

EVALUATION OF CONDITIONAL MEAN SPECTRA CODE CRITERIA  
FOR GROUND MOTION SELECTION

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SUPPLEMENTAL MATERIALS

Table S1: Disaggregation data for the approximate building location at 34.050°N, -118.251°W for Site Class C and OVE (4975-year) hazard level, obtained from 2014 USGS National Seismic Hazard Model (Petersen et al. 2015).

Period (s)	Distance to Rupture (km), $R$	Magnitude, $M$	Epsilon, $\epsilon$
0.01	8.47	7.01	1.56
0.2	8.63	6.98	1.57
1	9.31	7.16	1.50
3	12.35	7.39	1.51
5	17.93	7.57	1.50
7.5	41.27	7.76	1.56
10	96.60	7.91	1.58

Table S2: Key parameters used for ground motion selection, using the script accompanying Baker and Lee (2018). For this study, modifications were made to the original Matlab code to allow for input of a custom target spectrum prepared outside of the script (e.g., UHS, artificially modified CMS).

Variable Name	Variable Description	Value(s)	Notes
selectionParams.cond	conditional (0) or unconditional (1) selection	0 (UHS-based procedure), 1 (CMS-based procedures, except for special cases, see Notes at right)	choice of conditional vs. unconditional selection for CMS was found to have minor impact on results; special cases: $T^*=9$ s in theoretical CMS procedure; all targets in practical CMS procedures; all CMS targets scaled down to 10% of MCE spectral amplitudes (Fig. S2)
selectionParams.matchV	include (1) or exclude (0) vertical component of motion in selection	0	
selectionParams.maxScale	maximum allowed scaling factor	5	
selectionParams.nGM	number of ground motion records selected per target	40 default, 11 for supplemental ASCE 7-22 cases	
selectionParams.optType	optimization method for selection; sum of squared errors (0), KS-test D-statistics (1)	0	
selectionParams.Tmin, .Tmax	lower, upper bounds for spectral fitting	0.1s, 10s	extend beyond the minimum period range required by ASCE 7-22 in order to suppress unwanted artifacts (e.g., unreasonably high spectral amplitudes) at very low and high periods
selectionParams.tol	maximum tolerable percent error to skip optimization	10	
selectionParams.useVar	use computed variance in selection (1) or use zero variance (0)	0	zero variance used in order to match only the conditional mean spectra
selectionParams.weights	weights for errors in mean, standard deviation, and skewness, respectively	[5.0, 0.1, 0.1]	weights were chosen to focus on match of the mean spectra, with little priority given to the standard deviation and skewness
allowedRecs.D	range of permissible distances in record selection	[0, 50km] default, [0, 100km] for special cases, see Notes	special cases: $T^* = \{8, 9\}$ in theoretical CMS procedure, where the distance range was increased to reflect larger distances in hazard disaggregation
allowedRecs.Mag	range of permissible earthquake magnitudes in record selection	[6, 8]	
allowedRecs.Vs30	range of permissible Vs30 values in record selection	[-Inf, Inf]	
rup.Vs30	average shear wave velocity over top 30m of site	360 m/s	

