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Evaluation of the Relation between Seismic Input Energy and Spectral Velocity

Deprem Giriş Enerjisi İle Spektral Hız Arasındaki İlişkinin İrdelenmesi

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Abstract

Energy based seismic design concept is getting attention owing to its advantages over the conventional methodologies. Particularly, the consideration of duration and frequency content of the earthquake record are chief superiority of the concept. For this original design procedure, accurate determination of seismic input energy is crucially important. Because of solving energy balance equation is a tedious job, the seismic input energy is determined in terms of *equivalent velocity* in the literature mostly. However, it was also shown that this relation is valid for only undamped systems. Therefore, this study aims to provide the nonsteady relation between seismic input energy and equivalent velocity for damped systems. Intensive response history analyses were performed by using plenty of earthquake records those were selected by considering the impulsive characteristics (ordinary and pulse-like) and shear wave velocity. It was found that the relation given in the literature for seismic input energy and spectral velocity relation is not true for damped systems. Dependently, it is proposed a set of coefficients considering structural damping properties to modify the existing relation.

Keywords: *Input energy, Spectral velocity, Energy balance equation, Energy based seismic design.*

Öz

Deprem etkisine göre tasarım için önerilen enerji esaslı analiz yöntemleri sahip oldukları üstünlükler nedeniyle gün geçtikçe daha fazla ilgi görmektedir. Analizde depremin süresi ve frekans içeriğinin dikkate alınabiliyor olması bu tür yöntemlerin en önemli üstünlükleridir. Enerji esaslı analiz yöntemlerinin başarılı sonuç üretebilmesi için yapı sistemine giren deprem enerjisinin "doğru" tahmini önem taşımaktadır. Enerji denge denkleminin çözümüyle giren deprem enerjisini elde etmek zahmetli bir işlem olduğundan, bu büyüklük literatürde genellikle eşdeğer spektral hız cinsinden ifade edilmektedir. Bu ilişkinin sadece sönümsüz sistemler için geçerli olacağı literatürde tartışılmaktadır. Bu bağlamda, yapısal sönümün yapıya aktarılan deprem enerjisi ile eşdeğer hız arasındaki ilişkiye olan etkisi bu çalışmada araştırılmıştır. Çok sayıda deprem kaydı ve farklı sönüm özellikleri için zaman tanım alanında analizler gerçekleştirilmiştir. Deprem kayıtlarının seçiminde kayma dalgası hızı (V_{s30}) ve kayıt türü (sıradan ve darbe etkili) değişkenleri dikkate alınmıştır. Gerçekleştirilen analizler sonucunda, yapıya aktarılan deprem enerjisi ile eşdeğer spektral hız arasındaki ilişkinin farklı sönüm özellikleri için aynı olmadığı görülmüştür. Mevcut ilişki için yeni katsayılar önerilmiştir.

Anahtar Kelimeler: *Giren enerji, spektral hız, enerji denge deklemi, enerji esaslı sismik tasarım.*

1. Introduction

Current seismic design codes propose force and displacement-based analyses methods. The calculated representative horizontal loads are applied to story levels after reduced with a factor of *R.* This factor depends on predicted ductility level of the structure and material over-strength factor. The design is completed as structure resists to the reduced loads safely. However, the displacements and damage distribution are not certain in the procedure. Alternatively, displacement-based procedures were described as a comprehensive design method by several researches, [1]. Ultimate top displacement of the structure is predicted through the capacity curve and code-oriented acceleration spectrum. Strains on the structural members are able to be computed by the procedure and classified as proportional with the critical values. Nevertheless, the procedure disregards duration based cumulative damage and frequency content of the earthquake record, [2].

The developing seismic design concept namely *energy based seismic design* directly considers duration related cumulative damage, frequency content of earthquake record and hysteretic behavior of structural members. Moreover, energy is a scalar term whereas force and displacement are vectors. Therefore, it was mentioned that it will be a comprehensive design methodology in the near future, [1, 3]. The concept firstly introduced by Housner [4]. After that energy balance equation were derived by Akiyama [5] in time domain, Equation 1 where $\ddot{u}, \dot{u}, u$ and $\ddot{u}_g$ are relative acceleration, velocity, displacement of a single degree of freedom system (*SDOF*) and ground acceleration, respectively. The terms *m*, *c* and *f(u)* take part in the equation are also mass, damping and restoring force characteristics of the system, respectively. Left side of the equation stands for kinetic energy (E_k), damping energy (E_d) and strain energy (E_s), respectively. Right side of the equation is so-called as input energy (E_I).

$$m\int \ddot{u}\dot{u}dt + c\int \dot{u}^2 dt + \int f(u)\dot{u}dt = -m\int \ddot{u}_g \dot{u}dt \quad (1)$$

Uang and Bertero [6] derived absolute energy balance equation (Equation 2) and compared with the relative one. In the equation, $\ddot{u}_t$ and $\dot{u}_t$ are absolute acceleration and velocity of a *SDOF* system and u_g is displacement component of the earthquake record. The study concluded that the absolute and relative energy equations produce akin results for a constant ductility level.

$$\frac{m\dot{u}_t^{\,2}}{2} + c\int \dot{u}du + \int f(u)du = m\int \ddot{u}_t du_g \quad (2)$$

Since solution of the energy balance equation requires tedious computational efforts, some researchers proposed prediction equations and attenuation relations to determine input energy which is key term in the energy balance equation. Initially, Akiyama [5] utilized equivalent velocity (V_E) to predict the input energy, Equation 3 where *m* represents the mass.

$$\left(\frac{E_I}{m}\right)_{max} = \frac{V_E^2}{2} \quad (3)$$

Kuwamura and Galambos [7] computed V_E by considering dominant period (T_c) and intensity (I_e) of earthquake record, Equation 4. The intensity was determined by Equation 5.

$$V_E = \begin{cases} \dfrac{\sqrt{T_c I_e}}{2}\dfrac{1.2T}{T_c} & T \le T_c \\ \dfrac{\sqrt{T_c I_e}}{2} & T > T_c \end{cases} \quad (4)$$

$$I_e = \int \ddot{u}_g^2\, dt \quad (5)$$

Chai et al. [8] suggested a formulation for V_E based on the studies of Akiyama [5] and Kuwamura and Galambos [7], Equations 6-7 where PGV is peak ground velocity, PGA is peak ground acceleration and t_d is significant duration of the earthquake.

$$V_E = \Omega_V PGV \quad (6)$$

$$\Omega_V = \begin{cases} 1.2 \times 0.69 \left(\frac{PGA}{PGV} t_d\right)^{3/8} \frac{T}{T_c} & T \leq \frac{T_c}{1.2} \\ 0.69 \left(\frac{PGA}{PGV} t_d\right)^{3/8} & T > \frac{T_c}{1.2} \end{cases} \quad (7)$$

Several regression models were also derived to compute V_E in the literature, [2, 9-11].

Energy based design procedures were proposed for steel [12] and reinforcement concrete [13] structures. In these studies, input energy was predicted by using spectral velocity, Equation 8.

$$E_I = \frac{1}{2} m\, SV^2 \quad (8)$$

Similarly, Güllü et al. [14] predicted elastic input energy using spectral velocity (SV), structural period (T) and dominant period (T_C) of earthquake record, Equation 9.

$$E_I = 0.07 \frac{2g}{\pi} SV^2 \frac{T}{T_C} \quad (9)$$

Recently, Cheng et al. [15] proposed prediction equations for constant-strength and constant ductility input energy spectra. Energy equivalent velocity V_E was preferred in the study.

Input energy was computed by Equation 3 independent from the calculation method of V_E.

Güllü et al. [3] performed shake table tests on *SDOF* systems to obtain the input energy experimentally. The experimental results were compared with the predictions of V_E equations. It was shown that most of the equations under estimate input energy especially for near-fault type records. They concluded that discrepancy between the estimations of equations and the experimental results is related with damping property of the structure.

Most of the literature studies were performed by considering 5% damping ratio even Akiyama [5] proved that the relation (Equation 3) is valid for undamped systems.

In this paper, the relation between elastic relative input energy and spectral velocity is investigated for varying structural damping properties. The damping ratios of 0, 2, 5, 10, 20 and 40% were used. One thousand historical earthquake records were utilized to make comparisons between their input energy and spectral velocity counterparts.

Based on the results of the numerical study, new coefficients are proposed for Equation 3 to account structural damping properties.

