```
syms l s E A a F
% Part A
N1 = ((l-2*s)*(l-s))/l^2;
N2 = (4*(l-s)*s)/l^2;
N3 = (-(l-2*s)*s)/l^2;
N = [N1 N2 N3];
B = diff(N, s)
%Part B
prod = B.'*B;
simple = simplify(prod);
integralB = int(simple, s)
K = E*A*int(simple, s, 0, l)
%Part C
Nas = N*a*s;
integralC = int(Nas, s);
integralC = simplify(integralC)
Q_d = int(Nas, s, 0, l)
%Part D
s = l;
NL = subs(N)
s = l/2;
NL2 = subs(N)
Q_c = F*(NL + NL2)
%Part E
K_new = ((A*E)/(3*l))*[0, 0, 0;
                       0, 16, -8;
                       0, -8, 7];
Q_t = Q_c + Q_d;
u = Q_t/K_new
%Part F
Q_T_new = [7 -8 1]*u.';
constraint_force = simplify(Q_T_new)
%Part G
e = B*u.';
strain = simplify(e)
sigma = E*e;
stress = simplify(sigma)
```

*B =*

*[- (2*(l - s))/l^2 - (l - 2*s)/l^2, (4*l - 4*s)/l^2 - (4*s)/l^2, (2*s)/l^2 - (l - 2*s)/l^2]*

*integralB =*

*[ -(3*l - 4*s)^3/(12*l^4), -(4*s*(9*l^2 - 15*l*s + 8*s^2))/(3*l^4), (s*(3*l - 4*s)^2)/(3*l^4)]*
*[-(4*s*(9*l^2 - 15*l*s + 8*s^2))/(3*l^4), -(8*(l - 2*s)^3)/(3*l^4), -(4*s*(3*l^2 - 9*l*s + 8*s^2))/(3*l^4)]*
*[ (s*(3*l - 4*s)^2)/(3*l^4), -(4*s*(3*l^2 - 9*l*s + 8*s^2))/(3*l^4), -(l - 4*s)^3/(12*l^4)]*

```
K =

[ (7*A*E)/(3*l), -(8*A*E)/(3*l),    (A*E)/(3*l)]
[-(8*A*E)/(3*l), (16*A*E)/(3*l), -(8*A*E)/(3*l)]
[   (A*E)/(3*l), -(8*A*E)/(3*l),  (7*A*E)/(3*l)]


integralC =

[(a*s^2*(l - s)^2)/(2*l^2), (a*s^3*(4*l - 3*s))/(3*l^2), -(a*s^3*(2*l - 3*s))/
(6*l^2)]


Q_d =

[0, (a*l^2)/3, (a*l^2)/6]


NL =

[0, 0, 1]


NL2 =

[0, 1, 0]


Q_c =

[0, F, F]

Warning: Solution is not unique because the system is rank-deficient.

u =

[0, (l*(11*a*l^2 + 45*F))/(48*A*E), (l*(2*a*l^2 + 9*F))/(6*A*E)]


constraint_force =

-(3*l*(a*l^2 + 4*F))/(2*A*E)


strain =

(7*a*l^3 - 6*a*s*l^2 + 27*F*l - 18*F*s)/(12*A*E*l)


stress =
```

```
(7*a*l^3 - 6*a*s*l^2 + 27*F*l - 18*F*s)/(12*A*l)
```

*Published with MATLAB® R2024a*