RAC News

A WSIB Research Advisory Council Newsletter May 2002 Issue 2

RAC Newsletter

RAC RECEIVES 51 PROPOSALS IN 2002 COMPETITION

The WSIB Research Advisory Council (RAC) has received 51 proposals in response to its 2002 research grants competition.

The total funding requested by the 51 proposals is $7,015,563.64.

This year, the RAC created a new category of grant — Development Grants — to complement its Full Grants.

Development Grants recognize that the preparation of high quality, innovative research proposals often involves a great deal of preliminary work for which researchers may not have adequate resources. Development Grants are for 12 months or less and a maximum of $30,000.

Development Grants are typically for the development of new measurement tools, feasibility studies, or exploratory research.

Of the 51 proposals received by the RAC this year, thirteen are Development Grant proposals.

All proposals are currently being reviewed. Following review, the RAC will make its funding recommendations to the WSIB Board of Directors. The Board of Directors' decision should be announced by the end of June.

This is the RAC's fourth annual competition. To date, the WSIB has awarded a total of $7,694,078 for 47 research projects. The first competition was held in 1999.

RAC BOOTH AT THE AWCBC PUBLIC FORUM LAST NOVEMBER

WSIB Research Advisory Council Chair Robert Norman with the Research Secretariat at the Public Forum on Knowledge Transfer held by the Association of Workers' Compensation Boards of Canada last November in Toronto. The Council had a booth at the Forum featuring the WSIB's Solutions For Workplace Change research grants program, which the Council oversees. From left to right: Alice Peter, Robert Norman, W. (Wally) Lewyckyj, Perla Scala, Henry Hao.

In This Issue

COMPLETED PROJECTS:

1999 PROJECTS START REPORTING RESULTS

Research projects funded in 1999, the first year of the WSIB's Solutions for Workplace Change research grants program, are beginning to report their findings. We summarize the findings of two such studies below — other studies will be presented in future issues of RAC News. Please bear in mind that these summaries are based on reports submitted to the RAC by the research teams, and that the presentations of findings may undergo revision when they are published in peer-reviewed journals — it is generally preferable to consult the journal versions. RAC News will inform you where the findings of our funded projects are published. WSIB funding of projects does not imply WSIB endorsement of the findings. A complete list of projects funded by the WSIB's Solutions For Workplace Change research grants program is available on the WSIB website at http://www.wsib.on.ca/wsib/wsibsite.nsf/Public/ResearchProjects.

WEARING EARMUFFS IN COMBINATION WITH OTHER COMMON SAFETY DEVICES CAN COMPROMISE HEARING PROTECTION

HEARING PROTECTORS, SAFETY GLASSES, AND RESPIRATORY PROTECTIVE EQUIPMENT IN COMBINATION: EFFECT ON SOUND ATTENUATION

PRINCIPAL INVESTIGATOR: SHARON M. ABEL

It has long been known that the protection against high-level noise provided by earmuffs generally falls short of manufacturers' specifications. Specifications are based on an optimal fitting of the device by trained personnel, but in real life, people may not wear the device correctly. For instance, the earmuffs may not form an air-tight seal with the ear, they may not be sized correctly, the headband tension may be too slack, or the muffs may not have been properly maintained. Each of these factors can compromise the protection provided by the device.

There are gender differences as well. The protection afforded by earplugs depends to some extent on the cross-sectional area of the ear canal — the smaller the canal, the poorer the fit, the less the protection — and the ear canal is significantly smaller in women. One-size-fits-all devices may therefore provide poorer protection to women than to men.

What had not been studied is whether the protection provided by earmuffs would be further compromised if worn in combination with other protective devices. It is not unusual, for instance, for a worker to wear a hard hat, safety glasses, and a respirator in addition to earmuffs. In such a case, the muffs would be mounted on the hard hat, and the safety glasses and respirator might further compromise the seal between the muff and the ear.

