

Seismology Committee Background and Position Regarding 1997 UBC Eq. 30-7 and Drift September 2001

This reply is in behalf of the SEAOC Seismology Committee regarding the 1997 UBC Eq. 30-7 and the recent errata that exempts its use with computing drift demand. Eq. 30-7 was developed in 1995 by the Seismology Committee based on information and recommendations of the Strong Ground Motion Ad-Hoc Committee chaired by Dr. Charles Kircher. The purpose of the equation was to account for the peculiar characteristics of some ground motion recordings in the near field, that display both large acceleration and displacement response to very long periods, as shown in the Figures below. Equation 30-7 was essentially intended to replicate the flat relationship between acceleration (at a value of about 0.4g) and displacement evident in Figure 3, below. As originally conceived there was a displacement cutoff for the equation, replicating the effect seen in Figure 2, that for each ground motion, there is some period beyond which, displacement response remains essentially constant. However, as the code change developed, it was decided to also use this equation to account for the additional displacement demands that occur on weak systems, due to strength degradation effects, and the proposal was put forward without such a displacement limit. Since the cutoff was dropped, there was a compromise agreement in the Spring of 1996 among the coalition parties including SEAOC Seismology (the seismic provisions of the 1997 UBC was a compromise product of a coalition of parties...not just SEAOC Seismology) to exempt Eq. 30-7 from drift demand calculations. The exemption of Eq. 30-7 from drift is indicated on page 445 of Appendix C of the 1996 Bluebook, where the seismic provisions of the of the 1997 UBC were first published for our membership. It should be noted that both the 1997 UBC design spectra and equivalent base shear equations directly account for general increases in ground motion in the near field by near source factors.

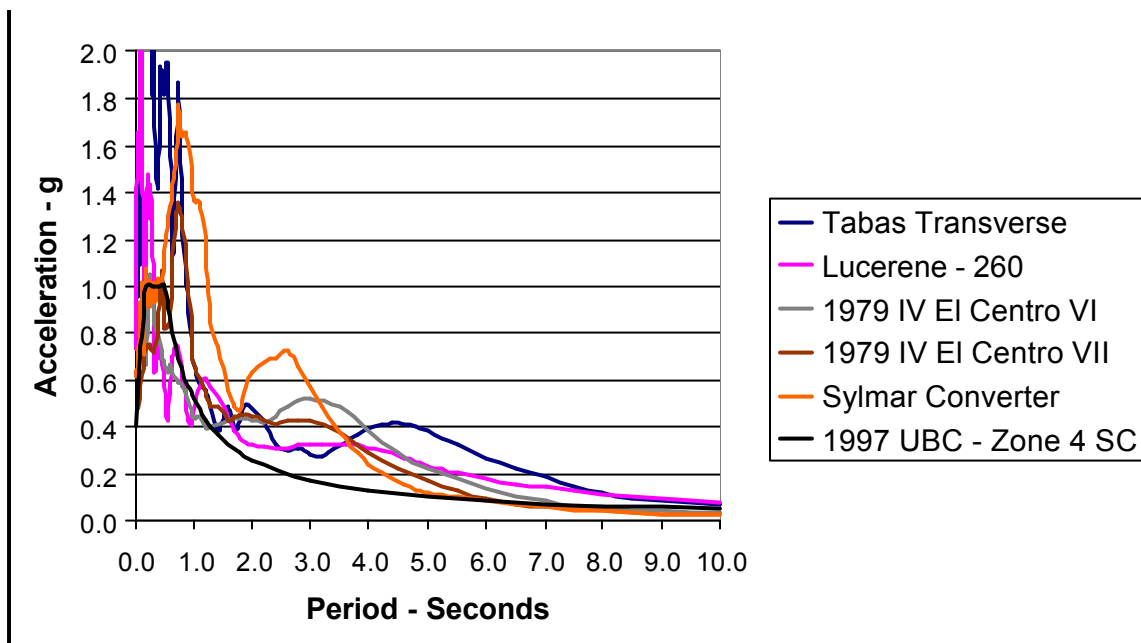


Figure 1 – Comparison of Near Fault Records and 1997 UBC Zone 4 Acceleration Response Spectrum

