SAFETY SCIENCE Monitor

Special Edition 1999

VOL 3

Safety in Action
25-28 February 1998

Occupational Hygiene
Article 4

WORKERS EXPOSURE TO OCCUPATIONAL NOISE WITHIN THE HIGH-RISE CONSTRUCTION INDUSTRY

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ABSTRACT

Worker exposure to noise on high-rise construction sites is an ever-present hazard and one that is commonly accepted by many industry workers. The potential risk to the individual through repeated exposure to excessive noise on these projects is very real, concerning but controllable. This study focuses on establishing a risk profile on workers exposed to excessive noise including the identification of high-risk operational areas and work activities influential in affecting worker exposure.

Involved were 238 workers from 20 occupational groups who were personally monitored for noise exposure during the construction of three high rise projects on the Gold Coast, Queensland. The study results clearly showed that high-rise construction workers are exposed to high levels of impact and steady state noise during work. In particular, occupational groups such as formwork carpenters (93.52 dB(A)), concreters (93.5 dB(A)), concrete line hand operators (92.97 dB(A)), formwork labourers (91.78 dB(A)), scaffolders (91.7 dB(A)), internal carpenters (91.41 dB(A)) and dogman (90.80 dB(A)) were identified as high risk exposure groups. As defined in Queensland legislation, noise exposure criteria represents an eight hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,\ 8hr}$ of 85 dB(A) or in the case of exposure to instantaneous noise levels a linear (unweighted peak) peak sound pressure level, Lpeak, 140 dB(lin).

Eight hundred and twenty nine workers (N-829) also participated in the questionnaire survey. The responses were varied; however, there was a direct correlation between personal dosimetry results in certain occupations and their perception on their current state of hearing. A high proportion of workers 644 (77.7%) have not undergone audiometric testing and 203 (30.3%) of the subjects indicated having symptoms of tinnitus (ringing in the ears). Noise emanating from machinery, tools and activities i.e. tower cranes, hammer drills, circular saws, dropping of materials and impulse noise from explosive power tools are just some of the noise sources characteristic of construction work.

Machoism, worker apathy, lack of industry self-regulation and organisational deficiencies in effectively managing noise and hearing conservation issues were identified as some of the major shortcomings prevalent within the industry. Although sophisticated technology has been devised to measure and control noise and minimise its impact within many industries, there is a lack of documented research into the state of noise and hearing conservation on high-rise construction sites specifically.

In conclusion, there is a case for more stringent noise exposure controls on these projects including the role and function of hearing conservation programs, including audiometric screening of workers, assessing risk and control of noise through engineering noise reduction. This paper briefly discusses the research findings following an eight-month study into noise within the high-rise construction industry.

INTRODUCTION

High rise construction work is by its very nature, hazardous, dynamic, complex and inherently noisy. Worker health and safety is a critical issue on these workplaces as the risks significantly increase due to the nature and size of the work. Noise, an insidious disease, is of particular concern within this industry as it is constantly active and progressively exerting it's destructive influence on unprotected workers within many occupational settings.

Within Queenslands' construction industry the incidence of industrial deafness (according to Australian Bureau of Statistics compensation claims) totalled 1236 claims during 1992-1997. The total cost of these claims, $5,132,101 say nothing about the injury and disease experiences of self-employed persons i.e. builders, contractors working within the various construction sectors.

The relationship between occupational noise exposure and hearing damage have been subjected to extensive scientific study both nationally and internationally (National Safety Council 1979, American Industrial Hygiene Association 1988, Division of Workplace Health and Safety 1996, Better Health Commission 1986). Causing no pain or noticeable disfigurement to its host, noise poses a very real risk of inflicting damage on the auditory senses. Prolonged exposure to loud sounds causes damage to the hair cells of the cochlea, resulting in hearing ability becoming progressively impaired. Commonly called noise induced hearing loss or industrial deafness, hearing impairment can severely downgrade a person's quality of life. The consequence of this loss leads to potential communication difficulties, isolation, impaired interpersonal relationships and a dangerous unawareness of life-threatening situations (Australian Standards – A Seminar 1990). Furthermore, hearing loss can also occur outside the workplace and these include presbycusis, sociocusis and hearing loss brought on by all kinds of medical abnormalities and acoustic trauma (Suter, 1986:6).

Current Situation

The current situation of noise control and hearing conservation within Australia has been perfectly describe by Else, (1990) who stated, that from a "historical perspective we have now progressed to compensating people for going deaf and providing many more people with hearing protectors with little being done to tackle the problem at the source" (396). This quote by Dennis Else raises serious questions about the state of noise control and hearing conservation across all industries in Australia. The National Occupational Health and Safety Commission (Worksafe) rated noise-induced hearing loss among the top occupational health hazards, second only to occupational back problems (Hickson et al, 1995). At present it appears that workers employed in many industries across Australia including the construction industry face noise problems that vary little from those experienced at the beginning of the industrial revolution.

