

# LECTURE 7 - RESPONSE TO PULSE EXCITATION

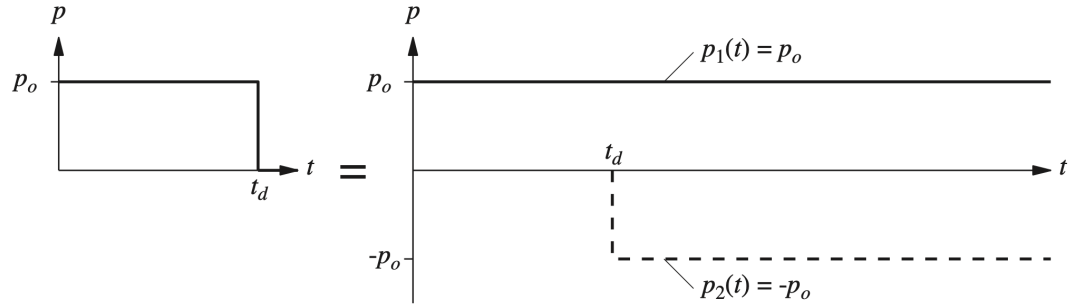
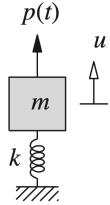
## CE 225

**Prof DeJong**

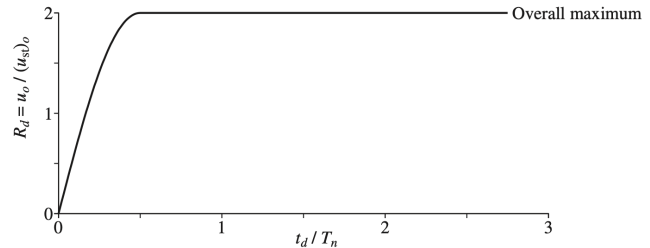
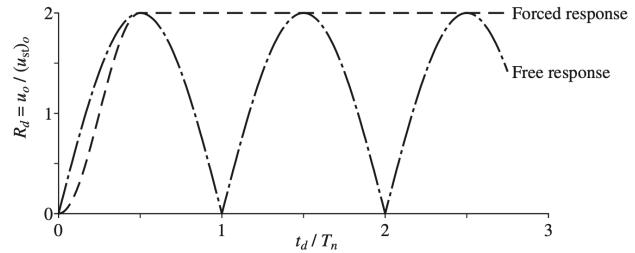
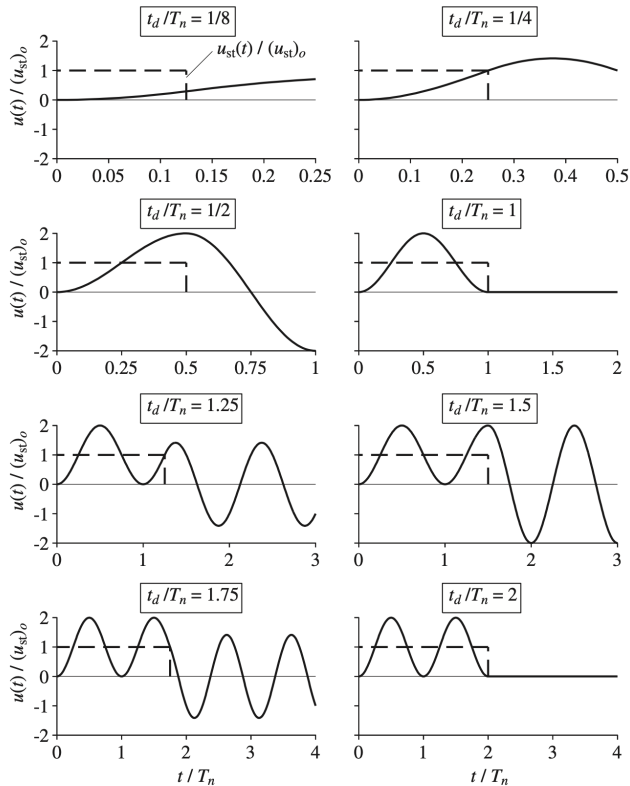
UC Berkeley

September 18, 2025

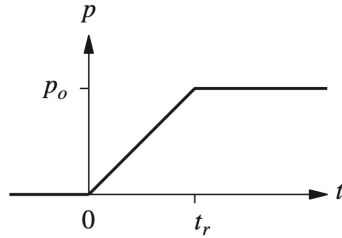
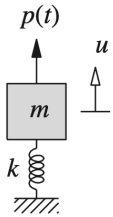
# STEP FORCE OF FINITE DURATION