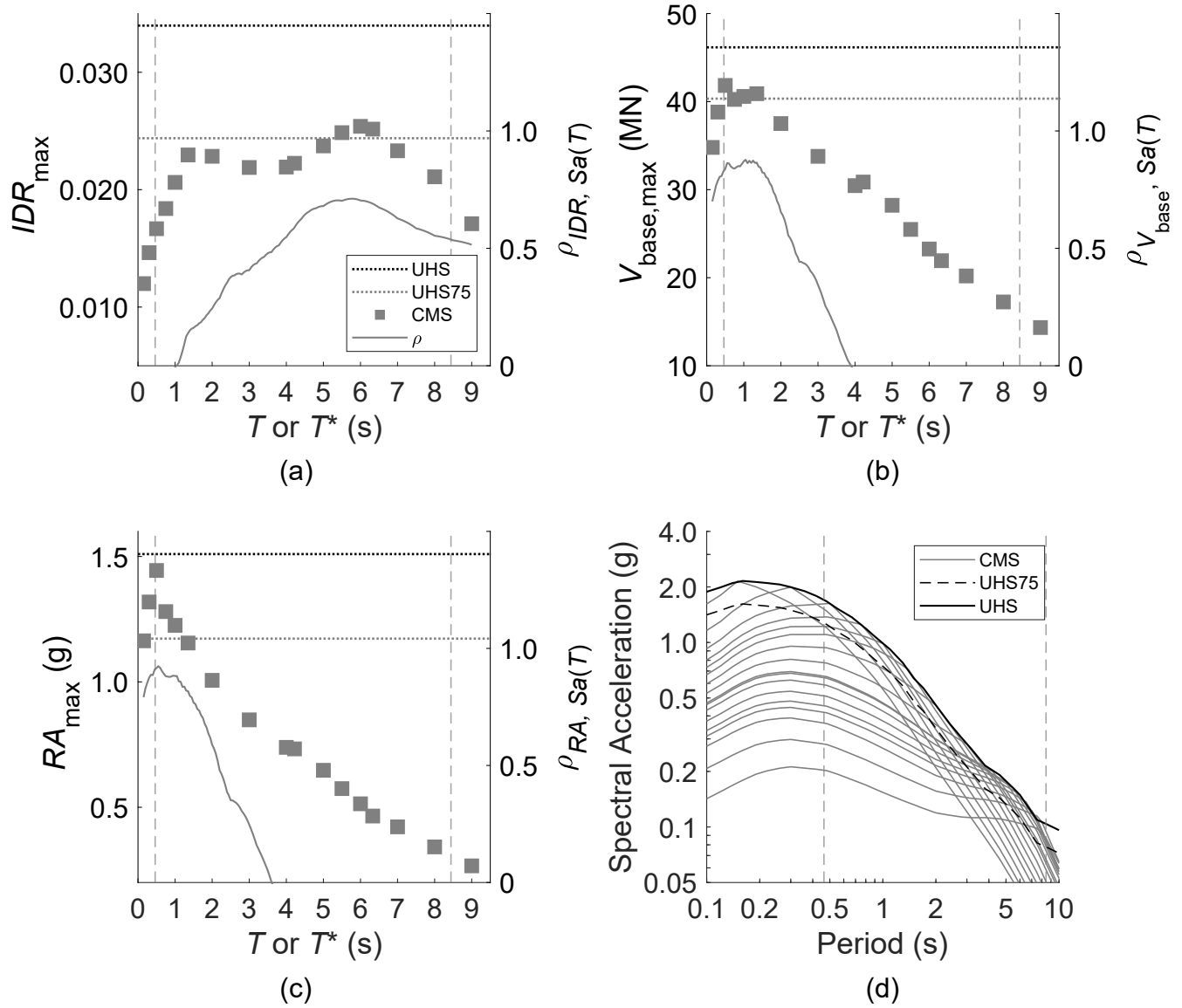


Figure S1: Theoretical CMS procedure at OVE (4975-year) hazard level: (a)-(c) EDP results for interstory drift ratio, base shear, and roof acceleration, respectively, with values of EDP- $Sa(T)$  correlation coefficients superimposed; (d) target spectra, with UHS-based spectra shown for reference.

