CONST-VIBRATIONS Listserv Newsletter # 6
Threshold or Cosmetic, Hair Sized Cracks Form the Basis of Vibration Control limits

Vibration control limits prevent strains/displacements/distortions in the responding structure(s) that would produce even threshold or cosmetic cracks in the weakest of wall coverings in structures that are already distorted. Cosmetic cracks are thinner than the width of a human hair. They are similar in size to those that normally appear as the result of the natural aging process as well as normal climatologically-induced expansion and contraction (Dowding, 2008). Blast induced cracking has been precisely defined by previous researchers in levels of increasing severity, and these terms amplify the meaning of threshold or cosmetic, hair sized cracking.

Precise descriptions of the levels of cracking should be used to describe cracks in wall materials from vibratory effects instead of the imprecise term "damage". Table 1 below from RI 8507, (Siskind, et al, 1980) describes these levels of increasing severity and links them to past studies where blast induced cracking had been observed. Threshold, or hair sized cosmetic cracks appear in the weakest portions of wall covering at lower levels of vibration than minor and major cracks. For instance in the Edwards and Northwood studies threshold cracking appeared at peak particle velocities of 76 mm/s (3 in./sec) in these older structures with plaster and lath wall covering; minor cracking appeared at 114 mm/s (4.5 in./sec) and major at 203 mm/s (8 in./sec). Appearance of threshold cracking at lower vibration levels observed in USBM RI 8507 have been discussed in earlier newsletters.

Table 1 (Table 10 from RI 8507)

Uniform classification	Description of damage	Studies of blasting damage
Threshold ----------	Loosening of paint; small plaster cracks at joints between construction elements; lengthening of old cracks.	Threshold: Dvorak (*15*); Edwards and Northwood (*16*); Northwood, Crawford, and Edwards (*38*). Minor: Thoenen and Windes (*51*).
Minor ----------	Loosening and falling of plaster; cracks in masonry around openings near partitions; hairline to 3-mm cracks (0 to ⅛ in.); fall of loose mortar.	Minor: Dvorak (*15*); Edwards and Northwood (*16*); Northwood, Crawford, and Edwards (*38*); Jensen and Rietman (*21*); Langefors, Westerberg, and Kihlstrom (*26*). Major: Thoenen and Windes (*51*).
Major ----------	Cracks of several mm in walls; rupture of opening vaults; structural weakening; fall of masonry, e.g., chimneys; load support ability affected.	Major: Dvorak (*15*); Edwards and Northwood (*16*); Northwood, Crawford, and Edwards (*38*); Langefors, Westerberg, and Kihlstrom (*26*).

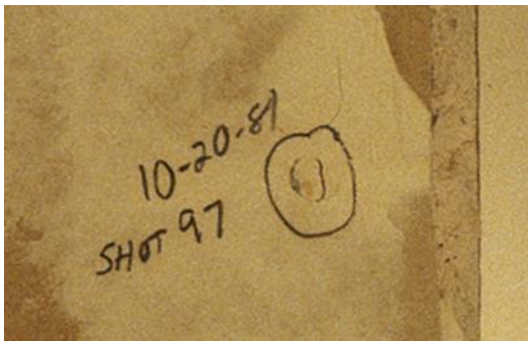

Figure 1
Photo of crack in plaster over nail ("nail pop") from test home in the USBM RI 8896 study

Threshold or cosmetic cracking is now an even more conservative measure of the onset of hair sized, cosmetic cracking than employed in the earlier RI 8507 study. During subsequent research even smaller cracks have been included in the threshold or cosmetic category. For instance in RI 8896 (Stagg et al, 1984) included the cracking of plaster covering of nails (shown in Figure 1) and the appearance of cracks in the joint tape compound in wall corners as indicators of threshold cracking. Inclusion of these

less visible manifestations of cosmetic cracking would imply a lower vibration control limit to prevent cosmetic cracking.

Even slight changes in wall response **without** any visible cosmetic cracking have been invoked to define vibration control limits. For instance in the absence of any visible cracking, a slight deviation in the linear, elastic, global, load-deformation response of a full scale concrete masonry unit (CMU) wall was employed by Siskind (1994) to determine a strain based control limit of 200 micro strains. In other words global strains less than 200 micro strains were unable to cause any deviation from an elastic response of the wall and no visible hair-sized cosmetic cracks. This dynamic testing of full scale CMU walls will be discussed in forthcoming newsletters.

REFERENCES

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