Local Absorbing Boundary Conditions for Wave Propagation in Viscoelastic Unbounded Domains

Introduction

- Absorbing Boundary Condition is one of the very significant aspect of wave propagation problem through unbounded domains.
- Reflections should be minimum when the wave reaches the boundary in order to analyze the system precisely.
- Most of the existing boundary conditions are not accounted for viscoelastic wave propagation.
- Absorbing Boundary Conditions proposed by Lysmer and Kuhlemeyer (1969) are modified to account for damping or viscosity in the system.

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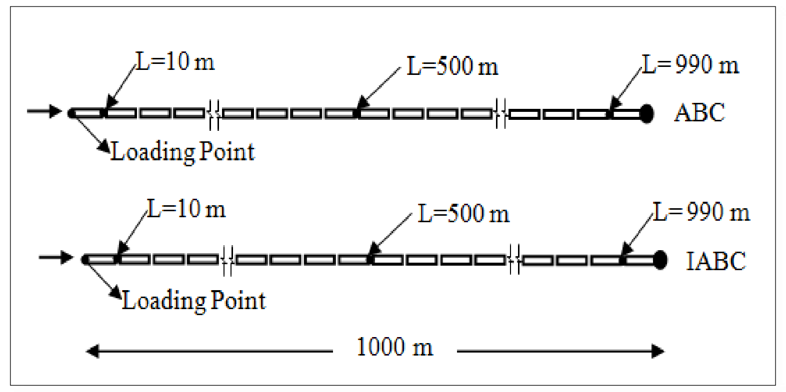
MATHEMATICAL FORMULATIONS

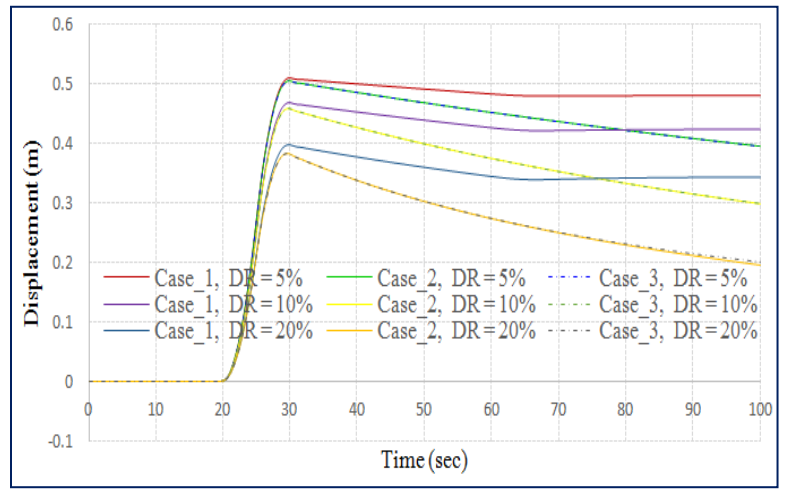
$\sigma = a.\rho.V_p.\dot{u} + 0.5a.\rho.V_p.\alpha.u$

$\tau = b.\rho.V_s.\dot{v} + 0.5b.\rho.V_s.\alpha.v$

The artificial boundary condition includes a dashpot with coefficient and a spring with coefficient.

