CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 16
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 370
Initial Y-Base Starting Zone Coordinate: 369

Remarks: cross section I-I', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	890	369	900	365
2	.5	.83	.35	900	365	910	361
3	.5	.83	.35	910	361	920	359
4	.5	.83	.35	920	359	930	357
5	.5	.83	.35	930	357	940	354
6	.5	.83	.35	940	354	950	351
7	.5	.83	.35	950	351	960	348
8	.5	.83	.35	960	348	961	347
9	.5	.74	.45	961	347	970	330
10	.5	.74	.45	970	330	996	330
11	.5	.74	.45	996	330	1005	310
12	0	.9	.5	1005	310	1119	310
13	0	.9	.5	1119	310	1120	306
14	0	.9	.5	1120	306	1130	305
15	0	.9	.5	1130	305	1140	304
16	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 16
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 3 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	16.87	20159	0.14
75%	17.98	22579	4.84
90%	18.98	24756	9.06
95%	19.58	26063	11.6
98%	20.25	27529	14.44

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	21.08	Maximum:	1.23	Maximum:	29710
Average:	16.87	Average:	.33	Average:	20159
Minimum:	11.99	G. Mean:	.14	Std. Dev.:	3584
Std. Dev.:	1.65	Std. Dev.:	6.95		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 553

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	8.09	5674	0.06
75%	10.21	8476	5.43
90%	12.11	10996	10.26
95%	13.26	12509	13.16
98%	14.54	14207	16.42

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	18.82	Maximum:	1.18	Maximum:	26235
Average:	8.09	Average:	.16	Average:	5674
Minimum:	2.34	G. Mean:	.06	Std. Dev.:	4149
Std. Dev.:	3.13	Std. Dev.:	7.96		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 286

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	15.25	17959	0.58
75%	18.66	25685	2.19
90%	21.73	32633	3.65
95%	23.57	36805	4.52
98%	25.64	41487	5.5

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	38.31	Maximum:	9.87	Maximum:	75043
Average:	15.25	Average:	.75	Average:	17959
Minimum:	7.51	G. Mean:	.58	Std. Dev.:	11441
Std. Dev.:	5.05	Std. Dev.:	2.39		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	16	13	1.16	1	0
2	19	15	1.24	1	0
3	17	14	1.34	1	0
4	18	14	1.53	1	0
5	20	15	1.64	1	0
6	20	16	1.65	1	0
7	21	17	1.65	1	0
8	22	18	1.8	2	0
9	39	30	3.12	15	8
10	17	7	2.76	2	0
11	37	29	3.3	17	3
12	No rocks	past end of cell			

13	No rocks	past end of cell
14	No rocks	past end of cell
15	No rocks	past end of cell
16	No rocks	past end of cell

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0

440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	45
980 To 990 ft	408
990 To 1000 ft	261
1000 To 1010 ft	0

1010	To	1020	ft	59
1020	To	1030	ft	156
1030	To	1040	ft	71
1040	To	1050	ft	0
1050	To	1060	ft	0
1060	To	1070	ft	0
1070	To	1080	ft	0
1080	To	1090	ft	0
1090	To	1100	ft	0
1100	To	1110	ft	0
1110	To	1120	ft	0
1120	To	1130	ft	0
1130	To	1140	ft	0
1140	To	1150	ft	0
1150	To	1160	ft	0
1160	To	1170	ft	0
1170	To	1180	ft	0
1180	To	1190	ft	0
1190	To	1200	ft	0
1200	To	1210	ft	0
1210	To	1220	ft	0
1220	To	1230	ft	0
1230	To	1240	ft	0
1240	To	1250	ft	0
1250	To	1260	ft	0
1260	To	1270	ft	0
1270	To	1280	ft	0
1280	To	1290	ft	0
1290	To	1300	ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 16
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 370
Initial Y-Base Starting Zone Coordinate: 369

Remarks: cross section I-I', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	890	369	900	365
2	.5	.83	.35	900	365	910	361
3	.5	.83	.35	910	361	920	359
4	.5	.83	.35	920	359	930	357
5	.5	.83	.35	930	357	940	354
6	.5	.83	.35	940	354	950	351
7	.5	.83	.35	950	351	960	348
8	.5	.83	.35	960	348	961	347
9	.5	.74	.45	961	347	970	330
10	.5	.74	.45	970	330	996	330
11	.5	.74	.45	996	330	1005	310
12	0	.9	.5	1005	310	1119	310
13	0	.9	.5	1119	310	1120	306
14	0	.9	.5	1120	306	1130	305
15	0	.9	.5	1130	305	1140	304
16	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 16
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 6 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	22.19	62644	0.05
75%	22.91	66339	5.84
90%	23.55	69662	11.05
95%	23.94	71657	14.18
98%	24.37	73896	17.69

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	24.67	Maximum:	.61	Maximum:	75419
Average:	22.19	Average:	.15	Average:	62644
Minimum:	17.43	G. Mean:	.05	Std. Dev.:	5471
Std. Dev.:	1.06	Std. Dev.:	8.58		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	16.39	35760	0.17
75%	17.85	41780	3.42
90%	19.16	47194	6.35
95%	19.95	50445	8.11
98%	20.83	54093	10.08

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	21.8	Maximum:	1.2	Maximum:	60794

Average: 16.39	Average: .29	Average: 35760
Minimum: 7.71	G. Mean: .17	Std. Dev.: 8915
Std. Dev.: 2.16	Std. Dev.: 4.82	

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 998

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	29.5	97531	2.75
75%	35.61	125954	5.7
90%	41.1	151519	8.36
95%	44.4	166868	9.96
98%	48.1	184093	11.75

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 39.13	Maximum: 14.61	Maximum: 151631
Average: 29.5	Average: 4.96	Average: 97531
Minimum: 7.83	G. Mean: 2.75	Std. Dev.: 42096
Std. Dev.: 9.04	Std. Dev.: 4.37	

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	16	14	.69	0	0
2	20	18	.81	0	0
3	19	17	.85	0	0
4	20	18	.93	0	0
5	22	19	1.04	1	0

6	24	21	1.04	1	0
7	25	22	1.06	1	0
8	25	23	1.12	1	0
9	39	31	1.93	15	11
10	20	15	2.27	1	0
11	37	26	2.73	19	13
12	No rocks	past end of cell			
13	No rocks	past end of cell			
14	No rocks	past end of cell			
15	No rocks	past end of cell			
16	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0

360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0

930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	2
1000 To 1010 ft	0
1010 To 1020 ft	30
1020 To 1030 ft	395
1030 To 1040 ft	549
1040 To 1050 ft	24
1050 To 1060 ft	0
1060 To 1070 ft	0
1070 To 1080 ft	0
1080 To 1090 ft	0
1090 To 1100 ft	0
1100 To 1110 ft	0
1110 To 1120 ft	0
1120 To 1130 ft	0
1130 To 1140 ft	0
1140 To 1150 ft	0
1150 To 1160 ft	0
1160 To 1170 ft	0
1170 To 1180 ft	0
1180 To 1190 ft	0
1190 To 1200 ft	0
1200 To 1210 ft	0
1210 To 1220 ft	0
1220 To 1230 ft	0
1230 To 1240 ft	0
1240 To 1250 ft	0
1250 To 1260 ft	0
1260 To 1270 ft	0
1270 To 1280 ft	0
1280 To 1290 ft	0
1290 To 1300 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 16
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 370
Initial Y-Base Starting Zone Coordinate: 369

Remarks: cross section I-I', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	890	369	900	365
2	.5	.83	.35	900	365	910	361
3	.5	.83	.35	910	361	920	359
4	.5	.83	.35	920	359	930	357
5	.5	.83	.35	930	357	940	354
6	.5	.83	.35	940	354	950	351
7	.5	.83	.35	950	351	960	348
8	.5	.83	.35	960	348	961	347
9	.5	.74	.45	961	347	970	330
10	.5	.74	.45	970	330	996	330
11	.5	.74	.45	996	330	1005	310
12	0	.9	.5	1005	310	1119	310
13	0	.9	.5	1119	310	1120	306
14	0	.9	.5	1120	306	1130	305
15	0	.9	.5	1130	305	1140	304
16	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 16
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 5 ft
Length: 10 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 46

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	20.12	249011	0.01
75%	22.86	298905	5.04
90%	25.33	343782	9.57
95%	26.8	370724	12.29
98%	28.46	400962	15.35

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	24.18	Maximum:	.19	Maximum:	342053
Average:	20.12	Average:	.01	Average:	249011
Minimum:	4.33	G. Mean:	.01	Std. Dev.:	73895
Std. Dev.:	4.06	Std. Dev.:	7.46		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 46

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	15.99	160286	0.05
75%	18.14	201204	4.81
90%	20.06	238008	9.1
95%	21.22	260103	11.67
98%	22.52	284901	14.55

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	22.24	Maximum:	.47	Maximum:	292692

Average:	15.99	Average:	.13	Average:	160286
Minimum:	8.92	G. Mean:	.05	Std. Dev.:	60601
Std. Dev.:	3.17	Std. Dev.:	7.05		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 46

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	24.93	356888	2.5
75%	32.14	507307	5.11
90%	38.62	642600	7.46
95%	42.52	723824	8.87
98%	46.88	814985	10.45

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	36.43	Maximum:	12.57	Maximum:	605725
Average:	24.93	Average:	4.74	Average:	356888
Minimum:	8.03	G. Mean:	2.5	Std. Dev.:	222777
Std. Dev.:	10.67	Std. Dev.:	3.87		

Remarks: cross section I-I', blocks from toe of model 2A

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	18	16	1.01	0	-1
2	20	14	5.54	0	-1
3	20	15	3.89	0	-1
4	20	13	4.46	0	-1
5	22	17	4.47	0	0

6	23	18	4.33	0	0
7	24	20	4.06	0	0
8	25	21	3.6	1	0
9	37	30	1.82	13	9
10	21	15	3.66	0	0
11	34	27	2.72	17	11
12	No rocks	past end of cell			
13	No rocks	past end of cell			
14	No rocks	past end of cell			
15	No rocks	past end of cell			
16	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2a\CrossSectionI-I'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0

360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	166
910 To 920 ft	304

920 To 930 ft	181
930 To 940 ft	247
940 To 950 ft	38
950 To 960 ft	18
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0
1000 To 1010 ft	0
1010 To 1020 ft	5
1020 To 1030 ft	15
1030 To 1040 ft	20
1040 To 1050 ft	6
1050 To 1060 ft	0
1060 To 1070 ft	0
1070 To 1080 ft	0
1080 To 1090 ft	0
1090 To 1100 ft	0
1100 To 1110 ft	0
1110 To 1120 ft	0
1120 To 1130 ft	0
1130 To 1140 ft	0
1140 To 1150 ft	0
1150 To 1160 ft	0
1160 To 1170 ft	0
1170 To 1180 ft	0
1180 To 1190 ft	0
1190 To 1200 ft	0
1200 To 1210 ft	0
1210 To 1220 ft	0
1220 To 1230 ft	0
1230 To 1240 ft	0
1240 To 1250 ft	0
1250 To 1260 ft	0
1260 To 1270 ft	0
1270 To 1280 ft	0
1280 To 1290 ft	0
1290 To 1300 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 31
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 418
Initial Y-Base Starting Zone Coordinate: 417

Remarks: Slope along cross section I-I'

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	750	417	760	414
2	.5	.83	.35	760	414	770	411
3	.5	.83	.35	770	411	780	407
4	.5	.83	.35	780	407	790	404
5	.5	.83	.35	790	404	800	400
6	.5	.83	.35	800	400	810	397
7	.5	.83	.35	810	397	817	394
8	.5	.73	.4	817	394	827	394
9	.5	.83	.35	827	394	830	389
10	.5	.83	.35	830	389	840	385
11	.5	.83	.35	840	385	850	381
12	.5	.83	.35	850	381	860	378
13	.5	.83	.35	860	378	870	376
14	.5	.83	.35	870	376	880	371
15	.5	.83	.35	880	371	890	369
16	.5	.83	.35	890	369	900	365
17	.5	.83	.35	900	365	910	361
18	.5	.83	.35	910	361	920	359
19	.5	.83	.35	920	359	930	357
20	.5	.83	.35	930	357	940	354
21	.5	.83	.35	940	354	950	351
22	.5	.83	.35	950	351	960	348
23	.5	.83	.35	960	348	961	347
24	.5	.74	.45	961	347	970	330
25	.5	.74	.45	970	330	996	330
26	.5	.74	.45	996	330	1005	310
27	0	.9	.5	1005	310	1119	310
28	0	.9	.5	1119	310	1120	306
29	0	.9	.5	1120	306	1130	305
30	0	.9	.5	1130	305	1140	304
31	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 31
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 3 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	24.67	43425	0.31
75%	26.58	49659	4.36
90%	28.29	55265	8.01
95%	29.32	58631	10.2
98%	30.47	62409	12.65

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 32.42	Maximum: 2.22	Maximum: 70924
Average: 24.67	Average: .65	Average: 43425
Minimum: 15.13	G. Mean: .31	Std. Dev.: 9232
Std. Dev.: 2.82	Std. Dev.: 6	

Remarks: Slope along cross section I-I'

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 987

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	16.38	21783	0.43
75%	19.67	29997	2.92
90%	22.63	37384	5.15
95%	24.41	41819	6.49
98%	26.4	46797	8

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 43.39	Maximum: 2.6	Maximum: 107643
Average: 16.38	Average: .68	Average: 21783
Minimum: 3.07	G. Mean: .43	Std. Dev.: 12164
Std. Dev.: 4.87	Std. Dev.: 3.68	

Remarks: Slope along cross section I-I'

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 955

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	25.23	41922	2.22
75%	32.18	58673	5.83
90%	38.43	73739	9.07
95%	42.18	82784	11.02
98%	46.39	92936	13.2

