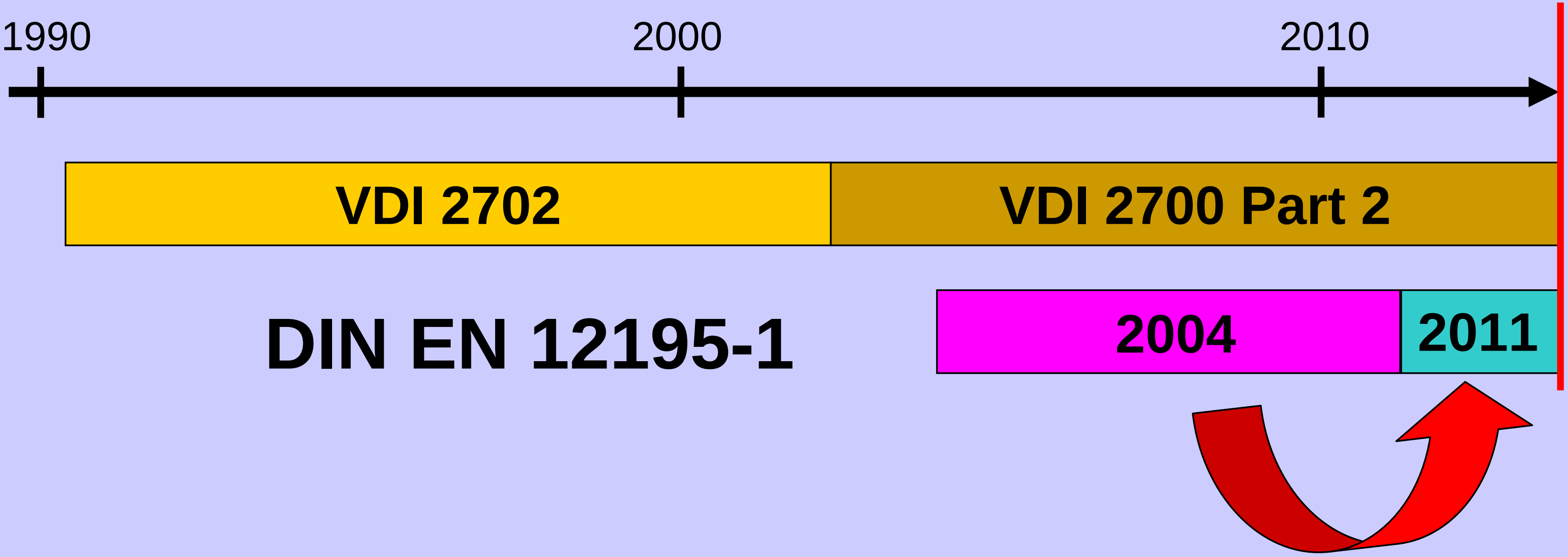
Securing of Cargo on the Roads – The Facts

Calculation and Assessment

Structure of the presentation:

- Regulations and points of concern
- Assessment of direct lashing
- Securing effect of tie-down lashing
- Comparison of calculation models for tie-down lashing
- Summary

