Advanced Composites
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Lecture - 36
Particular Solution for Semi-Infinite Plate (Case D)

Hello, welcome to Advanced Composites. Today is the last day of this week which is the 6th week of this course and what we have discussed throughout this week is solutions for semi-infinite plates. In 2 cases, we have solved the situation when the plate is symmetric and now we are working on plates which are having unsymmetric lamination sequences.

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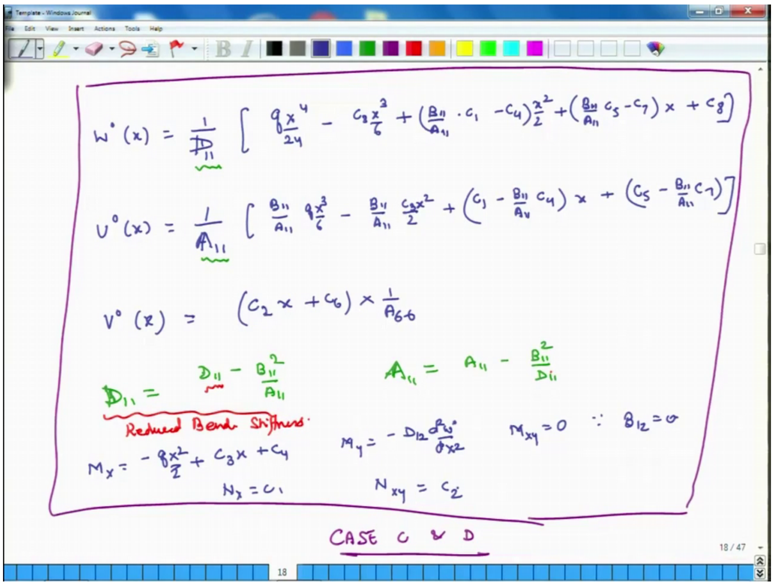

And, for cases C and D we have developed the solutions for U V and W as well as for M x M y and M xy and D 1 2. And, we have found that instead of just a simple D 1 1 we get a reduced bending stiffness term which is script D 1 1. Similarly, in the denominator in the expression for U x we have a script A 1 1 and in both these cases what we see is that the presence of bending this coupling matrix coupling stiffness matrix; it tends to reduce the bending stiffness as well as the in plane stiffness of the plate. So, that is one thing.

The other thing is that we have till so far not calculated the integration constants C 1 through C 8 and the value of these constants will be determined by implementing the boundary conditions. So, that is what we plan to do now. So, we have all these solutions for U V W also for M x M y and M xy and the next thing we are going to do is we are going to implement the solutions for these integration constants. We are going to calculate these integration constants. One thing I omitted writing in terms of the solution in the last class was that I did not explicitly write down the values of N's. So, N x is equal to C 1 N xy is equal to C 2 so, that is still there.

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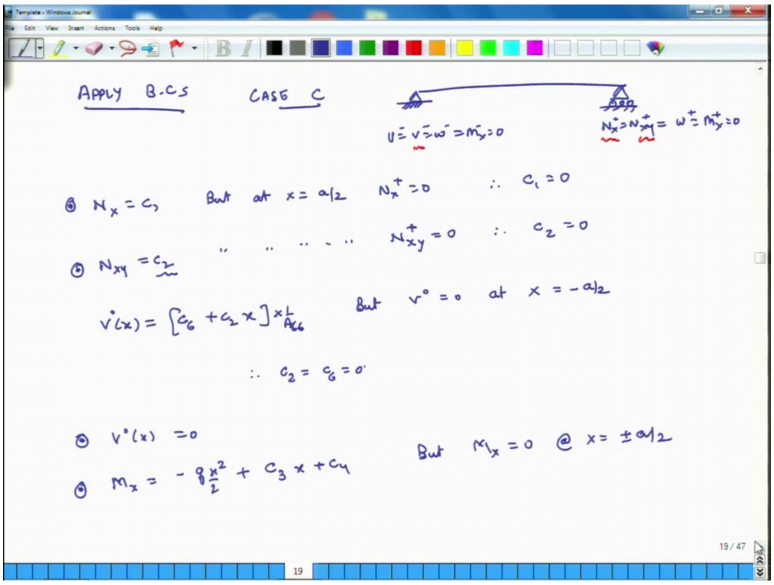