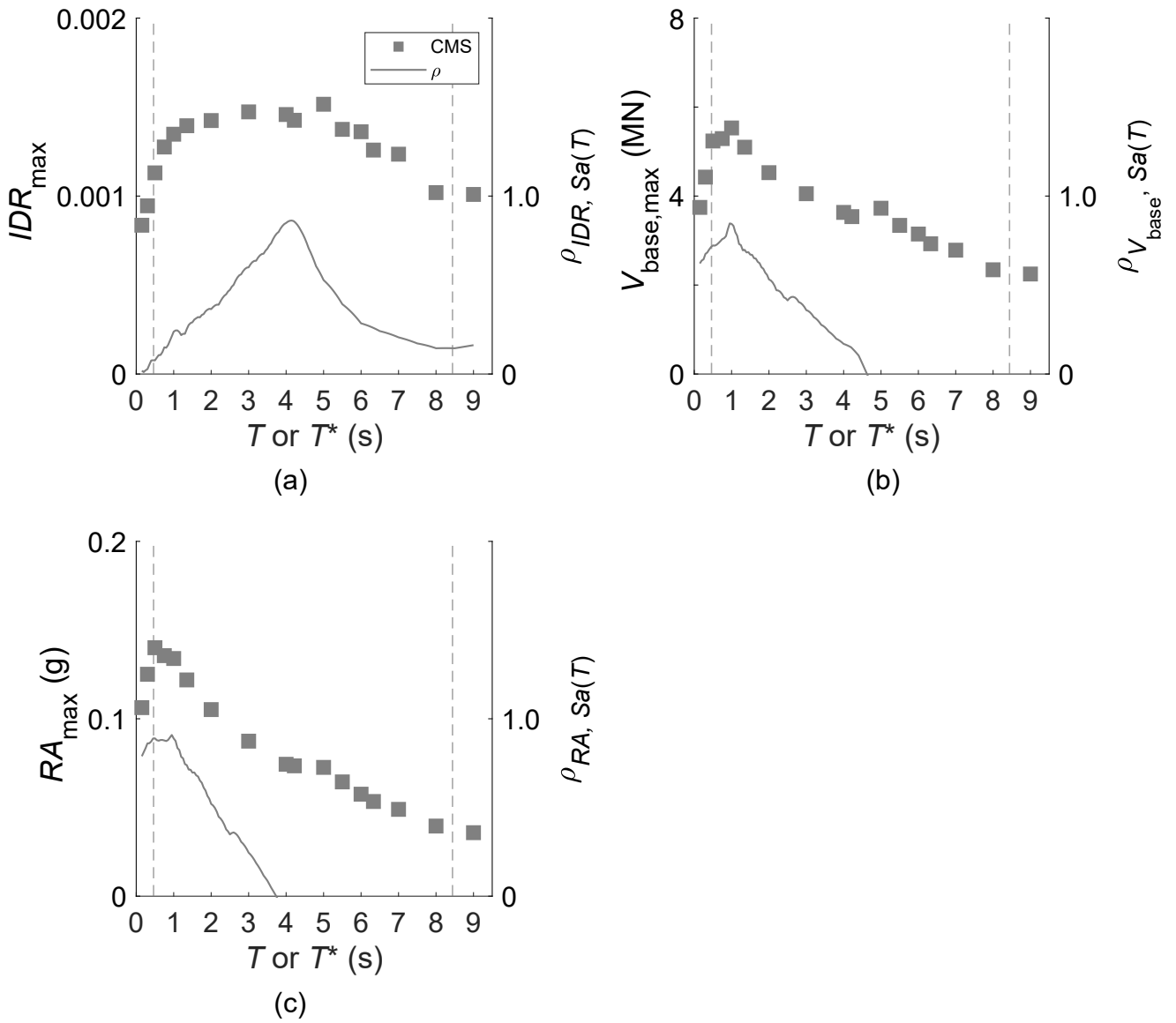


Figure S2: EDP results of theoretical CMS procedure using target spectra scaled to 10% of spectral amplitudes at MCE hazard level: (a) interstory drift ratio, (b) base shear, (c) roof acceleration. Values of EDP- $Sa(T)$  correlation coefficients superimposed.

