attached)

   where:

   FS = factor of safety to convert τ_{ult} to τ_w

   = 2.0 for τ_w normally 50 percent or less of τ_{ult} (from PTI, 1996, page 22 and from ASCE, 1997, page 30)

   L_b = bond length

   P = factored design load for the anchor

   d = diameter of the drill hole, assume, conservatively, 2 inches for cutslope

   τ_w = working bond stress along the interface between rock and grout

5. Determine design anchor configuration. Rock anchors are assumed spaced at 5-foot intervals, both horizontally and vertically, as per Geosciences calculation GEO.DCPP.01.23. Anchors are assumed oriented at about 15 degrees below horizontal and to have a free-stressing (unbonded) length of about 20 feet, also as per GEO.DCPP.01.23.

6. Determine design load for the anchors. The maximum dynamic load as determined in Table 23-4 of Geosciences Calculation GEO.DCPP.01.23 is 17 tonnes (38 kips) per anchor for anchors spaced as in (5) above. This includes a safety factor of 1.3.

7. Determine minimum required anchor bond length for anchors.

   For anchors in the cutslope, from equation (1) above,

   $L_b = (2.0 \cdot 38 \text{ kips}) / (\pi \cdot 2 \text{ inches} \cdot 0.150 \text{ kips/inch}^2) = 80 \text{ inches} = 6.7 \text{ feet}$

PTI (1996) also indicates that rock anchor bond length is normally not less than 10 feet for bar anchors in rock (page 22, attached). Therefore, it is recommended that the bond length be set at 10 feet for anchors in the cutslope.

8. Determine appropriate anchors for load and bond conditions. Anchors manufactured by Contech Systems (CTS), or other approved equivalent, are appropriate for this application. CTS bar anchors are summarized in downloaded web pages (pages 14 through 16, attached). Pages 14 and 15 tabulate nine different bar anchors. Grade 95H bars, page 16, for instance, with a yield strength of 75 ksi and an ultimate strength of 95 ksi, are made of hot-rolled steel and are very ductile, so are considered excellent for seismic applications. The 1-inch (25 mm) nominal diameter bar provides 43.3 kips load when locked off at 0.6 times the ultimate load. This lockoff load is greater than the factored load of 38 kips per anchor required to stabilize the cutslope during seismic loading, from (6) above, and ensures that the anchor is able to supply the ultimate load of 72.2 kips, or 1.6 times the lockoff load or 1.9 times the design load, if needed during loading. The anchors can be manufactured with Class I corrosion protection, page 17 attached, which provides double corrosion protection for permanent applications.

9. Determine bearing pads required to transfer loads to surface rock. Ultimate bearing capacity is determined as per GEO.DCPP.01.03 as follows:

   $q_u = \frac{1}{2} B \gamma_h N_\gamma$,

   where:

   B = footing width, (assume 2 feet square)

   γ_h = unit weight, (140 pcf)

   N_γ = bearing capacity factor, 569 for ϕ = 50 degrees, from GEO.DCPP.01.03

   so,

   $q_u = \frac{1}{2} (2) (0.140) (569) = 80$ ksf, $q_a = q_u / SF = 80 / 3 = 27$ ksf, say 20 ksf.

   Then pad capacity = (20 ksf) (2 feet) (2 feet) = 80 ksf > 72.2 kips ultimate anchor load. So a 2-foot by 2-foot concrete bearing pad is adequate.

RESULTS

To stabilize the cutslope and prevent rock blocks exposed after cut slope excavation from failing into the excavation under both static and seismic loading conditions, it is recommended that cut slope faces be protected from weathering and minor raveling by a wire-mesh-reinforced shotcrete facing. To stabilize larger rock blocks potentially prone to failure during seismic loading, it is recommended that anchors be installed in two-to-three-inch diameter holes on 5-foot centers drilled subhorizontally approximately 30 feet into the cut slope faces. Reinforced steel 2-foot square concrete pads should be formed and cast over the holes to distribute anchor loads to the rock surface. High-strength 1-inch diameter class 1 protected bar anchors are then inserted into the holes, grouted in the 10-foot bond zone, stressed to 43 kips, and then grouted in the remaining free stressing length. Anchors are additionally protected in the bond length by a grout-filled corrugated sheath, and in the free stressing length by a grease-filled sheath. These design features are illustrated in Figure 1, page 8, attached. Each bar should be installed and proof-tested as recommended by the Post-Tensioning Institute (PTI, 1996). It is recommended that additional holes, one approximately every fifth anchor, be drilled between anchor holes and lined with PVC drain pipe to ensure slope remains free-draining.