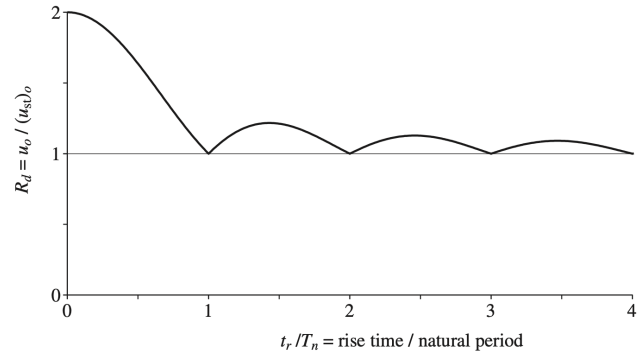
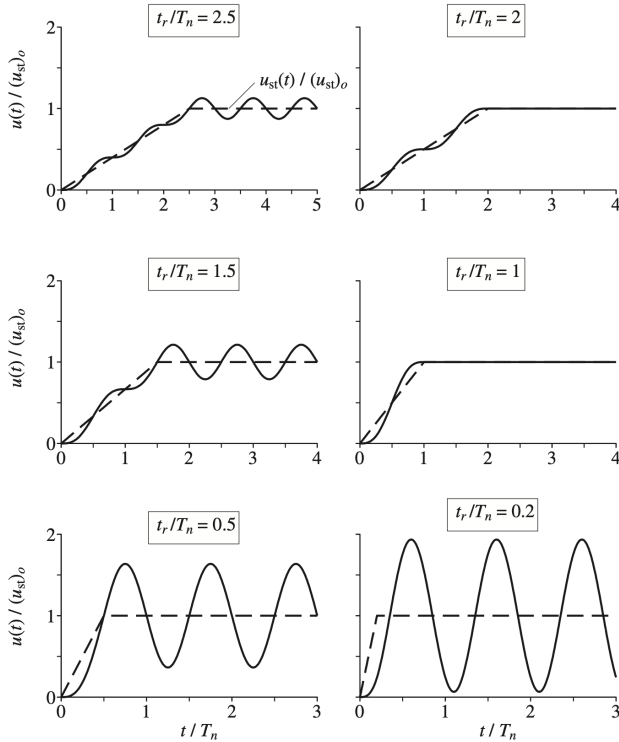
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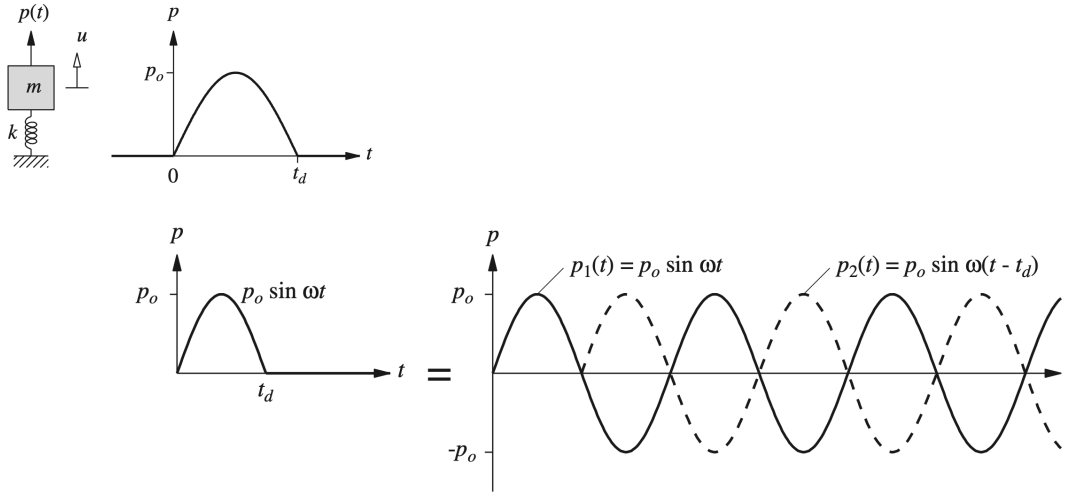
# STEP FORCE WITH FINITE RISE TIME