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 40.41	Maximum: 19.44	Maximum: 87649
Average: 25.23	Average: 5.36	Average: 41922
Minimum: 7.48	G. Mean: 2.22	Std. Dev.: 24808
Std. Dev.: 10.29	Std. Dev.: 5.34	

Remarks: Slope along cross section I-I'

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	13	10	1.06	0	0
2	15	12	1.19	1	0
3	19	15	1.28	1	0
4	19	16	1.32	1	0
5	22	18	1.48	1	0
6	23	18	1.6	1	0
7	25	20	1.71	2	0
8	20	14	2.26	1	0
9	23	16	2.38	6	4
10	31	19	3.96	4	0
11	28	20	2.44	2	0
12	27	21	2.21	2	0
13	27	20	2.3	2	0
14	30	24	2.61	4	0
15	28	21	2.36	2	0
16	30	23	2.61	3	0
17	35	25	2.56	2	0
18	29	23	2.42	3	0
19	30	22	2.66	2	0
20	31	24	2.81	3	0
21	33	24	2.72	2	0
22	32	25	2.82	2	0
23	33	25	2.9	3	1
24	40	32	3.53	17	12
25	26	15	4.65	2	0
26	38	27	3.98	22	11
27	No rocks	past end of cell			
28	No rocks	past end of cell			
29	No rocks	past end of cell			
30	No rocks	past end of cell			
31	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSectionI-I'_Model2b.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0

90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0

660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	13
990 To 1000 ft	32
1000 To 1010 ft	0
1010 To 1020 ft	96
1020 To 1030 ft	336
1030 To 1040 ft	351
1040 To 1050 ft	146
1050 To 1060 ft	26
1060 To 1070 ft	0
1070 To 1080 ft	0
1080 To 1090 ft	0
1090 To 1100 ft	0
1100 To 1110 ft	0
1110 To 1120 ft	0
1120 To 1130 ft	0
1130 To 1140 ft	0
1140 To 1150 ft	0
1150 To 1160 ft	0
1160 To 1170 ft	0
1170 To 1180 ft	0
1180 To 1190 ft	0
1190 To 1200 ft	0
1200 To 1210 ft	0
1210 To 1220 ft	0
1220 To 1230 ft	0

1230 To 1240 ft	0
1240 To 1250 ft	0
1250 To 1260 ft	0
1260 To 1270 ft	0
1270 To 1280 ft	0
1280 To 1290 ft	0
1290 To 1300 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 31
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 418
Initial Y-Base Starting Zone Coordinate: 417

Remarks: Slope along cross section I-I'

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	750	417	760	414
2	.5	.83	.35	760	414	770	411
3	.5	.83	.35	770	411	780	407
4	.5	.83	.35	780	407	790	404
5	.5	.83	.35	790	404	800	400
6	.5	.83	.35	800	400	810	397
7	.5	.83	.35	810	397	817	394
8	.5	.73	.4	817	394	827	394
9	.5	.83	.35	827	394	830	389
10	.5	.83	.35	830	389	840	385
11	.5	.83	.35	840	385	850	381
12	.5	.83	.35	850	381	860	378
13	.5	.83	.35	860	378	870	376
14	.5	.83	.35	870	376	880	371
15	.5	.83	.35	880	371	890	369
16	.5	.83	.35	890	369	900	365
17	.5	.83	.35	900	365	910	361
18	.5	.83	.35	910	361	920	359
19	.5	.83	.35	920	359	930	357
20	.5	.83	.35	930	357	940	354
21	.5	.83	.35	940	354	950	351
22	.5	.83	.35	950	351	960	348
23	.5	.83	.35	960	348	961	347
24	.5	.74	.45	961	347	970	330
25	.5	.74	.45	970	330	996	330
26	.5	.74	.45	996	330	1005	310
27	0	.9	.5	1005	310	1119	310
28	0	.9	.5	1119	310	1120	306
29	0	.9	.5	1120	306	1130	305
30	0	.9	.5	1130	305	1140	304
31	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 31
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 6 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 991

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	34.64	152746	0.16
75%	35.68	161233	5.7
90%	36.61	168866	10.68
95%	37.17	173449	13.68
98%	37.8	178592	17.03

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 39.11	Maximum: 1.51	Maximum: 187021
Average: 34.64	Average: .42	Average: 152746
Minimum: 28.6	G. Mean: .16	Std. Dev.: 12568
Std. Dev.: 1.54	Std. Dev.: 8.2	

Remarks: Slope along cross section I-I'

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 991

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	31.37	129424	0.76
75%	36.47	168583	2.63
90%	41.06	203804	4.31
95%	43.82	224949	5.31
98%	46.91	248681	6.45

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	50.53	Maximum:	5.48	Maximum:	288315
Average:	31.37	Average:	1	Average:	129424
Minimum:	17.87	G. Mean:	.76	Std. Dev.:	57995
Std. Dev.:	7.56	Std. Dev.:	2.76		

Remarks: Slope along cross section I-I'

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 991

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	33.4	135315	15.77
75%	35.21	149173	16.57
90%	36.84	161637	17.3
95%	37.82	169120	17.73
98%	38.92	177519	18.22

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	59.18	Maximum:	21.01	Maximum:	376702
Average:	33.4	Average:	15.99	Average:	135315
Minimum:	25.16	G. Mean:	15.77	Std. Dev.:	20524
Std. Dev.:	2.69	Std. Dev.:	1.19		

Remarks: Slope along cross section I-I'

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	14	13	.68	0	0
2	17	14	1.21	0	0
3	20	17	1.52	0	0
4	22	19	1.49	0	0
5	24	21	1.28	1	0
6	25	22	1.29	1	0
7	28	25	1.34	1	0
8	23	20	1.58	1	0
9	27	20	1.99	6	4
10	33	27	2.42	6	2
11	31	27	1.62	1	0
12	32	27	1.53	1	0
13	31	27	1.49	1	0
14	35	31	1.76	4	0
15	35	29	1.58	1	0
16	36	31	1.73	3	0
17	38	33	1.72	2	0
18	36	31	1.45	1	0
19	36	32	1.54	1	0
20	38	33	1.59	2	0
21	40	34	1.58	1	0
22	39	35	1.54	2	0
23	40	35	1.58	2	1
24	44	39	2	17	13
25	50	28	2.5	2	0
26	56	31	2.52	22	18
27	No rocks	past end of cell			
28	No rocks	past end of cell			
29	No rocks	past end of cell			
30	No rocks	past end of cell			
31	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0

30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0

600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	5
780 To 790 ft	1
790 To 800 ft	3
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0
1000 To 1010 ft	0
1010 To 1020 ft	0
1020 To 1030 ft	0
1030 To 1040 ft	1
1040 To 1050 ft	23
1050 To 1060 ft	289
1060 To 1070 ft	499
1070 To 1080 ft	170
1080 To 1090 ft	9
1090 To 1100 ft	0
1100 To 1110 ft	0
1110 To 1120 ft	0
1120 To 1130 ft	0
1130 To 1140 ft	0
1140 To 1150 ft	0
1150 To 1160 ft	0
1160 To 1170 ft	0

1170	To	1180	ft	0
1180	To	1190	ft	0
1190	To	1200	ft	0
1200	To	1210	ft	0
1210	To	1220	ft	0
1220	To	1230	ft	0
1230	To	1240	ft	0
1240	To	1250	ft	0
1250	To	1260	ft	0
1260	To	1270	ft	0
1270	To	1280	ft	0
1280	To	1290	ft	0
1290	To	1300	ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 31
Analysis Point 1 X-Coordinate: 960
Analysis Point 2 X-Coordinate: 990
Analysis Point 3 X-Coordinate: 1010
Initial Y-Top Starting Zone Coordinate: 418
Initial Y-Base Starting Zone Coordinate: 417

Remarks: Slope along cross section I-I'

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	750	417	760	414
2	.5	.83	.35	760	414	770	411
3	.5	.83	.35	770	411	780	407
4	.5	.83	.35	780	407	790	404
5	.5	.83	.35	790	404	800	400
6	.5	.83	.35	800	400	810	397
7	.5	.83	.35	810	397	817	394
8	.5	.73	.4	817	394	827	394
9	.5	.83	.35	827	394	830	389
10	.5	.83	.35	830	389	840	385
11	.5	.83	.35	840	385	850	381
12	.5	.83	.35	850	381	860	378
13	.5	.83	.35	860	378	870	376
14	.5	.83	.35	870	376	880	371
15	.5	.83	.35	880	371	890	369
16	.5	.83	.35	890	369	900	365
17	.5	.83	.35	900	365	910	361
18	.5	.83	.35	910	361	920	359
19	.5	.83	.35	920	359	930	357
20	.5	.83	.35	930	357	940	354
21	.5	.83	.35	940	354	950	351
22	.5	.83	.35	950	351	960	348
23	.5	.83	.35	960	348	961	347
24	.5	.74	.45	961	347	970	330
25	.5	.74	.45	970	330	996	330
26	.5	.74	.45	996	330	1005	310
27	0	.9	.5	1005	310	1119	310
28	0	.9	.5	1119	310	1120	306
29	0	.9	.5	1120	306	1130	305
30	0	.9	.5	1130	305	1140	304
31	0	.9	.5	1140	304	1300	300

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 31
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 5 ft
Length: 10 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 1: X = 960, Y = 348

Total Rocks Passing Analysis Point: 6

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	35.3	741759	0.06
75%	37.09	811856	15.34
90%	38.7	874904	29.08
95%	39.67	912755	37.34
98%	40.75	955237	46.6

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	38.26	Maximum:	.62	Maximum:	856844
Average:	35.3	Average:	.28	Average:	741759
Minimum:	31.09	G. Mean:	.06	Std. Dev.:	103816
Std. Dev.:	2.65	Std. Dev.:	22.63		

Remarks: Slope along cross section I-I'

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 2: X = 990, Y = 330

Total Rocks Passing Analysis Point: 6

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	30.6	565792	0.47
75%	31.52	599637	2.05
90%	32.35	630078	3.48
95%	32.85	648354	4.33
98%	33.41	668866	5.29

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	32.58	Maximum:	.9	Maximum:	635374
Average:	30.6	Average:	.59	Average:	565792
Minimum:	29.28	G. Mean:	.47	Std. Dev.:	50126
Std. Dev.:	1.37	Std. Dev.:	2.34		

Remarks: Slope along cross section I-I'

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Analysis Point 3: X = 1010, Y = 310

Total Rocks Passing Analysis Point: 6

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	34.4	672609	16.71
75%	35.16	700075	17.44
90%	35.84	724780	18.1
95%	36.25	739611	18.49
98%	36.71	756257	18.94

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	36.19	Maximum:	19.21	Maximum:	744015
Average:	34.4	Average:	16.76	Average:	672609
Minimum:	33.28	G. Mean:	16.71	Std. Dev.:	40678
Std. Dev.:	1.12	Std. Dev.:	1.09		

Remarks: Slope along cross section I-I'

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	14	13	.48	0	0
2	17	10	4.73	0	-1
3	20	15	5.72	0	0
4	21	18	3.76	0	0
5	24	19	4.71	0	0
6	25	22	2.2	0	0
7	27	24	2.1	0	0
8	24	20	2.38	0	0
9	25	21	2.39	5	4
10	30	27	3.13	3	0
11	32	27	2.37	1	0
12	32	28	2.57	0	0
13	30	28	1.81	0	0
14	34	31	2.2	1	0
15	32	30	1.58	0	0
16	34	32	.88	0	0
17	35	33	1.52	0	0
18	35	33	1.98	1	0
19	35	33	1.95	0	0
20	38	34	2.14	1	0
21	38	35	1.75	0	0
22	38	35	2.65	1	0
23	39	36	2.69	1	0
24	42	39	2.81	15	13
25	32	30	1.21	1	0
26	34	32	1.06	21	19
27	No rocks	past end of cell			
28	No rocks	past end of cell			
29	No rocks	past end of cell			
30	No rocks	past end of cell			
31	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection I-I'\Model 2b\CrossSectionI-I'_Model2b.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0

30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0

600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	831
770 To 780 ft	142
780 To 790 ft	15
790 To 800 ft	4
800 To 810 ft	2
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0
1000 To 1010 ft	0
1010 To 1020 ft	0
1020 To 1030 ft	0
1030 To 1040 ft	0
1040 To 1050 ft	0
1050 To 1060 ft	0
1060 To 1070 ft	4
1070 To 1080 ft	2
1080 To 1090 ft	0
1090 To 1100 ft	0
1100 To 1110 ft	0
1110 To 1120 ft	0
1120 To 1130 ft	0
1130 To 1140 ft	0
1140 To 1150 ft	0
1150 To 1160 ft	0
1160 To 1170 ft	0

1170	To	1180	ft	0
1180	To	1190	ft	0
1190	To	1200	ft	0
1200	To	1210	ft	0
1210	To	1220	ft	0
1220	To	1230	ft	0
1230	To	1240	ft	0
1240	To	1250	ft	0
1250	To	1260	ft	0
1260	To	1270	ft	0
1270	To	1280	ft	0
1280	To	1290	ft	0
1290	To	1300	ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 14
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 384
Initial Y-Base Starting Zone Coordinate: 383

Remarks: Slope along cross section A-A', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	678	383	680	382
2	.5	.83	.35	680	382	690	379
3	.5	.83	.35	690	379	700	376
4	.5	.83	.35	700	376	710	374
5	.5	.83	.35	710	374	720	372
6	.5	.83	.35	720	372	730	368
7	.5	.83	.35	730	368	740	365
8	.5	.83	.35	740	365	750	362
9	.5	.83	.35	750	362	760	358
10	.5	.74	.45	760	358	770	331
11	.5	.74	.45	770	331	798	331
12	.5	.74	.45	798	331	805	311
13	0	.9	.5	805	311	990	311
14	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1

Ending Cell Number: 14
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 3 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 1: X = 750, Y = 362

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	16.05	18212	0.13
75%	17.14	20461	4.86
90%	18.12	22484	9.13
9[illegible]%	18.71	23698	11.68
98%	19.37	25061	14.56

