Computer Methods of Analysis of Offshore Structures
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Module – 03
Lecture – 07
Fatigue Damage 2 (Part – 2)

We will do one more example which can be different from this for a trial for you to understand. I will just show this example for you, so problem number 3, let us say there is again a stress variation of a tubular joint.

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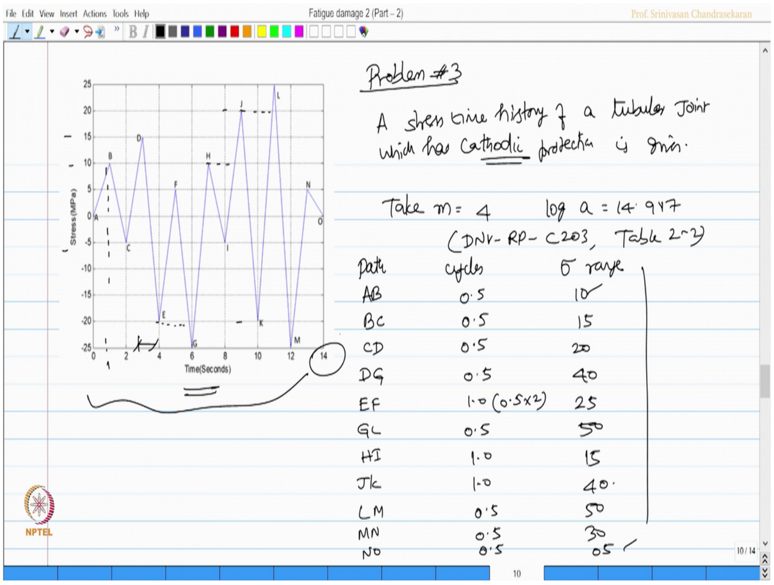

A stress time history, you can see here a stress time history time and stress time history of a tubular joint which has cathodic protection is given take M value as 4 and log a value for cathodic protection as 14.917 which is advised by DNV recommended practice C203 table 2 2 which we also dealt in the last example.

So, interestingly I can rotate this figure do the rain flow counting find the path and try to get this stress cycles and find the cumulative damage and do this, let me do the problem here directly. So, I am going to enter here the path the cycles and the stress range. So, A B, it varies from 0 to 10. So, I would say the stress range is 10 and cycle is A B which is 0.5 because this is actually 1. So, 0.5; similarly B C 0.5; stress value is 15.

You can see B C from 10 to minus 5, C D 0.5 20 DG starts from D drops at E, then goes to G. So, DG 0.5 because D and G are only 0.5, but the stress value is from minus 25 to 15 that is 40 EF, EF has got a reverse cycle. So, 1.0 that is 0.5 into 2; 1.0 and EF is 5 and minus 20. So, 25 GL again G drops at H goes at J drops at L. So, I get the full path GL which is 0.5 because G and H are at 0.5, but the value is minus 25 to plus 25 which is going to be 50, then H; I will have 1, again the reverse cycle will be 15, then JK will have again have 1 reverse cycle which is 40 because J and K minus 20 and plus 20; 40 and LM; LM is a full cycle 0.5, 25 and 20, 50 MN which is again 0.5 of 30 because M is minus 25 and N is 5, 30 and lastly NO 0.5 which is 5.

So, I can directly get the stress range once I get the stress range I can plot the stress bin as see in the figure, for example, if you look at the stress range of 5 it is 0.5. So, 5 it is 0.5 and 10 if you look at 10 is again 0.5.

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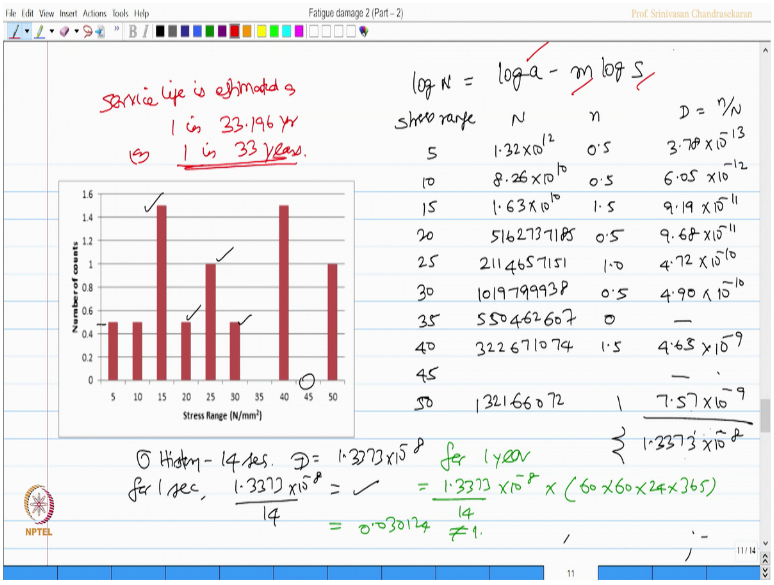

So, 10 is again 0.5. So, one can plot the stress bin directly once I have the stress bin I can calculate the N value. So, we know the equation log N is given by log a minus M log S. So, I now write down the values for all the stress range stress range N; N and D which is N by capital N stress range is 5, 10, 15, 20, 25, 30, 35, 40 and 45, 50, I write down the enter the N values 1.32 10 power 12 capital N, you can see is 1.32 small N is 0.5 from the figure you can see that.

Therefore this is going to be 3.78 10 power minus 30. So, for 10; 8.26 10 power 10; 0.5 6.05 10 power minus 12 and for 15 N is 1.63 10 power 10 and for 15 it is 1 0.5 and this is 9.19 10 power minus 11 and for 25 162737185, this is 0.5 20 is 0.5 and this becomes 9.68 10 power minus 11 and for 25 the N value is 2114657151 and this is 1.0; that is for 25 and this value becomes 4.72 10 power minus 10 and for 310197 triple 938 that is what I get from N and the value is 0.5 for 30 which becomes 4.90 into 10 power minus 10 and for 35; the value is 55046260 seven which is 0 35; there is no value there is no value for 40, this is 322671074 is 1 0.5 and its value is 4.65 10 power minus 9 and for 45 it is 0 because 45 has no stress value and 50; 132166072 and the value is one and.

This is 7; 0.5 6 into 10 power minus 9; I make the sum find the cumulative value which is 1.3373 10 power minus 8, once I know this the total duration is for fourteen seconds you can see here, it is for 14 seconds. Therefore, the stress history is for fourteen seconds and the damage estimated D is 1.3373 into 10 power minus 8. Therefore, for one second I can find which is 1.3373 10 power minus 8 by 14 which amounts to some value therefore, I want to find for one year it can be 1.3373 by 14 into 10 power minus 8 into 60, 60, 24, 365, I get this value as 0.030124 which is actually not equal to 1. I want to find the service life to find the service life I must equate to this and I leave that exercise to you for this problem the service life is estimated as please check the answer is estimated as 1 in 33.196 years or 1 in 33 years please check this answer.

So, friends the summary is; we did 3 numerical examples in this particular lecture, we understood; how to estimate the fatigue damage service life of a given system how to use the different constants different constants from D N V code to calculate the fatigue estimates if the stress history is given. We can directly get the cumulative damage if the stress history is not given, but the stress variation time history is known I can use rain flow counting method to try to get this.

So, friends we will do one more lecture in estimating the fatigue damage of thetas in a new generation offshore platform we will use the computer coding to find out the stress damage and then the service life of the structure in next class.

Thank you very much.