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The manual handling risk in the forestry workers

R. Gubiani [1] ,S.R.S.Cividino [1], M.Vello [1], E. Maroncelli [1],, G. Pergher [1]

[1]*DISA, Department of Agriculture and Environmental Sciences, Via delle Scienze 208, 33100 - Udine – Italy; rino.gubiani@uniud.it*

G1 EVENTUALE LOGO DEL CONVEGNO
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Introduction

- 40% area of Friuli Venezia Giulia Region is forestry located in mountain or hills land;

- the work not is only classic forestry operations (lumberjack) but more of new task as a soil bioengineering and land management;

- forestry work is generally characterized by a combination of natural and material risks to the health and safety of forest workers. The natural risks are associated with steep and broken terrain, dense crops and adverse working conditions, including extremes of climate - both hot and cold.

- workplaces in forestry is characterized by a preservation of natural environment during building in soil bioengineering operations or land management;

- in general in this workplace it is not possible to perform soil movements, and the natural floor is often not fit for walking or crossing over with machines. Of course this condition is unfavorable also for walking with loads;

- another problem is longer supply distances, and support structures (scaffolds, etc.) cannot be optimized. The machinery adopted is in general smaller and hand-assisted, such as wheelbarrows.

Introduction

Accident Frequency rate = 38.6 (others sectors = 26)

Accident severity rate = 4 (other sectors 1.12)

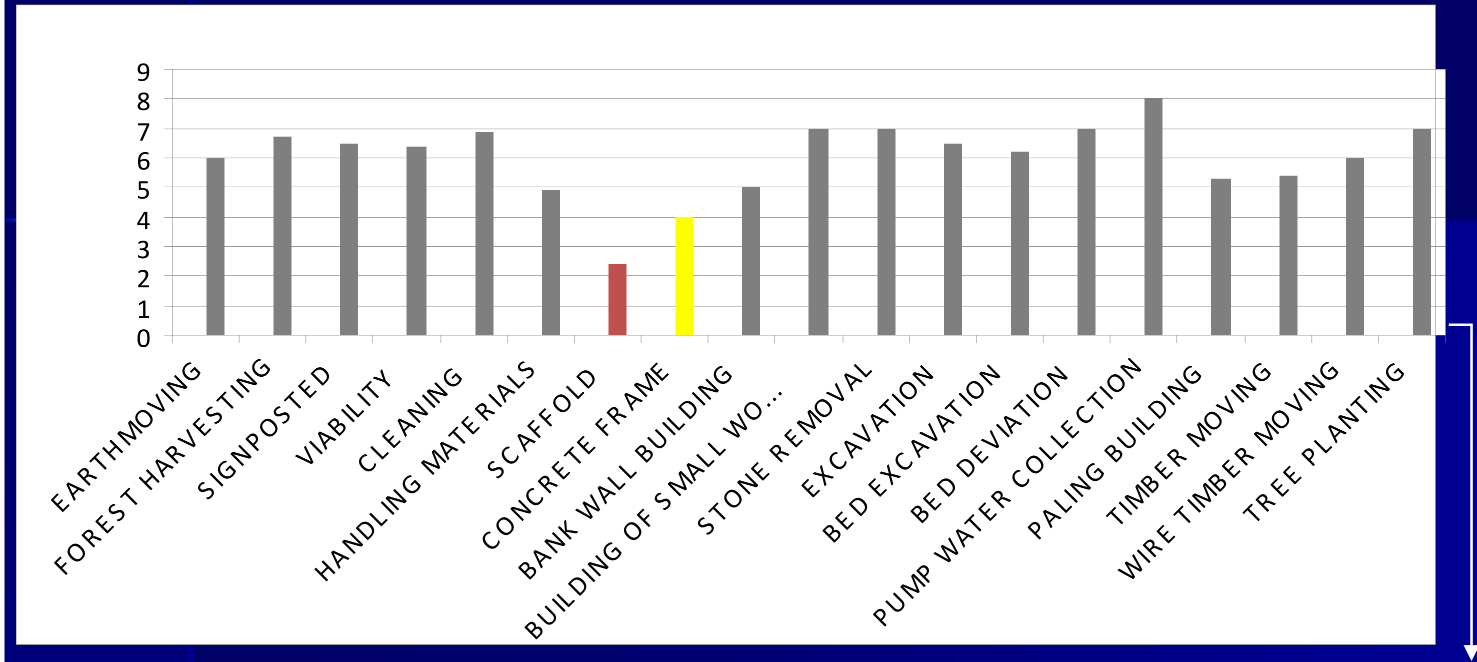
I.D. of injured worker:

Sex=male
Age= 43

Accident typology	%
Trees and animals	17
Machinery, equipment	17
Chainsaw, timber, soil conditions	38
Other	28

