



CEN/TC 158/WG 11
CEN/TC 158/WG 11 - Headforms and test methods
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N 123 CEN TC 158 WG 11 FE study Halldin Paris 20130930

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Background:

Committee URL: <http://cen.iso.org/livelink/livelink/open/centc158wg11>

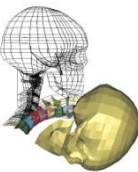
FE simulations of angled impacts
the helmeted HIII Head alone
compared to the HIII head attached
to the HIII neck and a human neck
model.

By Peter Halldin



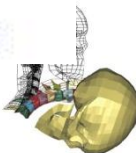
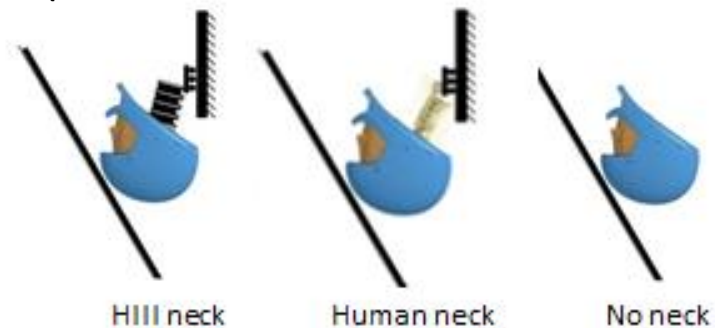
Objectives

- How is the head kinematics effected by the neck in direct impact conditions.



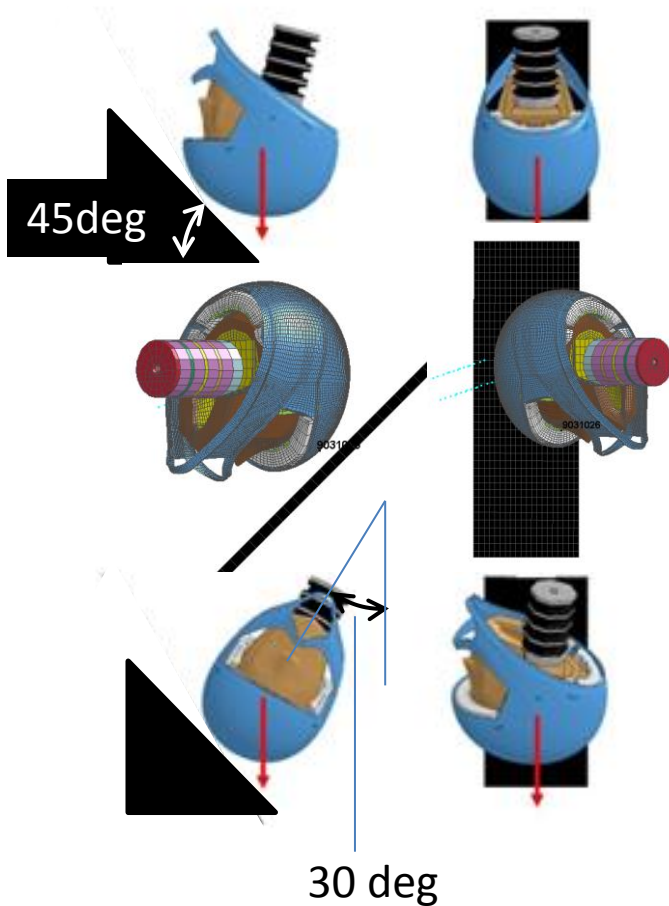
Configuration details

- Boundary condition neck: “Guided” neck bottom plate (T1) locked in Global X, Y, RotX, RotY and RotZ.
- Weight “T1-plate” =10kg-(mass of current neck)
- Coefficient of friction between:
 - Helmet/plate: 0.4
 - Helmet/head: 0.3
- Compare the results from the HIII neck with no neck and also a human neck model. (Halldin et al. 2001, Brodin et al 2005, Hedenstierna 2008).
- Impact speed: 7m/s
- Angle of Anvil : 45degree