Few studies have been published on worker exposure to noise within the high-rise construction industry. A study recently completed by Incolink in Victoria during the construction of the Crown Casino in Melbourne showed that around 70 percent of the workers were exposed to dangerous levels of noise six times above the limit of 85 decibels accepted by the State of Victoria's Hearing Conservation regulation (Incolink, as cited by the News Journal for the Civil & Structural Construction Contractor, 1998).

A number of audiological studies conducted overseas have shown a direct correlation between hearing loss and workers employed in the construction industry (Sinclair & Hafldson 1995, Chew and Lin 1991, Schneider et al 1995).

Methodology

Personal and environmental noise monitoring was conducted during the latter part of 1996 and during 1997. Construction workers were selected for participation on a planned or random basis and included workplace health and safety officers, steel-fixers, sprinkler fitters and project supervisors. In all, a total of two hundred and twenty-eight workers responded to the study.

The equivalent continuous sound pressure level for an eight hour work day or the $L_{Aeq,8h}$ was assessed by using Personal Noise Dosemeters B&K 4436 and Larson Davies 710 designed for the 3 dB rule and placed within the shoulder region of the worker. Downloading of the noise dose meters was via an IBM PC computer using the Model 710 and BZ7028 Dosimeter Software. All personal noise dose meters were factory calibrated prior to use and calibrated independently following downloading onto computer.

Environmental noise levels were recorded at various site locations using Bruel and Kjaer 2225 (Type2) and 2230 (Type1) Integrating Sound Level Meters fitted with windscreens to limit the effect of wind on the measurements. All sound monitoring equipment was factory calibrated prior to use and calibrated prior to and during the measurement period. Noise survey measurements were recorded as per Australian Standard (AS 1269-1989). The measurement reading and weighting, weather conditions, temperature, calibration intervals, wind speed etc were recorded each day of the field work.

The downloaded information i.e. L_{Aeq} and Peak (lin) noise measurements obtained from each site were entered on Microsoft Excel, Version 5.0 and a mean obtained. Because logarithmic units are used with the decibel scale normal arithmetical calculations cannot be used. To check the validity of the results a number of $L_{Aeq, 8h}$ 85 dB(A) levels were converted to a daily noise dose and normal arithmetic was applied to obtain a mean. Both methods produced very similar results. This data was then sorted in descending order to identify those occupational groups in higher risk categories. The development and use of a common questionnaire allowed for both closed and open-ended questions. The information collected was coded and entered into an IBM PC computer. Statistical analysis was performed with the aid of SPSS Version 6.1 a statistical computer program.

The construction sites were selected on the basis that the number of site workers would exceed one hundred and the plant and equipment used would be similar on each site. Working procedures were typical of high-rise construction work using currently acceptable practices, tools and materials. Each site was serviced by two tower cranes and a men and materials hoist.

To obtain a valid representative sample it was intended to obtain three or more daily measurements from each work group so that an objective means of comparing average daily noise dose measurements over several days could be calculated. Figure 1 lists the valid number of measurements obtained during the monitoring period. Nine samples were discarded through operator error or meter malfunction.

