

THE FUTURE OF EN13000

WINNIPEG 2018



DEMAG
BY TEREX





Explanation



This presentation contains a number of accident pictures.

For most cases we chose pictures of Terex products. As the typical mobile crane incidents are related to „crane physics“, maintenance and/or repair, planning and behaviour of people, same or similar situations can be easily found for products of other manufacturers (see e.g. Internet).

In general we see, that accidents with mobile cranes, which are designed and built according to international accepted standards, are related solely to planning, preparation/setup and/or use or may be the result of inappropriate inspection, maintenance and/or repair.



Standards 1



/Wikipedia/ ... International Standards are one way of **overcoming technical barriers** in international commerce cause by differnces among technical regulation and standards developed idependently and separately by each nation [...]

Safety standards shall ensure making **safe products** when being applied during design and building and create a **level playing field** with clear requirements for all participants in the market place.



Standards 2



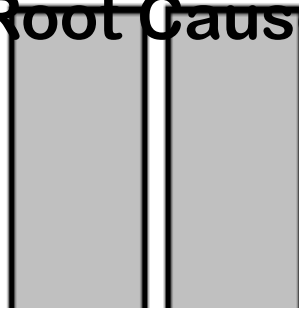
Europe: The **EC Machinery Directive** (EC MD) gives the essential health and safety requirements for machinery.

The manufacturer issues a **CE declaration of conformity** (... conformity with the EC MD) during a self certification procedure (visible by CE-mark and documentation).

Standards mandated under the EC MD may become a **harmonized standard** (as is **EN13000:2014**), the application of these standards during design gives the **presumption of conformity** with the EC MD.



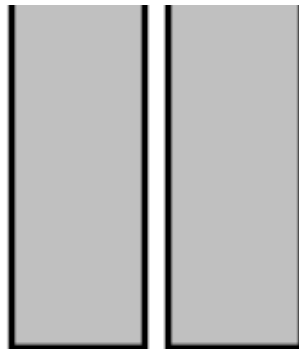
Crane Accidents – Root Causes

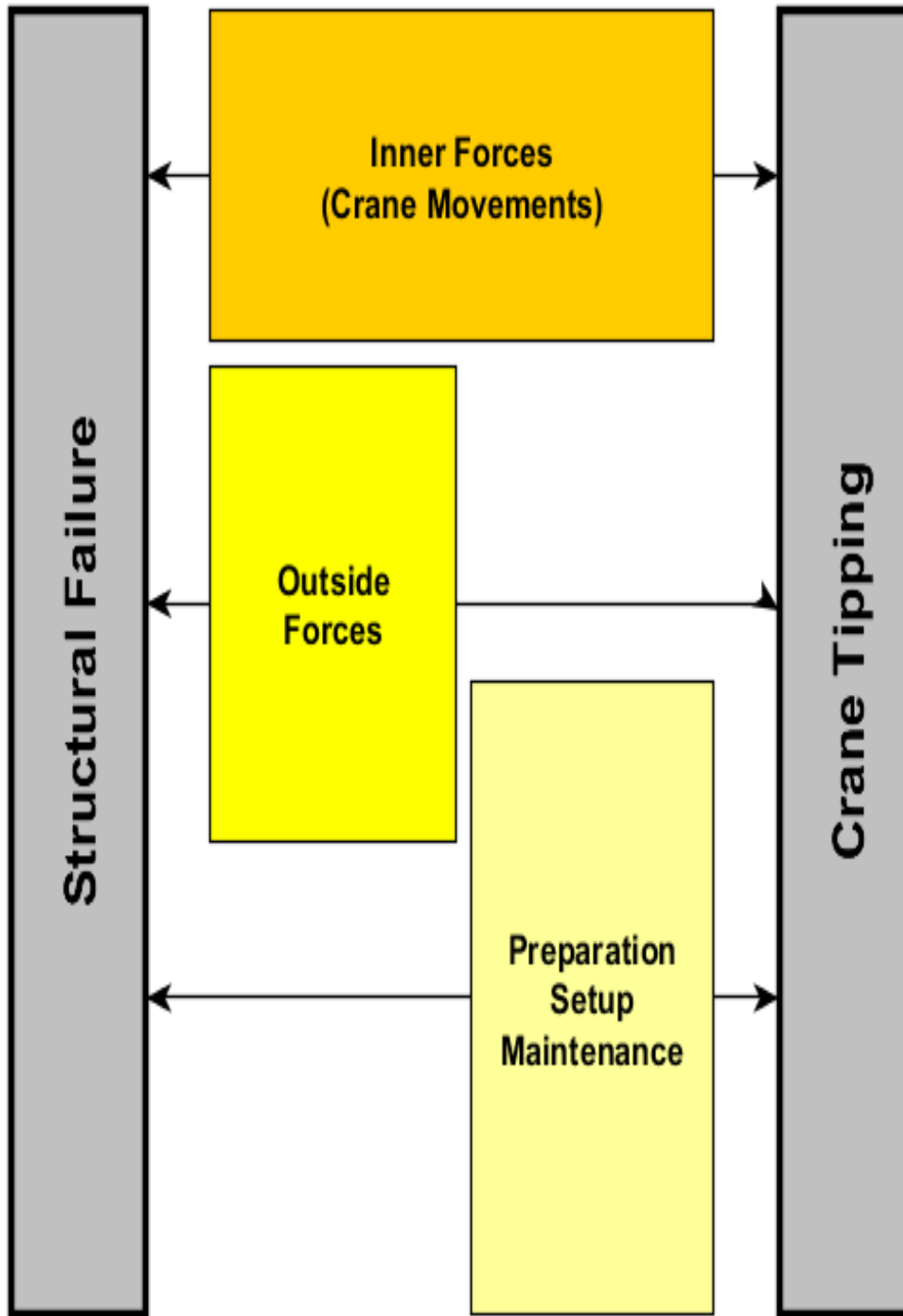


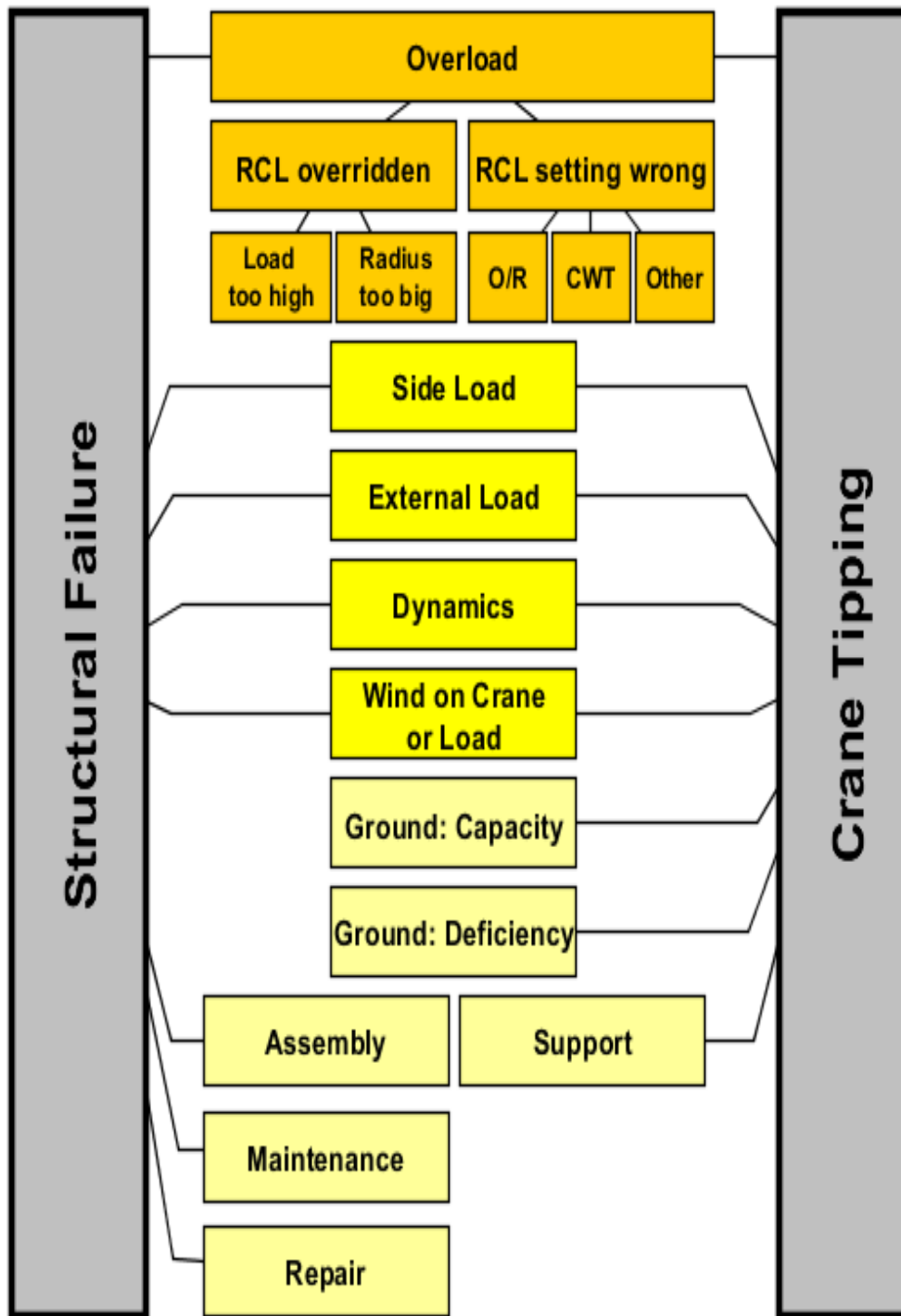
Structural Failure

Crane Tipping

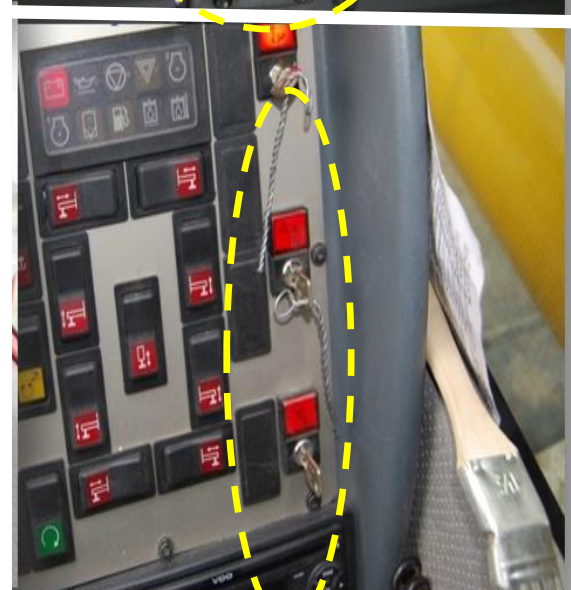
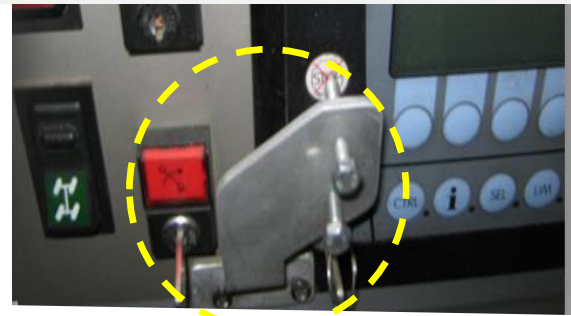
Focusing on structural failure and tipping, leaving aside e.g. contact to power lines...







