WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1HH RC dual system, High seismic code design (1995), High-rise (9 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.48	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.72	alpha1; generally 0.7 to 0.8
Building weight:	11577.50	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	6.13	0.37			apparent yield point
2	41.02	0.54			ultimate point (15% drop in strength)
3					beginning of lower plateau
4					end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

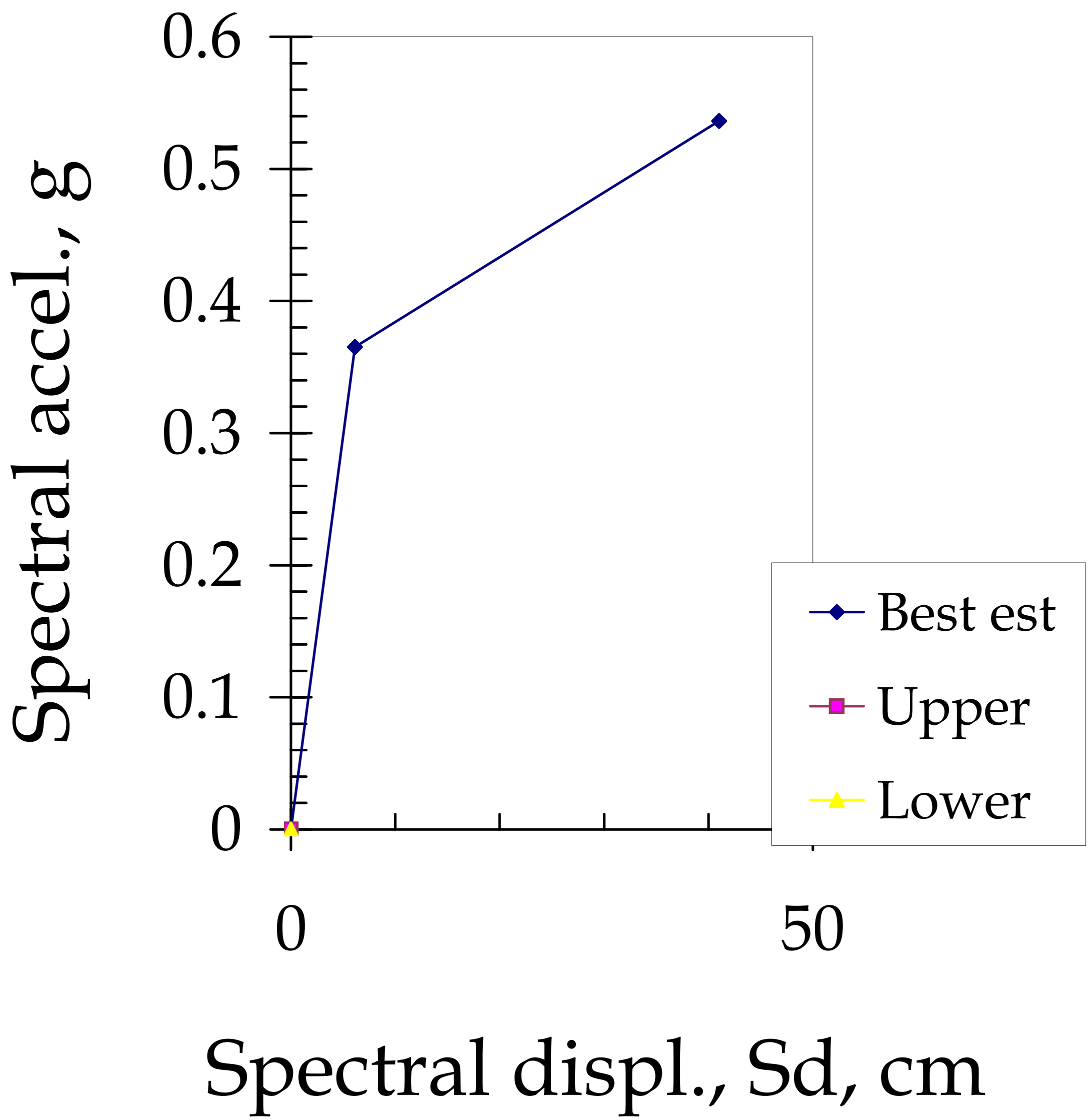
D14	41.02	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	49.22	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.6
0.5
0.4
0.3
0.2
0.1
0
Spectral accel., g
0
50
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1HL RC dual system, Low seismic code design (1959), High-rise (9 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.45	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.71	alpha1; generally 0.7 to 0.8
Building weight:	12457.38	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	3.52	0.19			apparent yield point
2	16.97	0.20			ultimate point (15% drop in strength)
3					beginning of lower plateau
4					end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

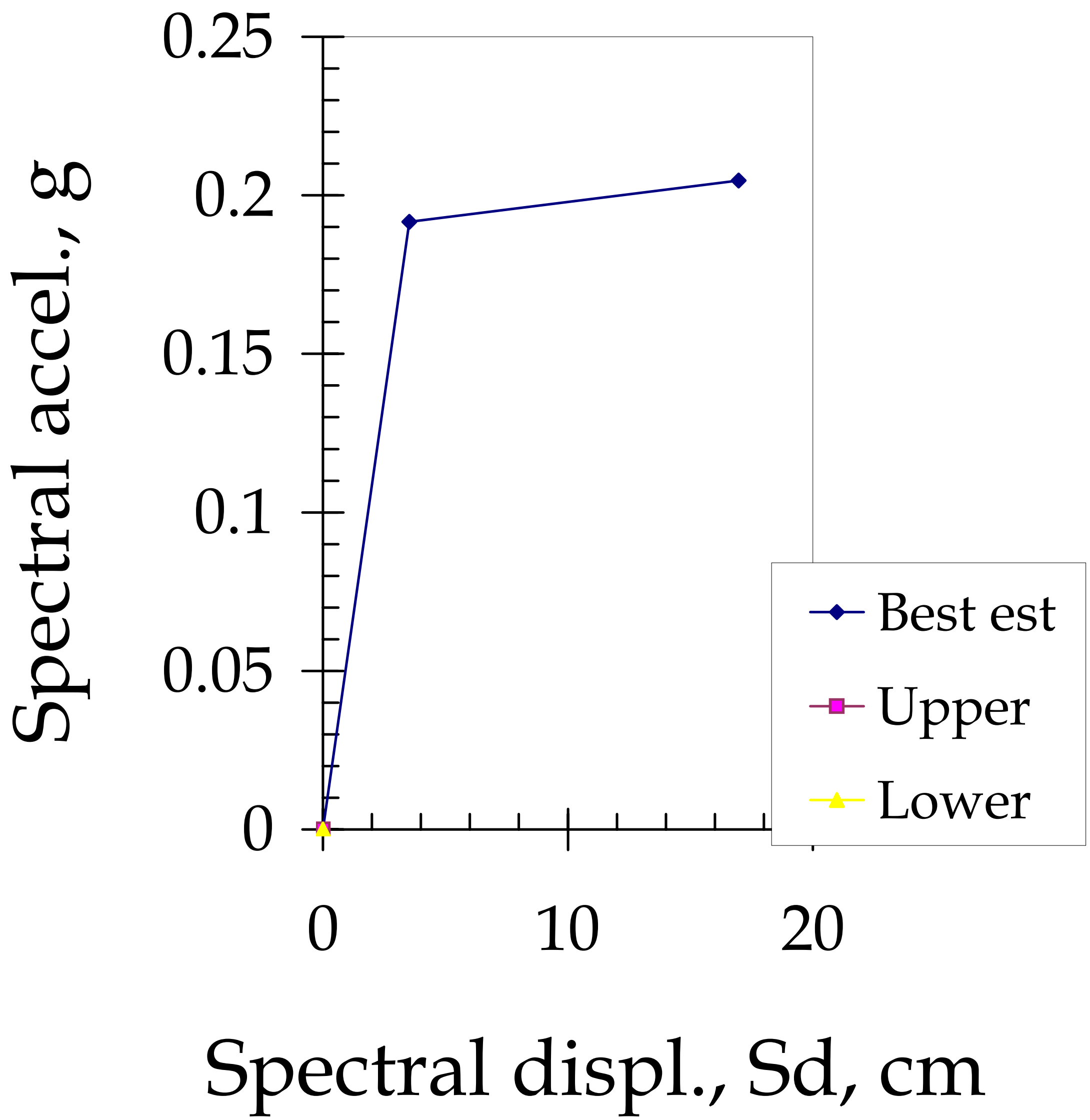
D14	16.97	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	18.66	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.25
0.2
0.15
0.1
0.05
0
0
10
20
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1LH RC dual system, High seismic code design (1995), Low-rise (2 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.26	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.90	alpha1; generally 0.7 to 0.8
Building weight:	2239.04	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.53	0.70			apparent yield point
2	17.42	0.80			ultimate point (15% drop in strength)
3	17.42	0.45			beginning of lower plateau
4	28.79	0.45			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?
Author's meaning of "upper bound":
How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?
Author's meaning of "lower bound":
How were these values & pushover points derived?

