LECTURE 7 - RESPONSE TO PULSE EXCITATION

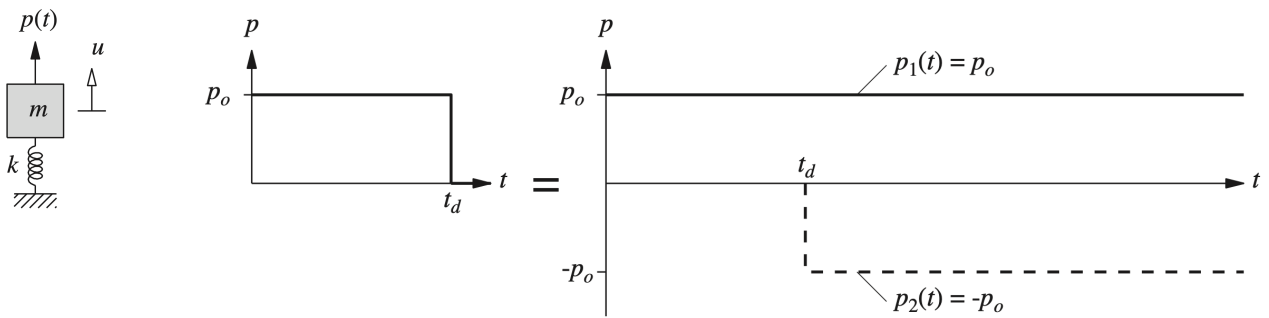
CE 225

Prof DeJong

UC Berkeley

September 18, 2025

STEP FORCE OF FINITE DURATION



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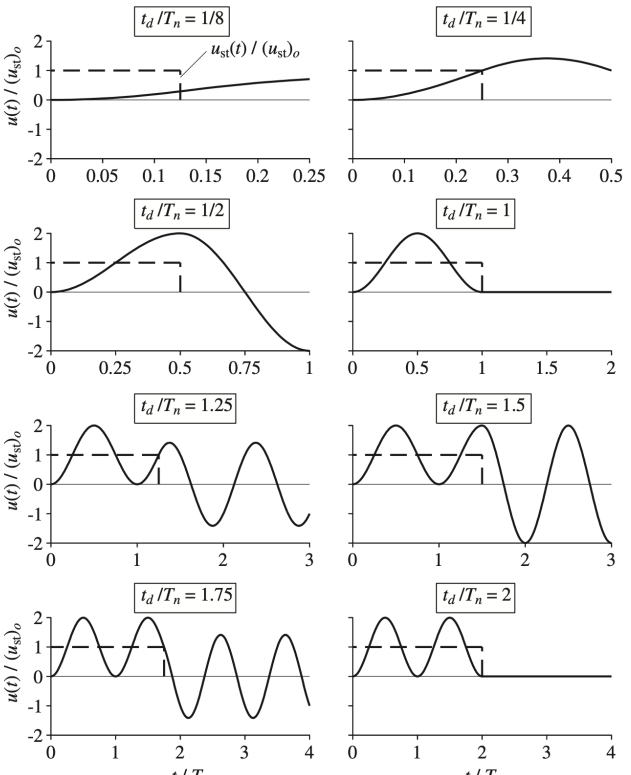
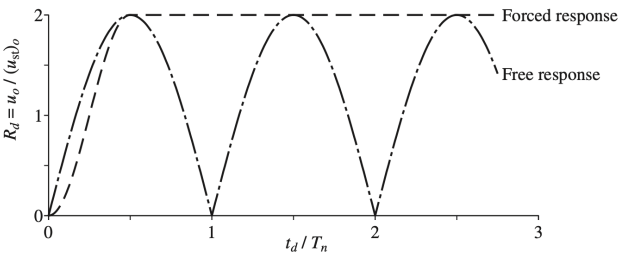
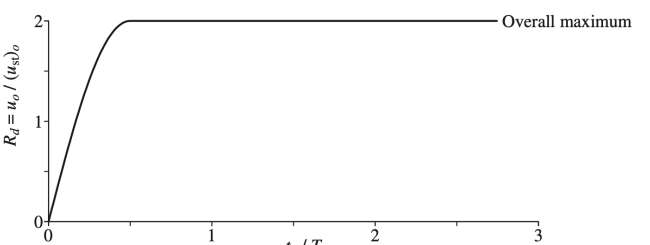
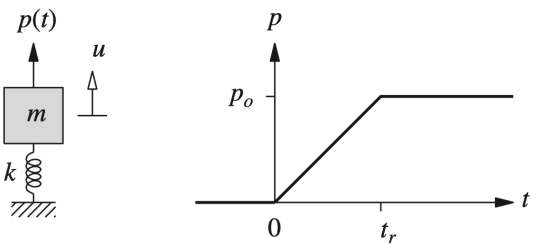