! Crane Accidents – Enabler



Til 2010 mobile cranes had an override key in direct reach of the operator



EN13000:2010 – 1st Version

EUROPEAN STANDARD

EN 13000

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2010

ICS 53.020.20

Supersedes EN 13000:2004

English Version

Cranes - Mobile cranes

Appareils de levage à charge suspendue - Grues mobiles

Krane - Fahrzeugkrane

This European Standard was approved by CEN on 19 December 2009.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EN13000:2010 - Experience

EUROPEAN STANDARD

EN 13000

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2010

ICS 53.020.20

Supersedes EN 13000:2004

English Version

Appareils

This Europ

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standards

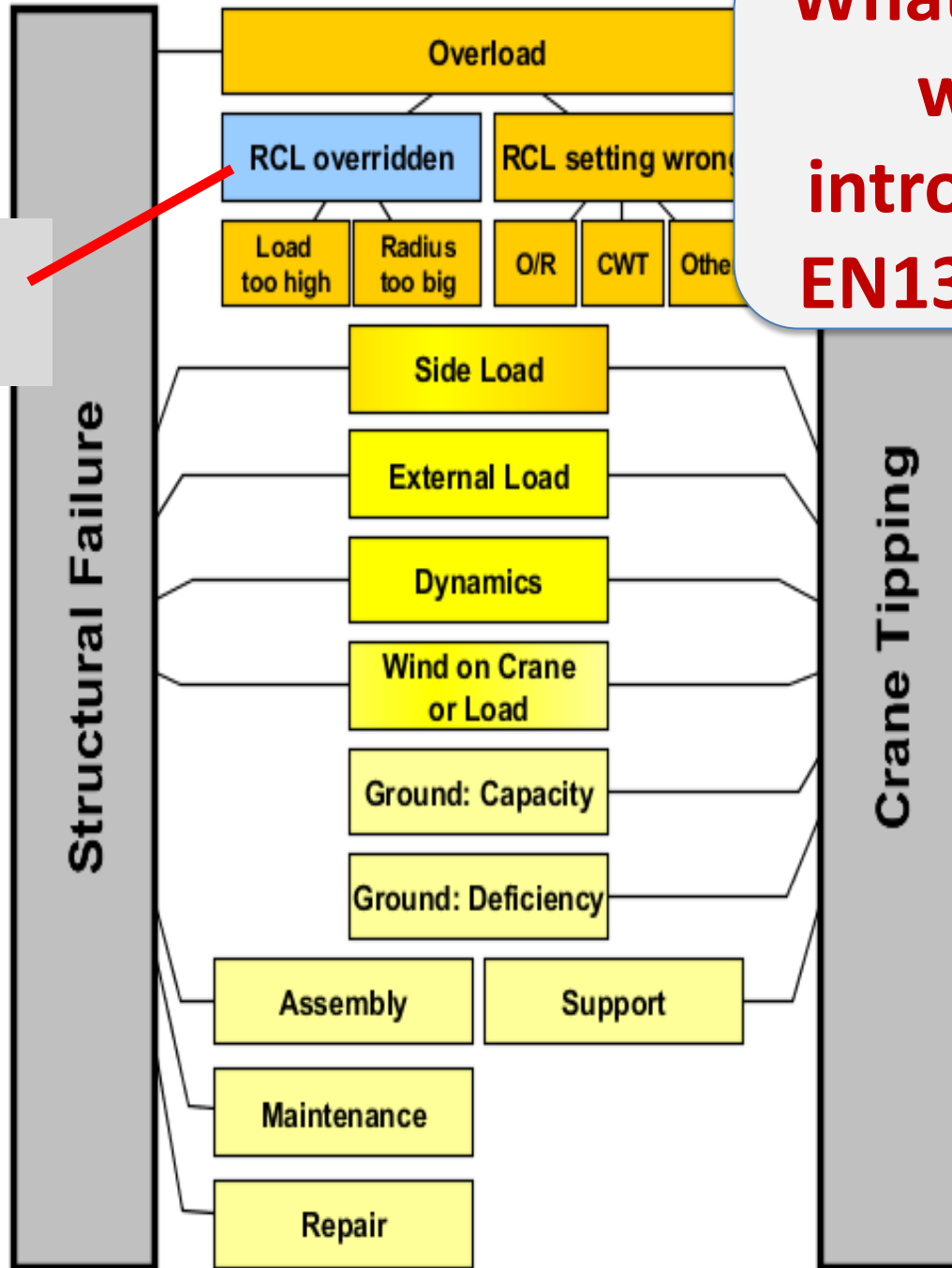
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under the
official ver

CEN mem
Finland, Fr
Portugal, Ro

- **In Europe a Category of Accidents (Overloading the Crane enabled by Override) completely has disappeared.**
- **Initial concerns were not confirmed in real application**

What happened with the introduction of EN13000:2010?

Eliminated by EN13000:2010







European Federation of
Materials Handling
Product Group Cranes and Lifting Equipment
Mobile Cranes



European Association of
Heavy Haulage Transport and Mo-
Cranes Group

Safety Alert - Press Release

Frankfurt, 12th April 2010
FEM PG CLE MC N 0219

Ref: Mobile Cranes – Influence of Wind Forces during Crane Operation

ESTA and FEM Product Group Mobile Cranes would like to inform:

It has come to our attention that wind forces acting on loads during lifting operations have led to a number of serious accidents especially in the wind mill industry.

Therefore we would like to point to the fact that influences of wind forces during crane operation, as described in detail in the load charts and operation manuals of the crane ma-

SAFETY ALERT

FEM ESTA press release
April 2010

In case of negligence, risk for life exists.

Address :
Postfach 71 08 64
60498 Frankfurt/Main

Telefon +49 (0)69-66 03 · 1500
Telefax +49 (0)69-66 03 · 1496
E-mail: Klaus.Pokorny@VDMA.org

Lyoner Straße 18
60528 Frankfurt



EUROPEAN
MATERIALS HANDLING
FEDERATION (FEM)
Product Group Cranes
and Lifting Equipment

FEM
5.016
(3 Ed)
April 2017

- Guideline -

**“Safety Issues in Wind Turbine Installation and
Transportation”**

- Leitfaden -

**“Sicherheitsrisiken während Aufbau und Transport von
Windkraftanlagen”**

FEM Guidance

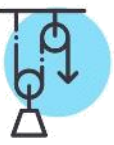
issued October 2012
(now 3rd edition 2017)

Fédération Européenne de la Manutention - Product Group Cranes and Lifting Equipment

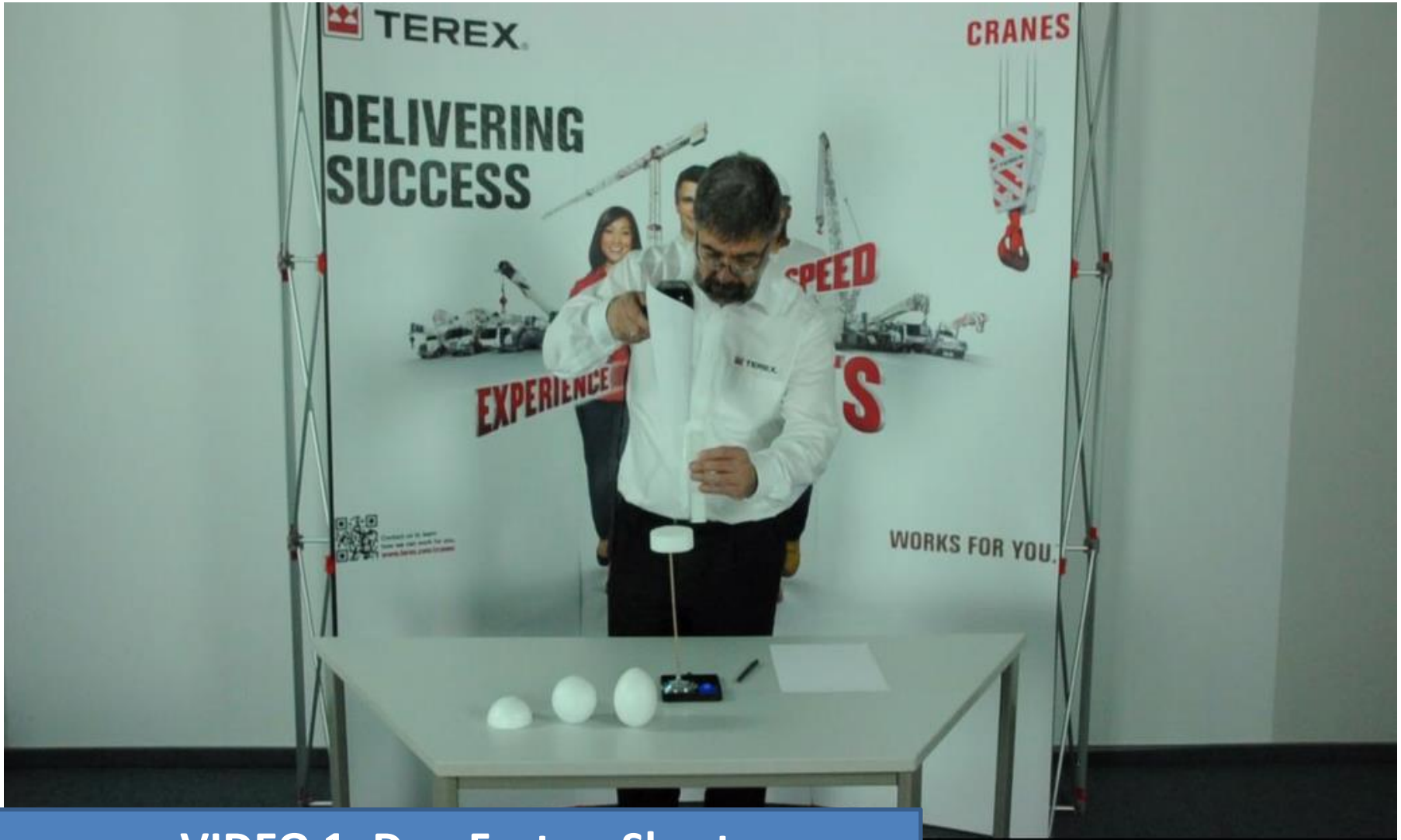
Copyright: FEM PG CLE

Sources see end of the document

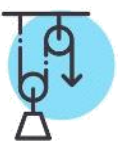
Available in: English (EN), French (FR), German (DE), Italian (IT), Spanish (ES)