Add rows as desired

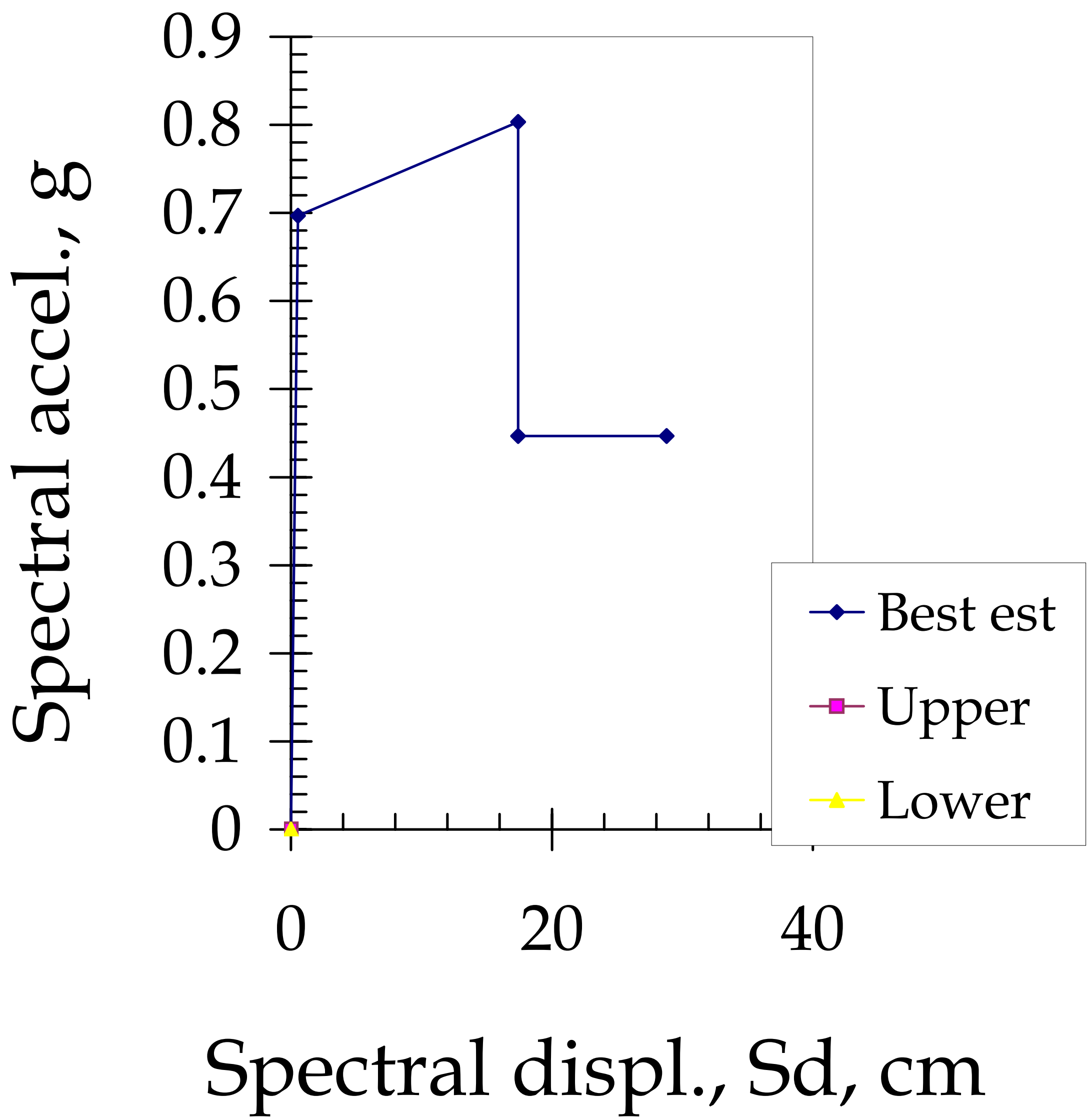
Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

D14	28.79	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	34.55	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves
For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design
For dual systems Sdc/D14=1.1 for low and 1.2 for high code design
Add rows as desired


Spectral accel., g
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1LL RC frame, High seismic code design (1995), High-rise (9 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.26	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.89	alpha1; generally 0.7 to 0.8
Building weight:	2555.74	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.27	0.25			apparent yield point
2	3.53	0.42			ultimate point (15% drop in strength)
3	3.53	0.28			beginning of lower plateau
4	4.38	0.28			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

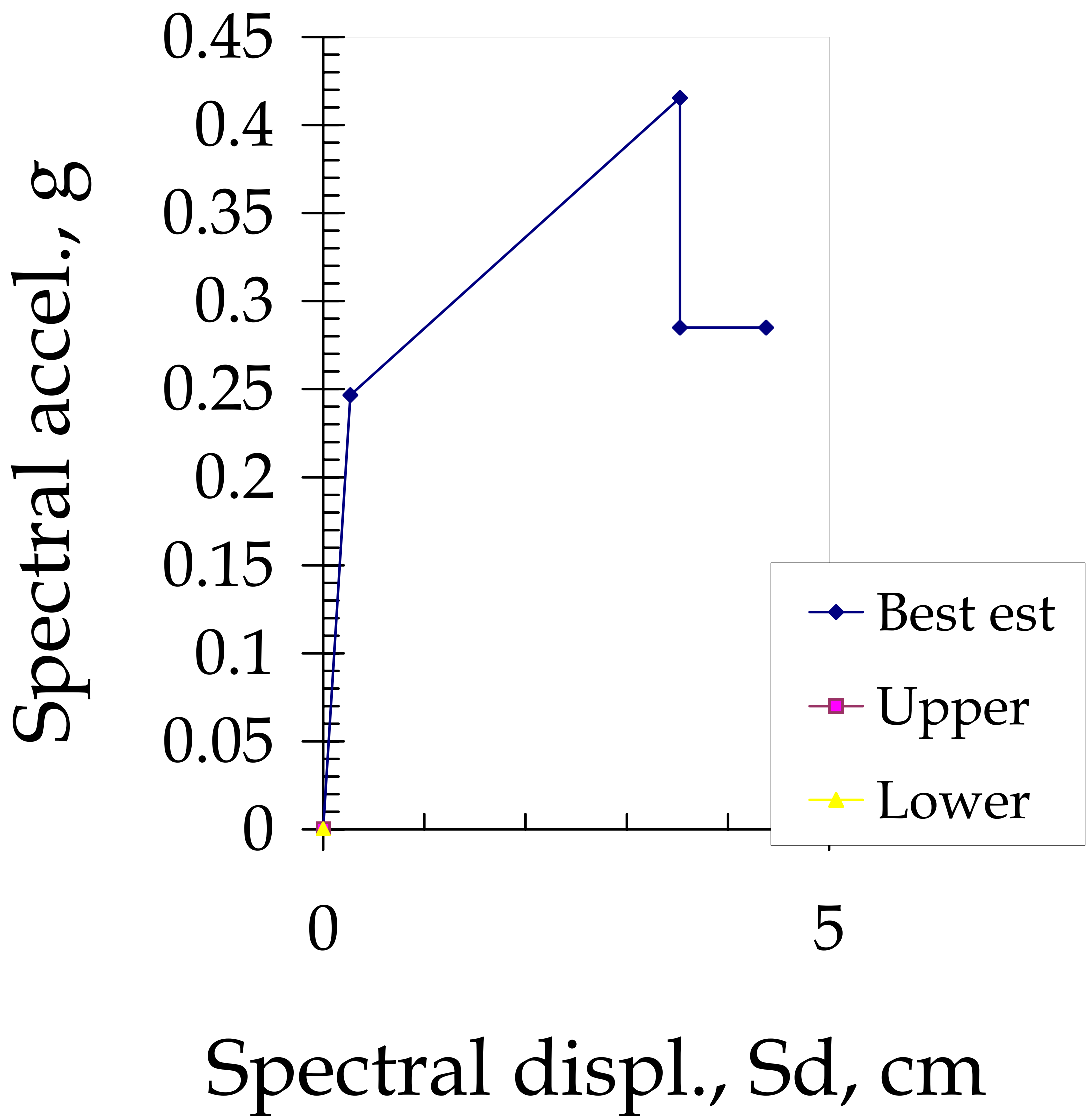
D14	4.38	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	4.82	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Spectral accel., g
0
5
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1MH RC dual system, High seismic code design (1995), Medium-rise (4 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.40	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.81	alpha1; generally 0.7 to 0.8
Building weight:	4810.14	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	1.28	0.33			apparent yield point
2	29.83	0.36			ultimate point (15% drop in strength)
3					beginning of lower plateau
4					end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

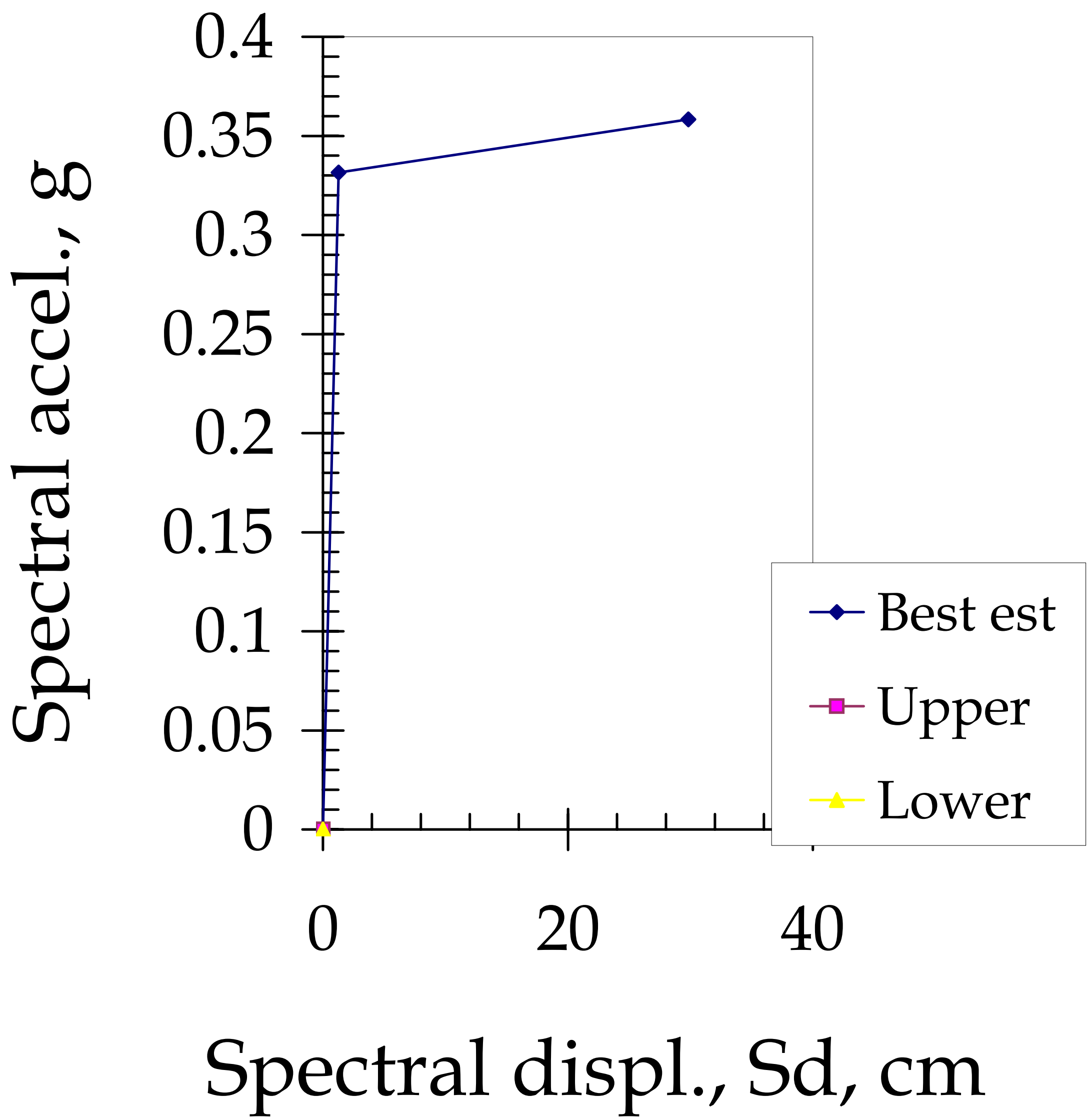
D14	29.83	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	35.80	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate: D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Spectral accel., g
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.1ML RC dual system, Low seismic code design (1959), Medium-rise (4 storeys), No infill walls
Geographic or other limitations:	Greece, Southern Europe

Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.40	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.80	alpha1; generally 0.7 to 0.8
Building weight:	5523.02	W, kN. Change and state units if desired
How were these values & pushover points derived?		

Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.97	0.17			apparent yield point
2	5.24	0.25			ultimate point (15% drop in strength)
3					beginning of lower plateau
4					end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

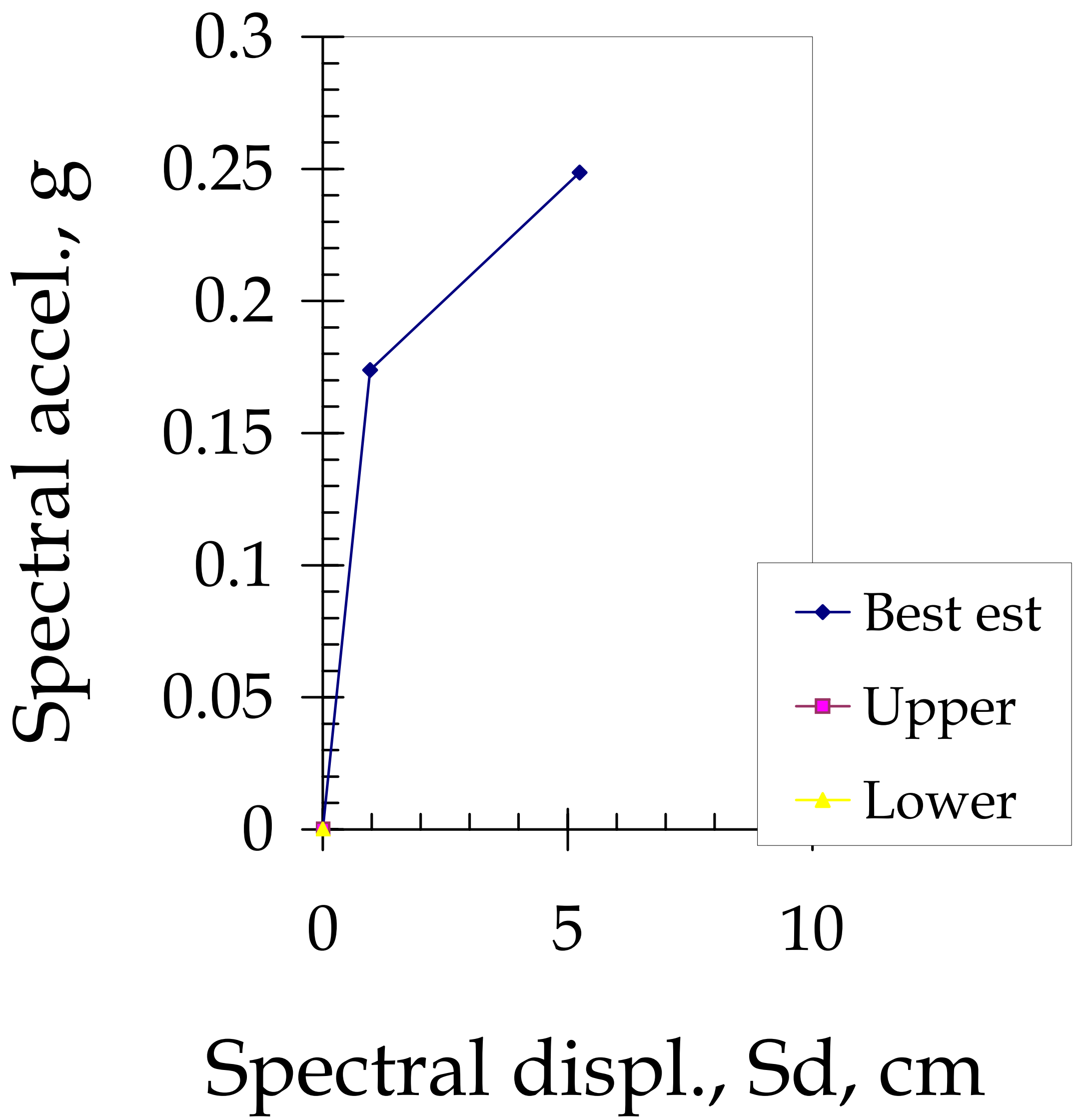
D14	5.24	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	5.77	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
Spectral accel., g
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2HH RC dual system, High seismic code design (1995), High-rise (9 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.44	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.75	alpha1; generally 0.7 to 0.8
Building weight:	11577.50	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	4.10	0.37			apparent yield point
2	28.40	0.52			ultimate point (15% drop in strength)
3	28.40	0.42			beginning of lower plateau
4	42.55	0.42			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

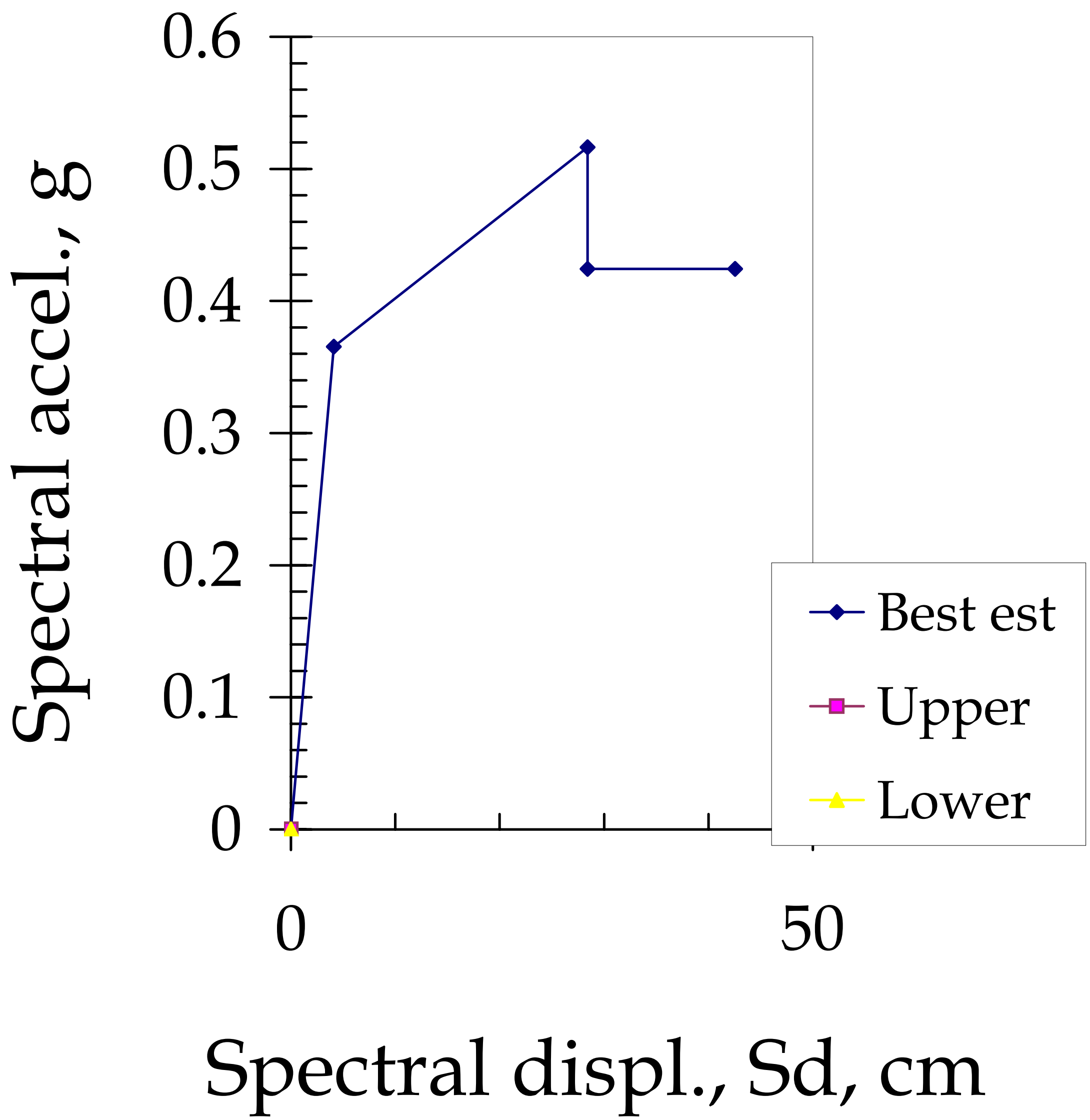
D14	42.55	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	51.06	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
Best est
Upper
Lower
Spectral displ., Sd, cm