German and European Regulations



Discussion

Points of Discussion DIN EN 12195-1
2004 Versus 2011

k factor

Coefficient of static or dynamic friction

Rolling factor

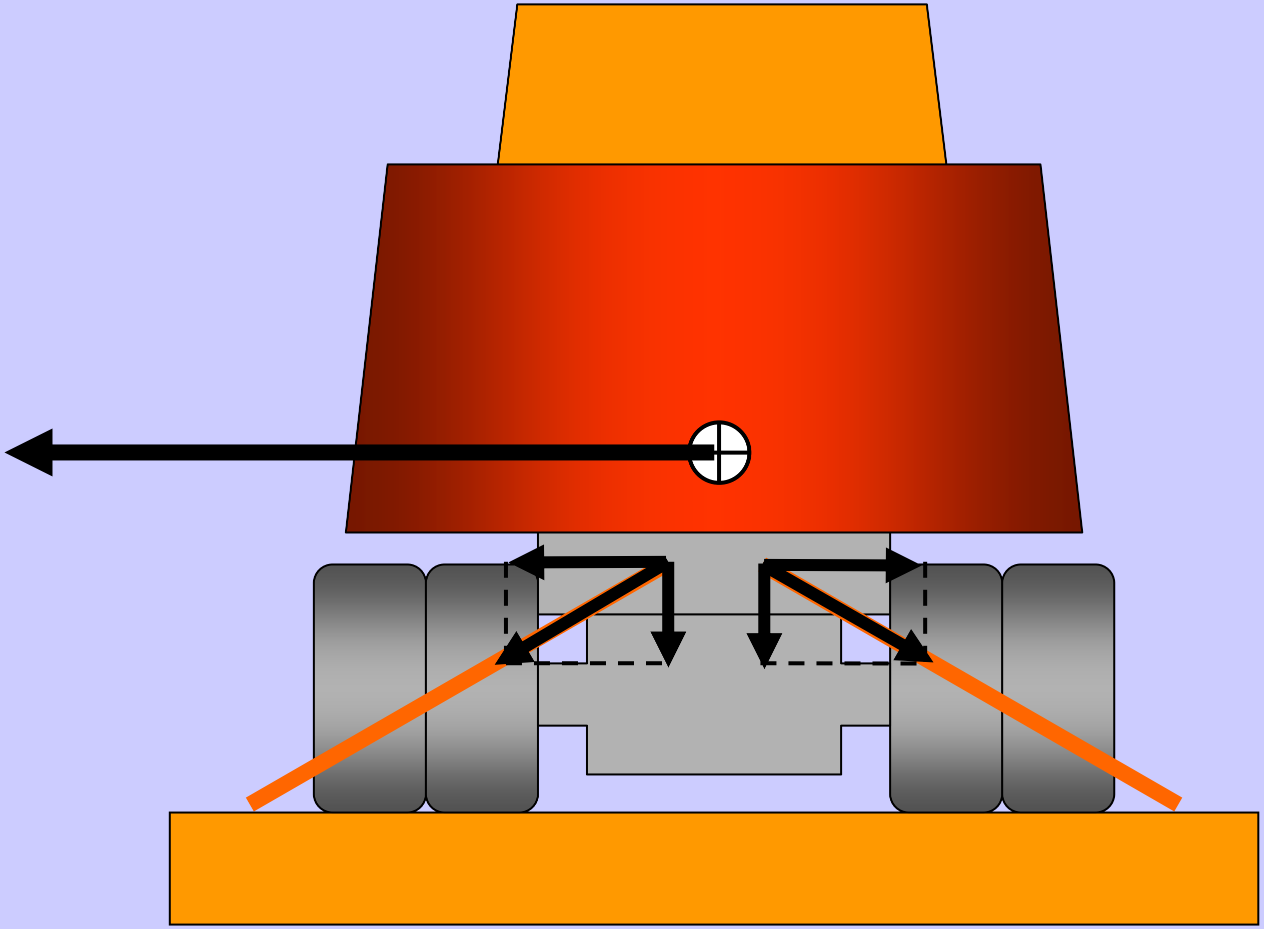
Static tilt test / dynamic test

Acceleration coefficient forward

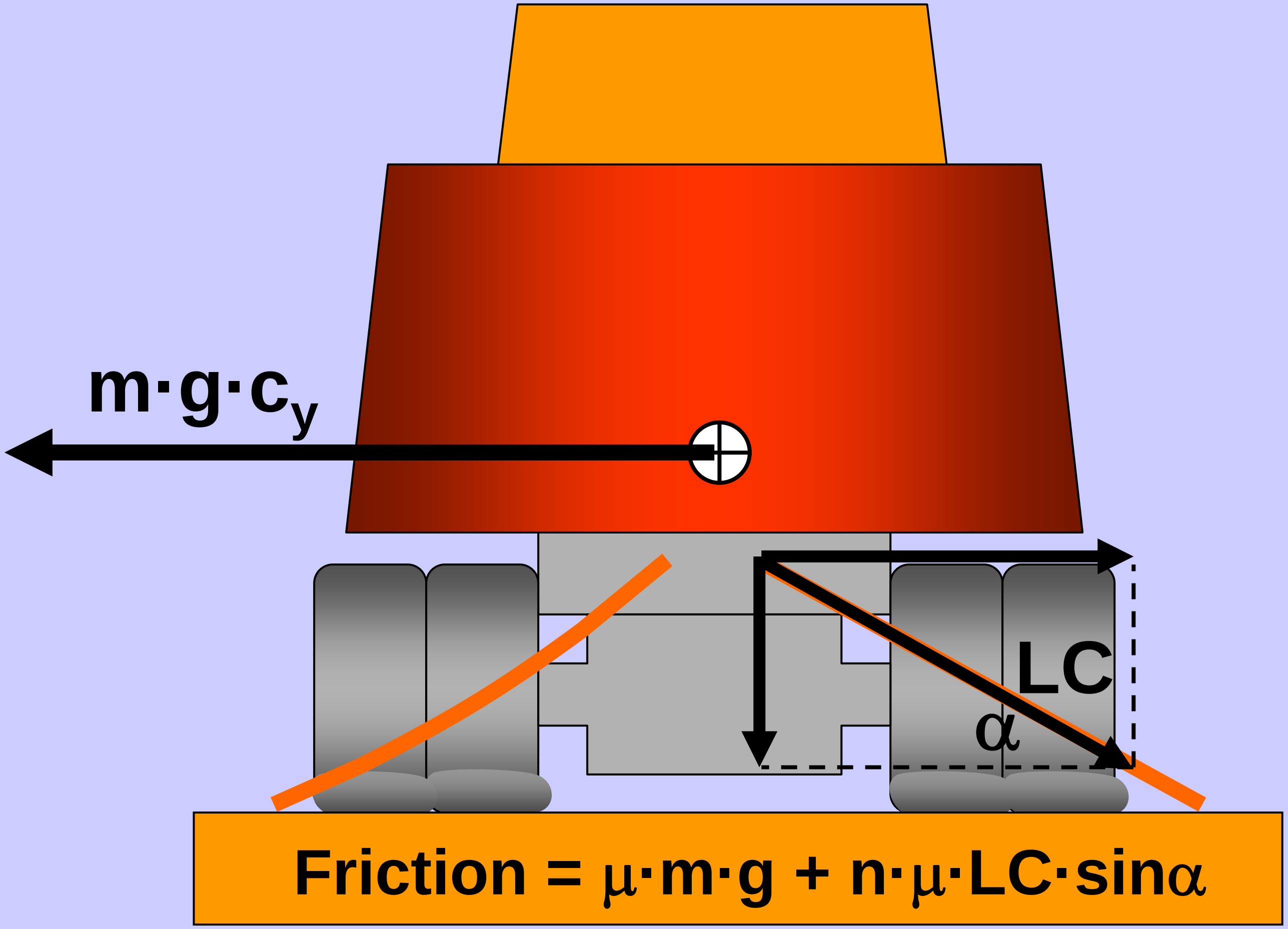
Securing Effect of Direct Lashing

Source: W. Strauch

Securing Effect of Direct Lashing

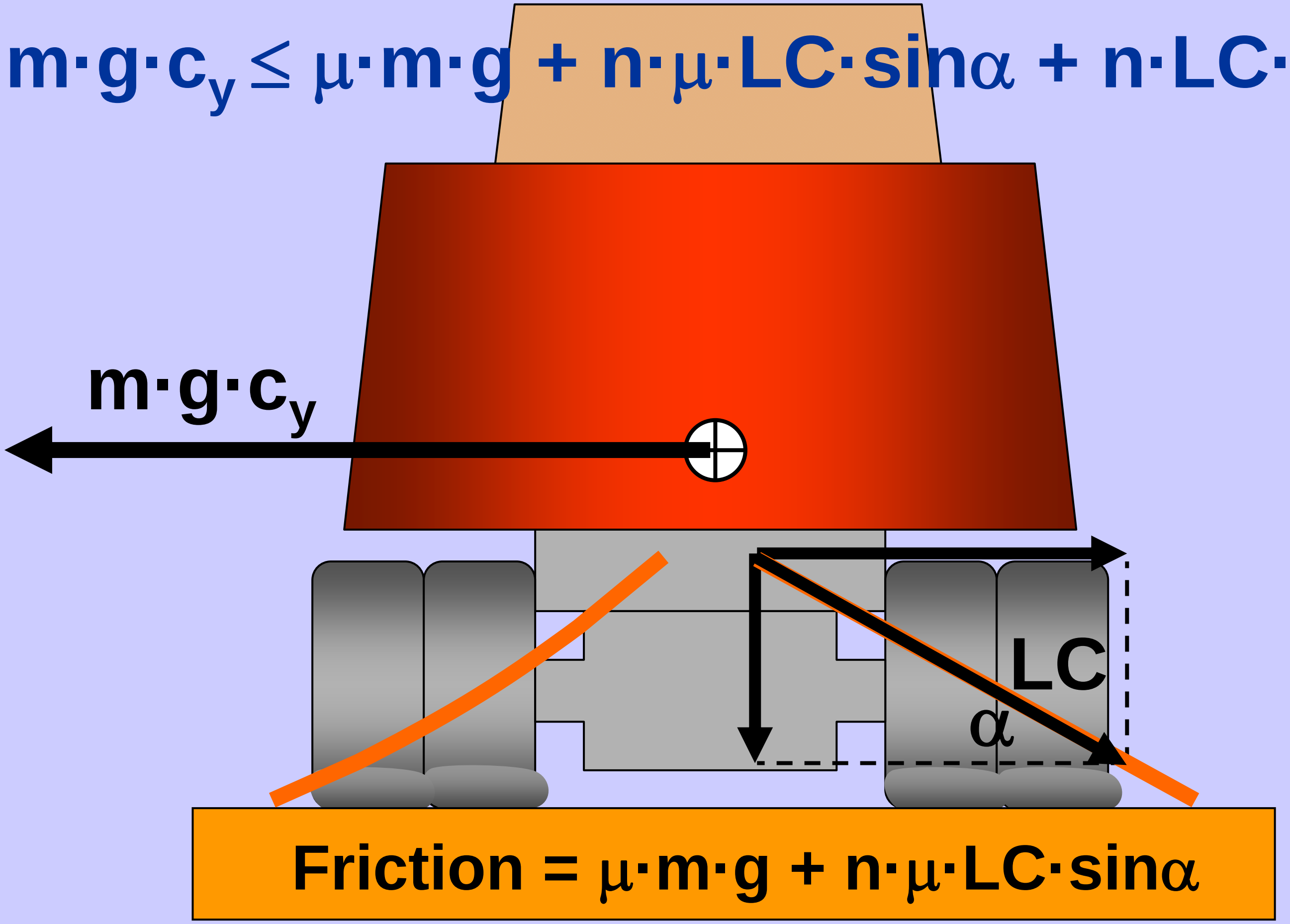


Securing Effect of Direct Lashing



Securing Effect of Direct Lashing

$$m \cdot g \cdot c_y \leq \mu \cdot m \cdot g + n \cdot \mu \cdot LC \cdot \sin\alpha + n \cdot LC \cdot \cos\alpha$$



Which Movement of the Cargo is Necessary?

Inclined traverse lashing only:

using chains: Δy = 1.4 cm

using webbing restraint assemblies: Δy = 3.6 cm

Traditional diagonal lashing:

using chains: Δy = 3...8 cm

using webbing restraint assemblies: Δy = 9...21 cm

Conclusion: Without any cargo movement or deformation no direct lashing is possible !

