

TABLE 5.3.1 CENTRAL DIFFERENCE METHOD†**1.0** *Initial calculations*

$$1.1 \quad \ddot{u}_0 = \frac{p_0 - c\dot{u}_0 - ku_0}{m}.$$

$$1.2 \quad u_{-1} = u_0 - \Delta t \dot{u}_0 + \frac{(\Delta t)^2}{2} \ddot{u}_0.$$

$$1.3 \quad \hat{k} = \frac{m}{(\Delta t)^2} + \frac{c}{2\Delta t}.$$

$$1.4 \quad a = \frac{m}{(\Delta t)^2} - \frac{c}{2\Delta t}.$$

$$1.5 \quad b = k - \frac{2m}{(\Delta t)^2}.$$

2.0 *Calculations for time step i*

$$2.1 \quad \hat{p}_i = p_i - au_{i-1} - bu_i.$$

$$2.2 \quad u_{i+1} = \frac{\hat{p}_i}{\hat{k}}.$$

$$2.3 \quad \text{If required: } \dot{u}_i = \frac{u_{i+1} - u_{i-1}}{2\Delta t}; \quad \ddot{u}_i = \frac{u_{i+1} - 2u_i + u_{i-1}}{(\Delta t)^2}.$$

3.0 *Repetition for the next time step*

Replace i by $i + 1$ and repeat steps 2.1, 2.2, and 2.3 for the next time step.