WIND ENERGY BUSINESS – PHYSICS OF WIND

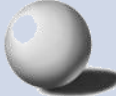

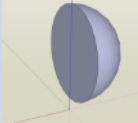
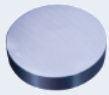


VIDEO 1: DragFactor_Short



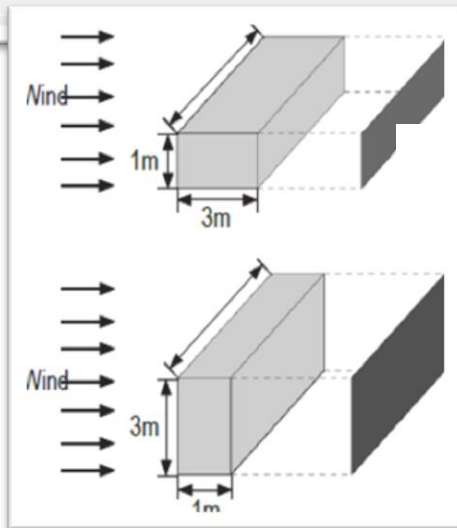
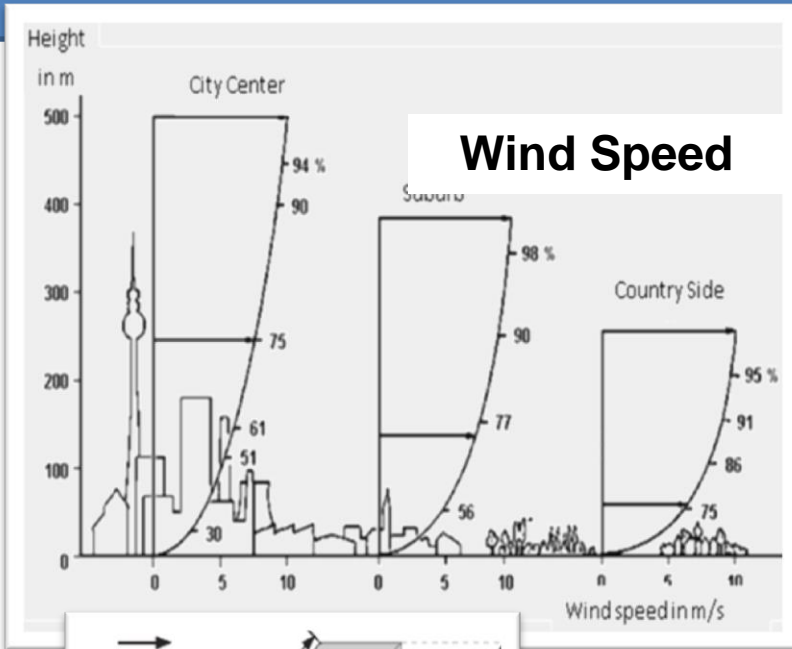
Wind Energy Business – Physics of Wind

Surprising Result for a simple Experiment

Item		measured	normalized ¹⁾	Literature
	Ball/Sphere	1.96	0.46	0.45 ... 0.5
	Egg Shape	1.59	0.37	0.3 ... 0.4
	Half Sphere	5.1	1.18	1.1 ... 1.2
	Plate/Disk	4.3	1.0	1.0 ... 1.1

1) Normalized = measured value divided by 4.3

The Essence of the FEM Guidance (included in EN13000:2014)



Shape	Drag Coefficient C_w
	1,1 to 2,0
	0,3 to 0,4
	0,6 to 1,0
	0,05 to 0,1
	approx. 1,6

Drag Factor

Standards assume sail area as 1m^2 per 1t of load * C_w of 1.2 (C_w max is 2.4)



EN13000:2014 – amended Version

EUROPEAN STANDARD

EN 13000:2010+A1

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2014

ICS 53.020.20

Supersedes EN 13000:2010

EN13000:2014 = EN13000:2010 PLUS

- **More information on Wind acting on Load and Crane.**
- **Introducing Outrigger Monitoring as „Operator’s Aid“**

Appareils d

This Europe
Amendment

CEN memb
Standard th
standards m

This Europe
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status as the

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EN13000:2018+ – complete new Version

EUROPEAN STANDARD

EN 13000:20 XX

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN13000:2018+

- **Slewing Angle Related Capacities**
- **Sideways Tipping Angle**
- **Design requirements Work@Height (FEM 5.022)**
- **External Warnings (Light Bar; FEM 5.014)**
- **More Information on Inspection (FEM 5.020)**
- **Information related to Travel On-Site**

Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



Innovation – Unleashing Capacities

HA 13.1t 2 38
 NET (t) MAX (t) Last (t) RAD (m) MAX (m)
 10.2 13.0 10.2 19.2 -

78%

Asymmetrische Stützbasis

35.9m

57.1°

36.2m

38.6m

22t 41t
 5t 21t

57.1°

19.2m

209.7°

79

70.2

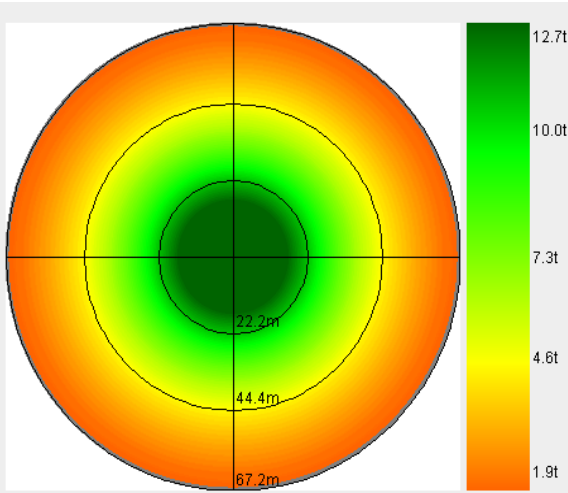
8.40

180°

90°

270°

0°



MAX (t)	RAD (m)	ANGLE (°)
12.7	16.03	61.7

79

18.7

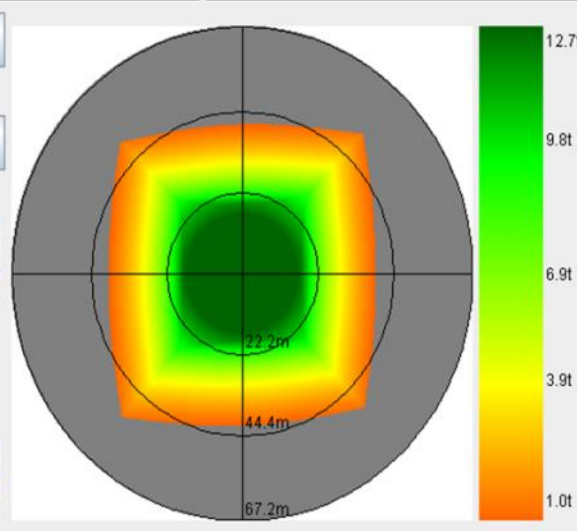
8.40

180°

90°

270°

0°



MAX (t)	RAD (m)	ANGLE (°)
9.6	25.88	43.9

79

41.1

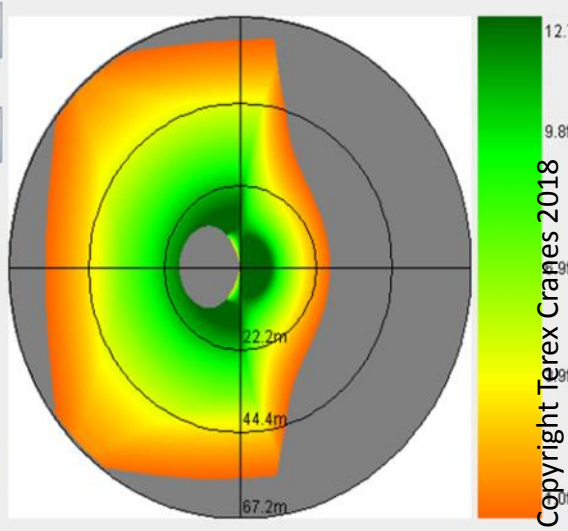
8.40

180°

90°

270°

0°



MAX (t)	RAD (m)	ANGLE (°)
3.7	50.76	42.0



Innovation – Unleashing Capacities

New in EN13000:2018+

- **Outrigger monitoring as integral part of RCL**
- **Sideways Stability requires cut-off of slewing movements**
- **Plausibility Check of Counterweight**



