LOGGING INDUSTRY RESEARCH ASSOCIATION

SKIDDER CAB DESIGN AND OPERATOR POSTURE

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ABSTRACT

An ergonomic evaluation of skidders commonly used in New Zealand logging operations was conducted using a Swedish checklist. Eight machines were covered by the survey.

Numerous basic design problems were found to exist. All but two skidders had poor seating. This, coupled with the high levels of Whole-Body Vibration to which operators are subjected, will inevitably lead to spinal problems. Further, operators were found to be adopting severe twisting postures for 35% to 54% of the work cycle.

It is recommended that the introduction of improved seating and mirrors (to reduce the incidence of twisting) be investigated.

INTRODUCTION

One of the findings of the Logging Workforce Survey (Gaskin et al, 1988) was the disproportionate number of logging machine operators who suffered back injuries/problems. To isolate possible causes of these types of injuries among skidder operators, a survey of cab dimensions and operator posture was conducted. Eight rubber-tyred skidders were included in the survey.

A study of Canadian skidder operations (Webb and Hope 1983) noted numerous basic design failings in skidders, including:

- lack of head room
- no grab rails to assist mounting and dismounting
- poor or no seat adjustability
- no climate control

The authors used a "forced choice" ergonomic checklist, developed by Aminoff et al.(1980). This checklist is based on ergonomic research carried out by the Swedish National Board of Safety and Health, The Logging Research Foundation and the College of Forestry in Sweden in the construction, mining, agricultural and forestry industries. A forced choice checklist provides the user with "Yes/No" questions and minimum measurements which must be met.

Investigations into the work environment of skidder operation have dealt specifically with levels of whole-body vibration

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(WBV) - a phenomenon which has been linked to fatigue and potential health problems (Webb and Hope 1983, Golsse and Hope 1987). The latter authors noted that "... **skidder operators appeared to be exposed to some of the most severe ride-induced vibrations encountered on industrial machines.**" One New Zealand study (Gaskin and Robinson 1987) compared the WBV levels imposed on an operator of a grapple skidder extracting clearfell radiata pine from formed tracks compared with across the cutover. This study noted substantial decreases in WBV levels when working on formed tracks. However, the operator was still subjected to 78% of the maximum allowable level (ISO 2631, 1978).

During the work cycle of a skidder, the operator is subjected to numerous factors that have the potential to result in back injury. These include:

- whole-body vibration (during travel empty and travel loaded).
- twisting to observe logs during breakout (this occurs both while the machine is "stationary" and during travel loaded with the machine moving).
- bending of the spine while attaching strops.
- bending and twisting while pulling the mainrope out.
- shock loadings caused by jumping off the machine, due to poorly designed steps and grab rails.

This Report discusses the results of the survey.

ACKNOWLEDGEMENTS

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STUDY DETAILS

Eight skidder operations were surveyed, representing a sample size of approximately 3% of the New Zealand skidder population (Liley, 1985). Each of the operations was videoed for between five and eleven cycles, depending on the length of the cycle. All the skidders were working in clearfell operations in Bay of Plenty forests. The video was then replayed and the operators position and task noted. For example, "machine moving; operator twisted to view rear". Sampling of the video was done at 15 second intervals and the frequency occurrence for each category calculated.

Information on cab access, cab dimensions, and seat characteristics of each skidder was also recorded, based on the method detailed in Aminoff et al (1980).

RESULTS

Survey of Skidders

Table 1 details the make, model, configuration, and age of each machine in the study.

Cab Access

Seven measurements were recorded to ascertain suitability of cab access (Figure 1). The results are presented in Table 2 by machine number. The **"Yes"/"No"** indicates whether the dimensions were satisfactory when compared with the minimum requirements from the checklist.

Half the machines had satisfactory width to the cab entrance, but on only one machine was the door high enough. The distance from the ground to the first step and the distance between steps was too high when compared with recommended maximums. Such a discrepancy could be easily fixed, as would the apparent lack of, or excessive height of grab rails. These failings place unnecessary

Table 1: Survey of Skidders

Machine No.	Make	Model	Configuration	Age
1	Caterpillar	528	Cable	12 years
2	Caterpillar	518	Cable	4 years
3	Tree Farmer	C8	Cable	not known
4	John Deere	640D	Cable	3 months
5	John Deere	740A	Cable	10 months
6	Caterpillar	528	Grapple	3 years
7	Caterpillar	528	Cable	not known
8	Caterpillar	518	Cable	4 years

Table 2 : Cab Access

Cab Access	Recomm-endation (mm)	Mean of Sample (mm)	Meets Recommendation Yes	No
Door - Height	1600 minimum	1440	1	7
- Width	620 minimum	606	4	4
Steps:				
Ground to 1st step	400 max.	694	0	8
1st to 2nd	200-300	412	1	7
2nd to 3rd	200-300	328	2	5 (1)
Grab Rails:				
Left rail base to ground	1600 max.	1730	3	4 (2)
Right rail base to ground	1600 max.	1614	2	3 (3)

Notes:

(1) - One machine had no 3rd step.
(2) - One machine had no grab rails left on it.
(3) - Two machines had no right hand grab rails left on it.

