



Crane cabs: ergonomics equals efficiency

- Quay cranes outreach themselves
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Ergonomics: the science of fitting the workplace to the worker, not the worker to the workplace. **Nick Elliott** looks at how to make the crane operator's life more comfortable and improve performance in the process.

Crane manufacturers, both as OEMs and as procurers of outsourced cab designs, pay close attention to ergonomics when it comes to cabs. Dr-Ing. K-P Franke of Noell Crane Systems says the guiding principles of crane cab design are "safety, functionality, stress reduction and comfort as a basis for achieving a maximum in fatigue-free, concentrated and efficient crane operation by the driver." On the same point, Kees Derks of Kalmar stresses: "Ergonomics (chair & controllers), visibility, space, minimum vibration, climate control, (ship) exhaust gas protection, 'cleanability', and noise levels in the cabin."

"There has been done a lot of research and development in optimizing seating, pedals, control elements and panels as well as their arrangement from an ergonomic point of view," continues Noell's Franke. "The limiting factor in stress and fatigue reduction is the angle of sight - downwards - and the reduced visibility because of the great distance between driver and the location where to pick or place the container." As to the future: "Cameras which trace the container and produce an image being projected at a screen arranged comfortably within the driver's field of view, could certainly help," he says.



■ A Liebherr driver's seat with the EMS display mounted conveniently for the driver

ARE YOU SITTING COMF

And, he adds: "Of course the efficiency of the driver influences the efficiency of the crane and finally the efficiency of the terminal. The higher the overall productivity of a terminal, the more it is dependent on the efficiency of the crane drivers. And when specifying the cab the

customer very much considers the experience, the proposals and the demands of his crane drivers. And of course the customer likes to get more for less money."

Other important points says Kees Derks, are the stiffness of the crane as well as the smoothness of the trolley rail-transition point. "This point (at the boom hinge) is passed 60-80 times per hour. A bumpy ride will lead to higher fatigue of the driver, read lower productivity."

For Liebherr an important consideration is that the control consoles are built to their own specifications rather than purchased off-the-shelf thus allowing optimum interfacing with its own crane system, as well as ensuring that the seat itself includes all the features required in respect of driver comfort and ergonomics. Liebherr provides a container crane specific digital driver display - the electronic monitor system (EMS) - in the cabin of all its container cranes. The driver, in addition to the default screen with general operation-specific data, can select from several menus to obtain critical information including fault data in large clear text format.

"Less load and fatigue, greater comfort, better visibility . . ."

DAAN POTTERS



And monitors, says Liebherr, are often provided in the cabin for cameras mounted at the A-Frame and the trolley.

HOLISTIC APPROACH

Ergonomists use a holistic approach to ensure that physical, cognitive, social, organizational, environmental and other relevant factors are all taken into account. Daan Potters of Dutch cab manufacturer Merford lists them:

- **Visibility:** sun-protection, anti-reflection, demisting, easy replacement and window cleaning
- **Climate control:** insulation, cooling, heating, demisting, fresh-air supply (filtered because of vessel exhaust emissions) and humidity control
- **Seating:** well designed sitting-position in combination with a well designed lay-out of control components
- **Safety:** structure and fixing of the cabin, access to the cabin, communication, visibility and controls
- **Noise control:** insulation to reduce sound from the outside and noise absorption to reduce reverberation-time and noise levels inside the cabin
- **Vibration control:** protection of the driver against annoying shocks and vibrations (health and efficiency) and to extend the lifetime of the cab itself and all integrated equipment



■ Traditional working posture

■ Working position in Ergoseat



■ A Merford cab: orders via Kalmar and ZPMC

better way to control the master controllers improves the efficiency of the crane, reduces complaints, downtime and opens the possibility to stretch shift duration. An increase of efficiency of 0.5% (about 1 extra move per 8 hours) will save about €9,000 a year on the crane costs alone, excluding land and waterside influences," explains Potters adding that when reduced illness and time off is taken into account the saving is greater.

WATCH YOUR BACK

Much research has been done into preventing or reducing strain and injury to the driver focusing on his musculo-skeletal system. Merford's Ergoseat (the company is supplying 29 cabins equipped with the Ergoseat to HNN (PSA) and P&O Ports, Antwerp for their new Kalmar STS cranes whilst ECT Rotterdam and GMP Le Havre have also purchased Ergocabs with the Ergoseat via ZPMC) is an example.