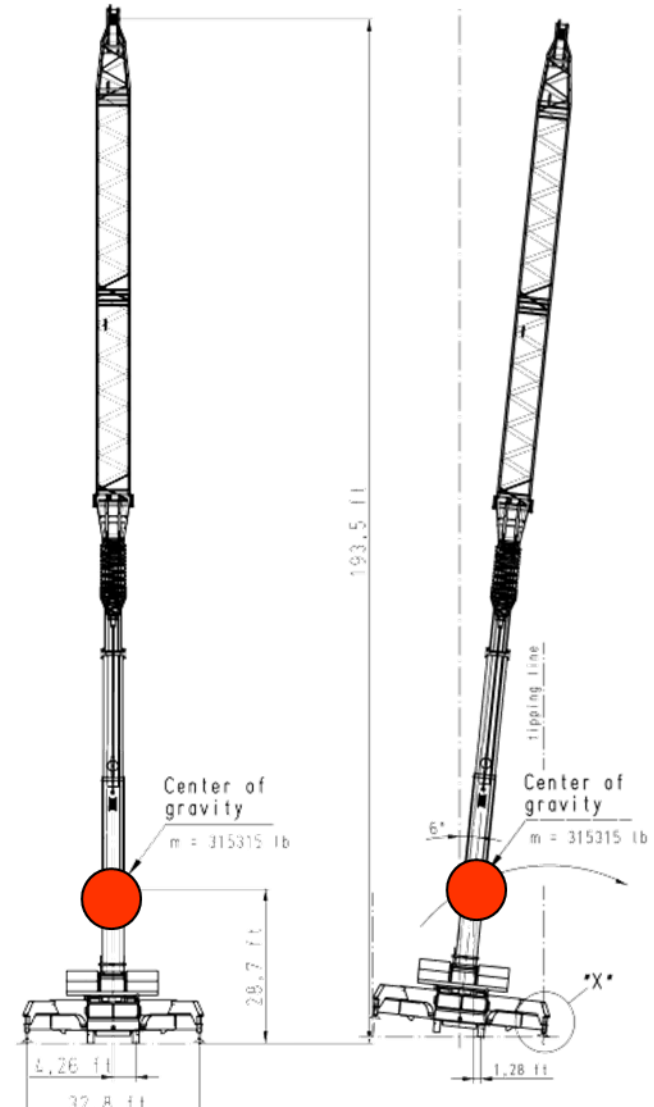
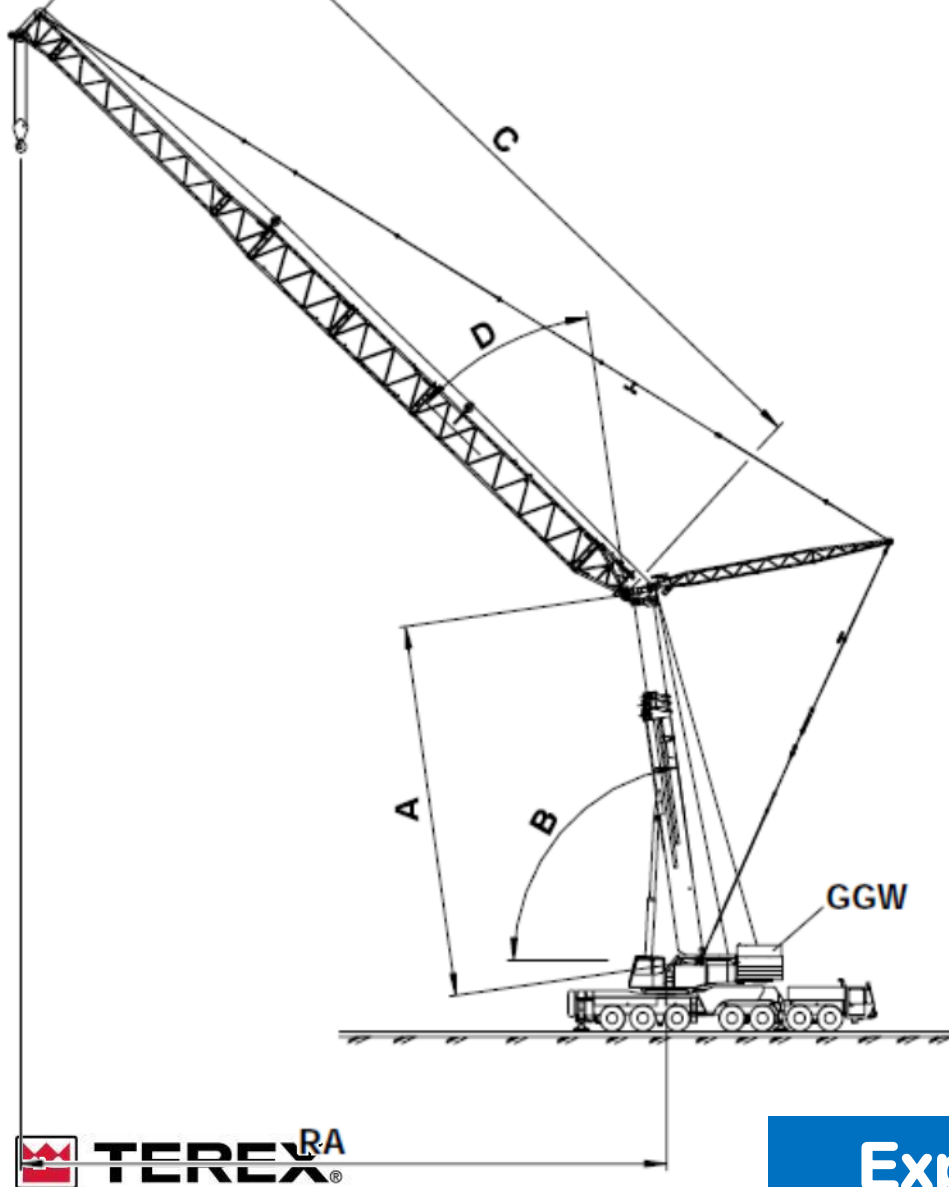
CC8800-1 w BoomBooster

Increasing sideways Stability leads to significant Capacity Increase

Experiment – Stiffness & Tipping Angle



! Travel On-Site (partially erected crane)



Experiment - CoG at Height

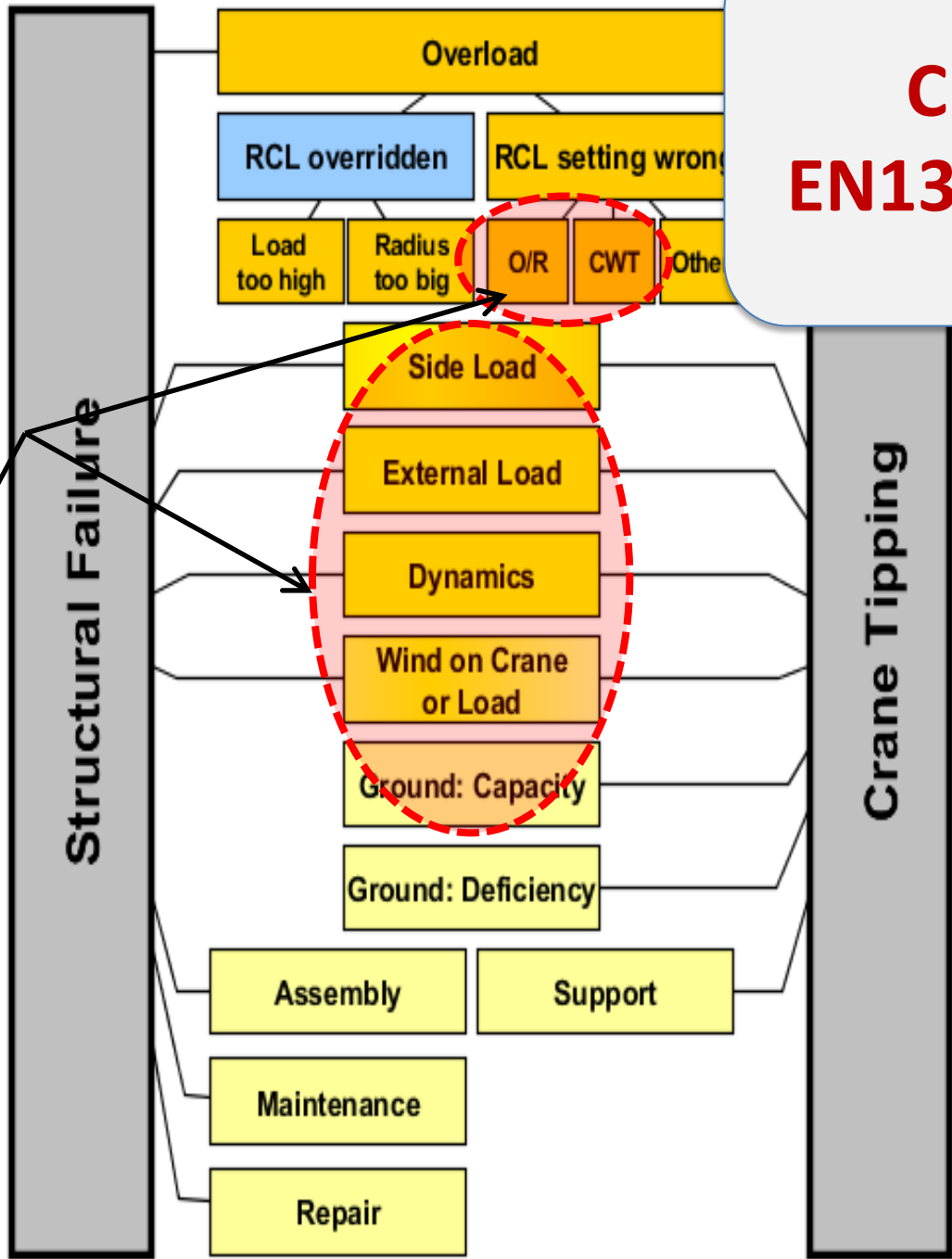
! Travel On-Site (partially erected crane)