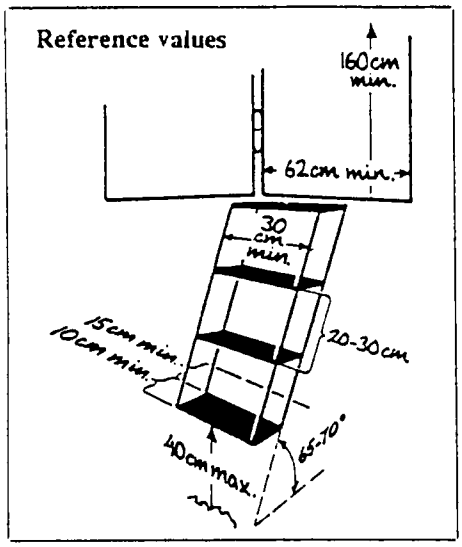

Figure 1 : Measurements recorded for cab access

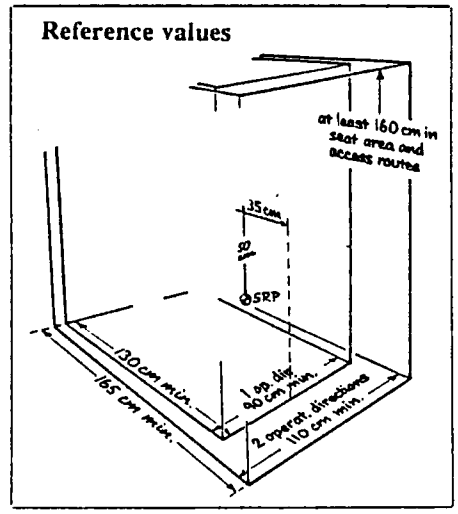

Figure 2 : Measurements recorded for operator's cab

stress on the operator who, as part of normal cable skidder operations, gets on and off the machine at least 80 times a day.

Operator's Cab and Seating

The methods of taking measurements are illustrated in Figures 2 and 3. The Seat Reference Point (SRP) refers to the intersection point of the centre of the seat back rest and the seat itself. None of the machines met the minimum requirement for cab height and depth. However, they all exceeded the requirements for the distance from ther SRP to the walls, front and floor of the cab.

While some aspects of the operator seating met minimum requirements, the lack of adjustment meant that, both taller than average, and shorter than average operators, would have some difficulty operating the machine (Table 3). Only one manufacturer of skidders in this survey had installed suspension seats. Research has shown that suspension seats are much more effective in reducing the levels of WBV transmitted to the operator (Golsse and Hope, 1987).

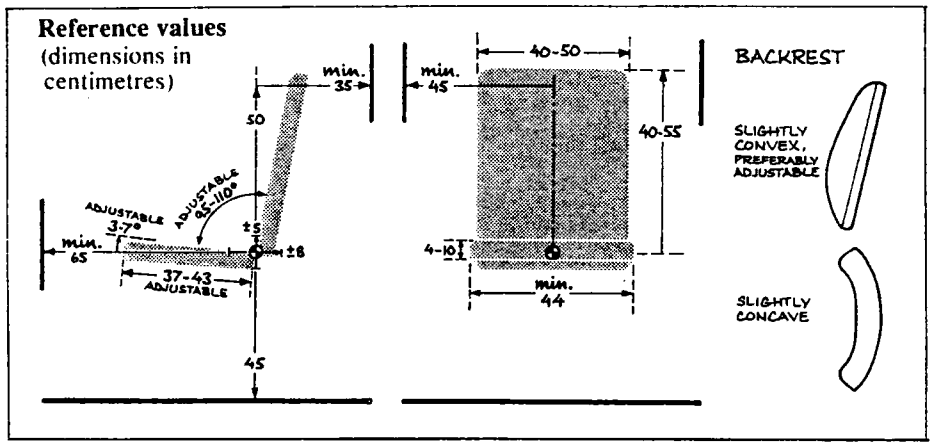

Figure 3 : Measurements recorded for operator's seating

Table 3: Operator's Seat

	Recommendation (mm)	Mean of Sample (mm)	Meets Recommendation Yes	No	
Seat Backrest :					
Width	*400 - 500*	*441*	*5*	*3*	
Height	*400 - 500*	*375*	*3*	*5*	
Adjustment	*Yes*		*-*	*8*	
Seat Cushion:					
Width	*440 min.*	*516*	*8*	*-*	
Thickness	*40 - 100*	*105*	*4*	*4*	
Seat Adjustment:					
Fore/aft	*Yes*		*7*	*1*	*(1)*
Vertical	*Yes*		*2*	*6*	
Suspension:	*Yes*		*2*	*6*	

Note:

(1) Seat had been welded up to stop movement

Operator Posture

The analysis of the video recording was classified into categories as shown in Table 4.