So, now we apply the boundary conditions and the first will be for case C and in case C the B C S are U equals V equals W equals M x equals 0 at the at x is equal to minus a over 2. And, here it is N x is equal to N xy is equal to W is equal to M x is equal to 0 at x is equal to plus a over 2. So, N x is equal to C 1, but at x is equal to a over 2 N x plus is equal to 0 so, therefore C 1 equals 0. So, we have implemented the first boundary condition which is this one ok. Next we apply the second boundary condition which is on N xy. So, we know that N xy is equal to C 2, but at x is equal to a over 2 N xy plus is equal to 0 therefore, C 2 equals 0. So, now we have implemented 2 boundary conditions.

The third is we will see what is V. So, V x is equal to C 6 plus C 2 x times 1 over A 6 6 ok, but we know that V naught is equal to 0 at x is equal to plus minus a over 2. So, if that is the case so, therefore C 2 is equal to C 6 is equal to 0. So, V naught x is 0; oh I am sorry V naught is 0 not at x is equal to plus minus a over 2, it is just at V naught 0 at x is equal to minus a over 2 and C 2 is already 0 we have calculated it. So, C 6 also comes out to be 0 ok. So, we have implemented now 3 boundary conditions out of 8 ok. The next boundary condition we will apply will be on M. So, we know that M x is equal to minus q x square over 2 plus C 3 x plus C 4 ok, but we know that M x is equal to 0 at x is equal to plus minus a over 2.

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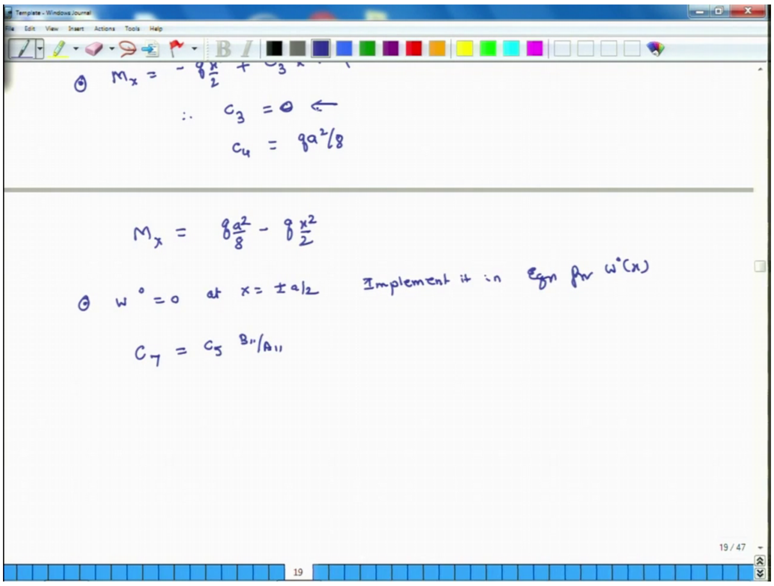

So, we do all these we apply both these boundary conditions and we find that therefore, C 3 is equal to 0 and C 4 is equal to qa square over 8. So, because of that M x is equal to q a square over 8 minus q x square over 2 same relation or I can have the same expression which is this M x is equal to q a square over 2 times 1 by 4 minus x by a whole square. So, this is my relation for M x.

