David Beneke Consulting
Finite Element Analysis for Engineering

WESTMEAD HOSPITAL - COOLING TOWERS
Harmonic Response Analysis

Date:	April 2016
Client:	Cardno

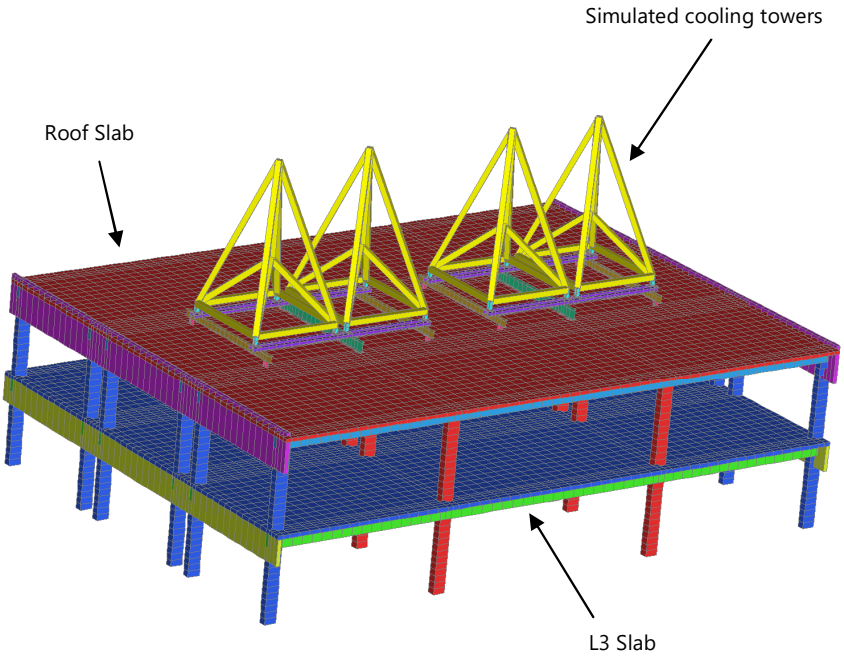
Project Description:

David Beneke Consulting was commissioned by Cardno to assist in the installation of some air conditioning cooling tower units at Westmead Hospital, Sydney. Unfortunately procurement of the specialised vibration isolation fixings which attach the cooling tower units to their supports was delayed. An alternative fixing with a reduced lead time was devised however it needed to be assessed prior to installation.

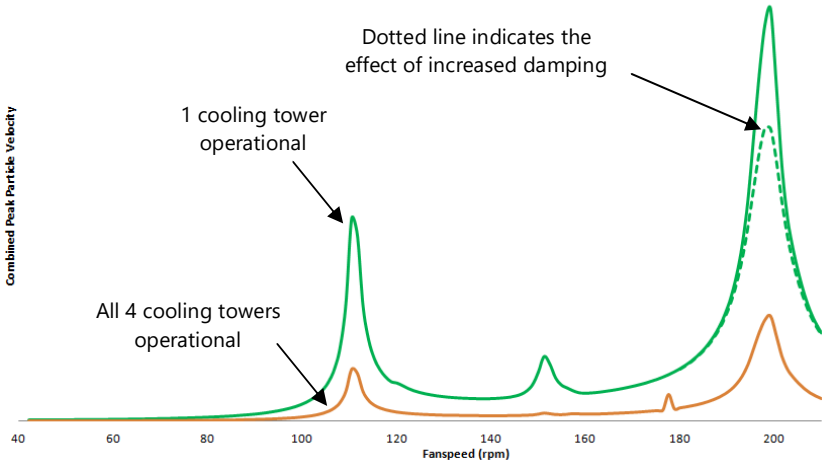
In order to assess the vibration isolation characteristics of the new fastening system, a 3 D finite element model of a discrete section of the reinforced concrete building which supported the cooling towers was created. This included the roof level (where the cooling towers were located) as well as the level below (Level 3) with building columns down to Level 2. The slabs were simulated using 2D plate/shell elements in conjunction with 1D line elements for the down turn beams (offset) and building columns. The cooling towers were simulated using stiff beams elements with nodal masses representing their centre of gravity. A specialised connection element was used to simulate the stiffness of the new fixing.

The out-of-balance load form the fan at the top of each cooling tower was simulated by two forces at 90 degrees to one another. Within the harmonic solver each of these forces was vibrated back and forth with the latter load 90 degrees out of phase. This had the effect of simulating a rotating load.

Multiple analyses were undertaken investigating changes in structural mass and damping within the frequency range of interest in order to assess the likelihood of perceptible vibrations for anyone standing on the Level 3 slab.



FEA model of the concrete building with cooling towers



Peak particle velocity versus fan-speed results

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