The effect of such combinations is precisely what Dr. Sharon Abel and her research team of Dr. Andrea Sass-Kortsak and Dr. Aneta Kielar set out to study. Taking a Class A earmuff (CSA standard Z94.2-94) mounted on a hard hat, they measured the protection provided by the muff when it was worn alone, when it was worn with safety glasses, when it was worn with an air-purifying half-mask

A Class A earmuff, mounted on a hard hat, being worn with safety glasses and an air-purifying half-mask respirator. Study results suggest such a combination significantly decreases the hearing protection provided by the earmuffs.

respirator, and when it was worn with both safety glasses and respirator. Each combination was tested at various sound frequencies, ranging from a low of 0.25 kHz to a high of 8.0 kHz.

The researchers found the following:

- the greatest protection was provided when the hat-mounted earmuffs were

worn alone, without safety glasses or respirator

- the least protection was afforded when the hat-mounted muffs were worn with both safety glasses and respirator
- under all combinations, the muffs protected best against higher-frequency sounds, their protection increasing steadily from 0.25 kHz to 1 kHz, and then leveling off
- the protection afforded to men was greater than that afforded to women.

The researchers were also concerned with the effects of protective earmuffs on workers who had pre-existing hearing loss. The concern here was that earmuffs might adversely affect the ability of hearing-impaired persons to hear warnings sounds or to comprehend speech. Although the earmuffs did not render sounds or speech inaudible to normal hearing persons, the earmuffs were found to occlude higher-frequency sounds in the hearing impaired. This means that both speech comprehension, which depends on higher frequency sounds, and the perception of high-frequency warning signals are more problematic for hearing impaired persons wearing earmuffs.

On the basis of these findings, the research team recommends the following:

- because earmuffs protect least against lower-frequency sounds, it may be better, in workplaces where protection against low frequency sounds is the concern, to use earplugs instead of earmuffs, since plugs provide significantly better low-frequency protection than muffs, and fit well regardless of other safety gear worn about the head
- attention should be paid to the sizing and fit of earmuffs, especially for women, whom protective devices tend to fit less well than men, and in situations where muffs are worn in combination with other devices, which affects their fit — the researchers point especially to the case where earmuffs are mounted on a hard hat, because here an optimal fit for the hard hat often means a less than an optimal fit for the muffs
- for users with pre-existing hearing loss, it may be better to choose a Class B protector to optimize the detection of warning signals and speech comprehension, while still protecting against further damage to hearing.

Dr. Sharon M. Abel is currently with the Communications Group at the Human Factors of Command Systems Section of the Defence & Civil Institute of Environmental Medicine. She can be reached at (416) 635-2037, or by email at sharon.abel@dciem.dnd.ca

IMPROVING THE DESIGN OF LHD EQUIPMENT IN UNDERGROUND MINES

UNDERGROUND MOBILE TRACKLESS EQUIPMENT VISIBILITY INVESTIGATION

PRINCIPAL INVESTIGATOR: ALAN W. SALMONI

Each year, some 160 incidents in Ontario mines involve Load-Haul-Dump (LHD) vehicles — large, mobile machines designed to move ore and other materials in the low, narrow confines of underground mine drifts. Some of these incidents result in lost-time claims, and some — seven in the years 1986-1996 — in fatalities. Four percent of the incidents, and 50% of the fatalities, are attributed to poor LHD operator visibility. In underground tunnels, where lighting conditions are poor, it is difficult for LHD operators to *see*.