Tie-Down Lashing

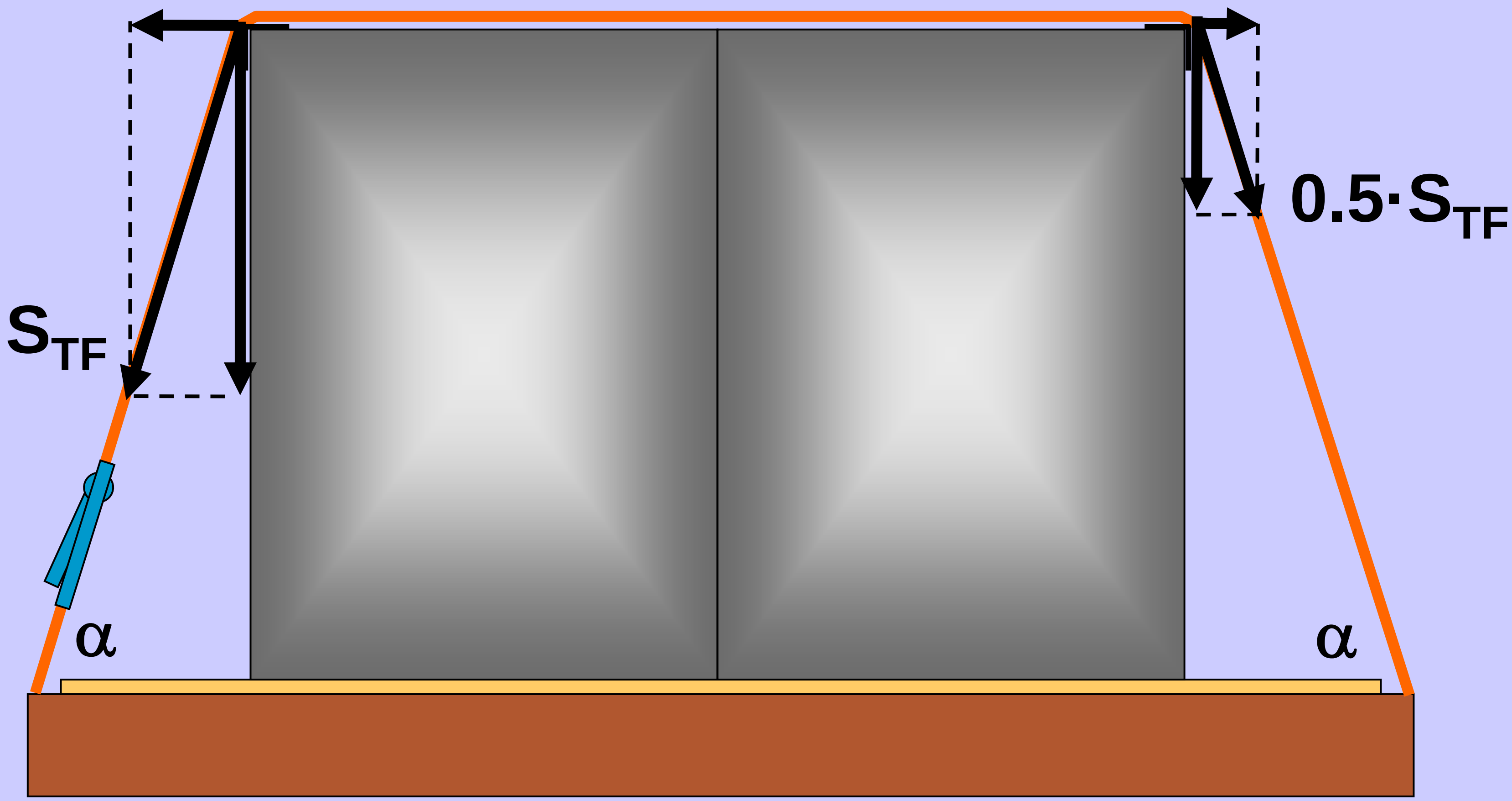
Tie-Down Lashing

Source: W. Strauch

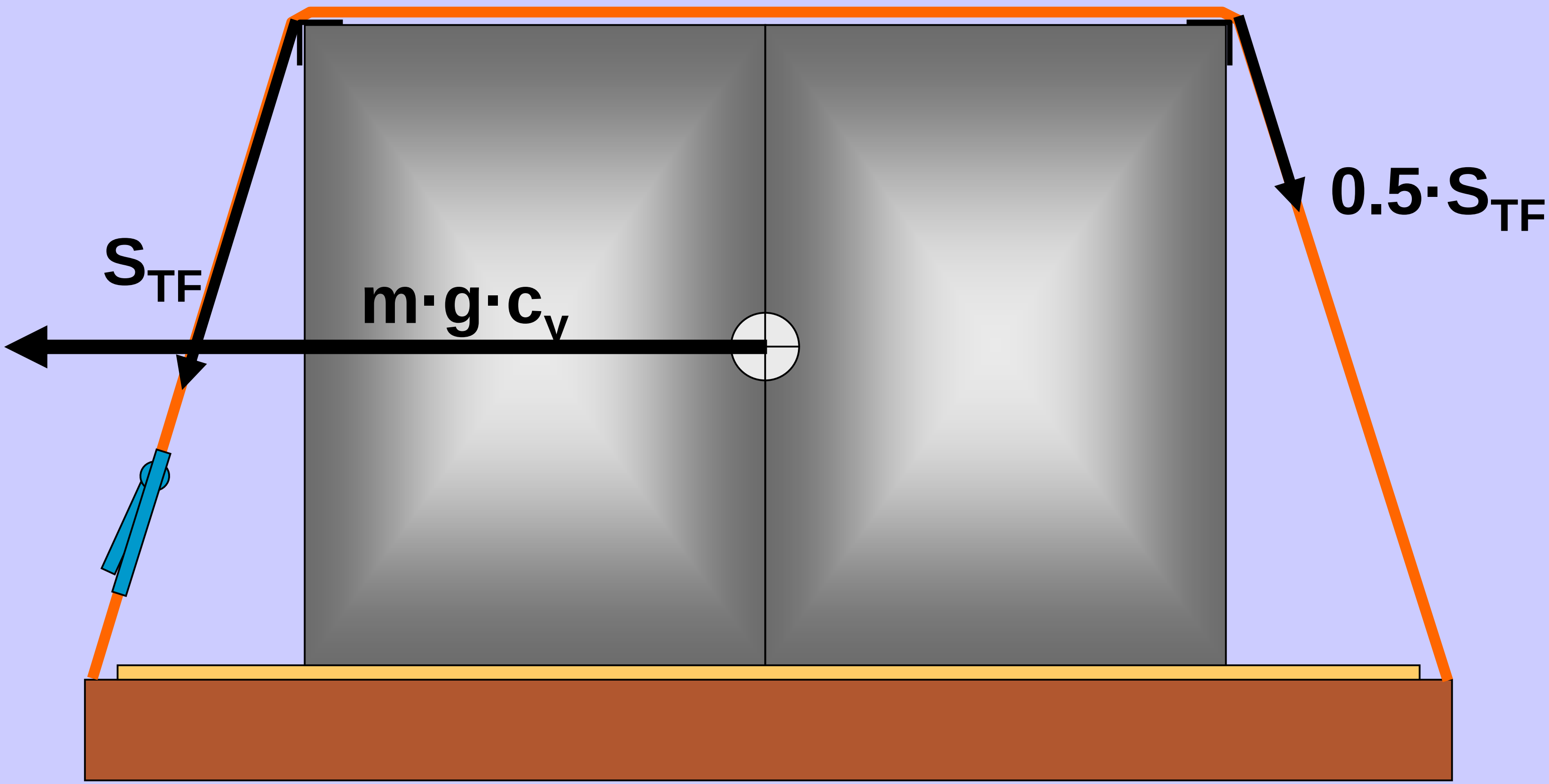
Tie-Down Lashing

Securing Effect of Tie-Down Lashing

traditional: $SW = k \cdot \mu \cdot S_{TF} \cdot \sin\alpha$ using k = 1.5



What Does Really Happen When Driving in an Extreme Curve?



