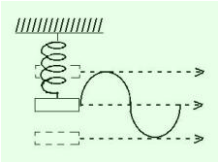

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Ergonomic Survey

Dear xxxxxx

As per your request I carried out a survey was to identify "Whole Body Vibration (WBV)" problem locations at various workstations in and around the sawmill.

The survey was carried out as close as possible to the guidelines set out in ISO standard 2631-1 –1997. I carried out the survey before I was familiar with the ISO standard and took all the readings in peak velocity (in/sec/sec). The ISO Standard requires the readings to be measured in RMS velocity (m/sec/sec). To obtain the readings in m/s/s the use of analysis equipment (with inbuilt weighting factors) that is specifically designed for this type of survey is required or complex mathematical calculations to calculate the "frequency-weighted" acceleration amplitudes. Frequency-weighting factors are used to calculate the reaction of the human body when exposed to different vibration frequencies. I have attached frequency spectrum graphs that clearly indicate the frequencies that are in evidence at each workstation; also, I have calculated the weighted value amplitude for the overall amplitude at each workstation. I did not calculate amplitude for every individual frequency recorded because this would have been a very lengthy exercise; however, I am sure that you will find the results valuable and help you identify the problem areas in the mill. If you require more information for individual workstations I will carry out another survey with the correct accelerometer filter and measure amplitude in three directions as per ISO guidelines i.e. X axis – back to chest, Y axis – right to left side and Z axis foot (or buttocks) to head. All of the readings below were taken in the Z axis – this was were I found the highest amplitudes.

To give you a brief insight into WBV I have obtained as much information as possible and condensed it to help you understand the findings of my survey.
Principle effects of vibration are:

- Degraded Health
- Impaired activities such as hand control and vision
- Impaired Comfort
- Motion sickness
- Fatigue

Frequencies in the range of 0.5Hz to 80 Hz are significant in terms of body response. Every object (or mass) has a resonant frequency for example when a bell is rung it will resonate at its natural frequency. When an object is vibrated at its resonance frequency, it will vibrate at maximum amplitude, which is larger than the amplitude of the original vibration. (You have probably seen the old film clip of a suspension bridge that is twisting back and forth until it self destructs – this is a good example of a small amount of force having a devastating effect, in this case the wind blowing over the bridge excited its natural/resonant frequency). In the human body individual members and organs have their own resonant frequencies and do not vibrate as a single mass. This causes amplification or attenuation of input vibrations by certain parts of the body due to their own resonant frequencies. The most effective exciting frequency for vertical vibration lies between 4 and 8 Hz. Vibrations between 2.5 and 5Hz generate strong resonance in the vertebra of the neck and lumbar region with amplification up to 240%. Between 4 and 6 Hz

resonances are set up in the trunk with amplification up to 200%. Vibrations between 20 and 30 Hz set up the strongest resonance between the head and the shoulders with amplification up to 350%. In a human body, this unwelcome situation may create chronic stresses and sometimes even permanent damage to the affected organs or body parts.

Frequency Effects:

Symptoms	**Frequency (Hz)**
General feeling of discomfort	4 – 9
Head Symptoms	13 –20
Lower jaw symptoms	6 – 8
Influence on speech	13 – 20
“Lump in throat”	12 – 16
Chest pains	5 – 7
Abdominal Pains	4 – 10
Urge to urinate	10 – 18
Increased muscle tone	13 – 20
Influence on breathing movements	4 – 8
Muscle contractions	4 – 9

Exposure guidelines for whole body vibration

Daily Exposure	**Acceleration Limits, in m/s/s (rms)**	
(hours)	**z-axis**	**x- or y- axis**
1	1.20	0.85
2.5	0.71	0.50
4	0.53	0.36
8	0.32	0.22
16	0.21	0.15
24	0.14	0.10