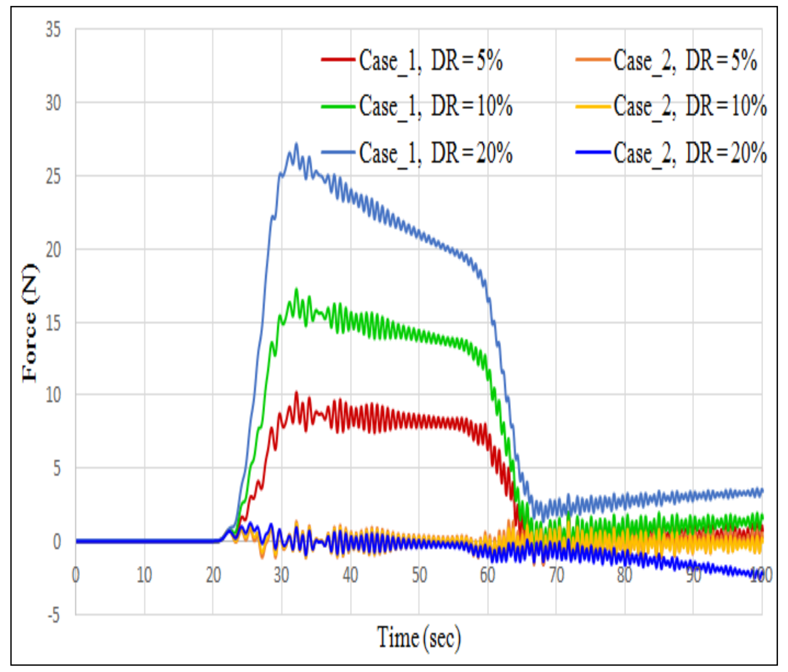
Numerical Results – 1D Wave Propagation



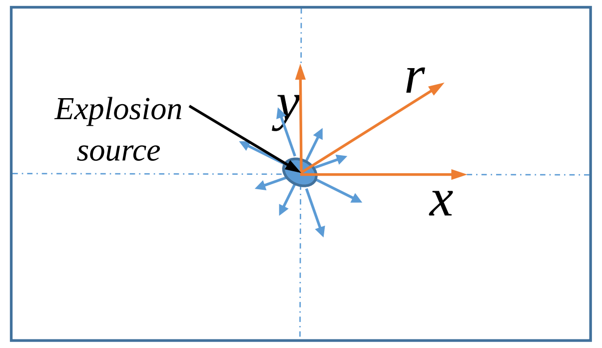


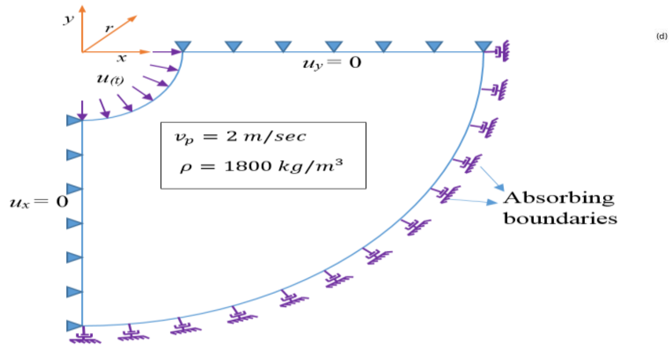
Models	# Elements	Element Length (m)	BC
Case_1	100	10	ABC
Case_2	100	10	IABC
Case_3	500	10	ABC

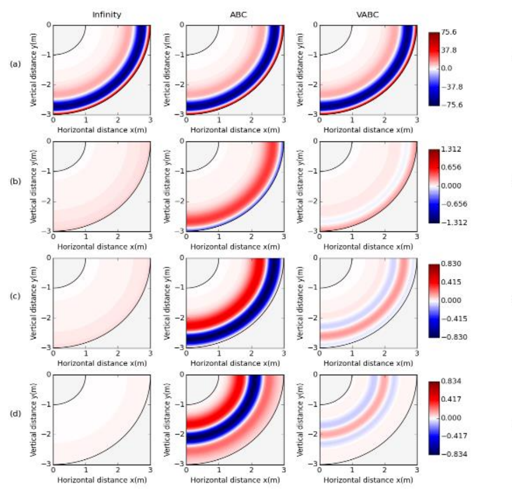
ANALYSIS:
The Triangular pulse of duration 10 seconds with maximum 1000N applied at left end .