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2HL RC dual system, Low seismic code design (1959), High-rise (9 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.43	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.74	alpha1; generally 0.7 to 0.8
Building weight:	12457.38	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	2.88	0.24			apparent yield point
2	12.32	0.26			ultimate point (15% drop in strength)
3	12.32	0.19			beginning of lower plateau
4	17.29	0.19			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

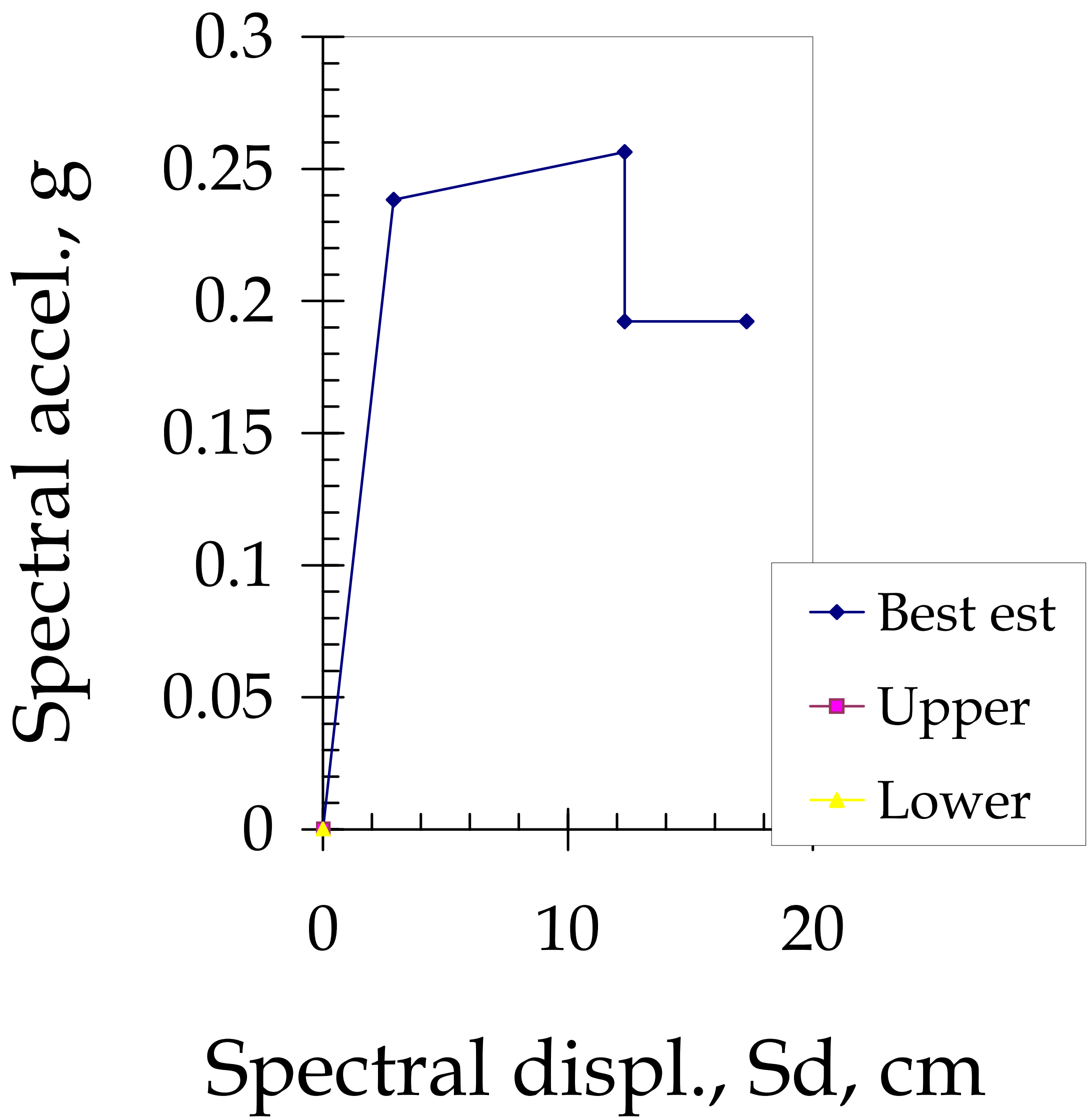
D14	17.29	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	19.02	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate: D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired



Spectral accel., g
0.3
0.25
0.2
0.15
0.1
0.05
0
0
10
20
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2LH RC dual system, High seismic code design (1995), Low-rise (2 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.26	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.91	alpha1; generally 0.7 to 0.8
Building weight:	2239.04	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.44	0.75			apparent yield point
2	17.46	0.86			ultimate point (15% drop in strength)
3	17.46	0.44			beginning of lower plateau
4	28.91	0.44			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

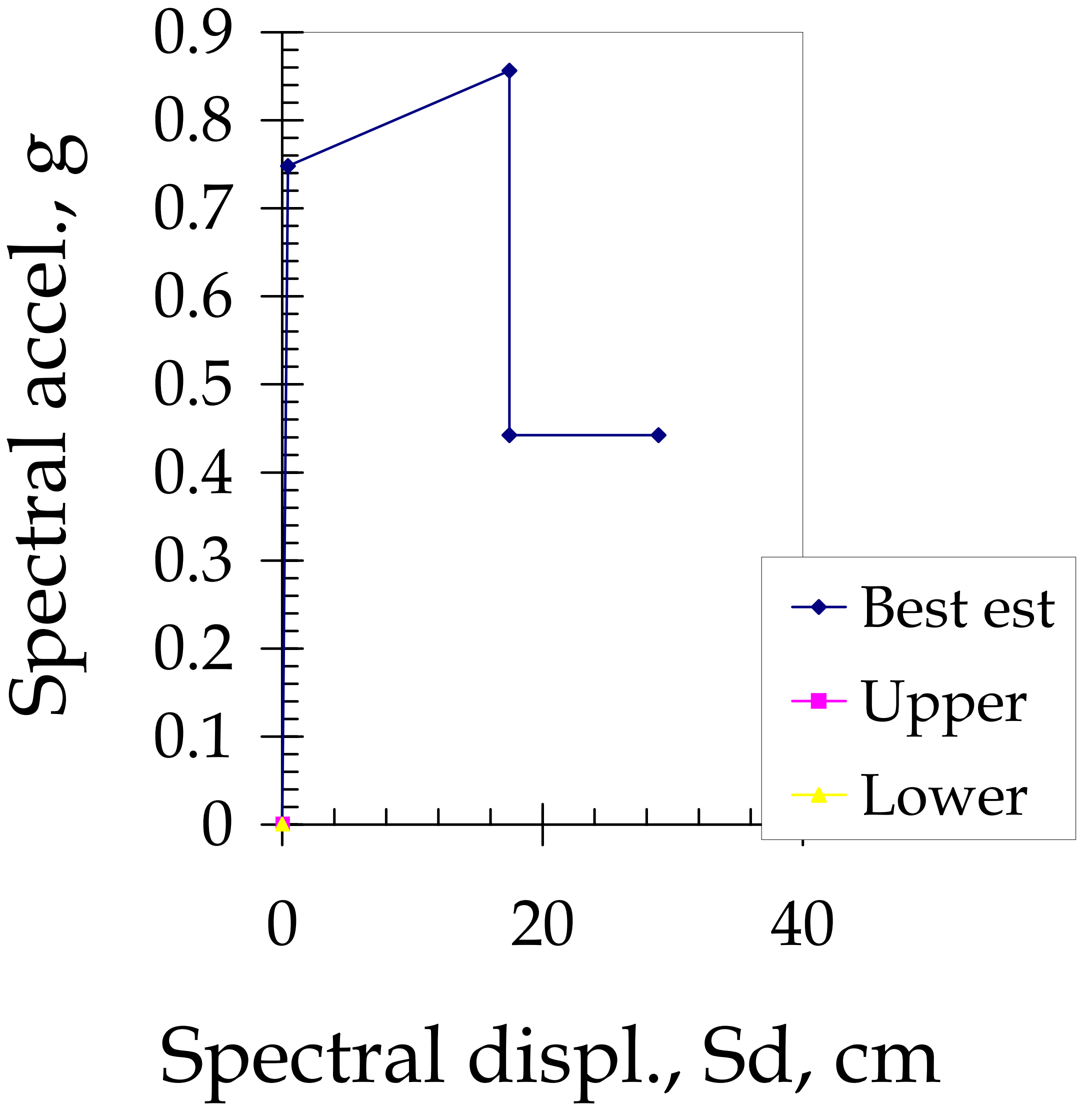
D14	28.91	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	34.70	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2LL RC dual system, Low seismic code design (1959), Low-rise (2 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.25	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.91	alpha1; generally 0.7 to 0.8
Building weight:	2555.74	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.43	0.40			apparent yield point
2	3.55	0.52			ultimate point (15% drop in strength)
3	3.55	0.39			beginning of lower plateau
4	4.24	0.39			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