- where high physical effort is accompanied by vibrations, noise and variable weather conditions, working conditions (i.e. lumberjack) were very strong, may cause cumulative disorders due to gradual and cumulative deterioration of the musculoskeletal system through continuous lifting / handling activities, e.g. low back pain;
- Posture and repetitive work tasks have been related to neck and shoulders troubles;
- Musculoskeletal disorders (MSDs) are in fact amongst the most common work-related problem in forestry yards. This cause to the significant temporary or permanent disability of workers, symptoms as pain, numbness and tingling;
- Unnatural and forced postures of the body when working increase a MSDs

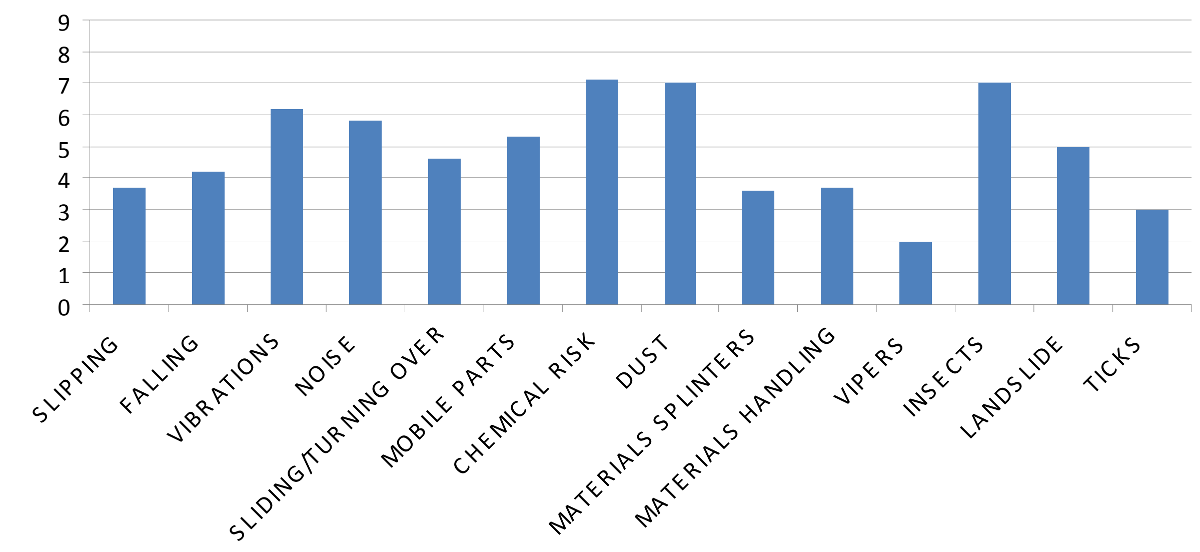
introduction



Workplace activity evaluation

Introduction

Specific risk evaluation



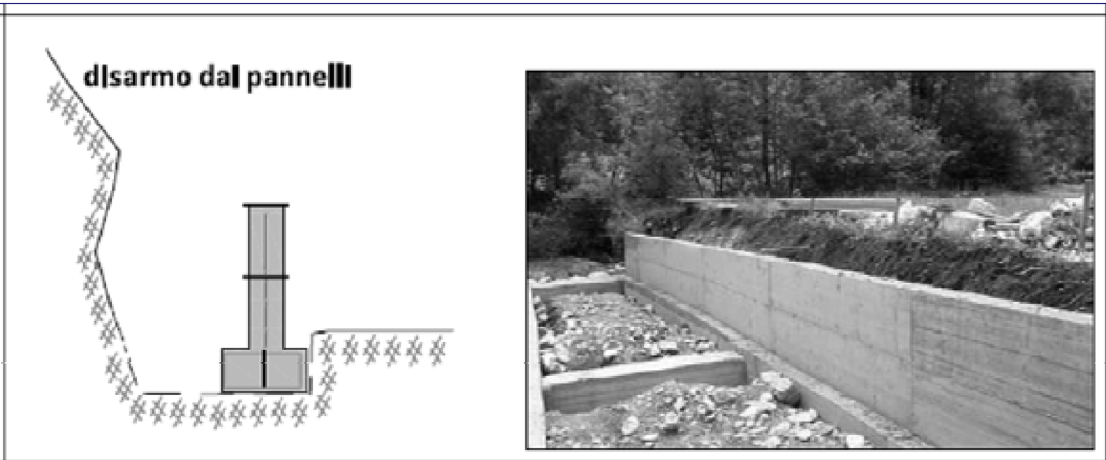
Working conditions

For assessing MSDs many methods have been developed about different work conditions:

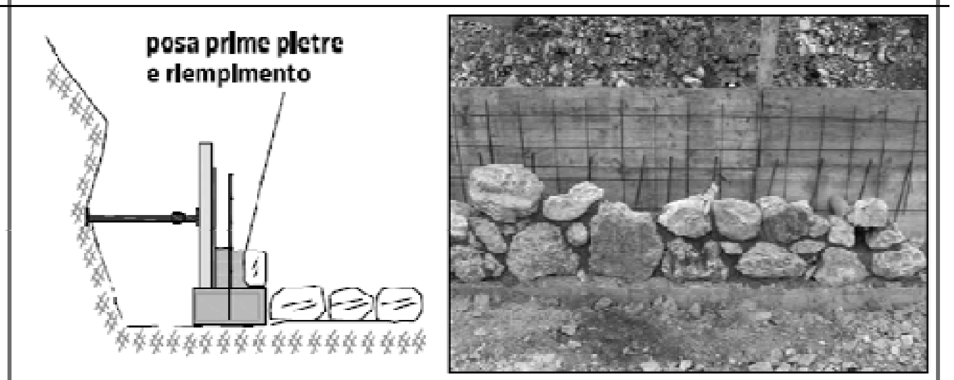
- NIOSH with update to European directives (UNI EN 1005-2 and ISO 11228-1. Is good for repetitive static work and simple task and results is a RWL (Recommended Weight Limit). For multiple task need calculate CLI (Composite Lifting Index);
- OWAS (Lundqvist et al., 1987) is well used in dynamic conditions of work (Calvo, 2008);
- OCRA Method (Colombini, 1998) is more indicated for repetitive task and efforts of the upper limbs and carried out a index, more high this index more risk to increase MSDs.
- Snook and Ciriello. This method was proposed for risk assessment while to carry, to push, to pull loads;
- TLV ACGIH (Threshold Limit Values - American Conference of Governmental Industrial Hygienists) have easy application in industry but not is very well for multitasking works;
- SUVA methods. Is good for all works and is based on observation system

Materials and methods

The task of the first workplace was the arrangement of the section of water outflow for the control of a small stream, through the realization of masonry in stone-coated concrete, both longitudinal and transversal, and located in Castelnuovo del Friuli (case A)



The task of the second workplace located in Moggio Udinese (case B) was to rebuild a channel with stonework and mortar



Case A consisted in covering a concrete wall with a layer of natural,regular stones, 20 to 25 cm wide approx. The phases of work were:

- supplying material and stones;
- approaching the workplace;
- splitting and/or modeling stones;
- lifting one stone and laying it on the wall or floor;
- filling empty spaces with mortar.

The average times for this work were:

- 9 seconds for moving the stone by hand from its initial position to the base of the wall;
- an average of 27 hammer shoots in 30 seconds for stone splitting and/or modeling;
- 4 seconds to lift the piece and place it in the wall; this involved an average 80 cm lifting movement;
- 26 seconds for fitting the stone in the wall with the hands and/or using a hammer;
- a total of 6 bending motions (including: lifting the stone, taking the hammer, laying a little piece of stone for best fitting and so on)
- 1.50 min for the complete operation (per stone).

Materials and methods

In case B were used stones with irregular form and weighing about 20-30 kg. The stones were placed in rows 0.20-0.45 m wide up to a height of 1.50 m. The phases of the work were:

- supply material and stones;
- approaching the workplace;
- splitting and/or shaping stones using a hammer, to create a suitable form;
- lifting each stone and lay it on the wall or floor; this implied moving the irregularly-shaped stone several times in order to find a suitable position;
- filling empty spaces with mortar.

In both workplaces three workers were employed:

- one unskilled craftsman in charge of cleaning the workplace, supplying materials, preparing mortar or concrete, etc.;
- one skilled bricklayer for supplying materials, building the masonry, finishing, etc.;
- one skilled bricklayer for supplying materials, building the masonry, finishing, driving machinery (mechanical digger, excavator or skidder.

Materials and methods

the research controlled 2 task:

- Task 1 - Building mansory;
- Task 2 - supplying 25-kg cement bags (the bags were delivered to the workplace on wooden pallets; the task consisted in raising one bag, placing it into a wheelbarrow, and carrying it near the workplace).

- In t2, L was 25 kg, lifting distance (D) about 30 cm, H about 40 cm with a 90° twisting of the body (A), and bad grasp (C). Frequency (F) was 9 lifts per minute with total duration < 1 h.

The work phases were recorded using a video-camera.

The time of each work phase, the size and weight of loads (stones or cement bags was determined using a chronometer, a meter and a dynamometer (Pro Kern, max. scale: 35 kg).

