New workstation design that might reduce Ergonomic injuries among Off-loaders in a mail distribution company in Toronto

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Background

- The process of manually offloading trucks in mail distribution centres is a strenuous and physically demanding task. Workers are at risk for development of fatigue and musculoskeletal disorders (MSD), including low back pain.
- High Impact Claims include MSDs, and account for more than 41% of all lost time benefit payments and almost 33% of all lost time claims over the past five years (2015 WSIB Statistical Report).
- In spite of many research studies and training programs on low back injury prevention, low back injuries still lead all others with 17%; indicating that current practices in manual material handling are not sufficient.
- A variety of controls are presented to reduce the possibility of musculoskeletal disorders. The most effective control is elimination of the hazard through automaton of the work process.
- The purpose of this study is to identify design solutions to reduce the risk of ergonomic strain during manual material handling.
- Automation is another solution which is not discussed here due to the costs.

Methodology

- Testing was carried out by observing three off-loaders in the performance of their regular job tasks. The current setup of the work environment is shown in (Figure 1 , Figure 5 and Figure 7).
- The workers' posture during the task was videotaped, and then analysed using 3D Static Strength Prediction Program™ (3DSSPP) software to estimate relavent joint loading as seen in (Figure 2).
- Joint moments and forces were normalized based on body height and weight of each participant.
- The ACGIH "Table 3. Threshold Limit Values (TLVs) for Frequent, Long Duration Lifting" was selected based on field observations of the number of lifts occurring per hour. Lifting posture was biomechanically selected according to the 12 bin-ACGIH grid.
- Spinal compression for each weight and posture combination was estimated. Every load lifted or lowered was compared to the ACGIH lifting TLVs for each location bin, and the peak and average spinal loads were calculated.

Figure 1. Study setup demonstrating original environmental and physical conditions, specifically glare and irregular loads.

Figure 2. 3DSSPP Software visualization of the work process.

Results

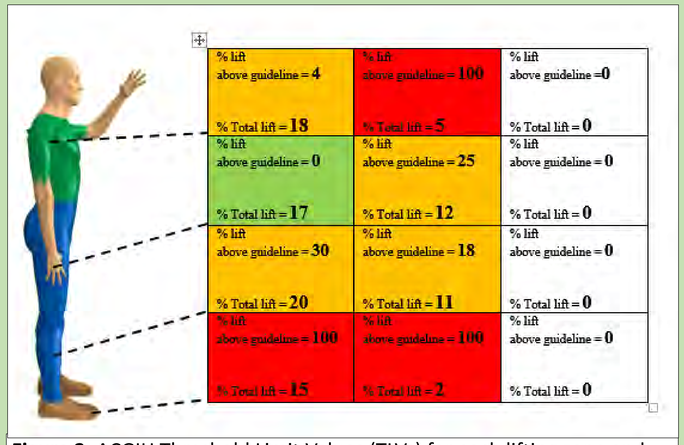

Figure 3. ACGIH Threshold Limit Values (TLVs) for each lifting zone and the average percentage of lifts in each zone.

Figure 5. Depiction of the current working conditions. The worker is frequently required to lift loads that are beyond their reach distances. In addition, very low levels of illumination are present and noise levels are very high.

Figure 6. Depiction of the new proposed lifting device used to eliminate the requirements for accessing the areas that are out of the workers' reach distances.

Discussion

- (Figure 3), shows the percentage of the lifts above and below the TLV set by the ACGIH guideline. The color code of red (high risk), orange (medium risk), and green (safe condition) are used to help understand the table.
- The safest condition is when the courier lifts the load within the height of the knuckle to the shoulder, provided the distance is less than 30cm. This occurs in only 17% of the lifting/lowering conditions evaluated.
- It was observed that 22% of the loads were handled at a rate above the ACGIH recommendation. Of the remaining 78%, 68% was within the ACGIH recommendation, but should be treated with caution. The final 32% of the loads lifted were classified as high risk, exceeding ACGIH guidelines. An example of a high risk lifting situation can be seen in Figure 5.
- The findings indicate a significant risk for the development of MSDs for workers preforming the task of off-loading trucks. Furthermore, there are several unfavorable environmental conditions present including insufficient illumination, high levels of noise, airflow and heat or cold stress.

Conclusion

- The results showed that the amount of pressure applied to the spine exceeded the ACGIH lifting Threshold Limit Values in many lifting positions.
- Most notably, lifting positions that require the operator to lift from below knee level and above the shoulder level placed the most load on the spine.
- The load is amplified by other ergonomic issues, including lifting heavy objects, awkward body posture and the fast paced repetitive nature of the task. This poses a significant hazard, as it increases the risk of acute injury and the development of musculoskeletal disorders.
- The controls suggested, to reduce the spinal load, include:
  - Installation of the lifting device, depicted in (Figure 6. and Figure 8) ,designed to eliminate the requirements for accessing the areas that are outside of the workers' reach safe distances.
  - Use of forklifts to offload the bins from the trucks to be manually offloaded by the workers as seen in (Figure 8).

Figure 7. The system that is currently in place. Off-loaders are required to enter the trailers to manually remove the packages. This increases the risk of the development of musculoskeletal disorders from poor ergonomic design. The risk is also increased by the various other environmental hazards that are present in the trailer.

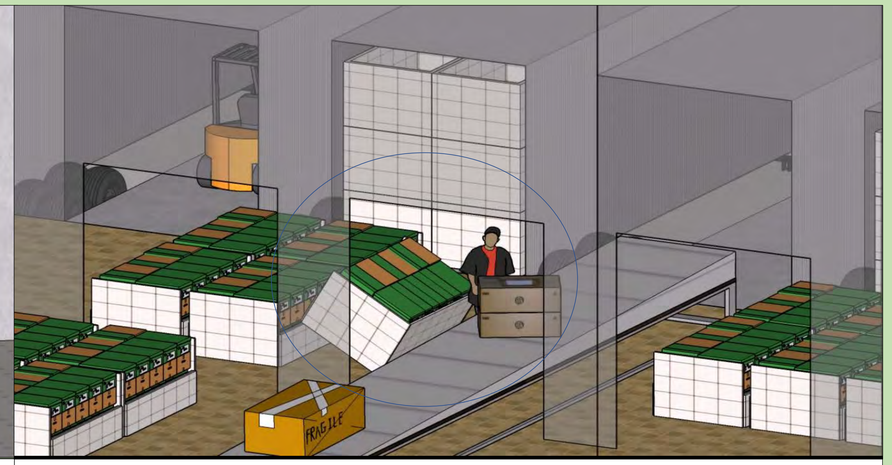

Figure 8. The new proposed design is a semi-automated system that reduces human engagement with the use of loading bins and forklifts to load the trailers. Workers no longer need to enter the trailer to off-load the packages.