REFERENCES

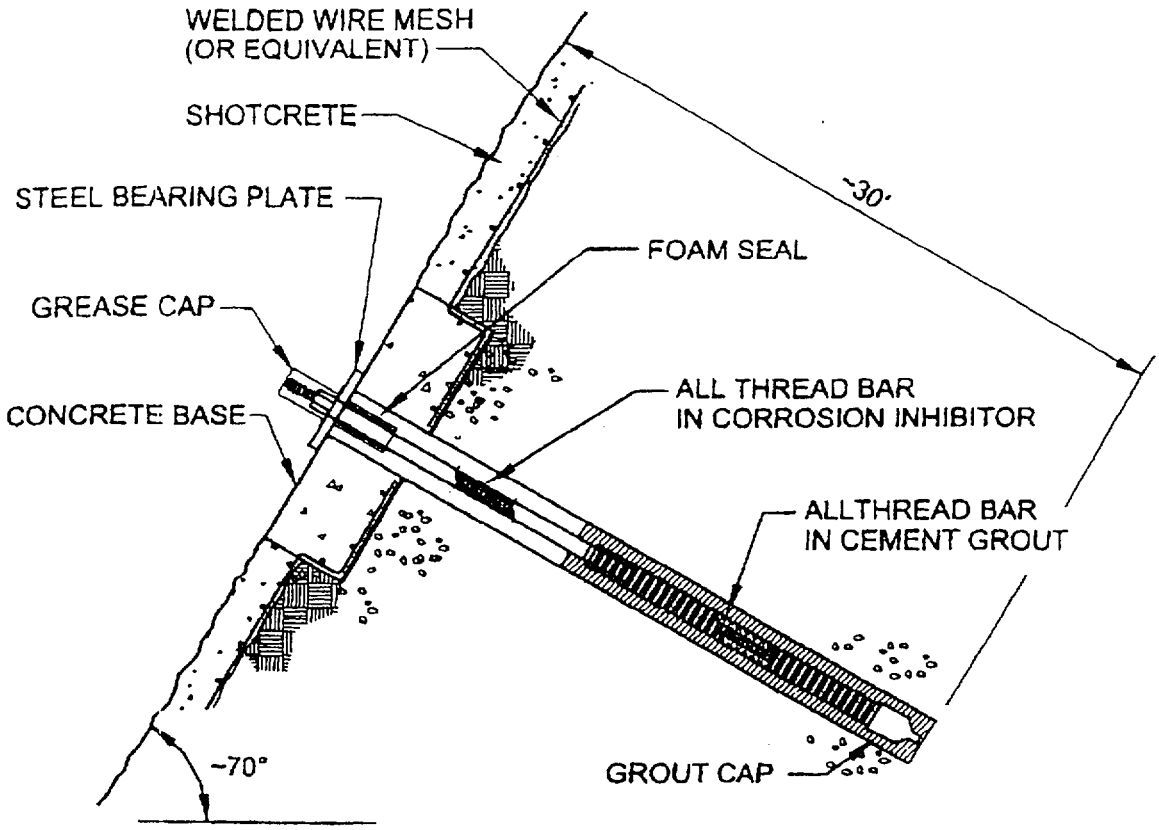
1. Geosciences Work Plan GEO 2001-03, Development of Engineering Properties for ISFSI and CTF Foundation Design, ISFSI Slope Analyses, and ISFSI Cut and Fill Slope Reinforcement Design for the DCPP ISFSI Site, rev. 1.
2. Lambe, T. William and Whitman, Robert V. (1969), Soil Mechanics, Wiley and Sons.
3. PTI (1996), Recommendations for prestressed rock and soil anchors, Post-Tensioning Institute, 70 pp.
4. ASCE (1996) Rock Foundations, as adapted from U.S. Army Corps of Engineers Manual EM 1110-1-2908, ASCE Press, New York, 129 pp.
5. GEO.DCPP.01.03, " Development of allowable bearing capacity for DCPP ISFSI pad and CTF stability analyses," rev. 1.
6. GEO.DCPP.01.05, " Determination of pseudostatic acceleration coefficient for use in DCPP ISFSI cutslope stability analyses," rev. 2.
7. GEO.DCPP.01.16, " Development of strength envelopes for non-jointed rock at DCPP ISFSI based on laboratory data," rev. 1.

8. GEO.DCPP.01.21, "Analysis of Bedrock Stratigraphy and Geologic Structure at the DCPP ISFSI Site," rev. 1.
9. GEO.DCPP.01.23, "Pseudostatic wedge (SWEDGE) analyses of DCPP ISFSI cutslopes," rev. 0.
10. DCPP ISFSI SAR Section 2.6 Topical Report Appendix I, Rock Engineering Laboratory Testing, dated 10/14/01.
11. Contech Systems website at www.contechsystems.com
12. Klimczak (10/9/01): letter from Richard Klimczak to Robert White, entitled "Transmittal of Requested Letters Industry Standards for Calculations GEO.DCPP.01.02 and .08, and Work Plans GEO.2001-01 and 02," dated 10/9/01.
13. Witter (11/5/01): letter from Rob Witter to Rob White, entitled "Completion of Data Reports," dated 11/5/01, and accompanying Data Report I, Rock Laboratory Test Data, Rev. 0.

ATTACHMENTS

1. Figure 1, Typical Rock Anchor Detail, attached as page 8.
2. Klimczak (10/9/01): letter from Richard Klimczak to Robert White, entitled "Transmittal of Requested Letters Industry Standards for Calculations GEO.DCPP.01.02 and .08, and Work Plans GEO.2001-01 and 02," dated 10/9/01, and VSL Corporation Test Anchor Calculations pages 6, 7, and 8, attached as pages 9 through 13.
3. Con-Tech Systems, Anchor Bar Technical Data, download from Contech Systems website at www.contechsystems.com, attached as pages 14 through 17.
4. Soil Mechanics, by T. William Lambe and Robert V. Whitman, published by John Wiley & Sons, 1969, cover sheet and page 149, attached as pages 18 and 19.
5. Recommendations for Prestressed Rock and Soil Anchors, by Post Tensioning Institute, 1996, cover sheet and pages 29-33, attached as pages 20 through 26.
6. Rock Foundations, by American Society of Civil Engineers, 1996, cover sheet and pages 70-71, attached as pages 27 through 30.
7. Witter (11/5/01): letter from Rob Witter to Rob White, entitled "Completion of Data Reports," dated 11/5/01, and accompanying Data Report I, Rock Laboratory Test Data, Rev. 0

GEO. DCMP.01.08 ~~Rev. 0~~ Rev. 1



TYPICAL ROCK ANCHOR DETAIL
(N.T.S.)

Figure 1

GEO.DCPP.01.08 ~~Rev. 0~~ Rev. 1

Memorandum

Date: October 9, 2001 File #: 72.10.05

To: Robert K. White
PG&E Geosciences Dept

From: Richard L. Klimczak, Project Engineer

Subject: Diablo Canyon Units 1 and 2
Transmittal of Requested Letters Industry Standards for Calculations GEO.DCPP.01.02 and .08, and Work Plans GEO.2001-01 and 02

Pacific Gas and Electric Company

Dear Rob,

Attached are copies of documents required by Jay Young on 10/5/01 and Joseph Sun on 10/8/01 and some additional documents which are referenced in Geosciences calculations.

Jay requested, in a 10/5/01 E-mail, copies of Items 1 and 2 (which are shown as references Nos. 4 and 9 cited in Revision 2 of Work Plan GEO 2001-02). The date for Item 2 is currently incorrectly shown as April 4, 1992 in the Work Plans GEO.2001-01 and GEO.2001-02. Both documents will be revised to correct the date. A copy of Item 3, ASCE 4-86, was previously FAXED to W. Savage of Geosciences.

Item 3 contains a February 1979 report on vital tank test anchors submitted by VSL Corporation. The report was previously FAXED to you and will be referenced in calculation GEO.DCPP.01.08.

Item No. 4, SECY-981-126, is referenced in Calculation GEO.DCPP.01.02. The document is also available on the NRC website at the link E-mailed to you on 10/8/01.

This transmittal is per requirements of DCPP Procedure CF3.ID17.