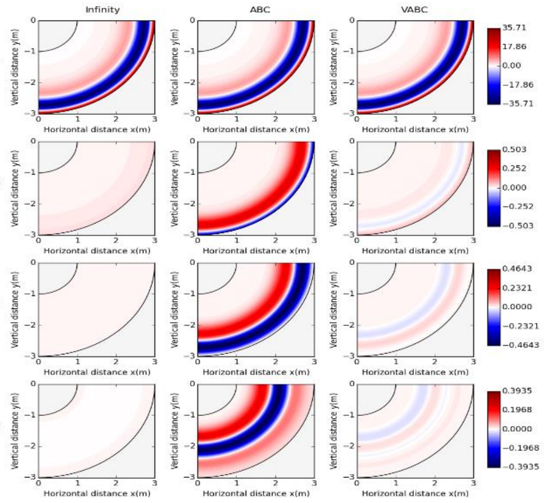
Numerical Results – 2D scalar P-wave propagation





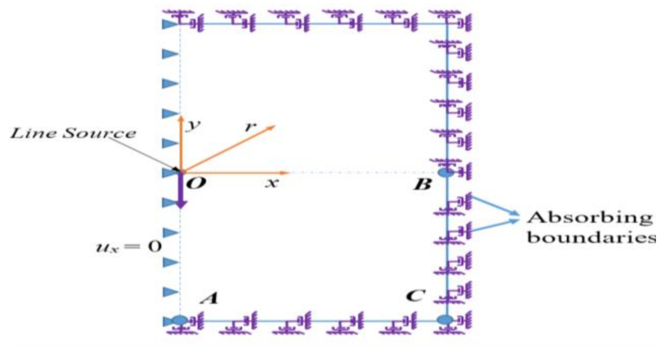


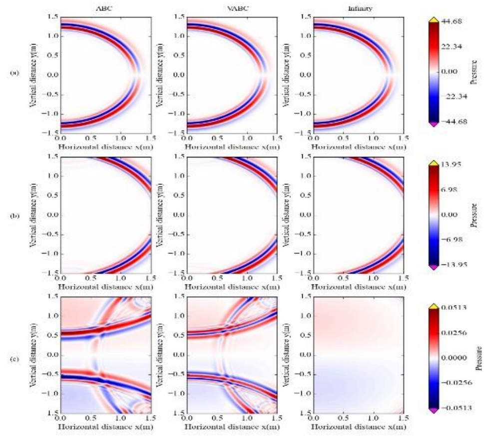
Pressure distribution (N/m2) $\alpha = 1$: (a) time t=2sec, (b) time t=3sec (c) time t=3.2sec and (d) time t=3.5sec



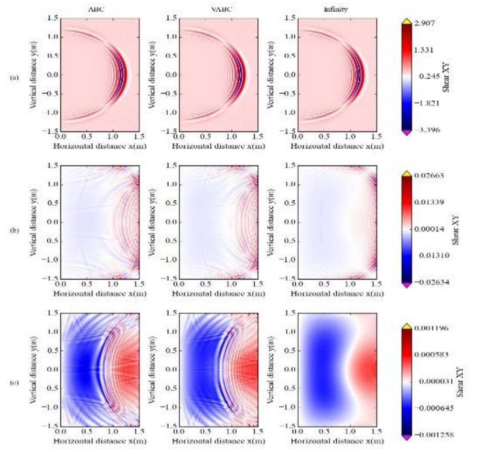
Pressure distribution (N/m2) $\alpha = 2$: (a) time t=2sec, (b) time t=3sec (c) time t=3.2sec and (d) time t=3.5sec

Numerical Results – 2D wave propagation





pressure distribution (N/m2) when damping coefficient, α = 10: (a) time t=0.8 sec, (b) time t=1.0 sec and (c) time t=1.1 sec



Shear stress distribution (N/m2), α = 10: (a) time t=1.4 sec, (b) time t=2.1 sec and (c) time t=2.5 sec

Conclusions

1) Present Absorbing Boundary Conditions includes the effect of Rayleigh Damping in the unbounded domain and produce very less or negligible reflections.
2) Displacements with current Absorbing Boundary Conditions are in excellent agreement with the extended mesh model.
3) The reflections aggregating at higher damping ratios with increase in the analysis time, therefore not suitable for high damping materials

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