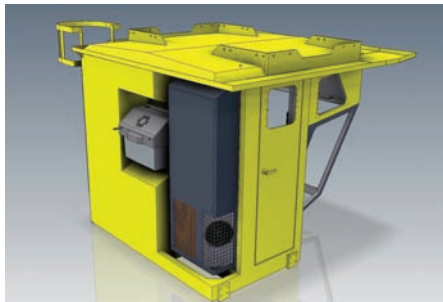


# Crane operator performance and health issues addressed

Merford Cabins has developed an operator cabin specifically for ship unloader cranes. Traditional problems relating to visibility, reflection and bad posture have been addressed, all aimed at improving the performance and health of operators.

When analysing the sitting position and viewing lines of existing ship unloader cabins, it became clear that many different sitting positions were used and view lines were blocked by the position of the cabin, the position of operator seat and the structure of the cabin. Furthermore, many operators often operate the crane with open windows. They do so to improve visibility and hear the crane running. However, working with open (bottom) windows leads to unhealthy and unsafe situations. There is a high risk that polluted exhaust emissions will enter the operator's cabin and efficient temperature control is impossible.

Step by step, it became clear to Merford that it was better to redesign the cabin completely. The resulting design features optimal visibility, a healthy posture according to ISO standard 11226 and optimal air and temperature control. Furthermore, by using the Merford Ergoseat, adjustments of the seat arrangement meet the P5-P95 working population in the Netherlands.



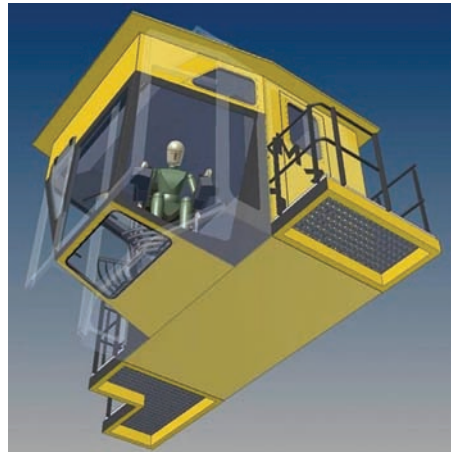
*This cabin features Merford's climate and filter units.*

Given that every process is distinct, the design of this cabin started by analysing the crane's duties. In the case of a ship unloader crane, the cabin can move separately from the trolley. This means that besides the position of the operator in the cabin, the ideal position of the cabin was analysed.

This analysis resulted in an optimum position for the cabin and the operator inside the cabin. Most of the time, this position is determined by the visibility of the process but an alternative position must be considered if the supposed optimum position would mean an unhealthy posture for the operator.

The next step was to analyse the routine actions of the crane operator. The purpose of this is to ensure that the crane operator has the controls and communication equipment required in an ergonomic layout. At the same time, the required posture of the crane operator has to be studied. This usually results in a specific seat arrangement.

The final task was to design a cab as a shell around the crane operator, protecting him/her from environmental influences (heat and cold, incoming light, dust, gases, noise, vibrations, movements and pollution etc). This must be accomplished without introducing any obstructions, unhealthy and unsafe situations.



*Merford's latest cabin design.*

During this final phase, all information gathered was put together, resulting in a view line study. To carry out this study, Merford used 3D software, showing visibility from the operator's perspective. As well as considering the cab structure and composition of the windows, different glass types were considered. In co-operation with operators, this led to the use of anti-reflective glass and a bottom window that can only be opened to clean the windows.

Because of the closed window, polluted air and dust inside the cabin is limited and efficient temperature control is possible. Temperature control is a must, especially in extremely hot environments. Temperature control is very important because it has been proved that people perform at their best at 23°C to 24°C. It has been demonstrated that lowering or raising the temperature by 5 °C reduces

performance by about 9% (Seppänen et al, 2003). The cabin is equipped with the Merford Climate Unit to create ideal working conditions.

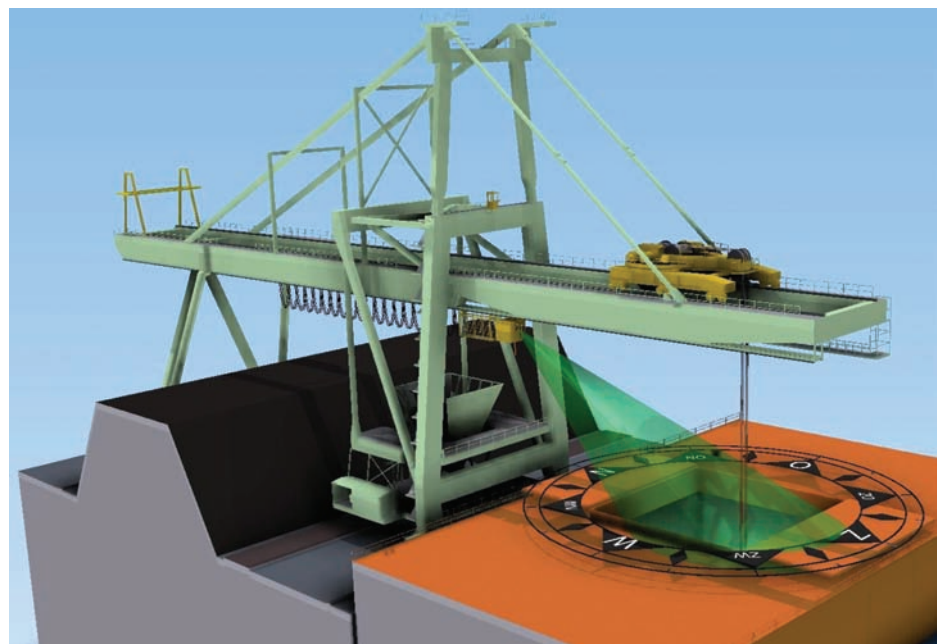
Air control is necessary because a certain volume of clean air and enough oxygen are needed. For air control purposes, Merford has developed a special filter unit. The use of chemical and dust filters limits the concentration of harmful gases. Unfortunately, there is always the possibility of polluted outside air leaking into the cab. This can be avoided by creating overpressure inside the cabin.