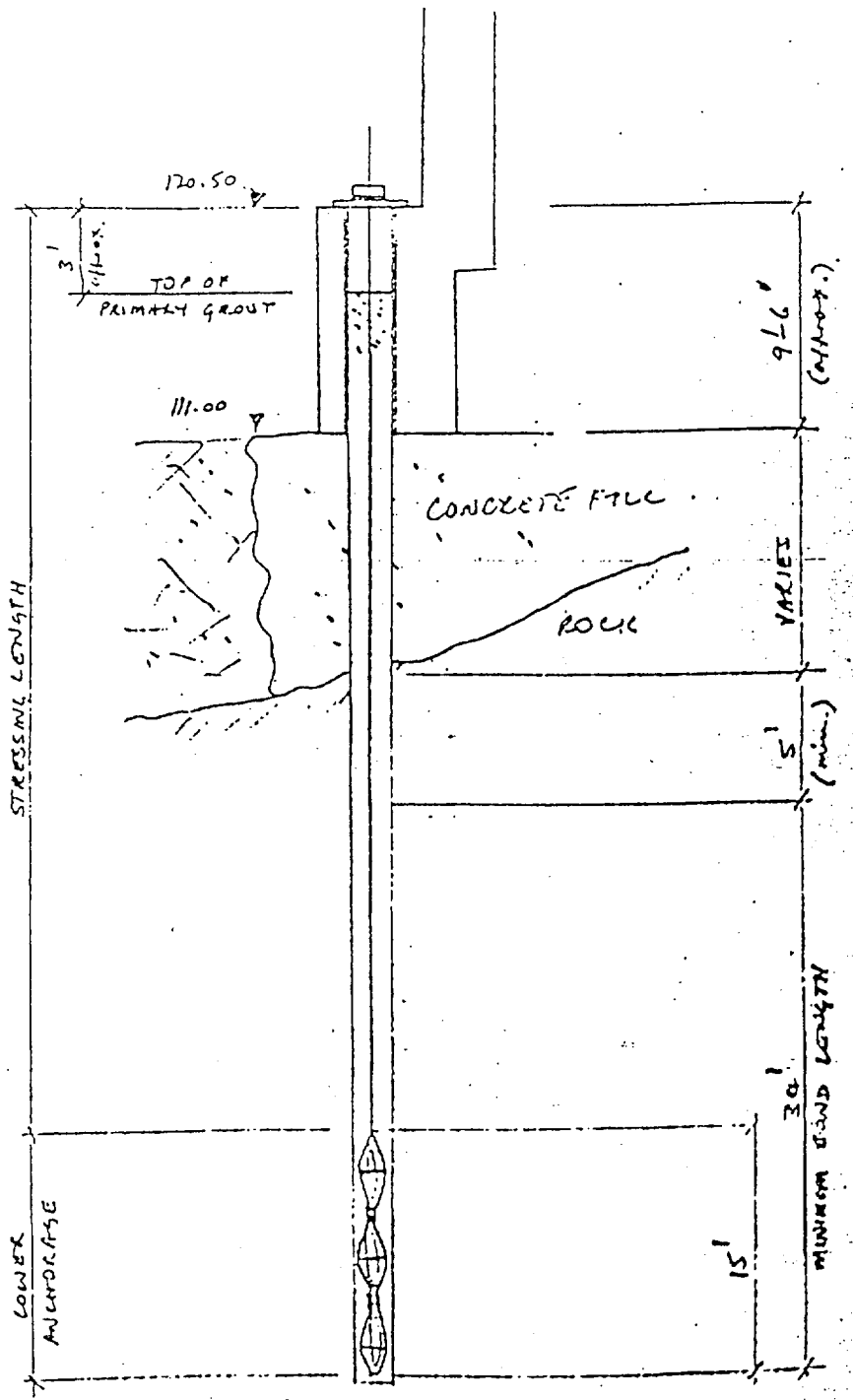
If you have comments or questions please contact me at (805) 595-6320 or A. Tafoya at (805) 595-6392.

Richard L. Klimczak
Project Engineer
Diablo Canyon Used Fuel Storage Project

cc:	LJStrickland	SLO B3	w/o
	BHPatton	SLO BB	w/o
	AFTafoya	SLO B10	
	CEHartz	SLO B0	w/o
	JISun	245 Market N4C, 422B	w/o
	JYoung	245 Market N4C, 413C	w/o
	DCPP Chronological File		
	DCPP RMS	DCPP 119/1	
	DCPP File No. 72.10.05		

GEO. DCPP.01.08 Rev. 1 ~~Rev. 0~~

VIDAL TANK ANCHOR DETAILS:



page 11 of 3032

DATE 2/7/91	TEST ANCHOR CALCULATIONS	2000 SANTA CRUZ AVE., LOS GATOS, CALIFORNIA (408) 354-0481
DES. BY	DIABLO CANYON VIDAL TANK ANCHORS	VSL Corporation
DWN. BY		8

Rev. 1

G.E.O.D. Opp. 2.1.08. Rev. 0

CALCULATION OF REQUIRED BOND LENGTHS IN VITAL TANK TEST ANCHORS BASED ON TEST ANCHOR RESULTS

Procedure:

Results from all three Vital Tank test anchors, and from the Federal test anchor Type 'B' (see Report 12/15/78) will be examined.

The reading from test anchor #3 will not be given as much weight because there was some grout leakage. This reduced the measured bond lengths from a calculated 10' to a measured 8.25' and may have left some voids.

Use a factor of safety of 2.5 over the design load of 692 K (see Preliminary Design 7/78, P1).

Calculated failure bond stress:

Federal test type 'B'

$$\frac{5.22 \text{ kips/inch}}{\pi \times 6.5} \qquad 156 \text{ p.s.i.}$$

V.T. Test Anchors #1

$$\frac{215^{k} \times 10^{3}}{\pi \times 7.5 \times 6.08 \times 12} \qquad 196 \text{ p.s.i.}$$

DATE 2/7/79	TEST ANCHOR CALCULATIONS	3211 NO. SANTA CRUZ AVE., LOS GATOS, CALIFORNIA (408) 354-2411 95030	95030
Dr. by Joel P.	DIRECT CASTING VITAL TANK ANCHORS	VSL Corporation	6
Dwg. No.			

GEO.DCVV.01.08 ~~Rev. 0~~ REV. 1

V.T. Test Anchor # 2

$$\frac{410^k \times 10^3}{\pi \times 7.5 \times 7.67 \times 12} = 189 \text{ p.s.i.}$$

V.T. Test Anchor # 3

$$\frac{320^k \times 10^3}{\pi \times 7.5 \times 8.25 \times 12} = 141 \text{ p.s.i.}$$

Discount the results of test anchor # 3 and mean value of $\boxed{180 \text{ p.s.i.}}$ as the failure bond stress.