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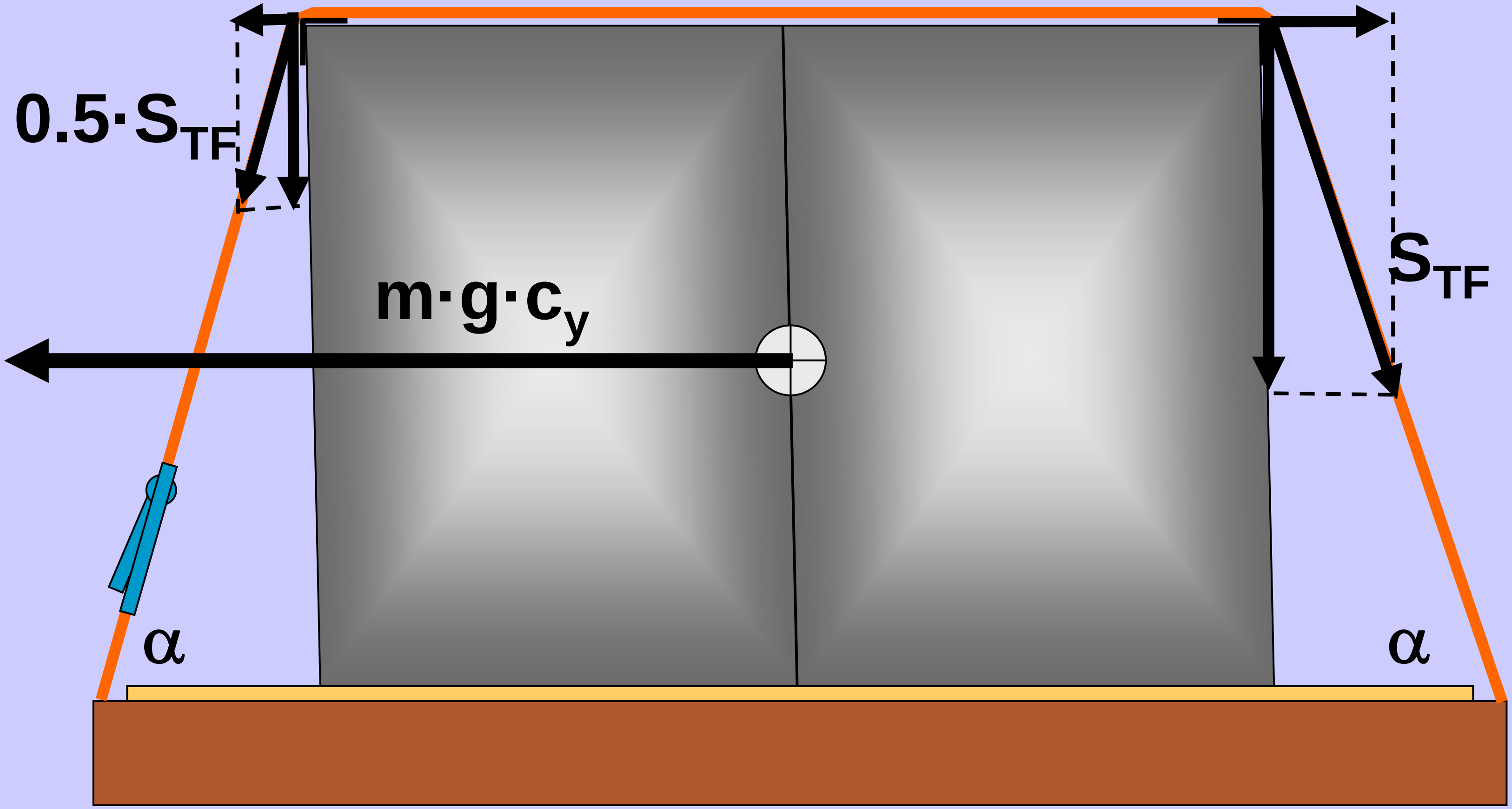
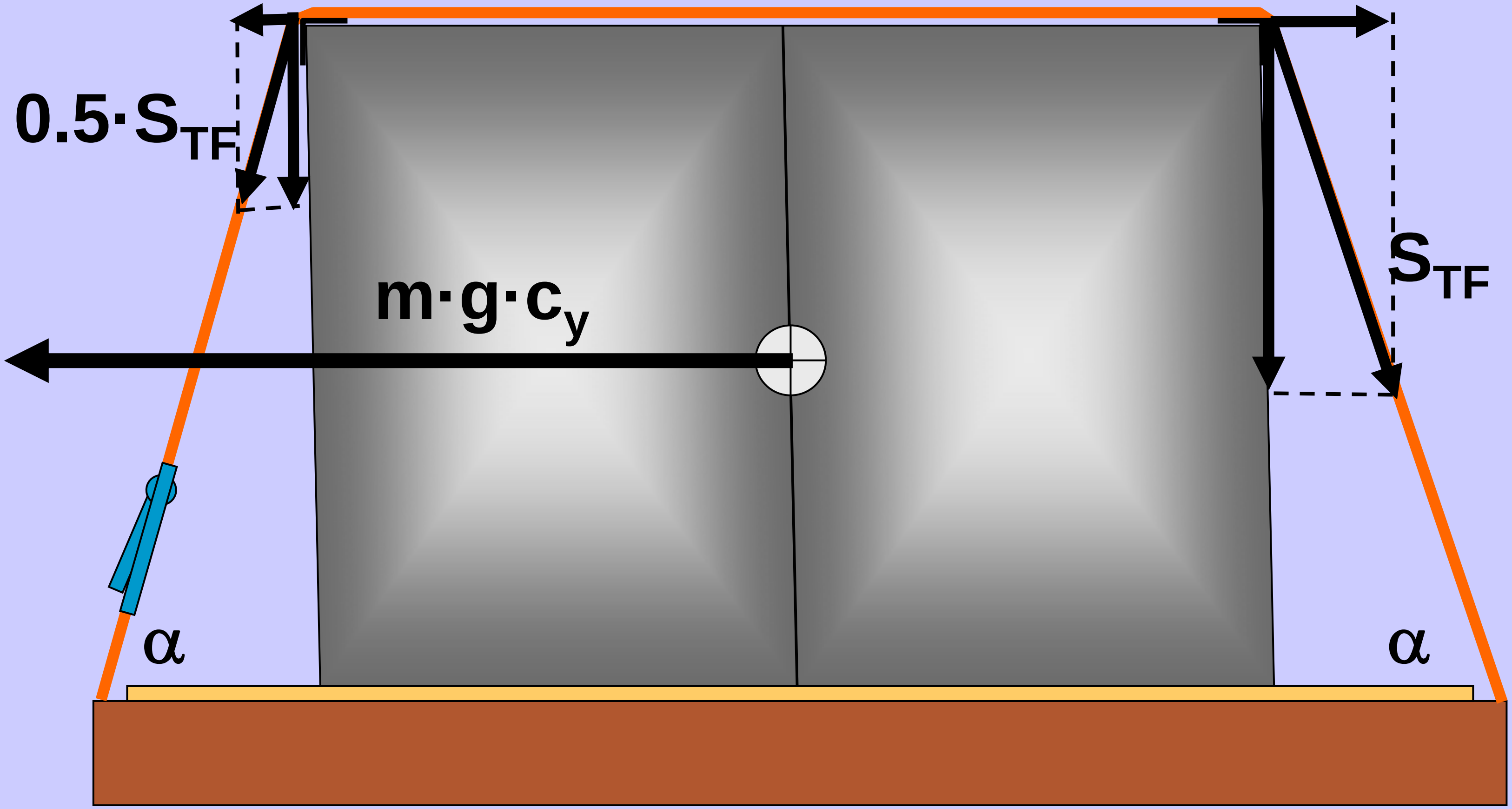