2. Material and Method

The relation between seismic input energy per unit mass (E_I/m) and spectral velocity (SV) are discussed here for varying structural damping properties. Large number of historical records (1094) were gathered from PEER NGA database [16]. The important properties of the records are listed in Appendix 1. The records were used without scaling and grouped by considering shear velocity (V_{s30}) and impulsive characteristics. The classification of the records is seen in Table 1. There is limited number of records for the soils with V_{s30} parameters higher than 1500 m/s. It should be noted that only horizontal components of the earthquakes were considered in the study.

Table 1. The classification of the selected earthquake records.

***V_{s30}* (m/sec)**	***Ordinary Record***	***Pulse Like Record***	***Group No***
0-179	202	12	1
180-359	200	116	2
360-759	200	140	3
760-1499	200	10	4
>1500	8	6	5
Σ	810	284	
Σ	**1094**		

Energy balance equation for each earthquake record were solved by homemade software called as *PW-SPECTs*, [17-18]. The software uses a fully automatic genetic algorithm. Totally, 3.29×10^6 response history analyses (501 period × 1094 record × 6 damping ratios) were performed for this purpose. After the seismic input energy per unit mass (E_I/m) and velocity (SV) spectra were constructed for the records, *best-fit analyses* are performed for each group in Table 1 to identify the relation between E_I/m and SV spectra.

Some specific characteristics of the records such as relations between *Joyner-Boore distance* (R_{JB}), V_{s30}, Arias intensity I_a [19] and significant duration t_d [20] with moment magnitude (M_w) are shown in Figure 1.

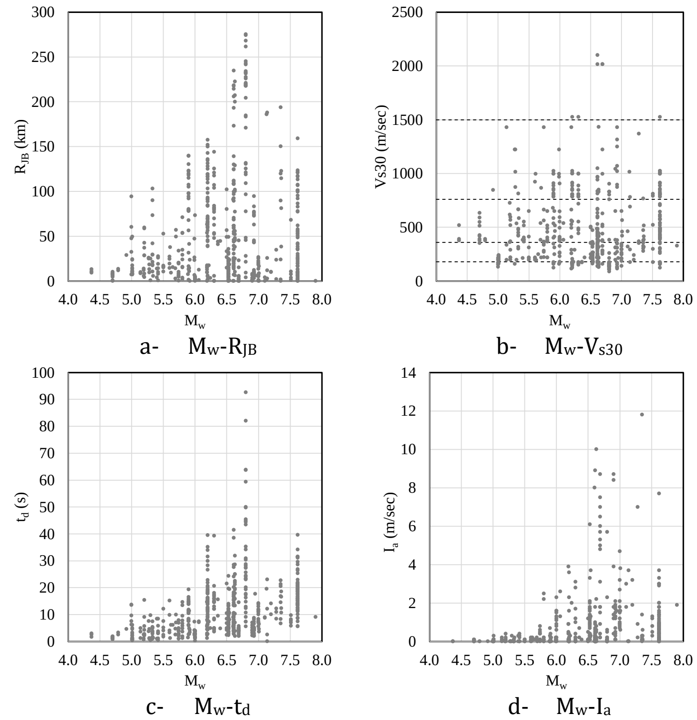

Figure 1. Some characteristics of the selected records.

3. Results

The achieved intensive response history analyses demonstrated that Equation 3 can be utilized for undamped systems. A similar evaluation was also made by Akiyama [5] depending on his closed form solutions.

E_I/m vs. SV relations obtained from the performed analyses were exemplified in Figures 2-5. The coefficients obtained from the analyses are collected in Table 2 for all cases.

Average value of coefficients was determined as 0.521 and 0.508 for ordinary and pulse-like records in undamped systems, respectively.

The coefficient of 0.5 in Equation 3 is not appropriate for damped systems, see Figures 2-5. It tends to increase with rising of damping, see Table 2. Because of the results deviate in a large range in high-damped systems (10% and more), the quadratic equation produces unsatisfactory approximations, see Figures 4e and 4f.

Since energy content of pulse like records is larger, the coefficients obtained for them are also larger. For instance, the pulse like records have a coefficient of 1.786 where the ordinary records' coefficient is 1.051 in the case of ξ=10%.

The data about pulse-like earthquakes is very limited in the databases. Dependently, the coefficients for pulse-like earthquakes were obtained from very limited number of records for some cases.

In addition to E_I/m vs. SV relation, damping effect on E_I/m was also discussed in this paper. Although several researchers concluded that damping scarcely effect input energy [21-25], recent studies [3, 18, 26-28] proved the opposite judgement.

In this study, input energies of the records computed for the considered damping ratios (0, 2, 5, 10, 20 and 40%) were scaled to the input energy generated for 5% damping, Fig. 6. The figure consists of the graphics representing damping vs. E_I/m relations for all the groups (grey solid lines). The average of the results is also shown on the figure with black dashed lines. It is realized that the effect of damping on E_I/m is significant. For instance, E_I/m of an undamped system is 2.5 times larger than the 5% damped system.

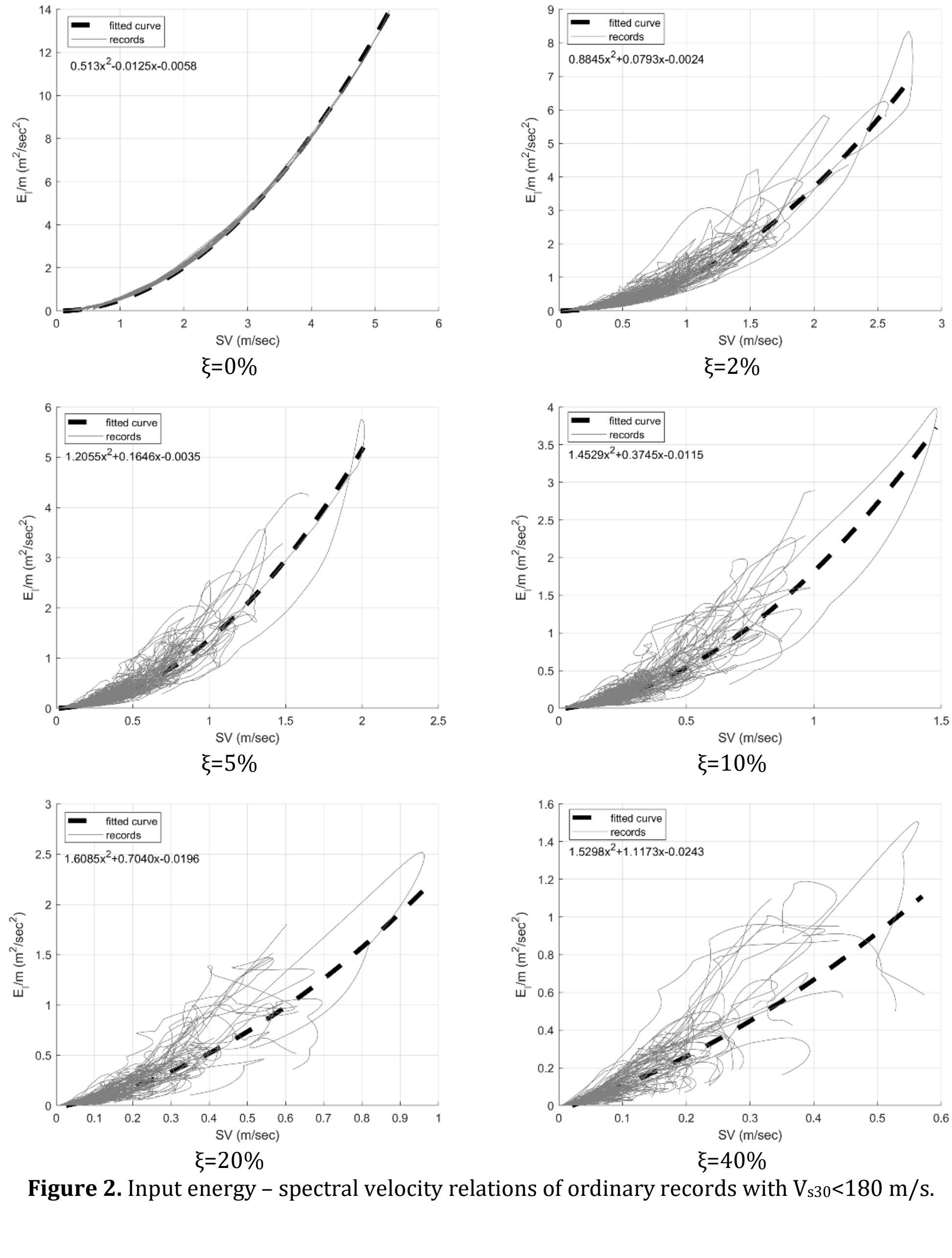

Figure 2. Input energy – spectral velocity relations of ordinary records with V_{s30}<180 m/s.