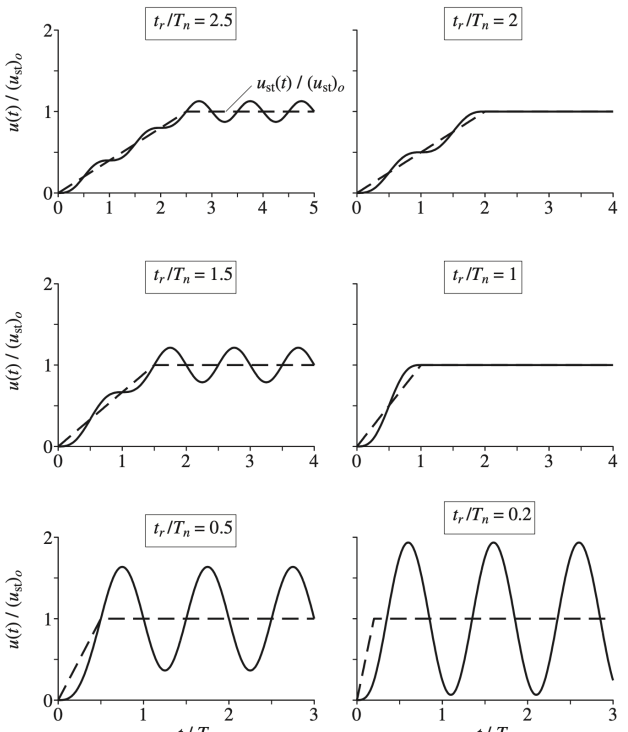


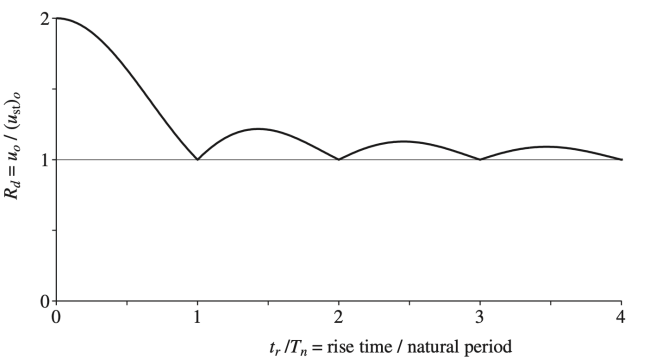


STEP FORCE WITH FINITE RISE TIME

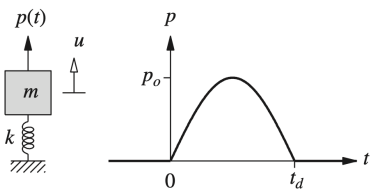


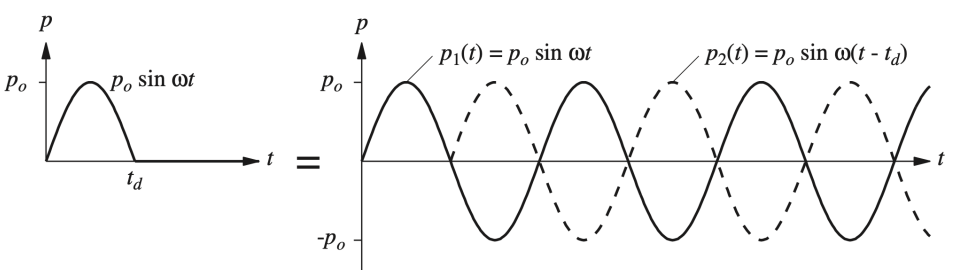
STEP FORCE WITH FINITE RISE TIME





