An Investigation of High Vibration Problem in Air Fin Coolers, 2003

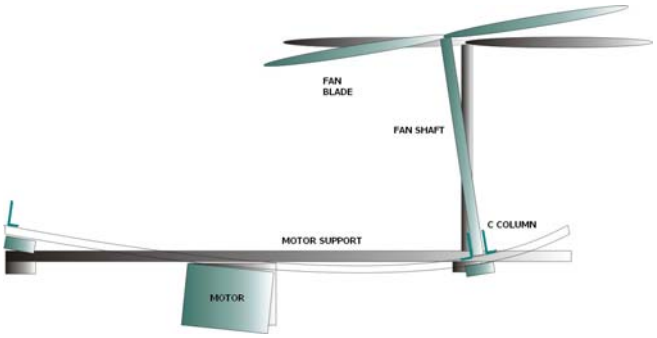
High vibration problem of the induced draft fan were investigated. Analysis techniques include Operating Deflection Shape (ODS) Analysis, Modal Analysis, on-line spectrum monitoring & trending and Finite Element Analysis (FEA).

The investigation includes the top and maintenance platforms structural beams that houses six induced draft fans. It is concluded that the root cause of the failure was due to the dynamic weaknesses of the structures, which lead to resonance problem. Modal analysis on the fan shaft has shown that there are a number of global and localized resonance (natural) frequencies between 3Hz to 16Hz. These low resonance frequencies were due to the huge mass of the tube bundle on the top platform, approximately 70,000kg, supported by C-columns of relatively low stiffness. Operation Deflection Shape (ODS) analysis showed that the dominating frequencies were at 13.75Hz and 14.6Hz which were the structural self-excitation frequency due to fluid (air flow) and blade passing frequency (4x), respectively.

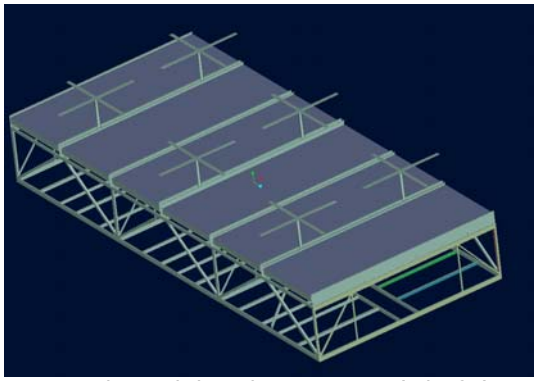
The global operating deflection shape showed that the bending movement of the centre top platform in vertical (Z-) direction had forced the maintenance platform to follow the bending movement due to their linkages. However, the most critical was the mid C columns-fan shaft-motor-motor support structure that showed a highly localized relative movement.

A close correlation between Finite Element model and Modal Analysis results were established. FRF Modal together with FEA revealed about 9 localized modes in 12 Hz ~ 16 Hz region mainly on the fan shaft, top platform C-columns and the motor support structural beams.

A dynamic design criterion was established that would shift the localized modes particularly in the 12 Hz ~ 16 Hz regions to above 16 Hz. As for the global modes, it will require a huge amount of stiffness to compensate the massive mass of the tube bundle.



Localized modes - the fan blade, shafts, C column, motor support and the motor forming localised motion



Complete Finite Element model of the structural beam area

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