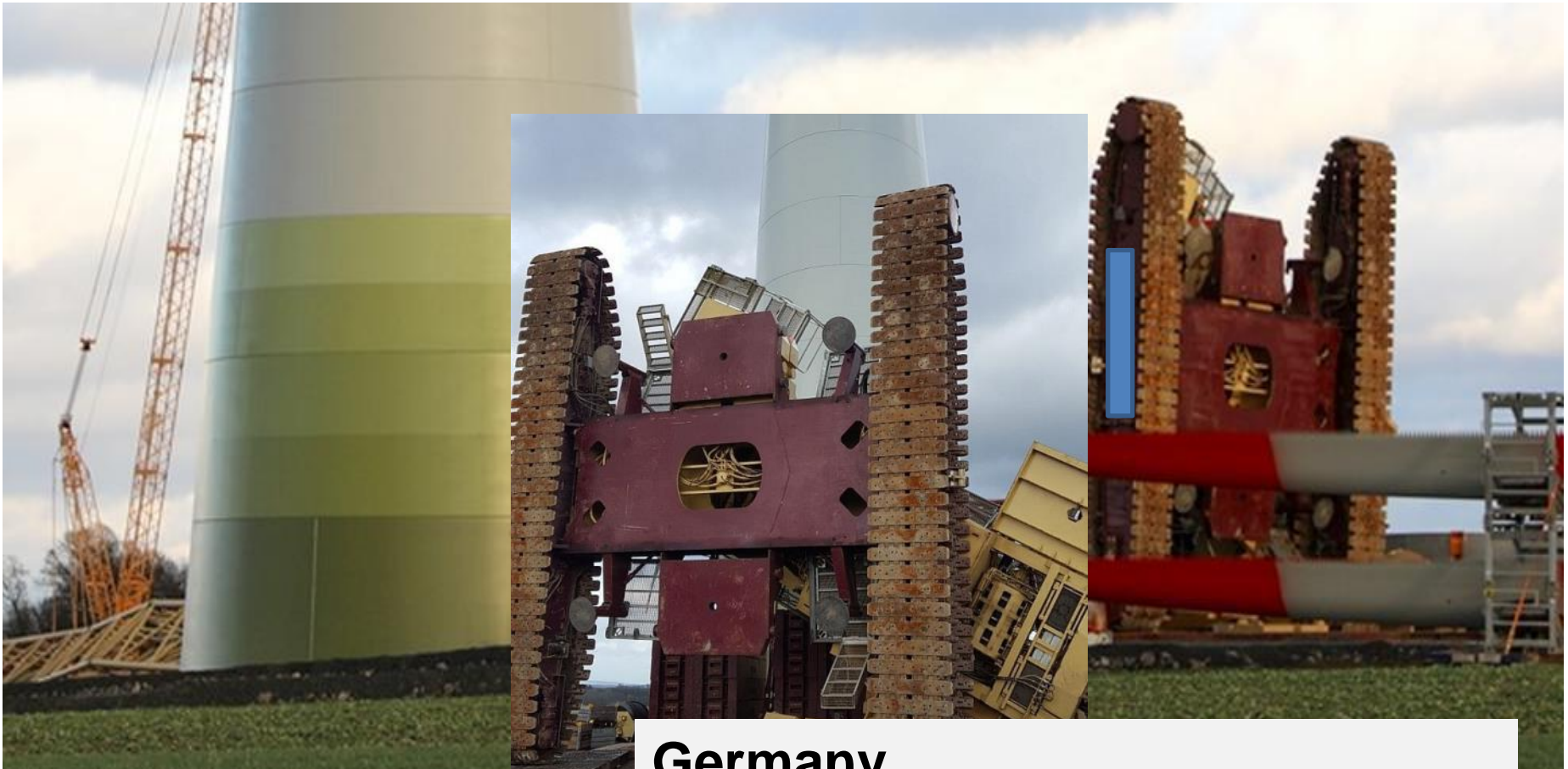
Changes EN13000:2018+

EN13000:2018+

W@H



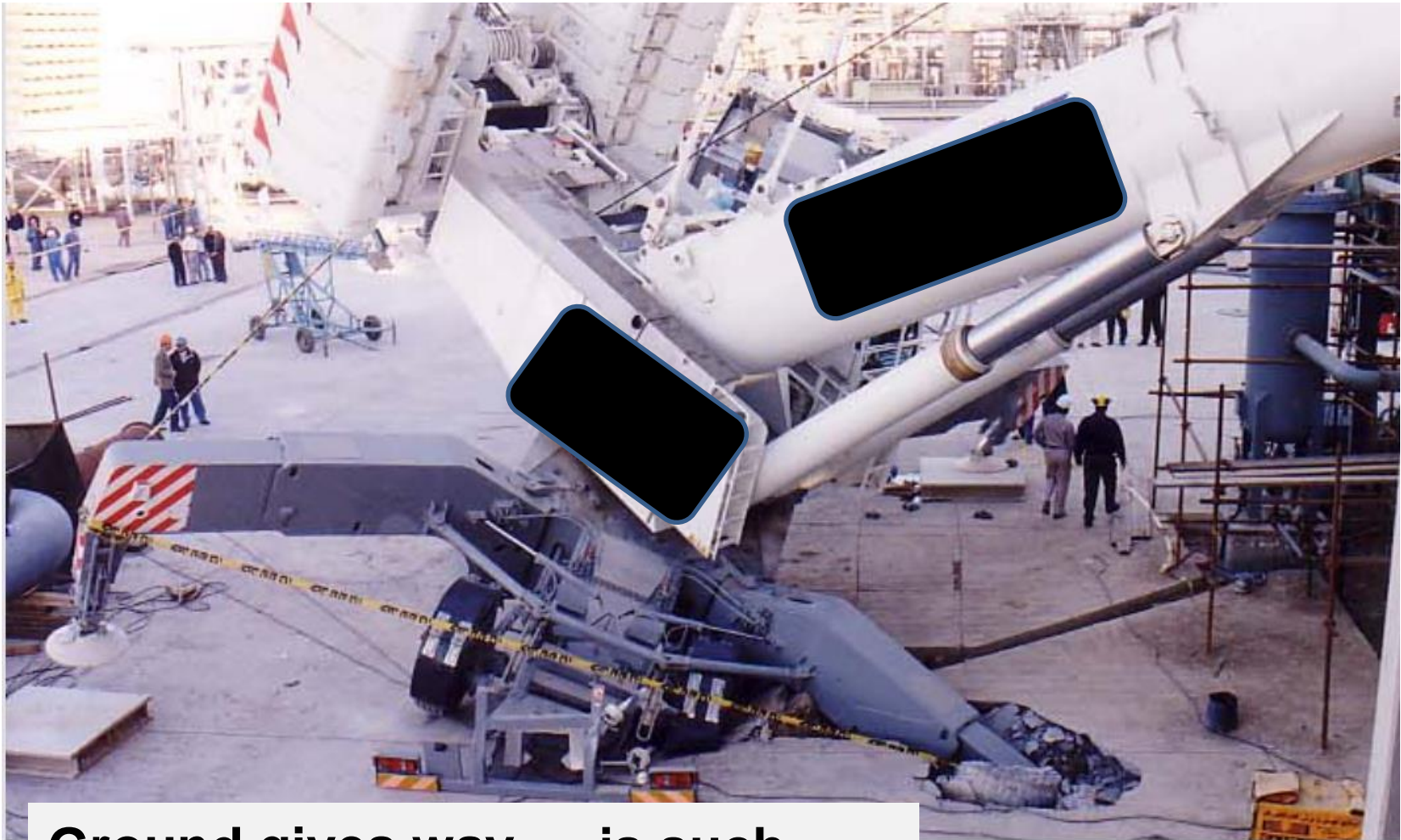
! Residual Risk – Wind out-of-Service



Germany

- Crane parked out of service,
- Storm wind from the front

! Residual Risk - Ground Conditions

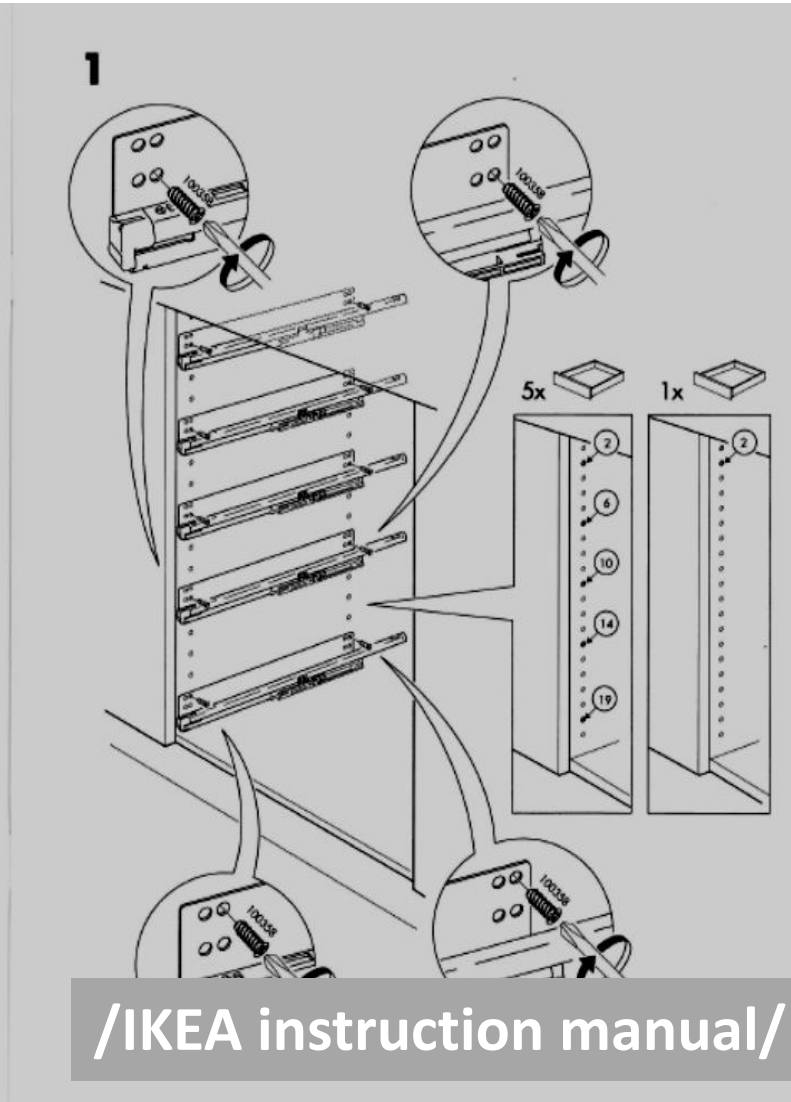
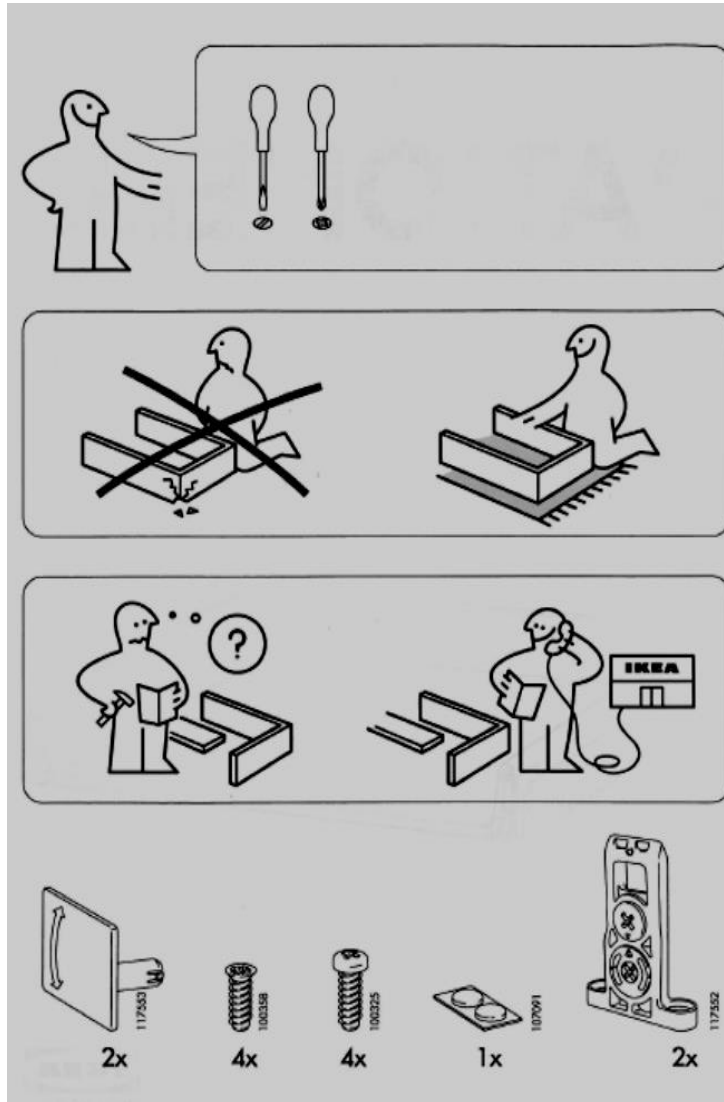


Ground gives way ... is such incident avoidable by advanced controls systems?