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	21.29	Maximum:	1.1	Maximum:	29410
Average:	16.05	Average:	.3	Average:	18212
Minimum:	10.78	G. Mean:	.13	Std. Dev.:	3330
Std. Dev.:	1.62	Std. Dev.:	7.02		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 2: X = 785, Y = 331

Total Rocks Passing Analysis Point: 939

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	10.33	8950	0.19
75%	12.9	13621	3.77
90%	15.21	17822	6.99
95%	16.6	20344	8.93
98%	18.16	23175	11.1

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	45.68	Maximum:	1.33	Maximum:	107202

Average:	10.33	Average:	.37	Average:	8950
Minimum:	2.96	G. Mean:	.19	Std. Dev.:	6917
Std. Dev.:	3.81	Std. Dev.:	5.3		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 3: X = 820, Y = 311

Total Rocks Passing Analysis Point: 210

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	11.87	11700	0
75%	14.83	16779	3.6
90%	17.49	21347	6.83
95%	19.09	24089	8.77
98%	20.88	27167	10.94

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	19.56	Maximum:	.78	Maximum:	28278
Average:	11.87	Average:	-.03	Average:	11700
Minimum:	3.87	G. Mean:	0	Std. Dev.:	7522
Std. Dev.:	4.38	Std. Dev.:	5.32		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	11	11	0	2	1
2	14	11	1.22	1	0
3	16	12	1.27	1	0
4	15	11	1.39	1	0
5	15	11	1.6	1	0

6	19	14	1.52	1	0
7	20	15	1.55	1	0
8	21	16	1.62	1	0
9	24	18	1.65	1	0
10	39	31	3.1	24	17
11	15	8	2.97	1	0
12	36	28	3.75	19	6
13	No rocks	past end of cell			
14	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0

380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	5
780 To 790 ft	246
790 To 800 ft	389
800 To 810 ft	0
810 To 820 ft	154
820 To 830 ft	183
830 To 840 ft	23
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0

950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 14
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 384
Initial Y-Base Starting Zone Coordinate: 383

Remarks: Slope along cross section A-A', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	678	383	680	382
2	.5	.83	.35	680	382	690	379
3	.5	.83	.35	690	379	700	376
4	.5	.83	.35	700	376	710	374
5	.5	.83	.35	710	374	720	372
6	.5	.83	.35	720	372	730	368
7	.5	.83	.35	730	368	740	365
8	.5	.83	.35	740	365	750	362
9	.5	.83	.35	750	362	760	358
10	.5	.74	.45	760	358	770	331
11	.5	.74	.45	770	331	798	331
12	.5	.74	.45	798	331	805	311
13	0	.9	.5	805	311	990	311
14	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1

Ending Cell Number: 14
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 6 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 1: X = 750, Y = 362

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	20.92	55668	0.04
75%	21.85	60239	6.14
90%	22.69	64350	11.63
95%	23.2	66818	14.93
98%	23.76	69588	18.63

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	23.68	Maximum:	.55	Maximum:	69427
Average:	20.92	Average:	.13	Average:	55668
Minimum:	12.25	G. Mean:	.04	Std. Dev.:	6769
Std. Dev.:	1.38	Std. Dev.:	9.04		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 2: X = 785, Y = 331

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	21.87	68182	0.62
75%	29.1	113000	2.52
90%	35.6	153310	4.23
95%	39.5	177511	5.25
98%	43.88	204672	6.4

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	48.8	Maximum:	6.99	Maximum:	242394

Average:	21.87	Average:	.87	Average:	68182
Minimum:	10.89	G. Mean:	.62	Std. Dev.:	66376
Std. Dev.:	10.7	Std. Dev.:	2.81		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 3: X = 820, Y = 311

Total Rocks Passing Analysis Point: 972

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	15.39	32238	0.15
75%	18.59	47551	6.47
90%	21.47	61324	12.14
95%	23.2	69593	15.55
98%	25.14	78873	19.38

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	40.89	Maximum:	6.02	Maximum:	171236
Average:	15.39	Average:	.44	Average:	32238
Minimum:	4.21	G. Mean:	.15	Std. Dev.:	22678
Std. Dev.:	4.74	Std. Dev.:	9.35		

Remarks: Slope along cross section A-A', blocks from toe of model 2A

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	11	11	0	4	3
2	15	13	.76	0	0
3	17	14	1.23	0	0
4	18	15	1.27	0	0
5	18	15	1.36	0	0

6	22	18	1.39	1	0
7	23	19	1.35	0	0
8	24	21	1.38	1	0
9	27	24	1.36	1	0
10	40	32	1.93	23	19
11	21	15	2.65	1	0
12	36	23	2.4	21	15
13	No rocks	past end of cell			
14	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0

380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	29
820 To 830 ft	259
830 To 840 ft	565
840 To 850 ft	147
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0

950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 14
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 384
Initial Y-Base Starting Zone Coordinate: 383

Remarks: Slope along cross section A-A', blocks from toe of model 2A

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	678	383	680	382
2	.5	.83	.35	680	382	690	379
3	.5	.83	.35	690	379	700	376
4	.5	.83	.35	700	376	710	374
5	.5	.83	.35	710	374	720	372
6	.5	.83	.35	720	372	730	368
7	.5	.83	.35	730	368	740	365
8	.5	.83	.35	740	365	750	362
9	.5	.83	.35	750	362	760	358
10	.5	.74	.45	760	358	770	331
11	.5	.74	.45	770	331	798	331
12	.5	.74	.45	798	331	805	311
13	0	.9	.5	805	311	990	311
14	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1

Ending Cell Number: 14
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 5 ft
Length: 10 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 1: X = 750, Y = 362

NO ROCKS PAST ANALSYSIS POINT 1

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 2: X = 785, Y = 331

NO ROCKS PAST ANALSYSIS POINT 2

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Analysis Point 3: X = 820, Y = 311

NO ROCKS PAST ANALSYSIS POINT 3

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	11	11	0	6	5
2	15	14	.87	0	0
3	17	9	4.93	0	-1
4	17	11	3.71	0	-1
5	18	10	4.6	0	-1

6	16	10	0	0	-1
7	No rocks	past end of cell			
8	No rocks	past end of cell			
9	No rocks	past end of cell			
10	No rocks	past end of cell			
11	No rocks	past end of cell			
12	No rocks	past end of cell			
13	No rocks	past end of cell			
14	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2a\CrossSectionA-A'_Model2a.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0

380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	898
700 To 710 ft	67
710 To 720 ft	23
720 To 730 ft	9
730 To 740 ft	3
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	0
840 To 850 ft	0
850 To 860 ft	0
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0

950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 23
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 412
Initial Y-Base Starting Zone Coordinate: 411

Remarks: Slope along cross section A-A', blocks from toe of model 2B

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	600	411	610	407
2	.5	.83	.35	610	407	620	402
3	.5	.83	.35	620	402	630	398
4	.5	.83	.35	630	398	640	395
5	.5	.83	.35	640	395	650	392
6	.5	.83	.35	650	392	656	388
7	.5	.73	.4	656	388	666	388
8	.5	.83	.35	666	388	670	385
9	.5	.83	.35	670	385	678	383
10	.5	.83	.35	678	383	680	382
11	.5	.83	.35	680	382	690	379
12	.5	.83	.35	690	379	700	376
13	.5	.83	.35	700	376	710	374
14	.5	.83	.35	710	374	720	372
15	.5	.83	.35	720	372	730	368
16	.5	.83	.35	730	368	740	365
17	.5	.83	.35	740	365	750	362
18	.5	.83	.35	750	362	760	358
19	.5	.74	.45	760	358	770	331
20	.5	.74	.45	770	331	798	331
21	.5	.74	.45	798	331	805	311
22	0	.9	.5	805	311	990	311
23	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1
Ending Cell Number: 23

Rock Density: 142 lb/ft^3

Rock Shape: Cylindrical
Diameter: 3 ft
Length: 3 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Analysis Point 1: X = 750, Y = 362

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)		Energy (ft-lb)	Bounce Ht. (ft)
50%	20.91	31269	0.23	
75%	22.64	36197	4.65	
90%	24.19	40629	8.63	
95%	25.12	43291	11.02	
98%	26.17	46277	13.69	

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	28.36	Maximum:	1.98	Maximum:	56771
Average:	20.91	Average:	.51	Average:	31269
Minimum:	13.12	G. Mean:	.23	Std. Dev.:	7298
Std. Dev.:	2.56	Std. Dev.:	6.55		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Analysis Point 2: X = 785, Y = 331

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)		Energy (ft-lb)	Bounce Ht. (ft)
50%	21.59	38670	0.7	
75%	30.96	66744	3.3	
90%	39.39	91994	5.64	

95%	44.46	107153	7.05
98%	50.14	124167	8.62

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 51.95	Maximum: 12.55	Maximum: 145551
Average: 21.59	Average: 1.41	Average: 38670
Minimum: 2.85	G. Mean: .7 Std. Dev.: 41577	
Std. Dev.: 13.88	Std. Dev.: 3.85	

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Analysis Point 3: X = 820, Y = 311

Total Rocks Passing Analysis Point: 665

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	14.11	16030	0.02
75%	17.99	25271	11.4
90%	21.48	33583	21.63
95%	23.57	38573	27.78
98%	25.92	44174	34.67

Velocity (ft/sec)	Bounce Height (ft)	Kinetic Energy (ft-lb)
Maximum: 42.16	Maximum: 6.51	Maximum: 97770
Average: 14.11	Average: .23 Average: 16030	
Minimum: 3.92	G. Mean: .02 Std. Dev.: 13686	
Std. Dev.: 5.74	Std. Dev.: 16.85	

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	16	13	1.12	1	0
2	20	17	1.28	1	0
3	22	18	1.37	1	0
4	23	19	1.51	1	0
5	24	19	1.62	1	0
6	28	23	2.02	4	1
7	21	15	2.74	1	0
8	24	17	2.83	4	1
9	27	17	3.24	3	0
10	28	17	2.88	2	0
11	25	18	2.74	2	0
12	27	19	2.69	1	0
13	25	18	2.7	2	0
14	25	17	2.77	2	0
15	29	20	2.87	2	0
16	28	20	2.58	2	0
17	28	21	2.56	2	0
18	31	23	2.68	2	0
19	40	32	3.63	25	19
20	24	12	4.48	2	0
21	37	25	4.18	21	11
22	No rocks	past end of cell			
23	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b.dat

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0
200 To 210 ft	0

210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0
770 To 780 ft	0

780 To 790 ft	27
790 To 800 ft	121
800 To 810 ft	0
810 To 820 ft	192
820 To 830 ft	369
830 To 840 ft	228
840 To 850 ft	62
850 To 860 ft	1
860 To 870 ft	0
870 To 880 ft	0
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 23
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 412
Initial Y-Base Starting Zone Coordinate: 411

Remarks: Slope along cross section A-A', blocks from toe of model 2B

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	600	411	610	407
2	.5	.83	.35	610	407	620	402
3	.5	.83	.35	620	402	630	398
4	.5	.83	.35	630	398	640	395
5	.5	.83	.35	640	395	650	392
6	.5	.83	.35	650	392	656	388
7	.5	.73	.4	656	388	666	388
8	.5	.83	.35	666	388	670	385
9	.5	.83	.35	670	385	678	383
10	.5	.83	.35	678	383	680	382
11	.5	.83	.35	680	382	690	379
12	.5	.83	.35	690	379	700	376
13	.5	.83	.35	700	376	710	374
14	.5	.83	.35	710	374	720	372
15	.5	.83	.35	720	372	730	368
16	.5	.83	.35	730	368	740	365
17	.5	.83	.35	740	365	750	362
18	.5	.83	.35	750	362	760	358
19	.5	.74	.45	760	358	770	331
20	.5	.74	.45	770	331	798	331
21	.5	.74	.45	798	331	805	311
22	0	.9	.5	805	311	990	311
23	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1

Ending Cell Number: 23
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 3 ft
Length: 6 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 1: X = 750, Y = 362

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	29.76	112865	0.12
75%	30.66	119147	5.47
90%	31.47	124797	10.28
95%	31.95	128189	13.17
98%	32.5	131996	16.41

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	33.65	Maximum:	1	Maximum:	143057
Average:	29.76	Average:	.3	Average:	112865
Minimum:	25.28	G. Mean:	.12	Std. Dev.:	9303
Std. Dev.:	1.33	Std. Dev.:	7.92		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 2: X = 785, Y = 331

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	46.01	236625	3
75%	51.86	280300	5.93

90%	57.12	319583	8.56
95%	60.28	343167	10.15
98%	63.82	369636	11.92

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	54.68	Maximum:	14.04	Maximum:	312328
Average:	46.01	Average:	5.17	Average:	236624
Minimum:	18.37	G. Mean:	3	Std. Dev.:	64684
Std. Dev.:	8.66	Std. Dev.:	4.34		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 3: X = 820, Y = 311

Total Rocks Passing Analysis Point: 1000

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	35.83	146081	3.1
75%	40.58	175586	6.02
90%	44.86	202124	8.64
95%	47.43	218056	10.22
98%	50.31	235937	11.99

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	44.03	Maximum:	15.46	Maximum:	204501
Average:	35.83	Average:	5.54	Average:	146081
Minimum:	16.27	G. Mean:	3.1	Std. Dev.:	43697
Std. Dev.:	7.04	Std. Dev.:	4.32		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	16	14	.73	0	0
2	22	19	.79	0	0
3	24	21	.82	1	0
4	25	22	.85	1	0
5	26	24	.86	1	0
6	30	27	1.32	3	1
7	24	20	1.32	1	0
8	26	22	2.11	4	2
9	29	23	1.88	4	0
10	30	24	2.05	3	0
11	29	25	1.43	1	0
12	30	26	1.38	1	0
13	29	26	1.33	1	0
14	30	26	1.34	1	0
15	33	29	1.44	2	0
16	34	29	1.24	1	0
17	34	30	1.33	1	0
18	36	32	1.39	2	0
19	42	38	2.14	24	21
20	30	24	2.36	1	0
21	31	26	2.61	21	18
22	No rocks	past end of cell			
23	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0
190 To 200 ft	0