τ_{ult}

Required bond length for V.T. anchors:

$$L_B = \frac{692^k \times 10^3 \times 2.5}{\pi \times 7.5 \times 12 \times 180} = 34.0 \text{ feet.}$$

Commence bond length at a level 5' below top of rock surface.

DATE 1/7/79	TEST ANCHOR CALCULATIONS	208 NO. SANTA CRUZ AVE., LOS GATOS, CALIFORNIA (408) 354-6581 95030	JOB NO
DES. BY	DIABLO CANYON VITRIFIED TIMBER ANCHORS	VSL Corporation	7
DWN. BY			

GEO.DCPP.01.08 ~~Rev. 0~~ Rev. 1

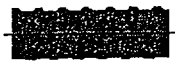
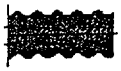
Products
Rock & Soil Anchors

Bars, Technical Data

Con-Tech Systems supplies bars of different strength and properties for rock anchors, soil nails, micropiles and form-tie systems. Accessories (couplers, nuts, bearing plates) are available for all types. All bars meet or exceed relevant specifications outlined in ASTM A-615 or ASTM A-722.

All bars and accessories can be galvanized, metallized or epoxy coated.

Please click on the Type Buttons to select

Type	Ultimate Strength	Yield Strength	Thread	Remarks
Mukusol	130 ksi 900 N/m^2	80 ksi 552 N/m^2		- High ductility; - Weldable - Rock & Soil anchors - Soil nails - Form Ties
Grade 95 H	95 ksi 655 N/m^2	75 ksi 517 N/m^2		- Hot rolled, very ductile - Rock & soil anchors - Soil nails
Grade 100 C	100 ksi 690 N/m^2	75 ksi 517 N/m^2		- Cold rolled, very ductile - Rock & soil anchors - Soil nails, Micropiles
Grade 120 H	120 ksi 840 N/m^2	94 ksi 657 N/m^2		- Hot rolled, very ductile - Rock & soil anchors - Soil nails
Grade 150 C	150 ksi 1050 N/m^2	120 ksi 838 N/m^2		- Cold rolled - Rock & soil anchors - Soil nails, Micropiles
	150 ksi			

GEO. DUPP. 01. 08 ~~Rev. 0~~ Rev. 1

Grade 150 H	1050 N/m^2	121 ksi 845 N/m^2	[redacted]	- Hot rolled - Rock & soil anchors - Soil nails
Grade 154 H	154 ksi 1075 N/m^2	137 ksi 957 N/m^2	[redacted]	- Hot rolled - Rock & soil anchors - Soil nails, Micropiles
Grade 160 H	160 ksi 1100 N/m^2	128 ksi 880 N/m^2	[redacted]	- Hot rolled, very ductile - Weldable - Rock & soil anchors - Soil nails - Form Ties
Grade 178 H	178 ksi 1240 N/m^2	156 ksi 1089 N/m^2	[redacted]	- Hot rolled - Rock & soil anchors - Soil nails

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GEO.DWP.01.08 ~~Rev. 0~~ Rev. 1

Products
Rock & Soil Anchors

CTS Grade 95 Hot Rolled Bars

LEFT HAND THREAD
(HOT ROLLED)

Notes:

1. This bar exceeds the physical properties of ASTM A-615 and is specifically manufactured for Rock- and Soil Anchors and Soil Nails.
2. The steel is very ductile and ideal for seismic applications.
3. Design load for temporary applications, up to 0.7 ULT.

Nominal Diameter	Cross. Sec. Area	Load Capacity			Maj. Thread Diameter	Weight	Part ID
		Ultimate	Test	0.6 ULT			
in mm	in^2 mm^2	kips kN	kips kN	kips kN	in mm	lbs/lf kg/m	
3/4 20	0.49 314	46.8 208	37 164.6	28.1 125	0.91 23	1.7 2.47	CTS 20/95-H
1 25	0.76 491	72.2 321	56.7 252.1	43.3 292.8	1.1 28	2.59 3.85	CTS 25/95-H
1 1/8 28	0.95 616	91.0 405	71.7 319.0	54.6 242.8	1.26 32	3.25 4.83	CTS 28/95-H
1 1/4 32	1.25 804	117.7 524	93.7 416.7	70.6 314.2	1.42 36	4.24 6.31	CTS 32/95-H
1 5/8 40	1.95 1260	184.6 821	145.7 648.3	110.8 492.7	1.77 45	6.63 9.87	CTS 40/95-H
2 50	3.04 1960	288.9 1285	226.7 1008.4	173.3 771.1	2.17 55	10.35 15.4	CTS 50/95-H
2 1/2 64	4.91 3167	497.9 2215.0	395.6 1760.0	298.8 1329.4	2.68 68	16.58 24.68	CTS 64/95-H

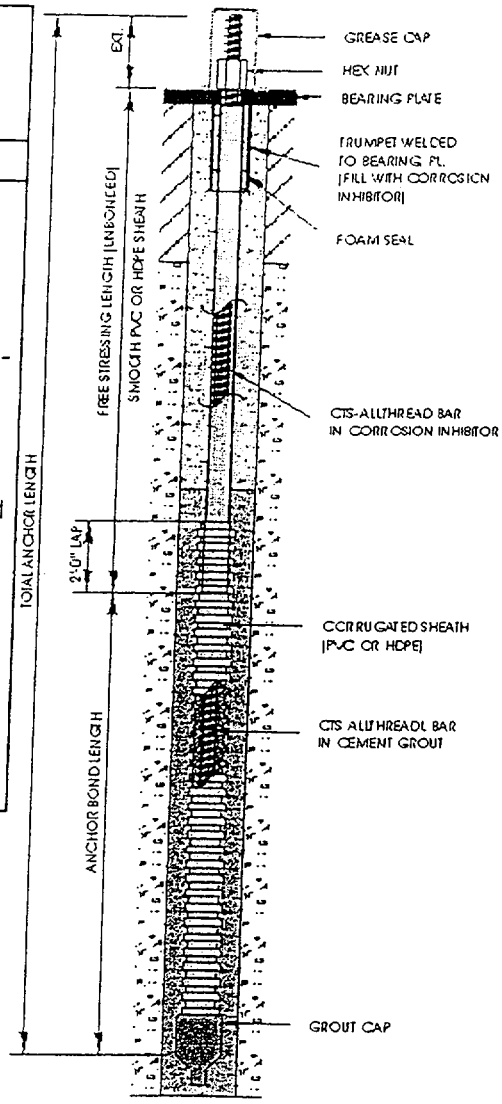
GEO-DCPV.01.08 ~~Rev. 0~~ Rev. 21

Products

Rock & Soil Anchors

Class I Protected Bar Anchor

ADSC/PTI Corrosion Protection Classification	Class I
Anchor Type	Active
Remarks	• Permanent anchor. • The Anchor head (bond length) may be factory pre-grouted. • The bond length is protected by the grout filled corrugated sheath • The free stressing length is protected by the grease filled sheath