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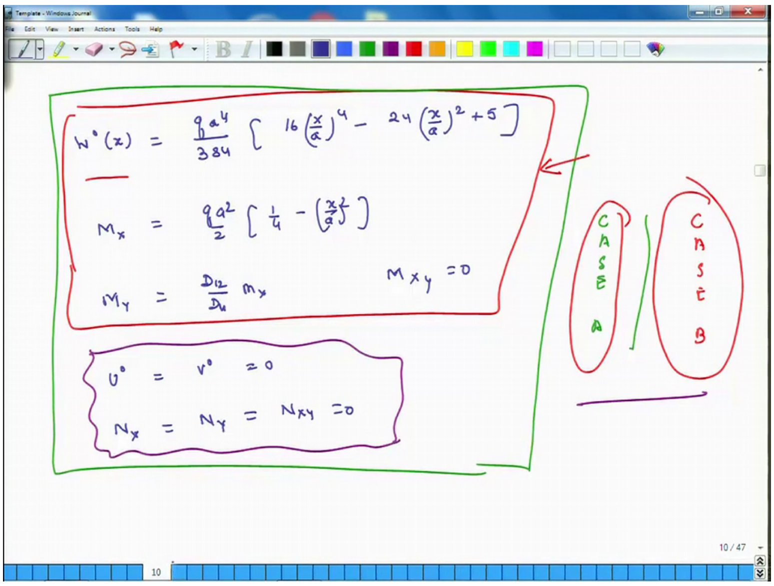

So, now we have applied 6 boundary conditions ok. So, we have calculated the value of C 1 C 2 C 6 C 3 C 4 and what we have not yet implemented our conditions on U and W. So, those are the conditions which I have not yet been implemented. So, the expression for W is this long thing and let us implement the so, we know that W, W is equal to 0 at x is equal to plus minus a by 2.

So, if we implement this condition implement it in equation for W naught x, what do we get? We get 2 conditions C 7 is equal to C 5 times B 1 1 by A 1 1, this is 1 condition we get because, then we implement this condition in this equation for W this term has to be 0 ok, this term has to be 0. So, when we do that we get this relation and we also get the other thing and C 3 is already 0. So, that term also goes away.

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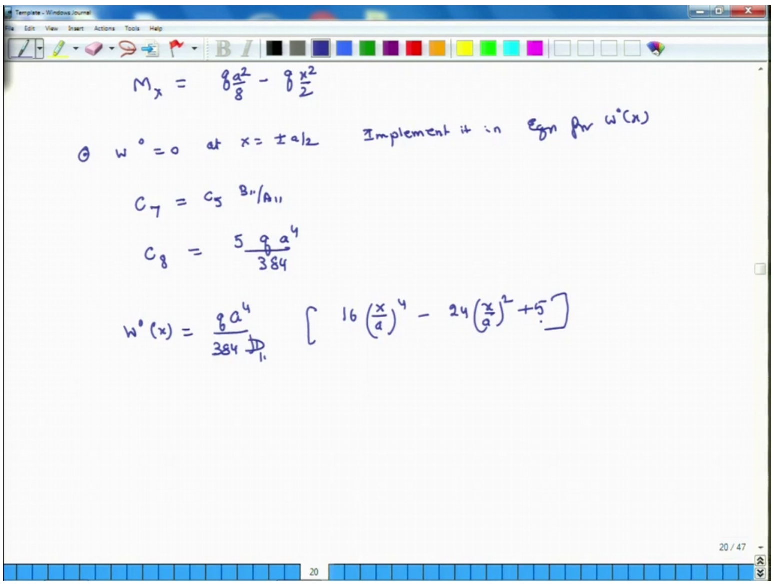

So, so the other condition we get is C 8 is equal to 5 q a 4 divided by 384. So, if we put all these things together what we get is W naught x equals a to the power of 4 times of course, q divided by 384 subscript D 1 1 into 16 x by a 4 minus 24 x by a square plus 5. So, we have now applied 7 boundary conditions. So, the only boundary condition, which is left is now on U ok. So, now we apply the 8th boundary condition which is on U and we apply on the equation for U naught ok.