200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	0
630 To 640 ft	0
640 To 650 ft	0
650 To 660 ft	0
660 To 670 ft	0
670 To 680 ft	0
680 To 690 ft	0
690 To 700 ft	0
700 To 710 ft	0
710 To 720 ft	0
720 To 730 ft	0
730 To 740 ft	0
740 To 750 ft	0
750 To 760 ft	0
760 To 770 ft	0

770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	0
830 To 840 ft	5
840 To 850 ft	254
850 To 860 ft	523
860 To 870 ft	208
870 To 880 ft	10
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

CRSP Input File -C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Input File Specifications

Units of Measure: U.S.
Total Number of Cells: 23
Analysis Point 1 X-Coordinate: 750
Analysis Point 2 X-Coordinate: 785
Analysis Point 3 X-Coordinate: 820
Initial Y-Top Starting Zone Coordinate: 412
Initial Y-Base Starting Zone Coordinate: 411

Remarks: Slope along cross section A-A', blocks from toe of model 2B

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.5	.83	.35	600	411	610	407
2	.5	.83	.35	610	407	620	402
3	.5	.83	.35	620	402	630	398
4	.5	.83	.35	630	398	640	395
5	.5	.83	.35	640	395	650	392
6	.5	.83	.35	650	392	656	388
7	.5	.73	.4	656	388	666	388
8	.5	.83	.35	666	388	670	385
9	.5	.83	.35	670	385	678	383
10	.5	.83	.35	678	383	680	382
11	.5	.83	.35	680	382	690	379
12	.5	.83	.35	690	379	700	376
13	.5	.83	.35	700	376	710	374
14	.5	.83	.35	710	374	720	372
15	.5	.83	.35	720	372	730	368
16	.5	.83	.35	730	368	740	365
17	.5	.83	.35	740	365	750	362
18	.5	.83	.35	750	362	760	358
19	.5	.74	.45	760	358	770	331
20	.5	.74	.45	770	331	798	331
21	.5	.74	.45	798	331	805	311
22	0	.9	.5	805	311	990	311
23	0	.9	.5	990	311	1000	309

CRSP Simulation Specifications: Used with C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Total Number of Rocks Simulated: 1000
Starting Velocity in X-Direction: 7.5 ft/sec
Starting Velocity in Y-Direction: 0 ft/sec
Starting Cell Number: 1

Ending Cell Number: 23
Rock Density: 142 lb/ft^3
Rock Shape: Cylindrical
Diameter: 5 ft
Length: 10 ft

CRSP Analysis Point 1 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 1: X = 750, Y = 362

Total Rocks Passing Analysis Point: 368

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	27.91	466270	0.02
75%	30.01	530604	6.21
90%	31.9	588469	11.79
95%	33.03	623209	15.13
98%	34.31	662198	18.89

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	34.09	Maximum:	.44	Maximum:	670022
Average:	27.91	Average:	.06	Average:	466270
Minimum:	9.96	G. Mean:	.02	Std. Dev.:	95281
Std. Dev.:	3.11	Std. Dev.:	9.18		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 2 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 2: X = 785, Y = 331

Total Rocks Passing Analysis Point: 366

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	43.46	1006319	1.87
75%	51.19	1261367	5.16

90%	58.14	1490766	8.12
95%	62.31	1628489	9.89
98%	67	1783059	11.89

Velocity (ft/sec)		Bounce Height (ft)		Kinetic Energy (ft-lb)	
Maximum:	53.98	Maximum:	12.38	Maximum:	1438184
Average:	43.46	Average:	3.52	Average:	1006319
Minimum:	10.36	G. Mean:	1.87	Std. Dev.:	377736
Std. Dev.:	11.45	Std. Dev.:	4.87		

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Analysis Point 3 Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Analysis Point 3: X = 820, Y = 311

Total Rocks Passing Analysis Point: 366

Cumulative Probability	Velocity (ft/sec)	Energy (ft-lb)	Bounce Ht. (ft)
50%	34.85	654552	2.35
75%	40.85	821874	5.63
90%	46.25	972370	8.58
95%	49.49	1062722	10.35
98%	53.13	1164127	12.34

Velocity (ft/sec)		Bounce Height (ft)			Kinetic Energy (ft-lb)	
Maximum:	43.87	Maximum:	15.97		Maximum:	940700
Average:	34.85	Average:	4.6	Average:	654552	
Minimum:	9.55	G. Mean:	2.35		Std. Dev.:	247811
Std. Dev.:	8.89	Std. Dev.:	4.86			

Remarks: Slope along cross section A-A', blocks from toe of model 2B

CRSP Data Collected at End of Each Cell - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

Velocity Units: ft/sec Bounce Height Units: ft

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	18	16	1.01	0	-1
2	22	16	6.14	0	0
3	24	19	4.85	0	0
4	25	20	3.4	0	0
5	26	21	3.92	0	0
6	30	25	5.03	2	0
7	23	19	2.45	1	0
8	26	20	2.59	3	2
9	29	22	3.21	2	0
10	30	23	3.16	2	0
11	29	24	2.51	1	0
12	29	24	2.65	0	0
13	29	24	3.14	0	0
14	29	24	3.65	0	0
15	33	26	4.36	1	0
16	33	27	2.84	1	0
17	34	28	3.11	0	0
18	37	30	3.16	1	0
19	43	36	2.48	23	20
20	30	24	3.52	1	0
21	31	26	3.01	21	18
22	No rocks	past end of cell			
23	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\CMB_WLA\ActiveProjects\1223 - PG&E Diablo Canyon\RockFall Analyses\CRSP Analyses\CrossSection A-A'\Model 2b\CrossSectionA-A'_Model2b_3x6footcylinder.doc

X Interval	Rocks Stopped
0 To 10 ft	0
10 To 20 ft	0
20 To 30 ft	0
30 To 40 ft	0
40 To 50 ft	0
50 To 60 ft	0
60 To 70 ft	0
70 To 80 ft	0
80 To 90 ft	0
90 To 100 ft	0
100 To 110 ft	0
110 To 120 ft	0
120 To 130 ft	0
130 To 140 ft	0
140 To 150 ft	0
150 To 160 ft	0
160 To 170 ft	0
170 To 180 ft	0
180 To 190 ft	0

190 To 200 ft	0
200 To 210 ft	0
210 To 220 ft	0
220 To 230 ft	0
230 To 240 ft	0
240 To 250 ft	0
250 To 260 ft	0
260 To 270 ft	0
270 To 280 ft	0
280 To 290 ft	0
290 To 300 ft	0
300 To 310 ft	0
310 To 320 ft	0
320 To 330 ft	0
330 To 340 ft	0
340 To 350 ft	0
350 To 360 ft	0
360 To 370 ft	0
370 To 380 ft	0
380 To 390 ft	0
390 To 400 ft	0
400 To 410 ft	0
410 To 420 ft	0
420 To 430 ft	0
430 To 440 ft	0
440 To 450 ft	0
450 To 460 ft	0
460 To 470 ft	0
470 To 480 ft	0
480 To 490 ft	0
490 To 500 ft	0
500 To 510 ft	0
510 To 520 ft	0
520 To 530 ft	0
530 To 540 ft	0
540 To 550 ft	0
550 To 560 ft	0
560 To 570 ft	0
570 To 580 ft	0
580 To 590 ft	0
590 To 600 ft	0
600 To 610 ft	0
610 To 620 ft	0
620 To 630 ft	353
630 To 640 ft	123
640 To 650 ft	73
650 To 660 ft	22
660 To 670 ft	1
670 To 680 ft	2
680 To 690 ft	6
690 To 700 ft	9
700 To 710 ft	4
710 To 720 ft	8
720 To 730 ft	14
730 To 740 ft	14
740 To 750 ft	3
750 To 760 ft	2

760 To 770 ft	0
770 To 780 ft	0
780 To 790 ft	0
790 To 800 ft	0
800 To 810 ft	0
810 To 820 ft	0
820 To 830 ft	4
830 To 840 ft	20
840 To 850 ft	96
850 To 860 ft	177
860 To 870 ft	66
870 To 880 ft	3
880 To 890 ft	0
890 To 900 ft	0
900 To 910 ft	0
910 To 920 ft	0
920 To 930 ft	0
930 To 940 ft	0
940 To 950 ft	0
950 To 960 ft	0
960 To 970 ft	0
970 To 980 ft	0
980 To 990 ft	0
990 To 1000 ft	0

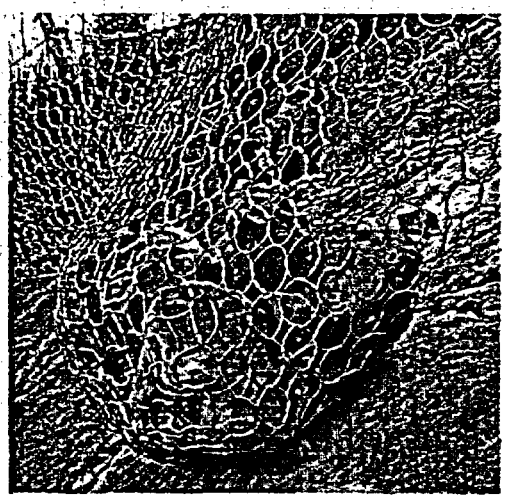
GEOBRUGG®

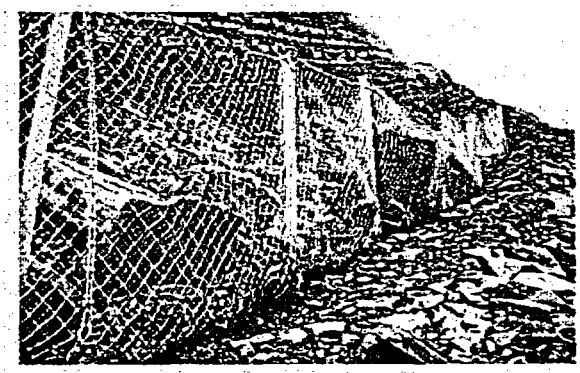
ROCKFALL PROTECTION

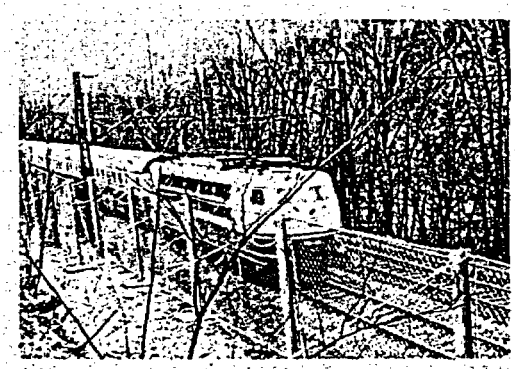
ROCKFALL PROTECTION

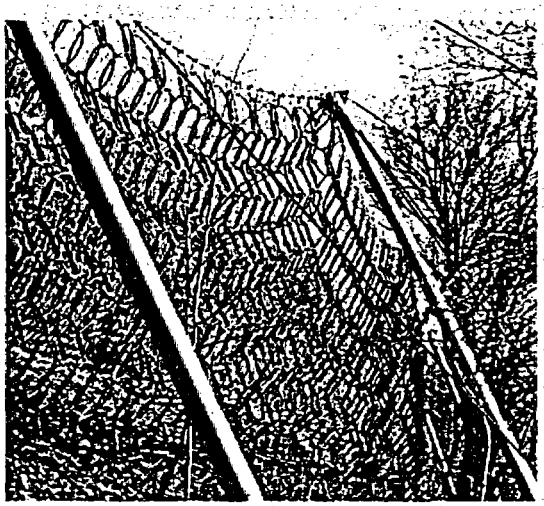
With the construction of overland transportation routes through vast areas of rough terrain, remote villages have found new neighbors. Trade and commerce has blossomed. With population growth more roads and raillines are constructed. These changes in the landscape and natural erosion sometimes have an adverse effect on the landmasses involved.

Potential dangers arise as rockfalls threaten the flow of traffic and the safety of the surrounding population.









Our specialists at GEOBRUGG have developed a series of safety systems in direct response to such potential dangers. One such system is the steel wire rope net, which is designed to absorb and retain rockfall.

All our safety systems at GEOBRUGG have been carefully designed and tested by our experts to ensure the highest standard of safety for you and the environment.

