**Assignment No**: 1

**Topic**: Formulation of simple 4-elements FEM for wave equation (Steady State)

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We have the wave equation as: ………………..( 1 )

Here is the displacement and “c” is the velocity of the medium.

For the steady state we assume time derivative part as “f”, so the eqn. becomes .….( 2)

Now our problem can be formulated as following:

dx = 0 “W” is the weight function …………….( 3 )

In one dimension above problem can be written as

dx = 0 ….………… ( 4 )

Subjected to the rigid boundary conditions (BC’s) as

Now above equation 4 can be written as following: ………..(5)

Which can be written as:

……….……….(6)

Now this eqn is to discretized in n element so we can write :

………………… (7)

Now we calculate the interpolating function, weights and corresponding derivatives, so

For the linear interpolation: and

And we can choose the weight as: W1= so …………..(8)

And W2= so   
On substituting the values into equation 7 from equation 8.

We place W=W1 and W=W2 one by one in equation 8 which yields two equations.

………………………………….. (9)

Which can be written as following

………………….. (10)

Which can be written as

……………………………………(11)

In Matrix form it can be written as

…………………………(12)

Now suppose we have four elements then we can write them in following manner:

Element 1 : ………..…………(13A)

Element 2: ………..…………(13B)

Element 3: ………..…………(13C)

Element 4: ………..…………(13D)

On merging above four equation we get:

………..……(14)

Which is the required equation.

QED.