HALF SINE PULSE





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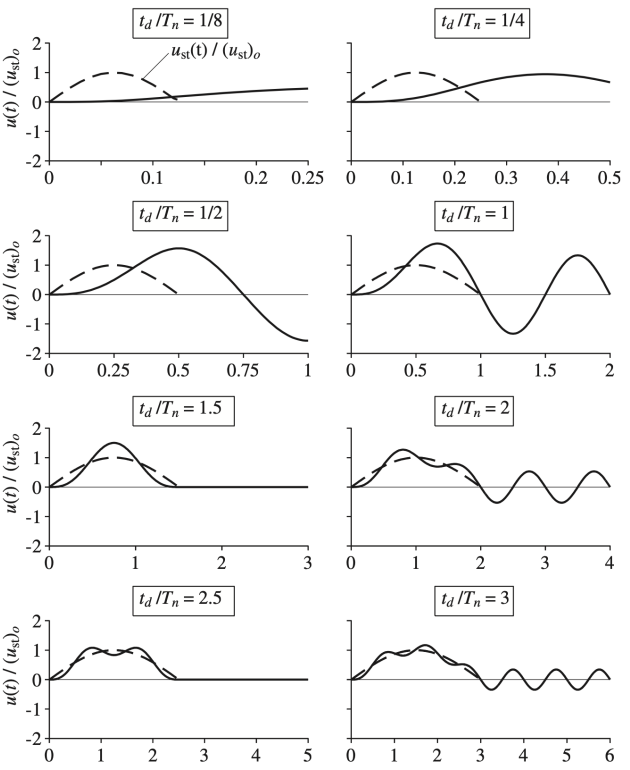
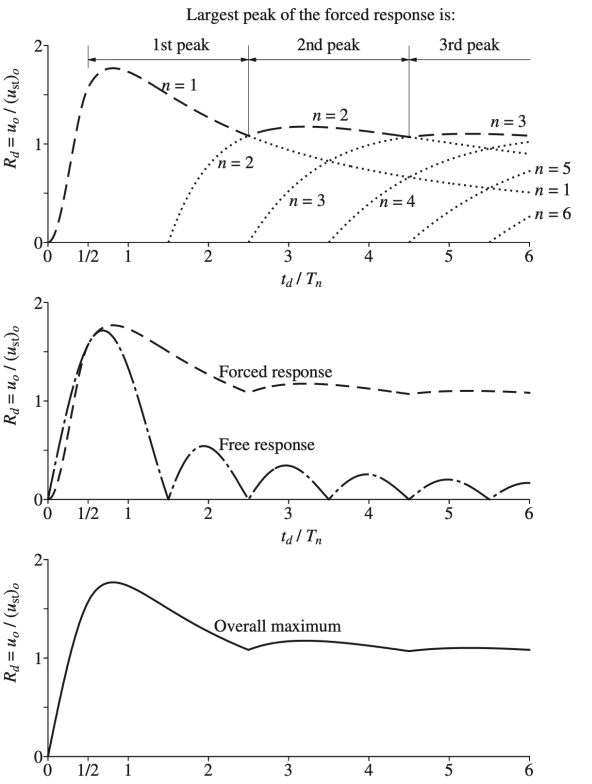
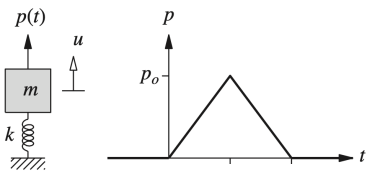
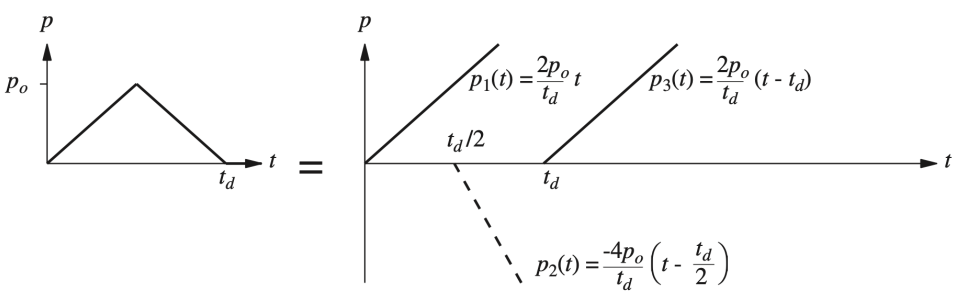


