

Focus on IFA's work

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Eye tracking on construction sites

Problem

Owing to their design, many construction machines provide an inadequate direct view of the machine's surroundings from the driver's cab. Visibility aids are intended to eliminate these blind spots; nevertheless, collisions repeatedly occur with humans (required to be) present in the work and danger zone. Hydraulic excavators are particularly affected.

Whereas for many years, mirrors were the only visibility aid on construction machinery, supplementary CCTV systems that are intended to provide an indirect view of hidden areas have also been in use for some time. On modern excavators for example, the area directly behind the machine is shown on a monitor in the cab.

A number of European and international standards contain requirements concerning visibility from the driver's cab and visibility aids on construction machinery. A number of parties have already drawn attention to the need for these standards to be revised (see for example KAN, 2014). It must be clarified in this context what parts of the danger zone should be visible from the cab and what form visibility aids should take in order for obstacles and humans in the danger zone to be detected and recognized as well as possible.

Against the background of these developments, a field study was to be conducted into the use and acceptance of visibility aids on hydraulic excavators, and scope estimated for optimization of their design.



"Dikablis" mobile eye tracker for tracking of eye movements (top, source: Ergoneers GmbH, Manching). Tracking on board the excavator: the red cross-hairs on the monitor show the focus of the eyes (bottom).

Activities

Eye tracking was conducted over several hours on excavator drivers on construction sites during normal working. A mobile eye tracker, worn by the driver in the same way as spectacles, was used for this purpose (see image).

Work tasks and excavator movements were recorded in parallel by observation.

The data recorded were used to analyse drivers' eye movements during critical excavator movements.

Results and Application

The results show that all visibility aids were viewed, i.e. used, during selected travel and rotating movements. The reversing monitor and the left-hand mirror were however used particularly often, the right-hand mirrors less so. It can therefore be assumed that CCTV systems generally meet with acceptance among excavator drivers. At the same time, the results show that mirrors and CCTV systems are suitable for checking the danger zone for different reasons. Whereas mirrors appear to be suitable for the area to the left of the machine, the area to the rear in particular and possibly also to the right can be monitored well with CCTV systems.

The results will be input into the work of standards committees and will support the formulation of provisions governing visibility from the driver's cab and governing visibility aids. The study provides manufacturers of construction machinery and of CCTV systems with insights into how their products are used in day-to-day practice. Construction companies can use the information to assess the suitability of different visibility aids on construction machinery.

Area of Application

Standards committees, manufacturers of construction machinery and mobile machinery, manufacturers of CCTV systems, parties involved in the health and safety of workers at work

Additional Information

- Kommission Arbeitsschutz und Normung (KAN): Earthmoving machinery: better visibility in sight. KANBrief (2014) No 4, p. 4
- Koppenborg, M.; Nickel, P.; Huelke, M.; Lungfiel, A.: Nutzung von Kamera-Monitor-Systemen bei Hydraulikbaggern. BauPortal (2016) No 3, pp. 35-37
- Koppenborg, M.; Huelke, M.; Nickel, P.; Lungfiel, A.; Naber, B.: Operator Information Acquisition in Excavators – Insights from a Field Study Using Eye-Tracking. In: Nah, F.F.-H.; Tan, C.-H. (Eds.): HCIBGO 2016, Part II, LNCS 9752, pp. 313-324. Springer, Heidelberg

Expert Assistance

IFA, Division 5: Accident prevention – Product safety

Literature Requests

IFA, Central Division