Static Variational formulation:

$$\boxed{\int_\Omega c_0(\vec{du}\cdot\vec{v}) + \int_\Omega \sigma(\vec{du}):\varepsilon(\vec{v}) + \int_\Omega \rho g v_3 = 0}$$

with $du_1 = du_2 = du_3 = 0$ at base

$$c_0 = \frac{\rho}{\beta \Delta t^2}$$

$$c_1 = \frac{\rho}{\beta \Delta t}$$

$$c_2 = \frac{\rho(1-2\beta)}{2\beta}$$

dynamic Variational formulation:

$$\boxed{\begin{aligned}&\int_\Omega c_0(\vec{du}\cdot\vec{v}) + \int_\Omega \sigma(\vec{du}):\varepsilon(\vec{v}) + \int_\Omega c_0(\vec{U}_{old}\cdot\vec{v}) \\ &+ \int_\Omega c_1(\vec{v}_{old}\cdot\vec{v}) + \int_\Omega c_2(\vec{a}_{old}\cdot\vec{v}) + \int_\Omega \rho g v_3 = 0\end{aligned}}$$

with $\vec{du} = \vec{U}_{signal}$ at base

: boundary conditions 'b'

: main matrix 'A'

in the variational formulation

Algorithm:

U_{signal}

- Solve Static ($du = A^{-1} b$)
- $U_{old} = du$
- loop on time
  - Solve dynamic ($du = A^{-1} b$)
  - update $U_{old}(du)$, $v_{old}(du)$, $a_{old}(du)$ using Newmark-β
- paraview U_{old}.