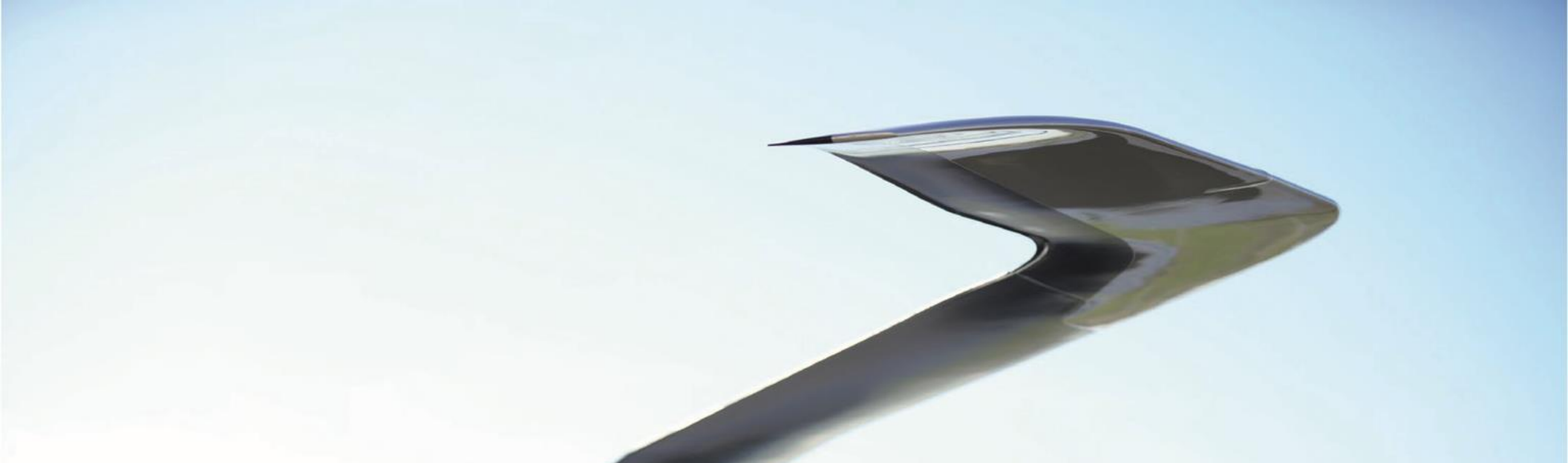




HELICOPTERS

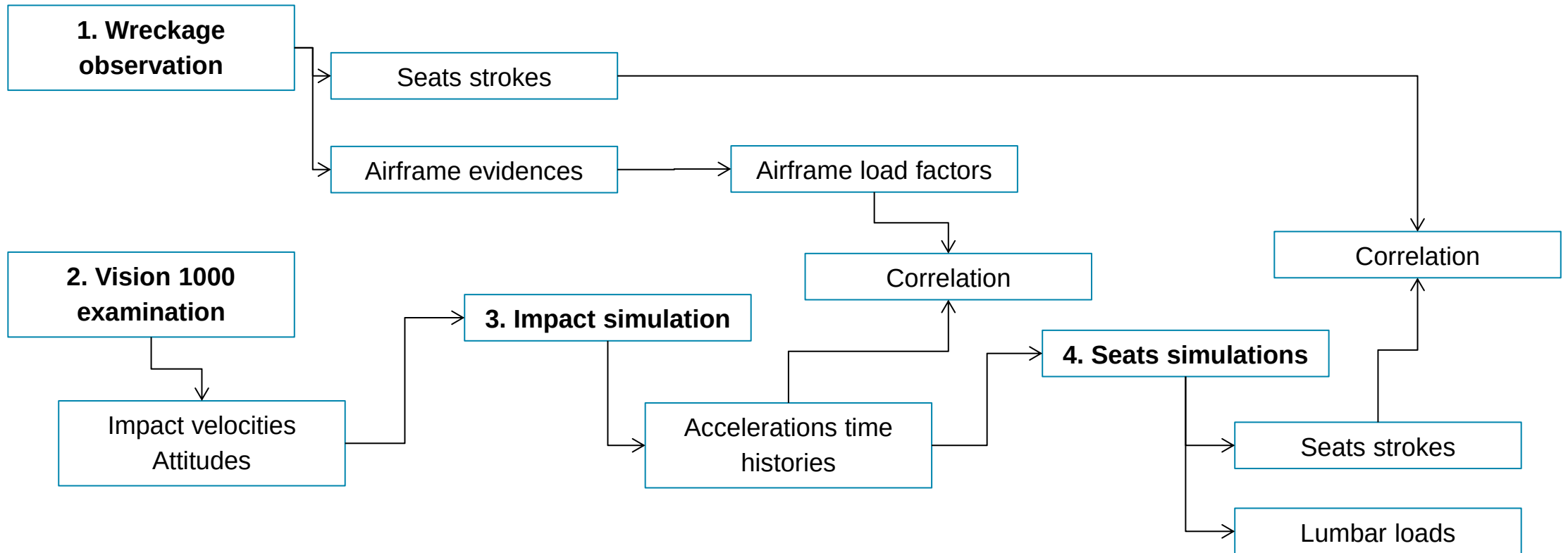
N11VQ Blue Hawaiian

EC130T2

Prud'homme-Lacroix Pierre
28 March 2017

AIRBUS

Presentations





EC130T2 s/n 8070 : Blue Hawaiian Helicopters

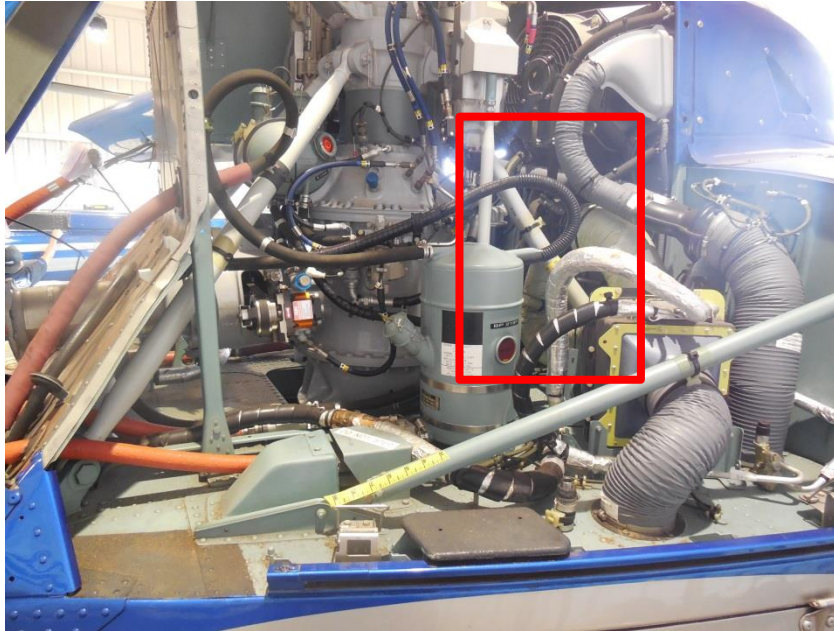


May 17th 2016

Nicolas GENELOT



MGB bars



Mechanical deck – right view

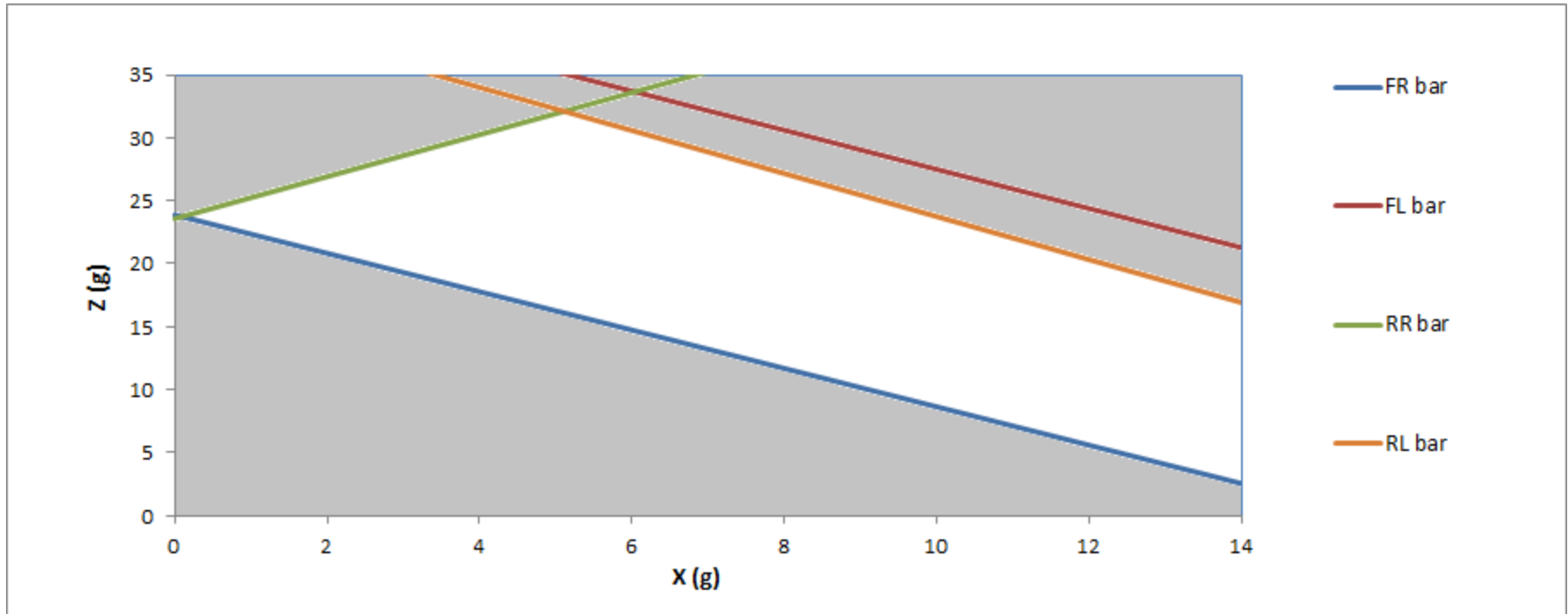


Right forward MGB bar

Key message: Front right MGB bar is bended (23mm deflection) . The 3 others bars don't show any permanent deformation