Securing Effect of Tie-Down Lashing

$$SW = 1.5 \cdot \mu \cdot S_{TF} \cdot \sin\alpha + 0.5 \cdot S_{TF} \cdot \cos\alpha$$

simplified: $SW = 1.8 \cdot \mu \cdot S_{TF} \cdot \sin\alpha$



Findings

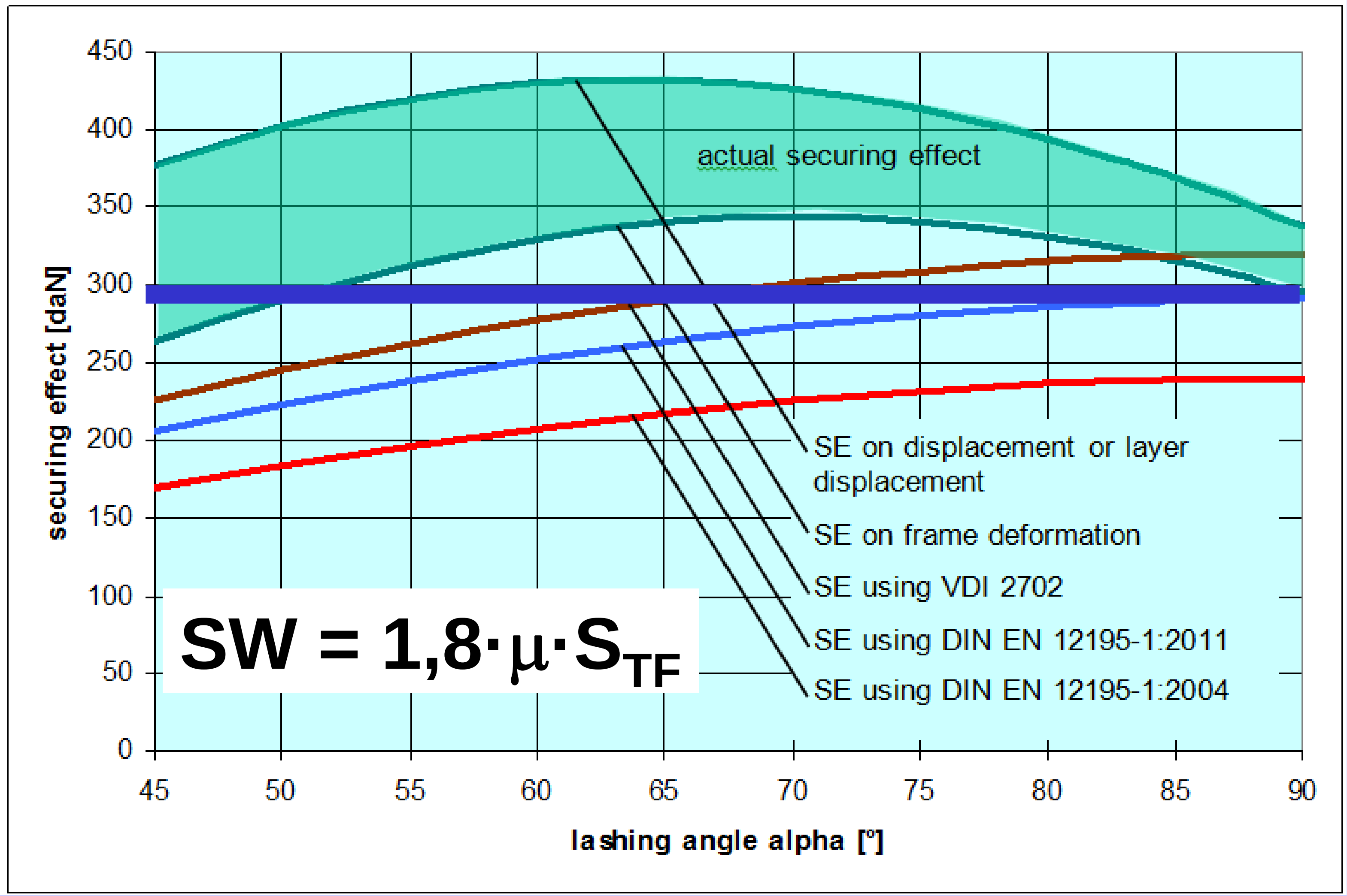
The k-factor can be widely neglected due to existing lateral force components.

Here, the necessary shifting of the cargo is only a fractional amount of the shifting necessary if secured by direct lashing.