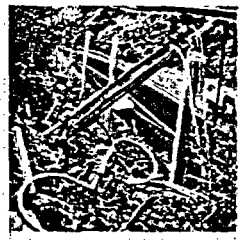
The appropriate system for dynamic loads:

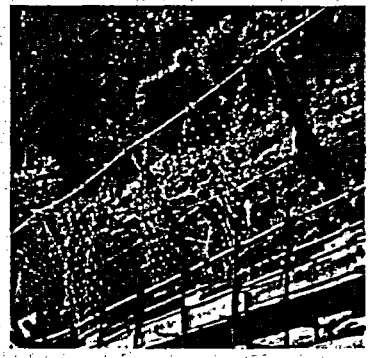
- Low energy range up to 75 kJ	low impact fence
- Medium energy range up to 1000 kJ	standard system
- High energy range up to more than 2000 kJ	special constructions

GEOBRUGG®

Profit from our expertise in:

- analysing potentially dangerous areas
- determining the degree of safety needs
- selecting the appropriate safety system for each problem
- delivery of the optimum safety system
- thorough supervision of construction projects by our experts

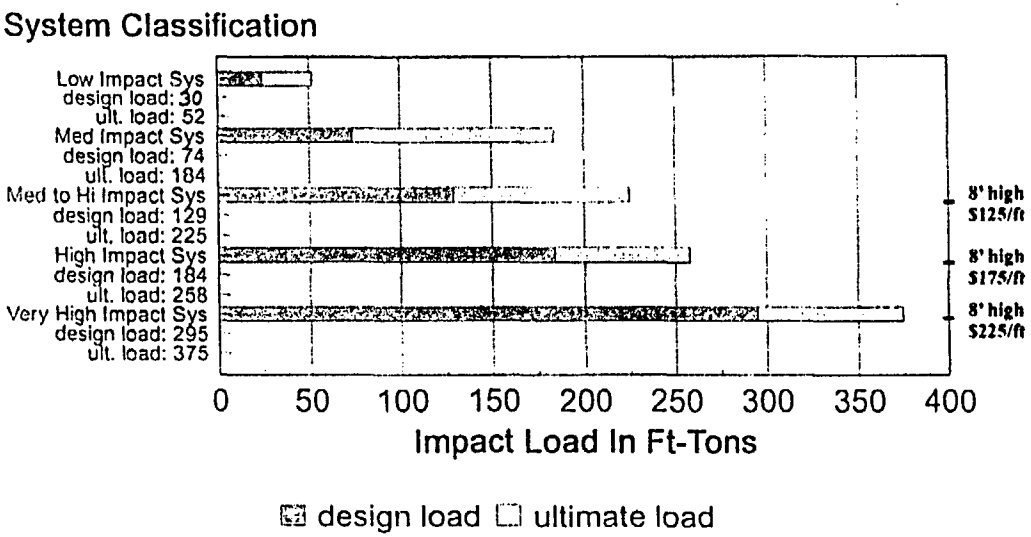




The experts at GEOBRUGG have greatly improved the rockfall protection systems, both in performance and maintenance needs as well as in construction and installation techniques. These advances have been achieved in part through the exchange of ideas and cooperation with various research institutes in the field. These advances will help conserve our natural environment well into the future. Our constant updating of techniques and materials have led to a cost efficient quality product providing a safe and sound environment for all to enjoy.

Brugg Cable Products, Inc.
11807 NE 99th Street, Suite 1160
Vancouver, WA 98682
Phone: (360) 253-3438
FAX: (360) 254-2522

Brugg Cable Products, Inc.
Rock Fall Retaining Systems
Impact Load Chart



As the system's design impact load is exceeded, the system's efficiency decreases and maintenance increases

Design and Ultimate values are based on field testing

BRUGG CABLE

WIRE ROPE PRODUCTS

STEEL WIRE ROPE SAFETY NET SYSTEMS: A BRIEF HISTORY OF APPLICATION TO ROCKFALL MITIGATION IN THE U.S.

TECHNICAL BULLETIN #4

STEEL WIRE ROPE SAFETY NET SYSTEMS: A BRIEF HISTORY OF APPLICATION TO ROCKFALL MITIGATION IN THE U.S.

Charles N. Yarnell
Sales & Marketing Manager
Brugg Cable Products, Inc.

ABSTRACT

Rockfall and debris flow can effectively be controlled by the application of steel wire rope net systems. Nearly a half century ago, Brugg Cable Products, Inc. recognized the advantages of wire rope netting for preventive structures and designed and installed the first wire rope safety net system for prevention of snow avalanches. Field testing of this net indicated that it can be alternatively used for protection against rockfall and debris flow. The main objective of continued development was to make full use of the flexibility of wire rope netting, its chief advantage over rigid-type systems. Over the years, numerous tests of rockfall protection systems have been performed in the factory and field, and a damping device was developed and added. Today, there are a wide variety of sophisticated protective netting systems available for a multitude of applications, including rockfall mitigation. These systems have been used extensively, our Company having over 1000 systems installed on a worldwide basis. Their introduction into the North American market has been progressing steadily from coast-to-coast.

A review of the approval, testing, design considerations, locations and performance of U.S. installations of wire rope safety net systems are presented with the hope that the information may contribute to reducing the dangers of rockfall and other hazards to our transportation system.

INTRODUCTION

Steel wire rope safety net systems used for rockfall mitigation evolved from the avalanche protection systems developed to protect Alpine villages in the 1950's. In the U.S., flexible safety nets to drape unstable rock faces, divert falling rock into catchment ditches, or as barrier fences to catch falling rock before entering traffic lanes, have been in-use as a remedial measure for only a few years.

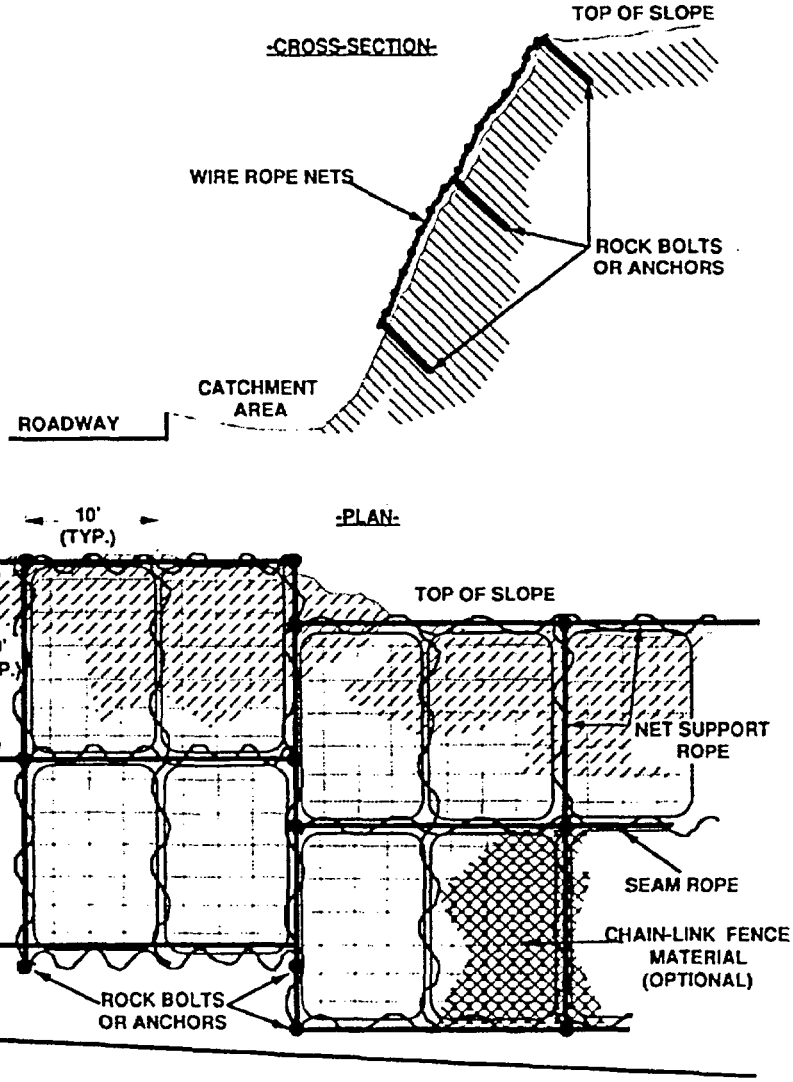
The basic system component, the wire rope safety net, is generally rectangular, although other geometric shapes can be, and have been, manufactured. The availability of a variety of sizes of steel wire rope (and the possibility of weaving in either a rectangular or diagonal manner), allows the designer to optimize the safety net for the particular service loads to be placed upon it. These loads can be either static or dynamic, which gives two general classifications of wire rope safety net application in rockfall mitigation: Slope Protection; and Rockfall Protection Barriers.

SLOPE PROTECTION

The steel wire rope safety net, due to its inherent strength and flexibility, can be used for draping large unstable rock faces and diverting rock slides, and in doing so, can control larger amounts of debris than previously used chain-link or gabion mesh materials. The increased static load handling capability compared to these other methods, results from both the anchorage's capacity (both shear and pull-out strength) as well as the larger diameter, steel wire rope used as a net support rope grid. The grid layout can vary from a single horizontal cable across the top of the slope to support the safety nets to a full horizontal and vertical net support rope grid around each safety net. (See Figure 1.)

Most of the U.S. applications of wire rope safety nets used or planned for slope protection to date, can be found in the Eastern United States. This may be the result of the limited rights-of-way along the transportation corridors, which preclude the use of other mitigation methods. However, wire rope safety nets can equally be used to control rock slopes of great height, such as those found in the Western United States, where the impact of a rockfall would exceed the rating of any barrier or catchment area.

FIGURE 1 - TYPICAL LAYOUT OF WIRE ROPE NETS USED FOR SLOPE PROTECTION



Applications

In the metropolitan New York City area, two different applications of wire rope safety nets have been installed on rock cuts in the Palisades formation. Rockfall from cuts in this highly fractured and jointed basaltic rock typically include a variety of different sized blocks. The third application is a rock slope in the Lehigh Gap in Eastern Pennsylvania

Metropolitan NYC Rail Line

The first application, a 1989 installation along a rail line, was composed of a total of 6,400 square feet of wire rope netting seamed to a 1/2" net support grid using 1/4" wire rope. Each net was 10' x 20' and was woven in a diagonal pattern to form 6" squares. The net support rope grid was attached to rock bolts spaced on 20 foot centers in two rows 40 feet apart along the face of the cut. Of particular interest is the black paint applied to the nets after fabrication to lessen the visual impact after installation. (See Figure 2.)

Figure 2 - Metro NY Rail Line

Sewage Treatment Plant

The second application, completed in March of 1991, involved draping 44,320 square feet of wire rope netting to the face of a vertical rock cut formed by the expansion of a sewage treatment plant located along the New Jersey side of the Hudson River. The nets were 8 ft. x 20 ft. each and woven in a rectangular pattern to form 6 in. squares. Rows of rock anchors, each 10 ft. to 20 ft. in length depending on location, were installed for the two-fold purpose of controlling large block fallout and attaching of the net support rope grid to the rock face. The grid in this case surrounds each net allowing large amounts of rock to be loaded upon the net(s) before maintenance cleaning would need to be performed. Chain-link material, under the netting, was also used along the crest for better control of the raveling already taking place at several locations. (See Figure 3.)

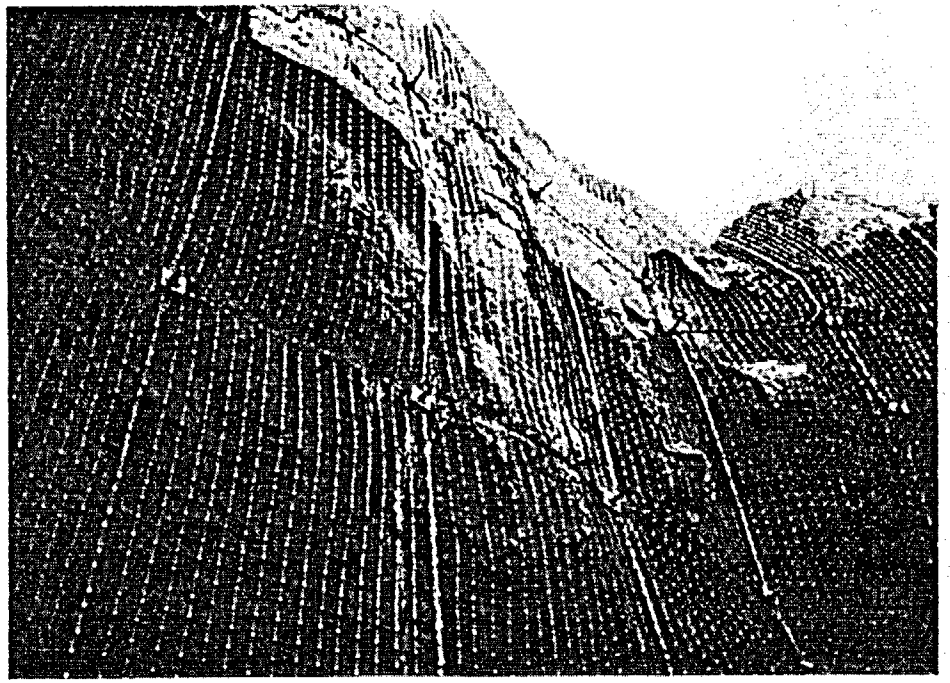


Figure 3 - Sewage Treatment Plant

Pennsylvania DOT

Completed in late 1991, 10 ft. x 20 ft. wire rope nets (rectangular weave, 12 in. square pattern) were installed on a rock slope as part of an emergency mitigation project along the Appalachian Trail in the Lehigh Gap (FA SR 248) in Eastern Pennsylvania. The area covered is 14,200 square feet with single net support ropes along the top and bottom of the area. Chain-link fence material was installed beneath the nets to prevent smaller rock and debris from coming through the netting. The nets are fastened to the net support ropes with seaming wire ropes, as is usual. (See Figure 4.)

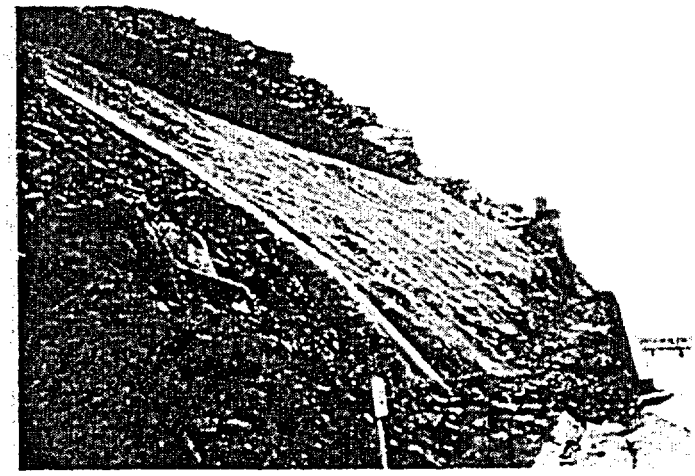


Figure 4 - Pennsylvania DOT

ROCKFALL PROTECTION BARRIERS

Rigid protective barriers constructed from heavy steel, timber, or concrete, if properly designed, can withstand rockfall effectively. However, repeated impacts from large kinetic forces will eventually damage rigid structures that will require expensive repair in the field. The wire rope safety net rockfall protection barrier, on the other hand, is a flexible structure capable of dissipating large amounts of kinetic energy.