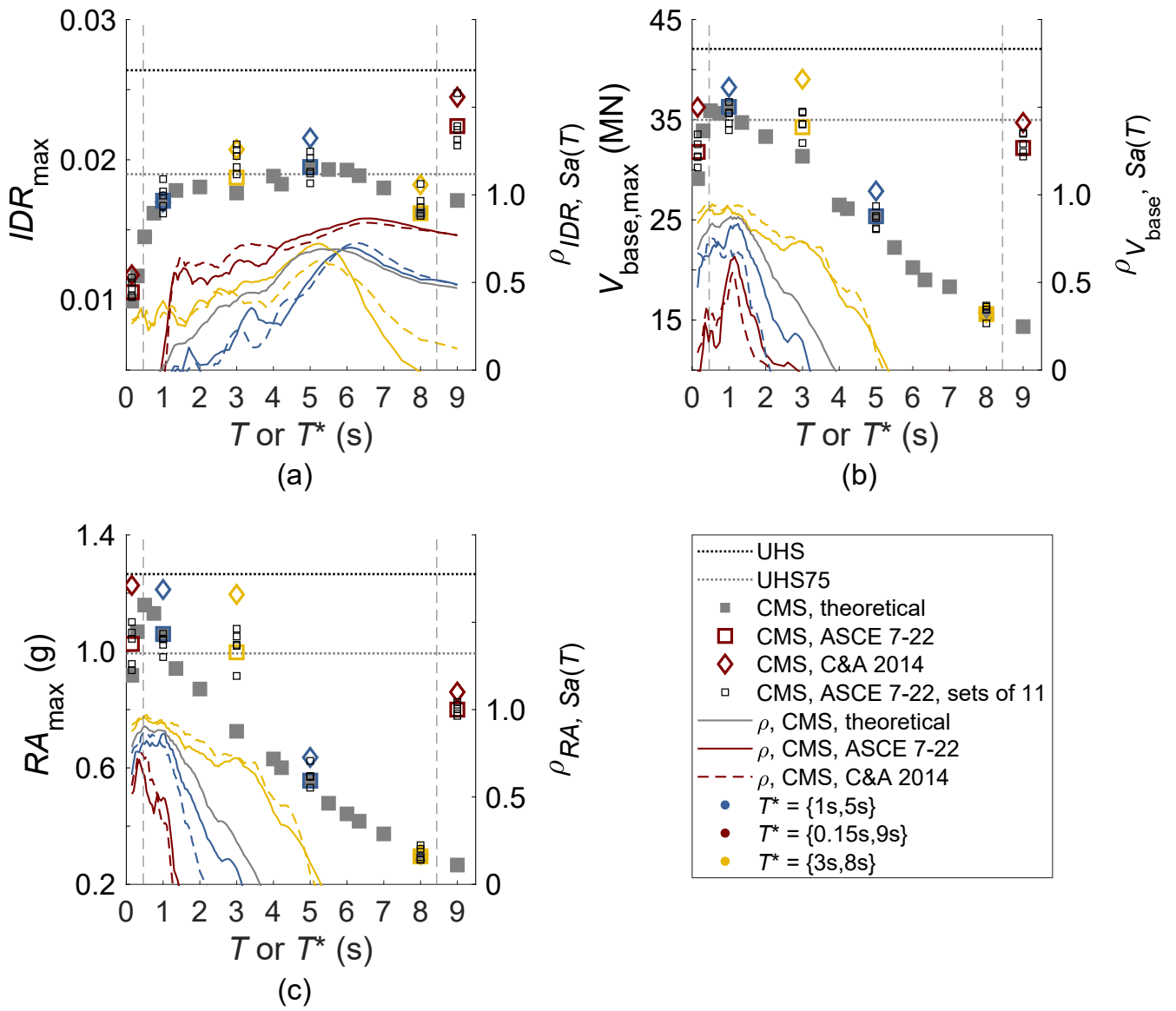


Figure S3: Comparison of EDP results of theoretical and practical CMS procedures at MCE hazard level: (a) interstory drift ratio, (b) base shear, (c) roof acceleration. Values of EDP-Sa(T) correlation coefficients superimposed.