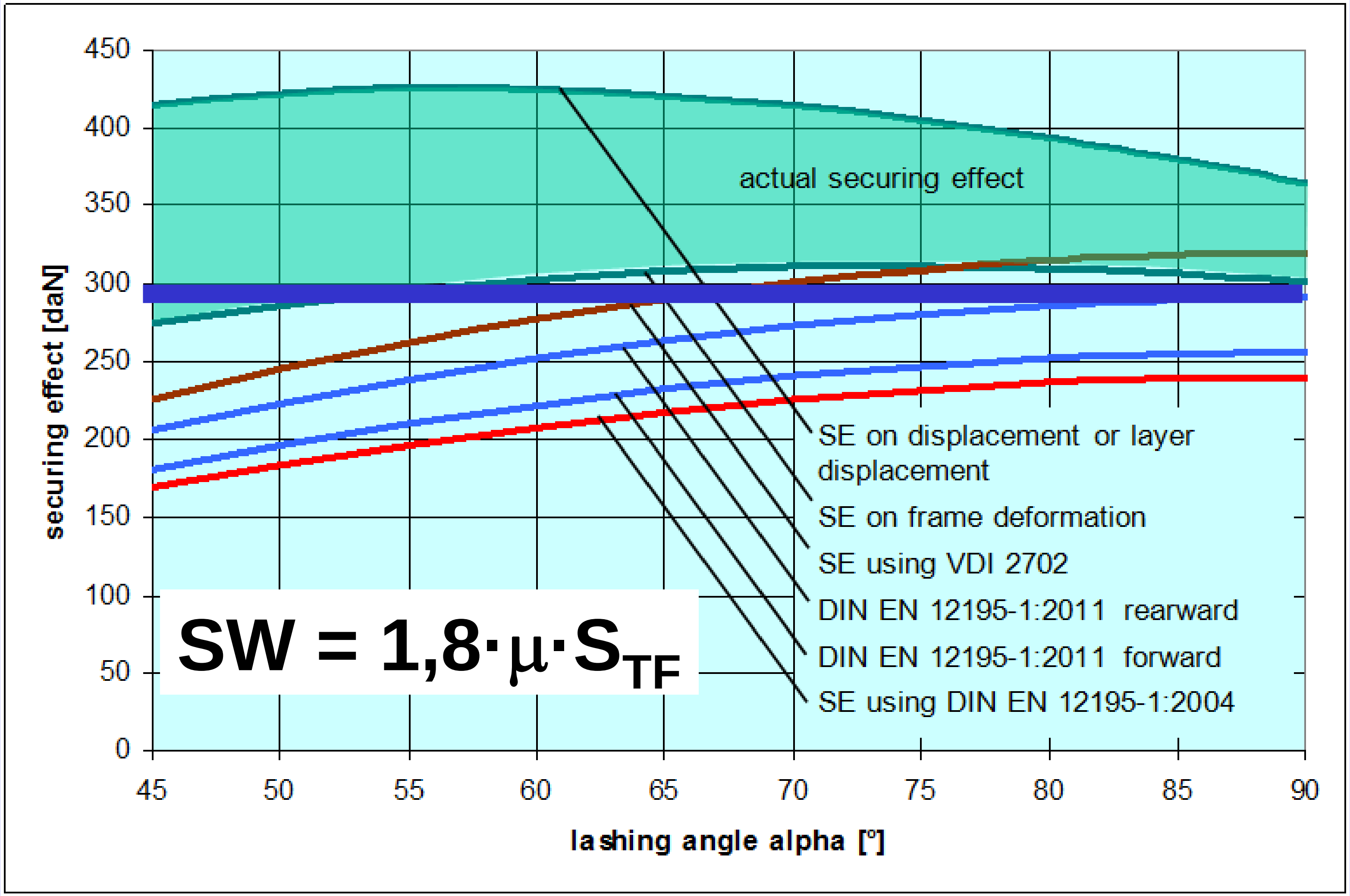
Even with the lashing angle = 90° the lateral force components are sufficient.

As well for the securing in longitudinal direction it is not necessary to consider the full amount of the k-factor.

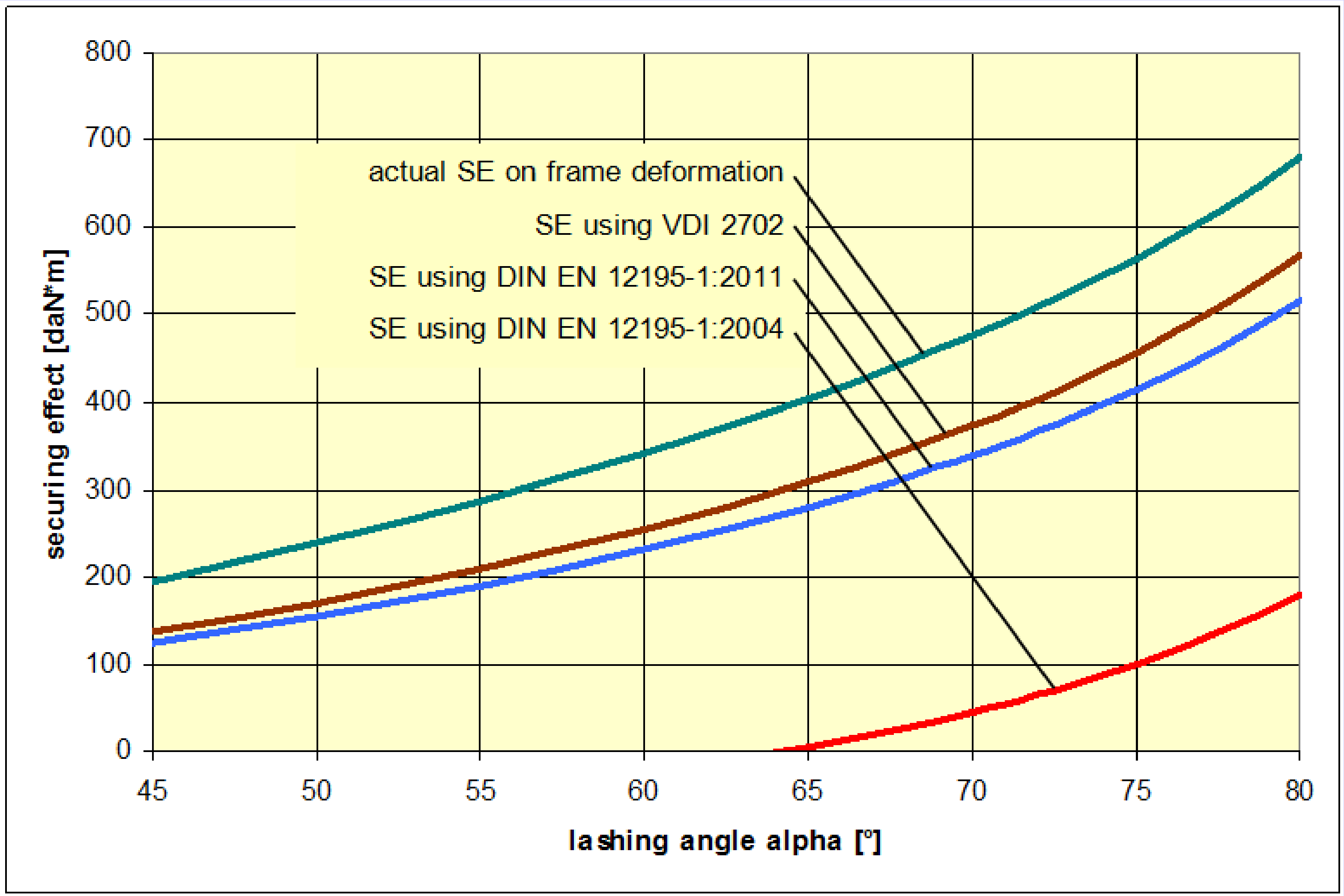
Comparing Assessment of Tie-Down Lashing (Forces Transverse to the Vehicle)