The purpose of these barriers is to slow down and catch sporadically falling rock and rubble. Kinetic energy is absorbed by utilizing the flexible wire rope safety nets and equipping the support structure with damping devices to control the forces and stopping distances under extreme load conditions. The damping device, also called a braking device or element, is composed of a friction brake and wire rope loop that is activated only when the friction force reaches a pre set value during heavier than normal rockfall conditions. Smaller rocks are stopped without the braking element.

The dimensions of the barrier are determined by the maximum kinetic energy the system must absorb and the height of the fence is dictated by the jumping height of the rocks. Installation is rather simple due to the relatively lightweight components used to construct the barrier. (See Figure 5.)

Applications

Since the mid 1980's, wire rope rockfall protection systems have been installed in several parts of the U.S. and their popularity is growing. In fact, almost as many systems are being installed at present as have been installed in the past.

California Department of Transportation - Field Tests and Evaluation of Rockfall Restraining Nets

In the fall of 1989, the California Department of Transportation field-tested and evaluated rockfall restraining nets engineered to absorb and dissipate rockfall impact energies to a maximum of 74 foot-Tons. The nets were supplied by two different suppliers and constructed by Caltrans personnel. Test rocks weighing from 300 to 13,000 pounds were rolled down a 250-foot-long, 34-degree slope into the nets. The rolling rocks and their impacts were recorded on video and high-speed (16mm) film from four different locations along the slope for analysis.

Rockfall impact energy was calculated by adding translational kinetic energy and rotational kinetic energy. Over 80 tests were conducted and analyzed. From these tests, rock net energy dissipation characteristics were determined. On the basis of field performance and the energy analyses, modifications and adjustments to net design were made to reduce field maintenance. These nets stopped rocks delivering impact energies 1.5 to 2.5 times the design load without requiring more than acceptable levels of maintenance (Duffy and Smith, 1990). (See Figure 6 and 7.)

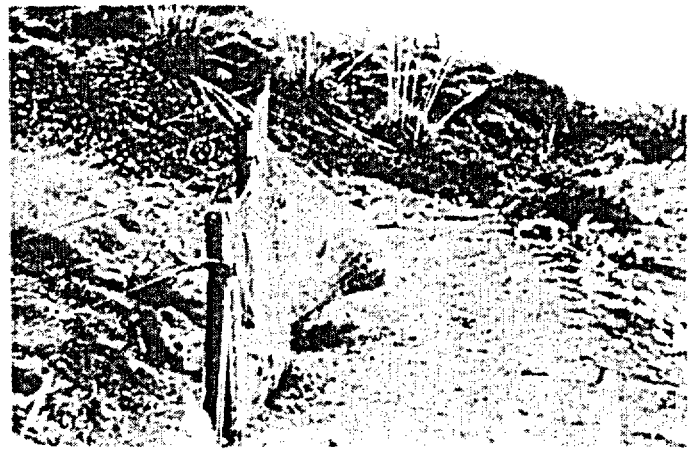
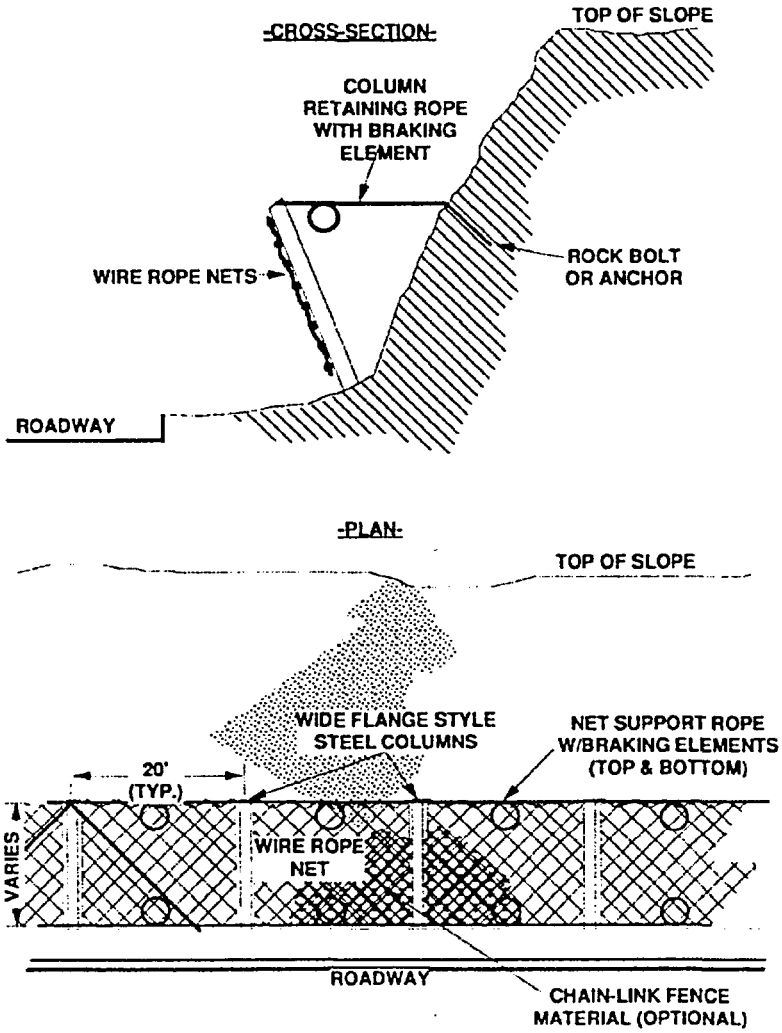


Figure 6 - CALTRANS Test (Brugg)

FIGURE 5 - TYPICAL LAYOUT OF WIRE ROPE NETS USED AS ROCKFALL BARRIER



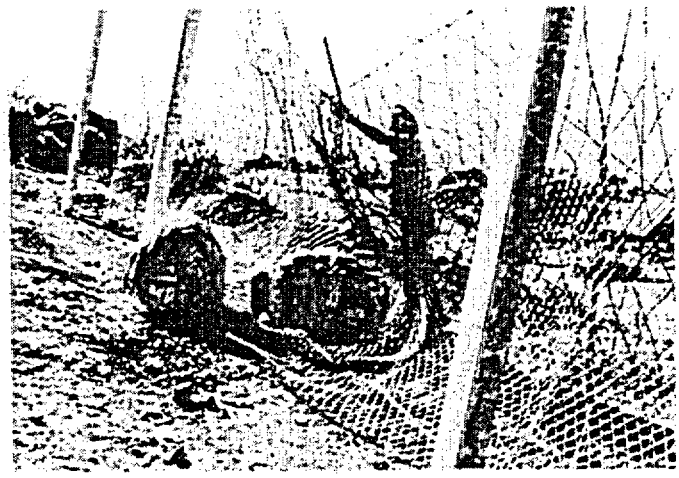


Figure 7 - CALTRANS Test (E)

Vail, Colorado

One of the first wire rope rockfall protection systems in the United States was installed in the Vail, Colorado area in 1985. Logically, man's expansion into previously uninhabited areas has increased the danger from rockfall and avalanche and consequently the risk to life and property.

The rockfall protection barriers are 240 ft. (height of 16.5 ft.) and 250 ft. (height of 10 ft.) in length stacked one above the other and each is capable of handling 22.5 foot-tons of impact energy. The nets used are diagonally woven for impact strength and have a mesh opening of 8 in. square. Columns are spaced at 16 ft. centers and there are no retaining wire ropes connected from these to the slope face. As will be seen, column retaining ropes are generally found when higher impact ratings are required. (See Figure 8.)

Figure 8 - Vail, Colorado

Grand Canyon - National Park Service

One of the few permanent structures located in the Grand Canyon National Park is the Roaring Springs Pump House. Rockfall from the surrounding terrain threatened to remove the "permanent" status of the pump house so proposals were prepared to add a rigid rock deflector fence to the side wall. Instead of a rigid fence, a flexible wire rope protection barrier was installed in the fall of 1989. Due to the remoteness of the site, this barrier was easy to transport and install because of its lightweight components. The barrier is constructed of nets 8 ft. in height, with mesh opening of 8 in. square, and a rating of 30 foot Tons impact (Thommen, 1989). (See Figure 9.)

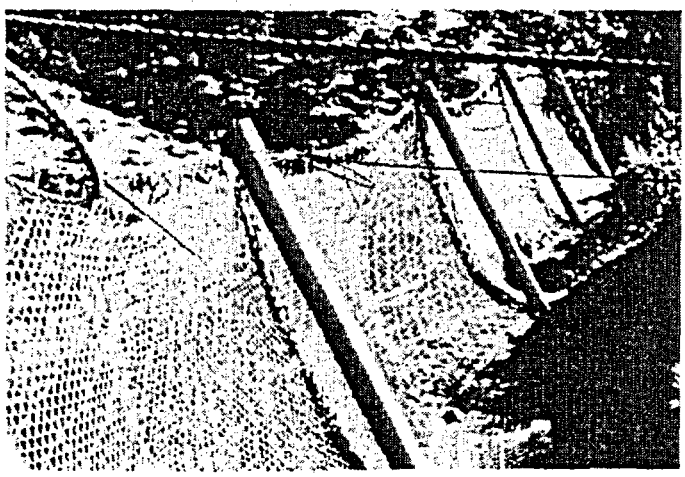


Figure 9 - Grand Canyon

New York State Thruway Authority - Harriman

Four rock slopes along the Palisades Interstate Parkway portion of the New York State Thruway presented conditions that made stabilization so expensive and disruptive of traffic that it became necessary to employ extensive protective measures. The high traffic volumes in this area made remedial efforts imperative and the limited right-of-way complicated the problem.

It was decided to construct a wall of sufficient height to create an adequate catchment area on the top of the backfill behind the wall. A wall-top fence system using a wire rope safety net/rockfall protection barrier was incorporated to both reduce the required height of the wall and stop splatter from rock falls (Cross, 1990).

The barrier was constructed using net heights of 12 ft. or 16 ft. and 20 ft. lengths, diagonally woven in an 8 in. square pattern. Chain-link fencing material was added to the rock slope side of the nets to retain smaller rock and debris. The barrier is set four feet back from the face of the wall to allow the fence to react under load without losing debris at the bottom. Angular nets were provided to match the elevation changes at intermediate and end points of the separate walls. Overall length of rockfall barrier was 5,360 feet and the project was completed in late 1990. (See Figure 10 and 11.)

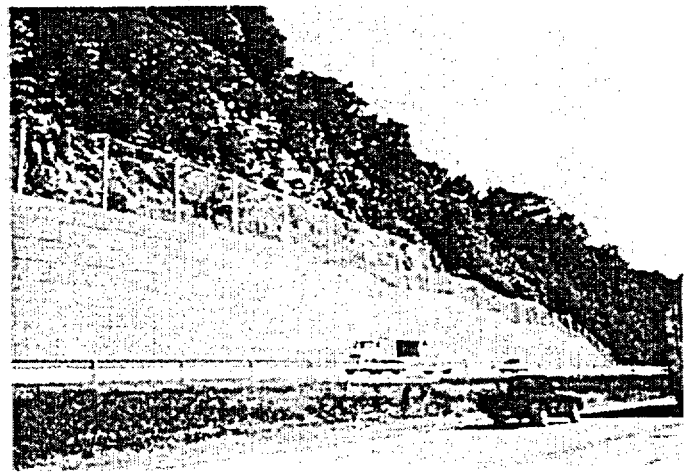


Figure 10 - NYS Thruway - Harriman

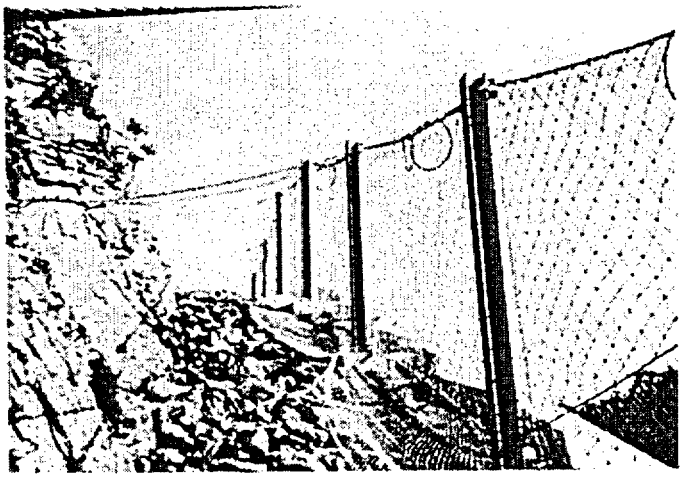


Figure 11 - NYS Thruway - Harriman

New York State Thruway Authority - A Design of a Temporary Reusable Rock Catchment Barrier (Patent Pending)

A number of recent projects along the New York State Thruway have required that traffic be maintained next to work zones where rock excavation was progressing. The geometry of the slopes along with an excavation sequence that requires multiple lifts has produced situations where material excavated from intermediate benches has to be dropped from substantial heights into relatively narrow catchment areas. A high level of risk of rock debris bouncing or splattering into active traffic lanes exists under these conditions. In most of the areas, high traffic volumes preclude the use of intermittent traffic shutdowns that would normally be employed. To resolve this problem a temporary, and reusable rock catchment system has been developed. This system has been designed to provide a level of security that allows the full range of activities on a rock excavation site, with the exception of blasting, to be conducted virtually unrestricted directly next to traffic. This system has been used successfully on three projects to date. Initial results indicate that actual performance greatly exceeds the design expectations (Cross (1991). (See Figure 12.)