## Seat arrangement/posture

Although scientific studies indicate sitting is not the ideal posture, many people spend several hours every day sitting in a chair. In addition, the equipment provided in a professional environment is not always tuned to specific tasks. Often, proper instructions are missing.

Because the number of seat arrangements produced for cranes is relatively small, the designs are derived mainly from other industries. The seat itself is commonly adapted from those produced for the truck industry. Many kinds of control station are available in the market but the typical circumstances in cranes require specific qualities and adjustments.

As a minimum, the size and adjustments have to meet the 5–95 percentile for males and females in the area of use. Suppliers must consider the size and adjustments useful for a wide range of body sizes. This kind of equipment requires a wide range of adjustments, which carries a risk of reduced quality and sometimes, fixed size compromises have to be



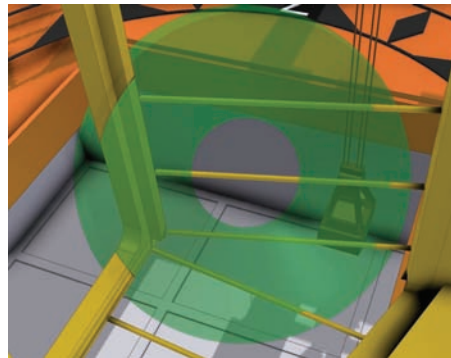
*Cabin position in a crane.*

accepted. Anthropometry now plays an important role in industrial design and ergonomics. Statistical data about distribution of body dimensions in the population are used to optimise products. For example, the required height adjustment of a seat should be about 5in to fit both a big male and a small female (difference in lower leg length).

To operate the master switches in an ergonomic way and to reduce shoulder load, the height of the consoles is important. Since the height of the seats is adjustable and both anthropometrical data and different postures must be considered, the height of the consoles needs to be adjustable compared to the seat. Anthropometrical data mandates the forward-backward position of the master switches also needs to be adjustable. Besides these practical issues, it is recommended to give crane operators the opportunity to vary their position. Experience teaches that it is helpful to have a seat arrangement that allows the operator to stand up and sit down while continuing operation.

When sitting, the main part of the body weight is transferred to the seat. A portion of the weight is also transferred to the floor, back rest and armrests. The location of transferred weight is the key to good seat design. When the proper areas are not supported, sitting in a seat all day can put unwanted pressure on the back, thereby causing pain. More likely, lower back and neck problems occur when crane operators are working in extreme postures. This is especially true for crane operators who are constantly looking downward. This can result in fatigue, physical complaints, loss of efficiency and even damage and/or dangerous situations.

The international standard ISO 11226,  
Ergonomics — Evaluation of Static Working



*View lines from Merford's latest cabin are much improved.*

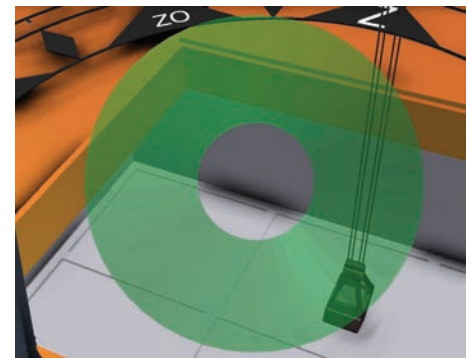
Postures, shows the maximum back inclination in relation to 'holding time' if the crane operator is not using an upper body support. As an example, the maximum holding time is 2.5 minutes when the back inclination is 40°. If the crane operator works in a dynamic environment (shocks and vibrations, horizontal movements), the loads on the lower back increase even more. An upper body support is highly recommended in this case.

### **Biomechanical evaluation**

In a laboratory test environment, data was recorded relative to the posture of 10 test persons. They were observed working in both traditional seat arrangements and the Ergoseat (a seat arrangement with upper body support via the arms). The data is input for biomechanical analyses.

To make it possible to make the calculations, the anatomic data of the test persons were also recorded and the loading on both cushion and armrests was measured during the computer task.

In the traditional seat, the lower back is under



significant stress. This is because the back muscles need to generate forces to counteract the forward torque of the upper body. However, in the seat with the adjustable consoles, a significant portion of the weight of the trunk, head, arms and hands is carried at the armrests. Mechanical loading on the lower back is thereby reduced by more than 50%. The further forward the operator leans, the more this reduction may be.

Another clear advantage of the Ergoseat with adjustable consoles is the potential variation in shoulder load over the course of the day. Crane operators may vary the load on their shoulders (and lower back) by varying the extent to which they lean on the arm support (ranging from total support to none). Hence, internal structures in the back and shoulder can recover during work and fatigue is reduced. In contrast, in the traditional situation, the load on the shoulders and lower back is constant and continuous while the operator is working.

**Reader Reply No.45**