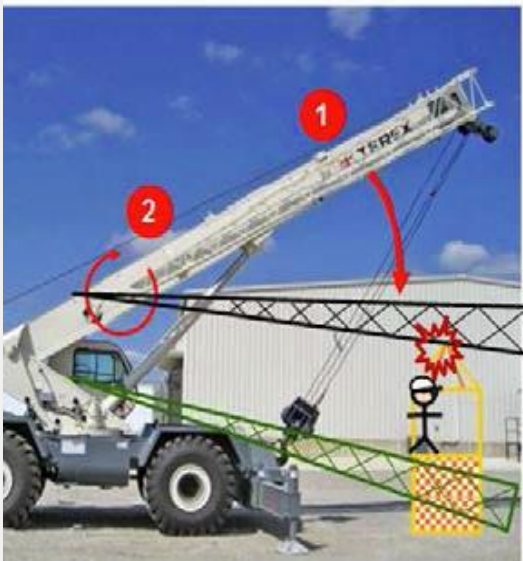
Residual Risk – Assembly Poka Yoke vs. Versatility



! Residual Risk – Lack of Inspection



d: Wednesday, 22nd May 2013
Falling Jib - Fatality



Mexico, insufficient inspection and maintenance causing 1 fatality





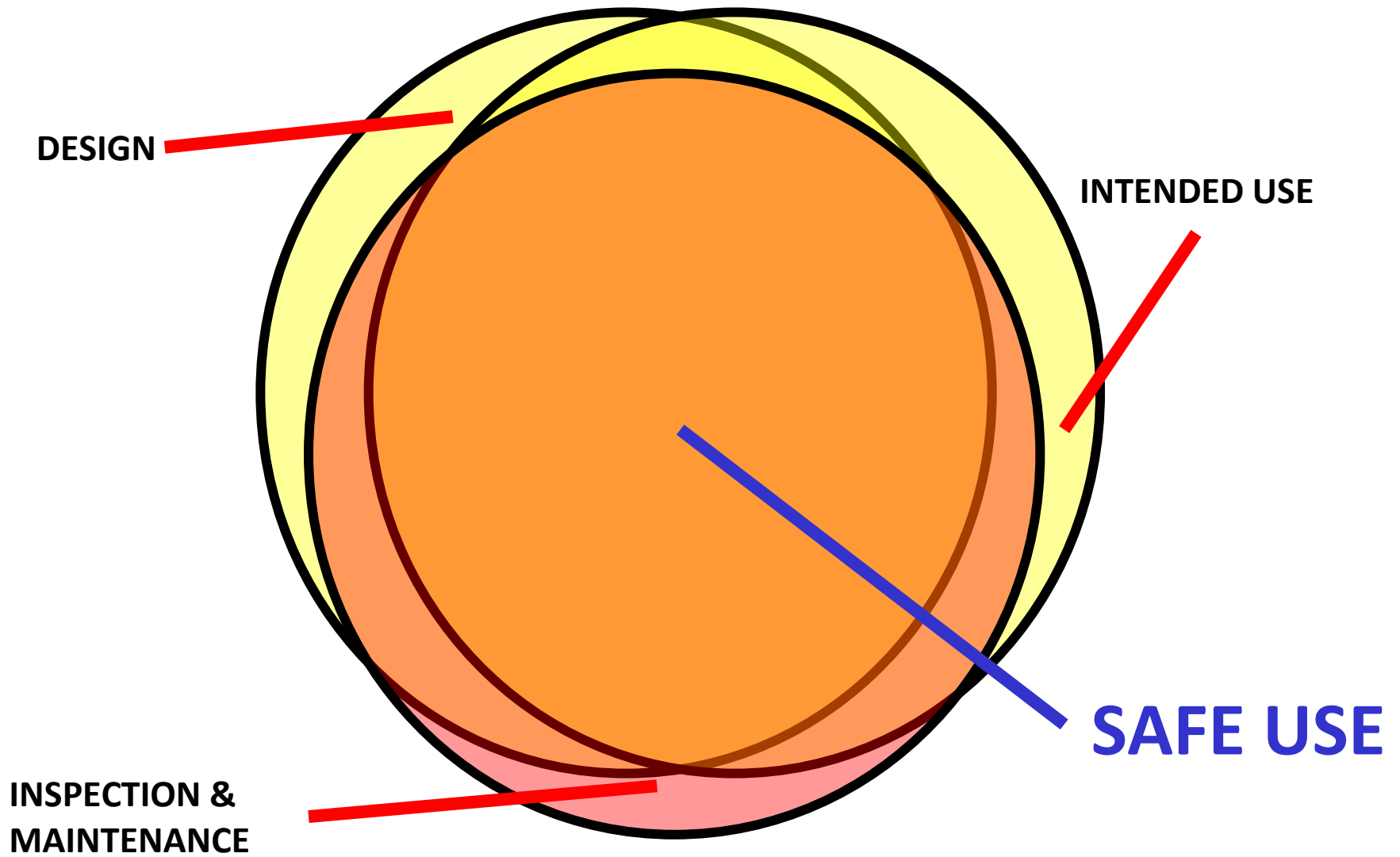
Residual Risk – Improper Repair and Maintenance



Repairing bent tube by heating up and pulling, pouring water when getting too soft... any idea what happens to the fine grain steel tube?



SAFE USE – 3 KEY ELEMENTS





Ground Pressures under Crawler

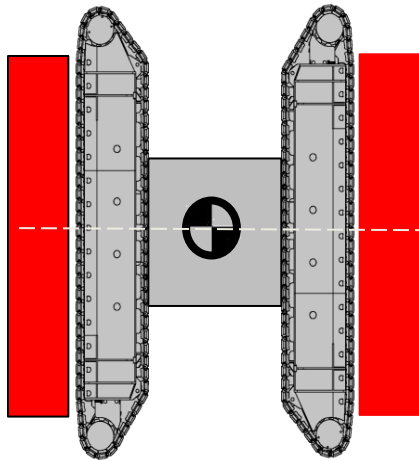


Reality beats ideal World

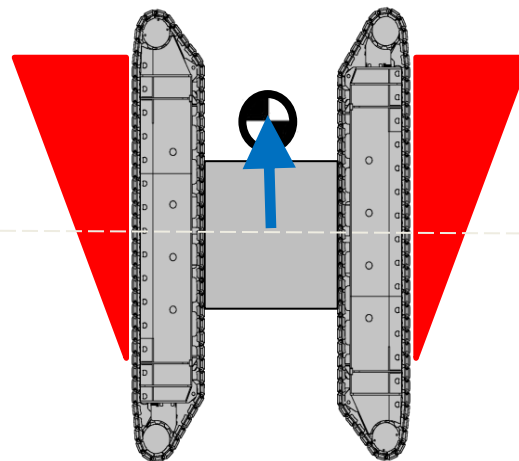


Crane Physics

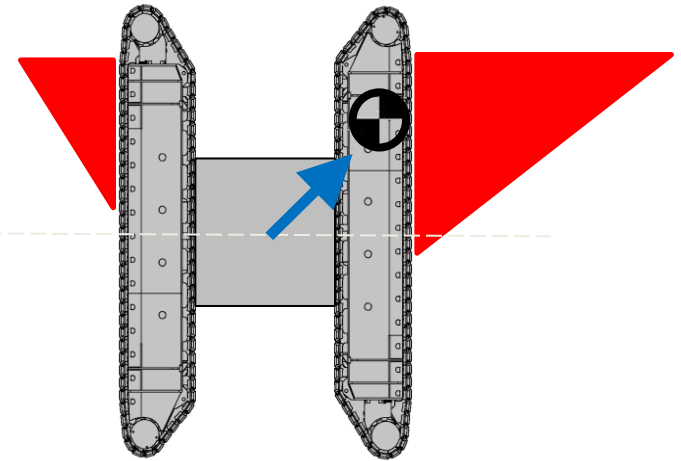
Ground Pressures



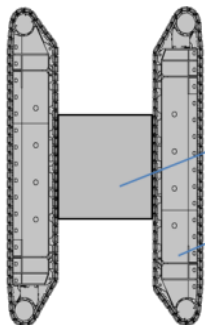
Symmetrical Loading





Symmetrical Loading to the Front



Non-Symmetrical Loading



Top View on Crawler car Body,
Crawlers turned to better indicate Shape

-  Symbol indicates Centre of Gravity
-  Symbols indicate Ground Pressure under Crawler





Crane Physics



Experiment: Shear Failure



Crane Physics



Vietnam

- Traveling on site w high load,
- Ground only partially prepared
- Ground gives way...



EN13000 - Summary

EN13000:2018+ - new technical Requirements

- **Slewing Angle Related Capacities**
 - Outrigger Monitoring integral part of RCL
 - Cut-of slewing movements (sideways tipping)
 - Plaubibility Check Counterweight
- **Sideways Tipping Angle**
- **Design requirements Work@Height (FEM 5.022)**
- **External Warnings (Light Bar; FEM 5.014)**
- **More Information on Inspection (FEM 5.020)**
- **Information related to Travel On-Site**

- **Introduction EN13849 (Safety related Parts of Controls)**
- **Calculation following EN13001**