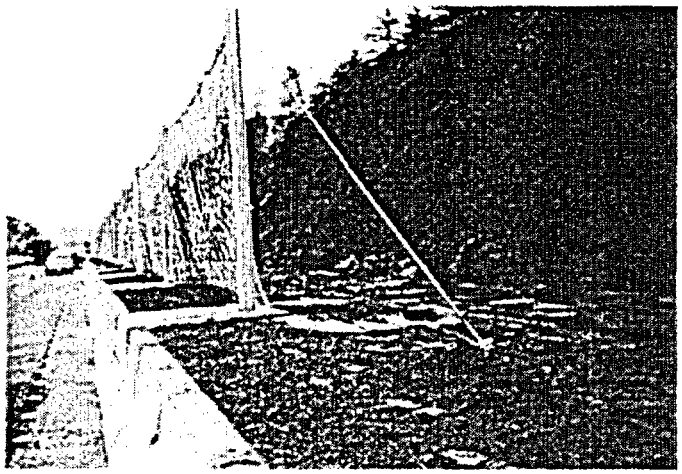


Figure 12 - NYS Thruway - Temporary Barrier

New Mexico - Manuelito Project

Installed in the fall of 1990, the New Mexico Highway & Transportation Department had a 256 ft. long rockfall protection barrier placed at their Manuelito job site. The 13.5 ft. high barrier is rated for a 130 foot-Ton impact, which necessitated a column spacing of 16 ft. center-to-center and a diagonally woven net with a 6 in. square pattern. As can be noted in Figure 11, pre-cast barrier is placed between the roadway and the rockfall barrier. Sufficient space must be allowed between the rockfall and pre-cast barriers for flexure of the nets when a rockfall impacts them. (See Figure 13.)

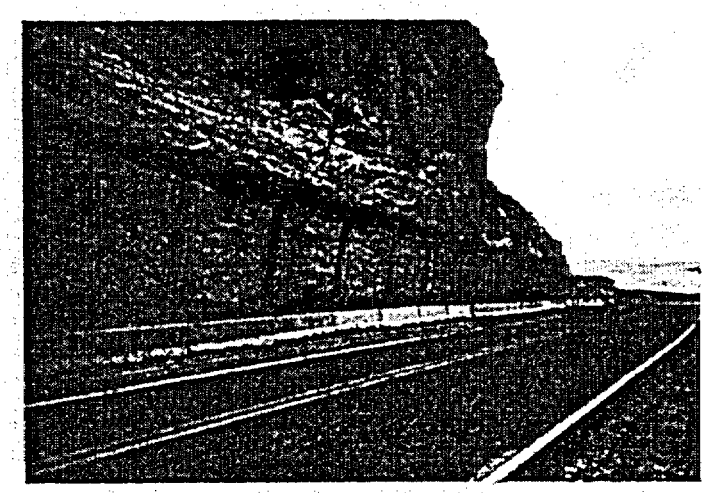


Figure 13 - NM Manuelito

Oregon State Highway Department - Shellrock Mountain

Along the Interstate, rockfall from a talus slope is being controlled in a catchment/fallout area behind a protective bin wall. However, unstable rock cliffs above the slope supply larger material, and even with the energy and velocity losses, the catchment area may be overloaded. Two solutions were considered: a barrier on top of the wall or a deceleration barrier up on the slope. The barrier on top of the wall was chosen for its economies of installation and maintenance.

Overall length of the barrier is 2,200 feet. Columns and nets were 6.5 ft. and 9 ft. in height to correspond to the varying height of the bin wall. This variation also necessitated the use of angular nets. The maximum impact rating of the 20 ft. long, 8 in. square mesh wire rope net barrier is 75 foot-Ton. (See Figure 14.)

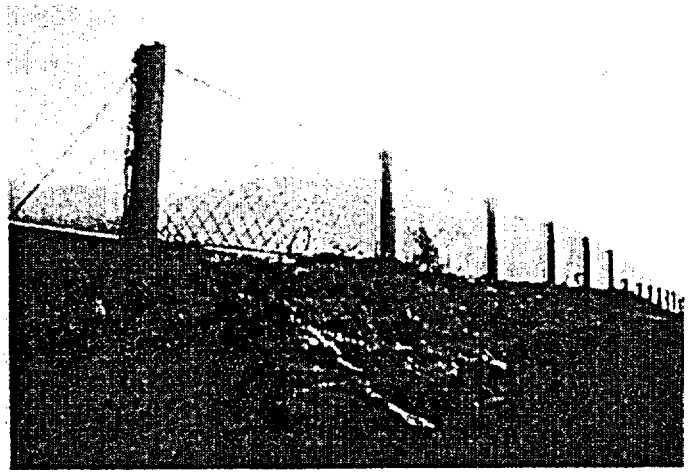


Figure 14 - Oregon Shellrock Mountain

Arizona Department of Transportation - Black Canyon/Sunset Point

One the projects constructed in the summer of 1991 is a 814 ft. long barrier along Interstate 17 north of Phoenix. Maximum impact rating is 60 foot-Ton for the 9 ft. high, 20 ft. long, 8 in. square mesh wire rope net barrier. Of particular interest are the three 18 ft. long "special" sections of barrier that have been designed for easy removal. This is to allow access through the pre-cast barrier and rockfall protective barrier for front-end loaders and other maintenance equipment used for the removal of rockfall build-up behind the barrier. Eventually, if not removed, this build-up of debris could form a jumping ramp for future rockfall. (See Figure 15.)

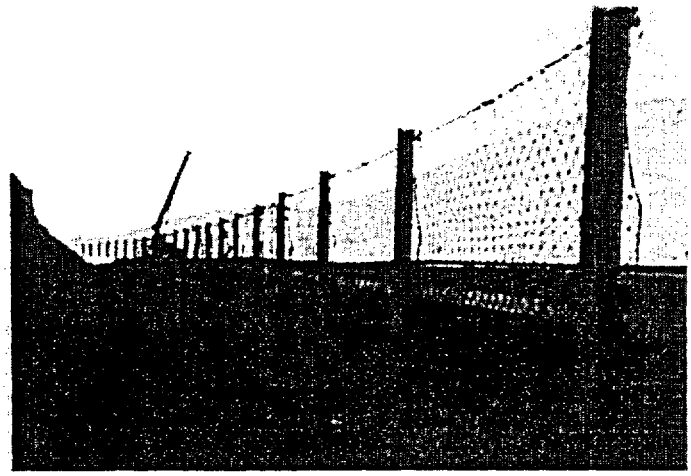


Figure 15 - ADOT Black Canyon/Sunset Point

New Mexico - Rio Arriba & Taos

NM 68 follows the Rio Grande River northward through Embudo Canyon on its way to Taos and the many tourist attractions located in that area. Of principal concern are the numerous rockfall occurrences along this highway. A portion of the rock cut has gabion mesh draped over the face and a 11.5 ft. high rockfall barrier is placed on the rock talus backslope above. Due to the varying elevation of the terrain over the approximately 3,000 ft. of barrier, a large number of angular nets are installed and the column-to-column spacing sometimes varies. Several large slide areas are also present that require installation of 40 ft. and 50 ft. net spans. Maximum impact rating is 105 foot-Tons. (See Figure 16.)

Figure 16 - New Mexico - Rio Arriba & Taos

Pennsylvania DOT

In conjunction with the slope protection nets mentioned earlier, 9.5 ft. x 20 ft wire rope nets (diagonal weave, 8 in. square pattern) are installed in a rockfall protective barrier system as part of the emergency mitigation project along the Appalachian Trail as it follows a path though the Lehigh Gap (PA SR 248) in Eastern Pennsylvania. The barrier is in three sections: two located along talus slide areas and one below a large rock outcrop that acts as a ramp. Maximum impact rating is 70 foot-Tons. (See Figure 17.)

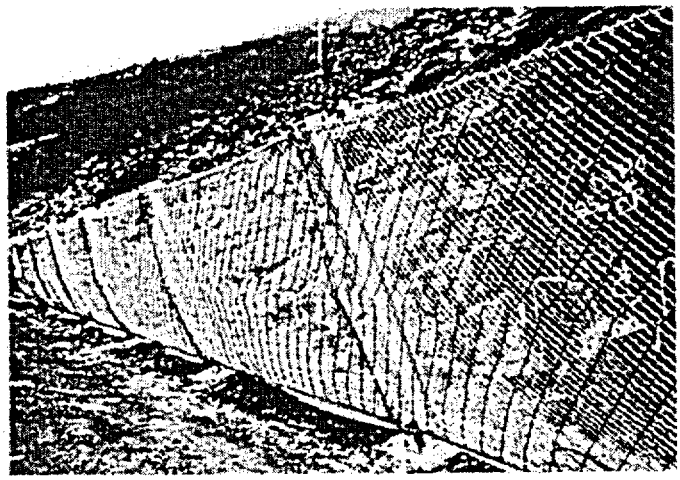


Figure 17 - Pennsylvania DOT

CONCLUSION

A review of the above applications reveal that rock slopes along the highways are receiving a good bit of attention. There is a saying: "Nothing draws attention like a good big mistake." Change the last word in the saying to "accident" and the reason for the public interest in highway rock slopes becomes evident.

It must be remembered that none of these systems can offer absolute protection. Every installation is designed to counter the most probable risks, according to certain criteria and statistical data such as: position of the object to be protected, ground conditions, steepness of slope, size of rocks, etc. The prevention of improbable extremes requires a disproportionate expenditure, but at reasonable cost it is possible to provide relatively good protection and reduce risk to an acceptable level.

References

Cross, Richard H. (1990), "Creating An Elevated Catchment Area Using A Precast Modular Wall System", Proceedings of the 41st Annual Highway Geology Symposium, August, 1990, Albuquerque, NM

Cross, Richard H. (1991), "A Design For A Temporary Reusable Rock Catchment Barrier", Proceedings of the 42nd Annual Highway Geology Symposium, May, 1991, Albany, NY

Duffy, John D.; and Smith, Duane D. (1990), Field Tests And Evaluation Of Rockfall Restraining Nets, CA/TL-90/05, Office of Transportation Materials and Research, California Department of Transportation, Sacramento, CA

Thommen, Robert A. (1989), "First Wire Rope Net Rockfall Protective Barrier Installed At The Grand Canyon National Park", Proceedings of the 40th Annual Highway Geology Symposium, May, 1989, Birmingham, AL

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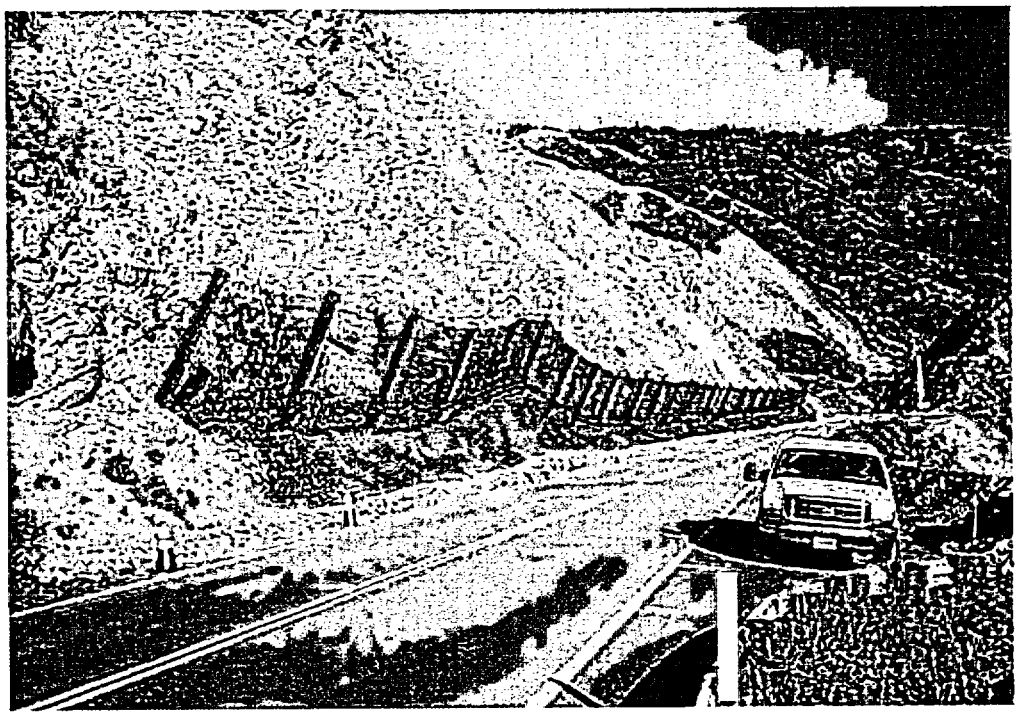
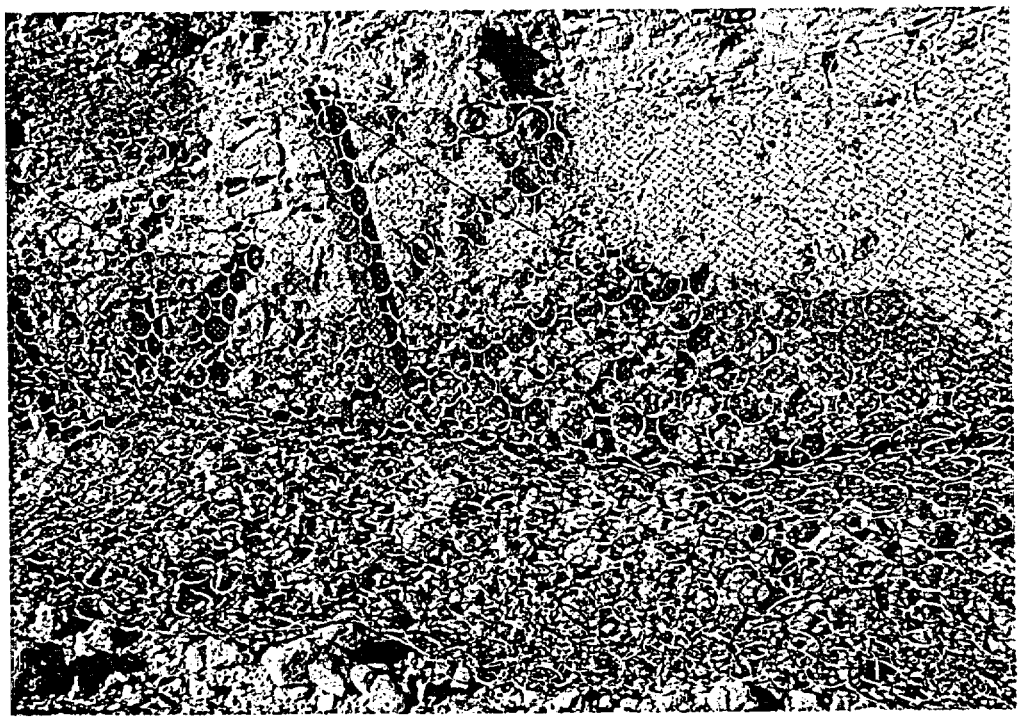
Note: This paper was presented during the Highway and Railroad Slope Maintenance Symposium, held in conjunction with the 34th Annual Meeting of the Association of Engineering Geologists in Chicago, Illinois, on October 2-3,1991.