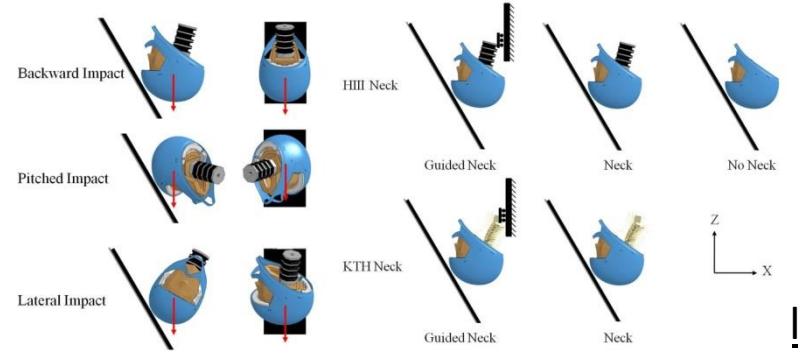
Simulation set up

Impact Ry



Impact Rz

Impact Rx



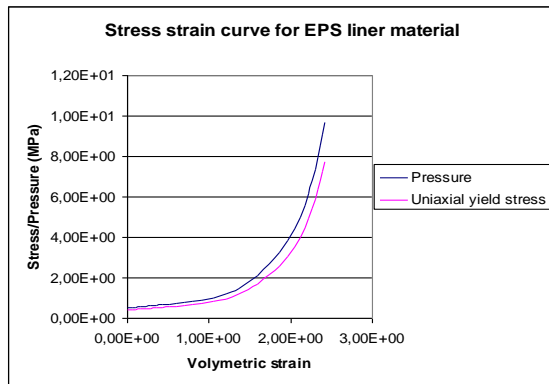
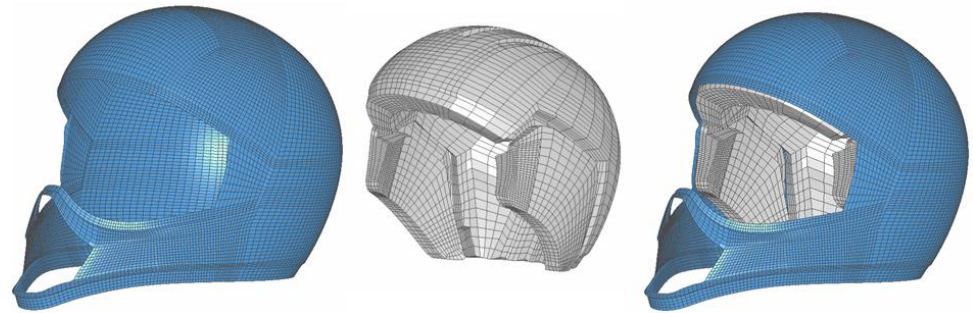
X-axis 45 degree.

Bottom plate of HIII head is horizontal.
Then rotate head 30 degree around local X-axis.



FE model of helmet

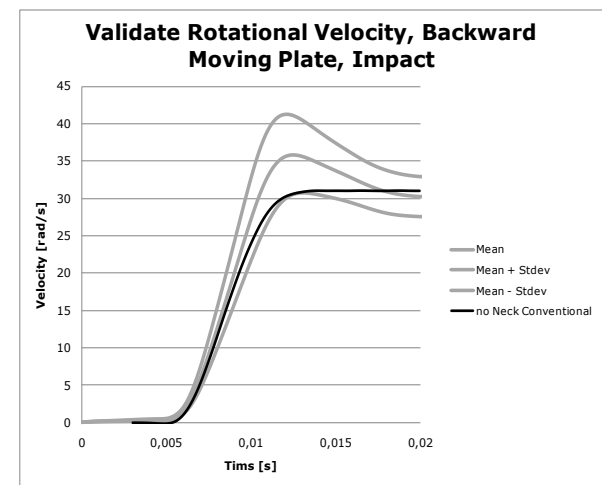
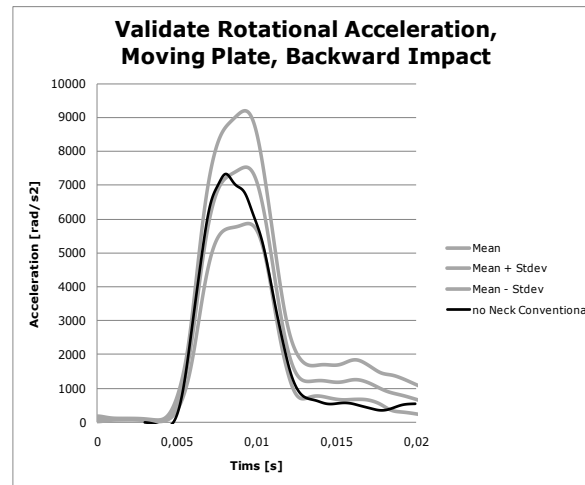
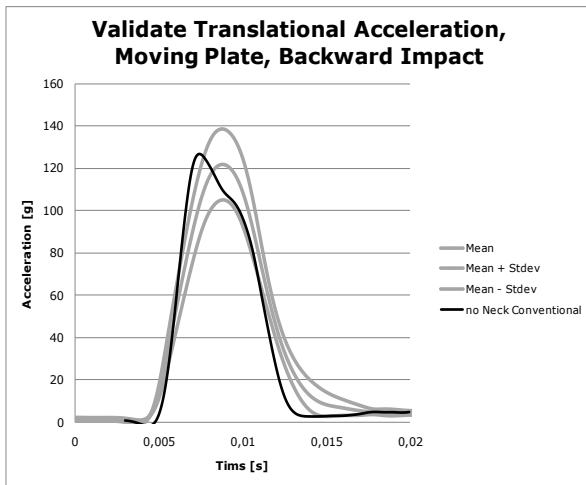
- The helmet shell was modeled by 13470 shell elements with a thickness of 1,5mm
- The shell was modeled as a glass fibre reinforce shell (*MAT_COMPOSITE_FAILURE_SHELL_MODEL)
- The liner consists of three different parts and was modeled as EPS liner with densities 35, 50 and 70 kg/m³ (*MAT_BILKHU/DUBOIS_FOAM in LSDYNA). A total of 14582 elements were used.