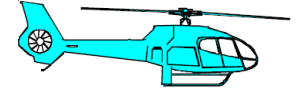
MGB bars – Domain reduction

$Y = 4.0 \text{ g}$



One MGB bar buckled, three others without damage

Engine support



Engine deck



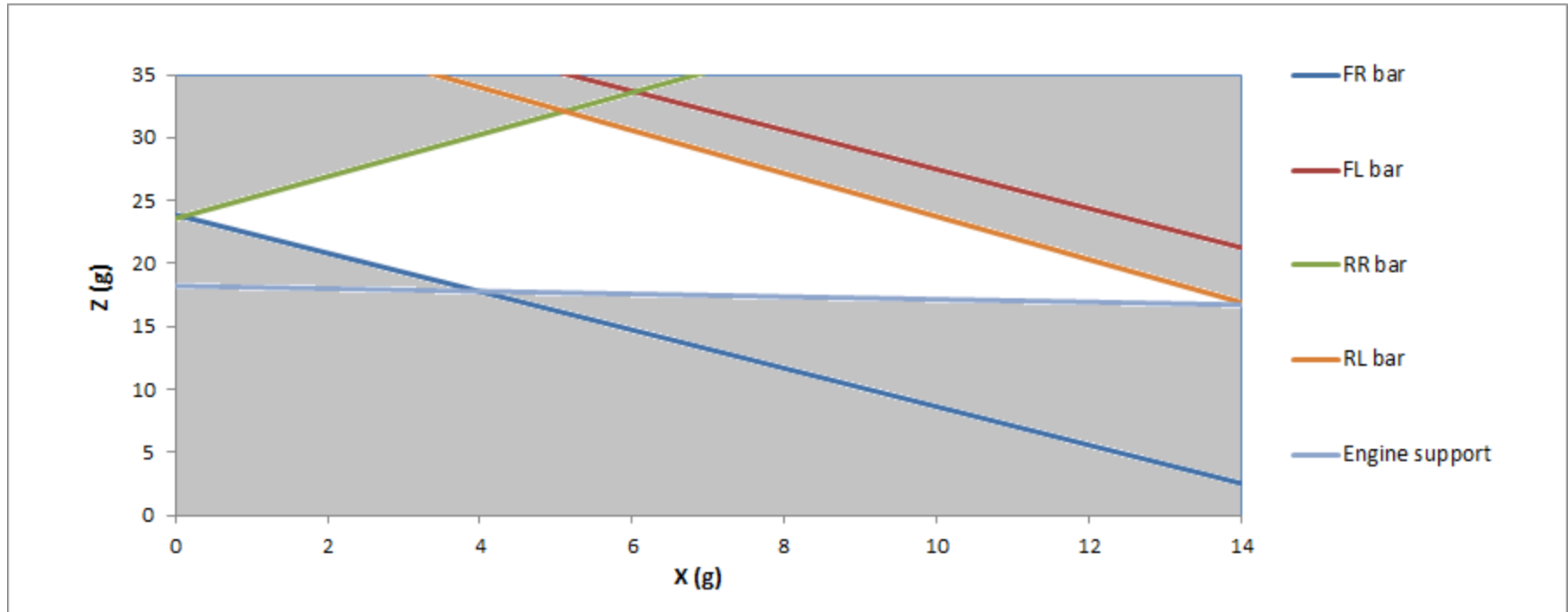
Engine support

Key message:

- Buckling area below engine support
- Permanent deformation on engine support
- Distance from engine deck is 6.8 cm at rear part of support & 7.6 cm at the front part of support

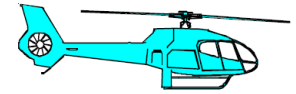
Engine support – Domain reduction

Y = 4.0 g



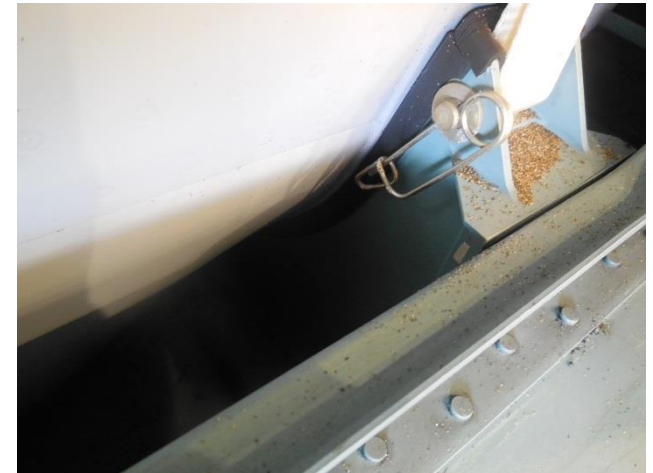
Observed bending of engine support allows domain reduction

Fuel tank



Crashworthy fuel tank

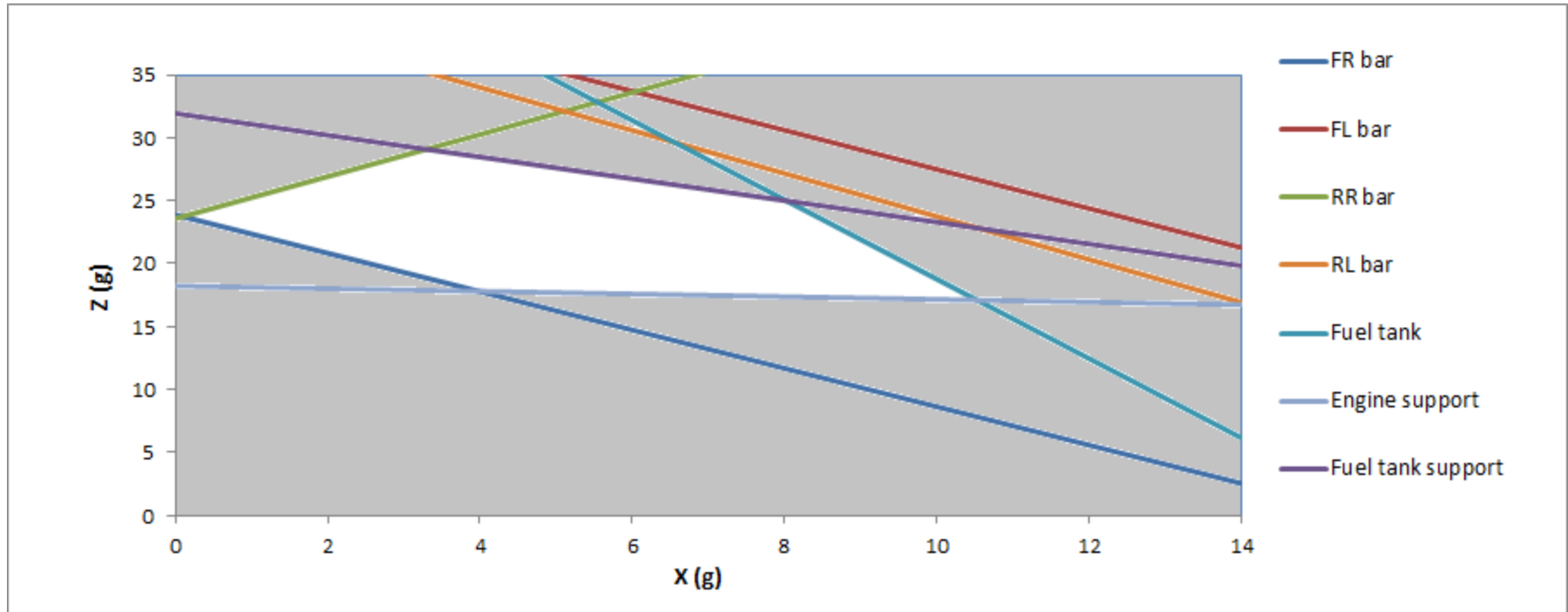
Key message: no deformation seen on fuel tank
and surrounding structure