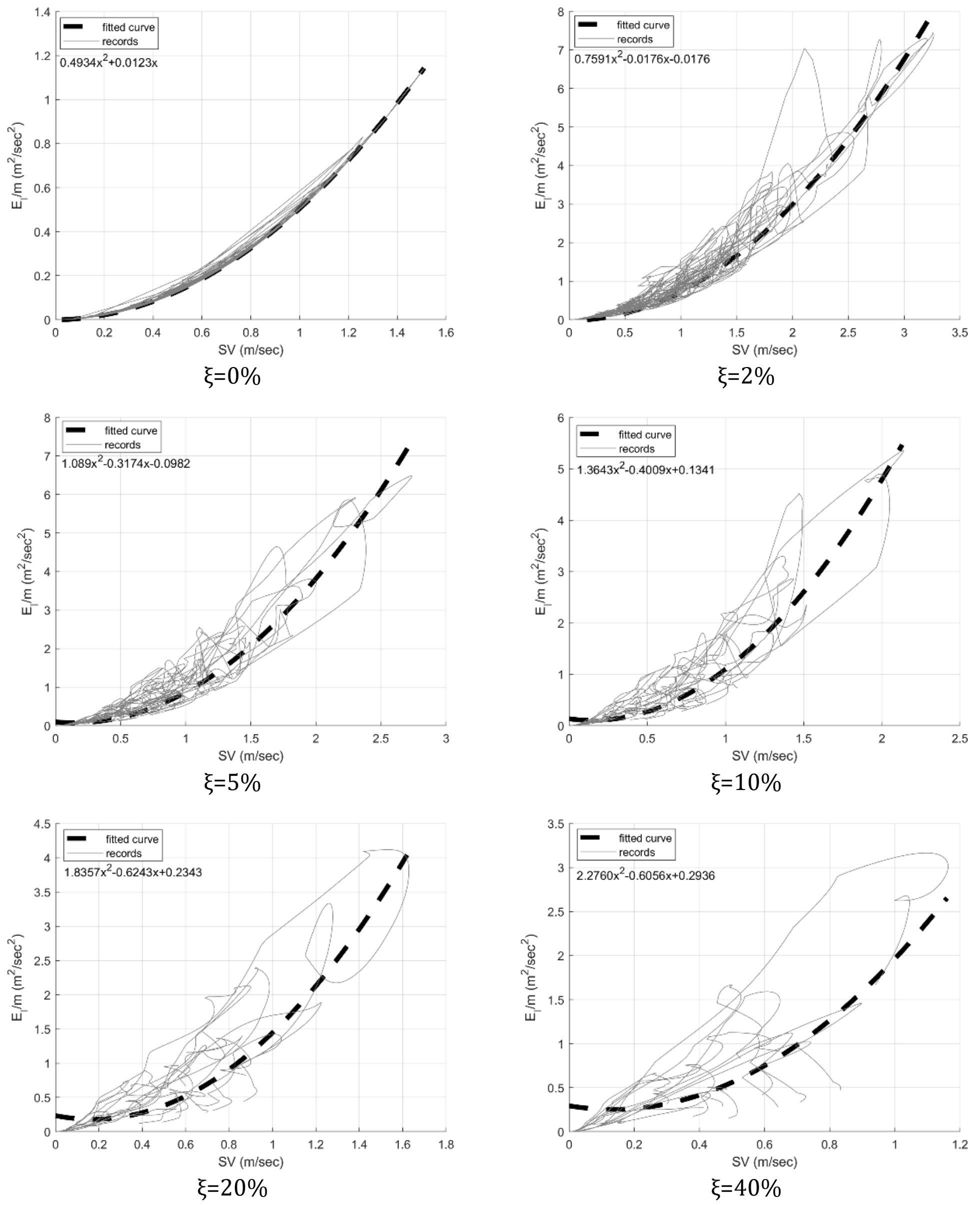

Figure 3. Input energy – spectral velocity relations of pulse-like records with V_{s30}<180 m/s.

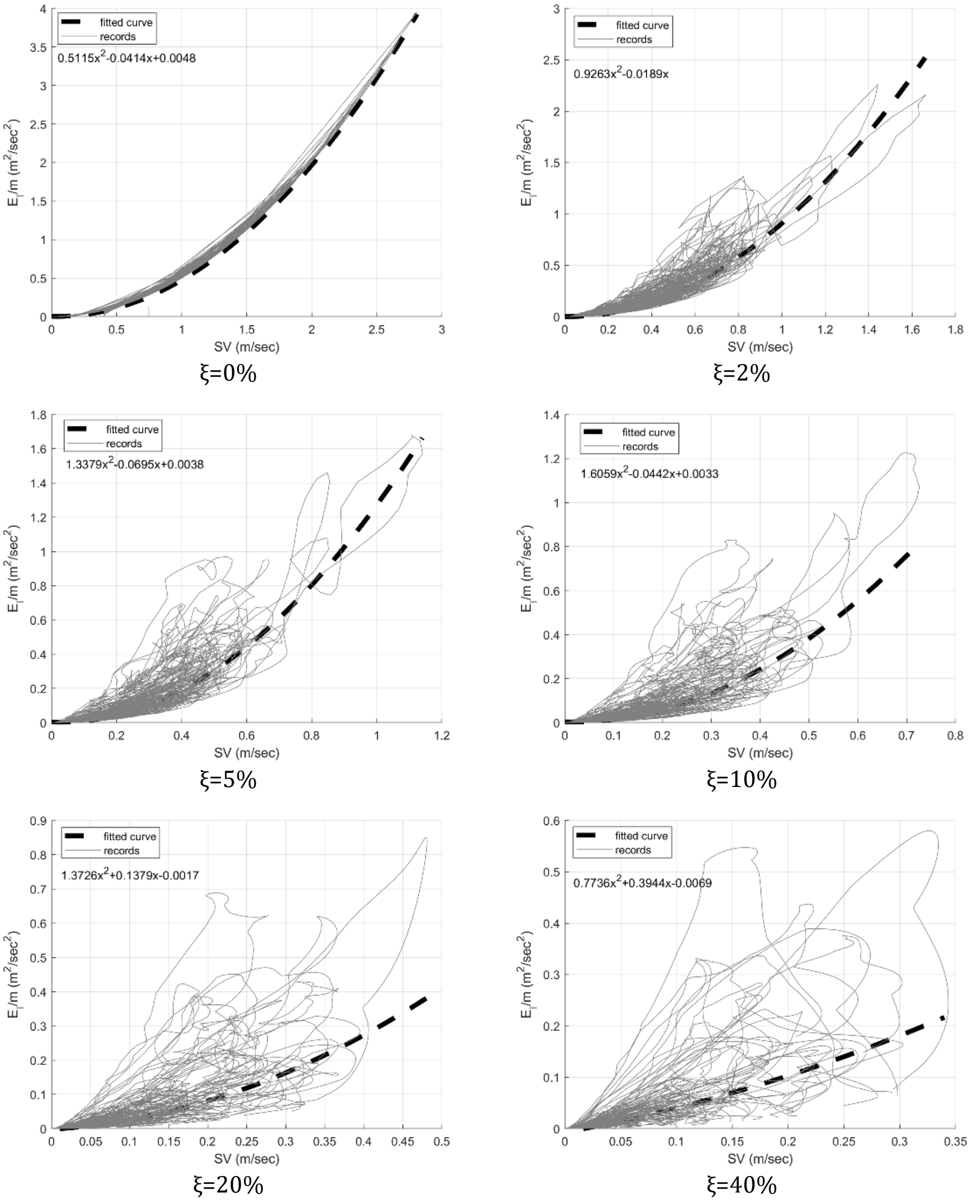

Figure 4. Input energy – spectral velocity relations of ordinary records with $360<V_{s30}<760$ m/s.