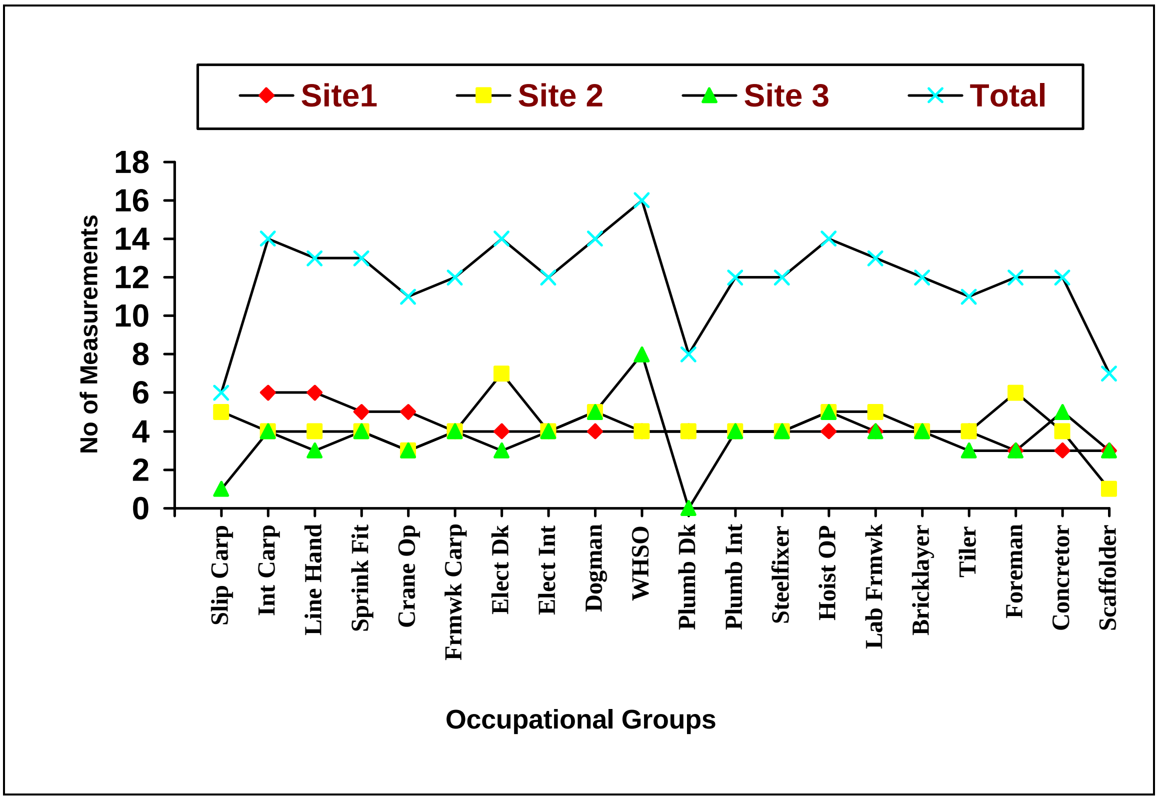

Figure 1 Allocation of dosemeter measurements across sites One, Two and Three

Criteria

The criteria for the noise exposure survey were those of the Workplace Health and Safety Act, 1995 and in particular those of the Workplace Health and Safety Regulation 1997 "Part 10-Noise" (68). This Regulation in part states: "excessive noise" is a level of noise above –

a) an 8 hour equivalent continuous A-weighted sound pressure level of 85dB(A), referenced to 20 micropascals,

b) an unweighted peak sound pressure level of 140dB(Lin), referenced to 20 micropascals.

RESULTS

Personal Monitoring

$L_{Aeq,8h}$ - 8-hour equivalent continuous A-weighted sound pressure level of 85 dB(A)

L_{peak} 140 dB(Lin) - unweighted peak sound pressure level of 140 dB(lin)

All Sites Combined $L_{Aeq,8hr}$ Measurement

The graphical representation (Figure 2) shows that eighteen of the twenty trades (90%) exceeded the Statutory Exposure Limit of $L_{Aeq,8h}$ 85 dB(A) by 0.15 to 8.52 dB(A).