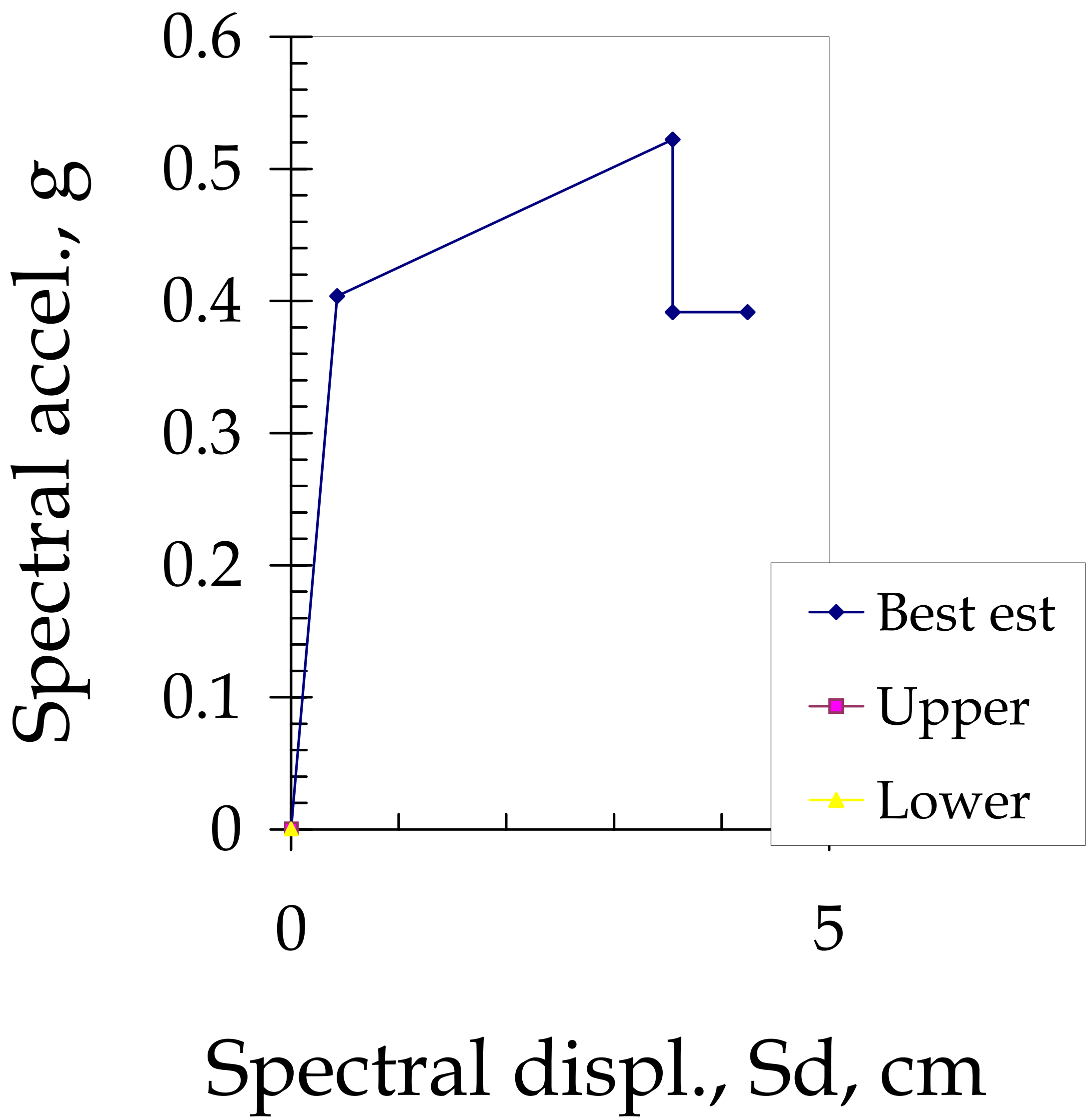
D14	4.24	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	4.67	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.6
0.5
0.4
0.3
0.2
0.1
0
Spectral accel., g
0
5
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2MH RC dual system, High seismic code design (1995), Medium-rise (4 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe

Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.38	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.83	alpha1; generally 0.7 to 0.8
Building weight:	4810.14	W, kN. Change and state units if desired
How were these values & pushover points derived?		

Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	1.15	0.41			apparent yield point
2	13.82	0.41			ultimate point (15% drop in strength)
3	13.82	0.33			beginning of lower plateau
4	30.20	0.33			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

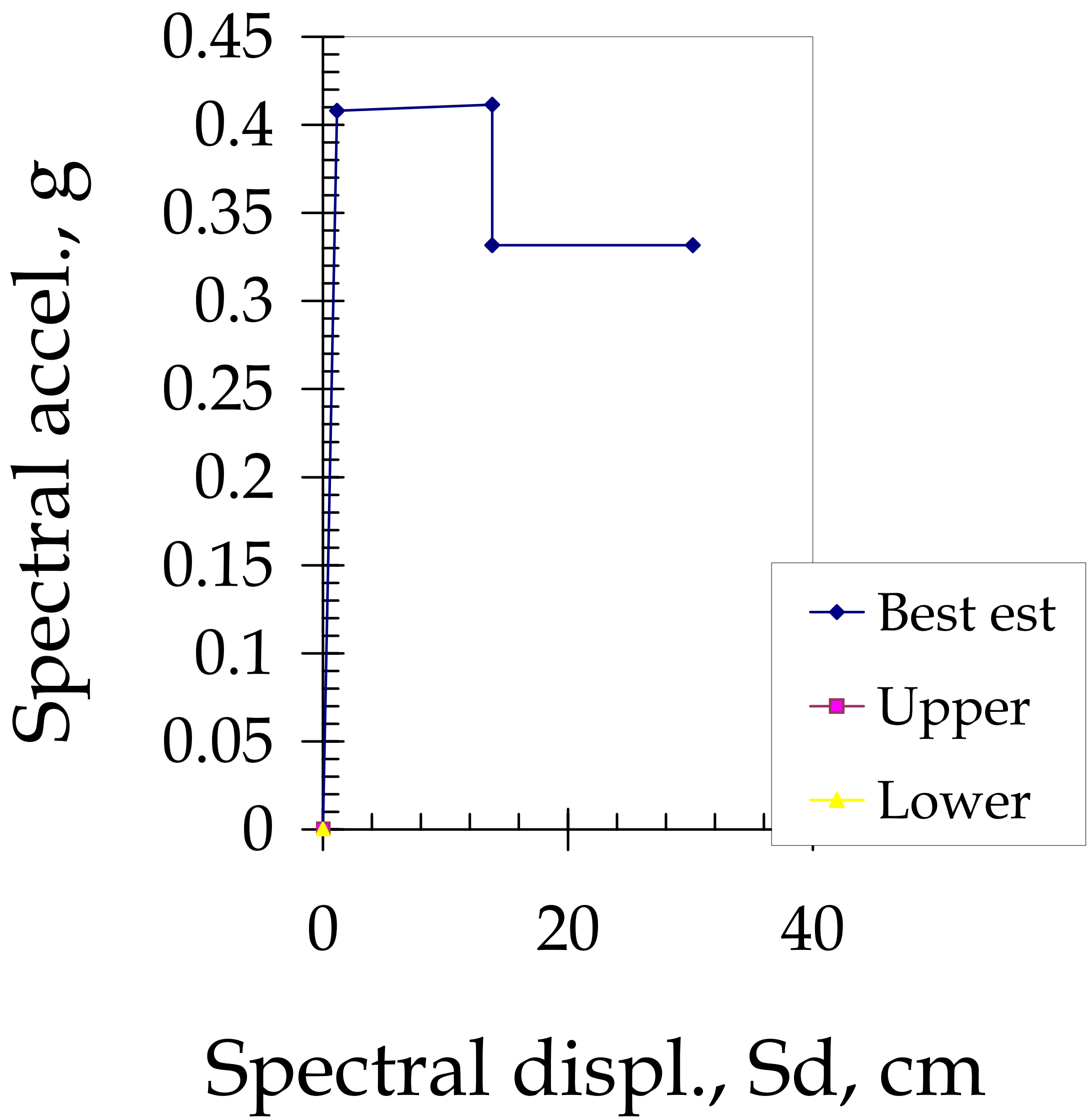
D14	30.20	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	36.24	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.2ML RC dual system, Low seismic code design (1959), Medium-rise (4 storeys), Fully infilled
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.38	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.82	alpha1; generally 0.7 to 0.8
Building weight:	5523.02	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.86	0.23			apparent yield point
2	5.39	0.28			ultimate point (15% drop in strength)
3	5.39	0.24			beginning of lower plateau
4	6.07	0.24			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

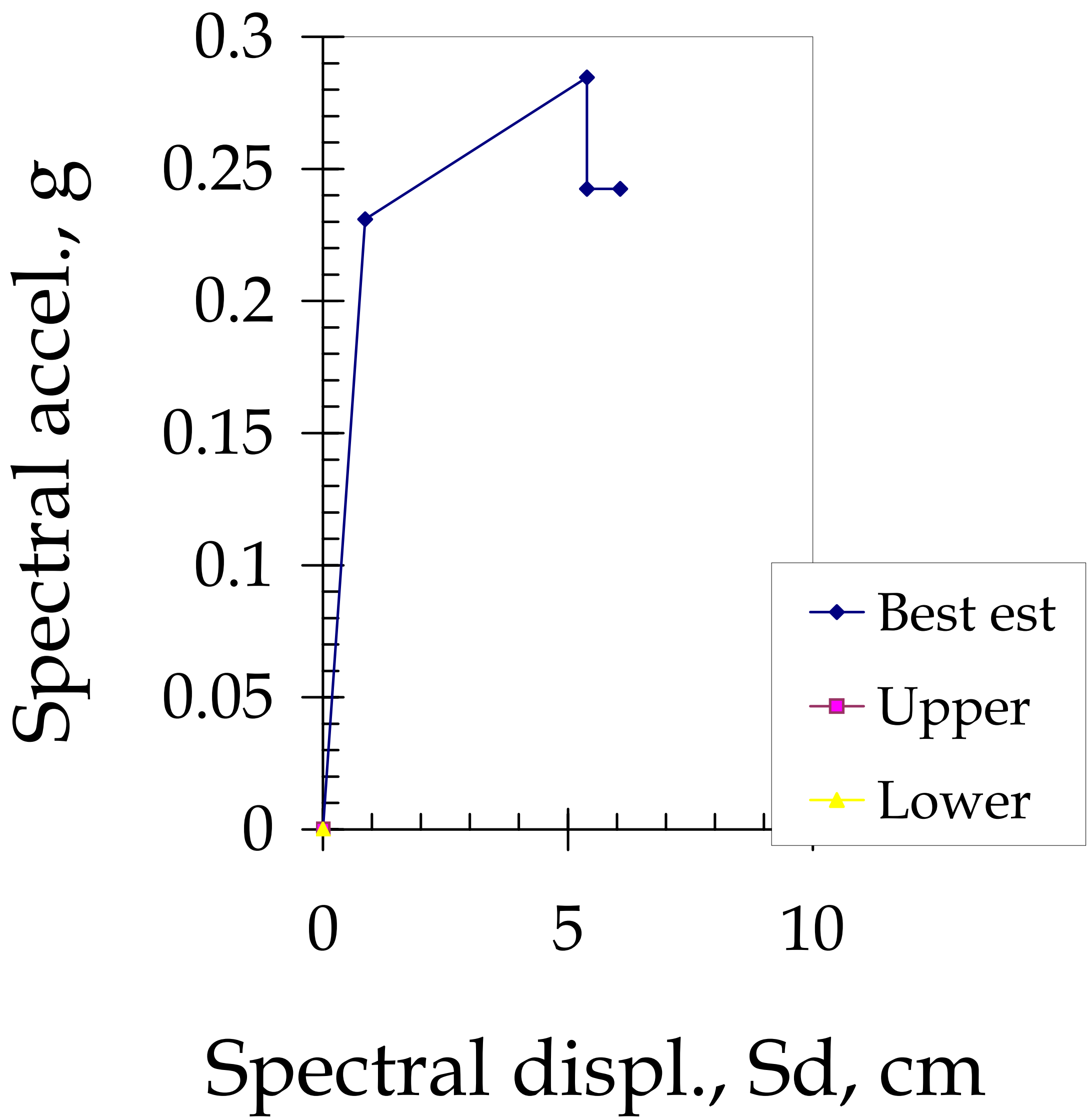
D14	6.07	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	6.68	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3HH RC dual system, High seismic code design (1995), High-rise (9 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.44	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.76	alpha1; generally 0.7 to 0.8
Building weight:	11577.50	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	4.14	0.36			apparent yield point
2	28.91	0.51			ultimate point (15% drop in strength)
3	28.91	0.44			beginning of lower plateau
4	43.48	0.44			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