October 07, 2000

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GEO. DCPY. 01. 08 ~~Rev. 0~~ Rev. 1

Soil Mechanics

T. William Lambe • Robert V. Whitman

Massachusetts Institute of Technology

1969

JOHN WILEY & SONS, New York • Chichester • Brisbane • Toronto • Singapore

Table 11.3 Summary of Friction Angle Data for Use in Preliminary Design

	Friction Angles							
	Slope Angle of Repose		At Ultimate Strength		At Peak Strength			
					Medium Dense		Dense	
Classification	i(°)	Slope (vert. to hor.)	ϕ_{cv}(°)	tan ϕ_{cv}	ϕ(°)	tan ϕ	ϕ(°)	tan ϕ
Silt (nonplastic)	26 to 30	1 on 2 1 on 1.75	26 to 30	0.488 0.577	28 to 32	0.532 0.625	30 to 34	0.577 0.675
Uniform fine to medium sand	26 to 30	1 on 2 1 on 1.75	26 to 30	0.488 0.577	30 to 34	0.577 0.675	32 to 36	0.675 0.726
Well-graded sand	30 to 34	1 on 1.75 1 on 1.50	30 to 34	0.577 0.675	34 to 40	0.675 0.839	38 to 46	0.839 1.030
Sand and gravel	32 to 36	1 on 1.60 1 on 1.40	32 to 36	0.625 0.726	36 to 42	0.726 0.900	40 to 48	0.900 1.110

From B. K. Hough, *Basic Soils Engineering*. Copyright © 1957, The Ronald Press Company, New York.
Note. Within each range, assign lower values if particles are well rounded or if there is significant soft shale or mica content, higher values for hard, angular particles. Use lower values for high normal pressures than for moderate normal pressure.

problems involving man-made fills, it is difficult to either measure or estimate the friction angle of a sand on the basis of laboratory tests alone. For these reasons, extensive use is made in practice of correlations between the friction angle of a sand and the resistance of the natural sand deposit to penetration.

Figure 11.14 shows an empirical correlation between the resistance offered to the standard penetration spoon (Chapter 7) and the friction angle. Inevitably, any such correlation is crude. The actual friction angle may deviate by $\pm 3°$ or more from the value given by the curve. The given relation is intended to apply for depths of overburden up to 40 ft, and is conservative for greater depths.

11.6 SUMMARY OF MAIN POINTS

1. The strength of soil can be represented by a Mohr envelope, which is a plot of τ_{ff} versus σ_{ff}. Generally the Mohr envelope of a granular soil is curved. For stresses less than 100 psi, the envelope usually is almost straight so that

$$\tau_{ff} = \sigma_{ff} \tan \phi$$

where ϕ is the friction angle corresponding to the peak point of the stress-strain curve.

2. The value of ϕ for any soil depends upon ϕ_μ and upon the amount of interlocking; i.e., the initial void ratio and σ_{ff}.
3. Where sand is being subjected to very large strains, ϕ_{cv} should be used in the failure law. Unless the sand is very loose, ϕ_{cv} will be less than ϕ. Where the sand is sliding over the surface of a structure, the friction angle will vary from ϕ_μ to ϕ_{cv}, depending on the smoothness of the surface.
4. A knowledge of the effect of composition helps guide the selection of materials to be used in man-made fills
5. Materials to be used in man-made fills should be tested using the actual range of confining pressures which will be encountered in the fill.
6. For many practical problems, the friction angle of an *in situ* sand deposit can be determined by indirect means, such as the standard penetration test.

PROBLEMS

11.1 Given the following triaxial test data, plot the results (*a*) in a Mohr diagram and (*b*) in a p–q diagram, and determine ϕ by each method.

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RECOMMENDATIONS FOR PRESTRESSED ROCK AND SOIL ANCHORS

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The designer is required to use his judgement in assessing the available information and choosing appropriate safety factors. In particular, strand to grout bond shall be evaluated by strand bond tests for each strand manufacturer.

6.7 Bond Length Design

The design guidelines for estimating the load transfer capacity in the bond length are based on field experience and on full scale tests of anchors.

6.7.1 Rock Anchors

The bond length can be estimated by the following equation:

$$L_b = \frac{P}{\pi \; d \; \tau_w}$$

Where:

- L_b = bond length
- P = design load for the anchor
- π = 3.14
- d = diameter of the drill hole
- τ_w = working bond stress along the interface between rock and grout

The average ultimate bond stress depends upon the:

1. Shear strength of the rock.
2. Discontinuities in the rock mass, including the spacing and orientation of bedding planes, joints and fractures.

COMMENTARY

ground liable to creep, the safety factor for the grout/ground interface may need to be increased to reduce average working stresses and so keep long term losses within tolerable limits.

Strand from different manufacturers has shown very different bond properties. Strand passing the bond capacity test described in Chapter 10 is expected to have adequate bond capacity.

The bond length normally is not less than 4.5m (15 ft) for ASTM A416 strand and 3.0m (10 ft) for ASTM A722 Type II bars. Most bond lengths are less than 10m (35 ft). In competent rock, the bond stresses are concentrated at the top of the bond zone and are not uniformly distributed along the bond length. Bond lengths greater than 10m (35 ft) may not be necessary in competent rock and are not effective, unless special provisions are taken to ensure transfer of load to the bottom of the bond zone. *

For normal applications, the bond between the tendon and the primary grout is not critical, provided that the steel surface, especially for strand, is not contaminated by lubricants, grease or soil. *

The drill hole diameter is a function of the tendon diameter, as well as drilling methods and equipment.

When selecting the working bond stress, the engineer should consider the critical nature of the anchor application, variations in the rock properties, and the installation procedures. The working bond stress used to determine the bond length is normally 50 percent or less of the ultimate bond stress. *

The ultimate bond stress between the rock and the

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3. Minerals in the rock which may "lubricate" the bond zone or reduce the grout strength.

4. Method of drilling and cleaning the drill hole

5. Drill hole diameter

6. Strength of the grout

7. Grouting procedure

The typical values shown in Table 6.1 are not intended for final design. Working bond stresses shall be established on a project-by-project basis after review of geologic data, rock cores and previous experience.

