INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

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Technology, Social Impact

Effect of Fault Normal and Fault Parallel Components of Near and Far Fault Ground Motions on Low Rise Buildings

Scope of Study & Objectives

- Near-fault ground motions pose considerable uncertainties in characteristics of ground motion.
- Existing codes of practice do not specify critical characteristics of ground motion for design.
- Effect of characteristics of ground motion in fault normal and parallel directions in the near-fault region on orientation of building is critical.
- The major objective of the study is to understand the damage caused to the building when subjected to various types of ground motions with different characteristics arising due to fault normal, fault parallel, near and far field nature of ground motions.

Approach

- Four categories of ground motions sets
  - *Near-fault ground motions with pulse whose pulse period less than the building's natural period*
  - *Near-fault ground motions with pulse whose pulse period greater than the building's natural period*
  - *Near-fault ground motions without pulse*
  - *Far-Fault ground motions*
- Four analysis cases to perform nonlinear response history
  - Fault Normal applied along longitudinal direction of building
  - Fault Normal applied along transverse direction of building
  - Fault Parallel applied along longitudinal direction of building
  - Fault Parallel applied along transverse direction of building

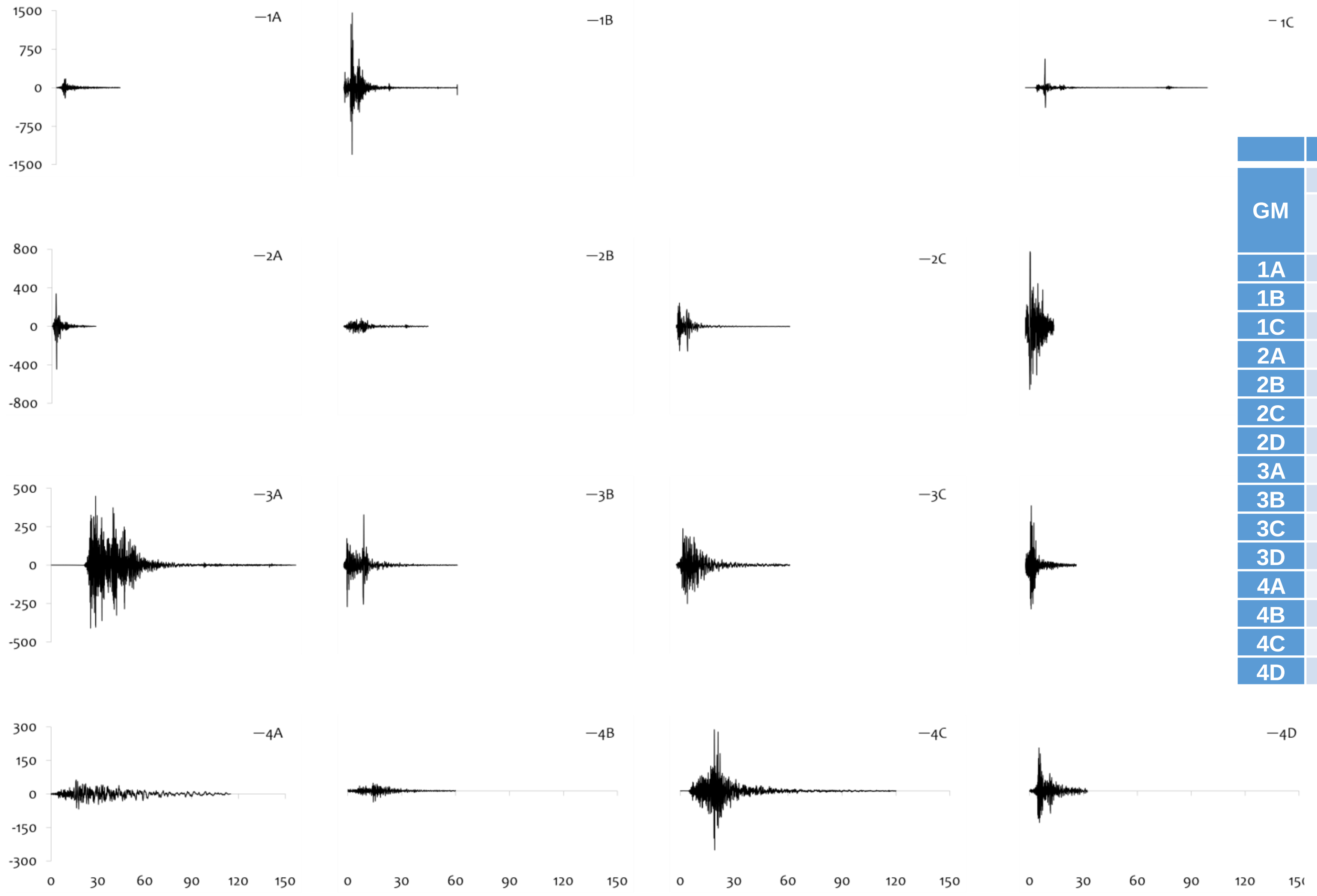


Fig 1. Acceleration time history of 15 ground motions considered for the study

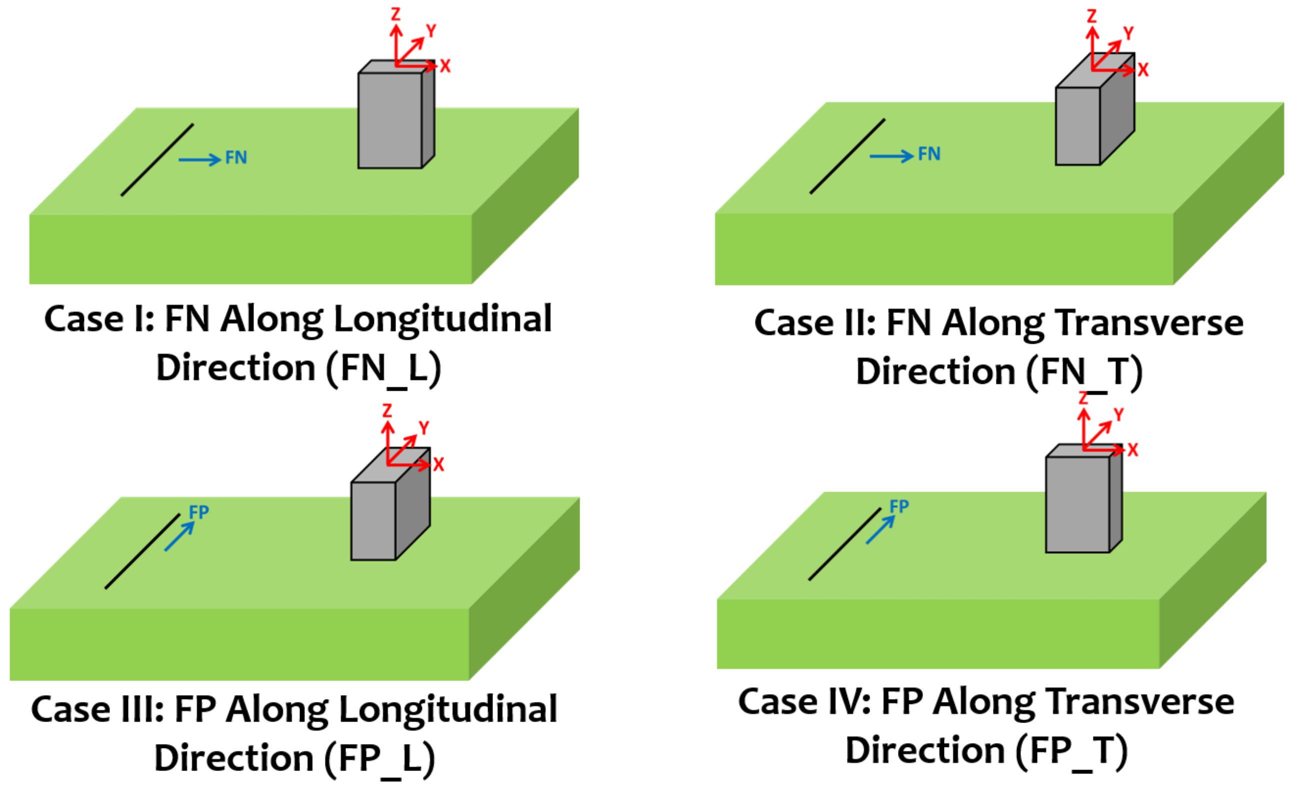
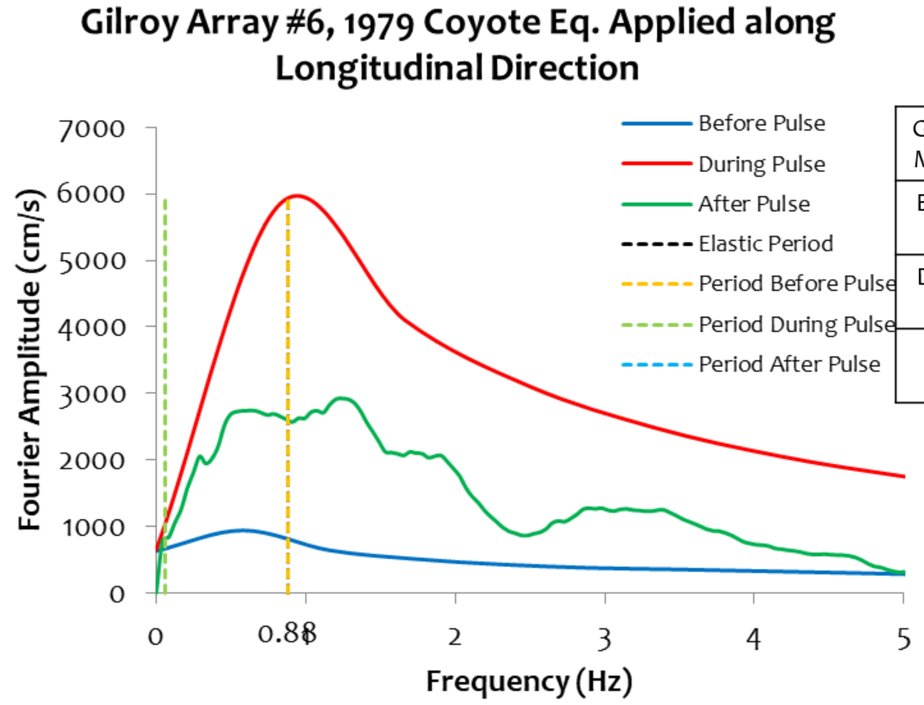