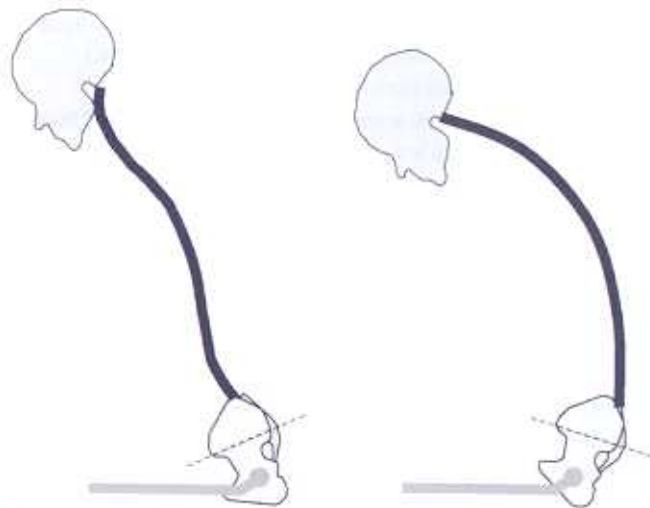
ORTABLY?

- **Lifetime:** proportionally, the cab is a small part of a heavy crane. The design, welding and painting system will be determinative of the cabin's lifetime.

Further enhancements include suspending the seat from the ceiling, improving the driver's view and avoiding an awkward posture as he looks down. Both seat and consoles are suspended from the same system to create the same movements between body and hands in a dynamic situation. Especially, the low frequency shock when passing the boom junction will be absorbed perfectly," says Potters.

Further attention to detail includes adding an extra protective coating on the outside of the windows to prevent sticking of pollutants and raindrops. Several types of tinted glass, sun-blinds, sun-covers and foil are available to protect the driver against sunlight and reflection of sunlight from the water; plus the option of electrically (resistance foil) heated walkable bottom windows and double-glazing to prevent condensation inside and out.

"Less load and fatigue, greater comfort, better visibility and a



■ Figures 1 & 2



■ **Looking down from the Ergoseat . . .**

In STS cranes, RTG's and RMG's, work requires the operators to look downwards almost continuously. Such a viewing angle forces the neck and back into an unfavourable, flexed posture. Consequently, many crane drivers suffer from neck and back complaints. One 1989 study revealed that 64% of crane drivers examined were suffering from back complaints and 42% of them from neck complaints. To evaluate the Ergoseat, Merford asked TNO Work & Employment (TNO) as an independent scientific institute, to make an objective comparison.

A biomechanical analysis was done for both the traditional working posture of a crane driver and the posture on the Ergoseat. Also a practical study was performed at Thamesport, in the UK. For the practical study nine operators were observed during a two-hour shift in both the Ergocab and the traditional cab. "During this shift the operators were observed, they were interviewed, they filled in a questionnaire and they were recorded by video," says TNO.

The main conclusions from the evaluation were:

- The Ergoseat may have a positive effect on the state of health as two main risk factors are clearly reduced.
- The outside view is improved. Crucial in this respect is the seat's suspension from the cab ceiling and the armrest mounted controls.
- It is not unlikely that the Ergoseat will improve performance. A better view, less discomfort, less physical loading and less fatigue are all factors that may well increase task efficiency.
- On the other hand, an innovative concept such as the Ergoseat requires a good introduction and some time to get used to.

Importantly the study noted that the viewing demands of some of the driver's activities more or less dictate the crane driver's working posture. The study states: "A lot of time is spent looking downwards while positioning the spreader on top of the container or positioning the container. The typical crane driver's posture is quite slumped. The

trunk does not remain straight, and does not flex forward in the hip joint, as sometimes depicted by simple manikins (see figure I). Instead the hip angle remains around 90° and the trunk is flexed to a C-form (see figure II). The backrest can hardly be used. Because of this slumped posture the neck flexion is only moderate (20-30° from neutral). The legs are spread to be able to view downwards. "For short periods of time one can even see extreme variants of this posture. This can occur when the crane driver

■ . . . onto this

wants to look over a container, thus not having to use a stevedore helping him handle a container out of sight or when he wants to see what is below and behind him while moving from ship to shore. He then sometimes even leans with a hand on the floor, depending on the maximum viewing angle the cab allows. "So the crane drivers working posture involves slight to extreme back and neck flexion for prolonged periods of time. Prolonged bending of the neck and prolonged bending of the trunk are known as risk factors for the development of neck pain. In addition to the above posture problems, the shocks of the cabin are certainly an aggravating factor and so it is no surprise that many drivers have complaints." TNO quantified the reduction of loads in the lower back as up to 50% or more in the Ergoseat compared to a traditional seat.



■ **The Ergoseat is suspended from the cab's ceiling**