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DISTRIBUTION OF BREAKS IN THE CONSTRUCTION INDUSTRY

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The performance of tasks with high physical loads corresponds very strongly with the necessity for breaks, which should be taken depending on the workload. The actual situation on construction sites is totally different, since breaks were traditionally arranged and almost unchanged over the last decades, with no connection to the workload. This claim was substantiated by a recent survey of supervisors (N = 64) and construction workers (N = 177). The results showed that the majority of respondents would not change the current break arrangement, particularly supervisors, who did not see the importance of an evaluated break distribution. However, a need for change is seen in statements of the construction workers' unions to reduce stress additionally caused by high temperatures. The suggested new approach for customized breaks in connection to physical loads in this study leads to the following: The overall working time should be split into three almost comparable shares, with a duration of 2.5 to 3.5 hours, to reach a total of 9 to 10 working hours. But even if these breaks are changed in the way we suggest, the authors would recommend additional breaks if the construction workers have to perform very strenuous work, or if climate conditions increase the strain.

Keywords: Break distribution, Workload, Survey.

1 INTRODUCTION

The performance of tasks with high physical loads is connected with the necessity for breaks. Therefore, these breaks should be taken depending on the kind of work performed, such as in factories. On construction sites, however, the situation is rather different: Breaks are often traditionally arranged. Their allocation has almost been unchanged over past decades, and in most cases they are not set in connection to the workload.

2 VALUATION OF THE BREAK SITUATION

2.1 Method

In a survey given to supervisors and construction workers, the break situation status of construction workers had to be evaluated from their point of view. A questionnaire was sent to different construction companies in Austria, with 241 returned (64 answered by supervisors and 177 by construction workers). The form had three parts: (1) General information to classify the attendants by age, duration of working at the current company, and their working sector; (2) Work duration, times of breaks, and the daily

departure time from home (as well as the use of and the necessity for breaks) were collected; (3) They had to give their opinion to the statement, "A different break distribution could result in higher productivity".

2.2 Data Analysis

2.2.1 *General information*

The mean age of the attending supervisors was 36 years and for construction workers 41. More than 50% of the construction workers were employed less than one year in the current company.

2.2.2 *Break situation*

The results of the answers according to the break distribution are presented in Table 1:

Table 1: Distribution of breaks.

		Start of work	**Forenoon break**	**Duration**	**Lunch break**	**Duration**	**Afternoon break**	**Duration**	**End of work**
Supervisors		5:45-8:00	9:00-9:30	15-30 min	12:00-12:30	25-60 min	15:00-15:30		16:30-18:00
	mean			19,45 min		41,16 min			
	N			41		60			
Workers		4:30-8:00	9:00-10:00	10-30 min	11:30-12:30	20-60min	15:00	15-30 min	16:30-19:00
	mean			21,95 min		38,13 min		18,2 min	
	N			100		129		28	

The most remarkable outcome is that the time between breaks becomes longer and longer during the course of a work day, while a break in the afternoon was found only for a very small share of the participants.

The wide range of the start of work can be explained by two factors: (1) the time leaving home and (2) the travel time to the site. In connection to the distribution of breaks, the intended use of breaks was a required question; 97% of the supervisors supposed that construction workers use their breaks for recovery, while only 83% of the workers actually said that they actually need the break for recovery.

Concerning the structure of genuine breaks, only 3% of the construction workers would change the starting time of the forenoon break or have an additional break, if there is currently no break; 6% would delay the lunch break; 17% of the construction workers would like to have an additional break in the afternoon. Supplementary remarks of the construction workers lead to the result that breaks should be set according to the workload or boundary conditions such as temperature or humidity.

3 CALCULATING WORK / REST SCHEDULES

A theoretical framework used to schedule breaks according to actual working conditions was developed by Hsie et al. (2002) based on the findings of Konz (1998a, 1998b). Hsie et al. designed a calculation for the maximum acceptable work duration (MAWD) based on the relationship between actual oxygen consumption at work ($VO2_{work}$) and individual maximum oxygen consumption ($VO2_{max}$). The key is the identification of $VO2_{work}$ amounts, especially during work. Accurate measurement is difficult when highly-straining work is performed, so instead the heart rate can be monitored and oxygen consumption calculated based on additional laboratory tests (Abdelhamid and Everett 1999, Schlagbauer 2012a). Abdelhamid and Everett also presented mean physiological values for different trades within the construction industry. Schlagbauer (2012b and 2013) presented a calculation model predicting the heart rate of selected construction work tasks (bricklaying and concreting work) in order to forecast the output performance level in the course of a work day. This calculated heart rate can also be applied in order to set individual breaks according to the workload.

Grübler (2012) combined the ideas of Hsie et al. (2002) and Schlagbauer (2012a and 2012b, 2013) in order to monitor bricklaying tasks. Grübler indicated that actual breaks were sufficient for the investigated workload at forenoon, but in the afternoon, the missing of restricted breaks leads to additional individual breaks in order to cover the workload. He also pointed out that, if the ability to set individual breaks was missing due to several reasons (in most cases the kind of the work process of construction operations), output performance was reduced.