Fuel tank support

Fuel tank – Domain reduction

Y = 4.0 g



No damage observed on fuel tank, nor support, domain is reduced

X frame



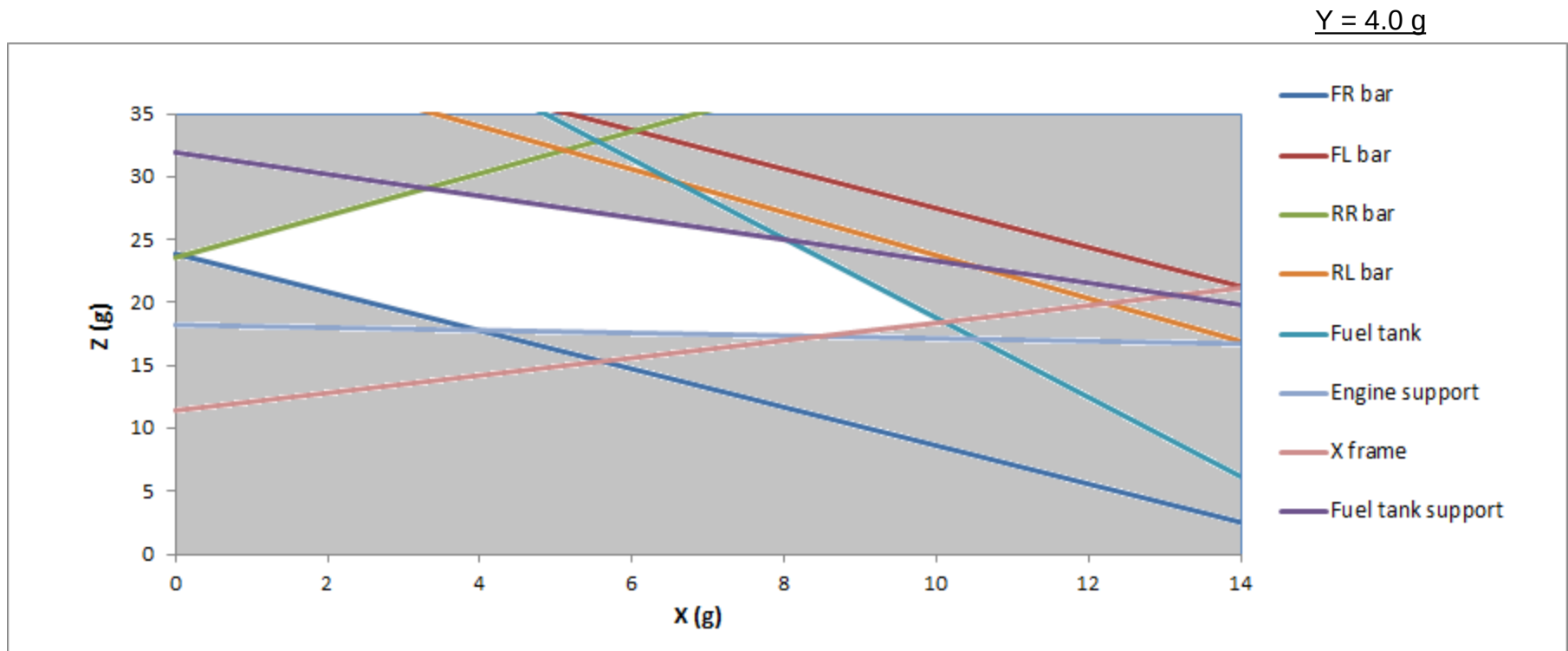
X wall – left side

Key message: Left X wall is damaged in rear bottom corner (2 buckling area). Right X wall not seem to be damaged



X wall – left side – lower rearward corner

X frame – domain reduction



Left X frame is buckled, domain is slightly reduced

Right Canopy rod



Mechanical deck – right view

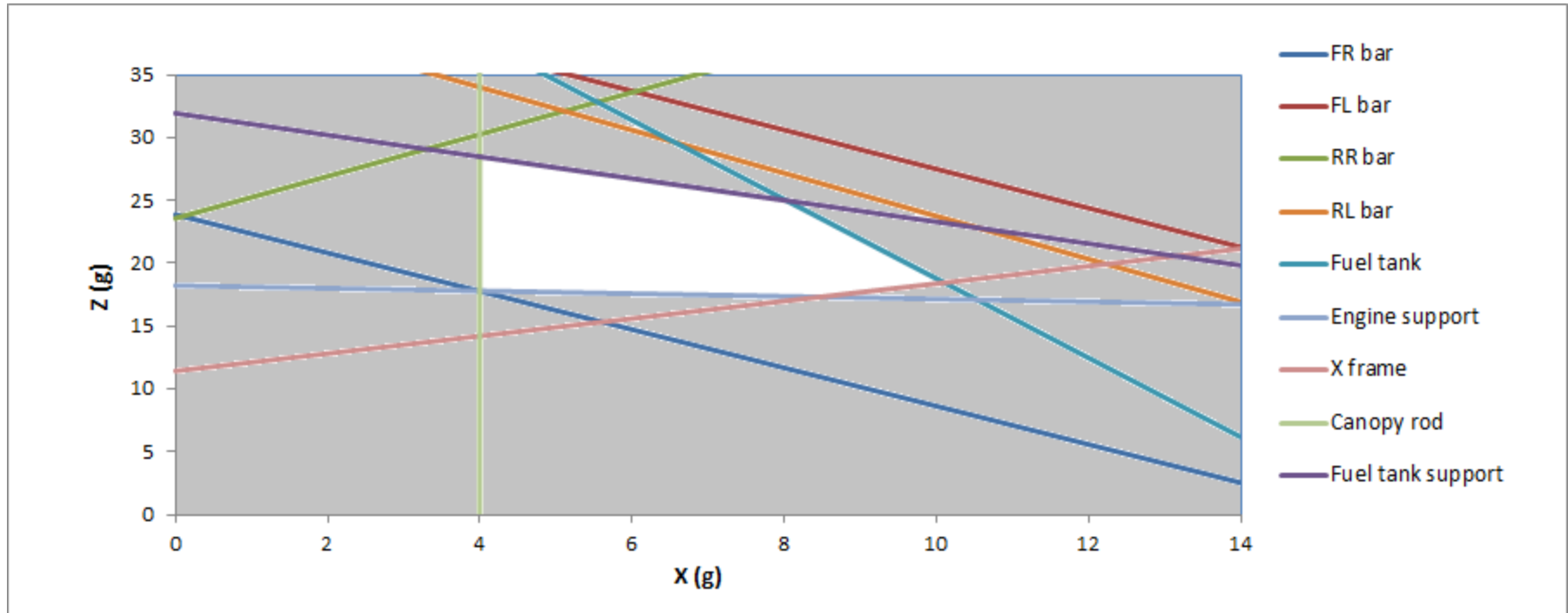
Key message: rivets junction at the bottom is damaged (rod bearing), minimum 1 inch displacement