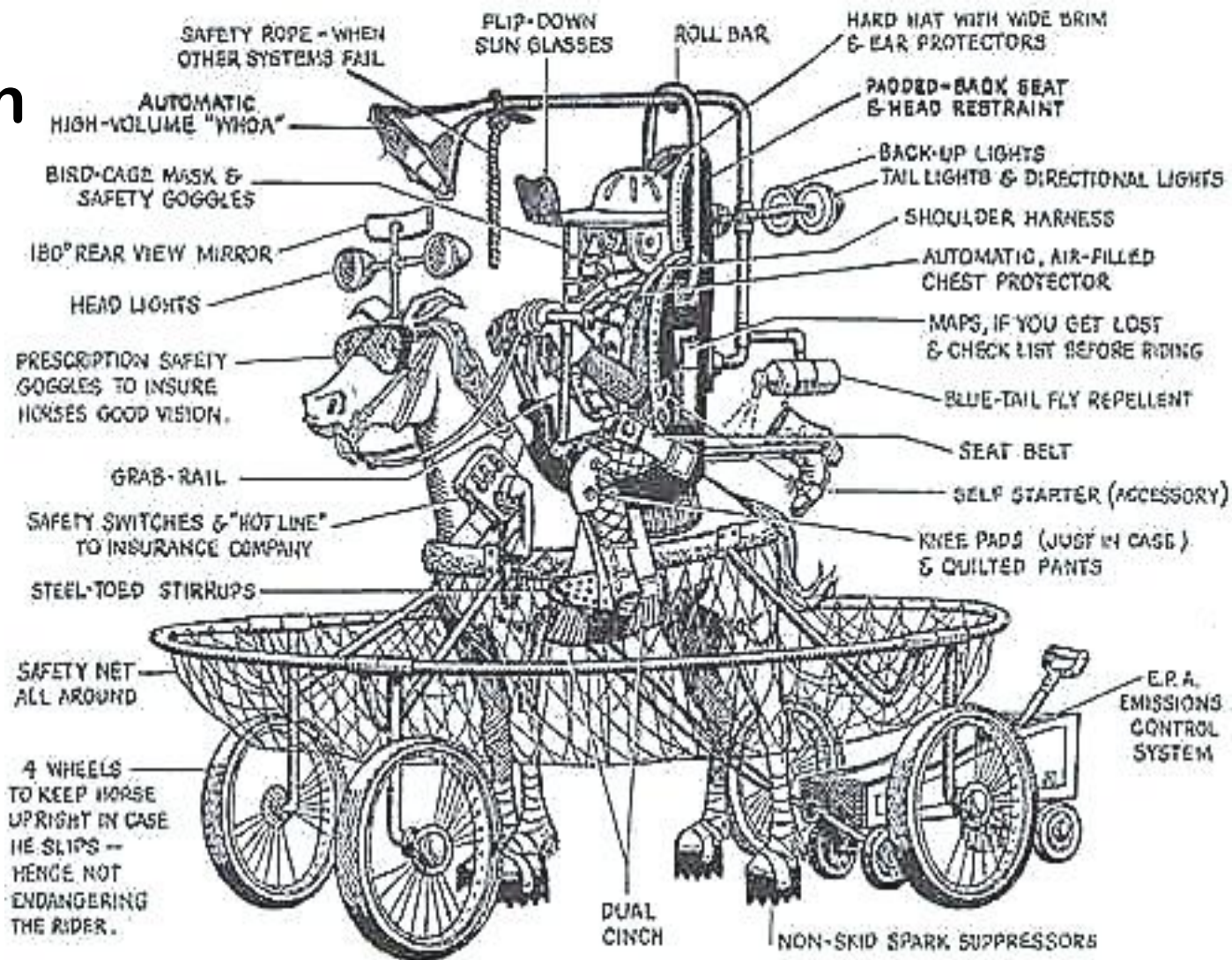


Question

More Sensors

=

higher Level of Safety?



Cowboy after O.S.H.A.



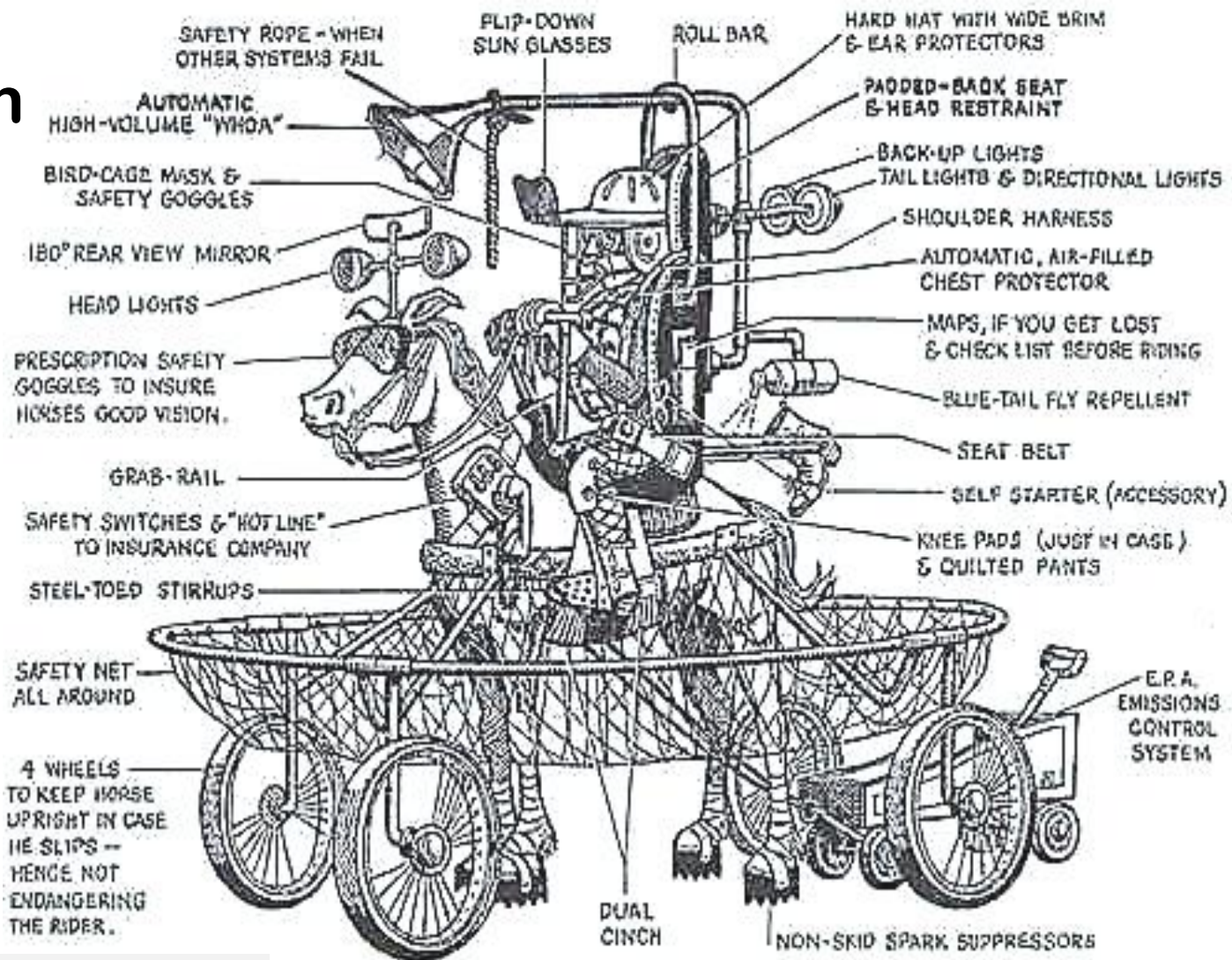
Question

More Sensors

=

higher Level of Safety?

... how much control do we want/accept?



Cowboy after O.S.H.A.

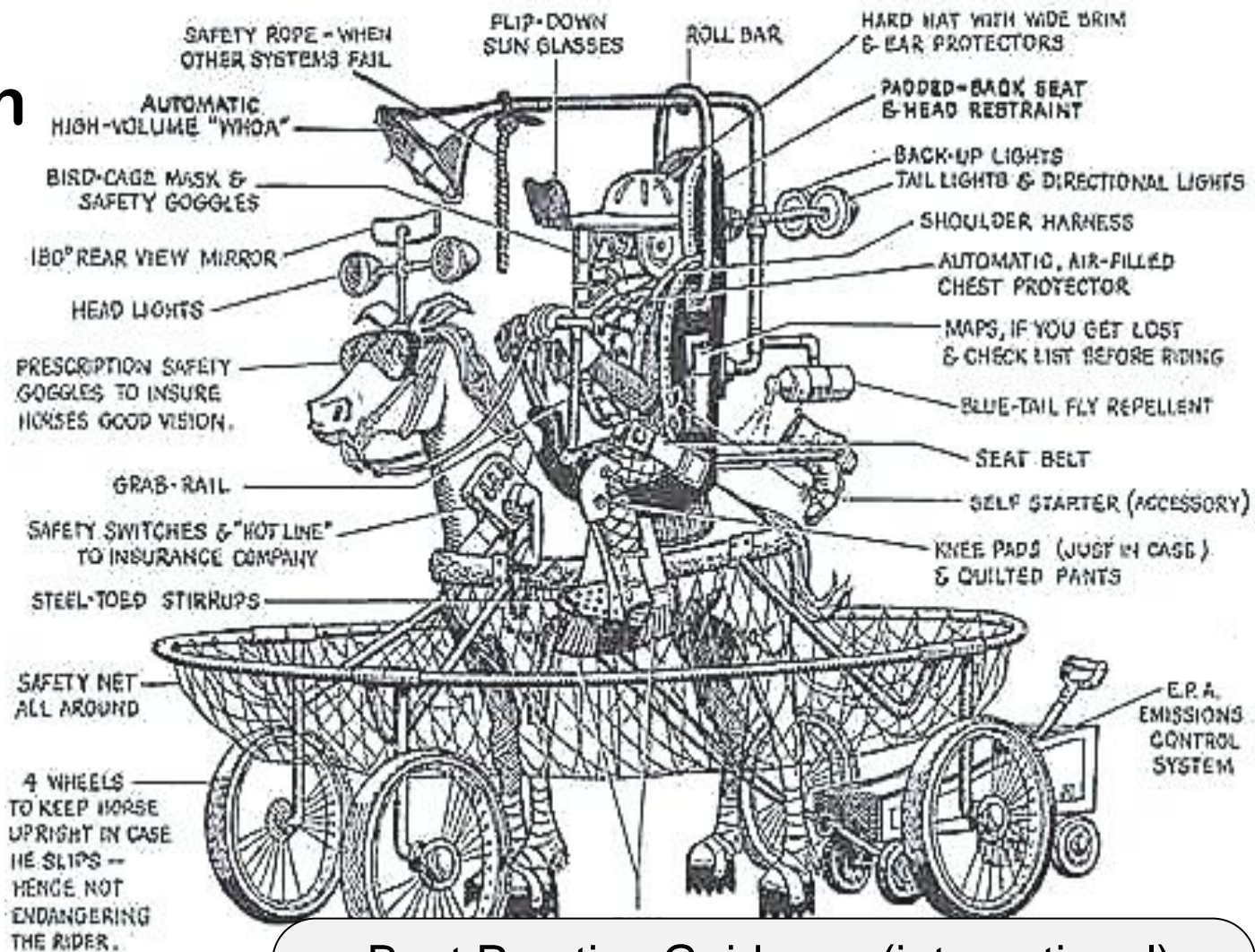


Question

More Sensors

•=

• higher Level of Safety?



... how much control do we want/accept?