Each rock anchor shall be tested in order to verify the load carrying capacity of the anchor and to preload the tendon (see Chapter 8).

For anchors in weak or weathered rock masses, pressure grouting techniques may be used to successfully enhance grout to rock bond values.

COMMENTARY

anchor grout can be approximated by using a value of 10% of the unconfined compressive strength of the rock, up to a maximum value of 3.1 MPa (450 psi).

ROCK	AVERAGE ULTIMATE BOND STRESS-ROCK/GROUT	
	MPa	PSI
Granite & Basalt	1.7 - 3.1	250 - 450
Dolomitic Limestone	1.4 - 2.1	200 - 300
Soft Limestone	1.0 - 1.4	150 - 200
Slates & Hard Shales	0.8 - 1.4	120 - 200
Soft Shales	0.2 - 0.8	30 - 120
Sandstones	0.8 - 1.7	120 - 250
Weathered Sandstones	0.7 - 0.8	100 - 120
Chalk	0.2 - 1.1	30 - 155
Weathered Marl	0.15 - 0.25	25 - 35
Concrete	1.4 - 2.8	200 - 400

Table 6.1 Typical Average Ultimate Bond Stresses-Rock/Grout

6.7.2 Soil Anchors

6.7.2.1 General Considerations

The existing theoretical and empirical methods for predicting anchor capacity should only be used for preliminary design estimate purposes. The final anchor capacity shall be verified by field testing each anchor.

Actual bond length dimensions for specific design loads are based on installation techniques and should be determined by the specialty anchor contractor.

Normally, the bond length for soil anchors is in the range of 6-12m (20-40 ft). Bond lengths greater than 15m (50 ft) in soil may not be necessary and are not effective unless provisions are taken to allow transfer of the load to the bottom of the bond zone.

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The bond length is dependent on the following variables:

1. Method of drilling and cleaning of the drill hole.
2. Soil properties
   a) Permeability
   b) Density
   c) Angle of internal friction ϕ
   d) Shear strength
   e) Degree of consolidation
   f) Changes of soil properties within the bond zone
3. Overburden pressure
4. Hole diameter or designed variations in hole diameter
5. Grout pressure and grout take
6. Number of postgrouting cycles

Minimum bond lengths of 4.5m (15 ft) are recommended for all types of soil. In general, cohesive soils will require longer bond lengths than non-cohesive soils.

6.7.2.2 Cohesive Soils

A. Gravity Grouted Anchors (Straight Shaft)

The bond length can be estimated by the following equation:

$$L_b = \frac{P}{\pi \, d \, \tau_w}$$

Where:

L_b = bond length
P = design load for the anchor
π = 3.14
d = diameter of the drill hole
τ_w = working bond stress along the interface between soil and grout

'oil anchors in soft to medium cohesive soils ;andard penetration resistance less than 8 lows per 0.3m (8 blows per ft)] require ›ng-term creep tests.

The bond zone consists of a constant diameter drill hole which may be cased or uncased depending on the stability of the hole.

Underreamed anchors have been used in the past, but, for commercial and technical reasons, are not routinely installed today and not addressed in these Recommendations.

The value of τ_w is sometimes expressed as a function (typically 30 to 50 percent) of the undrained shear strength of the soil. Alternatively and more commonly, an empirical value of 0.03 to 0.07 MPa (5 to 10 psi) is used as a working stress for shaft friction (τ_w) in stiff to very stiff cohesive soils.

Tested values for soil anchors constructed in the U.S. have varied considerably. Table 6.2 gives some examples for the ultimate bond stress range between grout and surrounding soil.

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B. Pressure Grouted Anchors (Straight Shaft)

The bond zone is grouted under a pressure higher than 0.35 MPa (50 psi) through a casing or hollow stemmed auger during withdrawal. The effective bond values will be somewhat higher than for gravity grouted anchors as a result of the application of grout pressure.

COMMENTARY

ANCHOR TYPE	AVERAGE ULTIMATE BOND STRESS-SOIL/GROUT MPa	PSI
• Gravity Grouted Anchors (Straight shaft)	0.03 - 0.07	5 - 10
• Pressure Grouted Anchors (Straight shaft)		
- Soft Silty Clay	0.03 - 0.07	5 - 10
- Silty Clay	0.03 - 0.07	5 - 10
- Stiff Clay, Med. to High Plasticity	0.03 - 0.10	5 - 15
- Very Stiff Clay, Med. to High Plasticity	0.07 - 0.17	10 - 25
- Stiff Clay, Med. Plasticity	0.10 - 0.25	15 - 35
- Very Stiff Clay, Med. Plasticity	0.14 - 0.35	20 - 50
- Very Stiff Sandy Silt, Med. Plasticity	0.28 - 0.38	40 - 55

Table 6.2 Typical Average Ultimate Bond Stresses-Cohesive Soils

Note: Actual values for pressure grouted anchors depend on the ability to develop pressures in each soil type.

C. Post-Grouted Anchors

This type of anchor is generally used in cohesive or mixed soils.

Post-grouting can increase the load carrying capacity of straight shafted anchors by 20 to 50 percent or more per phase of post-grouting. Three post grouting phases are considered a practical limit.

6.7.2.3 Cohesionless Soils

A. Gravity Grouted Anchors (Straight Shaft)

This type of anchor may be treated in the same

0.07 to 0.14 MPa (10-20 psi) may be used as a

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manner as a straight shaft anchor drilled in cohesive soils, except that the allowable working shaft friction will commonly be much higher.

B. Pressure Grouted Anchors (Straight Shaft)

Pressure grouted anchors in cohesionless soil develop capacities far in excess of the load expected from applying conventional soil mechanics theory. Pressure grouting can be achieved either through the casing or auger. Overburden pressure, angle of internal friction, density and grain size of the soil particles, hole diameter, grout pressure, grout take and method of drilling are very significant factors in the development of load carrying capacity. The resistance of this type of anchor to pullout develops from shaft friction along the grout body.

COMMENTARY

guide value for τ_w, when the average depth of overburden is 4.5m (15 ft) or more, at the bond zone location.

*

As a rough guide, Table 6.3 may be used for calculating the ultimate load for small diameter (75-150mm) (3 to 6 in.) pressure grouted (0.35 to 2.8 MPa) (50 to 400 psi) anchors installed in cohesionless soils with an average depth of overburden of 4.5m (15 ft).