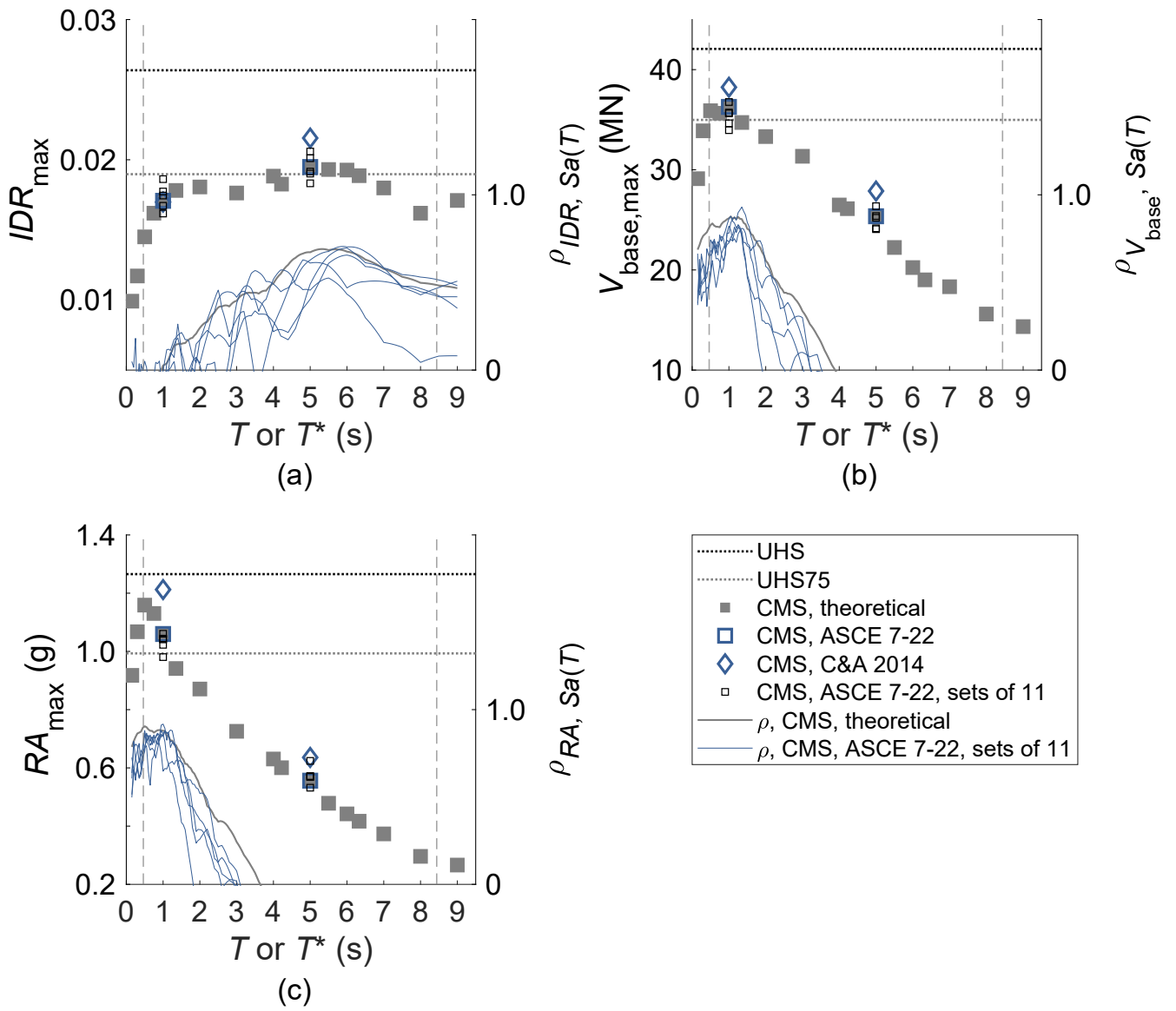


Figure S4: EDP spectra and correlation coefficient curves for practical CMS procedure at MCE hazard level using  $T^* = \{1s, 5s\}$  and sets of 11 or 40 motions.