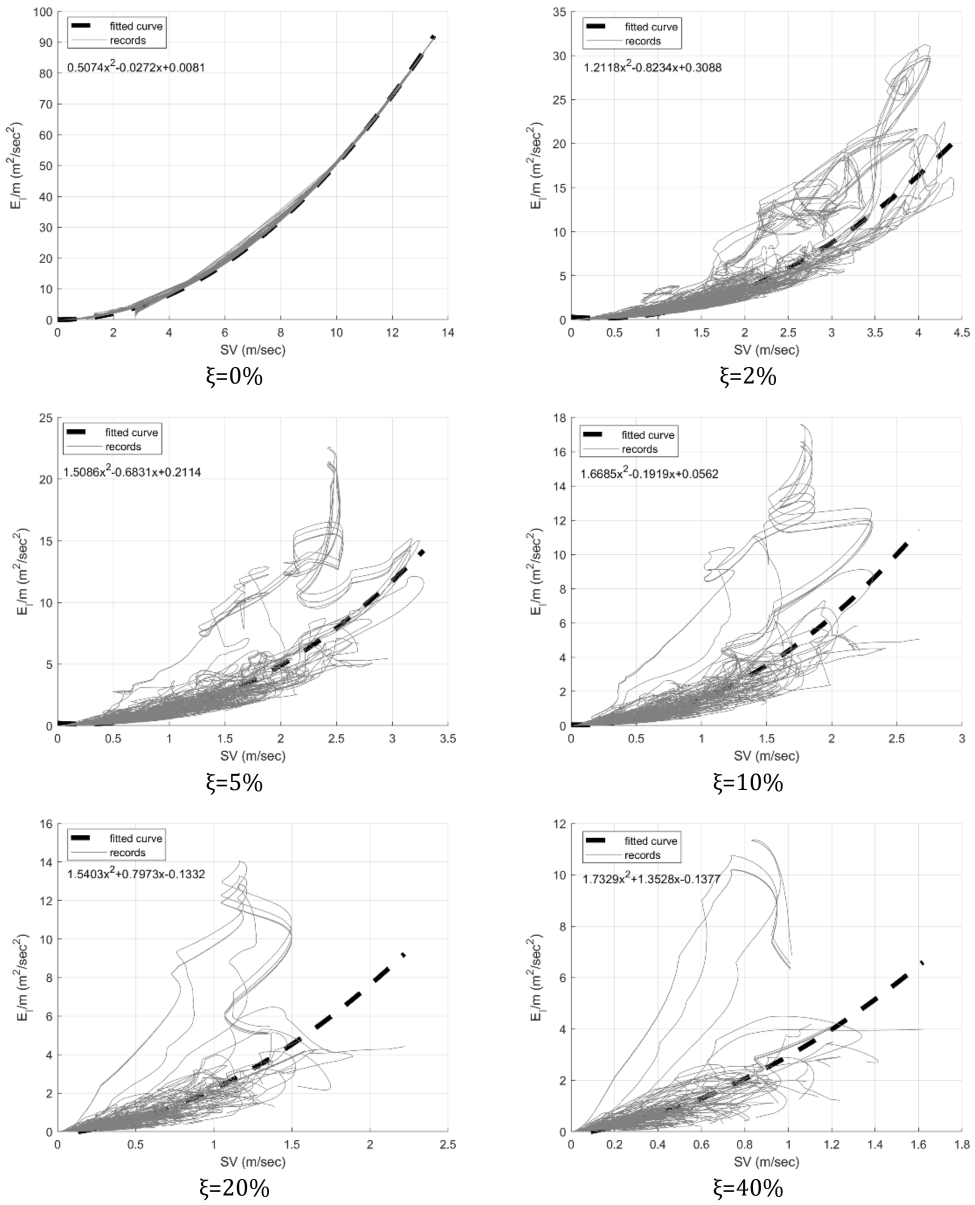

Figure 5. Input energy – spectral velocity relations of pulse-like records with 360<V_{s30}<760 m/s.

Table 2. Coefficients for *E_I/m-SV* relation.

Ordinary						Pulse-like						Gr
0%	2%	5%	10%	20%	40%	0%	2%	5%	10%	20%	40%	**ξ**
0.513	0.885	1.206	1.453	1.609	1.530	0.493	0.759	1.089	1.364	1.836	2.276	1
0.580	0.807	0.760	0.583	0.300	0.280	0.541	1.202	1.934	3.323	5.123	6.209	2
0.512	0.926	1.338	1.606	1.373	0.774	0.507	1.212	1.509	1.669	1.540	1.733	3
0.503	0.623	0.712	0.804	0.852	1.013	0.498	1.021	1.248	1.321	1.817	2.373	4
0.498	0.719	0.814	0.809	0.653	0.531	0.501	0.893	1.174	1.251	1.026	0.314	5
0.521	0.792	0.966	1.051	0.957	0.826	0.508	1.017	1.391	1.786	2.268	2.581	**Avr**

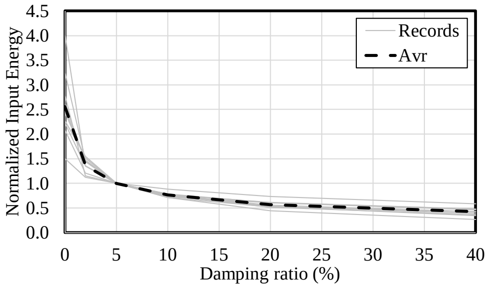

Figure 6. Variation of input energy by damping ratio.

4. Discussion and Conclusion

Energy equivalent velocity equation given in Equation 3 is generally preferred to calculate seismic input energy. It was evaluated by extensive response history analyses for the earthquakes with different characteristics and structural damping properties in this paper. Following results can be concluded:

- The equation is indisputably valid for undamped systems.
- For the damped systems, it is obtained new coefficients for the equation those vary in the range of 0.508-2.578. However, equivalent parameters should not be utilized for the systems that damped higher than 5%.
- The obtained coefficients for the equation tend to increase with rising of damping.
- The deviations between the results of the numerical analyses and estimations of the quadratic relation are increasing for larger damping ratios.
- The deviation is larger for pulse-like records in general.
- The quadratic equation even with the modified coefficient cannot represent the E_I/m vs. SV relation for high-damped systems.
- Damping is extremely effective on E_I/m.

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Appendix 1. Important properties of the selected records.