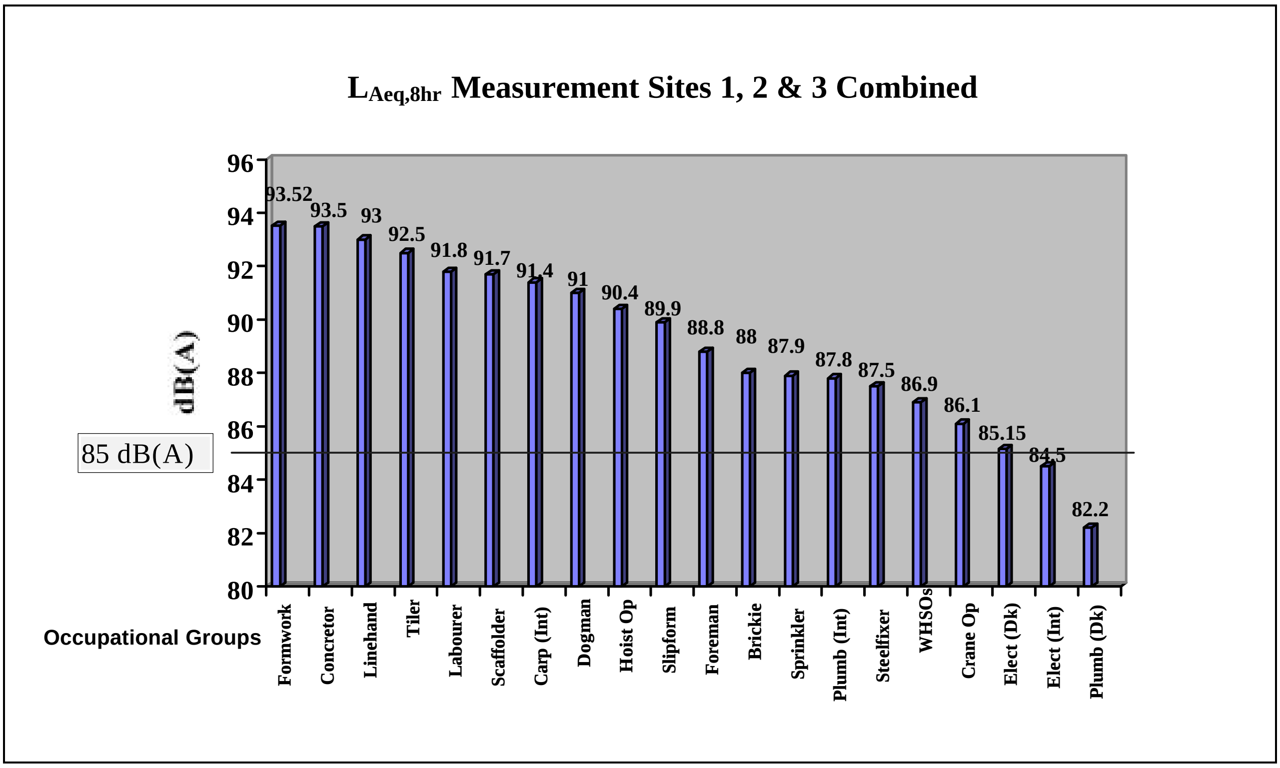

Figure 2 $L_{Aeq,8hr}$ Mean values (in descending order) for the various occupational groups on Sites One, Two and Three combined.

From an industry perspective those worst affected by high levels of noise were formwork carpenters (93.52dB(A)), concreters (93.5 dB(A)), concrete line hand operators (92.97 dB(A)), tilers (92.53 dB(A)), formwork labourers (91.78 dB(A)), scaffolders (91.7 dB(A)) and internal carpenters (91.41 dB(A)). Internal electricians (84.48 dB(A)) and deck plumbers (85.15 dB(A)) were identified as being least at risk of being exposed to excessive noise levels.

Indeed, the present study showed excessive noise levels exists in many occupational settings during the construction of multi-storey buildings. External trade groups working on upper formwork decks i.e. formwork carpenters, concreters, concrete line hand operators are particularly at risk. Within these settings, tower crane noise, the use electrical power tools, and work activities significantly influence worker exposure to noise.

ALL SITES COMBINED LIN PEAK MEASUREMENTS

The graphical representation (Figure 3) shows that seven of the twenty occupational groups (35%) exceeded the Statutory Exposure Limit of 140 dB(Lin) Peak limit by 0.07 to 5.97 dB(Lin).

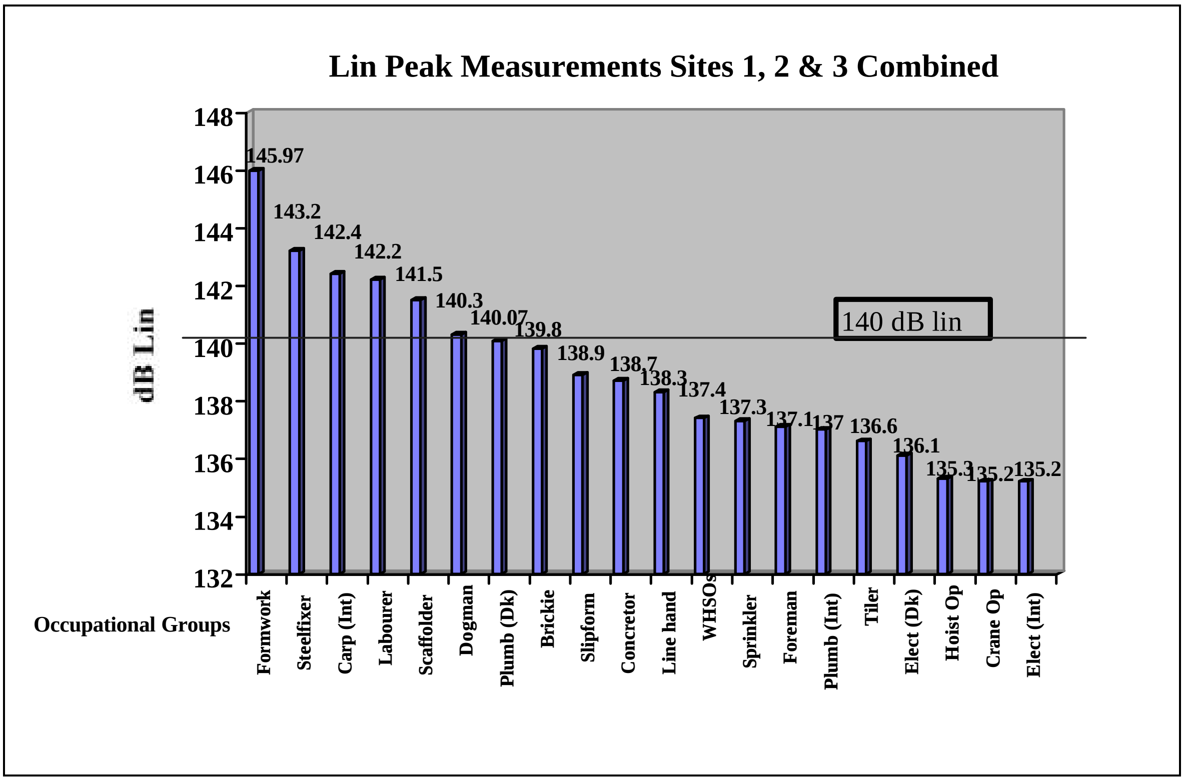

Figure 3 Peak mean values (in descending order) for the various occupational groups on Sites One, Two and Three combined.