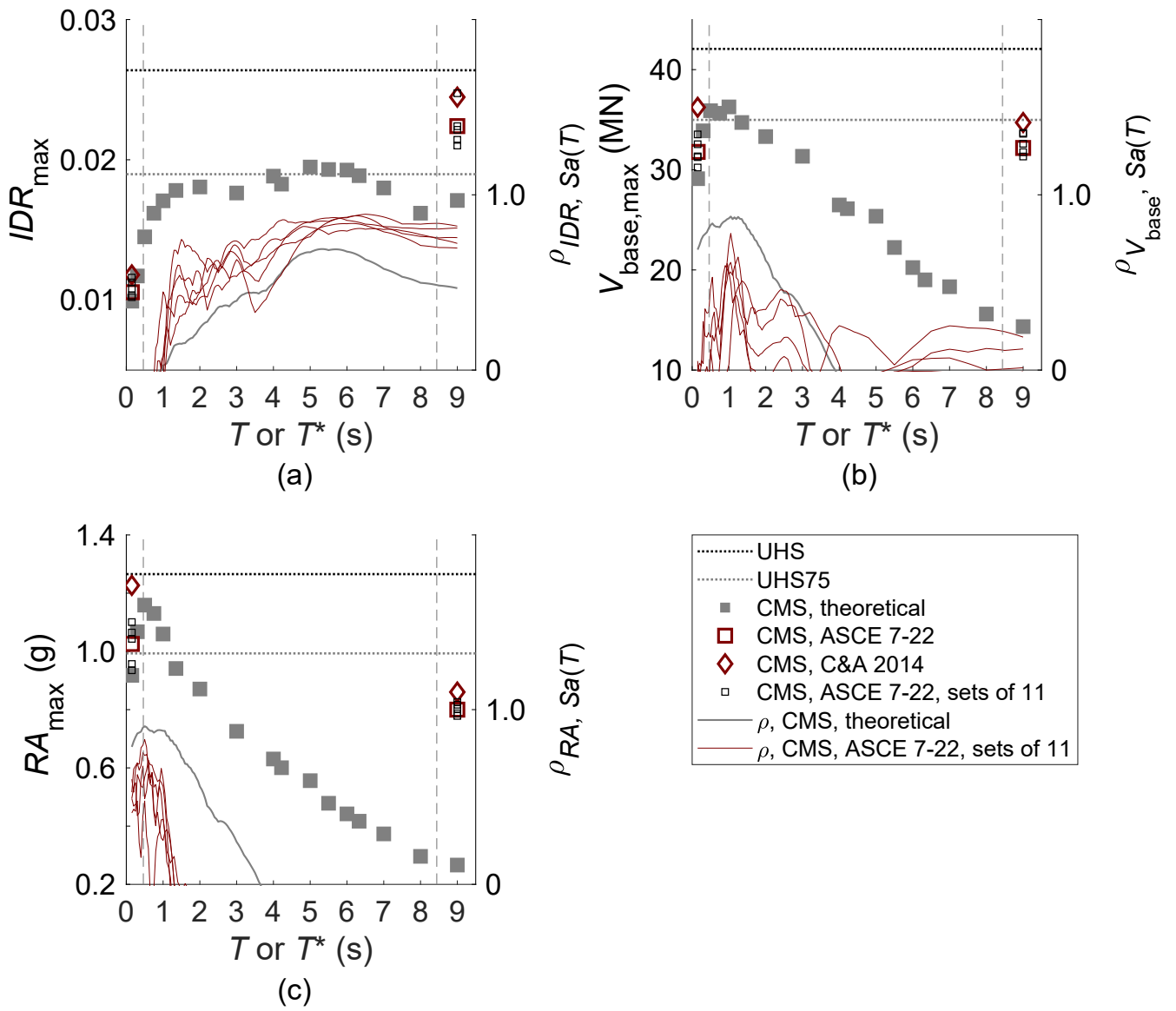


Figure S5: EDP spectra and correlation coefficient curves for practical CMS procedure at MCE hazard level using  $T^* = \{0.15s, 9s\}$  and sets of 11 or 40 motions.