RSN	Earthquake	M_w	R_{jb} (km)	V_{s30} (m/s)
1	"Helena_ Montana-01"	6	2.07	593.35
2	"Helena_ Montana-02"	6	2.09	551.82
3	"Humbolt Bay"	5.8	71.28	219.31
4	"Imperial Valley-01"	5	32.44	213.44
5	"Northwest Calif-01"	5.5	52.73	219.31
6	"Imperial Valley-02"	6.95	6.09	213.44
7	"Northwest Calif-02"	6.6	91.15	219.31
8	"Northern Calif-01"	6.4	44.52	219.31
9	"Borrego"	6.5	56.88	213.44
10	"Imperial Valley-03"	5.6	24.58	213.44
11	"Northwest Calif-03"	5.8	53.73	219.31
12	"Kern County"	7.36	114.62	316.46
13	"Kern County"	7.36	122.65	415.13
14	"Kern County"	7.36	81.3	514.99
15	"Kern County"	7.36	38.42	385.43
16	"Northern Calif-02"	5.2	42.69	219.31
17	"Southern Calif"	6	73.35	493.5
18	"Imperial Valley-04"	5.5	15.11	213.44
19	"Central Calif-01"	5.3	25.11	198.77
20	"Northern Calif-03"	6.5	26.72	219.31
21	"Imperial Valley-05"	5.4	13.78	213.44
22	"El Alamo"	6.8	121	213.44
23	"San Francisco"	5.28	9.74	874.72
24	"Central Calif-02"	5	7.28	198.77
25	"Northern Calif-04"	5.7	56.94	219.31
26	"Hollister-01"	5.6	19.55	198.77
27	"Hollister-02"	5.5	17.2	198.77
28	"Parkfield"	6.19	17.64	408.93
30	"Parkfield"	6.19	9.58	289.56
31	"Parkfield"	6.19	12.9	256.82
32	"Parkfield"	6.19	63.34	493.5
33	"Parkfield"	6.19	15.96	527.92
34	"Northern Calif-05"	5.6	27.36	219.31
35	"Northern Calif-06"	5.2	37.11	198.77
36	"Borrego Mtn"	6.63	45.12	213.44
37	"Borrego Mtn"	6.63	222.42	316.46
38	"Borrego Mtn"	6.63	199.84	217.92
39	"Borrego Mtn"	6.63	207.14	415.13
40	"Borrego Mtn"	6.63	129.11	442.88
41	"Lytle Creek"	5.33	103.23	450.28
42	"Lytle Creek"	5.33	21.33	477.22
43	"Lytle Creek"	5.33	17.4	813.48
44	"Lytle Creek"	5.33	29.18	301.95
45	"Lytle Creek"	5.33	18.39	667.13
46	"Lytle Creek"	5.33	73.46	316.46
47	"Lytle Creek"	5.33	90.25	425.34
48	"Lytle Creek"	5.33	29.49	421.44
49	"Lytle Creek"	5.33	42.14	667.13
50	"Lytle Creek"	5.33	10.7	486
51	"San Fernando"	6.61	55.2	280.56
52	"San Fernando"	6.61	173.16	360.45
53	"San Fernando"	6.61	111.88	241.41
54	"San Fernando"	6.61	214.32	338.54
55	"San Fernando"	6.61	111.37	385.69
56	"San Fernando"	6.61	61.79	235
57	"San Fernando"	6.61	19.33	450.28
58	"San Fernando"	6.61	92.25	477.22
59	"San Fernando"	6.61	89.37	813.48
60	"San Fernando"	6.61	217.54	184.75
61	"San Fernando"	6.61	218.17	256.82
62	"San Fernando"	6.61	96.81	301.95
63	"San Fernando"	6.61	25.58	634.33
64	"San Fernando"	6.61	59.52	394.18
65	"San Fernando"	6.61	43.95	308.35
66	"San Fernando"	6.61	139.14	328.09
67	"San Fernando"	6.61	130	591
68	"San Fernando"	6.61	22.77	316.46
69	"San Fernando"	6.61	58.99	217.92
70	"San Fernando"	6.61	22.23	425.34
71	"San Fernando"	6.61	13.99	602.1
72	"San Fernando"	6.61	19.45	600.06
73	"San Fernando"	6.61	17.22	670.84
74	"San Fernando"	6.61	193.25	303.79
75	"San Fernando"	6.61	108.56	443.85
76	"San Fernando"	6.61	109.01	441.25
77	"San Fernando"	6.61	0	2016.13
78	"San Fernando"	6.61	24.16	452.86
79	"San Fernando"	6.61	25.47	415.13
80	"San Fernando"	6.61	21.5	969.07
81	"San Fernando"	6.61	35.54	529.09
82	"San Fernando"	6.61	68.84	248.98
83	"San Fernando"	6.61	52.64	421.44
84	"San Fernando"	6.61	205.77	354.06
85	"San Fernando"	6.61	108.01	459.37
86	"San Fernando"	6.61	124.79	442.88
87	"San Fernando"	6.61	30.7	667.13
88	"San Fernando"	6.61	24.69	389
89	"San Fernando"	6.61	61.75	669.48
90	"San Fernando"	6.61	124.38	322.42
91	"San Fernando"	6.61	61.72	487.23
92	"San Fernando"	6.61	68.38	347.67
93	"San Fernando"	6.61	39.45	298.68
94	"San Fernando"	6.61	61.64	486
95	"Managua_ Nicaragua-01"	6.24	3.51	288.77
96	"Managua_ Nicaragua-02"	5.2	4.33	288.77
97	"Point Mugu"	5.65	15.48	248.98
98	"Hollister-03"	5.14	9.99	1428.14
99	"Hollister-03"	5.14	8.85	198.77
100	"Hollister-03"	5.14	8.56	335.5
101	"Northern Calif-07"	5.2	28.73	567.78
102	"Northern Calif-07"	5.2	8.2	219.31
103	"Northern Calif-07"	5.2	28.48	368.72
104	"Northern Calif-07"	5.2	58.78	594.83
105	"Northern Calif-07"	5.2	59.7	518.98
106	"Oroville-01"	5.89	7.79	680.37
107	"Oroville-02"	4.79	13.55	391.76
108	"Oroville-02"	4.79	12.07	377.25
109	"Oroville-04"	4.37	9.22	519.15

110	"Oroville-04"	4.37	13.37	391.76
111	"Oroville-04"	4.37	11	377.25
112	"Oroville-03"	4.7	5.95	427.38
113	"Oroville-03"	4.7	0	634.85
114	"Oroville-03"	4.7	7.35	418.97
115	"Oroville-03"	4.7	7.38	589.8
116	"Oroville-03"	4.7	0.77	514.91
117	"Oroville-03"	4.7	8.67	391.76
118	"Oroville-03"	4.7	8.7	352.22
119	"Oroville-03"	4.7	4.79	548.76
120	"Oroville-03"	4.7	10.2	377.25
121	"Friuli_ Italy-01"	6.5	49.13	496.46
122	"Friuli_ Italy-01"	6.5	33.32	249.28
123	"Friuli_ Italy-01"	6.5	80.37	352.05
124	"Friuli_ Italy-01"	6.5	102.05	356.39
125	"Friuli_ Italy-01"	6.5	14.97	505.23
126	"Gazli_ USSR"	6.8	3.92	259.59
127	"Fruili_ Italy-03"	5.5	10.56	310.68
128	"Fruili_ Italy-03"	5.5	16.33	412.37
129	"Fruili_ Italy-03"	5.5	16.26	649.67
130	"Friuli_ Italy-02"	5.91	10.99	310.68
131	"Friuli_ Italy-02"	5.91	41.37	249.28
132	"Friuli_ Italy-02"	5.91	14.65	412.37
133	"Friuli_ Italy-02"	5.91	14.37	649.67
134	"Izmir_ Turkey"	5.3	0.74	535.24
135	"Santa Barbara"	5.92	23.75	465.51
136	"Santa Barbara"	5.92	0	514.99
137	"Tabas_ Iran"	7.35	119.77	377.56
138	"Tabas_ Iran"	7.35	24.07	324.57
139	"Tabas_ Iran"	7.35	0	471.53
140	"Tabas_ Iran"	7.35	89.76	302.64
141	"Tabas_ Iran"	7.35	193.91	280.26
142	"Tabas_ Iran"	7.35	150.33	354.37
143	"Tabas_ Iran"	7.35	1.79	766.77
144	"Dursunbey_ Turkey"	5.34	5.57	585.04
145	"Coyote Lake"	5.74	5.3	561.43
146	"Coyote Lake"	5.74	10.21	1428.14
147	"Coyote Lake"	5.74	8.47	270.84
148	"Coyote Lake"	5.74	6.75	349.85
149	"Coyote Lake"	5.74	4.79	221.78
150	"Coyote Lake"	5.74	0.42	663.31
151	"Coyote Lake"	5.74	33.69	281.61
152	"Coyote Lake"	5.74	20.44	367.43
153	"Coyote Lake"	5.74	20.44	362.98
154	"Coyote Lake"	5.74	19.46	335.5
155	"Norcia_ Italy"	5.9	31.43	401.34
156	"Norcia_ Italy"	5.9	1.41	585.04
157	"Norcia_ Italy"	5.9	13.21	535.24
158	"Imperial Valley-06"	6.53	0	259.86
159	"Imperial Valley-06"	6.53	0	242.05
160	"Imperial Valley-06"	6.53	0.44	223.03
161	"Imperial Valley-06"	6.53	8.54	208.71
162	"Imperial Valley-06"	6.53	10.45	231.23
163	"Imperial Valley-06"	6.53	23.17	205.78
164	"Imperial Valley-06"	6.53	15.19	471.53
165	"Imperial Valley-06"	6.53	7.29	242.05
166	"Imperial Valley-06"	6.53	49.1	336.49
167	"Imperial Valley-06"	6.53	13.52	259.86
169	"Imperial Valley-06"	6.53	22.03	242.05
170	"Imperial Valley-06"	6.53	7.31	192.05
171	"Imperial Valley-06"	6.53	0.07	264.57
172	"Imperial Valley-06"	6.53	19.76	237.33
173	"Imperial Valley-06"	6.53	8.6	202.85
174	"Imperial Valley-06"	6.53	12.56	196.25
175	"Imperial Valley-06"	6.53	17.94	196.88
176	"Imperial Valley-06"	6.53	21.98	249.92
178	"Imperial Valley-06"	6.53	10.79	162.94
179	"Imperial Valley-06"	6.53	4.9	208.91
180	"Imperial Valley-06"	6.53	1.76	205.63
181	"Imperial Valley-06"	6.53	0	203.22
182	"Imperial Valley-06"	6.53	0.56	210.51
183	"Imperial Valley-06"	6.53	3.86	206.08
184	"Imperial Valley-06"	6.53	5.09	202.26
185	"Imperial Valley-06"	6.53	5.35	202.89
186	"Imperial Valley-06"	6.53	35.64	212
187	"Imperial Valley-06"	6.53	12.69	348.69
188	"Imperial Valley-06"	6.53	30.33	316.64
190	"Imperial Valley-06"	6.53	24.61	362.38
191	"Imperial Valley-06"	6.53	31.92	242.05
192	"Imperial Valley-06"	6.53	14.75	193.67
193	"Imperial Valley-07"	5.01	10.83	223.03
194	"Imperial Valley-07"	5.01	24.26	208.71
195	"Imperial Valley-07"	5.01	11.17	231.23
196	"Imperial Valley-07"	5.01	49.4	242.05
197	"Imperial Valley-07"	5.01	23.76	237.33
198	"Imperial Valley-07"	5.01	10.73	202.85
199	"Imperial Valley-07"	5.01	13.61	196.25
200	"Imperial Valley-07"	5.01	17.32	188.78
201	"Imperial Valley-07"	5.01	14.54	162.94
202	"Imperial Valley-07"	5.01	9.69	208.91
203	"Imperial Valley-07"	5.01	8.56	205.63
204	"Imperial Valley-07"	5.01	7.4	203.22
205	"Imperial Valley-07"	5.01	7.32	210.51
206	"Imperial Valley-07"	5.01	8.18	206.08
207	"Imperial Valley-07"	5.01	7.87	202.26
208	"Imperial Valley-07"	5.01	7.69	202.89
209	"Imperial Valley-08"	5.62	9.39	193.67
210	"Livermore-01"	5.8	29.19	517.06
212	"Livermore-01"	5.8	23.92	403.37
213	"Livermore-01"	5.8	34.66	367.57
214	"Livermore-01"	5.8	15.19	377.51
215	"Livermore-01"	5.8	15.84	384.47
216	"Livermore-01"	5.8	53.35	650.05
217	"Livermore-02"	5.42	27.76	517.06
219	"Livermore-02"	5.42	10.03	403.37
220	"Livermore-02"	5.42	26.07	367.57
221	"Livermore-02"	5.42	0.79	387.04
222	"Livermore-02"	5.42	7.94	550.88
223	"Livermore-02"	5.42	14.31	377.51
224	"Livermore-02"	5.42	19.09	384.47
225	"Anza (Horse Canyon)-01"	5.19	12.24	724.89
226	"Anza (Horse Canyon)-01"	5.19	5.85	617.78

