Radio remote controls:

improving safety in tower crane operations.

Agenda

1. General safety aspects.
1.1. Working with radio remote controls vs. working from the cabin.
1.2. General legal aspects of working with radio remote controls.

2. Enhancing safety by technical developments in radio remote technology.
2.1. Intelligent access control by Smart Cards.
2.2. New possibilities of data / video feedback.
2.3. Specific safety features.

3. Frequency issues
3.1. Legal requirements.
3.2. Latest frequency management systems.

4. Summary / Outlook / Discussion

Working with radio remote controls vs. working from the cabin.

Operation from the cabin:

- For a single lift, at least 2 workers are required:
  the crane operator + someone to give signals and to hook on the load.
- The crane operator has to trust the commands of the signalman.
- Depending on the position of the signalman, directions could be mixed up.
- Communication by walkie-talkie could cause dangerous misunderstandings.
- But: For some working situations, working from the cabin is essential.

Working with radio remote controls vs. working from the cabin.

Operation by radio control:

- Just 1 operator is required to do the complete lift, no signalman needed.
- The operator can position himself with optimum view to the working area.
- Misunderstandings by bad communication are avoided.

→ **radio controls can save money and increase safety!**

General legal aspects of working with radio controls.

- There are no general restrictions for the use of radio controls with tower cranes.
- The respective regulation for the use of machinery (e.g. the machinery directive) has to be followed.
- The respective local accident prevention regulation has to be followed.
- The use of radio frequencies has to be approved by the responsible authorities.

Enhancing safety

Intelligent access control by Smart Cards.

- The radio control can be activated by an individually-configured Smart Card only

  → safe protection from unauthorized use.

- Specific access levels can be defined for every user

  → safety-relevant functions can be restricted to authorized operators only.

  → the functions of the radio control / the crane can be adapted to the experience of the operator.

- In combination with a data logger, operational data of the radio control can be stored and evaluated for each user.

Enhancing safety

Feedback by LCD / TFT: more information, more safety.

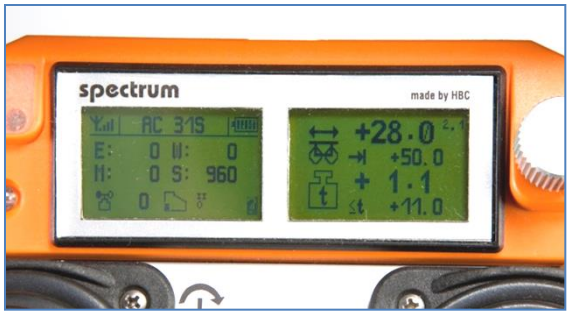
This option enables the indication of valuable crane information, error messages and warnings on the control panel.

Feedback by LCD:

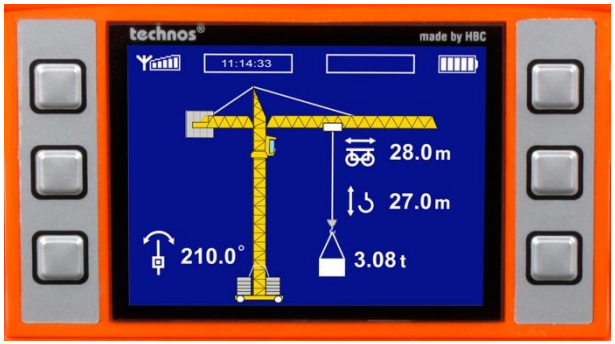
- Full graphical display.
- Easy customization.
- Various status information, such as battery & signal strength.
- Most diverse feedback information available, such as weight and measuring data, height of hook, load weight.
- Warnings, error messages.

Feedback by TFT:

- Large 3.5″ color screen.
- Fully customizable.
- Easy navigation by push buttons.
- Additional functions available by softkeys.
- Most diverse data available.



Feedback by LCD.



Feedback by 3.5″ TFT.

Enhancing safety

Live video transmission: keeping an eye on all movements.

- The live video transmission with video camera enables safe and precise working in demanding situations.
- This safety feature works with up to 8 video cameras.
- The cameras can be mounted in a good position on the crane and transmit live color images of the working situation from the best angle possible.
- The images are shown on the 3.5″ TFT in good resolution (320 x 240 pixels) and with a clear structure. The operator thus has an additional eye on the machine and the working environment, even when the operation is difficult.

Enhancing safety

Protection from unintended movements.

- In specific emergency situations, intelligent safety features can prevent unintended movement commands from being given to the crane, protecting the operator as well as other personnel in close proximity to the crane in use.

  They can activate
  - if the transmitter receives a hard impact.
  - in the event that the transmitter is dropped or thrown.

- Depending on the ordered version, the features can operate in three different ways:
  - The complete radio system is shut down.
  - Safety-relevant functions are de-activated.
  - A previously defined function (e.g. crane horn) is activated.

radiomatic® shock-off

radiomatic® zero-g

radiomatic® zero-g

Shut-down on implausible control commands.