Formwork carpenters also rated highest (145.97 dB(lin)) in regard to their lin peak levels, followed by steel fixers (143.19 dB(lin)), internal carpenters (142.4 dB(lin)), formworker labourers (142.25 dB(lin)), scaffolders (141.5 dB(lin)) and dogman (140.29 dB(lin)). Internal electricians (135.18 dB(lin)), tower crane operators (135.2 dB(lin)), and hoist operators (136.14 dB(lin)) were among those who were not exposed to excessive peak levels.

Apart from exposure to steady state noise, impact and impulse noise is more damaging to hearing due to the very high sound energies generated in a very short period of time (ACTU 1983). This damage is partially caused through the inability of the two muscles of the ossicles (tensor tympani muscle and the stapedius muscle) to react and provide protection to the ear within 25 msec, which is much longer than most impulsive-type noise (Division of Workplace Health and Safety - Intermediate noise and hearing conservation manual, 1996). Metal to metal impact noise created from hammering metal shutters and formwork frames, dropping of materials and impulsive noise sources, explosive power tools and compressors are examples of this damaging noise.

ENVIRONMENTAL MONITORING

The work activities, equipment and materials used (e.g. concrete vibrators, power saws, hammers, explosive power tools) all contribute to worker overexposure to noise. Workers involved in formwork, concrete placement, formwork stripping were found to exceed their daily noise dose in approximately 1-2 hours.

Many workers were found not to be wearing hearing protection while undertaking these tasks. Table 1 shows a few of the typical noise sources found on site that can lead to worker over exposure to noise.

Table 1 Typical environmental noise sources

Noise Source (Make, Model & Description)	Measurement Location and work being undertaken	Results in $L_{Aeq,60sec}$ dB(A) or slow/fast dB(A)	Peak Levels in dB(A)	Exposure time allowed for unprotected ears based on $L_{Aeq,8h}$ 85 dB(A)		
Tower Crane	At 1000 revs. Inside cabin with sound proofing on walls and ceiling	73 $L_{Aeq,60sec}$		>8	00	00
Favco Favell M230D	Inside cabin at 1000 revs.	81 $L_{Aeq,60sec}$		>8	00	00
Two way communication device in cabin	Two way radio communication device with incoming whistle signal approximately one metre from operators ear	88-93 slow		2	45	00
Stripping out areas loading out, hitting of frames	Formwork labourers stripping formwork from 1st floor ceiling level. Within work area.	92.5 $L_{Aeq,60sec}$		1	25	30
Reid EXP 666 Express High velocity power tool	Fastening 100x75mm oregon timber onto concrete wall using red charge. At operators ear.		>140 lin peak	00	00	00
Pneumatic Jack Hammer Drill	Jack hammering concrete wall/pier. At operators ear.	108.0 slow		00	2	15
Ryobi 14 inch Drop saw	Cutting 10mm metal thread. At op ear	95 fast		00	48	00
Concrete Vibrator	One concrete vibrator at operators ear	88.1 $L_{Aeq,60sec}$		00	4	00
Air Compressor	Blowing off deck with compressed air	102 fast		00	9	00
Hoist (man and materials)	Taken at operators ear during the operation of the hoist	89 fast		3	12	00
Hoist (man and materials)	During opening and closing of Hoist Doors with metal threshold		131 peak lin			
Hilti DXA40 **Low Velocity** Explosive Power tool.	Fixing metal stud to floor using green charge. At operators ear		126 peak Lin			
Makita Drop saw LS1211	Internal carpenters cutting 12mm skirting pine. At operators ear	98 fast		00	24	00
Screw Gun with clutch engaged	Internal carpenter joining metal studs at door openings in bathroom. At operators ear	105 slow		00	4	30
Kango Type 900k 1050w Impact Drill	Chipping concrete from top of concrete slab. At operators ear	103 slow		00	7	30
Placement of concrete on slipform deck	Line hand operators placing concrete into slip forms. Three vibrators in operation. Within 2 m of operation.	101 $L_{Aeq,60sec}$			12	00
Hammer Drill Hilti TE1	Internal carpenter drilling through metal stud into concrete wall. At operators ear.	105 slow		00	4	30
Makita 9 ¼ inch circular saw	Cutting 19mm form ply. At operators ear.	105 slow			4	30
Finishing nail gun	Fixing skirting board onto internal walls. At operators ear		127 peak lin			

Questionnaire Results

On completion of the study, a total of 829 questionnaires were collected, detailing personal and work history information on the worker. Under normal circumstance the subjects were asked to complete the questionnaire while undertaking site induction training. The results were statistically analysed for frequency distribution, Pearson chi-square and analysis of variance.