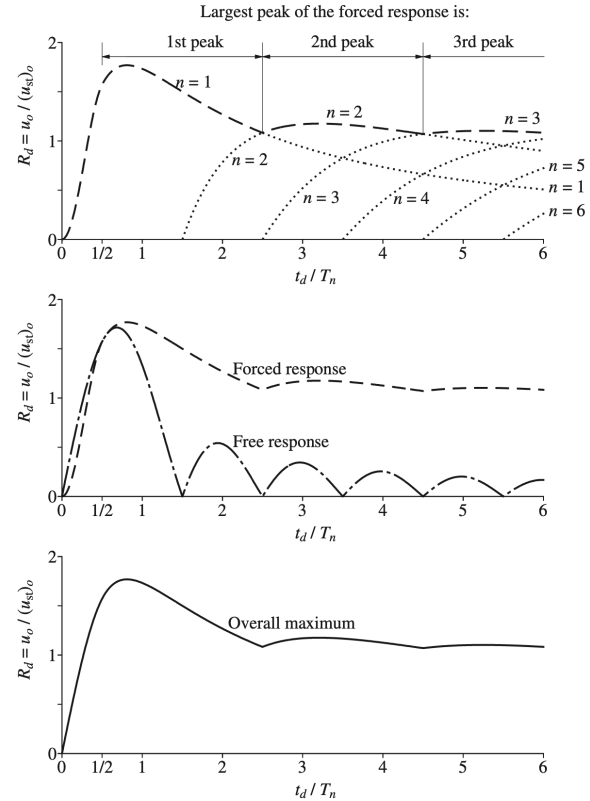
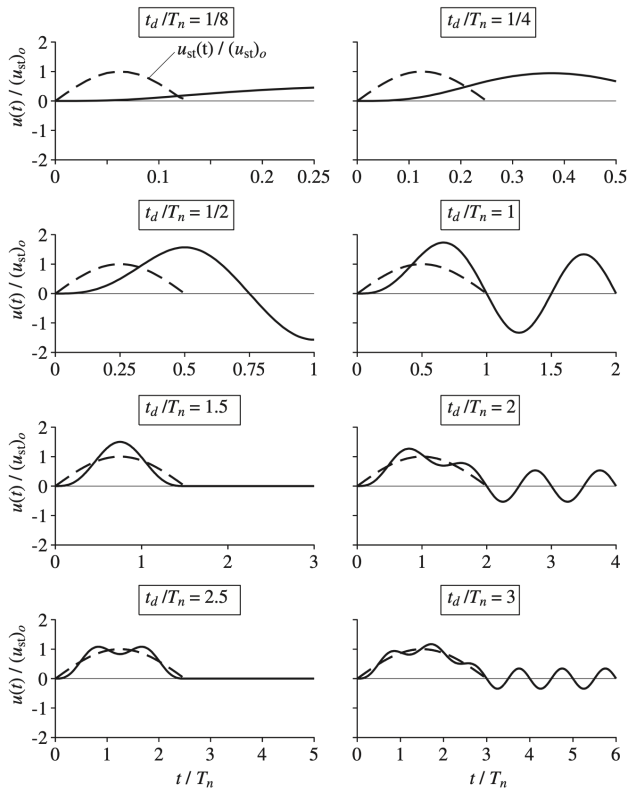
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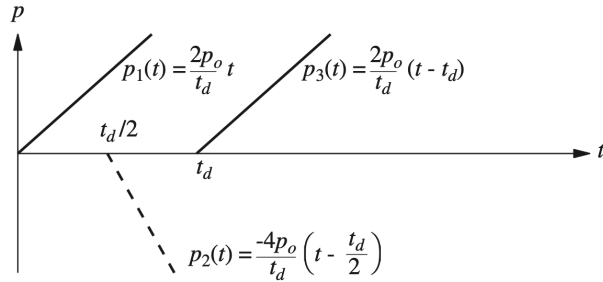
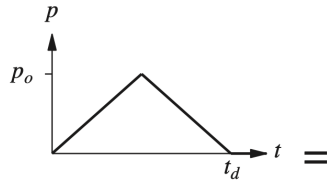
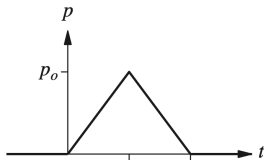
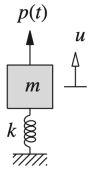
# HALF SINE PULSE