The RWL consist of the following multipliers:

RWL= LC x Hm x Vm x Dm x Am x Fm x CM

Materials and methods

- $CLI = STLI_1 + \Delta FILI_2 + \Delta FLI_3 \ldots + \Delta FILI_n$ where $FILI_2$ $(1/FM_{1,2} - 1/FM_1)$

- In t1, CLI was calculated for stones weighing 5, 10, 15, 20 and 25 kg (L), stone sizes about 3, 5, 7 and 10 cm, and lifting distances (D) of 20, 40, 60 and 80 cm. The average H was 50 cm with a 30° twisting of the body (A). Variable C was difficult to evaluate, because since all stones were of irregular form, while F was calculated as one lift every 2 minutes for all the time in the workday (7 hours).
- In t2, L was 25 kg, lifting distance (D) about 30 cm, H about 40 cm with a 90° twisting of the body (A), and bad grasp (C). Frequency (F) was 9 lifts per minute with total duration < 1 h.

The SUVA method considered:

- time factor (TF) with 3 sub factors: lift task; load time; carry task; rate 1 to 10;
- load evaluation (LE), rate 1 to 8;
- posture evaluation (PE), rate 1 to 8;
- implementation evaluation (IE), 0 to 2.

Results

Table 1 – Example of calculation NIOSH lift index while building a stone masonry (task 1).

Task	Weight	Lift high	Distance to floor	Vertical distance (V)	Distance (D)	Horizontal distance (H)	Asymmetric angle (A)	Frequency (F)	Length of task	**Coupling (C)**	RWL	STLI	FILI	CLI
	kg	cm		cm	cm	cm	degree °	(n./min)	minutes	**B=bad; G=good**				
lift	25	150	10	30	40	50	30	2	100	B	6.7	3.7	3.1	2.8
lift	25	150	10	10	20	50	30	2	60	B	7.5	3.4	3.1	2.9
lift	15	100	7	53	60	50	30	2	20	B	6.7	2.3	3.4	3.3
lift	10	50	5	95	100	50	30	2	120	B	5.9	1.7	3.6	3.3
lift	10	150	5	135	140	50	30	2	40	B	6.2	1.6	3.6	3.3
lift	5	150	3	117	120	50	30	2	50	B	6.2	0.8	3.7	3.2

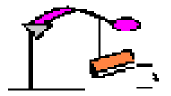
Results

Recommended Weight Limit (RWL)

Load Constant (LC)

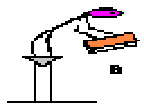
age	Male	Female		data task
> 18 old	25	20		25

Horizontal Multiplier (HM)



high (cm)	0	25	50	75	100	125	150	>175	125
rate	0,77	0,85	0,93	1	0,93	0,85	0,78	0	0.85

Vertical Multiplier (VM)

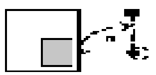


lift	25	30	40	50	70	100	170	>175	30
rate	1	0,97	0,93	0,91	0,88	0,87	0,86	0	0.97

Distance Multiplier (DM)

distance (cm)	25	30	40	50	55	60	>63		40
rate	1	0,83	0,63	0,5	0,45	0,42	0		0.63

Asymmetric Multiplier (AM)



angle	0°	30°	60°	90°	120°	135°	>135°		90
rate	1	0,9	0,81	0,71	0,52	0,57	0		0.71

Coupling Multiplier (CM)

gripping	poor
rate	0,9

VM	75 cm <	>75 cm
good	1.00	1.00
fair	0.95	0.92
poor	0.90	0.85

poor
0.90

Frequency Multiplier (FM)

frequency	0,2	1	4	6	9	12	>15
work duration < 1 hour	1	0,94	0,84	0,75	0,52	0,37	0
work duration from 1 to 2 hours	0,95	0,88	0,72	0,5	0,3	0,21	0
work duration from 2 to 8 hours	0,85	0,75	0,45	0,27	0,52	0	0

9
0.52

RWL = LC x HM x VM x DM x AM x CM x FM	4.31
STLI	5.8

Results

SUVA methodology were applied also for this task.

- The values were: 4 (TF) x 4 (LE) x 4 (PE) x 1 (IE) = 64
- This rate were processed again about the adjusted rate and this new rate were 91.

Conclusions

- Preservation of natural environment during building workplace implies longer supply distances, and support structures (scaffolds, etc.) cannot be optimized.
- The machinery adopted is in general smaller and hand-assisted, such as wheelbarrows.
- In general in this workplace it is not possible to perform soil movements, and the natural floor is often not fit for walking or crossing over with machines. Of course this condition is unfavorable also for walking with loads.
- The consequences were longer supply distances than in a standard workplace, more materials to shift, more stress for workers.

Conclusions

Research has suggested three kinds of solutions:

- - first, a technical one, consists in mechanizing those operations where the loads are heavy or there is a lot of repetitive moving;
- - second, a technical managerial one, proposes a reorganization of the turns of works and better management of workplace. Must organize also training about correct mode of shift and lift loads;
- - third, give to the workers some equipment same as abdominal belt. This solution will be tested in next researches.

THANK FOR YOUR ATTENTION