Overall, the workforce was aged between 15 and 65 with the majority of the workers, 661 (79.7%) grouped between 20 to 45 years of age. Males dominated the workforce 816 (98.4%)

Audiometric Testing

One of the most significant findings was the very high proportion of workers 644 (77.7%) who have not undergone audiometric screening. One hundred and eighty one (21.8%) confirmed having undergone a hearing test in the past. When asked whether the hearing tests revealed any loss 60 (7.2%) of the workers indicated having some degree of hearing impairment. Ninety-four (11.3%) stated having no loss.

Hearing Loss

The responses shown in Table 2 were derived from questions asked about the individual's perception about their current hearing status and hearing difficulty within family and social environments. Over 20% of the subjects perceived some form of hearing difficulty or condition. It must be acknowledged that the sample population also included those work groups i.e. painters, plasterers and gyprock fixers who are seldom exposed to high levels of noise during work.

Table 2 Perception of hearing loss within family and social environments

Response	Perception of hearing loss within family and social environments							
	Tinnitus all occupations and ages		Understanding Conversation with background noise		Having to raise volume levels of TV etc within the home		Complaints from family members about hearing	
Yes	203	24.5%	285	34.4%	253	30.5%	174	21.0%
No	619	74.7%	536	64.7%	571	68.9%	648	78.2%
Missing	7	0.8%	8	.9	5	0.6%	7	0.8%
Total	829	100%	829	100%	829	100%	829	100%

Information on noise issues

The survey also looked retrospectively at issues affecting worker education and training within the industry especially from the time the person first left school to join the workforce and when commencing work for a new employer. As can be seen in Table 3, on first leaving school to join the workforce 518 (62.5%) had not been informed of the dangers of exposure to noise. These numbers are not surprising when considering that health and safety has only come to the fore during the last ten years.

There is a definite need for employers and construction companies alike to be better informed on noise and hearing conservation issues so that workers are not unnecessarily placed at risk to exposure to excessive noise. A comprehensive induction training package delivered to the workers on site would be of valuable assistance in raising worker awareness to the dangers of noise within the industry.

Table 3 Worker training and education

Information on whether the respondents were informed of the dangers of noise after leaving school to join the workforce.			Was education and training provided into the hazards of noise when first commencing work for a new employer		
Response	Total people working on site all ages		Response	Total people working on site all ages	
Yes	292	35.2%	Always	202	24.4%
No	518	62.5%	Sometimes	442	53.3%
Missing	19	2.3%	Never	136	16.4%
Total	829	100%	Open Response	2	.2
			Missing	47	5.7
			Total	829	100%

Agencies providing information to workers

These questions look at those agencies and individuals that have been responsible for providing the necessary information and training to industry employees on noise. As shown in Table 4, trade schools, employer groups, trade and labour unions and site inductions all played a significant role in imparting information on noise to workers. It also appears that information sharing among co-workers, family and friends also influenced the dissemination of information.

The large number of workers not responding to this questions could imply that they have received no training or could not remember when training was provided. The results did show that 156 workers had worked for ten years before being informed about the dangers of noise.

Table 4 Agencies providing information to workers and when the information was provided

Agencies responsible for providing education and training on noise.			How long after the person commenced work to when first informed about the dangers of noise.		
Classification	Total people working on site all ages		Years	Total people working on site all ages	
Trade Schools	187	22.6%	0-1	80	9.7%
Employer	185	22.3%	1-2	195	23.5%
Unions	123	14.8%	3-4	72	8.7%
Site Inductions	142	17.1%	5-6	66	8.0%
First arrived on site	3	.4%	7-10	102	12.3%
Open response (workmates etc)	87	10.5%	11-15	46	5.5%
Other schools	6	.7%	16-19	8	1.0%
Never	1	.1%	20-24	22	2.7%
Missing	95	11.5%	25-35	24	2.9%
Total	829	100%	Never	8	1.0
			Missing	206	24.7%
			Total	829	100%

Type of hearing protection used and the frequency of use

As depicted in Table 5, one hundred and eighty nine subjects (22.8%) reported always wearing hearing protection while a further 562 (76.8%) reported only wearing hearing protection while working in noisy environments.