*MAT_COMPOSITE_FAILURE_SHELL_MODEL						
Density (Kg/M ³)	Ea (Pa)	Eb (Pa)	Ec (Pa)	Poissons ratio, ba	Poissons ratio, ca	Poissons ratio, cb
1054.0	6.8900E+10	6.8900E+10	4.0300E+9	0.30	0.24	0.24
			Bulk modulus of failed material			
Gab (Pa)	Gbc (Pa)	Gca (Pa)	6.72E+9			
27.0E+9	1.55E+9	1.55E+9				
Longitudinal compressive strength	Longitudinal tensile strength	Transverse compressive strength	Transverse tensile strength	Shear strength		
1.8000E+8	3.3100E+9	1.8000E+8	3.3100E+9	1.1550E+7		



Comparison of FE model of MC helmet to benchmark study of 12 different MC helmets



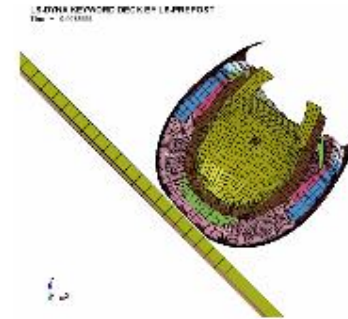
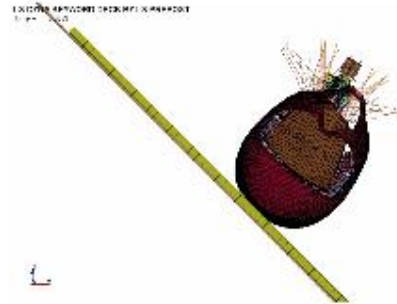
Examples from simulations