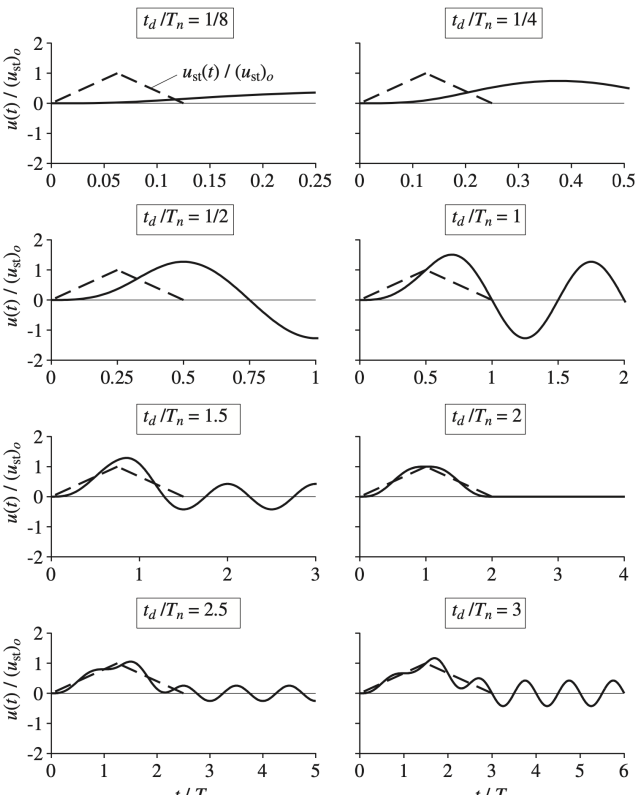


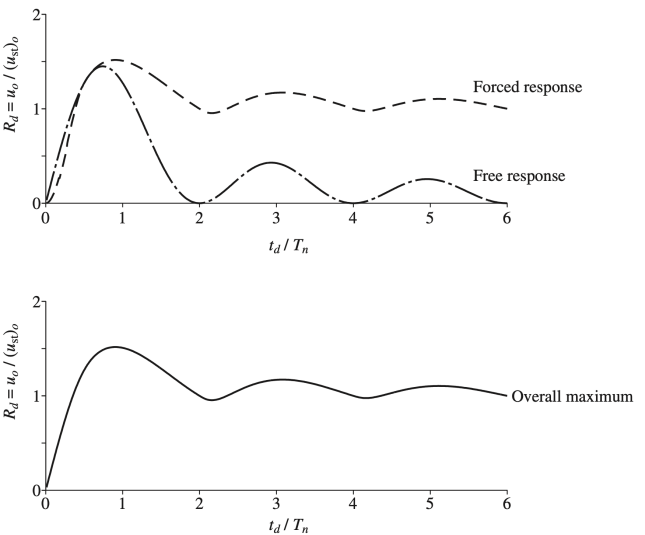
TRIANGULAR PULSE





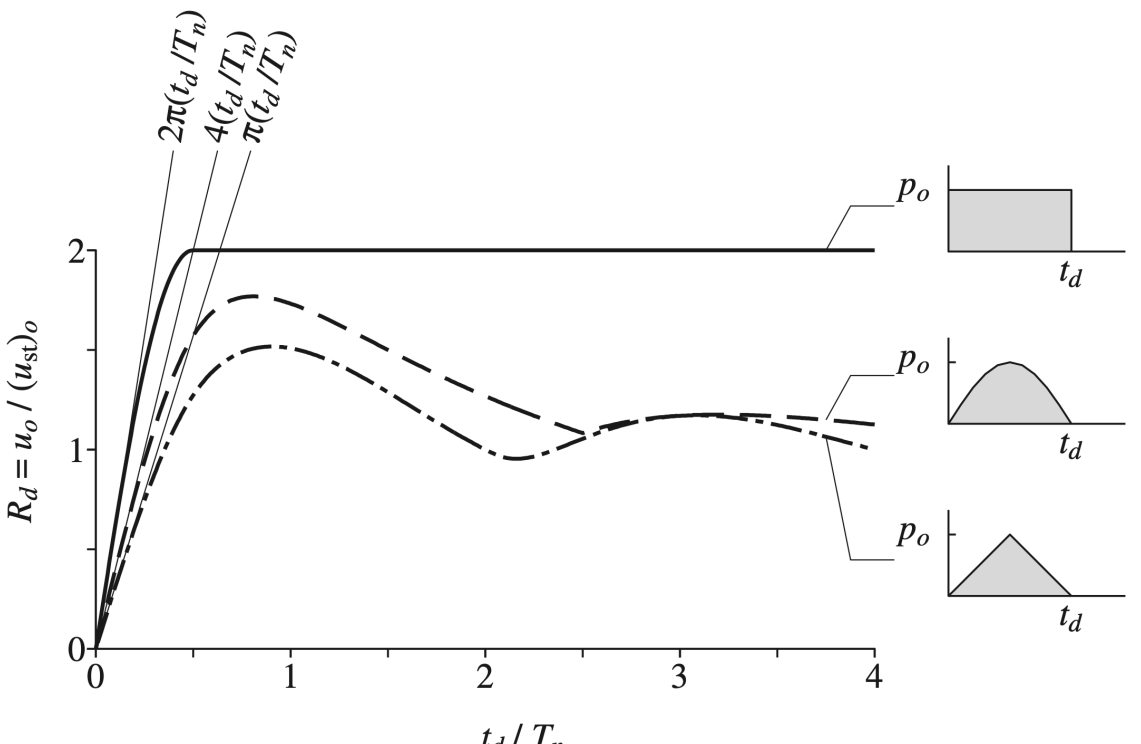
TRIANGULAR PULSE





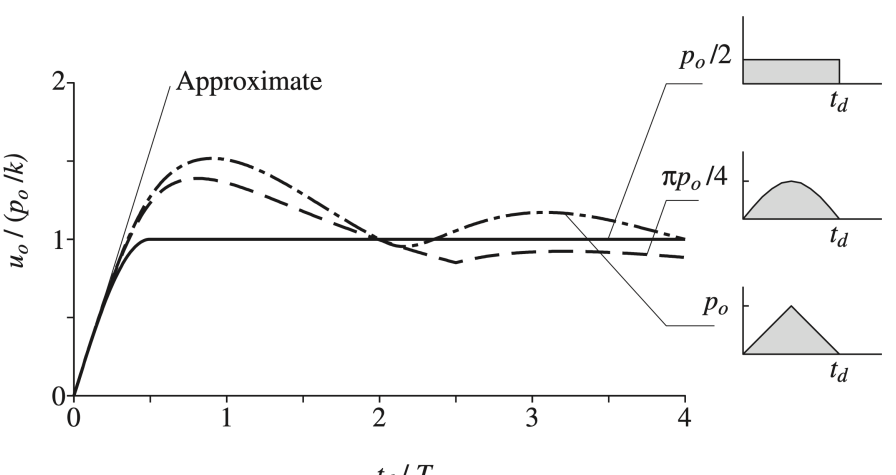
COMPARISON OF PULSE SHAPES

RESPONSE ENVELOPES

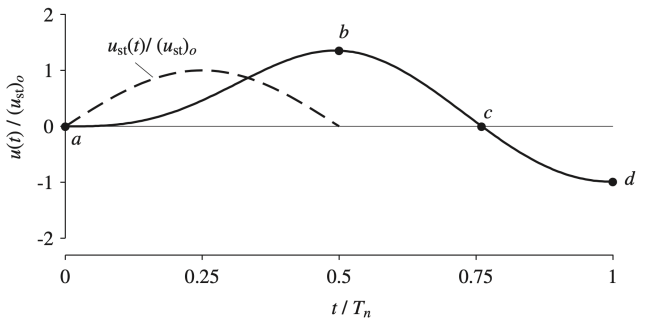


IMPULSES OF SHORT DURATION

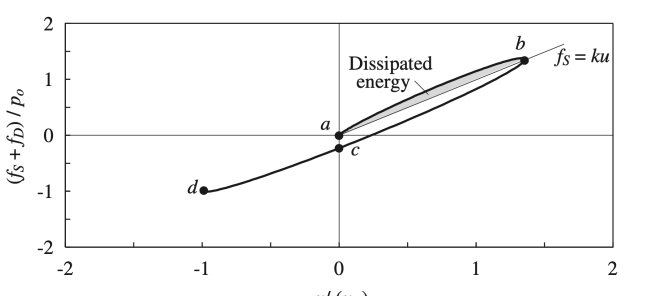
- Assume impulse can just be treated as initial velocity (generally conservative)



EFFECT OF DAMPING



(a)



(b)

(a) Response of damped system ($\zeta = 0.1$) to a half-cycle sine pulse force with $t_d/T_n = \frac{1}{2}$;
(b) Force-deformation diagram showing energy dissipated in viscous damping.