Table 5 Hearing protection used and frequency of use

What type of hearing protection do you use			Do you wear hearing protection earmuff, earplugs while working in noisy environments		
Response	Total people working on site all ages		Responses	Total people working on site all ages	
Earmuff	282	34.0%	At all times	189	22.8%
Earplug	424	51.1%	Sometimes but only working in noisy environments	562	67.8%
Earmuff and Earplug	57	6.9%	Never	46	5.5%
Open response	5	0.6%	Open response	12	1.4%
None	7	0.8%%	Missing	20	2.5%
Missing	54	6.6%	Total	829	100%
Total	829	100.0%			

The use of earplugs by industry workers is prevalent. However, the study also found that the incorrect fitting and use of these devices is widespread. This is alarming especially when 424 (51.1%) of the study population stated that they used these devices. In regard to those workers who only wear hearing protection while working in noisy environments there is a concern that the workers decision could be adversely influence by the individual's perception of loudness and/or existing hearing loss. Worker education and training was again found to be deficient in this area and should seen as a priority issue for the industry.

Reported use of hearing protection and reasons for non-use

As shown in Table 6 the reported reasons for non-use of hearing protectors shows that only 96 (11.6%) considered the devices uncomfortable, while 42 (5.1%) considered that hearing protectors interfered with communication. It appears that this answer may be related to the workers' concerns that the use of hearing protectors may increase the risk of injury. The large number who did not respond to this question 688 (82.9%) probably answered "No" to the initial question.

Table 6 Reported use of hearing protection and reasons for non-use

Do you find the wearing of hearing protectors a hindrance			Why do they consider that wearing hearing protection is a hindrance		
Response	Total people working on site all ages		Attributes	Total people working on site all ages	
Yes	198	23.9%	Uncomfortable	96	11.6
No	575	69.4%	Communication difficulties	42	5.1%
Sometimes	5	0.6%	Open response	3	0.4%
Open response	2	0.2%	Missing	688	82.9%
Missing	49	5.9%	Total	829	100%
Total	829	100.0%			

Statistical Analysis

The statistical analysis comparing a number of worker responses to the questionnaire were carried out using Pearson chi-square analysis as set out in Table 7.

Table 7 Statistical Analysis

Variables	Pearsons chi-square Analysis Significance level 5% P<0.05			
	Has the worker experienced ringing in the ears i.e. Tinnitus	Difficulty in understanding a conversation with background noise	Having to raise volume levels of TV etc within the home	Do family members complaints about the workers' level of hearing
Occupation - Job Category	P= < 0.04963	P= < 0.0002	P= < 0.0002	P= < 0.0000
Age of worker	P= < 0.0000	P= < 0.0000	P= < 0.0000	P= < 0.0000
Does the worker wear hearing protection while working in noisy environments	P= < 0.0000	P= < 0.0000	P= < 0.0000	P= < 0.0000
Years in current occupation	P= < 0.71693	P= < 0.50965.	P= < 0.13547	P= < 0.00128

From the statistical analysis it can be implied that the results in the category of occupation and age of the worker are "statistically significant" at $p<0.05$ level. This means that the difference in perceived hearing disease rates between the study and control populations could not be expected by chance alone. Therefore, a cause has been implied. However, when considering that over 33% of the respondents reported working in occupations other than construction during their careers then some proportion of hearing loss could be assigned to that period of employment.

Disturbingly, these statistics also show a significant relationship between those workers who were asked whether they wore hearing protection while working in noisy environments and their perceived hearing status. When considering that 562 (67.8%) of workers reported only wearing hearing protection in noisy environments there is a concern that these workers may or may not be wearing hearing protective devices HPD's while working in noisy environments. This could be the direct result of the worker's subjective perception of loudness. Research conducted by Hickson et al (1995, p268) found that the wearing of "hearing protection was related to several factors including the department in which the subjects work, the perceived noisiness of the workplace, and the subjects' perception of the need for protectors". It was also noted that "subjects convinced that hearing protection was not necessary were less inclined to wear them" (268).

With reference to over-exposed construction workers this perception of loudness could be further eroded through an existing hearing loss resulting in the worker not realising an immediate risk to their hearing. It stands to reason that as the individual's perception of loudness changes with progressive hearing loss so will the desire and the acceptance to wear HPD's.

Analysis of Variance

The mean noise exposure levels obtained from personal noise monitoring results were entered into SPSS Version 6.1 and one way anova (analysis of variance) was applied to determine whether or not noise exposure levels vary significantly from one site to another. The results of one way anova indicated no significant differences $P = 0.3978$ between those occupational groups monitored from each site. The null hypothesis that there is no difference in noise exposure levels between sites must, based on the noise exposure results, therefore be accepted.