GEOBRUGG®

Installed:	2002	System:	184 ft-ton with "net skirt"
Location:	Along U.S. 1, near Big Sur, CA	Owner:	CALTRANS
Project:	Big Creek		

4 meters high, 190 meters long. This barrier includes a "net skirt" that is attached to the bottom support rope of the barrier. The bottom cable guides are attached 0.5 meters off of the ground to allow rocks to move under the net skirt into the ditch at the side of the road. The bottom picture shows the impact of a small slide in November 2002 with the rocks moving under the net skirt into the ditch.

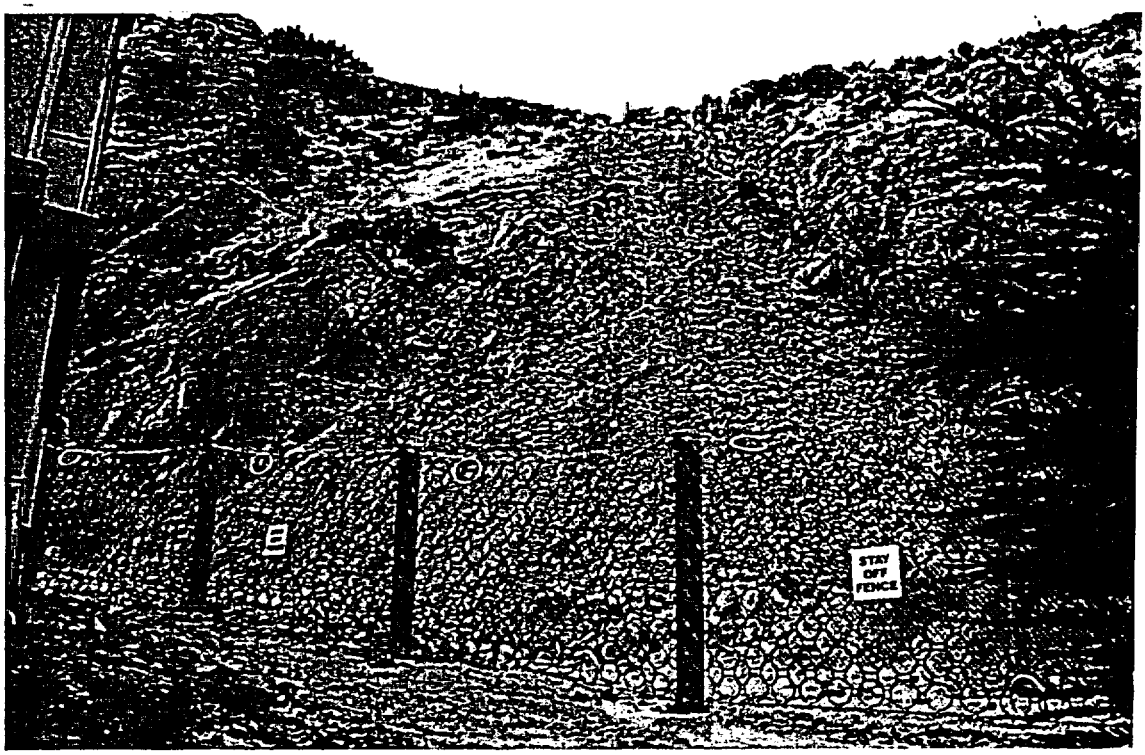


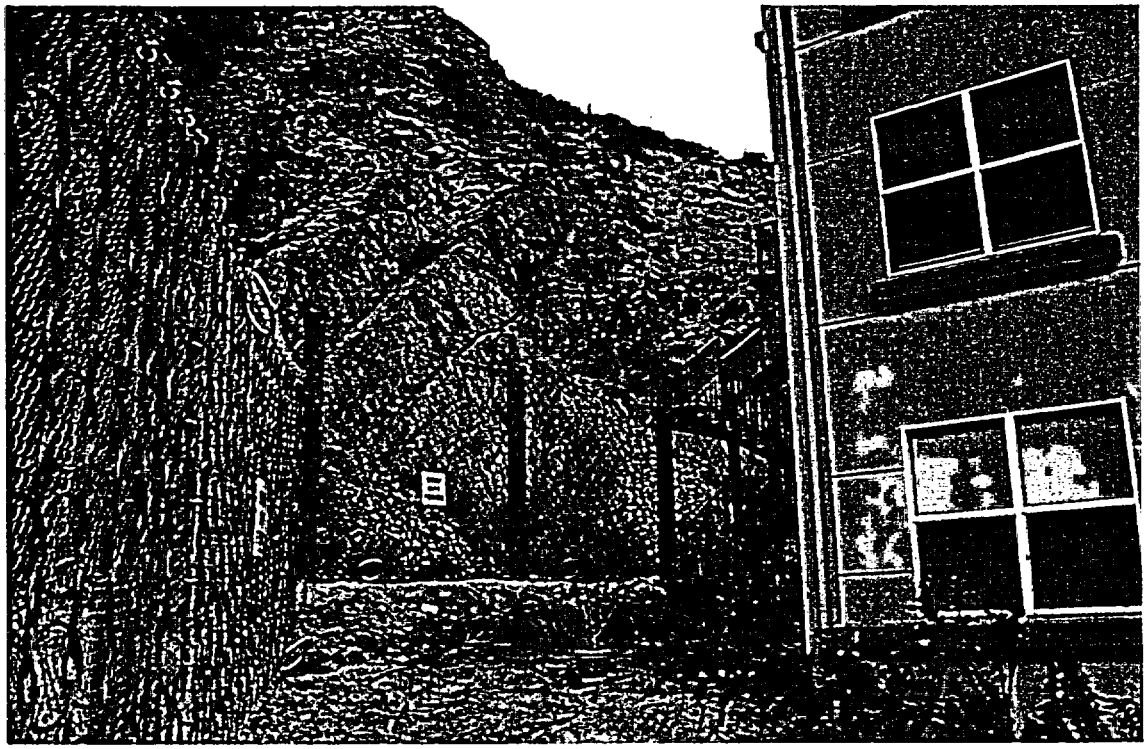


GEOBRUGG®

Installed:	2002	System:	129 and 295 ft-ton barriers
Location:	San Francisco, CA	Owner:	Citiscape Property Mgmt. Group
Project:	Stoneridge		

Height varies from 3.5 to 4.5 meters. Total length of 242 meters. These barriers were installed to protect a condiminium complex from a failing quarry wall.





GEOBRUGG®

GeoBrugg Rockfall & Debris Flow Protection Systems
California Installations to date

Southern California:

1) Gaviota State Park
   Location: Along highway 101 at Gaviota Pass and within Gaviota State Park. ~30 miles north of Santa Barbara.
   Description: Medium and High impact Rockfall Protection Barriers along and above the north and southbound lanes
   Owner: California Dep't of Transp. (Caltrans).
2) Laguna Canyon
   Location: Along the Laguna Canyon highway at Laguna Beach.
   Description: Debris Flow protection fence.
   Owner: California Dep't of Transp. (Caltrans)
3) Lamb Canyon
   Location: Along route 79 in Riverside County south of Beaumont.
   Description: Low Impact Rockfall Protection Barrier at ~PM 38.5, and net draping at ~PM 41.25.
   Owner: Caltrans & Riverside County.
4) The Grapevine
   Location: North of L.A. along the northbound lanes of I-5 just north of Fort Tejon, near the runaway truck escape ramp.
   Description: Low and High impact Rockfall Protection Barriers, and anchored Cable Net Draping.
   Owner: Caltrans
5) Foothills Blvd.
   Location: Along Foothills Blvd. at intersection with Riderwood (near Sunland Blvd.) on the north side of L.A.
   Description: Low impact Rockfall Protection Barriers.
   Owner: City of Los Angeles.
6) Los Angeles County Jail
   Location: 12500 Big Tujunga Road, Los Angeles.
   Description: Medium Impact Rockfall Protection Barrier.
   Owner: Los Angeles County
7) Eagle Rock Operations Center
   Location: Metro Water District, Eagle Rock Operations Center, LA.
   Description: Cable Net Draping.
   Owner: Metropolitan Water District.
8) Killen Trail
   Location: Along Killen Trail, just off of route 74 near the summit, south of Lake Elsinore.
   Description: Cable Net Draping.
   Owner: Riverside County Transportation Commission.
9) W. Palisades Drive
   Location: Along W. Palisades Drive, Pacific Palisades, CA.
   Description: Very High Impact Debris Flow Protection Barrier.
   Owner: Headlands Properties and City of Los Angeles.

GEOBRUGG®

10) Coachella Valley Water District
    Location: Lake Cahuilla State Park, Thermal, CA.
    Description: Cable Net Draping.
    Owner Coachella Valley Water District
11) State Route 18
    Location: Along S.R. 18 near San Bernardino, CA.
    Description: 74 & 180 ft-ton Rockfall Protection Barriers on slope above highway.
    Owner: Caltrans.
12) Cajon Subdivision
    Location: Along BNSF rail lines near Victorville, CA.
    Description: 74 ft-ton Rockfall Protection Barriers alongside rail lines.
    Owner: Burlington Northern Santa Fe Railroad.
13) Palm Springs Aerial Tramway
    Location: Palm Springs, CA
    Description: 74 ft-ton Rockfall Protection Barrier alongside the tramway.
    Owner: Palm Springs Aerial Tramway.
14) Woodward Road
    Location: Along Woodward Road in San Marcos, CA (near San Diego)
    Description: Cable net slope drape
    Owner: Ryland Homes
15) Lake Mathews
    Location: Near Lake Mathews in Riverside County
    Description: Tecco mesh slope drape
    Owner: Metropolitan Water District

Northern California:

16) Waddell Bluffs
    Location: Along highway 1, ~20 miles north of Santa Cruz, CA.
    Description: Medium Impact Rockfall Prot'n Barrier.
    Owner: California Dep't of Transp. (Caltrans)
17) Santa Cruz County rte. 9 near Felton
    Location: Along Santa Cruz County rte. 9 near Felton, at MP 4.
    Description: Medium Impact Rockfall Prot'n Barrier.
    Owner: Caltrans
18) Hwy. 1. at Monterey County
    Location: Along Hwy. 1, at MP 20.1 in Monterey County.
    Description: Rock Backfill Retaining Barrier
    Owner: Caltrans
19) Route 24 at Orinda
    Location: Along eastbound route 24 between Oakland & Walnut Creek.
    Description: High Impact Debris Flow Prot'n Barrier
    Owner: Caltrans
20) Ralston Powerhouse
    Location: At the Ralston powerhouse, east of Sacramento
    Description: Ring Net Slope Draping.
    Owner: PG & E

21) French Meadows Penstock
Location: near the Desolation Wilderness, west of Lake Tahoe at Hell Hole Reservoir.
Description: High Impact Rockfall Prot'n Barrier.
Owner: PG & E

22) Mosquito Canyon
Location: At Mosquito Bridge, north of Placerville, CA.
Description: High Impact Rockfall Prot'n Barrier, and Cable Net Draping.
Owner: Eldorado County D.O.T.

23) Union Valley Powerhouse
Location: Near Pollock Pines, off of Hwy. 50 east of Sacramento
Description: Medium Impact Rockfall Prot'n Barrier
Owner: Sacramento Municipal Utility District

24) Boulder Creek
Location: Along Santa Cruz County Rte. 9, near Boulder Creek, CA.
Description: Tecco Mesh System and 129 ft-ton Debris Flow Protection Barrier alongside the highway.
Owner: Caltrans.

25) Big Sur
Location: Along U.S. 1, near Big Sur, CA
Description: 129 ft-ton rock retaining barrier.
Owner: Caltrans

26) Stoneridge Estates
Location: Private development in Danville, CA (East Bay Area).
Description: 74 ft-ton Debris Flow Protection Barrier protecting homes.
Owner: Private Developer.

27) Terra Bay Woods
Location: Private development in South San Francisco, CA.
Description: 25 ft-ton Rockfall & Debris Flow Prot'n Barriers on slope protecting homes.
Owner: Private developer.

28) Rain Rocks
Location: Along U.S. 1, near Big Sur, CA
Description: Cable net slope drape.
Owner: Caltrans

29) Patrick Creek
Location: Along Rt. 199 near Patrick Creek, CA
Description: 74 ft-ton Rockfall Protection Barrier protecting highway
Owner: Caltrans

30) Cow Cliffs
Location: Along U.S. 1, near Big Sur, CA
Description: 180 ft-ton Rockfall Protection Barrier with ring net skirting below
Owner: Caltrans

31) Stone Ridge Condominiums
Location: near the Cow Palace in San Francisco
Desription: 129 and 295 ft-ton Rockfall Protection Barriers protecting condos
Owner: CitiScape Property Management Group

32) Confusion Hill
Location: Along U.S. 101 near Garberville, CA
Description: Cable net drape fence
Owner: Caltrans

33) South Fork
Location: Penstock access road off of Rt. 120 near Groveland, CA

Description: Cable net drape fence
Owner: Hetch Hetchy Water and Power