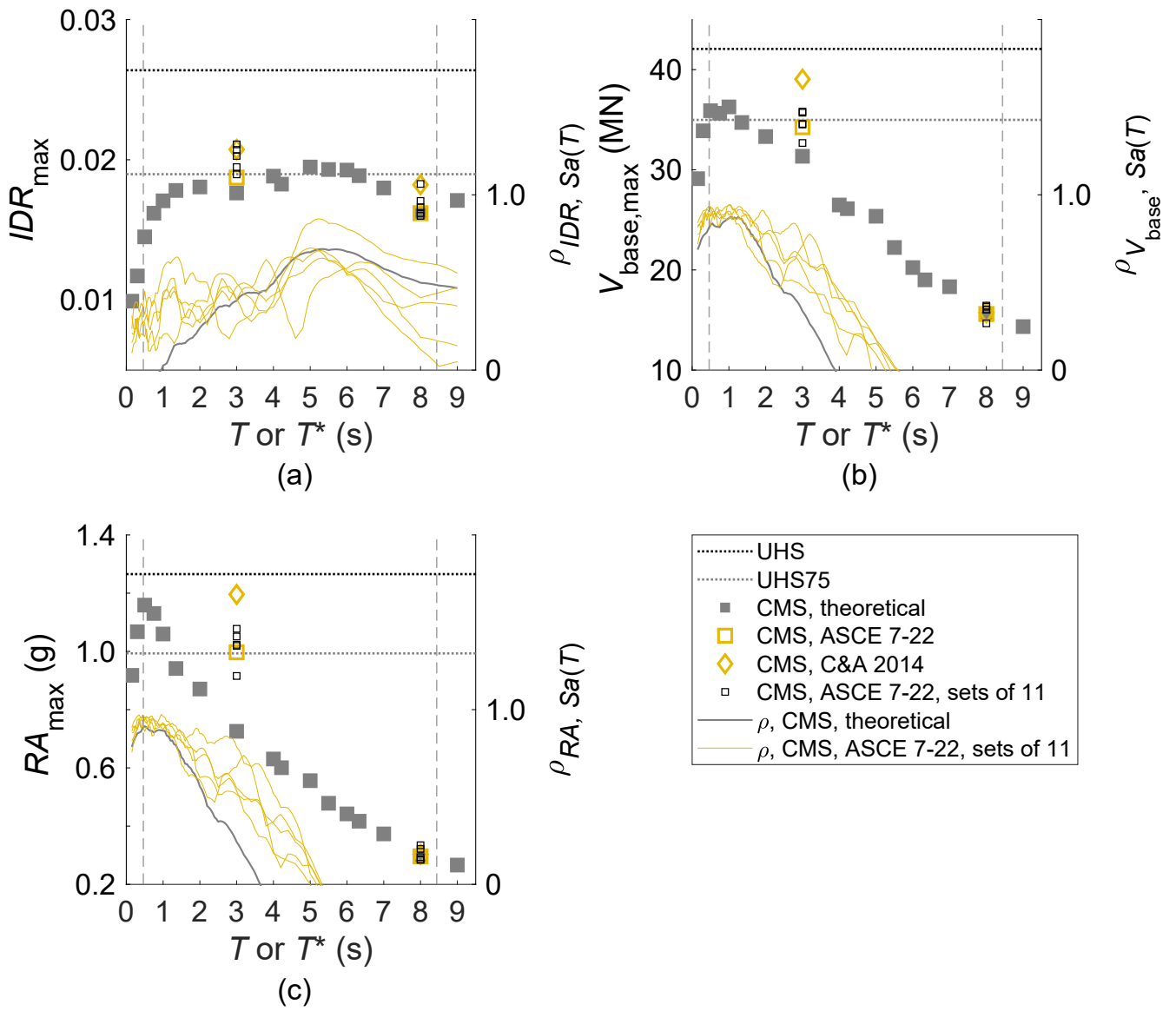


Figure S6: EDP spectra and correlation coefficient curves for practical CMS procedure at MCE hazard level using  $T^* = \{3s, 8s\}$  and sets of 11 or 40 motions.