ANCHOR TYPE	AVERAGE ULTIMATE BOND STRESS-SOIL/GROUT	
	MPa	PSI
• Gravity Grouted Anchors (Straight Shaft)	0.07 - 0.14	10 - 20
* • Pressure Grouted Anchors (Straight Shaft)		
- Fine-Med. Sand, Med. Dense-Dense	0.08 - 0.38	12 - 55
- Med.-Coarse Sand (w/gravel),Med. Dense	0.11 - 0.66	16 - 95
- Med.-Coarse Sand (w/gravel),Dense - Very Dense	0.25 - 0.97	35 - 140
- Silty Sands	0.17 - 0.41	25 - 60
- Dense Glacial Till	0.30 - 0.52	43 - 75
* - Sandy Gravel,Med. Dense-Dense	0.21 - 1.38	31 - 200
- Sandy Gravel,Dense-Very Dense	0.28 - 1.38	40 - 200

Table 6.3 Typical Average Ultimate Bond Stresses-Cohesionless Soils

Note: *Actual values for pressure grouted anchors depend on the ability to develop high pressures in each soil type.*

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ROCK FOUNDATIONS

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ABSTRACT

This manual provides technical criteria and guidance for the design of rock foundations for civil works or other similar large military structures. It provides a minimal standard to be used in planning a satisfactory rock foundation design under normal conditions. Unusual or special site, loading, or operating conditions may require advanced analytical designs that are beyond the scope of this material.

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1110-1-2907 as an untensioned reinforcement element consisting of a rod embedded in a mortar or grout-filled hole. Dowels provide positive resistance to dilation within a rock mass and along potentially unstable contact surfaces. In addition to the development of tensile forces resisting dilation, passive resistance against sliding is developed within a rock mass when lateral strains occur. The interaction between the dowel and the rock mass is provided through the cohesion and friction developed along the grout column, which bonds the rod and the rock. Untensioned anchor systems should not be used to stabilize gravity structures.

SECTION II. METHODS OF ANALYSIS

9-5. GENERAL.

Typically, analyses of systems used to anchor mass concrete structures consist of one of two methods: procedures based on classical theory of elasticity or procedures based on empirical rules or trial and error methods. The gap between the methods has been narrowed by research in recent years but has not significantly closed to allow purely theoretical analysis of anchor systems. The following discussions on methods of analyses are divided into tensioned and untensioned anchor systems.

9-6. ANALYSES FOR TENSION ANCHOR SYSTEMS.

The design and analysis of anchor systems include determination of anchor loads, spacing, depth, and bonding of the anchor. Safety factors are determined by consideration of the following failures: within the rock mass, between the rock and grout/anchor, between the grout and the tendon or rod, and yield of the tendon or top anchorage.

A. Anchor Loads. Anchor loads for prestressed tensioned anchors are determined from evaluation of safety factor requirements of structures. Anchors may be designed for stability considerations other than sliding to include overturning and uplift. Other factors must also be considered. However, anchor forces required for sliding stability assurance typically control design. Procedures for determining anchor forces necessary for stability ofconcrete gravity structures are covered in EM 1110-2-2200.

B. Anchor Depths. Anchor depths depend on the type of rock mass into which they are installed and the anchor pattern (i.e., single anchor, single row of anchors, or multiple rows of anchors). The anchor depth is taken as the anchor length necessary to develop the anchor force required for stability. The entire anchor depth lies below the critical potential failure surface.

(1) Single anchors in competent rock. The depth of anchorage required for a single anchor in competent rock mass containing few joints may be computed by considering the shear strength of the rock mobilized around the surface area of a right circular cone with an apex angle of 90 deg. (see Figure 9-2A). If it is assumed that the in-situ stresses, as well as any stresses imposed on the foundation rock by the structure, are zero; then the shear strength can be conservatively estimated as equal to the rock mass cohesion. In such cases, the anchor depth can be estimated from Equation 9-1.

$$D = [(FS)\,(F)/c\,\pi]^{1/2} \qquad (9\text{-}1)$$

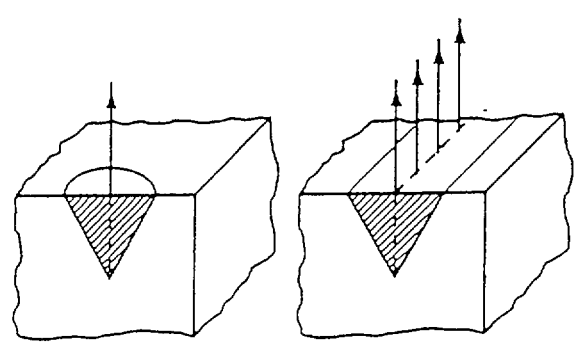
where

D = required depth of anchorage
FS = appropriate factor of safety
c = rock mass cohesion intercept; and
F = anchor force required for stability.

(2) Single row of anchors in competent rock. The depth of anchorage for a single row of anchors (Figure 9-2B) installed in competent rock and spaced a distance s apart may be computed as follows:

$$D = \frac{(FS)\,(F)}{cs} \qquad (9\text{-}2)$$

where F = anchorage force on each anchor. All other parameters are as previously defined.



(a) (b)

FIG. 9-2. Geometry of Rock Mass Assumed to Be Mobilized at Failure: (a) Individual Anchor in Isotropic Medium; (b) Line of Anchors in Isotropic Medium (after Littlejohn 1977)

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(3) Multiple rows of anchors in competent rock. For a multiple row of anchors with rows spaced a distance l apart, typically, only the weight of the rock mass affected is used in calculations of resisting force. Under this assumption, the depth of anchorage required to resist a anchorage force F per anchor is computed as follows:

$$D = \frac{(FS)\,(F)}{\gamma\, l\, s} \qquad (9\text{-}3)$$

where γ = unit weight of the rock. All other parameters are as previously defined.

(4) Single anchor in fractured rock. In fractured rock, the strength of the rock mass subjected to a tensile force (the anchor force) cannot typically be relied upon to provide the necessary resistance. For this reason, only the weight of the affected cone is considered. Based on this assumption, the depth of anchorage is completed as follows:

$$D = \left(\frac{3(FS)\,(F)}{\gamma\ \ \pi}\right)^{1/3} \qquad (9\text{-}4)$$

where γ = unit weight of the rock. All other parameters are as previously defined.

(5) Single row of anchors in fractured rock. As in the case of a single anchor in fractured rock, typically, only the weight of the affected wedge of rock is relied upon to provide the necessary resistance. Hence, for a single row of anchors in fractured rock spaced s distance apart, the anchorage depth is computed as follows:

$$D = \left(\frac{(FS)\,(F)}{\gamma\ s}\right)^{1/2} \qquad (9\text{-}5)$$

All other parameters are as previously defined.