227	"Anza (Horse Canyon)-01"	5.19	13.8	360.45	1054	"Northridge-01"	6.69	5.54	325.67
230	"Mammoth Lakes-01"	6.06	1.1	382.12	1063	"Northridge-01"	6.69	0	282.25
231	"Mammoth Lakes-01"	6.06	12.56	537.16	1084	"Northridge-01"	6.69	0	251.24
233	"Mammoth Lakes-02"	5.69	2.91	382.12	1085	"Northridge-01"	6.69	0	370.52
234	"Mammoth Lakes-02"	5.69	14.28	537.16	1086	"Northridge-01"	6.69	1.74	440.54
285	"Irpinia_ Italy-01"	6.9	8.14	649.67	1091	"Northridge-01"	6.69	23.1	996.43
292	"Irpinia_ Italy-01"	6.9	6.78	382	1106	"Kobe_ Japan"	6.9	0.94	312
316	"Westmorland"	5.9	16.54	348.69	1108	"Kobe_ Japan"	6.9	0.9	1043
326	"Coalinga-01"	6.36	43.83	173.02	1114	"Kobe_ Japan"	6.9	3.31	198
334	"Coalinga-01"	6.36	41.04	178.27	1119	"Kobe_ Japan"	6.9	0	312
451	"Morgan Hill"	6.19	0.18	561.43	1120	"Kobe_ Japan"	6.9	1.46	256
452	"Morgan Hill"	6.19	53.89	116.35	1147	"Kocaeli_ Turkey"	7.51	68.09	175
455	"Morgan Hill"	6.19	14.9	1428.14	1148	"Kocaeli_ Turkey"	7.51	10.56	523
459	"Morgan Hill"	6.19	9.85	663.31	1161	"Kocaeli_ Turkey"	7.51	7.57	792
566	"Kalamata_ Greece-02"	5.4	4	382.21	1165	"Kocaeli_ Turkey"	7.51	3.62	811
568	"San Salvador"	5.8	2.14	489.34	1176	"Kocaeli_ Turkey"	7.51	1.38	297
569	"San Salvador"	5.8	3.71	455.93	1182	"Chi-Chi_ Taiwan"	7.62	9.76	438.19
608	"Whittier Narrows-01"	5.99	26.3	160.58	1193	"Chi-Chi_ Taiwan"	7.62	9.62	427.73
643	"Whittier Narrows-01"	5.99	23.4	1222.52	1209	"Chi-Chi_ Taiwan"	7.62	24.13	169.52
680	"Whittier Narrows-01"	5.99	6.78	969.07	1212	"Chi-Chi_ Taiwan"	7.62	48.49	172.1
703	"Whittier Narrows-01"	5.99	47.25	996.43	1228	"Chi-Chi_ Taiwan"	7.62	42.15	169.84
718	"Superstition Hills-01"	6.22	17.59	179	1229	"Chi-Chi_ Taiwan"	7.62	77.19	160.67
722	"Superstition Hills-02"	6.54	18.48	266.01	1244	"Chi-Chi_ Taiwan"	7.62	9.94	258.89
723	"Superstition Hills-02"	6.54	0.95	348.69	1245	"Chi-Chi_ Taiwan"	7.62	36.06	804.36
729	"Superstition Hills-02"	6.54	23.85	179	1247	"Chi-Chi_ Taiwan"	7.62	50.61	175.68
732	"Loma Prieta"	6.93	43.06	133.11	1256	"Chi-Chi_ Taiwan"	7.62	53.3	789.18
759	"Loma Prieta"	6.93	43.77	116.35	1257	"Chi-Chi_ Taiwan"	7.62	52.46	1525.85
760	"Loma Prieta"	6.93	45.42	126.4	1307	"Chi-Chi_ Taiwan"	7.62	101.24	909.09
764	"Loma Prieta"	6.93	10.27	308.55	1310	"Chi-Chi_ Taiwan"	7.62	86.61	124.27
765	"Loma Prieta"	6.93	8.84	1428.14	1319	"Chi-Chi_ Taiwan"	7.62	83.02	782.59
766	"Loma Prieta"	6.93	10.38	270.84	1334	"Chi-Chi_ Taiwan"	7.62	78	158.13
767	"Loma Prieta"	6.93	12.23	349.85	1347	"Chi-Chi_ Taiwan"	7.62	57.69	996.51
780	"Loma Prieta"	6.93	94.56	169.72	1352	"Chi-Chi_ Taiwan"	7.62	113.39	913.77
788	"Loma Prieta"	6.93	72.9	895.36	1357	"Chi-Chi_ Taiwan"	7.62	101.23	155.32
789	"Loma Prieta"	6.93	83.37	1315.92	1366	"Chi-Chi_ Taiwan"	7.62	106.72	1010.4
795	"Loma Prieta"	6.93	75.96	1249.86	1371	"Chi-Chi_ Taiwan"	7.62	158.96	806.48
797	"Loma Prieta"	6.93	74.04	873.1	1378	"Chi-Chi_ Taiwan"	7.62	123.56	1004.58
802	"Loma Prieta"	6.93	7.58	380.89	1402	"Chi-Chi_ Taiwan"	7.62	38.36	491.08
803	"Loma Prieta"	6.93	8.48	347.9	1421	"Chi-Chi_ Taiwan"	7.62	99.54	167.18
804	"Loma Prieta"	6.93	63.03	1020.62	1432	"Chi-Chi_ Taiwan"	7.62	116.64	816.9
808	"Loma Prieta"	6.93	77.32	155.11	1440	"Chi-Chi_ Taiwan"	7.62	120.84	1023.45
828	"Cape Mendocino"	7.01	0	422.17	1442	"Chi-Chi_ Taiwan"	7.62	95.31	807.68
838	"Landers"	7.28	34.86	370.08	1445	"Chi-Chi_ Taiwan"	7.62	107.42	856.38
879	"Landers"	7.28	2.19	1369	1446	"Chi-Chi_ Taiwan"	7.62	117.31	1022.77
900	"Landers"	7.28	23.62	353.63	1452	"Chi-Chi_ Taiwan"	7.62	92.01	887.68
962	"Northridge-01"	6.69	45.44	160.58	1475	"Chi-Chi_ Taiwan"	7.62	56.03	569.98
982	"Northridge-01"	6.69	0	373.07	1476	"Chi-Chi_ Taiwan"	7.62	28.04	406.53
983	"Northridge-01"	6.69	0	525.79	1477	"Chi-Chi_ Taiwan"	7.62	30.17	489.22
1004	"Northridge-01"	6.69	0	380.06	1478	"Chi-Chi_ Taiwan"	7.62	40.88	423.4
1011	"Northridge-01"	6.69	15.11	1222.52	1479	"Chi-Chi_ Taiwan"	7.62	35.68	393.77
1013	"Northridge-01"	6.69	0	628.99	1480	"Chi-Chi_ Taiwan"	7.62	19.83	478.07
1044	"Northridge-01"	6.69	3.16	269.14	1481	"Chi-Chi_ Taiwan"	7.62	25.42	297.86
1045	"Northridge-01"	6.69	2.11	285.93	1482	"Chi-Chi_ Taiwan"	7.62	19.89	540.66
1050	"Northridge-01"	6.69	4.92	2016.13	1483	"Chi-Chi_ Taiwan"	7.62	22.06	362.03
1051	"Northridge-01"	6.69	4.92	2016.13	1485	"Chi-Chi_ Taiwan"	7.62	26	704.64
1052	"Northridge-01"	6.69	5.26	508.08	1486	"Chi-Chi_ Taiwan"	7.62	16.74	465.55