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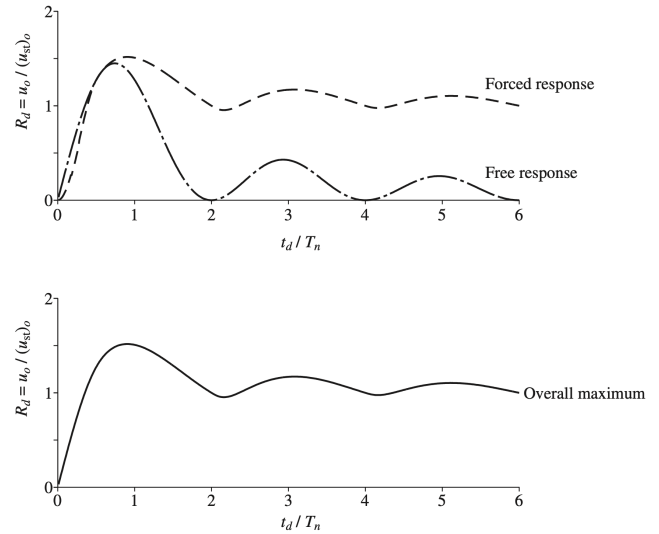
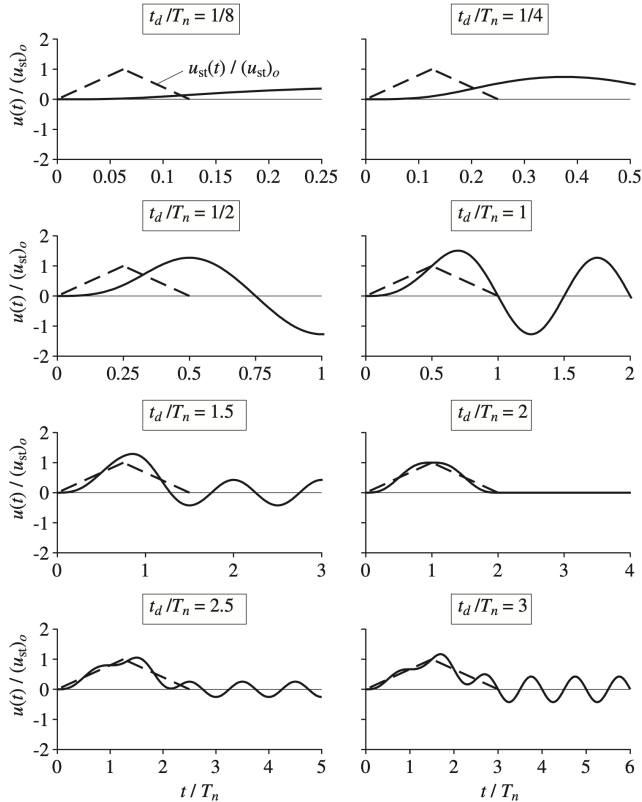


