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Good Vibrations?! Underestimated Risk of Vibrations from Work Pedelecs

Normal bikes are on the way out – many postmen and women are no longer riding conventional bikes but instead a work pedelec; in other words an electrically assisted bike. Other sectors, such as trade and outpatient care, are also opting for transport pedelecs or trialling their use to potentially save time in towns and cities. What sounds progressive as a work aid entails not only benefits for employees. The (new) burdens are frequently underestimated: A much greater unladen weight that needs to be moved owing to sturdier frames and batteries, a higher workload due to a larger loading area and the strain resulting from hand, arm and whole body vibrations.

The LIA.nrw has set about tackling the latter problem in the "Vibrations from Work Pedelecs" project. As work pedelecs are not only powered purely by physical force, they fall under *"9. Verordnung des Produktsicherheitsgesetzes (Maschinenverordnung)"* (Ordinance of the Machinery Directive, Directive 2006/42/EC of the European Parliament and of the Council). This obliges manufacturers to indicate the level at which vibrations can occur during the use of certain products. This information is so far absent from the instruction manuals of bikes.
A maximum usage time and protective measures for employees are difficult to determine and often lacking in the overall risk assessment. However, employers need to check whether their employees are exposed to a risk. A suspension that diminishes vibrations – thereby resulting in lower loads – is not provided in many models available on the market.

Why are vibrations a problem?

The general effect of vibrations on humans depends on the frequency, the level, type and direction of the vibration as well as the duration of load. Individual circumstances such as age and physical condition influence both short-term and permanent effects on health. People exposed to frequent vibrations often complain about pain in the back and shoulder region as well as in the hands, arms and knees.

Whole body vibrations involve mechanical vibrations that are transferred the entire body. When ridung a work pedelec, vibrations are typically transferred via the buttocks to the back and throughout the body. Harm to health due to increased vibration loads are typically manifested in discomfort and pain in the buttocks and back. Many years of exposure can lead to symptoms of wear in the spine.

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Effect of the road surface on whole body vibrations

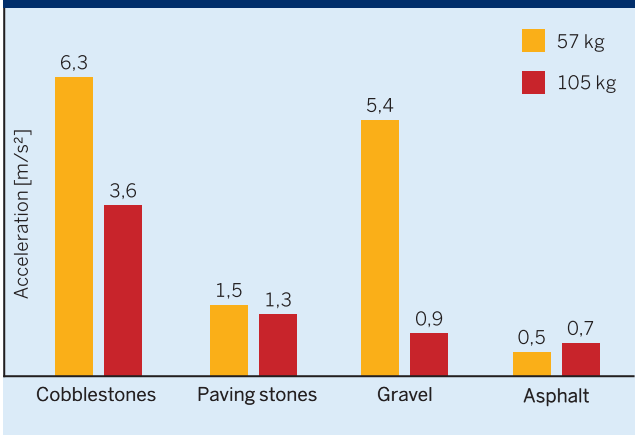

Figure 1: Comparison of the measured values for whole body vibrations at 15 km/h with different body weight

Central results

Different influences affect the level of vibration when using work pedelecs:

- The road surface the rider is travelling over is a crucial factor in the extent of the vibrations. Cobblestones are more difficult and strenuous to ride over than an asphalted surface.
- The greater the speed, the greater the extent of the vibrations.
- The lighter the rider's weight, the greater the vibration strain.
- The maximum vibration values are attained when unladen.
- The load from whole body vibrations is greater than that from hand-arm vibrations. The limit values are reached in a short period for the whole body vibrations.
- The lower the tire pressure, the lower the vibration load.

About the project

The "Vibrations from Work Pedelecs" project was realised by the LIA.nrw in cooperation with the Professional Association for Transport Economics Postal Logistics and Telecommunication, the University of Technology Hamburg-Harburg and velotech.de GmbH. The measuring technology corresponded here to the specifications of DIN EN 804. The mono work pedelec is equipped with luggage racks. According to the manufacturer, a payload with max. 15 kg for the front and max. 35 kg for the rear luggage rack is permissible, at a permissible total weight of around 180 kg. It does not have any suspension whatsoever. The three-wheel work pedelec has a luggage rack on the handlebars and an ample load area on the rear, on which an open transport box is mounted. The permissible total weight is 300 kg, whereby max. 25 kg are permissible for the front luggage rack and max. 150 kg for the rear transport box.

The rides during the project did not present a normal working day, although the term road tests leads you to assume this. For instance, it is not possible to make any statement regarding what effect sudden impacts can have on riding over cobblestones and potholes. Although the measuring methods are very practical, their reproducibility is limited. They are extremely time consuming for manufacturers, employers as well as appointed exerts and test institutes. A uniform measuring method would be conceivable in future, for instance the use of a drum test rig with variable loads for generating a definite vibration profile so as to ascertain corresponding vibrations from this. The project results could also help in the development of a technical standard in order to provide the manufacturers of work pedelecs with measuring specifications in future.

Further information and sources

- **Contacts at the LIA.nrw:** Martin Nordhaus, martin.nordhaus@lia.nrw.de and Sara Rack, sara.rack@lia.nrw.de
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Institute for Work Design
of North Rhine-Westphalia (LIA.nrw)
Gesundheitscampus 10
44801 Bochum
www.lia.nrw

Tel. 02 11 31 01 - 11 33
Fax 02 11 31 01 - 11 89
info@lia.nrw.de
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Institute for
Work Design
of North Rhine-Westphalia