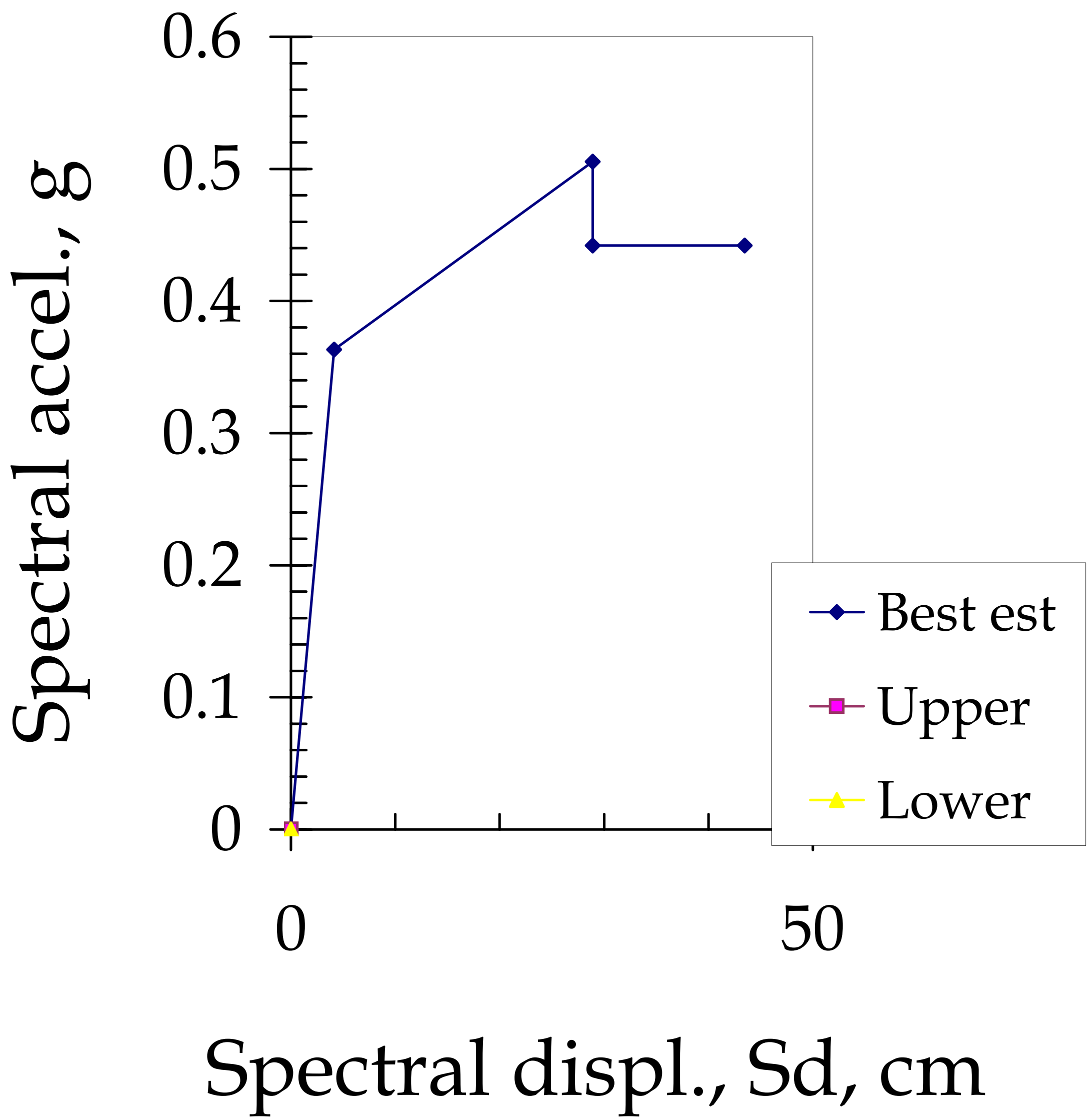
D14	43.48	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	52.18	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3HL RC dual system, Low seismic code design (1959), High-rise (9 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe

Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.43	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.75	alpha1; generally 0.7 to 0.8
Building weight:	12457.38	W, kN. Change and state units if desired
How were these values & pushover points derived?		

Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	2.75	0.23			apparent yield point
2	12.13	0.25			ultimate point (15% drop in strength)
3	12.13	0.19			beginning of lower plateau
4	17.30	0.19			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

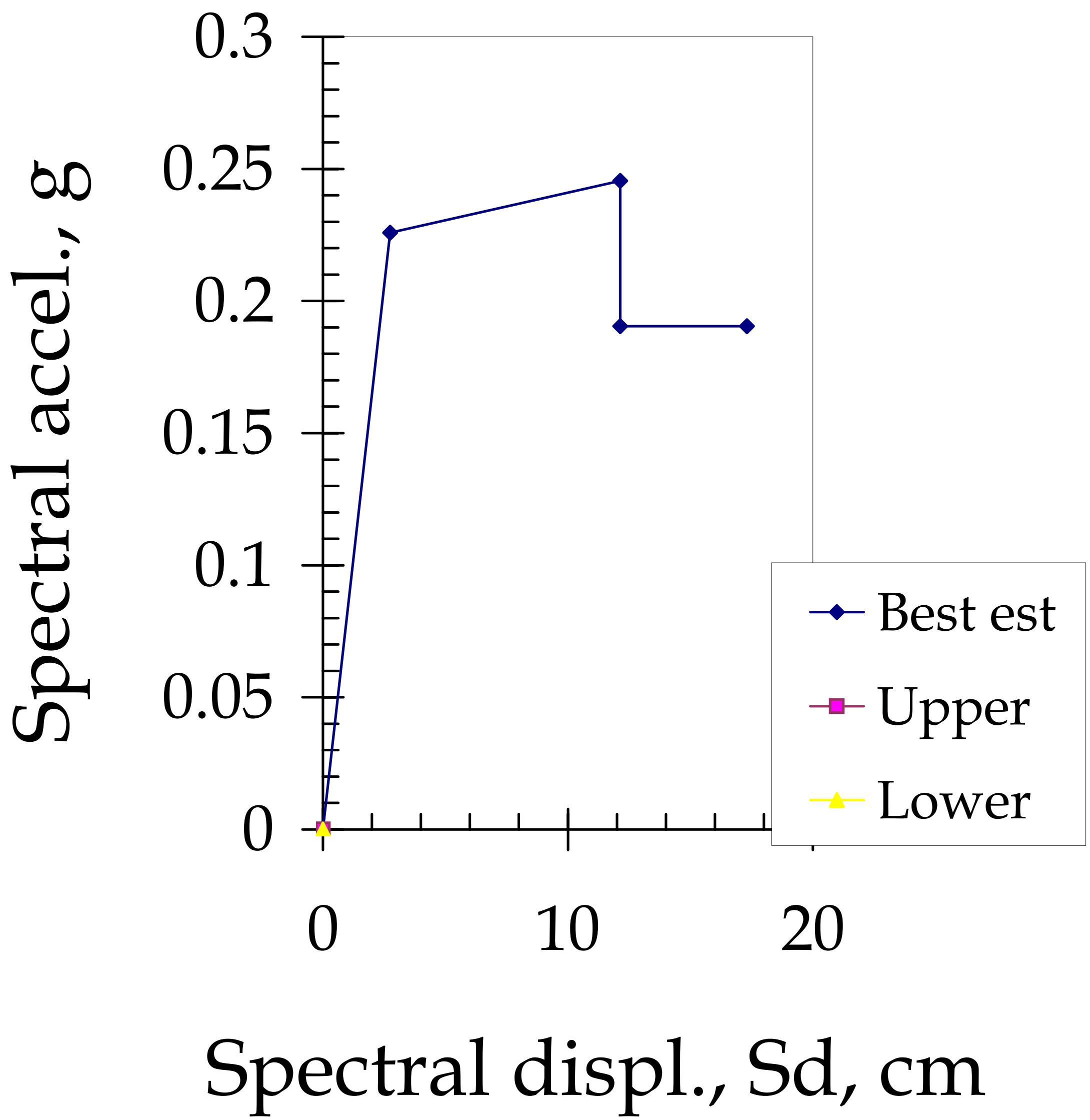
D14	17.30	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	19.03	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.3
0.25
0.2
0.15
0.1
0.05
0
Spectral accel., g
0
10
20
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3LH RC dual system, High seismic code design (1995), Low-rise (2 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.26	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.91	alpha1; generally 0.7 to 0.8
Building weight:	2239.04	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.49	0.73			apparent yield point
2	17.55	0.81			ultimate point (15% drop in strength)
3	17.55	0.44			beginning of lower plateau
4	29.04	0.44			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

