Compressive load in tapered circular bar, with temperature change

```
> restart;
```

Geometrical constraint: no overall deformation:

```
> eq1:= delta=0;
```

$$eq1 := \delta = 0$$

Deformation is sum of incremental deformations; strain is not constant:

```
> delta:=int(epsilon(x),x=0..L);
```

$$\delta := \int_0^L \varepsilon(x)\,dx$$

Strain is sum of mechanical and thermal components:

```
> epsilon(x):=sigma(x)/E + alpha*Delta[T];
```

$$\varepsilon(x) := \frac{\sigma(x)}{E} + \alpha\,\Delta_T$$

Stress is load (constant over *x*) divided by *A* (not constant):

```
> sigma(x):=P/A(x);
```

$$\sigma(x) := \frac{P}{\mathrm{A}(x)}$$

Variation of *A(x)* with diameter:

```
> A(x):=Pi*d(x)^2/4;
```

$$\mathrm{A}(x) := \frac{1}{4}\,\pi\,\mathrm{d}(x)^2$$

Linear variation of diameter with distance *x*:

```
> d(x):=d[1]-(d[1]-d[2])*(x/L);
```

$$\mathrm{d}(x) := d_1 - \frac{(d_1 - d_2)\,x}{L}$$

Everthing now known; solve eq1 for *P*:

```
> 'P'=simplify(solve(eq1,P));
```

$$P = -\frac{1}{4}\,\alpha\,\Delta_T\,\pi\,E\,d_2\,d_1$$

```
>
```

3.11 Mechanics of Materials
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