- Best Practice Guidance (international)
- Safe Systems of Work
- Formalized Operator Training
- Operator Licenses (mutual Recognition)

CAUTION

THIS MACHINE

HAS NO BRAIN

USE YOUR OWN

SUPPLEMENTARY MATERIAL



DEMAG[®]
BY TEREX

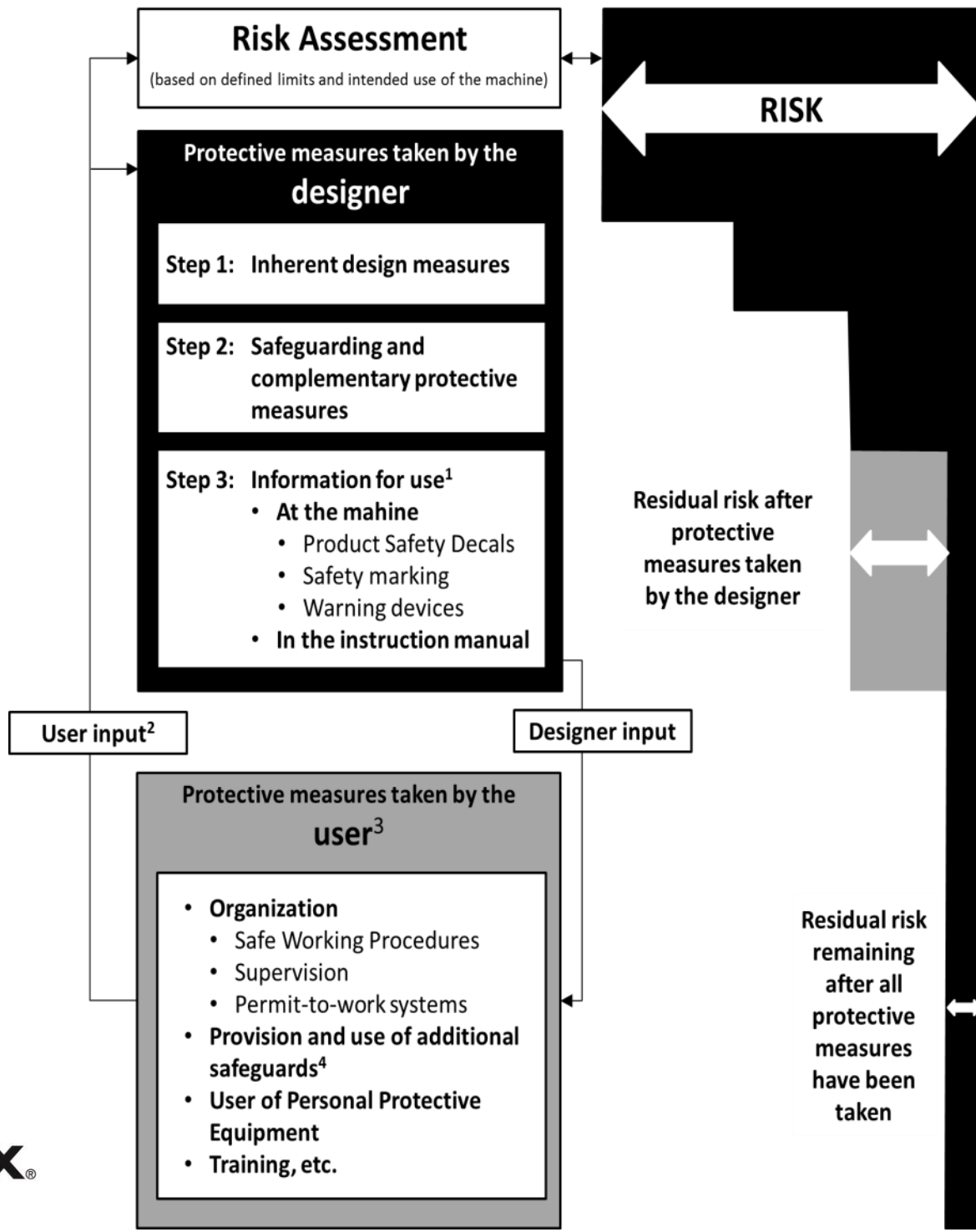




SELF INTRODUCTION, KLAUS MEISSNER



- 61 yrs old, mechanical engineer
- since 1988 in the mobile crane business (Demag)
- 1988 – 1997 Trails/Homologation, Design Slew Bearings
- 1997 – 2001 Leader Controls and Controls systems (IC1)
- 2002 – 2008 Leader R&D Terex Demag (mobile cranes) 2003 – 2006 leading R&D Terex Peiner (tower cranes)
- Since 2008 supporting engineering @ Terex Cranes worldwide re product safety, engineering systems & IPM
- Appointed expert (German BG) mobile cranes
- President FEM (EU trade association) mobile cranes
- Convenor EN13000 (EU safety standard mobile cranes)
- klaus.meissner@terex.com



Collaboration for our Industry



Topic	Status
EU framework directive for homologation of Mobile Cranes as SPV	EC Dir.
Noise of Equipment used Outdoors (FEM)	EC Dir.
EU Diesel engine emissions Stage V (FEM)	EC Dir.
UK STGO (with UK CPA)	UK reg.
FEM 5.014:2013 - External Warning signals of the Rated Capacity Limiter, speed reductions and Event Recorder for mobile cranes	published
FEM 5.016:2017 (3rd ed) - Guideline – Safety Issues in Wind Turbine Installation and Transportation (presentations WW with >4000 attendees)	published
FEM 5.020:2013 - Guideline – Hydraulic Hoses on Mobile Cranes	published
FEM 5.022:2015 - Guideline – Work at Height – Safety Measures	published
FEM 5.023:2014 - Guideline – Using Mobile Cranes for Pile Driving/Extraction	published
FEM 5.024:2017 - Guideline - Safe Use of High Performance Fibre Ropes in Mobile Crane Applications	published
ESTA FEM European Crane Operator License	Test phase
ICSA N001:2016 (2nd edition) - Guidance - Leaving mobile cranes unattended	published
ICSA N002:2016 - Guidance - Lifting A Load With Several Mobile Cranes (Multiple Crane or Tandem Lifting)	published
ICSA N003:2016 - Guidance - Lifting of Persons with Mobile Cranes	published

Collaboration, ongoing Topics

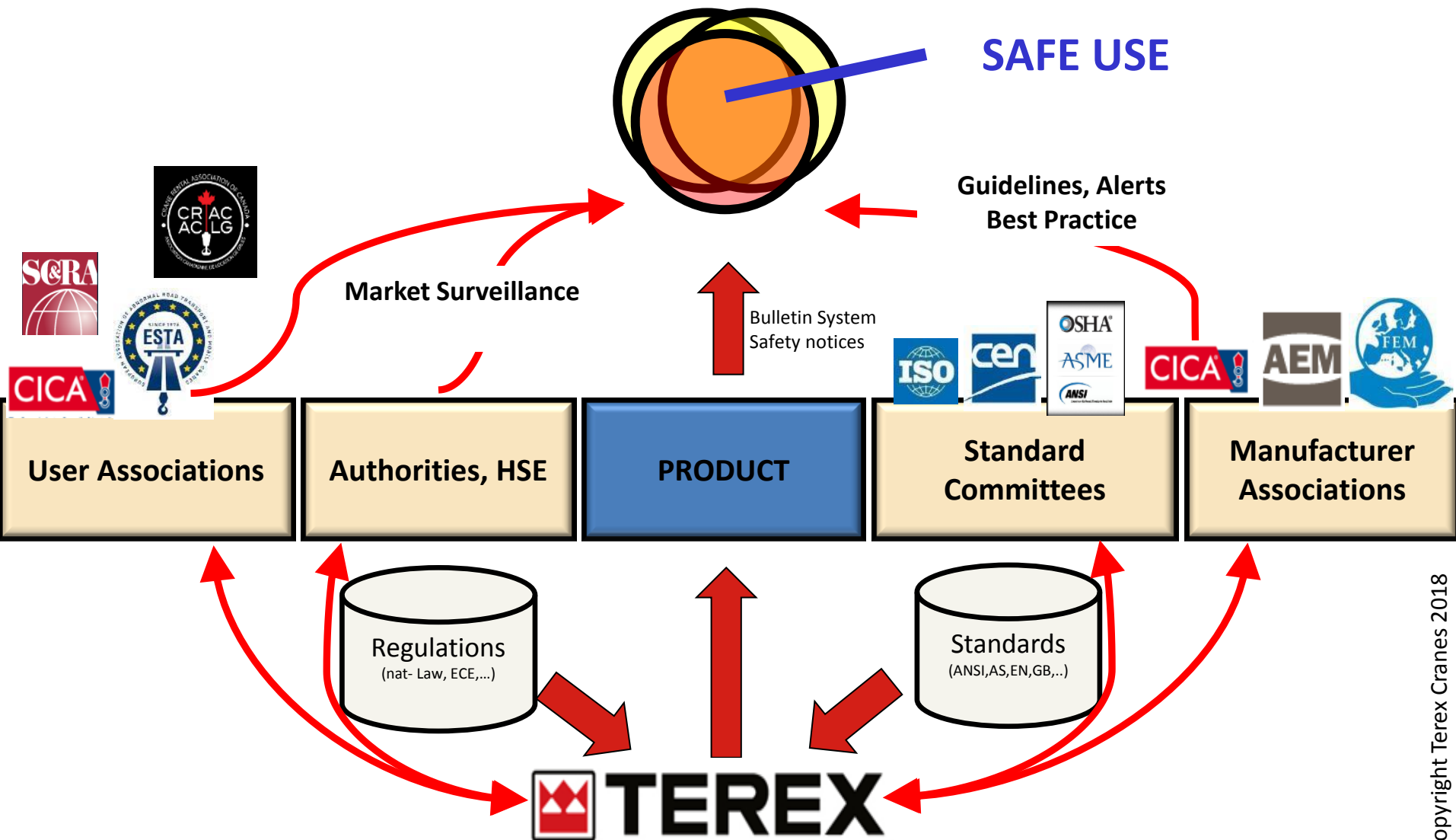


Topic	Status
EU and ECE framework directive for homologation of Mobile Cranes (transfer to ECE regulation)	ongoing
EU Noise of Equipment used Outdoors , next stage	ongoing
EU Diesel engine emissions Stage V – development of industry guidance by FEM	ongoing
EU Directive for industrial and agricultural vehicles	ongoing
VDMA wind safety culture working group – guidance for lift in wind farms (refers to FEM 5.016)	ongoing
CEN TC 147 WG11 EN13000 new version	ongoing
ISO TR on fibre ropes (based upon FEM 5.024:2017 - Guideline - Safe Use of High Performance Fibre Ropes in Mobile Crane Applications)	ongoing
ESTA FEM ECOL - European Crane Operator License, review and support after test phase	ongoing
ICSA guidance for lifting from barges	ongoing
ICSA guidance for construction roads in wind farms	ongoing
...	

FEM documents - <http://www.fem-eur.com/publications/technical-guidance/> please select mobile cranes then and you get the list

ICSA documents - <http://www.fem-eur.com/product-groups/cranes-lifting/> please scroll down - links to ICSA docs at the bottom of the page

TEREX, our NETWORK



NETWORK worldwide



International Crane Stakeholders Assembly (ICSA)

ICSA consists of several organisations representing the crane industry: Association of Equipment Manufacturers (AEM), Crane Industry Council of Australia (CICA), Crane Rental Association of Canada (CRAC), European Association of abnormal road transport and mobile cranes (ESTA), European Materials Handling Federation (FEM), Specialized Carriers & Rigging Association (SC&RA), China Construction Machinery Association (CCMA).

ICSA's mission is threefold:

- Facilitate information sharing and meaningful dialogue between crane industry stakeholders on safety, technical and regulatory issues of concern to the international crane industry.
- Provide an environment for, and encourage the creation of, significant networking opportunities between industry stakeholders and promote consensus positions on behalf of the crane industry on issues of common concern, so that ICSA members can make representation to relevant regulatory and/or standardisation bodies.
- Promote the harmonization of international standards.