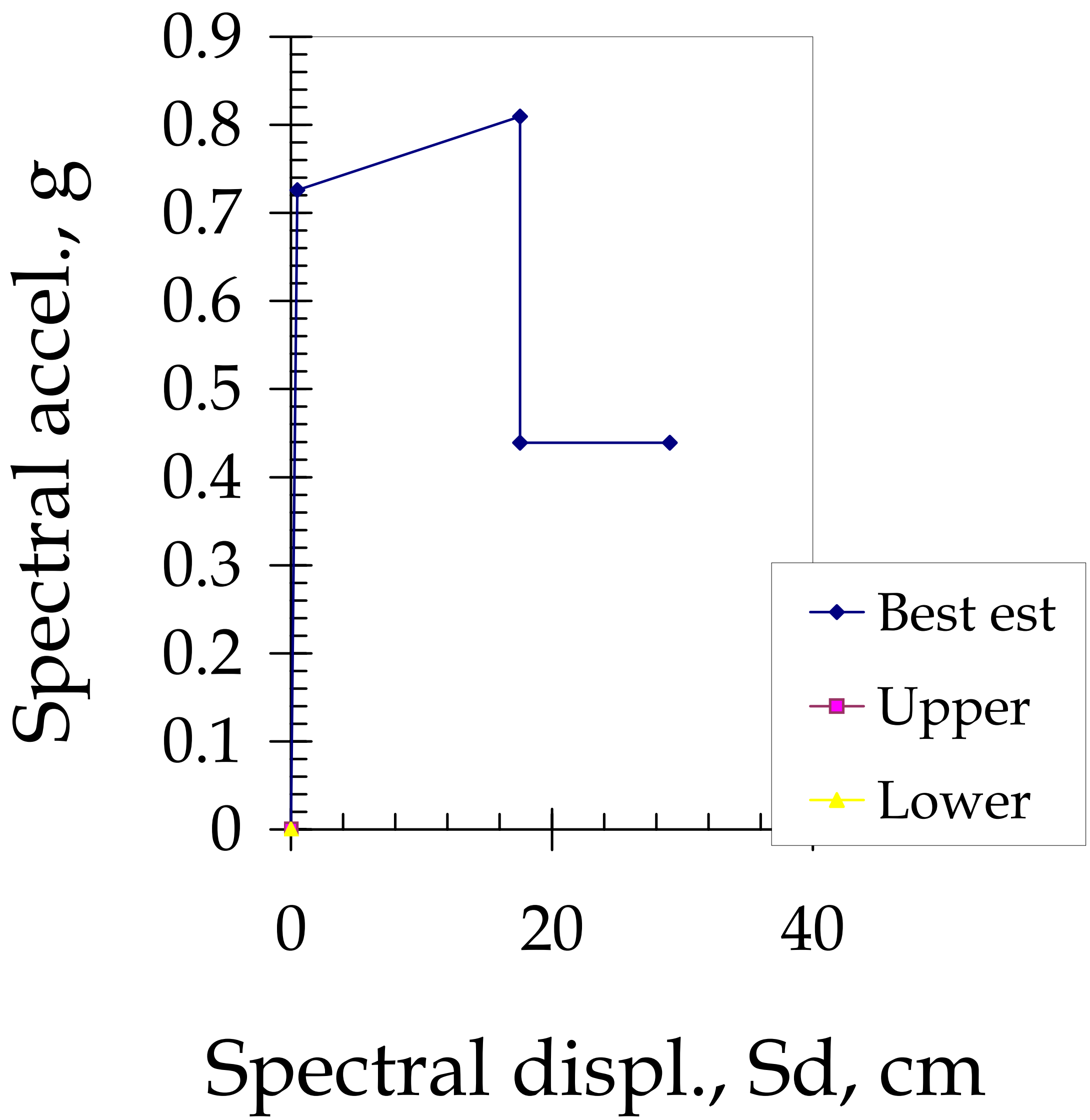
D14	29.04	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	34.84	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate: D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


Spectral accel., g
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3LL RC dual system, Low seismic code design (1959), Low-rise (2 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.25	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.91	alpha1; generally 0.7 to 0.8
Building weight:	2555.74	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.31	0.30			apparent yield point
2	3.56	0.45			ultimate point (15% drop in strength)
3	3.56	0.32			beginning of lower plateau
4	3.93	0.32			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

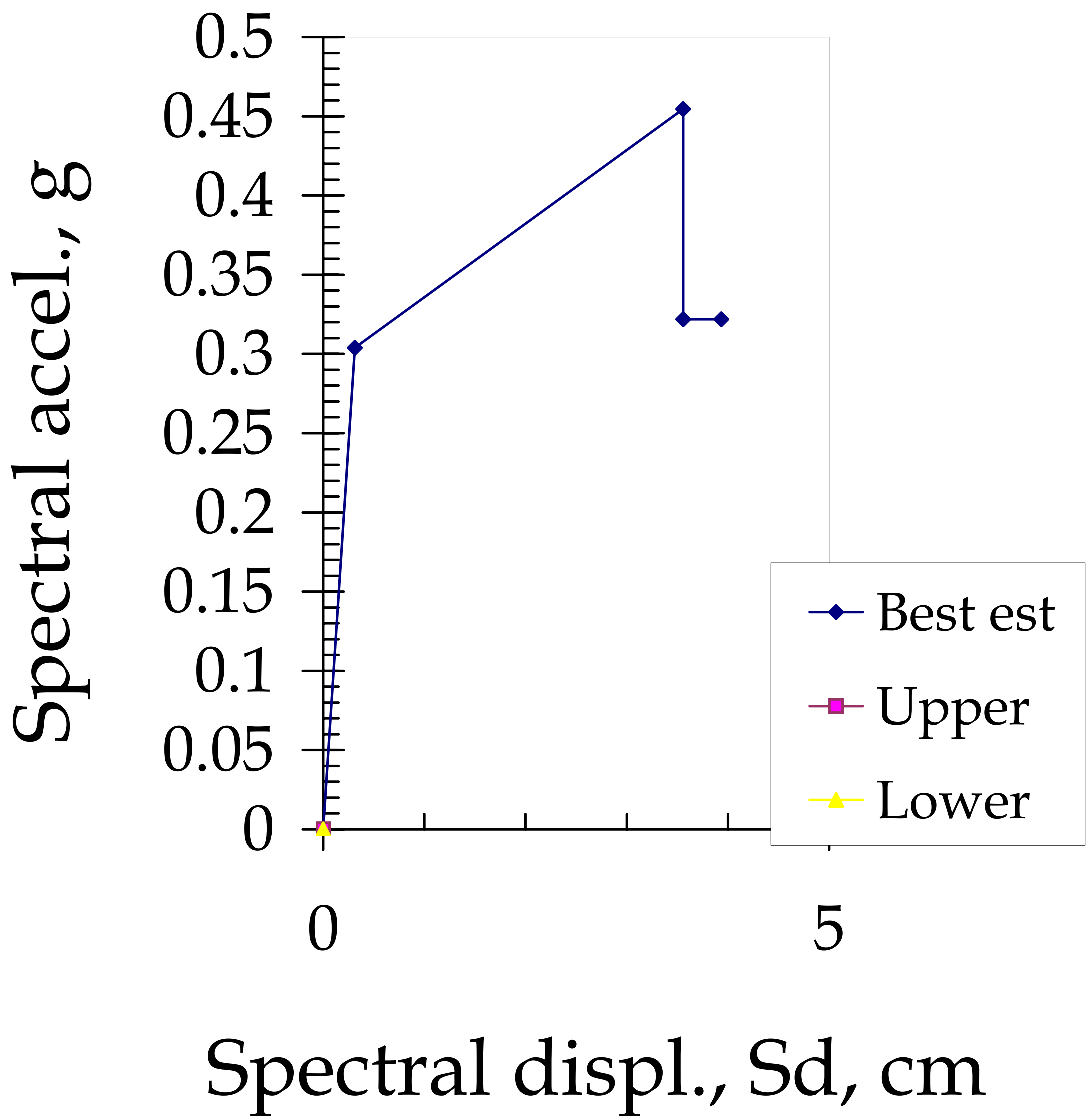
D14	3.93	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	4.33	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate: D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Spectral accel., g
0
5
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3MH RC dual system, High seismic code design (1995), Medium-rise (4 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe
	Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.38	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.84	alpha1; generally 0.7 to 0.8
Building weight:	4810.14	W, kN. Change and state units if desired
How were these values & pushover points derived?		
		Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	1.10	0.38			apparent yield point
2	15.40	0.39			ultimate point (15% drop in strength)
3	15.40	0.33			beginning of lower plateau
4	30.33	0.33			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?

Author's meaning of "upper bound":

How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?