DISCUSSION

This project investigated worker exposure to noise within the high-rise construction industry with emphasis on identifying those "at risk" work groups. Given that the study was conducted under typical working conditions and that a representative sample size was obtained it is possible to make a generalisation across the high-rise construction industry that many workers are at risk from being repeatedly exposed to excessive levels of noise during work. The analysis of variance also strengthens this inference.

In concluding, it would not be unfair to state that worker exposure to noise remains relatively uncontrolled and that hearing conservation within the industry is practically non-existent. Indeed, the present study indicates that nearly all work groups are being repeatedly exposed to high levels of noise in excess of the legal $L_{Aeq,8hr}$ limits and very little is being done to correct the situation. At present there is minimal compliance with Workplace Health and Safety Legislation, although this is not surprising. There is no specific legal obligation imposed on principal contractors or employers to specifically implement a hearing conservation program at construction workplaces where excessive noise levels exists. However, employers can discharge their legal obligation by complying with the provision outlined in Section 69(1) of the Workplace Health and Safety Regulation 1997 Part 10 –Noise, by preventing workers from being exposed to excessive noise. Under Section 31 of the Workplace Health and Safety Act 1995 the principal contractor has a legal obligation for ensuring that the employer discharges this obligation. As can be expected, the consequence is that noise has received passive attention and the current level of noise prevention strategies implemented on construction sites has been one of supplying hearing protection devices.

Worker apathy, lack of industry self-regulation, meagre attention to risk management, lack of trained personnel and organisational deficiencies in managing contractor safety were identified as some of the major shortcomings prevalent within the industry. There is an urgent need for industry information and training on noise and for the audiometric screening of workers. The appropriateness of the current legislation on noise should also be reviewed. Given the extent of the noise problem it is incumbent upon all industry stakeholders including building industry associations, unions, subcontracting groups and the Department of Training and Industrial Relations, Workplace Health and Safety, to consult and discuss future hearing conservation initiatives to prevent worker overexposure to noise.

CONCLUSION

As the current situation stands, it is imperative that the industry moves towards further strengthening noise and hearing conservation efforts within their organisations. This could be partially achieved by the industry developing an industry code of practice on noise; and by ensuring the development and implementation of effective health and safety management systems supported by policies and practical procedures that can be integrated with normal business operations.

In the absence of any recognition of this problem or improvement in the current position situation, it is likely that the industry will find itself entering the twenty-first century in a similar position with the human costs in terms of the hearing impaired, increasing.

REFERENCES

1. ACTU-VTHC Occupational Health and Safety Unit. Health and Safety Bulletin-Guidelines for the control of noise at work, Sept 1983 No 33 Victoria Aust.
2. Australian Standard 1269-1989 - “Acoustics-Hearing Conservation”.
3. Australian Standard 1259.2-1990 - “Acoustics-Sound Level Meters, Part 2: Integrating-Averaging”.
4. Australian Standard 1990 Hearing Conservation (A Seminar)
5. Better Health Commission - *Looking Forward to Better Health* 1986 Vol. 3 (217-225).
6. Chew, T., Lin, W. (1991) “Major Factors of Industrial Noise-Induced Hearing Loss in Hong Kong”. *Environmental Monitoring and Assessment.* 19:525-527.
7. Division of Workplace Health and Safety, (1996) Noise and Hearing Conservation Manual - Intermediate. Brisbane
8. Else, D (1990). “Noise Control : An opportunity for the 1990s” *The Journal of Occupational Health and Safety*.6(5) : 395-398.
9. Hickson, L., Phua, S , McPherson, B., (1995). “Use of hearing protection by factory workers: if not, why not?” *The Journal of Occupational Health and Safety*.11(3): 265-270.
10. Merry, C.J and Franks, J.R. (1995) Historical assessment and future directions in the prevention of occupational hearing loss. *Occupational Medicine: State of the Art Reviews.* 10:3, 669-681.
11. News Journal for the Civil & Structural Construction Contractor, Vol 13(3), April 1998. A Reed Business Publication.
12. Noise & Conservation Manual (1988) American Industrial Hygiene Association 4th Edition
13. Sass-Korsak, A., (1997) “Noise in not the only problem,”. *OHS Canada - March 13(2).*
14. Schneider, S., Johanning, E., Belard, J-L and Engholm, G. (1995). Noise, vibration and heat and cold. *Occupational Medicine: State of the Art Reviews.* 10:2, 363-383.
15. Sinclair, J., Halidson, W. (1995). Construction Noise in Ontario. *Applied Occupational and Environmental Hygiene*, 10(5), 457-460.
16. Suter, A. (1988) Noise & Conservation Manual (1988) 4th ed American Industrial Hygiene Association Ohio USA.
17. Workplace Health and Safety Act 1995.
18. Workplace Health and Safety Regulation 1997 Part 10 Noise