# TRIANGULAR PULSE



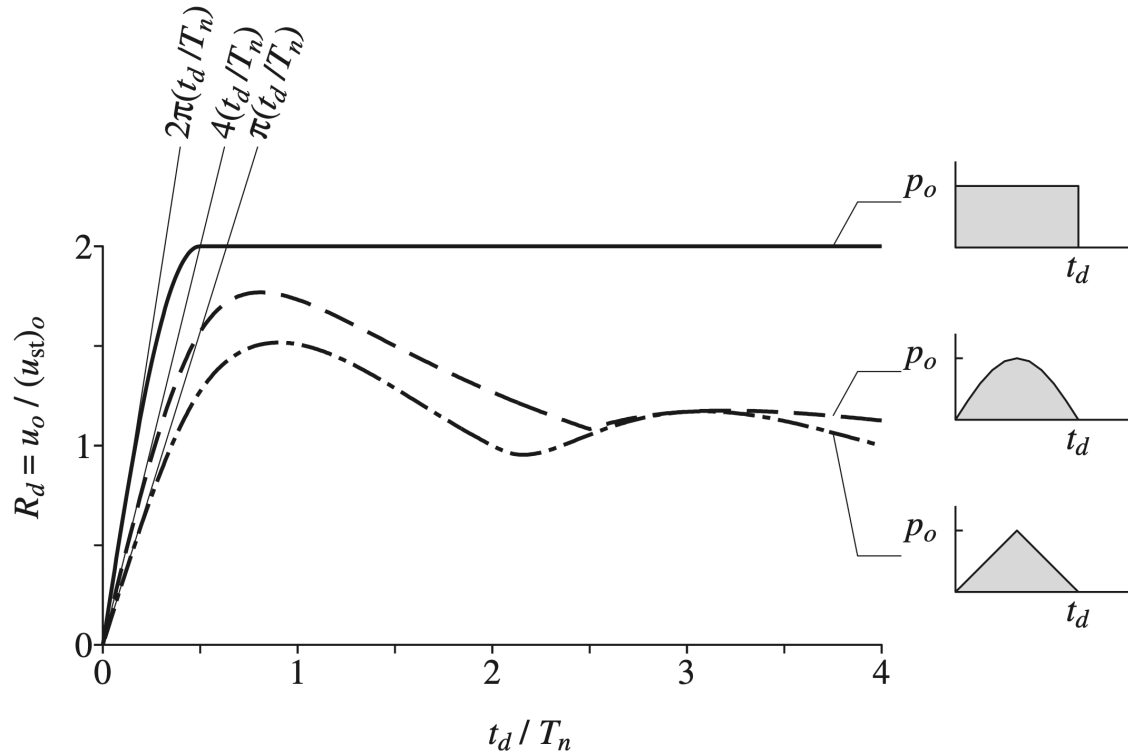


# TRIANGULAR PULSE



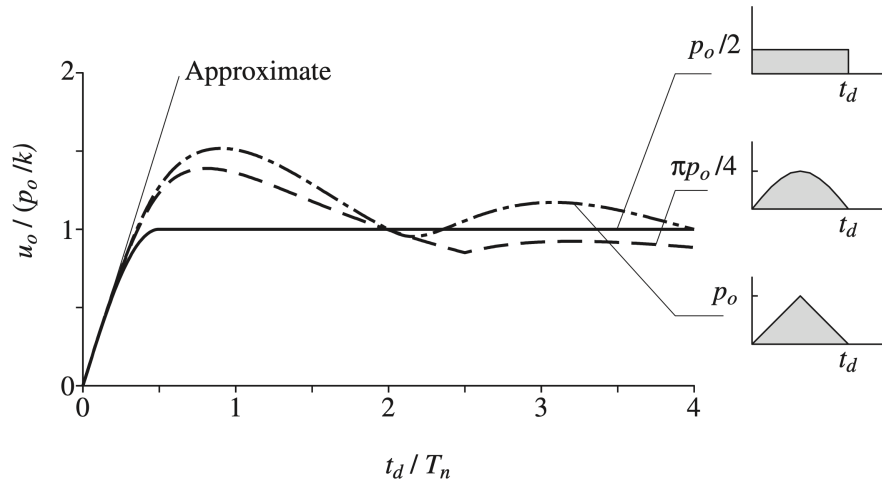
# COMPARISON OF PULSE SHAPES

## RESPONSE ENVELOPES

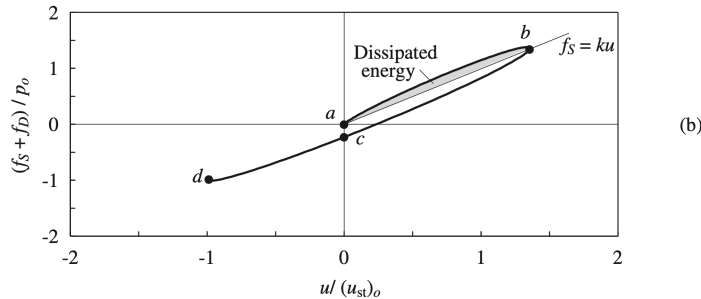
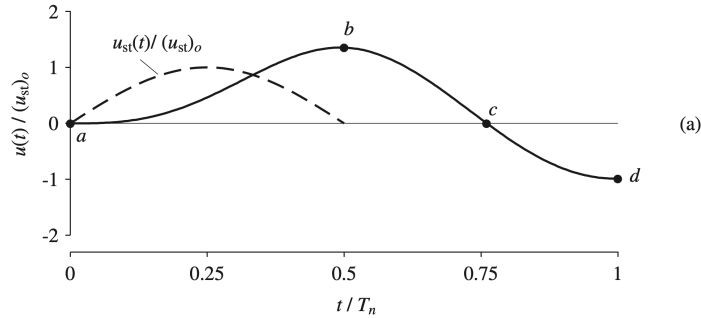