Right inclined rod lower junction

Right Canopy rod – Domain reduction

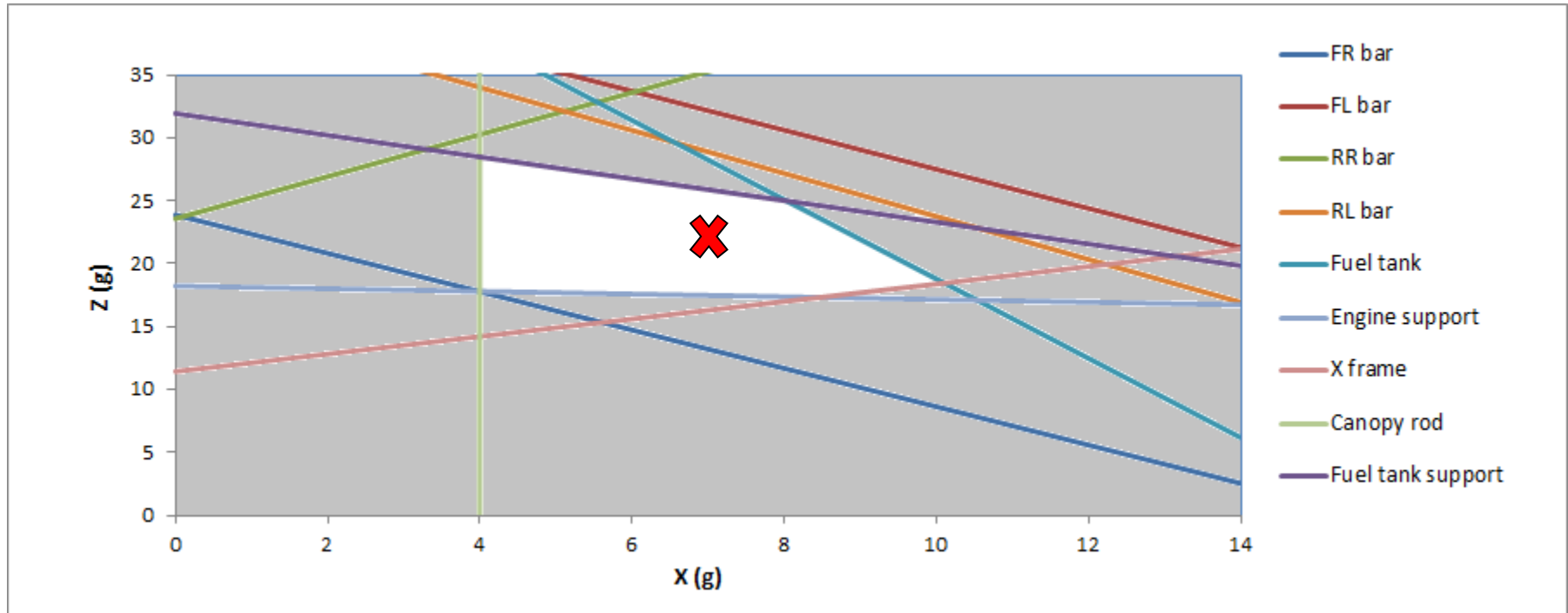
Y = 4.0 g



Domain is reduced

Impact conditions proposal

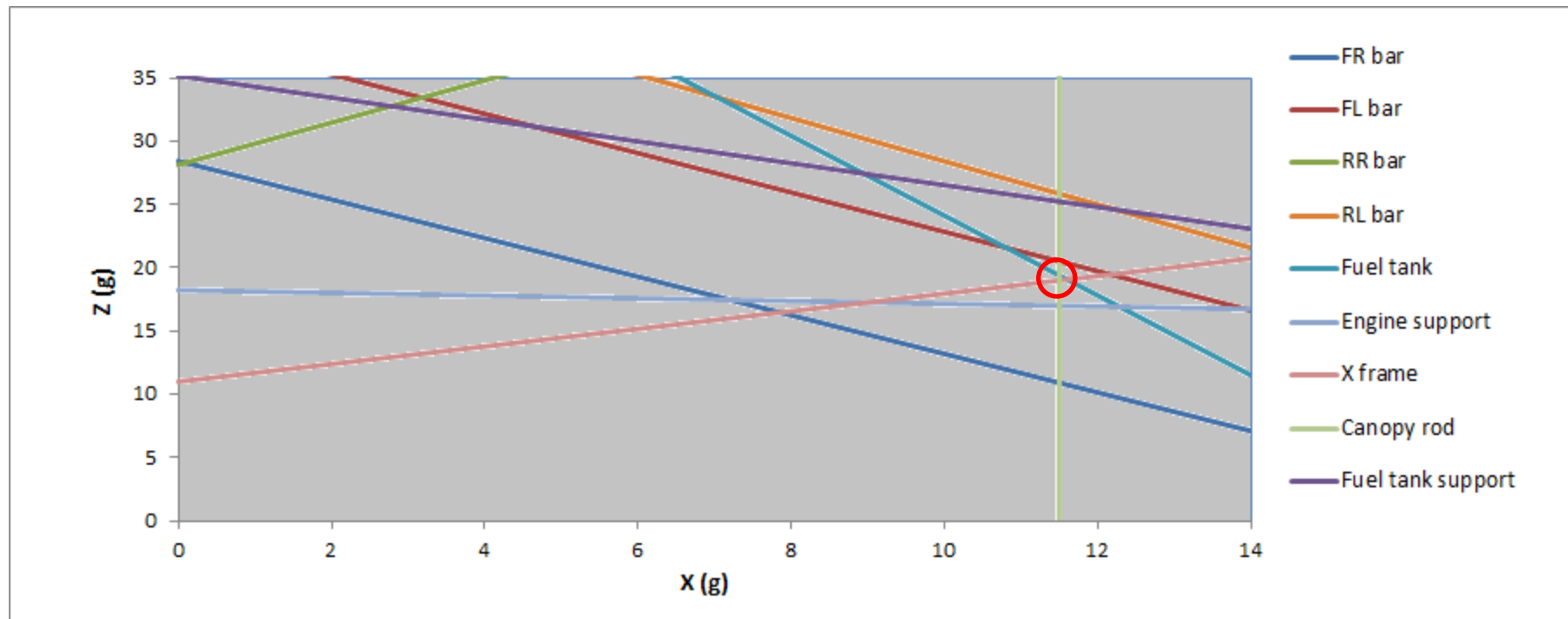
Y = 4,0 g



Proposal for impact load factors :

- X = 7.2g
- Y = 4.0g
- Z = 21g

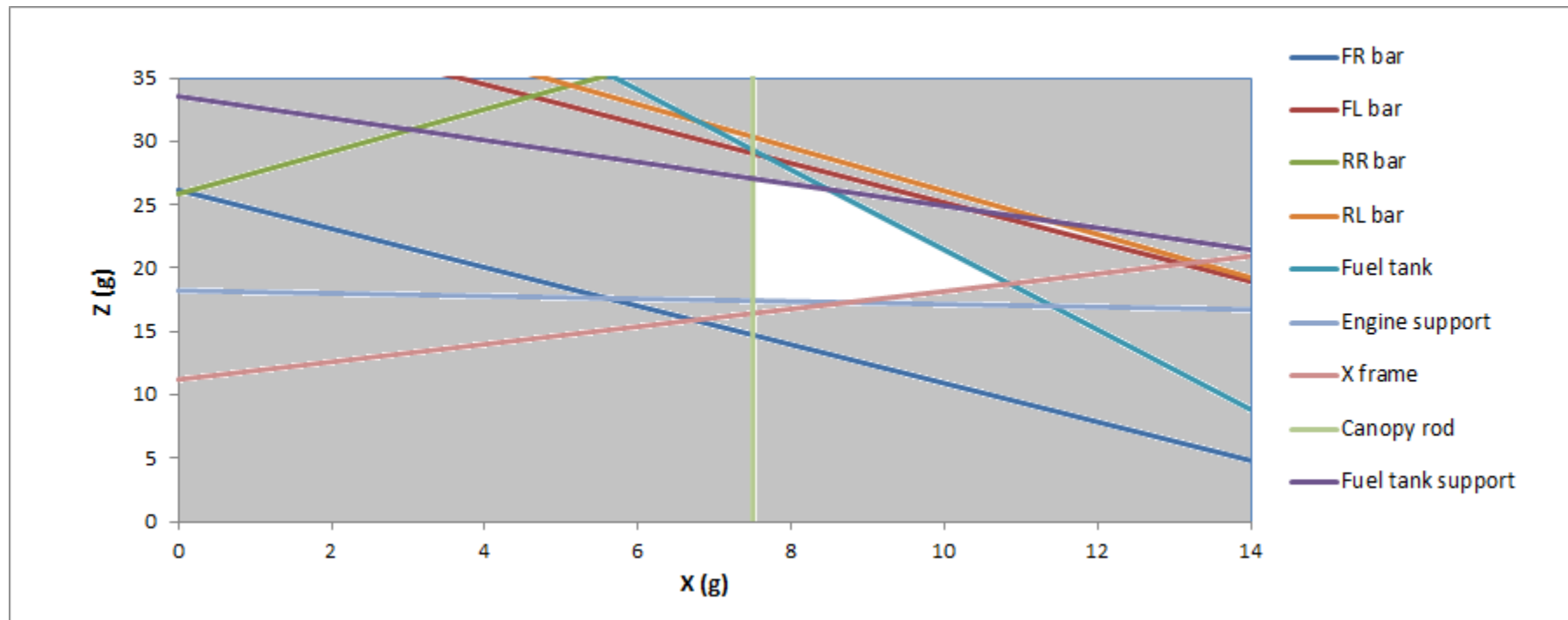
Envelope details (1)



Y is fixed to its minimum value

- Y = 2.0g
- X = 11.5g
- Z = 19.4g

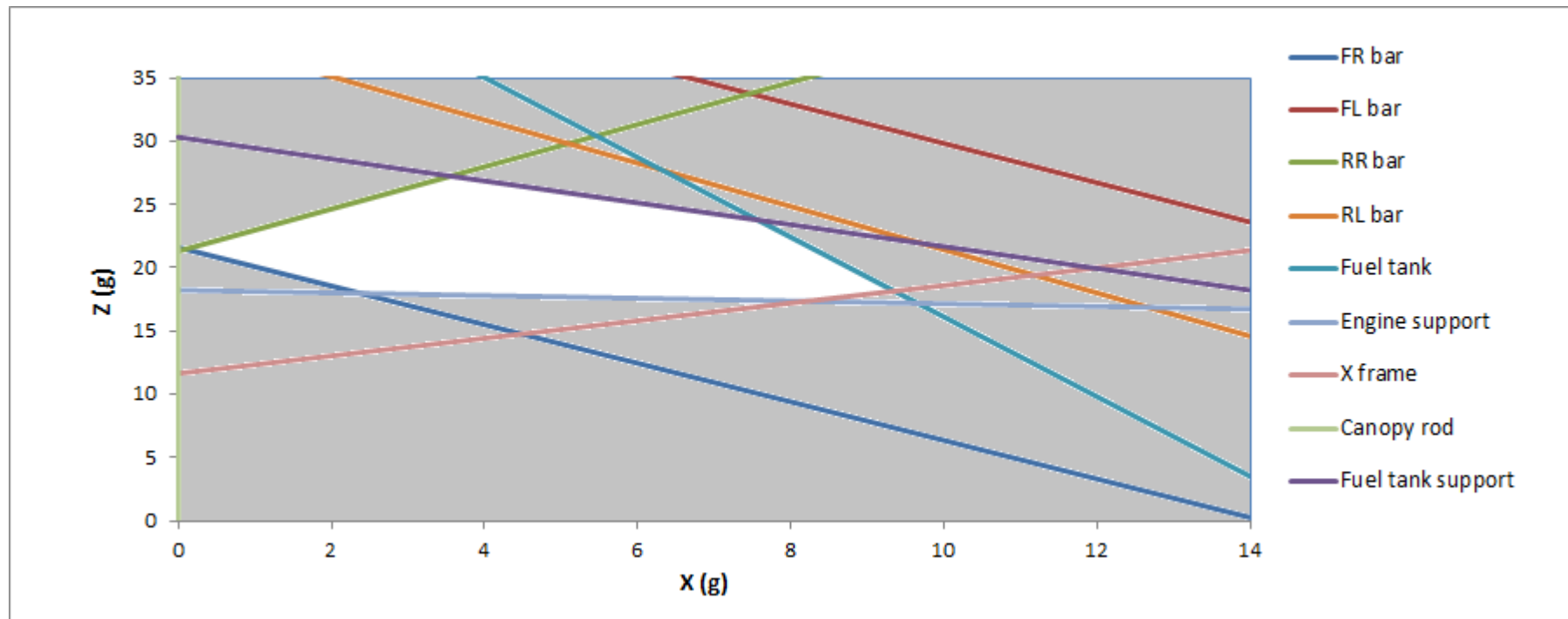
Envelope details (2)