The frequency of observations by posture category was calculated (Figures 4 and 5). The cable skidder data (Figure 4) is presented separately to the grapple skidder (Figure 5) due to differences in the operating cycle. The information in Figure 4 is the mean value for the seven cable machines.

In the cable skidder operations, the operator was in a posture which had potential to result in back injury for 47% of the time.

Of most concern is the 34.5% of the time the operator's back is twisted while the machine is moving. The operator is already subjected to high levels of WBV while the machine is travelling, and together with a twisted posture, this results in a high probability of back injury.

The operator of the grapple skidder was twisting while the machine was moving (high risk) for 54% of his time and twisting while the machine was stationary (medium risk) for 15% (Figure 5). Thus he was exposed to potential back injury for nearly 70% of his work cycle.

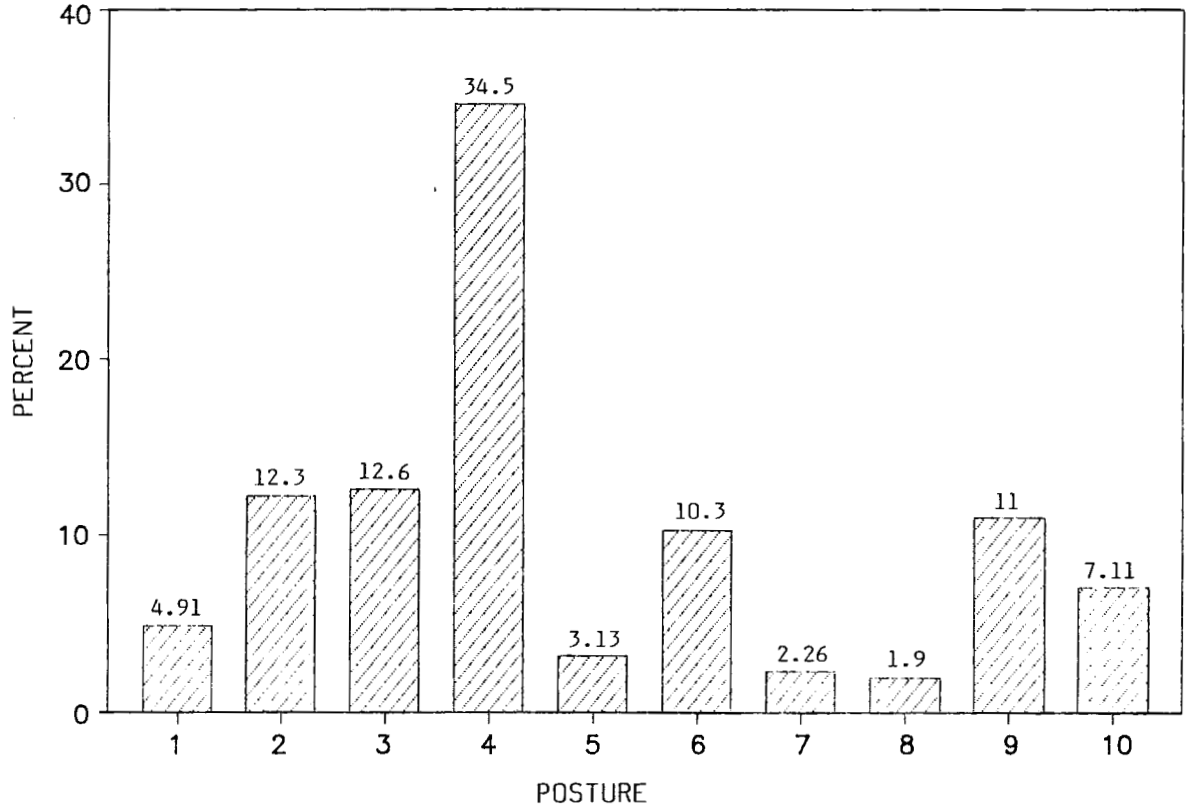

Figure 4 : Skidder Operator Posture - Cable Skidder (Observations at 15 second intervals)

