

# When cranes and trailers can become deadly weapons



Safety expert Richard Krabbendam warns of what can go wrong if the laws of physics are ignored – and provides a checklist of measures to help ensure safe lifting operations.

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The lifting of heavy loads requires training and skill but, besides that, it is very important that operators and persons involved in handling heavy lifts understand the fundamental laws of nature.

If you do not respect the laws of nature, heavy lift operations can go horribly wrong, as was demonstrated on August 3, 2015, in the Netherlands city of Alphen aan den Rijn, when a 187-tonne bridge section was being lifted by two hydraulic cranes positioned on two barges. Fortunately, the incident did not cause any casualties but the cranes suffered severe damage, as did some of the surrounding houses – and it generated a huge amount of international media attention.

Investigations by the local authorities are ongoing and a detailed report will be published showing what went wrong and what measures have been suggested to



The aftermath of the recent crane incident in Alphen aan den Rijn in the Netherlands.

prevent this type of incident from happening again.

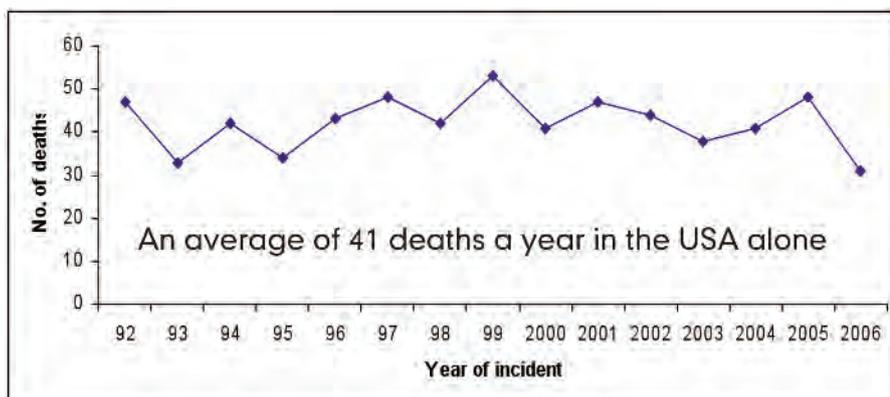
The laws of nature – in this particular case the three laws of Newton, as explained in the March/April 2015 issue of HLPFI pages 107-109 – apply to the lifting of loads. In addition, one must understand that when a load is lifted by a crane and is freely

suspended in the main tackle, it is as if the centre of gravity (CoG) of the load is in the top of the crane's jib.

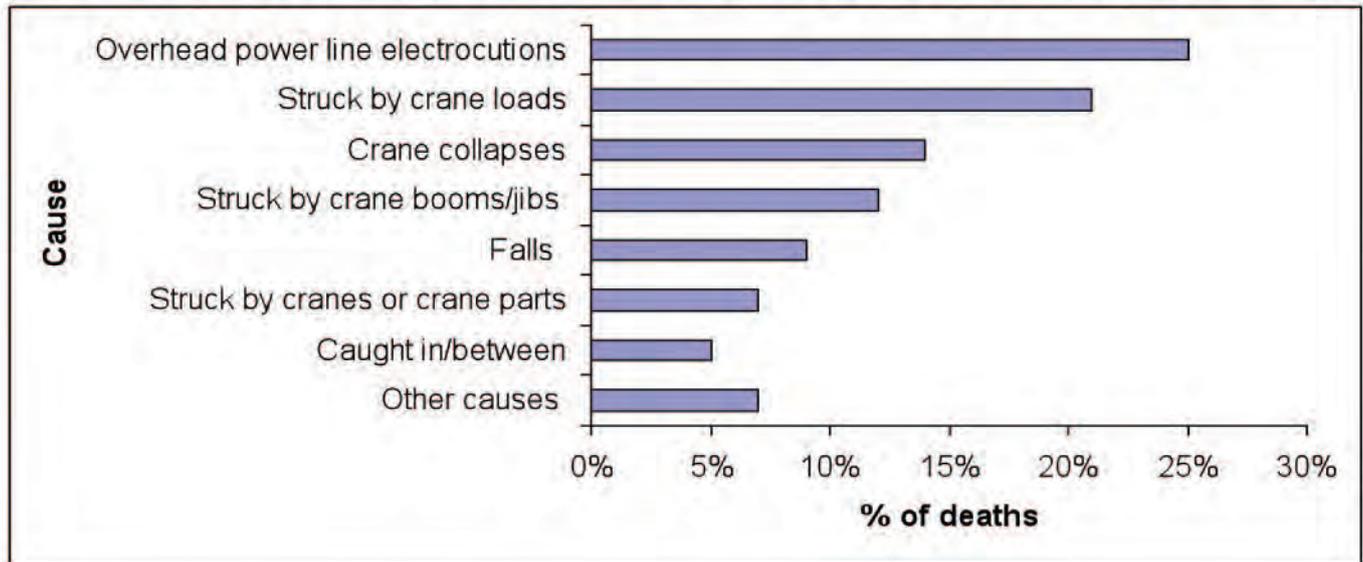
The force of a lifted load of 100 tonnes pulling at the jib head will easily pull the crane over if it is not perfectly suspended in a vertical direction. Cranes are designed for a certain maximum load, with a safety margin against tipping, and all load charts are now based on 75 percent of the tipping moment. The CoG of the load is always suspended vertically under the hook. The inclusion of the following crane incidents is designed to trigger the safety awareness of operators, planners, project managers and others involved, in the hope that we can all learn from mistakes made in the past.