Y is fixed to

- Y = 3.0g
- X goes from 7.5g to 11.0g
- Z goes from 17.4g to 27.1g

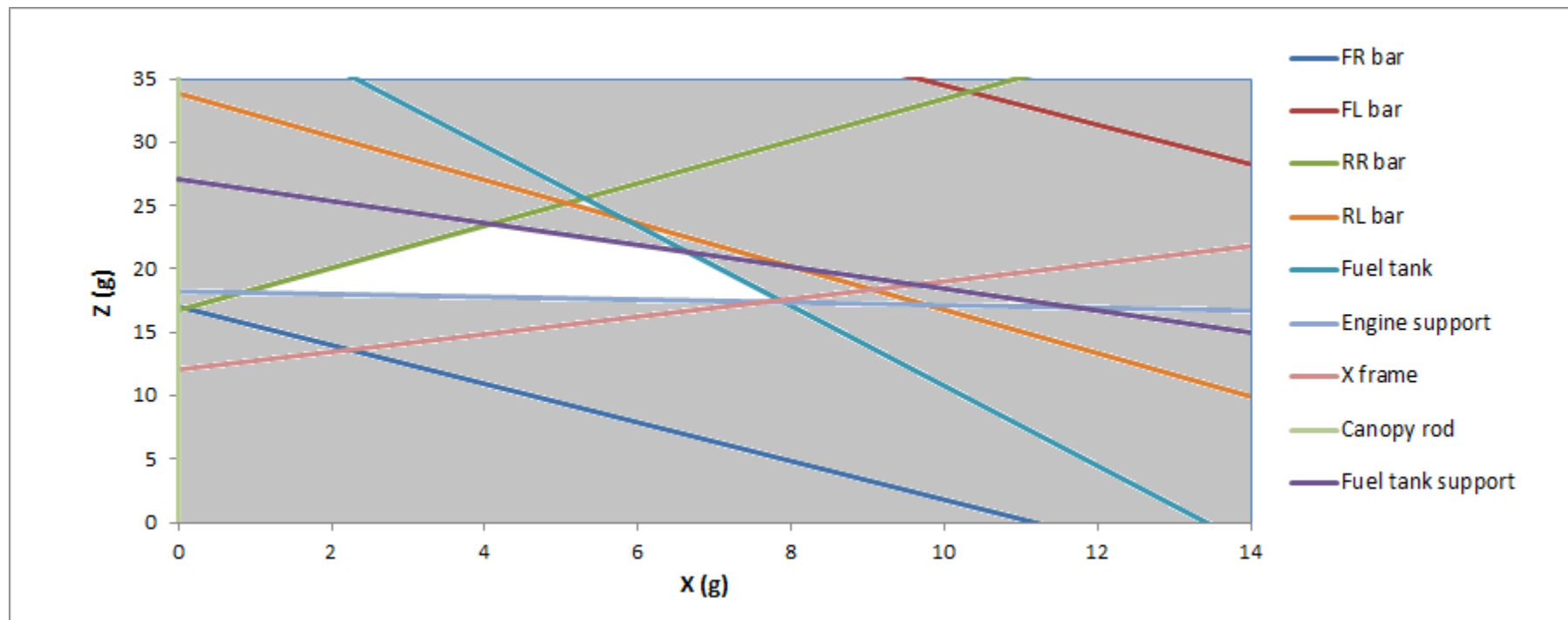
Envelope details (3)



Y is fixed to

- Y = 5.0g
- X goes from 0g to 9.0g
- Z goes from 17.4g to 29.7g

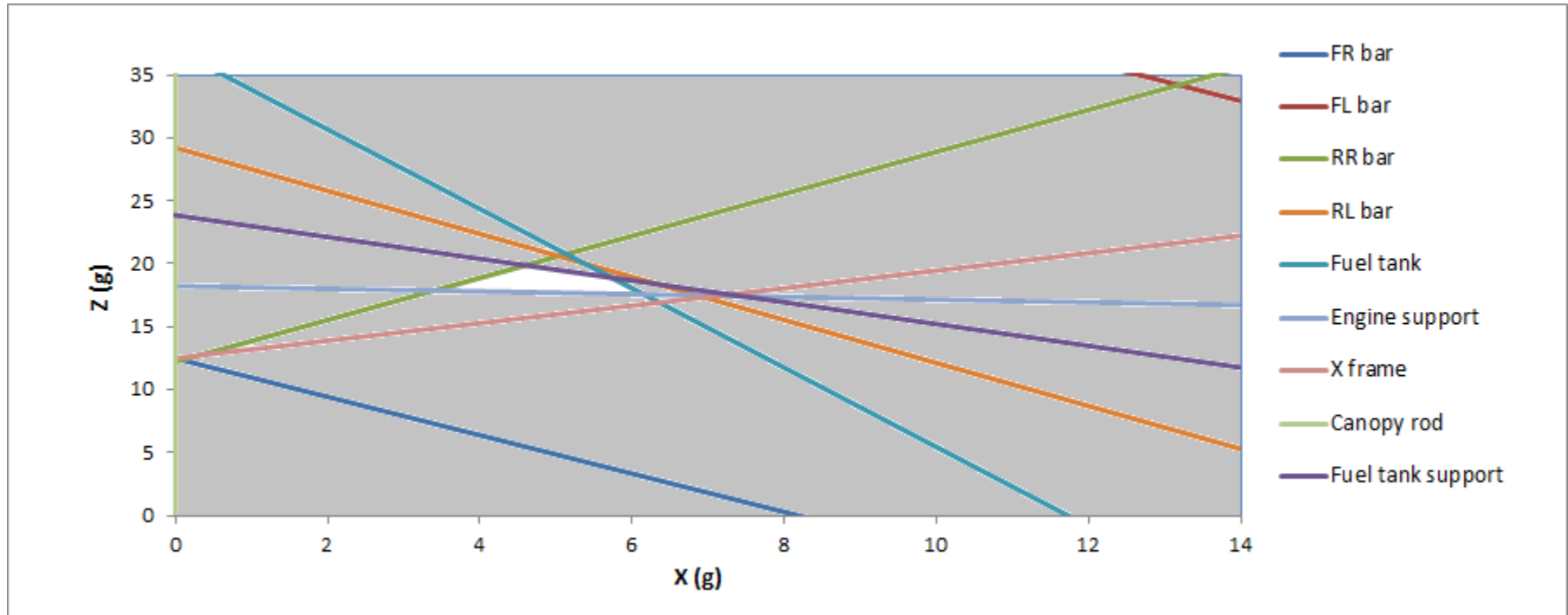
Envelope details (4)



Y is fixed to

- Y = 7.0g
- X goes from 1.0g to 8.0g
- Z goes from 17.4g to 25.1g

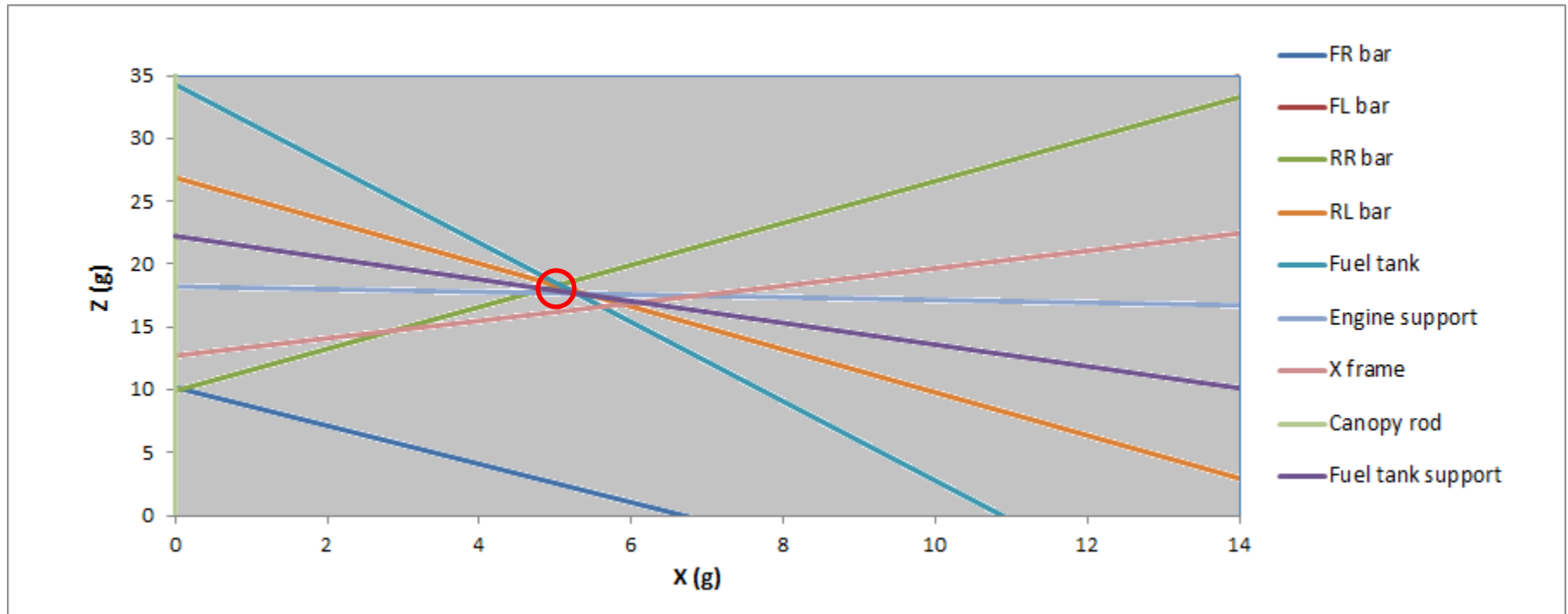
Envelope details (4)



