

Landwards Conference 2013

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Safe machines.

Why failure analysis is essential for design safety.



Introduction



- Ex-Harper Adams Agricultural Engineering student.
- Took the tough decision not to go back to the family dairy farm.
- Enjoy a career developing my skills and knowledge very much within agriculture.
- Now form part of a Health & Safety consultancy team.

Newmac Ltd



Courtesy of Rotochopper Inc. St Martin MN USA.



- Multi-skilled team of professional consultants covering Health and Safety legislation, environmental management, expert witness work & CDM co-ordination.
- Successful business model, over 16 years of service to industry.
- Includes management of CE technical files for a range of agricultural and processing equipment with Europe and the US.
- Also include project analysis work which has involved secondment work in Iceland, and producing modelling scenarios for Asian based feed milling operations.

Defining machinery life cycle, within agriculture.



Machinery demonstrations plot. UK Cereals 2012.

- The most realistic advert for a tractor once used the strapline;

“There's only one thing I need a tractor for, that's every damn thing”.

So with such a challenge, where
' we start ?



What is the market for agricultural machinery?

Legal compliance



- Understanding the requirements (European CE marking, requirements for USA and Russia).
- Maintaining safety documentation in-line with legislation.
- How far to go with applying standards.
- Industry guidance.
- Historical accident statistics.

Commercial decisions.



- Budgeted sales.
- Competitor activity.
- Split market. Increased no. of SME's vs large global players.
- Innovation and development focused on increased efficiency and resource management.
- End consumer has a bigger say in what route the industry takes.
- Industry will need to maintain and develop high calibre of decision making personnel.

Developing our knowledge of failure.



- As engineers we need to define the failure, and establish root cause.
- No matter how good we are, or how good we think we are, unless we establish this our subsequent designs will ultimately be a failure.
- We will then be left with a bigger mess to sort out, because two teams of designers will have made a *?*!
Up.



Please note that this tanker does not represent the one referred to in the case study.

Machinery manufacturers were present during the attempt to commission the equipment.

Case Study.

- A **tanker unit and rear injector** assembly quickly became bogged down when entering the field.
- The **tractor unit correctly sized** to pull the assembly, **struggled** from the outset.
- The tanker unit had to discharge its contents into **another unit** to be moved onto fresh ground.
- **Weight distribution?** A heavy machine with a **variable** weight on light land. Maybe a consideration?

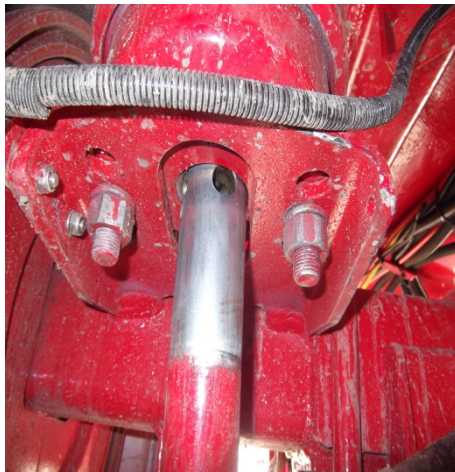
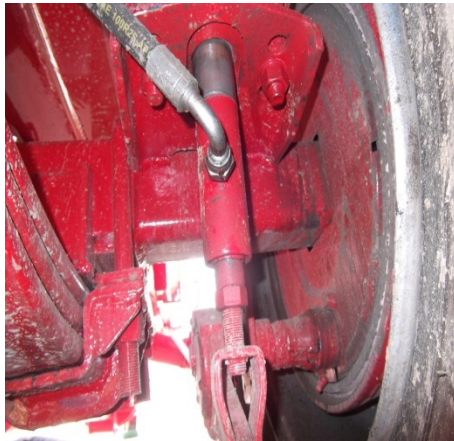
As an independent assessor what information can we use ?



- Picture courtesy of Michael Burdge (Yatton) www.michaelburdge.com

- Talk to the people involved.
- What was the designer trying to achieve ?
- How many different component suppliers are involved ?
- Forget emotion, you have a clean sheet.
- Look at the situation. Take notes and then find somewhere to think.

What happens when we apply this process ?



- Two large capacity tankers operating in one field. One existing unit coped with the conditions, one didn't.
- What don't I understand about this type of equipment. Apply simple problem solving techniques first.
- Unit had heavy duty running gear, air brake assembly, and it still got stuck ??
- Physical investigation established a failure.
- Tractor struggling, could the brakes have locked on ?
- Sequence of events begins to make sense.

So where does this leave us regarding machinery safety and life cycle ?



- Risk assessment is a series of **logical steps** to enable, in a **systematic way**, the **analysis and evaluation** of the risks associated with **machinery**. (Ref BS 12100:2010).
- Isn't this the process engineers take when applying their knowledge and skills?
- So to apply safe practices, we need to fully understand our designs. In turn we must maximise the machines potential without compromising safety.

And there's more to come.....



Courtesy of Sukup Mfg Co. Sheffield, Iowa, USA.

- Developing safety systems with a “known level” of control, and identifying potential for “critical failure”.
- Potential for a diverging Europe makes interpretation of standards more challenging.
- Transport legislation is now a high priority given the size and potential road speeds.

So its down to us again...



“If you are looking for perfect safety, you will do well to sit on a fence and watch the birds; but if you really wish to learn, you must mount a machine and become acquainted with its tricks by actual trial.”

Wilbur Wright, from an address to the Western Society of Engineers in Chicago, 18 September 1901



Thank you for your time.

- Any questions, please ask.
- We can follow up with more detailed discussions.
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