Fig 2. Cases of analyses considered for all the ground motions that are applied on the building

Observations

Table 1. Drift and number of nonlinear hinges formed during nonlinear time history analysis

GM	In Longitudinal Direction: Drift (%) FN	FP	Building subjected to FN: A to IO	IO to LS	LS to CP	CP	Building subjected to FP: A to IO	IO to LS	LS to CP	CP	In Transverse Direction: Drift (%) FN in T	FP in T	Building subjected to FN: A to IO	IO to LS	LS to CP	CP	Building subjected to FP: A to IO	IO to LS	LS to CP	CP
1A	3.43	1.51	95	139	52	288	231	237	30	70	2.27	1.54	156	128	43	208	229	213	15	67
1B	1.84	0.72	204	164	112	34	350	0	0	0	1.86	0.72	203	165	105	9	316	0	0	0
1C	4.41	1.51	131	100	36	286	166	276	44	16	4.47	1.82	140	143	8	290	222	199	67	130
2A	3.99	2.18	126	52	106	189	258	124	136	147	4.05	2.21	81	90	72	259	194	172	180	78
2B	2.02	1.82	124	193	72	111	319	177	118	52	2.07	1.89	167	126	70	118	229	177	96	27
2C	5.50	2.02	187	33	48	278	135	157	112	44		2.06	453	6	4	11	165	150	81	33
2D	4.59	2.74	68	111	15	250	136	165	40	175	4.61	2.70	114	91	40	265	116	173	42	161
3A	2.80	0.63	193	86	35	212	269	0	0	0	2.78	1.65	182	62	67	181	203	174	29	86
3B	2.01	1.85	185	192	0	120	160	208	108	84	1.98	1.85	163	176	13	113	172	175	81	90
3C	2.60	3.59	279	67	101	178	107	126	44	216	2.80	3.63	225	82	70	227	113	77	66	228
3D	1.03	0.72	377	100	0	0	415	0	0	0	1.04	0.73	360	63	0	0	385	0	0	0
4A	2.38	2.71	122	120	3	215	122	87	39	182	2.40		116	114	5	206	187	94	83	161
4B	1.46	1.50	252	180	45	34	261	232	3	56	1.47	1.51	229	180	26	42	257	220	27	39
4C	1.28	1.97	292	215	6	56	215	131	148	151	1.30	2.05	265	226	18	12	170	119	103	163
4D	2.07	2.41	194	188	54	73	182	112	37	173	0.54	0.77	155	0	0	0	252	0	0	0



Ground Motion	Total	A to IO	IO to LS	LS to CP	CP
Before Pulse	930	0	0	0	0
During Pulse	930	117	51	123	218
After Pulse	930	126	52	106	289

Fig 3. Fourier transform of three portions of ground motion recorded at Gilroy Array#6, 1979 Coyote Earthquake indicating the elastic and inelastic time periods of buildnig correlated with number of hinges formed during nonlinear time history analysis

Conclusions

- Damage is considerably higher when subjected to near fault ground motions with pulse whose pulse period greater than building period.

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