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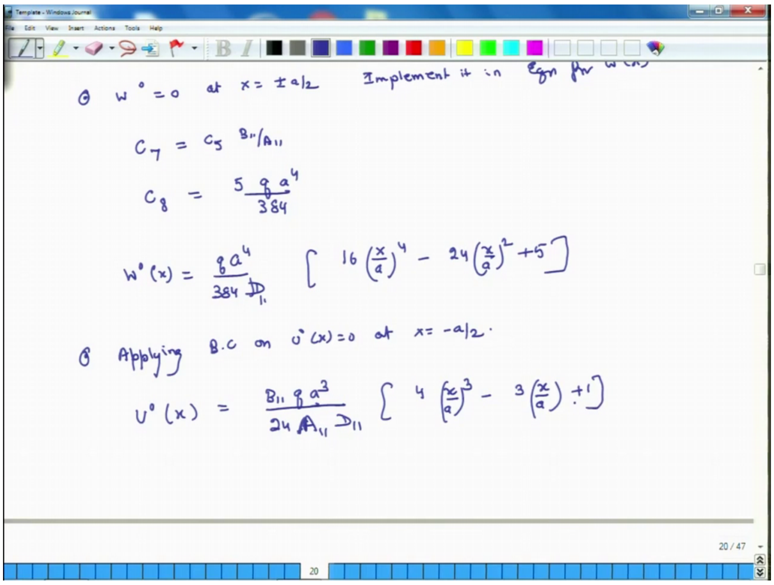

So, applying the B.C on U naught x is equal to 0 at x is equal to minus a over 2, what do we get? We get ultimately this is the equation we get if you do the math carefully. So, this is equal to B 1 1 q a cube divided by 24 subscript A 1 1 times D 1 1 into 4 x by a cube minus 3 x by a plus 1 ok. So, we will compile the results.

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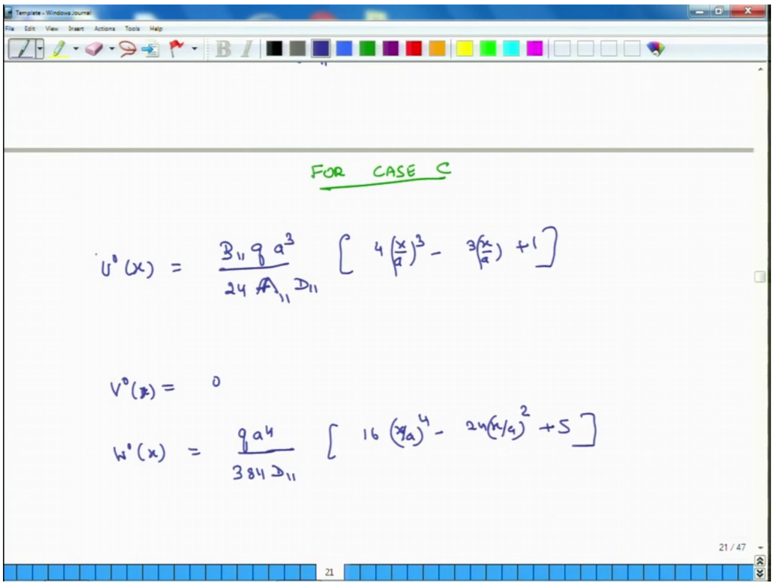

So, U naught x so, these are the results for case C. So, what are the equations? The equations are U naught x is equal to B 1 1 q a cube divided by 24 subscript A 1 1 times D 1 1 4 x over a cube minus 3 x over a plus 1. And, V naught V naught is equal to 0 and W naught is equal to q a 4 divided by 384 D 1 1 16 x over a minus 24 x over a plus 5, oh this is 2 the power of 4 and this is to the power of 2 ok.

So, these are the relations we get for W and for U and V and what we will do is we will continue this discussion next week also because; this is what we have solved for case C. Similarly, what we will also do is we will solve for case D and see whether these solutions are same or different. So, that concludes our discussion for today and I look forward to seeing you next week at the same time that is on Monday.

Thank you very much. Have a great weekend bye.