1487	"Chi-Chi_ Taiwan"	7.62	35	520.37
1489	"Chi-Chi_ Taiwan"	7.62	3.76	487.27
1491	"Chi-Chi_ Taiwan"	7.62	7.64	350.06
1492	"Chi-Chi_ Taiwan"	7.62	0	579.1
1493	"Chi-Chi_ Taiwan"	7.62	5.95	454.55
1496	"Chi-Chi_ Taiwan"	7.62	10.48	403.2
1498	"Chi-Chi_ Taiwan"	7.62	17.11	272.67
1501	"Chi-Chi_ Taiwan"	7.62	9.78	476.14
1502	"Chi-Chi_ Taiwan"	7.62	16.59	645.72
1503	"Chi-Chi_ Taiwan"	7.62	0.57	305.85
1505	"Chi-Chi_ Taiwan"	7.62	0	487.34
1510	"Chi-Chi_ Taiwan"	7.62	0.89	573.02
1511	"Chi-Chi_ Taiwan"	7.62	2.74	614.98
1515	"Chi-Chi_ Taiwan"	7.62	5.16	472.81
1518	"Chi-Chi_ Taiwan"	7.62	55.14	999.66
1519	"Chi-Chi_ Taiwan"	7.62	6.98	538.69
1528	"Chi-Chi_ Taiwan"	7.62	2.11	389.41
1529	"Chi-Chi_ Taiwan"	7.62	1.49	714.27
1530	"Chi-Chi_ Taiwan"	7.62	6.08	494.1
1531	"Chi-Chi_ Taiwan"	7.62	12.87	410.45
1548	"Chi-Chi_ Taiwan"	7.62	13.13	599.64
1550	"Chi-Chi_ Taiwan"	7.62	8.27	462.1
1571	"Chi-Chi_ Taiwan"	7.62	121.45	826.15
1587	"Chi-Chi_ Taiwan"	7.62	62.11	845.34
1599	"Duzce_ Turkey"	7.14	187.99	175
1602	"Duzce_ Turkey"	7.14	12.02	293.57
1613	"Duzce_ Turkey"	7.14	25.78	782
1649	"Sierra Madre"	5.61	37.63	996.43
1709	"Northridge-06"	5.28	18.53	1015.88
1715	"Northridge-06"	5.28	13.15	1222.52
1843	"Yountville"	5	94.18	133.11
1852	"Yountville"	5	47.65	169.72
1943	"Anza-02"	4.92	28.79	845.41
2114	"Denali_ Alaska"	7.9	0.18	329.4
2175	"Chi-Chi_ Taiwan-02"	5.9	67.81	169.52
2178	"Chi-Chi_ Taiwan-02"	5.9	92.14	172.1
2192	"Chi-Chi_ Taiwan-02"	5.9	79.64	169.84
2193	"Chi-Chi_ Taiwan-02"	5.9	119.96	160.67
2207	"Chi-Chi_ Taiwan-02"	5.9	78.6	804.36
2209	"Chi-Chi_ Taiwan-02"	5.9	94.3	175.68
2215	"Chi-Chi_ Taiwan-02"	5.9	56.46	789.18
2263	"Chi-Chi_ Taiwan-02"	5.9	122.96	909.09
2266	"Chi-Chi_ Taiwan-02"	5.9	107.49	124.27
2275	"Chi-Chi_ Taiwan-02"	5.9	105.24	782.59
2284	"Chi-Chi_ Taiwan-02"	5.9	98.04	158.13
2296	"Chi-Chi_ Taiwan-02"	5.9	80.14	996.51
2317	"Chi-Chi_ Taiwan-02"	5.9	122.52	167.18
2328	"Chi-Chi_ Taiwan-02"	5.9	139.47	816.9
2334	"Chi-Chi_ Taiwan-02"	5.9	118.29	807.68
2335	"Chi-Chi_ Taiwan-02"	5.9	130.24	856.38
2336	"Chi-Chi_ Taiwan-02"	5.9	139.9	1022.77
2339	"Chi-Chi_ Taiwan-02"	5.9	114.98	887.68
2396	"Chi-Chi_ Taiwan-02"	5.9	78.11	999.66
2447	"Chi-Chi_ Taiwan-02"	5.9	97.46	845.34
2473	"Chi-Chi_ Taiwan-03"	6.2	45.69	169.52
2476	"Chi-Chi_ Taiwan-03"	6.2	70.11	172.1

2492	"Chi-Chi_ Taiwan-03"	6.2	59.24	169.84
2493	"Chi-Chi_ Taiwan-03"	6.2	98.42	160.67
2508	"Chi-Chi_ Taiwan-03"	6.2	59.99	804.36
2510	"Chi-Chi_ Taiwan-03"	6.2	72.24	175.68
2514	"Chi-Chi_ Taiwan-03"	6.2	65.46	789.18
2561	"Chi-Chi_ Taiwan-03"	6.2	125.18	158.13
2633	"Chi-Chi_ Taiwan-03"	6.2	103.2	999.66
2687	"Chi-Chi_ Taiwan-03"	6.2	93.15	845.34
2715	"Chi-Chi_ Taiwan-04"	6.2	38.59	169.52
2718	"Chi-Chi_ Taiwan-04"	6.2	61.1	172.1
2734	"Chi-Chi_ Taiwan-04"	6.2	6.02	553.43
2736	"Chi-Chi_ Taiwan-04"	6.2	56.35	169.84
2737	"Chi-Chi_ Taiwan-04"	6.2	84.01	160.67
2753	"Chi-Chi_ Taiwan-04"	6.2	39.3	804.36
2755	"Chi-Chi_ Taiwan-04"	6.2	63.37	175.68
2759	"Chi-Chi_ Taiwan-04"	6.2	65.26	789.18
2805	"Chi-Chi_ Taiwan-04"	6.2	116.17	913.77
2818	"Chi-Chi_ Taiwan-04"	6.2	119.21	150.18
2929	"Chi-Chi_ Taiwan-04"	6.2	68.95	845.34
2955	"Chi-Chi_ Taiwan-05"	6.2	66.53	169.52
2958	"Chi-Chi_ Taiwan-05"	6.2	88.66	172.1
2975	"Chi-Chi_ Taiwan-05"	6.2	83.74	169.84
2976	"Chi-Chi_ Taiwan-05"	6.2	113.51	160.67
2989	"Chi-Chi_ Taiwan-05"	6.2	69.76	804.36
2990	"Chi-Chi_ Taiwan-05"	6.2	90.92	175.68
2995	"Chi-Chi_ Taiwan-05"	6.2	44.36	789.18
2996	"Chi-Chi_ Taiwan-05"	6.2	49.84	1525.85
3042	"Chi-Chi_ Taiwan-05"	6.2	134.67	909.09
3044	"Chi-Chi_ Taiwan-05"	6.2	119.18	124.27
3053	"Chi-Chi_ Taiwan-05"	6.2	117.03	782.59
3062	"Chi-Chi_ Taiwan-05"	6.2	109.71	158.13
3091	"Chi-Chi_ Taiwan-05"	6.2	149.89	150.18
3094	"Chi-Chi_ Taiwan-05"	6.2	157.44	1004.58
3117	"Chi-Chi_ Taiwan-05"	6.2	135.78	167.18
3135	"Chi-Chi_ Taiwan-05"	6.2	131.28	807.68
3138	"Chi-Chi_ Taiwan-05"	6.2	142.68	856.38
3139	"Chi-Chi_ Taiwan-05"	6.2	151.93	1022.77
3145	"Chi-Chi_ Taiwan-05"	6.2	127.97	887.68
3194	"Chi-Chi_ Taiwan-05"	6.2	91.5	999.66
3251	"Chi-Chi_ Taiwan-05"	6.2	84.68	845.34
3282	"Chi-Chi_ Taiwan-06"	6.3	53.54	169.52
3285	"Chi-Chi_ Taiwan-06"	6.3	76.99	172.1
3302	"Chi-Chi_ Taiwan-06"	6.3	69.66	169.84
3303	"Chi-Chi_ Taiwan-06"	6.3	103.8	160.67
3318	"Chi-Chi_ Taiwan-06"	6.3	62.46	804.36
3319	"Chi-Chi_ Taiwan-06"	6.3	79.2	175.68
3324	"Chi-Chi_ Taiwan-06"	6.3	47.81	789.18
3325	"Chi-Chi_ Taiwan-06"	6.3	52.33	1525.85
3374	"Chi-Chi_ Taiwan-06"	6.3	107.04	782.59
3390	"Chi-Chi_ Taiwan-06"	6.3	82.06	996.51
3403	"Chi-Chi_ Taiwan-06"	6.3	144.01	150.18
3420	"Chi-Chi_ Taiwan-06"	6.3	125.31	167.18
3429	"Chi-Chi_ Taiwan-06"	6.3	120.87	807.68
3430	"Chi-Chi_ Taiwan-06"	6.3	117.56	887.68
3473	"Chi-Chi_ Taiwan-06"	6.3	5.72	443.04
3475	"Chi-Chi_ Taiwan-06"	6.3	0	489.32