4 CONSTRUCTION OPERATION

Additional to physiological influences the construction work process often precludes the workers to set their breaks individually or at the right moment. Since the construction industry is mainly based on economic targets, the achievable performance can be named as additional influence on the possibility and distribution of breaks. Hofstadler (2005) presents five major influences on the performance (“daily working time”, “perturbation”, “training level”, “practice level”, “number of workers” und “output performance value”) that have to be considered during the planning phase and later in the distribution of tasks by the foreman.

A connection between the factors “daily working time t” and “training level” as well as “practice level” and the break situation is assumed. Training and practice level force the need for skilled workers, who usually need less time, to become acquainted to the processes on different construction sites, and work faster on a higher performance level. Additionally, the tasks that have to be fulfilled by one worker were reduced, and more specialists can be found on a site. This also leads to improved performance, since training levels of the tasks carried out were very high, but the need for more different workers also went up.

Looking at the daily schedule, it is important to keep in mind that the work place on the site cannot be left without preparation (e.g., safety work). Additionally, many construction sites are located within town centers, therefore construction has to be

cleaned at every break and when the workday is over. Hence, before each break there are at least 5 to 10 minutes of safety preparation or cleaning works. After each break the workers also need 5 to 10 minutes to return to their workflow.

Usually construction sites have a recreation area, and additional time is needed to get from the work place to the rest area and back. At high-rise buildings or tunnels in particular this takes a long time if the transportation is not planned well. Therefore it is impossible to set very short individual breaks at any time of the day without a reduction of the economic output. The often-suggested micro breaks, which last only 3 to 5 minutes, are only possible if they can be integrated in the construction process and held directly at the work place. The other problem is, that, due to the often changed workflow, it is nearly impossible for construction company owners to plan such breaks far in advance. In conclusion, they can only be conducted if they are arranged by workers and foremen on site.

5 PROPOSAL FOR A CHANGED BREAK DISTRIBUTION

Based on the questionnaire and additional collected statements of company owners, the construction companies are only willing to set breaks according to the government laws. In the Austrian construction industry, regulations force at least one break of a duration of 60 minutes, but this break can also be divided into several shares.

By bringing together the different positions of company owners, with their strong economic views, and the need of the workers for well-distributed breaks, we can recommend the following break allocations. The overall working time should be split into three almost comparable shares, with a duration of 2.5 to 3.5 hours, to reach the total of 9 to 10 working hours. This would lead to the following timetable for an eight- or ten-hour workday (Table 2):

Table 2: Allocation of breaks for different working hours.

	Actual break allocation	**Duration of work**	**Planned break allocation**	**Duration of work**
Start of work:	7:00	7:30	7:00	
1st break:	9:00 to 9:20	2 hours	10:30 to 11:00	3:30 hours
2nd break	12:00 to 12:40	2:40 hours	14:30 to 15:00	3:30 hours
End of work	18:00	5:20 hours	18:00	3:00 hours

As presented above, the idea is to set the first and second break later in the day, in order to reduce the long working period in the afternoon without a fixed break. Also, keep the total break time and number of breaks on the same level. But even if these breaks are changed in the suggested way, the authors would recommend additional breaks if the construction workers have to perform very strenuous work or if climate conditions cause more strain (Schlagbauer 2012b).

6 CONCLUSION

The evaluation of the break situation status in the construction industry was the topic of a questionnaire answered by 64 supervisors and 177 construction workers. Concerning the actual structure of genuine breaks, only 3% of the construction workers would change the forenoon break, 6% would delay the lunch break, and 17% would like to have an additional break in the afternoon. Supplementary breaks should be set according to the workload or high temperature or humidity.

In our suggested new approach, the overall working time should be split into three almost comparable shares with a duration of 3:00 to 3:30 hours to reach the total of 9 to 10 working hours. But even if these breaks are changed in the suggested way, the authors would recommend additional breaks if the construction workers have to perform very strenuous work or the climate conditions have an additional high impact on the strain. These additional breaks can be set based on a recently discovered calculation model for the stress and strain of construction work tasks.

References

Abdelhamid, T. S., and Everett, J. G., Physiological demands of concrete slab placing and finishing work, *Journal of Engineering and Management*, 125, 47-52. 1999.

Grübler, C., *Analyse von belastungsfaktoren und gesundheitsrisiken im bauwesen, Diplomathesis*, TU Graz, 2009.

Hofstadler, C., *Bauablaufplanung: Interaktionsdiagramm für bewehrungsarbeiten, Baumarkt und Bauwirtschaft*, Heft 01, 55, 2005.

Hsie, M. et al., A model used in creating a work-rest schedule for laborers, *Automation in Construction*, 18, 762–9, 2009.

Konz, S., Work/Rest: Part I - Guidelines for the practitioner, *International Journal of Industrial Ergonomics*, 22, 67–71, 1998a.

Konz, S., Work/Rest: Part II - The scientific basis (knowledge base) for the guide, *International Journal of Industrial Ergonomics*, 22, 73–99, 1998b.

Schlagbauer, et al., Integration of sports scientific knowledge in the scheduling of construction projects, *Research to Practice*, 2012a.

Schlagbauer, et al., Workload and task distribution in formwork and masonry work, CIB W099 International Conference, *Modeling and Building Safety*, 2012b.

Schlagbauer, D., and Heck, D., Change in output performance due to prolonged work. *Proceedings*, ISEC Conference, 2013.