Y is fixed to

- Y = 9.0g
- X goes from 4.0g to 6.0g
- Z goes from 17.5g to 20.5g

Envelope details (5)



Y is fixed to its maximum value

- Y = 10.0g
- X = 5.0g
- Z = 17.7g

Conclusion on impact conditions

According to envelope details, loads factor felt can go from:

- $X = 1.0g$ to $11.5g$
- $Y = 2.0g$ to $10.0g$
- $Z = 17.4g$ to $29.7g$



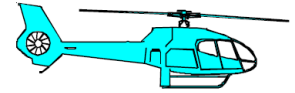
EC130T2 s/n 8070 : Blue Hawaiian Helicopters



Sept. 22nd 2016

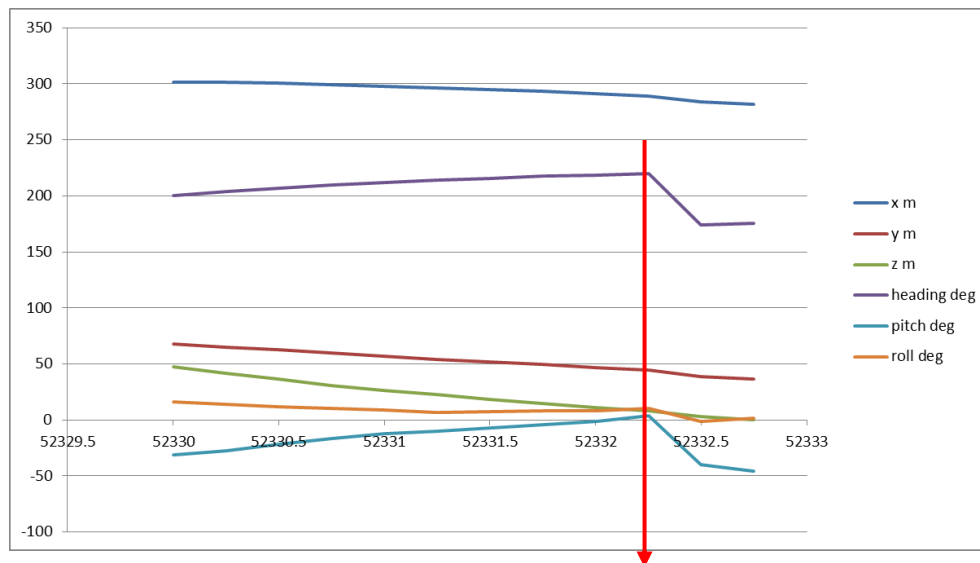
Pierre PRUD'HOMME LACROIX  **AIRBUS**
HELICOPTERS

Vision 1000 – Data's extraction



Data's used from Vision 1000 records (function of time).

- GPS coordinates (latitude, longitude, altitude)
 - > x, y, z, location versus a reference point close to the beach
- Attitudes (pitch, roll, heading)



Supposed impact time = 52332.25

When the Vision 1000 is submitted to a significant acceleration, the recorded values become no more realistic.

The supposed impact time is then selected at $t = 52332.25$ which corresponds to the last logical values, the following attitudes are clearly not possible (especially in terms of variation).

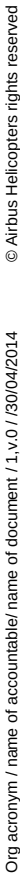
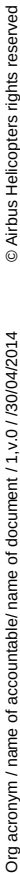
Key message: This supposed impact time (52332.25) could be checked with the video records.

Org acronym / name of accountable/ name of document / 1,v.0 / /30/04/2014



Org acronym / name of accountable/ name of document / 1,v.0 / /30/04/2014

- Org acronym / name of accountable/ name of document / 1,v.0 / /30/04/2014

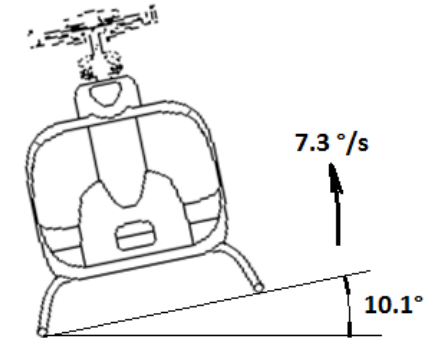
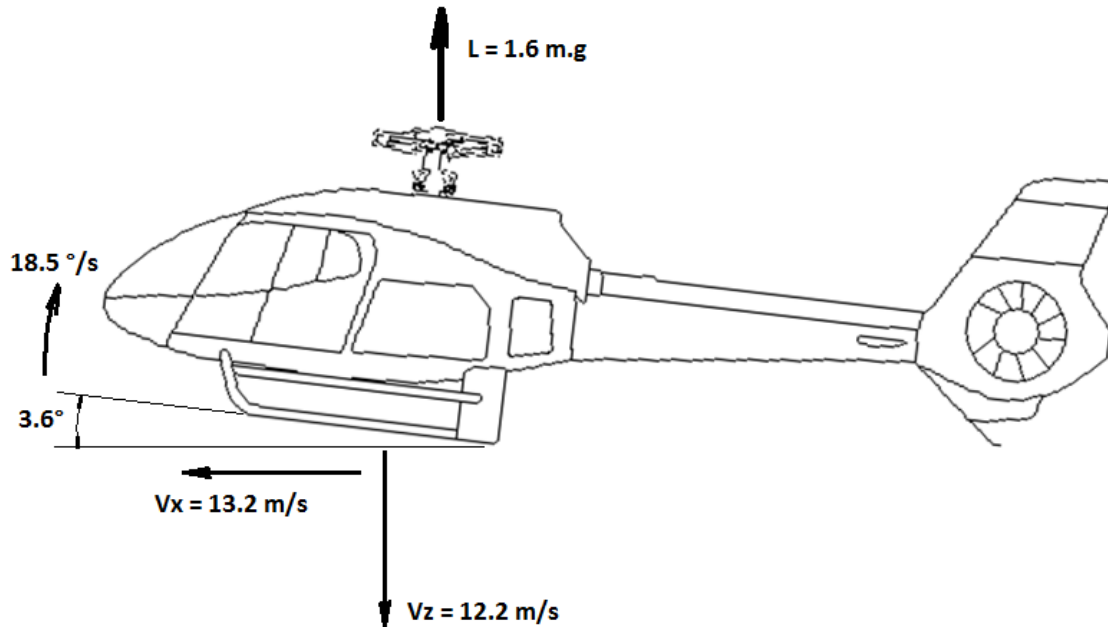


Org acronym / name of accountable/ name of document / 1,v.0 / /30/04/2014

Impact conditions



The attitudes and velocities at the ground impact are extracted from the two last time steps :



Flight path reconstruction



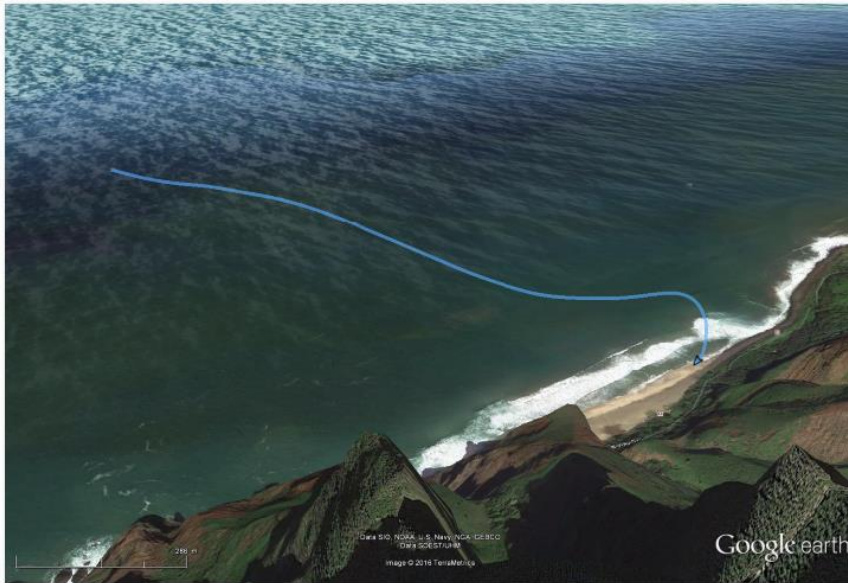
The realism of the flight path reconstruction is tested by superposition of the calculated values with screen caption of « Google earth » beach views.