EFFECT OF DAMPING

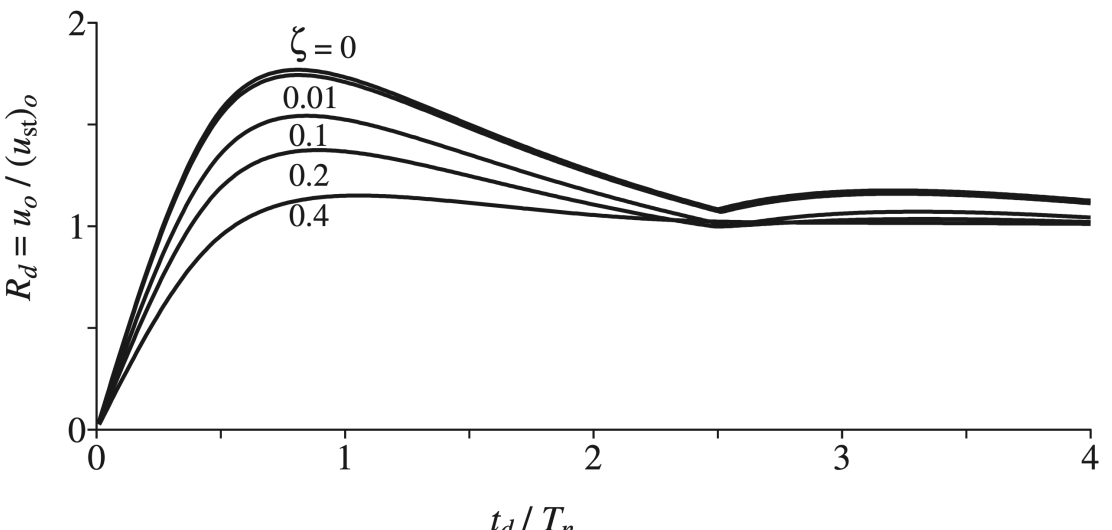


Figure 4.11.2 Shock spectra for a half-cycle sine pulse force for five damping values.