(6) Multiple rows of anchors in fractured rock. For multiple rows of anchors with rows spaced a distance apart, again only the weight of the affected rock mass resists the anchor force. In this respect, Equation 9-3 is valid.

C. Anchor Bonding. The above equations, presented for analysis of anchor system, assume sufficient bond of the anchor to the rock such that failures occur within the rock mass. The use of grouted anchorages has become practically universal with most rock reinforcement systems. The design of grouted anchorages must, therefore, ensure against failure between the anchor and the grout, as well as between the grout and the rock. Experience and numerous pull-out tests have shown that the bond developed between the anchor and the grout is typically twice that developed between the grout and the rock. Therefore, primary emphasis in design and analysis is placed upon the grout/rock interface. For straight-shafted, grouted anchors, the anchor force that can be developed depends upon the bond stress, described as follows:

$$F = \pi d L \tau \qquad (9\text{-}6a)$$

$$\tau = 0.5\tau_{ult} \qquad (9\text{-}6b)$$

where

- d = effective diameter of the borehole;
- L = length of the grouted portion of the anchor bond length (normally not less than 10 ft);
- τ = working bond strength; and
- τ_{ult} = ultimate bond strength at failure. Values of ultimate bond strength are normally determined from shear strength data, or field pull-out tests. In the absence of such tests, the ultimate bond stress is often taken as 1/10 of the uniaxial compressive strength of the rock or grout (whichever is less) (Littlejohn 1977) up to a maximum value of 4.2MPa (i.e., 600 psi).

9-7. DOWELS.

Structures should, in principle, be anchored, when required, to rock foundations with tensioned or prestressed anchorage. Since a displacement or partial shear failure is required to activate any resisting anchorage force, analysis of the contribution of dowels to stability is at best difficult. Dilation imparts a tensile force to dowels when displacements occur over asperities, but the phenomenon is rarely quantified for analytical purposes.

9-8. DESIGN CONSIDERATIONS.

A. Material Properties. The majorities of material properties required for the design of anchor systems are also typically required for the investigation of other aspects of the foundation design. The selection of appropriate material properties is discussed in Chapter 4 of this manual. Design anchor force derived from calculations not associated with sliding instability must consider the buoyant weight of rock where such rock is submerged below the surface water or ground water table. Tests not necessarily considered for typical foundation investigations but needed for anchor evaluations include rock anchor pull-out tests and chemical tests of

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WLA

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Mr. Robert White
Geosciences Department
Pacific Gas & Electric Company
245 Market Street, Rm. 421-N4C
San Francisco, CA 94105

November 5, 2001

Re: **Completion of Data Reports (formerly appendices)**

Dear Rob:

This letter transmits to Geosciences the following Diablo Canyon ISFSI Data Reports (formerly called appendices) that were prepared under the WLA Work Plan, Additional Geologic Mapping, Exploratory Drilling, and Completion of Kinematic Analyses for the Diablo Canyon Power Plant Independent Spent Fuel Storage Installation Site, Rev. 2 (11/28/00) using data collected under that Work Plan and a second WLA Work Plan, Additional Exploratory Drilling and Geologic Mapping for the ISFSI Site, Rev. 1 (9/21/01).

Diablo Canyon ISFSI Data Report A - Geologic Mapping in the Plant Site and ISFSI Site Areas, Rev. 0, November 5, 2001, November 5, 2001, prepared by J. Bachhuber, 42 p.

Diablo Canyon ISFSI Data Report B - Borings in ISFSI Site Area, Rev. 0, November 5, 2001, prepared by J. Bachhuber, 244 p.

Diablo Canyon ISFSI Data Report C - 1998 Geophysical Investigations at the ISFSI Site Area, (Agbabian Associates and GeoVision), Rev. 0, November 5, 2001, prepared by J. Bachhuber, 84 p.

Diablo Canyon ISFSI Data Report D - Trenches in the ISFSI Site Area, Rev. 0, November 5, 2001, prepared by J. Bachhuber, 66 p.

Diablo Canyon ISFSI Data Report E, - Borehole Geophysical Data (NORCAL Geophysical Consultants, Inc.), Rev. 0, November 5, 2001, prepared by C. Brankman, 303 p.

Diablo Canyon ISFSI Data Report F - Field Discontinuity Measurements, Rev. 0, November 5, 2001, prepared by J. Bachhuber and C. Brankman, 85 p.

Diablo Canyon ISFSI Data Report G - Soil Laboratory Test Data (Cooper Testing Laboratory), Rev. 0, November 5, 2001, prepared by J. Sun, 63 p.

Diablo Canyon ISFSI Data Report H - Rock Strength Data and GSI Sheets, Rev. 0, November 5, 2001, prepared by J. Bachhuber, 37 p.

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Diablo Canyon ISFSI Data Report I - Rock Laboratory Test Data (GeoTest Unlimited), Rev. 0, November 5, 2001, prepared by J. Sun, 203 p.

Diablo Canyon ISFSI Data Report J – Petrographic Analysis and X-Ray Diffraction of Rock Samples (Spectrum Petrographics, Inc.), Rev. 0, November 5, 2001, prepared by J. Bachhuber, 204 p.

Diablo Canyon ISFSI Data Report K - Petrographic and X-Ray Diffraction Analyses of Clay Beds (Schwein/Christensen Laboratories, Inc.). Rev. 0, November 5, 2001, prepared by J. Bachhuber, 36 p.

In addition to the revisions of those reports required under the various Work Plans, Mr. Scott Lindvall, the WLA ITR for the ISFSI project, has performed independent technical reviews of the Diablo Canyon ISFSI Data Reports as part of his review of Calculation Package GEO.DCPP.01.21, Analysis of Bedrock Stratigraphy and Geologic Structure at the DCPP ISFSI Site. He finds that the reports clearly and accurately compile and organize the data.

Mr. Albert Tafoya from the Diablo Canyon ISFSI Project Office in San Luis Obispo, Mr. Dale Marcum, NQS Technical Oversight for the project, and William Page of your office provided comments on the August versions of the Diablo Canyon ISFSI Data Reports (formerly called appendices) and their comments have been addressed.

These reports are submitted to you as per the PG&E Geosciences Department Calculation Procedure GEO.001, Rev. 04 (10/10/01).

We look forward to any comments you may have.

Sincerely,
WILLIAM LETTIS & ASSOCIATES, INC.

Robert C. Witter
Project Manager

CC: William Page