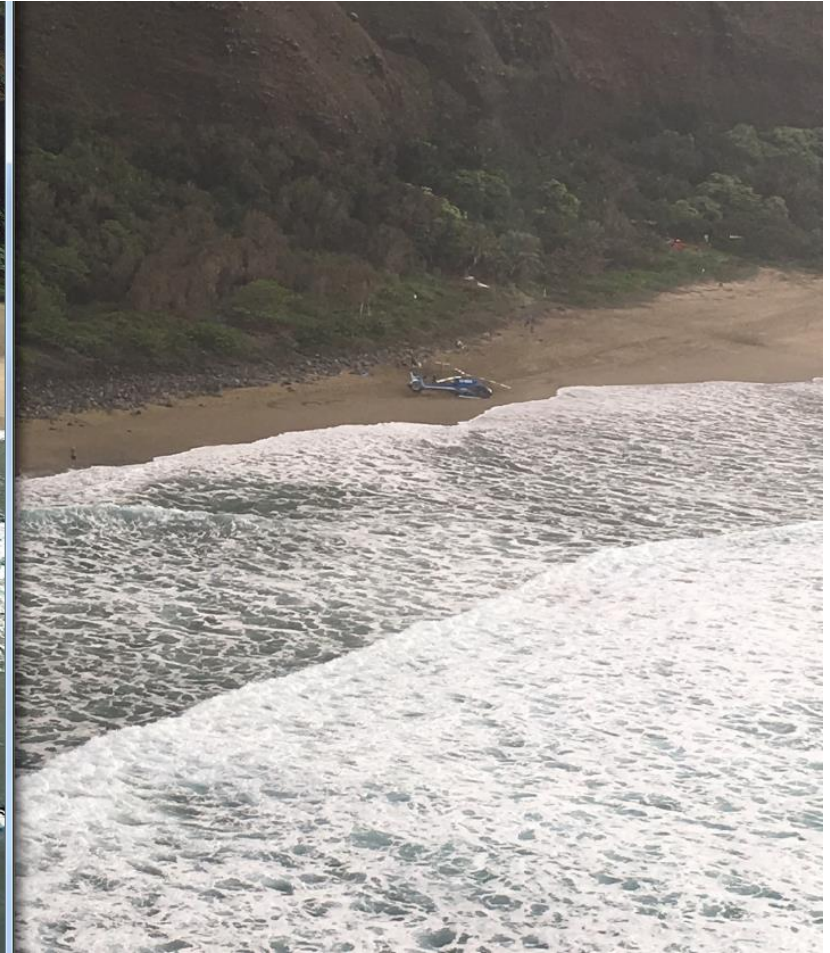
Additional checks

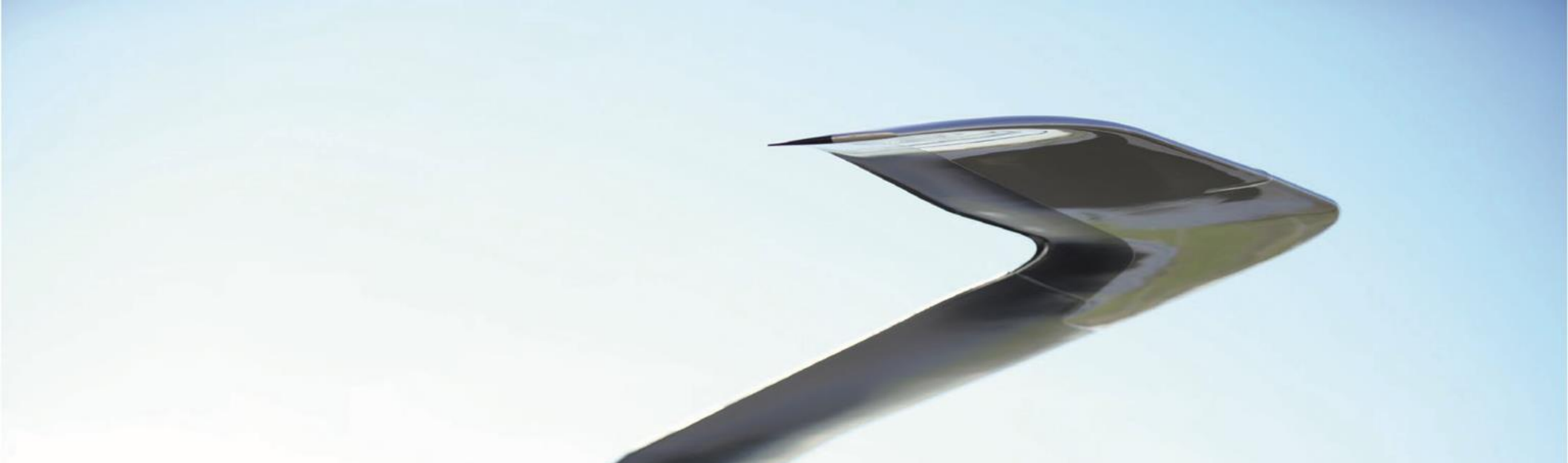


The GPS coordinates time history can be used with « google earth » to visualize the flight path



Additional checks





HELICOPTERS

N11VQ Blue Hawaiian

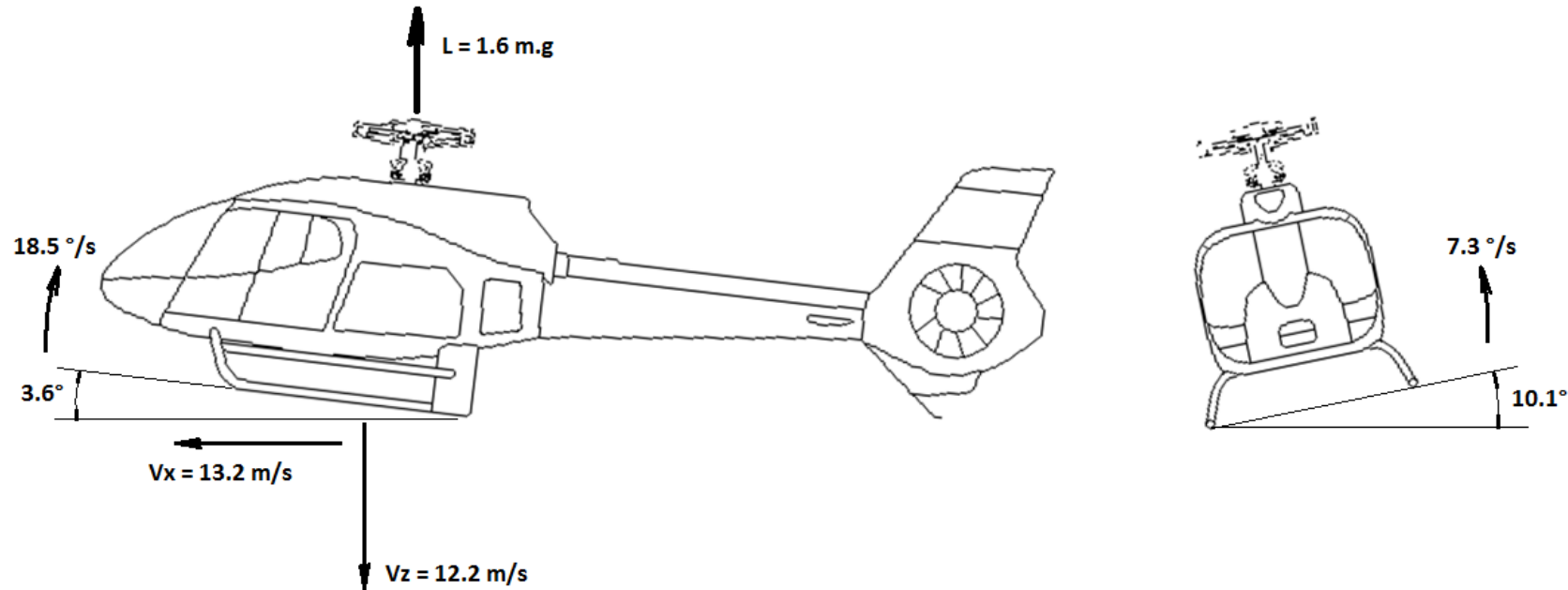
EC130T2 Hard landing in sand

Prud'homme-Lacroix Pierre, Genelot Nicolas
22 February 2017

AIRBUS

Recall on impact conditions

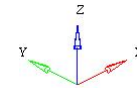
Data issued from GPS and Vision 1000



Mecano simulation

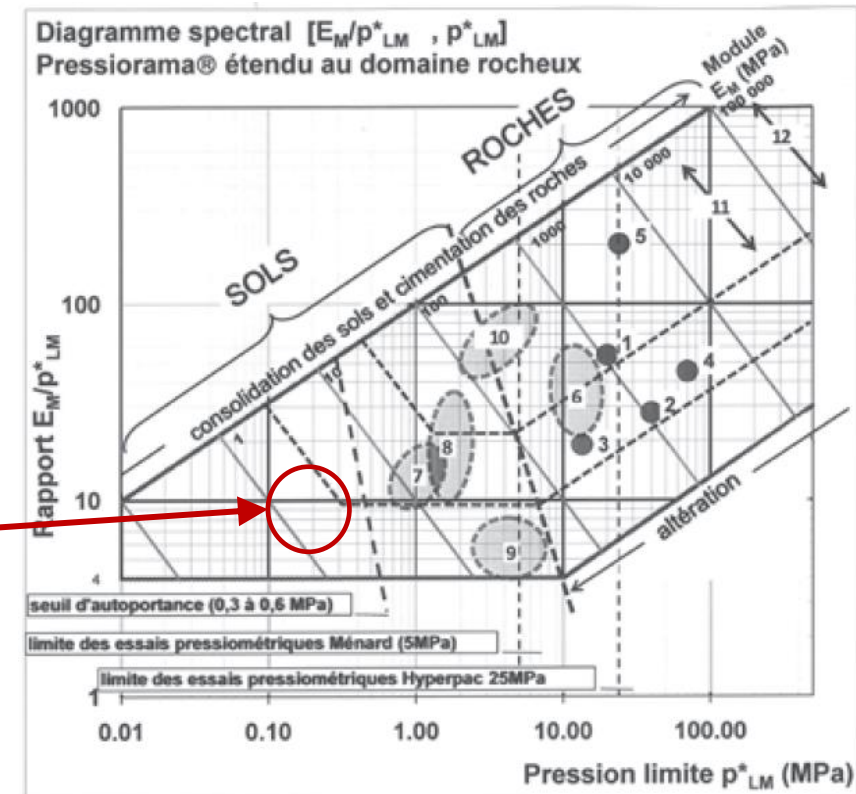
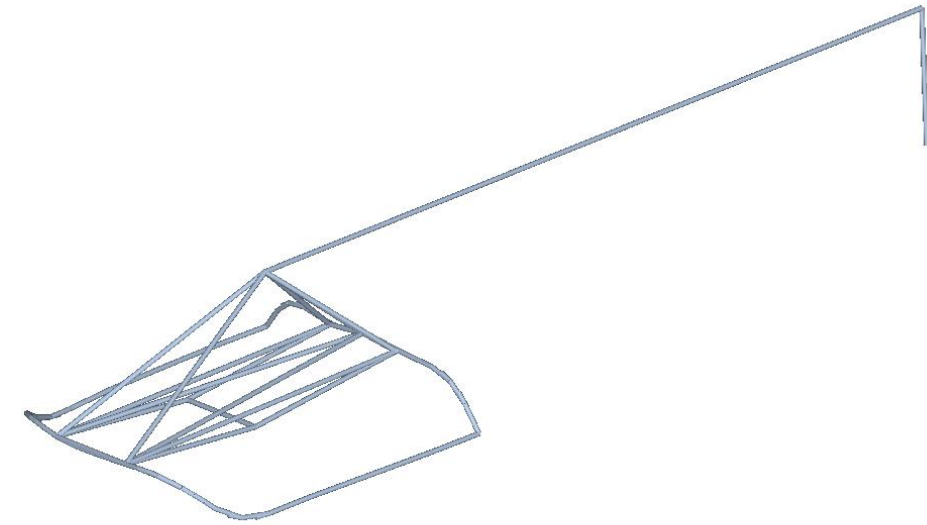
Model composed of :