BLAST LOADING

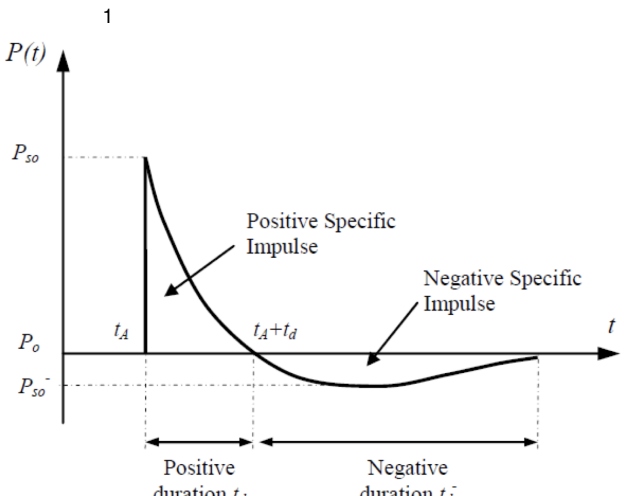


Figure 2: Blast wave pressure – Time history

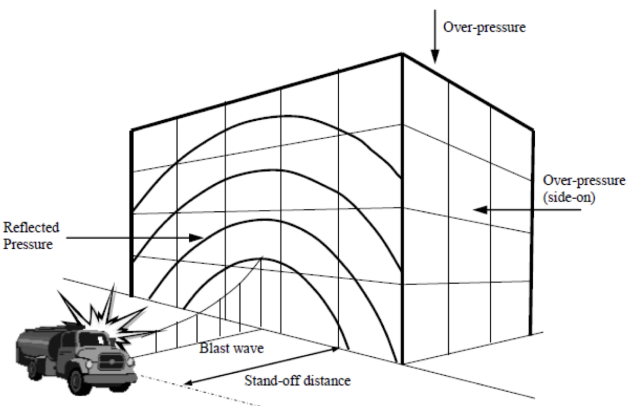


Figure 3: Blast loads on a building

[1] Ngo et al. (2007). EJSE Special Issue: Loading on Structures

BLAST LOADING

PRESSURE AMPLIFICATION

OKLAHOMA CITY BOMBING

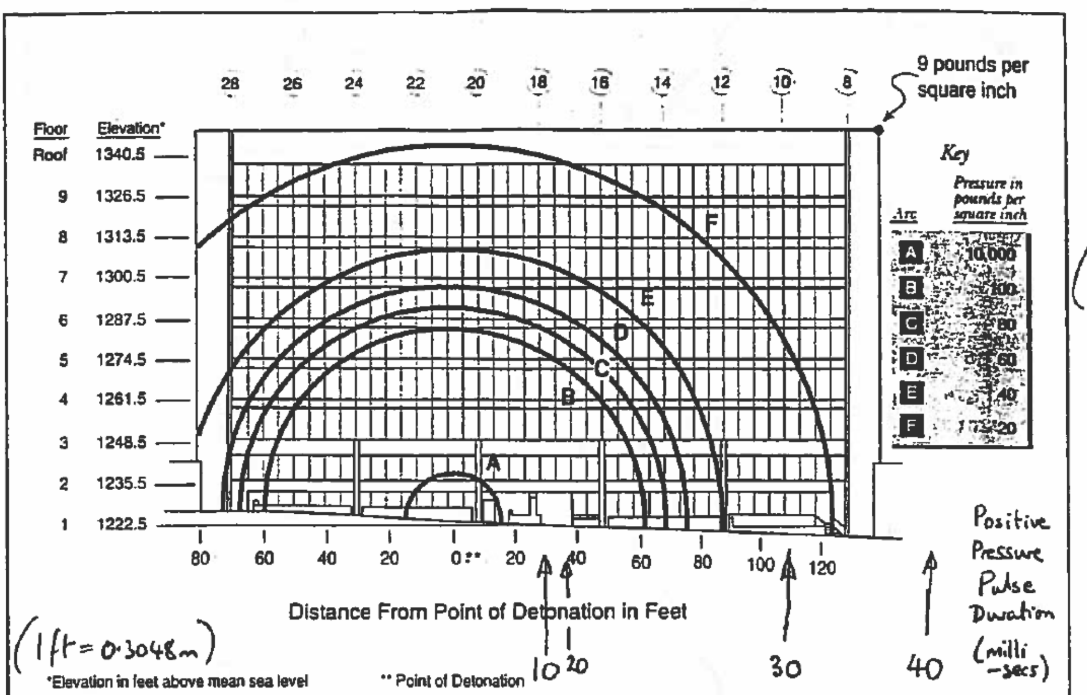


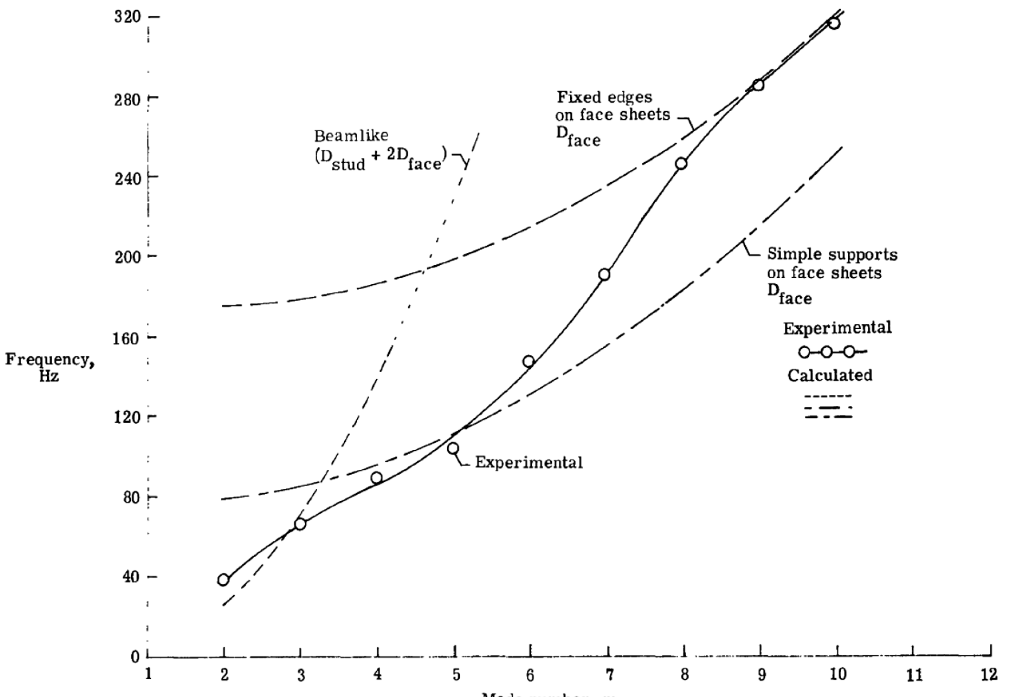
Figure 3-5 *Peak overpressures on north elevation of nine-story portion of Murrah Building.*

SIMPLIFIED APPROACH

Global building response:

- Assume impulse only causes initial velocity:
- Assume damping has small effect:

WHAT ABOUT WINDOW/WALL ELEMENT?