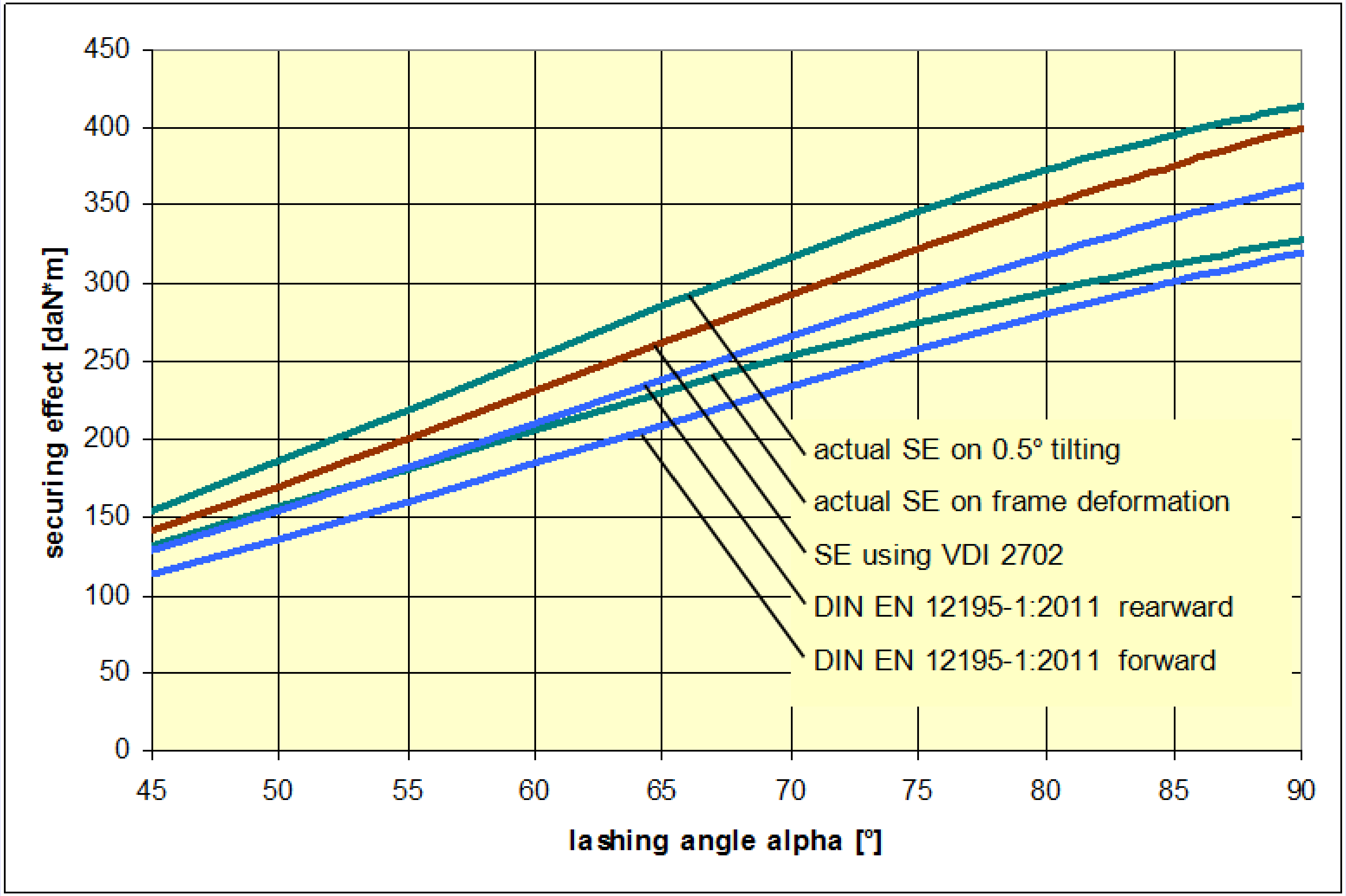
Comparing Assessment of Tie-Down Lashing (Forces Longitudinal to the Vehicle)



Comparing Assessment of Tie-Down Lashing (Momentums Transverse to the Vehicle)



Comparing Assessment of Tie-Down Lashing (Momentums Longitudinal to the Vehicle)



Summary

If an external force is acting on a secured cargo, a small shifting and/or deformation is unavoidable.

To become effective, direct lashing needs shifting or deformation of the cargo up to the lower range of decimetres.

Summary

Tie-down lashing using a single-side tensioning element must take into account a loss of force transmission (k-factor).

However, this loss of force transmission is compensated by additional securing effects due to cargo shifting and deformation in the lower range of centimetres.

The calculation model used in DIN EN 12195-1:2011 for the assessment of tie-down lashing therefore is adequate and even includes slightly more safety than the Guideline VDI 2700 Part 2:2002.

Publication to this Presentation

www.tis-gdv.de

- German / English
  - TIS-News:
    - Securing cargo for the road – the facts

Many Thanks for Your Attention