# IMPULSES OF SHORT DURATION

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

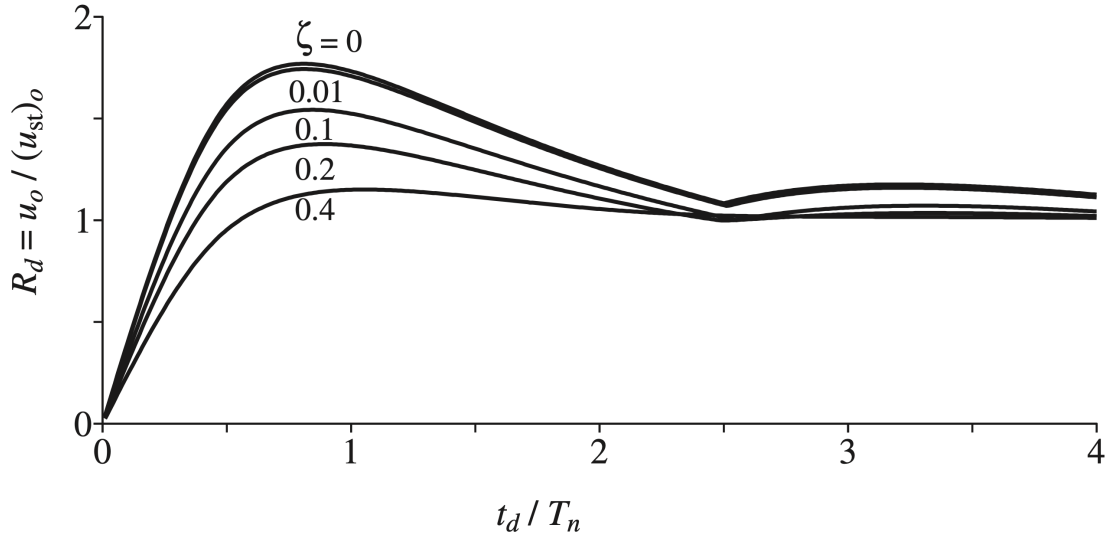


# EFFECT OF DAMPING



- (a) 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

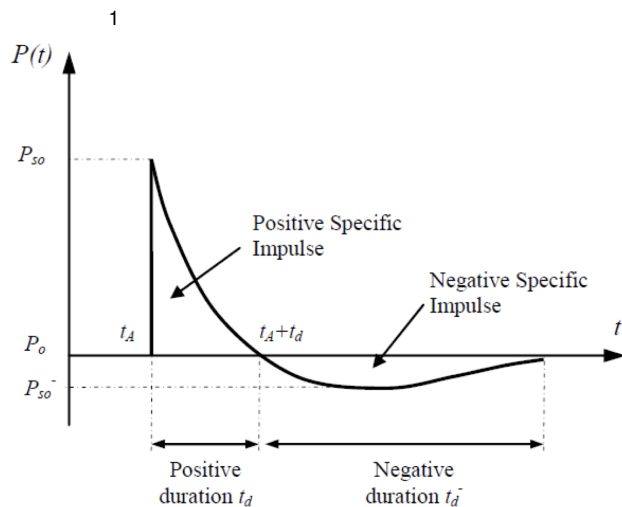


Figure 2: Blast wave pressure – Time history

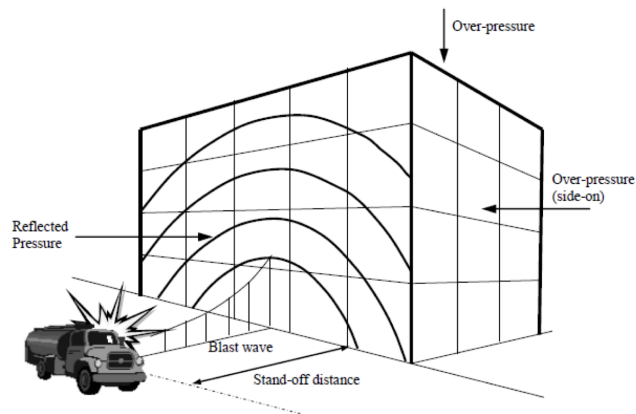