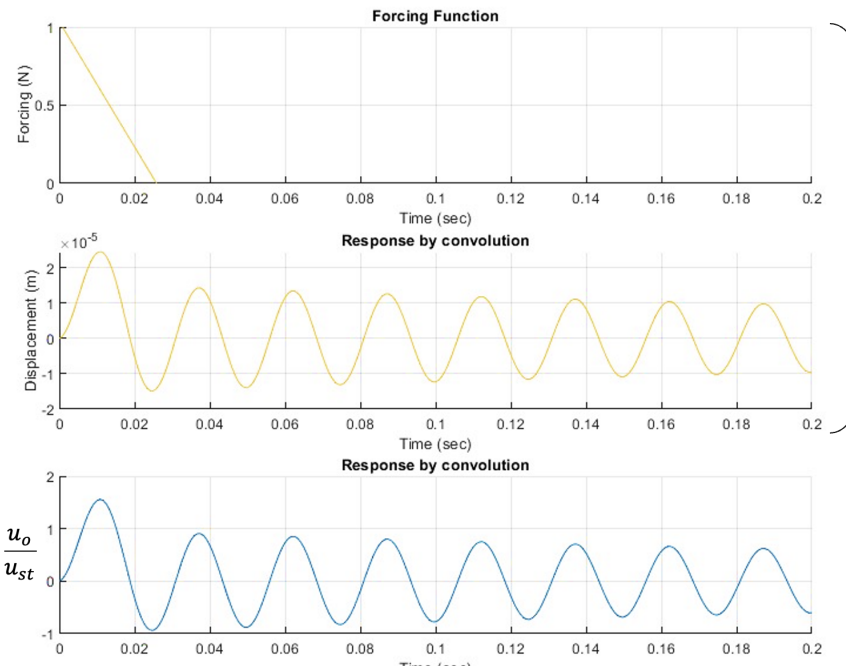


(b) Vertical plywood.

WINDOW/WALL ELEMENT

WINDOW/WALL ELEMENT

CONVOLUTION TO FIND THE RESPONSE



$$m = 1$$
$$P_{so} = 1$$
$$t_d = T_n = 0.025$$
$$\zeta = 1\%$$

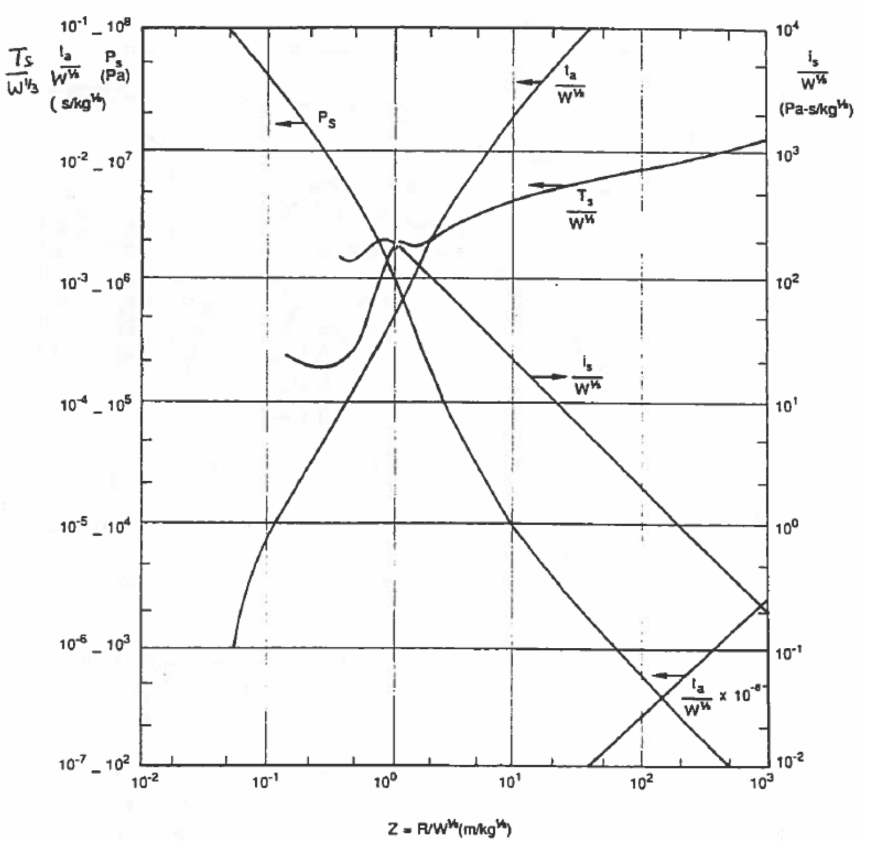


Figure 3.8 *Side-on blast wave parameters for spherical charges of TNT (after Ref. 6)*