- This function will activate if one or more joysticks are actuated in an implausible manner.
- If, for example, the operator moves the joystick successively in different directions in an irregular manner, the intelligent process will activate.
- This protects the operator from potential dangers. At the same time, the crane is protected from wear, since straining, abrupt movements are prevented.
- Depending on the ordered version, the feature can operate in three different ways:
  - The complete radio system is shut down.
  - Safety-relevant functions are de-activated.
  - A previously defined function (e. g. crane horn) is activated.
- In order to prevent unnecessary work interruptions, the automatic shut-down only intercedes after a sequence of multiple questionable movement commands.

Enhancing safety

Speed limit by micro drive.

- With the micro drive function, the driving speed of the crane can be easily limited to a predetermined value.
- Even if the joystick is fully actuated, the operator cannot exceed the speed limit.
- In this manner, demanding drive maneuvers can be managed with ease and inexperienced users can be protected from potential dangers that can result from “speeding.”

Keeping direction with the orthogonal drive.

- With the orthogonal drive function, the operator can only move the crane into the direction that they initially engage with the joystick.
- The operator will have to return the joystick back to zero position before another directional command can be activated.
- Diagonal movements are not possible.
- This function is ideal for situations where the operator has to navigate through narrow, straight ways.
- Dangerous situations caused by unintentional diagonal movements are being prevented.

Front panel lighting.

- With the front panel lighting, the operator can clearly read and locate all functions, at any time, under working conditions with limited light.
- When necessary, the operator simply switches on multiple LEDs, which are integrated into the rollover bar, with a switch or button on the transmitter.
- The operating elements are immediately visible again and potential dangers resulting from incorrect operation of the radio control, based on poor visibility, can be prevented.

Enhancing safety

Catch-release:
shared crane, increased efficiency.

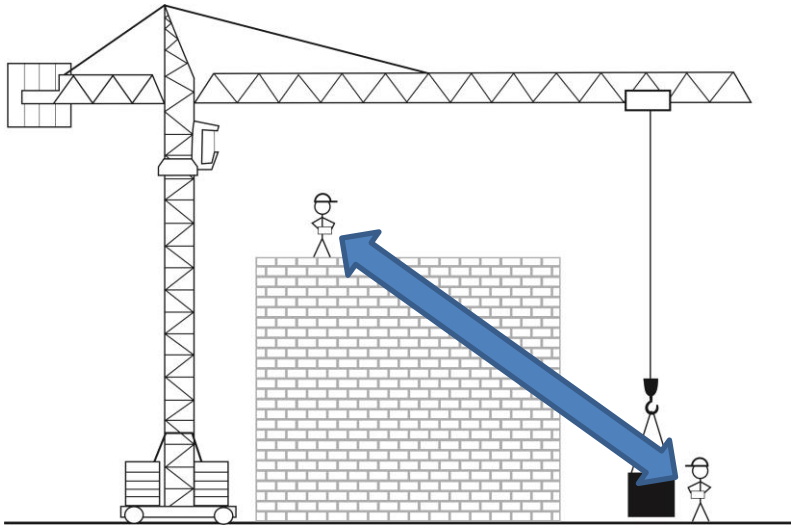
- 1 crane can be controlled alternately by 2 radio controls

  → 2 users can share one crane.
  → crane efficiency can be increased significantly.

- Walking distances in working areas with long runways can be reduced.

- Special working situations such as loading and unloading without a good view of the load or the positioning of loads are optimized and efficiency is increased.

- Option: extended catch-release, e.g. 3 operators and 4 cranes.



Frequency issues

Legal requirements.

- Depending on the country of destination, there are various legal requirements for the use of radio controls, e.g.:
  - Frequency allocation plans
  - Approval of the product
  - and other.
- Throughout most European countries, there are harmonized legal standards regarding the use of frequencies for radio controls.
- Approvals are provided by the radio control manufacturer / supplier.

RF module TC240.

Frequency issues

Frequency management:

manual / semi-automated technologies.

Manual frequency switch

- With the manual frequency switch, the operator can quickly change the radio frequency by a push button.

radiomatic® AFS (Automatic Frequency Selection)

- When the radio control is activated, the system automatically searches for a free radio channel.
- In case another radio signal causes frequency conflicts by working on the same channel, all the user has to do is activate the function again. radiomatic® AFS immediately looks for a free radio frequency and work can continue without any loss of time.

Frequency management:

Fully-automated technologies.

2.4 GHz technology

- 2.4 GHz technology works with automatic frequency coordination and thus ensures interruption-free working in areas with many radio users.
- With the worldwide frequency band, 2.4 GHz technology can be used all over the world.

radiomatic® AFM (Automatic Frequency Management)

- AFM stands for Automatic Frequency Management: the system constantly detects free radio frequencies.
- If the radio frequency currently in use is also occupied by another radio system, radiomatic® AFM automatically switches to a free radio frequency within a fraction of a second; the user can continue work completely undisturbed.

Questions?

Thank you for your attention.