Exercises 5.2

4.Find the matrix B for a three-node triangular element given nodal coordinates(x1,y1),(x2,y2) and (x3, y3). Why matrix B is constant along the element and what does it imply?

```
clear all
clc
```

```
syms x1 x2 x3
syms y1 y2 y3
syms xi eta
```

```
C = [x1 y1; x2 y2; x3 y3];
```

```
B = compute_B(C, xi, eta)
```

B =

$$\begin{pmatrix} \sigma_4 & 0 & \sigma_1 & 0 & \sigma_5 & 0 \\ 0 & \sigma_2 & 0 & \sigma_6 & 0 & \sigma_3 \\ \sigma_2 & \sigma_4 & \sigma_6 & \sigma_1 & \sigma_3 & \sigma_5 \end{pmatrix}$$

where

$$\sigma_1 = -\frac{\overline{y_1} - \overline{y_3}}{\sigma_7}$$

$$\sigma_2 = -\frac{\overline{x_2} - \overline{x_3}}{\sigma_7}$$

```
function B = compute_B(C, xi, eta)
nnodes = size(C, 1);
ndof = 2;
dN   = tri3_derivs(xi, eta);
J    = C'*dN;
dNdX = dN/J;
    for i = 1: nnodes
    c = (i-1) * ndof;
    B(1, c+1) = dNdX(i,1);
    B(2, c+2) = dNdX(i,2);
    B(3, c+1) = dNdX(i,2);
    B(3, c+2) = dNdX(i,1);
    end
end

function dN = tri3_derivs (xi, eta)
n = [ 1 - xi - eta
           xi
                eta];
dN = [diff(n, xi) diff(n, eta)];
end
```