Figure 3: Blast loads on a building

# BLAST LOADING

## PRESSURE AMPLIFICATION

# OKLAHOMA CITY BOMBING

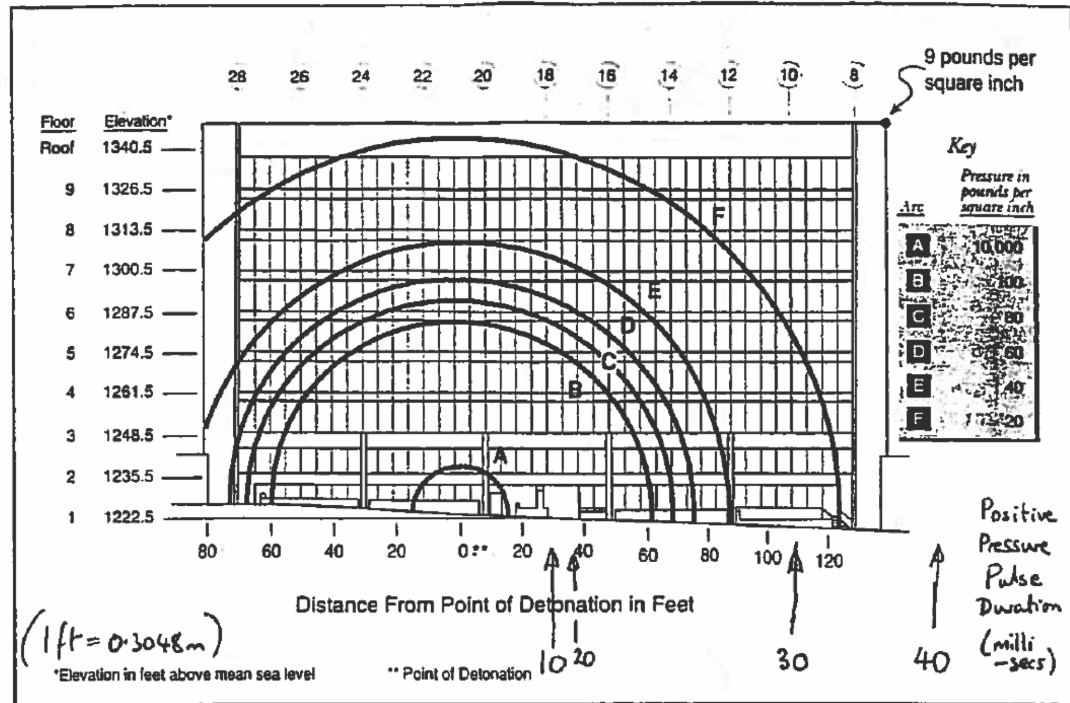


Figure 3-5 Peak overpressures on north elevation of nine-story portion of Murrah Building.

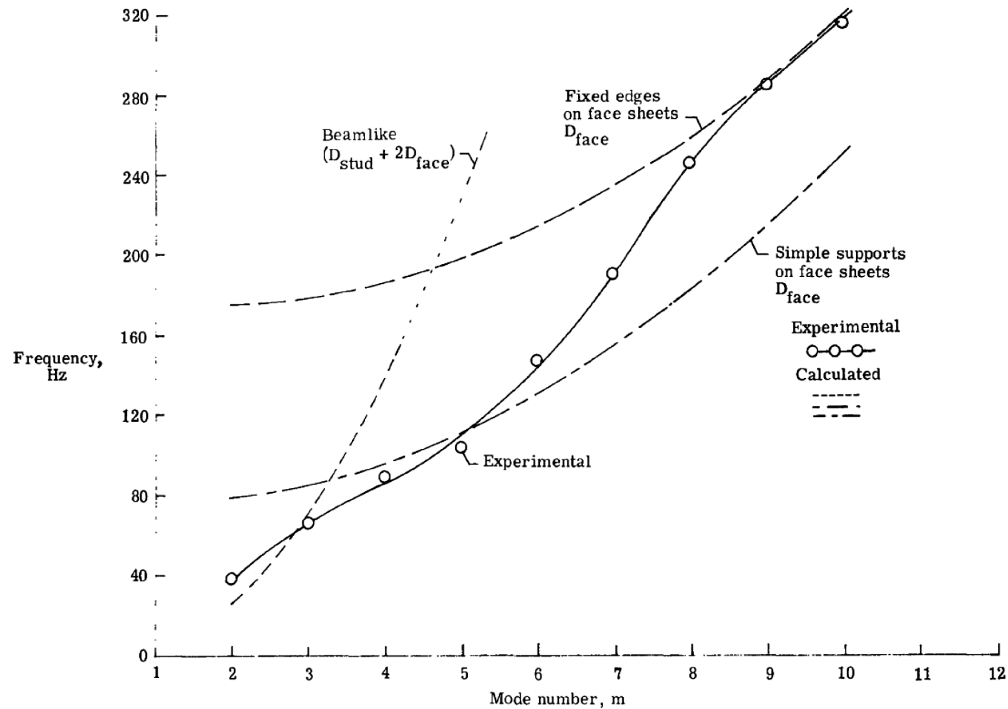


# SIMPLIFIED APPROACH

Global building response:

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

## WHAT ABOUT WINDOW/WALL ELEMENT?

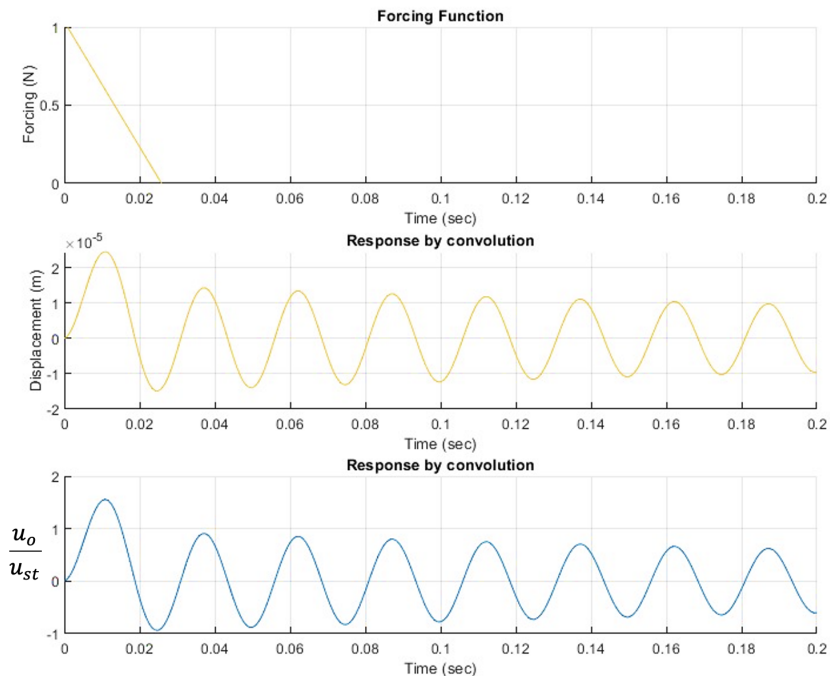


(b) Vertical plywood.

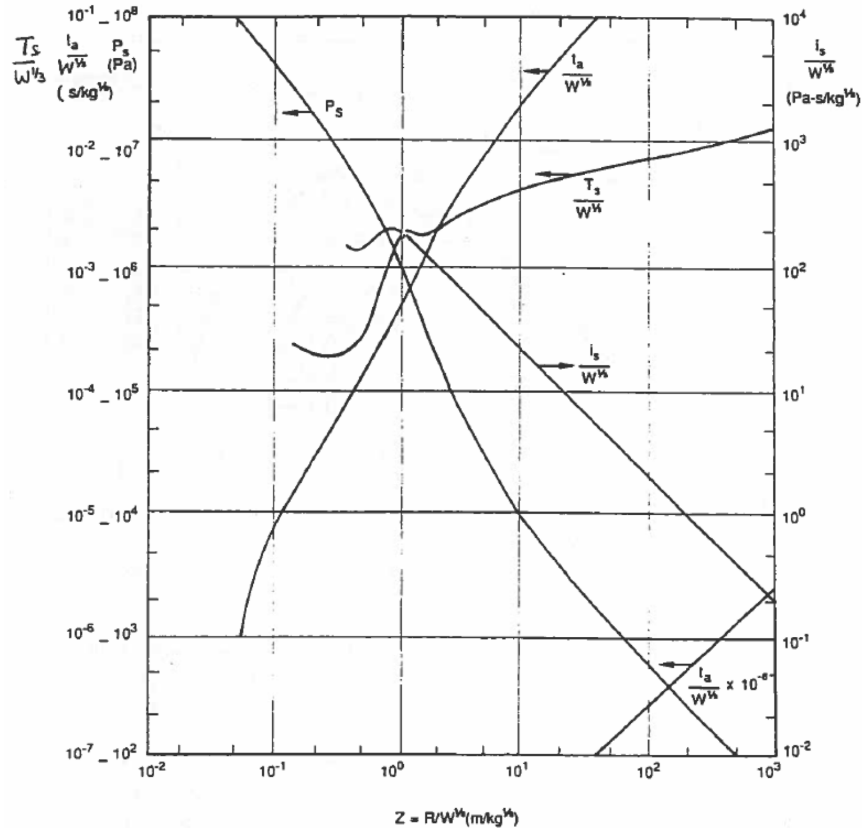
# WINDOW/WALL ELEMENT

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## CONVOLUTION TO FIND THE RESPONSE



$$\left. \begin{array}{l} m = 1 \\ P_{so} = 1 \\ t_d = T_n = 0.025 \\ \zeta = 1\% \end{array} \right\}$$



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