HIII

Human

No neck

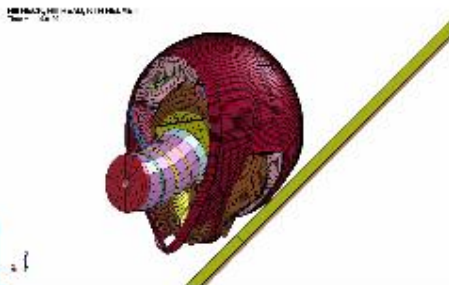
Rx



Ry



Rz

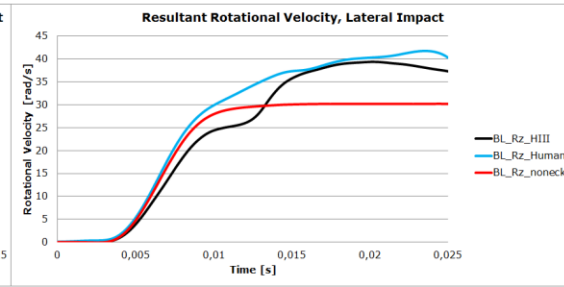
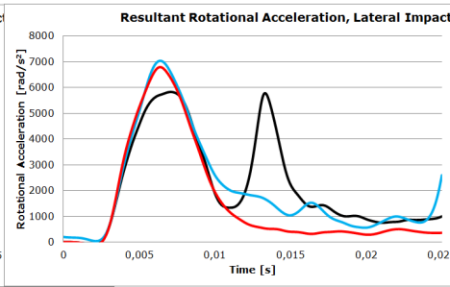
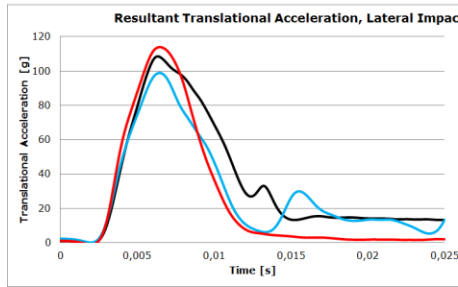
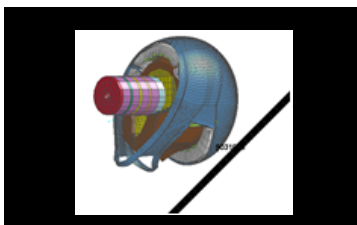
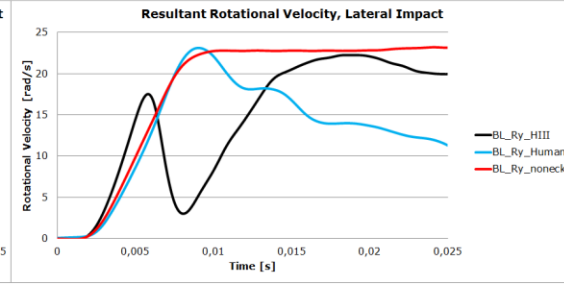
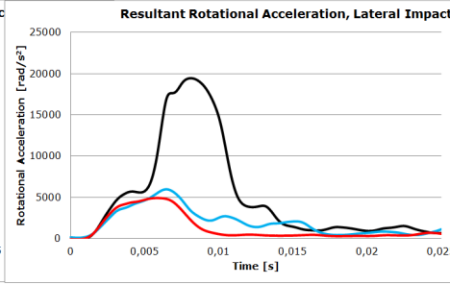
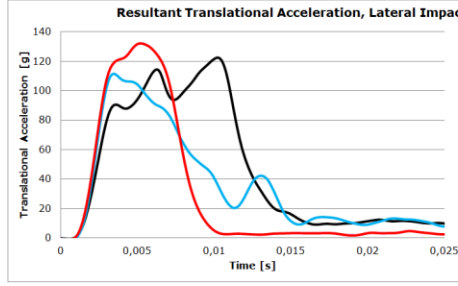
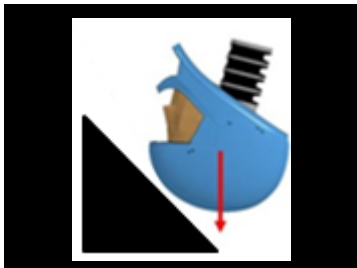
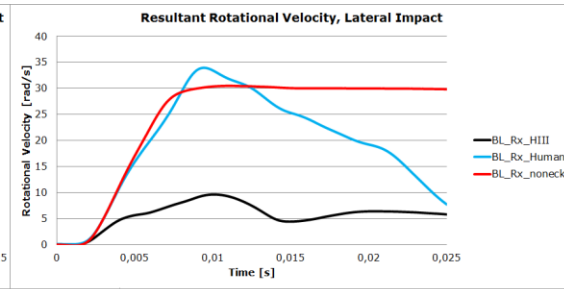
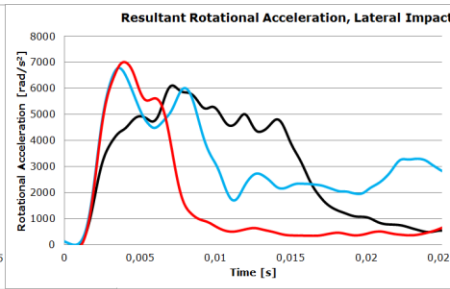
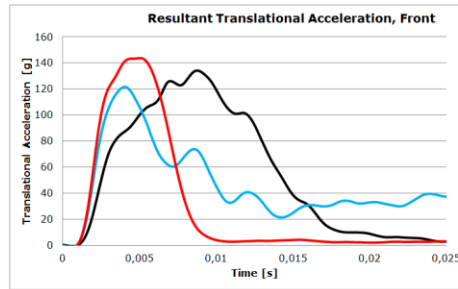
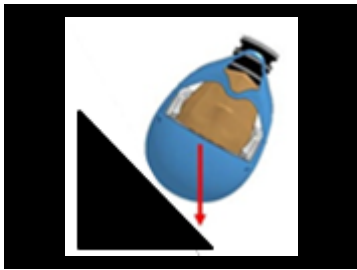


Results from simulations

Translational acceleration

Angular acceleration

Angular velocity



— HIII neck

— Human neck

— No neck



Conclusion

- The results differs between the different neck configurations for the Lateral (Rx and the Frontal (Ry).
- It is believed that the HIII neck could be used for Pitched Rz impact.
- Frontal (Ry) and Lateral (Rx) impacts must be investigated further.