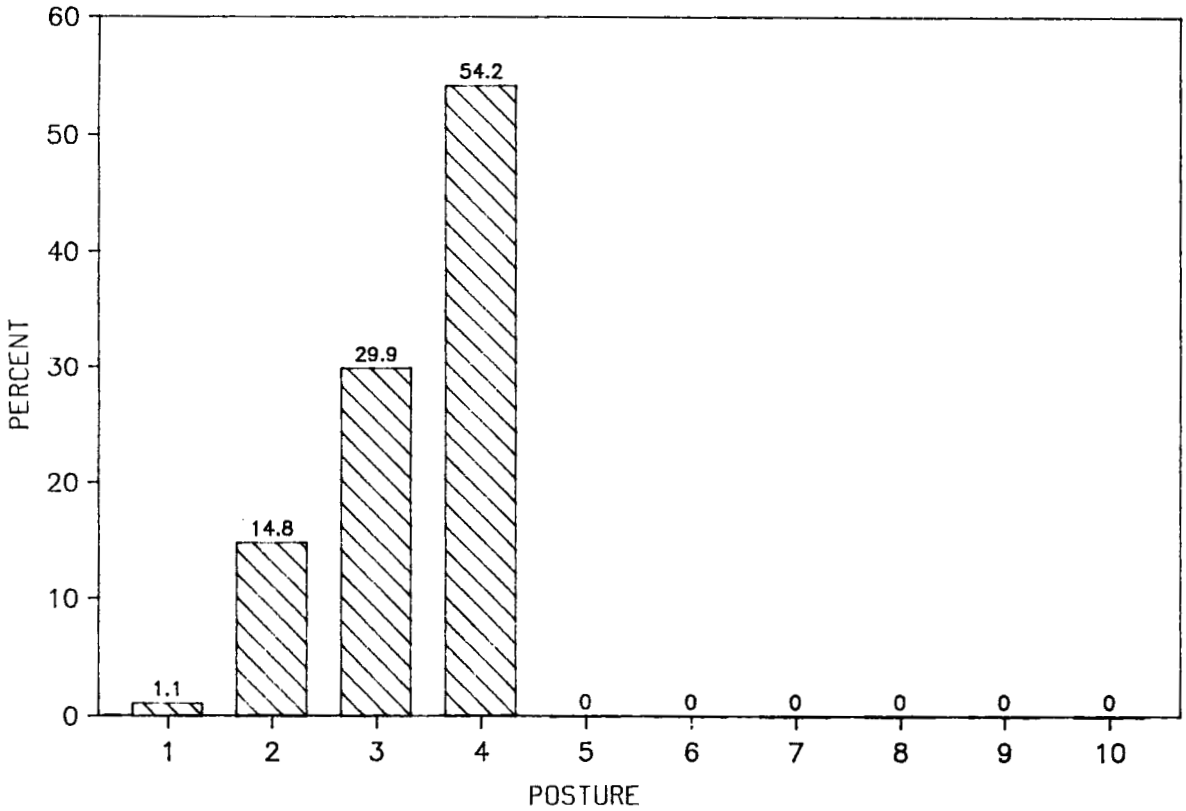

Figure 5 : Skidder Operator Posture - Grapple Skidder (Observations at 15 second intervals)

Table 4: Classification of Operator Posture.

	Posture	Risk Low	Medium	High
1	*Machine stationary, operator looking forward - normal posture.*	1	-	-
2	*Machine stationary, operator twisted.*	-	2	-
3	*Machine moving, operator normal posture.*	1	-	-
4	*Machine moving, operator twisted.*	-	-	3
5	*Operator mounting/dismounting.*	-	2	-
6	*Standing at rear of machine sorting mainrope and strops prior to hooking on.*	1	-	-
7	*Pulling mainrope.*	-	2	-
8	*Pulling mainrope, twisted posture.*	-	-	3
9	*Attaching strops, back bent more than 60 degrees from upright position.*	-	-	3
10	*Walking.*	1	-	-

DISCUSSION AND CONCLUSIONS

This survey was limited in terms of survey size, and range of makes and models of skidders included. However the results, especially of cab dimension measurements, closely followed the findings of Webb and Hope's study. This suggests that little additional information would be gained from a larger survey.

Many of the deficiencies noted in the basic design of the skidder cab such as access facilities and lack of seat adjustment, could be easily and cheaply fixed. For example, the distance between the ground and the 1st step could easily be reduced by attaching a further "flexible" step.

Only one manufacturer supplied suspension seating as standard. Popular brands of this type of seating, eg. "Bostrom", can be fitted to skidders. The cost, including seat and fitting, is approximately $1500. Golsse and Hope noted that WBV levels, while still exceeding the ISO maximum permissible level, were lower for cable skidders with suspension seats.

The frequency of operators twisting to view behind the machine, especially while the machine is moving, is of concern. This poor posture could be reduced or avoided by fitting mirrors to the skidder.

It is recommended that the introduction of improved seating and mirrors for skidders be further investigated.

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