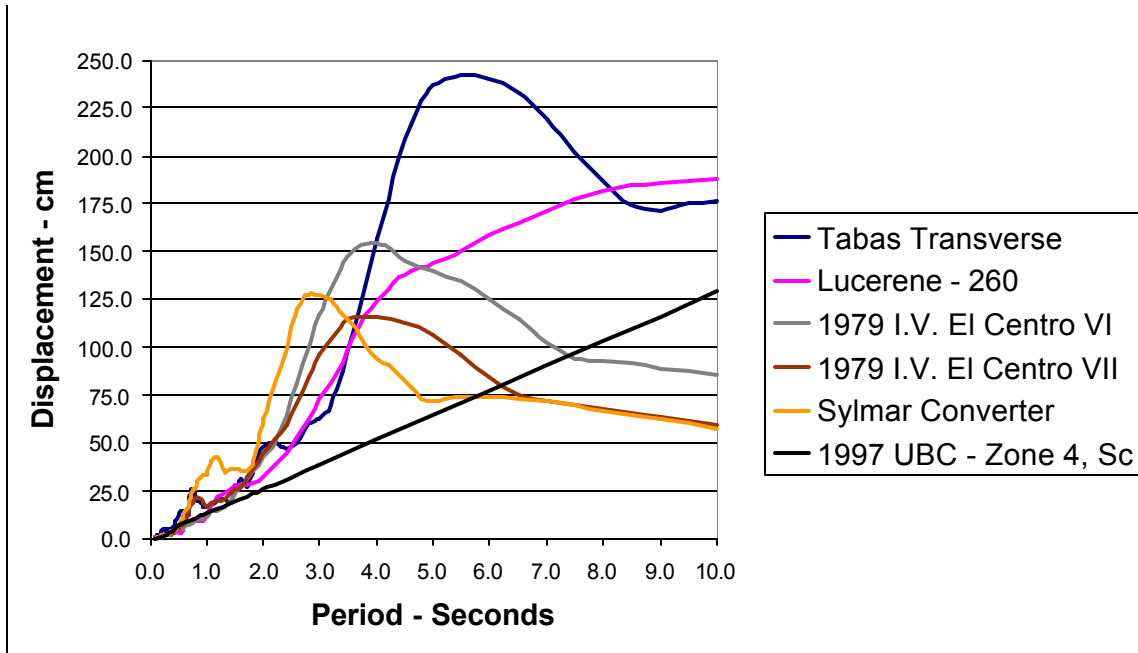


Figure 2 – Comparison of Near Fault Records and 1997 UBC Zone 4 – Displacement Response Spectrum

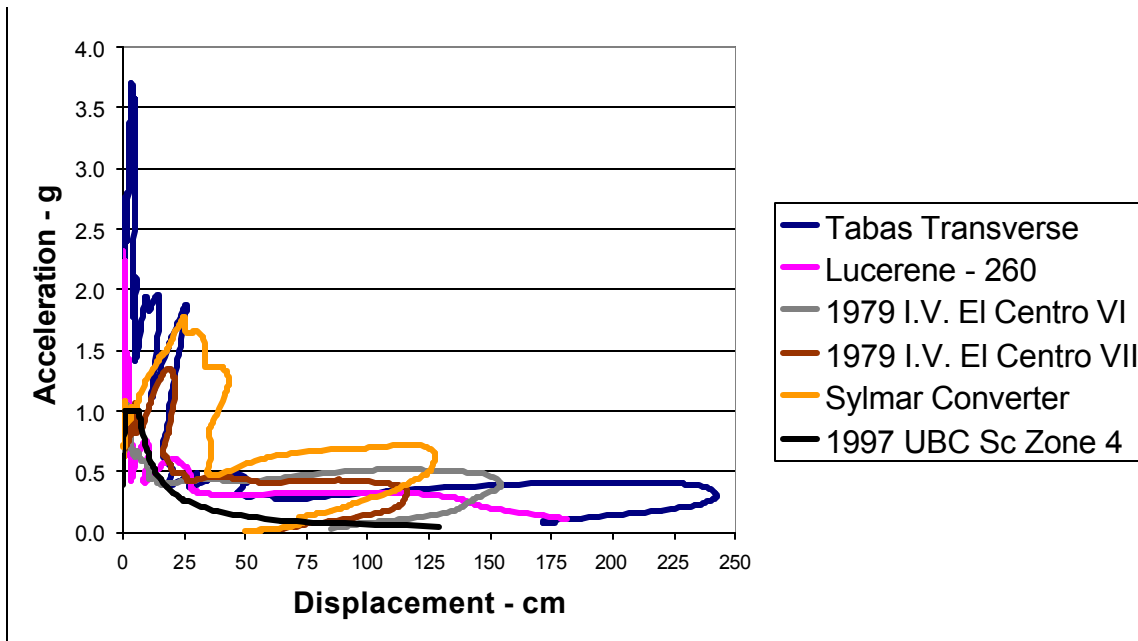


Figure 3 – Comparison of Near Fault Records and 1997 UBC Zone Spectrum in Acceleration – Displacement (ADRS) format

In August of 1998, ICBO staff identified and brought to the attention of the Seismology Committee proposed errata for for the 1997 UBC including exempting Eq. 30-7 from drift. However, during the interim period of Sept. of 1996 when the seismic provisions were approved in St. Paul and Aug. of 1998 when the structural errata was presented to SEAOC Seismology Committee for concurrence, many significant investigations of the effects of near field

pulses had been undertaken especially those by Heaton and Hall of CalTech. These investigations confirmed the earlier work of the SEAOC Seismology's Strong Ground Motion Subcommittee that in the near field of large earthquakes, tall structures need to be stiffer as well as stronger if they were to safely withstand the near field pulse effects of large earthquakes. One way to achieve this objective is to require that the minimum base shear of formula 30-7 be used when calculating drift. Therefore when the SEAOC Seismology Committee was asked whether to endorse the errata which would add the exemption for formula 30-7, a majority of the committee voted not to endorse the errata because of concerns about near field pulses. None of the other coalition members in attendance at the meeting endorsed the errata. A secondary problem was that ICBO had suspended code changes for the UBC so there was no way to modify the code to delete or modify the exemption for formula 30-7 if the errata was endorsed.

In December of 2000, over 3 ½ years after the 1997 UBC was first printed and available for purchase, a member of the coalition who was not present at the Seismology Committee meeting in Aug. of 1998, realized that the Eq. 30-7 should have been exempt from the drift demand calculations and requested that ICBO issue such an errata. Since that was what was approved in St. Paul, ICBO had no choice but to issue the errata.

It is currently SEAOC Seismology's position that Eq. 30-7 should be used for drift demand as stated in the 1999 Bluebook. A similar equation exists in the 2000 IBC for Seismic Design Categories E and F (near field zone) and is not exempt from drift demand. The Building Seismic Safety Council NEHRP Provision Update Committee will be investigating improvements to the minimum load/drift criteria in this area which should be reflected in the 2003 NEHRP, ASCE 7-05 and the 2006 IBC.

For the Seismology Committee

- Robert Bachman - Past Seismology Committee Chair (1994-1995)
- Ron Hamburger - 2003 NEHRP PUC Chair
- Charles Kircher - Chair, Strong Ground Motion Ad-Hoc Committee