To be completely obvious, the $i=0$ eqn is

$$a_0\langle\phi_0',\phi_0'\rangle + a_1\langle\phi_1',\phi_0'\rangle + a_2\langle\phi_2',\phi_0'\rangle - \langle 3,\phi_0\rangle - \frac{d\hat{T}}{dz}\phi_0\Big|_{z=0}^{z=3} = 0$$

and likewise the $i=1$ and 2 eqns

__OR__ we can write as a linear algebra eqn set!

$$\begin{bmatrix} \langle\phi_0',\phi_0'\rangle & \langle\phi_1',\phi_0'\rangle & \langle\phi_2',\phi_0'\rangle \\ \langle\phi_0'\phi_1'\rangle & \langle\phi_1'\phi_1'\rangle & \langle\phi_2'\phi_1'\rangle \\ \langle\phi_0'\phi_2'\rangle & \langle\phi_1',\phi_2'\rangle & \langle\phi_2',\phi_2'\rangle \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \\ a_2 \end{Bmatrix} = \begin{Bmatrix} \langle 3,\phi_0\rangle + \phi_0\frac{d\hat{T}}{dz}\Big|_0^3 \\ \langle 3\phi_1\rangle + \phi_1\frac{d\hat{T}}{dz}\Big|_0^3 \\ \langle 3\phi_2\rangle + \phi_2\frac{d\hat{T}}{dz}\Big|_0^3 \end{Bmatrix}$$

at this point all we need to do is calc the various integrals. Note many terms are zero since Basis fns are zero over some of the domain so $\langle\phi_0',\phi_2'\rangle = 0$ since ϕ_0 and ϕ_2 don't overlap.

from page 1 $\quad \phi_0' = -1$, $\phi_2' = \frac{1}{2}$ and $\phi_1' = 1$ in e_0
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad = -\frac{1}{2}$ in e_1

so $\langle\phi_0'\phi_0'\rangle = \langle -1\ -1\rangle$ over $e_0 = 1$

$\langle\phi_1'\phi_1'\rangle$ requires for thought, it has values in both e_0 and e_1 so we could write it as

$$\langle\phi_1',\phi_1'\rangle = \langle\phi_1',\phi_1'\rangle^{e_0} + \langle\phi_1',\phi_1'\rangle^{e_1}$$

__example__ one of the terms

$$\langle\phi_1',\phi_1'\rangle^{e_1} = \int_1^3\left(-\tfrac{1}{2}\right)\cdot\left(-\tfrac{1}{2}\right)dz = \frac{z}{4}\Big|_{z=1}^{z=3} = \frac{1}{2}$$

It is usefull to write the matrix eqn in terms of the <u>elements</u>

since we have to integrate terms that span 2 elements as the sum of 2 integrals