3479	"Chi-Chi_ Taiwan-06"	6.3	81	999.66
3542	"Chi-Chi_ Taiwan-06"	6.3	84.03	845.34
3548	"Loma Prieta"	6.93	3.22	1070.34
3697	"Whittier Narrows-02"	5.27	26.14	160.58
3718	"Whittier Narrows-02"	5.27	25.04	1222.52
3744	"Cape Mendocino"	7.01	8.49	566.42
3746	"Cape Mendocino"	7.01	16.44	459.04
3799	"Hector Mine"	7.13	185.92	1015.88
3828	"Yountville"	5	60.29	155.11
3893	"Tottori_ Japan"	6.61	108.34	834.56
3895	"Tottori_ Japan"	6.61	99.64	760.54
3920	"Tottori_ Japan"	6.61	70.52	1047.01
3925	"Tottori_ Japan"	6.61	15.23	940.2
3934	"Tottori_ Japan"	6.61	16.6	138.76
3954	"Tottori_ Japan"	6.61	15.58	967.27
3962	"Tottori_ Japan"	6.61	45.98	169.16
3965	"Tottori_ Japan"	6.61	6.86	139.21
4040	"Bam_ Iran"	6.6	0.05	487.4
4065	"Parkfield-02_ CA"	6	1.37	383.9
4083	"Parkfield-02_ CA"	6	4.66	906.96
4097	"Parkfield-02_ CA"	6	1.6	648.09
4098	"Parkfield-02_ CA"	6	1.66	326.64
4100	"Parkfield-02_ CA"	6	1.63	173.02
4101	"Parkfield-02_ CA"	6	4.95	397.36
4102	"Parkfield-02_ CA"	6	2.55	230.57
4103	"Parkfield-02_ CA"	6	3.3	410.4
4107	"Parkfield-02_ CA"	6	0.02	178.27
4113	"Parkfield-02_ CA"	6	1.22	372.26
4115	"Parkfield-02_ CA"	6	0.88	265.21
4126	"Parkfield-02_ CA"	6	2.85	260.63
4151	"Niigata_ Japan"	6.63	101.78	133.05
4167	"Niigata_ Japan"	6.63	52.15	828.95
4200	"Niigata_ Japan"	6.63	55.9	173.09
4201	"Niigata_ Japan"	6.63	48	149.97
4203	"Niigata_ Japan"	6.63	38	174.55
4204	"Niigata_ Japan"	6.63	25.14	128.12
4211	"Niigata_ Japan"	6.63	10.21	418.5
4215	"Niigata_ Japan"	6.63	46.66	134.5
4228	"Niigata_ Japan"	6.63	6.27	375
4247	"Niigata_ Japan"	6.63	100.37	849.01
4248	"Niigata_ Japan"	6.63	77.39	1432.75
4312	"Umbria-03_ Italy"	5.6	14.67	922
4438	"Molise-02_ Italy"	5.7	49.6	865
4451	"Montenegro_ Yugoslavia"	7.1	0	462.23
4458	"Montenegro_ Yugoslavia"	7.1	3.97	318.74
4480	"L'Aquila_ Italy"	6.3	0	475
4482	"L'Aquila_ Italy"	6.3	0	552
4483	"L'Aquila_ Italy"	6.3	0	717
4847	"Chuetsu-oki_ Japan"	6.8	9.43	383.43
4900	"Chuetsu-oki_ Japan"	6.8	274.22	162.09
4915	"Chuetsu-oki_ Japan"	6.8	233.95	135.4
4916	"Chuetsu-oki_ Japan"	6.8	261.44	158.16
4926	"Chuetsu-oki_ Japan"	6.8	219.2	829.46
4941	"Chuetsu-oki_ Japan"	6.8	217.94	143.47
4942	"Chuetsu-oki_ Japan"	6.8	232.37	161.64
4947	"Chuetsu-oki_ Japan"	6.8	241.67	166.02
4948	"Chuetsu-oki_ Japan"	6.8	245.24	147.06
4949	"Chuetsu-oki_ Japan"	6.8	275.3	163.55
4951	"Chuetsu-oki_ Japan"	6.8	267.98	148.51
4965	"Chuetsu-oki_ Japan"	6.8	242.95	135.18
4969	"Chuetsu-oki_ Japan"	6.8	219.73	760.04
4989	"Chuetsu-oki_ Japan"	6.8	118.79	133.05
5006	"Chuetsu-oki_ Japan"	6.8	77.65	828.95
5013	"Chuetsu-oki_ Japan"	6.8	125.46	803.57
5043	"Chuetsu-oki_ Japan"	6.8	232.55	904.15
5048	"Chuetsu-oki_ Japan"	6.8	170.79	830.77
5103	"Chuetsu-oki_ Japan"	6.8	217.49	106.83
5106	"Chuetsu-oki_ Japan"	6.8	183.23	144.14
5117	"Chuetsu-oki_ Japan"	6.8	96.52	166.91
5119	"Chuetsu-oki_ Japan"	6.8	109.16	139.13
5120	"Chuetsu-oki_ Japan"	6.8	131.53	108.21
5122	"Chuetsu-oki_ Japan"	6.8	130.55	133.05
5126	"Chuetsu-oki_ Japan"	6.8	204.27	174.55
5129	"Chuetsu-oki_ Japan"	6.8	219.6	111.33
5150	"Chuetsu-oki_ Japan"	6.8	221	138.54
5151	"Chuetsu-oki_ Japan"	6.8	227.32	113.57
5157	"Chuetsu-oki_ Japan"	6.8	217.55	141.79
5161	"Chuetsu-oki_ Japan"	6.8	231.35	89.32
5172	"Chuetsu-oki_ Japan"	6.8	225.96	146.72
5181	"Chuetsu-oki_ Japan"	6.8	184.68	122.07
5256	"Chuetsu-oki_ Japan"	6.8	48.1	173.09
5257	"Chuetsu-oki_ Japan"	6.8	45.54	149.97
5259	"Chuetsu-oki_ Japan"	6.8	27.92	174.55
5260	"Chuetsu-oki_ Japan"	6.8	21.37	128.12
6434	"Tottori_ Japan"	6.61	234.49	2100
6887	"Darfield_ New Zealand"	7	18.05	187
6897	"Darfield_ New Zealand"	7	5.28	295.74
6906	"Darfield_ New Zealand"	7	1.22	344.02
6911	"Darfield_ New Zealand"	7	7.29	326.01
6927	"Darfield_ New Zealand"	7	5.07	263.2
6928	"Darfield_ New Zealand"	7	25.21	649.67
6942	"Darfield_ New Zealand"	7	26.76	211
6959	"Darfield_ New Zealand"	7	19.48	141
6960	"Darfield_ New Zealand"	7	13.64	293
6962	"Darfield_ New Zealand"	7	0	295.74
6966	"Darfield_ New Zealand"	7	22.33	207
6969	"Darfield_ New Zealand"	7	20.86	247.5
6975	"Darfield_ New Zealand"	7	6.11	249.28
8119	"Christchurch_ New Zealand"	6.2	1.92	206
8123	"Christchurch_ New Zealand"	6.2	5.11	141
8161	"El Mayor-Cucapah_ Mexico"	7.2	9.98	196.88
8164	"Duzce_ Turkey"	7.14	2.65	690
8606	"El Mayor-Cucapah_ Mexico"	7.2	10.31	242