LHD design does not help. Designs aim at maximizing carrying capacity, maneuverability, and fit in confined spaces, and these are typically achieved at the expense of operator visibility. Even some of the safety features of LHDs — like the cab for the operator's protection — interfere with visibility by introducing blind spots. The low height of LHDs, and the cab's position on the LHD's left side, make it difficult for the operator to see objects around the machine, especially on the far side. Among the most common accidents are collisions with other vehicles unseen by the LHD operator, or with equipment left lying on the drift floor. Many of the injuries arising

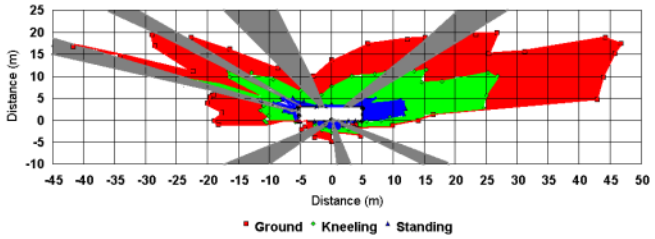
Load-Haul-Dump (LHD) vehicles such as this one are used to move ore in underground mine drifts. Designed for maximum load capacity and for fitting within confined environments, they usually offer very poor operator visibility.

out of LHD incidents are to the LHD operators themselves.

Dr. Alan Salmoni of Laurentian University set out to obtain the information necessary to correct this problem. The object of his research project was two-fold: to document scientifically the precise nature of visibility interferences of various LHD models, and to see whether computer simulations could be useful in designing LHDs that avoid these problems.

To achieve the first objective, Dr. Salmoni, with his research team of Dr. Robert Whissell of Laurentian University and Tammy Eger and Jim Cluff of the Mines and Aggregates Safety and Health Association (MASHA), constructed line-of sight diagrams for 11 different LHD models, and determined the pattern of visual interferences specific to each. This objective analysis was supplemented by a survey of 130 LHD operators, which asked the operators to rate the visibility of the LHD models they were familiar with, and to identify the objects that interfered with visibility most. The operators' subjective evaluations generally concurred with the objective line-of-sight analyses.

LINE-OF-SIGHT DIAGRAM FOR A COMMON LHD VEHICLE



A line of sight diagram for an 8-yard LHD vehicle with a cab. The operator is positioned at position (0,0). The LHD vehicle is represented by the white rectangle. The area in which the ground cannot be seen from the operator's position is shown in red, the area in which a kneeling person cannot be seen is in green, and the area in which a standing, 1.7-meter-tall person could not be seen is in blue. Complete blockages (blind spots), due mostly to the operator's cab, are shown in grey.

The research team found that:

- no two LHD models have the same visibility characteristics
- visibility is poorest for larger machines, and for machines with cabs
- visibility on the operator's right side is especially poor due to the cab's standard location on the left side of the vehicle, with the front right corner and back right corner being most obstructed
- operator cabs, lights, and light brackets are responsible for most blind spots
- visibility is impaired by wheel covers, bucket lip extensions, oversized buckets, light posts, booms, air intake cylinders, radiator backs, and fire extinguishers
- the two objects most frequently identified by operators as especially difficult to see are kneeling pedestrians and equipment left lying on the ground
- the three environmental factors that decrease visibility most are fog, dust, and steep hills.

To understand the visual challenges posed by a dimly-lit underground environment, Dr. Salmoni's team also studied the role of contrast and luminance in the visibility of underground objects.

With respect to the project's second objective, the team found that JACK software could be effectively used to help design LHDs that eliminate visibility problems. This is an important finding, because it makes possible design recommendations at the much less expensive developmental phase, rather than after a machine has been designed and manufactured. In the 2001 competition, Dr. Salmoni and his team were awarded a second WSIB grant to use computer simulations to make LHD design recommendations.

But even the results of the team's first study have had practical applications. Working closely with MASHA, Dr. Salmoni's team and its findings have:

- informed a "visibility campaign" in the Ontario mining industry
- helped design a safety package titled "Visibility and the Safe Operation of Load Haul Dump Vehicles," which is available through MASHA
- help launch a test pilot of a knowledge transfer program at a small gold mine in northeastern Ontario.

Dr. Alan W. Salmoni is currently Director of the School of Kinesiology, Faculty of Health Sciences, at the University of Western Ontario. He can be reached at (519) 661-3541, or by email at asalmoni@uwo.ca.