Author's meaning of "lower bound":

How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

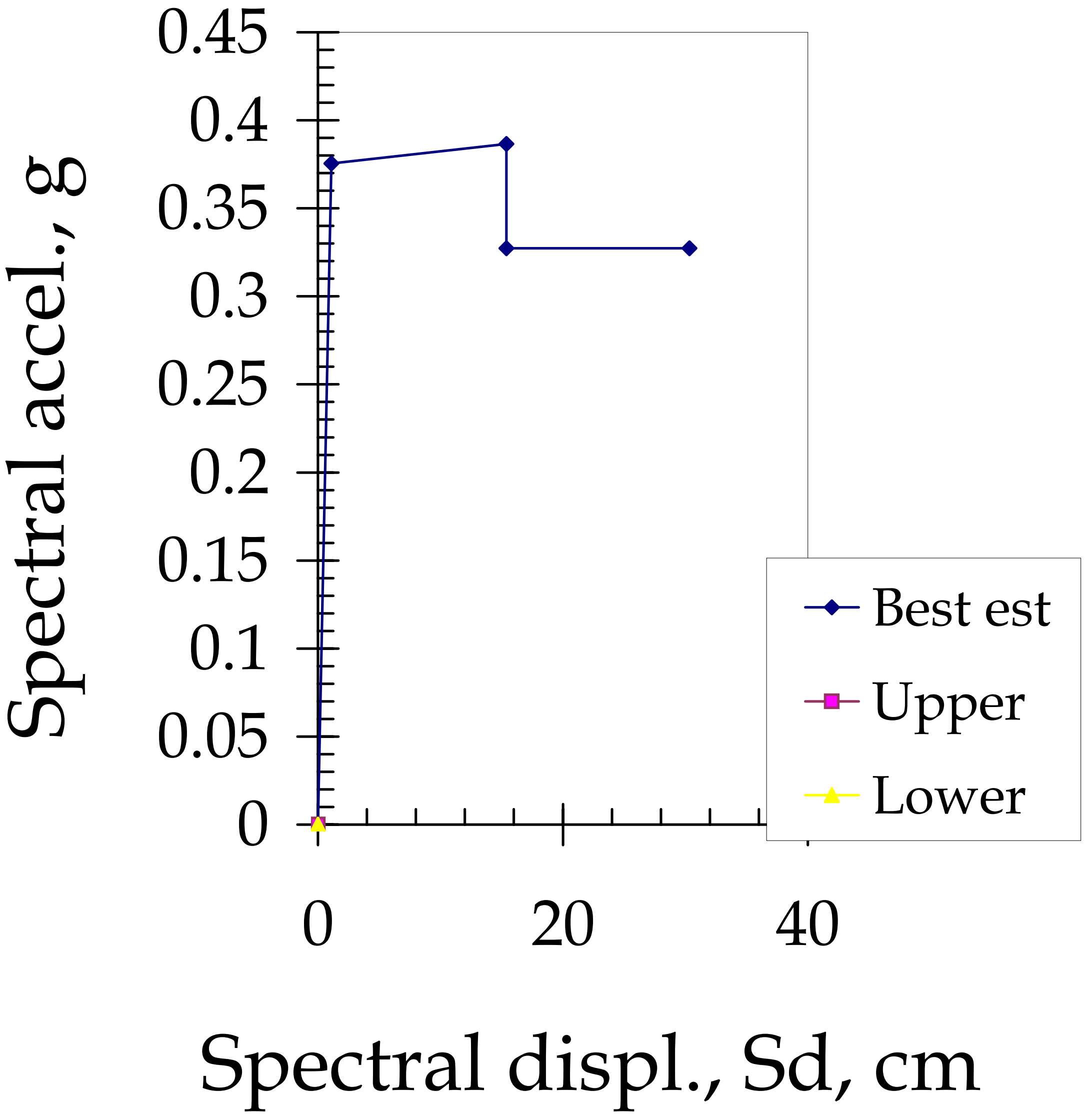
D14	30.33	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	36.40	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate: D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves

For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design

For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Spectral accel., g
0
20
40
Spectral displ., Sd, cm
Best est
Upper
Lower

WHE-PAGER PHASE 2: DEVELOPMENT OF ANALYTICAL SEISMIC VULNERABILITY FUNCTIONS

Author:	Kappos Andreas, Panagopoulos Georgios
Date:	9/15/2009
Structure type (describe as broadly as possible):	RC4.3ML RC dual system, Low seismic code design (1959), Medium-rise (4 storeys), Soft storey (pilotis)
Geographic or other limitations:	Greece, Southern Europe

Add rows as desired

Basic pushover curve for this structure type

Pushover X-axis:	Sd (cm)	Choose spectral displacement (Sd), inches; or Roof displacement (Deltar), inches. Change and state units if desired.
Pushover Y-axis:	Sa (g)	Choose spectra acceleration (Sa), g; or base shear (V), kip. Change and state units if desired.
Elastic damping ratio:		Small-amplitude damping ratio, fraction of critical
1st mode participation factor:	1.38	PFfR; generally 1.3 to 1.5; same as (effective height)/(total roof height)
Effective mass coefficient:	0.83	alpha1; generally 0.7 to 0.8
Building weight:	5523.02	W, kN. Change and state units if desired
How were these values & pushover points derived?		

Add rows as desired

Pushover curve control point	X	Y	Damping	Comment	
0	0	0	5		Control point for plotting purposes
1	0.79	0.21			apparent yield point
2	5.12	0.27			ultimate point (15% drop in strength)
3	5.12	0.17			beginning of lower plateau
4	5.51	0.17			end of lower plateau

Optional: upper and lower-bound range of pushover curves for this structure type

Upper-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the Y-axis?
Author's meaning of "upper bound":
How were these values & pushover points derived?

Add rows as desired

Optional upper-bound pushover curve

Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Lower-bound pushover curve, e.g., 99 out of 100 buildings of this type would have pushover curve inside the area bounded between this curve and the X-axis?
Author's meaning of "lower bound":
How were these values & pushover points derived?

Add rows as desired

Optional lower-bound pushover curve

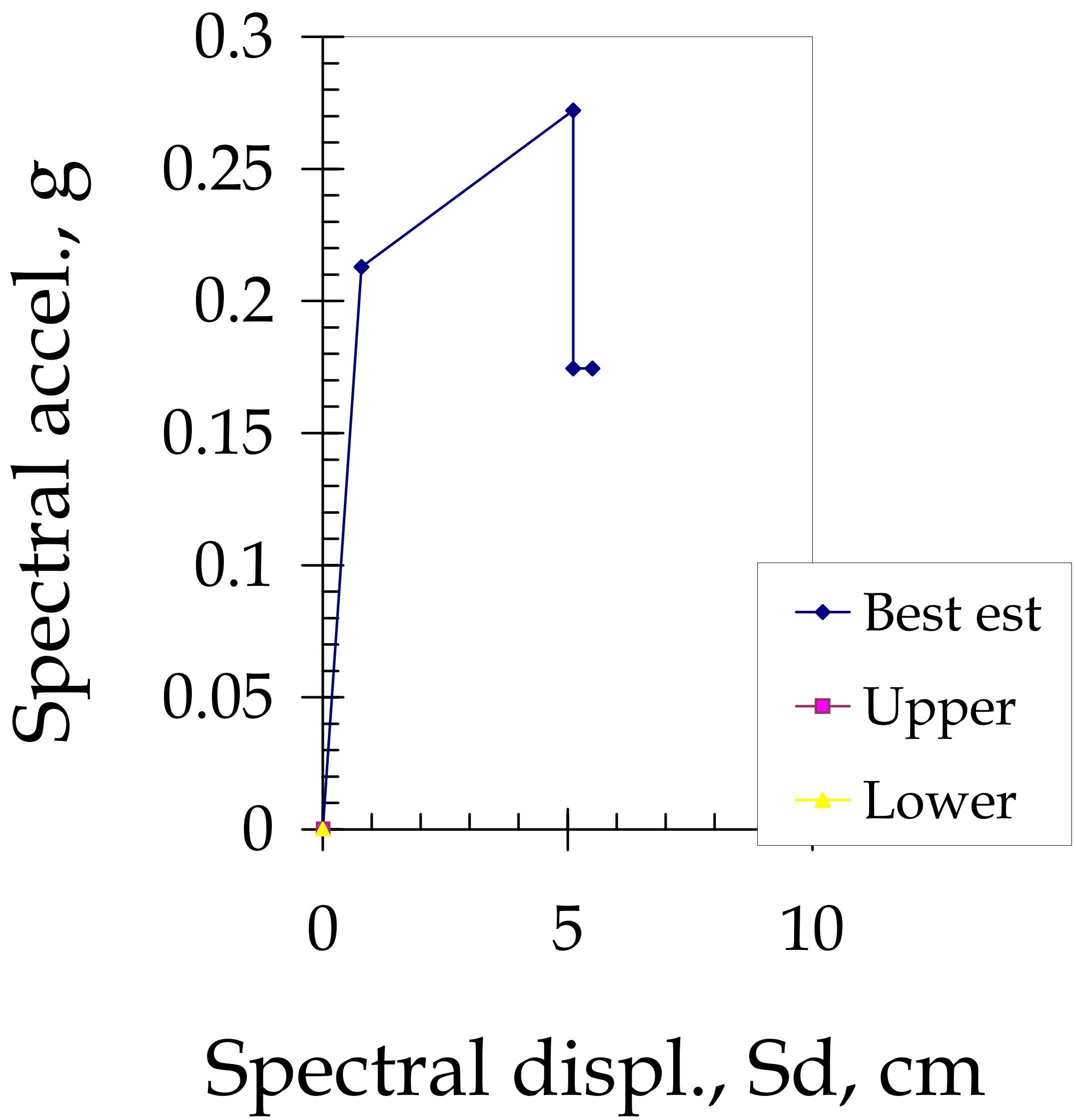
Pushover curve control point	X	Y	Damping	Comment	
0	0	0			Control point for plotting purposes
1					E.g., yield point?
2					E.g., ultimate point?
3					E.g., beginning of lower plateau?
4					Add rows as desired

Other requested parameters

D14	5.51	median drift (in same units as pushover X-axis) associated with complete structural damage, i.e., drift with 50% chance that the structural component of the building cannot be economically repaired
B14	0.60-0.80	logarithmic standard deviation of drift associated with complete structural damage. May need to be guessed
Sdc	6.06	the median value of drift (in same units as pushover X-axis) associated with collapse, e.g., Sdc = (roof drift at collapse)/PFfR.
L15		indoor fatality rate given collapse. Many contributors may be unable to provide this value. Porter, Comartin, and Holmes will fill such gaps
PC		mean fraction of building area collapsed, given complete structural damage. Again Porter, Comartin, and Holmes will fill gaps
kshort		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for short-duration (M <= 5.5) events
kmed		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for medium-duration (5.5 < M < 7.5) events
klong		If HAZUS-style damping preferred, and author can judge, this is the degradation factor for long-duration (M >= 7.5) events

Explain how these values were arrived at, providing citations if appropriate D14=Sd(4) for 4-linear curves or Sd(2) for bilinear curves
For frame systems Sdc/D14=1.3 for low, 1.4 for medium and 1.5 for high code design
For dual systems Sdc/D14=1.1 for low and 1.2 for high code design

Add rows as desired


0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
Spectral accel., g
Spectral displ., Sd, cm
Best est
Upper
Lower