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Failure of Cable Reel Flat Spring of Crane: Beyond Fatigue Life Use

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Abstract : The hot rolled slab lifting crane cable reel drum (CRD) failed due to failure of cable reel flat spring which are inside the cassette of CRD. CRD is used for the movement of tong cable. Stereoscopic observation revealed beach marks and Scanning Electron Microscopy showed striations confirming fatigue mode of failure. Chemical composition should be spring steel (Cr-Mo-V) as per IS 3431:1982 instead of C-Mn steel. To find out the reason of fatigue failure, the theoretical fatigue life of flat spiral spring has been calculated. The calculation of number of fatigue cycles included bending moment, maximum stress on the spring, ultimate tensile strength and alternative stress. The bending moment determination has been taken account with various parameters like Young's Modulus, width, thickness, outer diameter, arbor diameter, pay out the length and angular deflection in rotations. With all the required data, the calculated fatigue life turned to be 10000 cycles, but the spring served 15000 cycles which clearly indicated beyond fatigue life usage. Different UTS values have been plotted with respect to the number of fatigue cycles and clearly showed that the increase in UTS by 40% increases fatigue life by 50%. The significance of higher UTS lied here, and higher UTS depends on modified chemistry with proper tempered martensite microstructure. This kind of failure can be easily avoided by changing the crane spring maintenance schedule from 2 years to 1.5 years considering 600 cycles per month. The plant has changed changing the schedule of cable reel spring and procured new flat reel spring made of 50CrV2 steel.

Keywords : cable reel spring, fatigue life, stress, spring steel
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