## Crane stability

Two of the most important issues are the stability of a crane and the surface on which it is positioned. The outrigger, or crawler



## Causes of Crane-Related Deaths in Construction, 1992-2006



loads, should be adequately spread on the ground and they should not exceed the maximum allowable ground load. During the construction of the Arena Corinthians stadium in São Paulo, Brazil, a 1,350-tonne capacity Liebherr LR11350 lifted a 420-tonne roof section and travelled forward with the load, trying to install it on the stadium roof.

Due to insufficient load spreading of the crawler tracks on the ground, one crawler side gave way resulting in a severe incline of the crane with the main boom collapsing and the load falling down. Two construction staff died in this incident; for more details see [www.heavyliftnews.com/accidents/fatal-crane-collapse-sao-paulo-world-cup-stadium](http://www.heavyliftnews.com/accidents/fatal-crane-collapse-sao-paulo-world-cup-stadium).

Here we saw a high capacity crawler crane travelling forward on rain-soaked soft ground with a 420-tonne load on the hook

at the end of a 102 m boom, so the leveraged forces on the boom footpins must have been multiplied many times over.

By any standard, this fatal incident cannot be properly described as an 'accident' as it was not accidental in its nature. This series of factors was entirely foreseeable for any director who cared to look.

When using a multimillion dollar crane, you cannot ignore proper load spreading, by means of hard wood crane mats or steel pontoon type load spreaders, under the crawler tracks.

### Crane mats

In a fatal incident on November 18, 2012, a Terex Demag CC6800 crane tipped over in Vungtau, Vietnam, while lifting a load of around 315-350 tonnes. Again, no crane mats were used to spread the load under the crawler tracks while the crane was travelling

with the load. The crane and load were heavily damaged, but even worse was the fact that three workers were killed and two badly injured.

The crane mats were available on site, but they were not used as the operators greatly underestimated the forces beneath the crawler tracks and the load-bearing capacity of the soil on which they were travelling.

### Stopping these incidents

How can we avoid these unfortunate incidents? It starts with understanding the laws of nature and paying attention to the points below:

- Crane operators and other personnel should be properly trained and only qualified and experienced personnel should be used.
- Conduct complete crane and rigging inspections and use only certified equipment.
- Have an effective preventive maintenance programme.
- Do not exceed the maximum lift capacity of the crane at a certain radius.
- Ensure proper load spreading under outriggers or crawler tracks.
- Do not abuse the crane and follow the operations manual.
- Check the rigging of the load to the hook block.
- Appoint an experienced and qualified rigging supervisor, who is in charge of the operation.
- Ensure proper communication when assembling or disassembling the crane as well as during the lifting job.
- Ensure correct supervision of all aspects



During the roof installation at the Arena Corinthians stadium in São Paulo, Brazil, one crawler side gave way resulting in a severe incline of the crane with the main boom collapsing and the load falling down.

of a crane operation, from assembly to disassembly.

- Make a Lift Plan or detailed Method Statement, depending on the complexity of the project.
- Explain the operation in a Toolbox meeting to all operational personnel prior to the start of the job.
- Check the vertical state of the lift tackle in at least two directions before starting the lift and keep the tackle vertical at all times.
- Keep crane in a horizontal position.
- All personnel involved in the project must wear personal protective equipment.
- Check stability of the load when lifting from lift points below the CoG.
- Check stability of the barge in cases where a crane is positioned on a barge.
- Check wind force.
- Check lifting points on the load.

The above list is far from complete and depends on the complexity of the project. In the UK, for example, a Risk Assessment is a legal obligation – see Reg 3(1) of the Management Regulations 1999 – and a Risk Assessment is not just a paper exercise, but



In a fatal incident at Vungtau in Vietnam, a crawler crane tipped over while lifting a load of around 315-350 tonnes in a situation where crane mats were available to spread the load and should have been used.

the starting point of a methodology resulting in Safe Systems of Work for crane lifts, the common law obligation in the UK.

Anyone working in the crane industry who thinks: “It will never happen to me”, consider that the most effective way for employers to defend themselves from a

manslaughter charge arising from an unintended or negligent fatal incident is to prove that all staff were trained in Safe Systems of Work. If you think training is expensive, try having an accident.

Tragically, 96 men, women and children have been killed by cranes and lifting operations worldwide since January 1, 2014, and figures recorded show 18 people were killed in June and July 2015 alone.



*Please note, this article is intended for guidance only. While every care has been taken to ensure the accuracy of the contents, no responsibility will be accepted by the publishers for any errors.*

**Richard Krabbendam** was a heavy lift specialist during his whole working career, after which he formed Krabbendam Advisory Service. A Master of Mechanical Engineering from Delft University of Technology, he has worked with BigLift and Mammoet, and was a co-founder of ITREC. He helped to set up Jumbo Offshore and was involved in the development of its super heavy lift carrier fleet, the J-Class, which uses two 900-tonne mast cranes for subsea installation works. Since his retirement from Jumbo he has been working as a freelance trainer/engineering consultant.

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