- Landing gear with beam elements with plastic behaviour
- Rigid aircraft structure with mass and inertia
- Tail skid with 1D element driven with a load/displacement curve



Aircraft “fall” is controlled during 1st simulation step to :

- Reach attitude at impact time
- Reach speed at impact time
- Reach aircraft lift at impact time
- Plastic ground representing sand ($E_M = 2 \text{ MPa}$; $p_{LM}^* = 0.2 \text{ MPa}$)

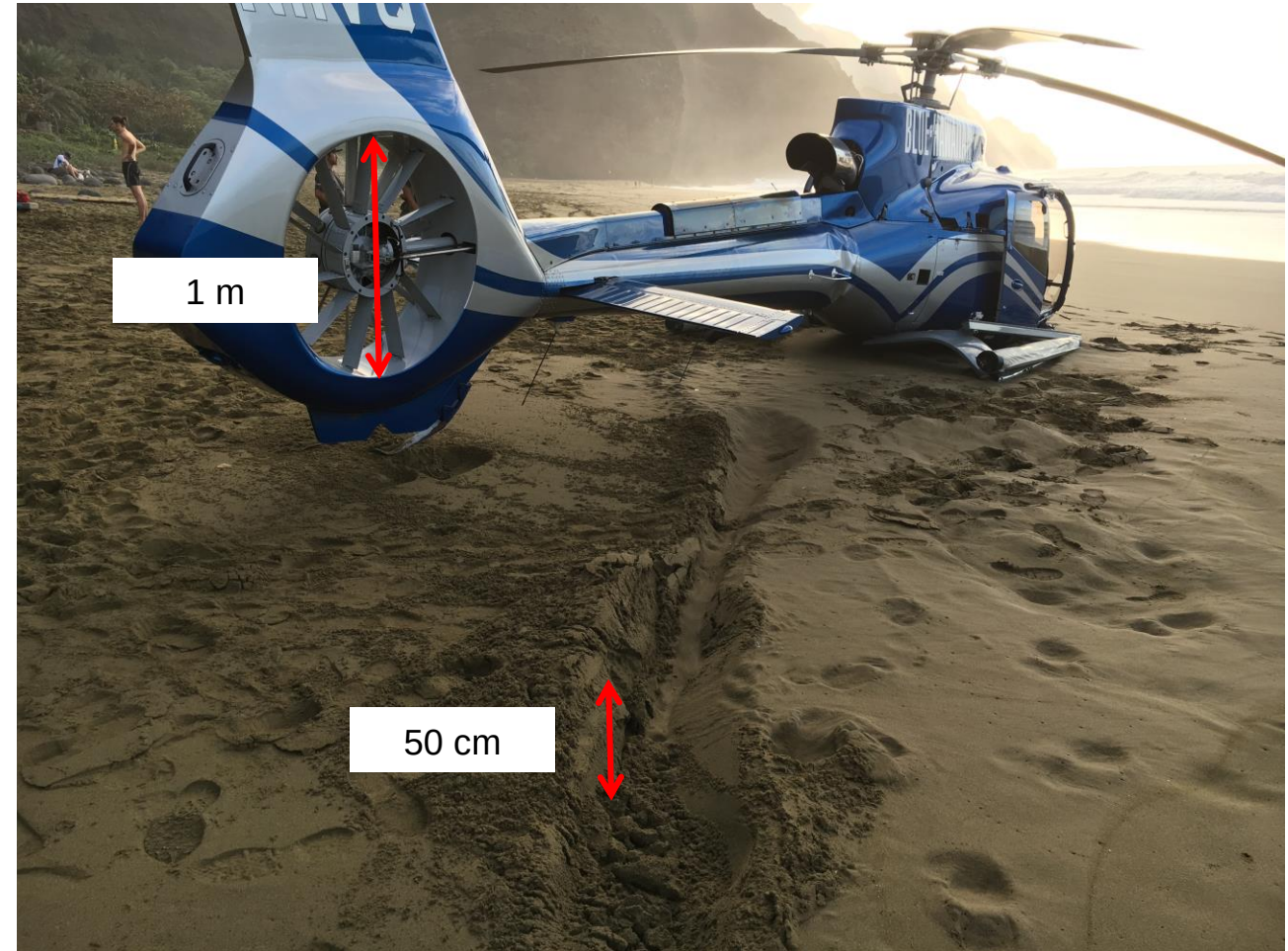
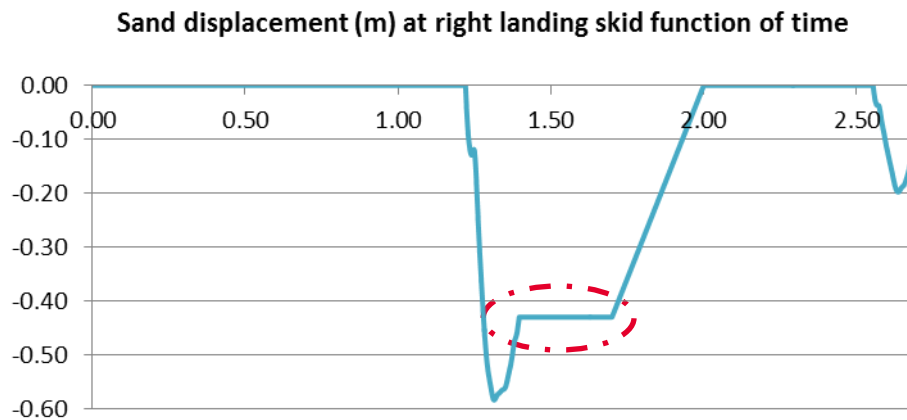


Tracks in Sand

Sand penetration, Z displacement:

- Estimation on crash picture : 50 cm
- Mecano model : 43 cm

Good correlation of simulation



Bouncing after impact

Bouncing distance :

- Estimation on crash picture : 6.5 m
- Mecano model : 6.7 m

Good correlation of simulation

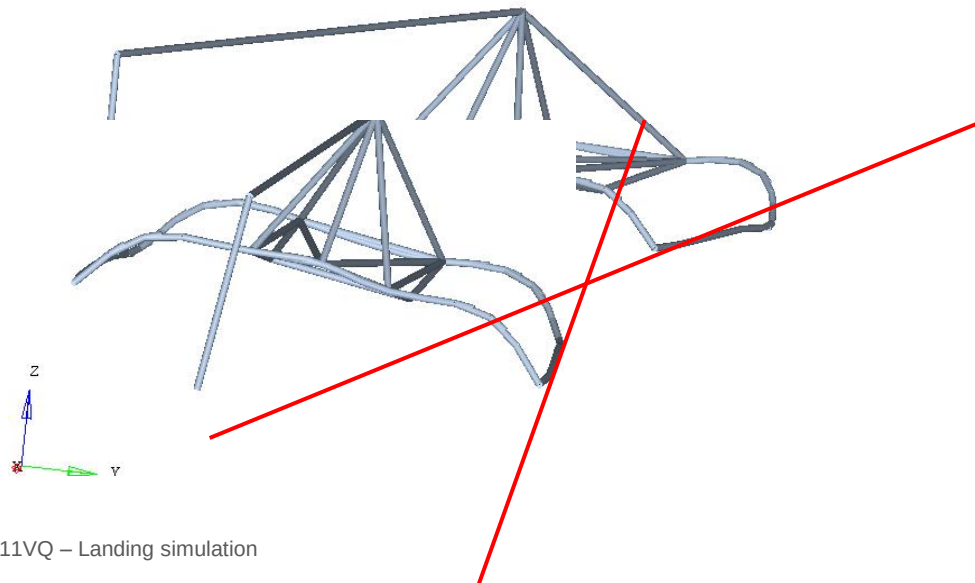


Bouncing after impact

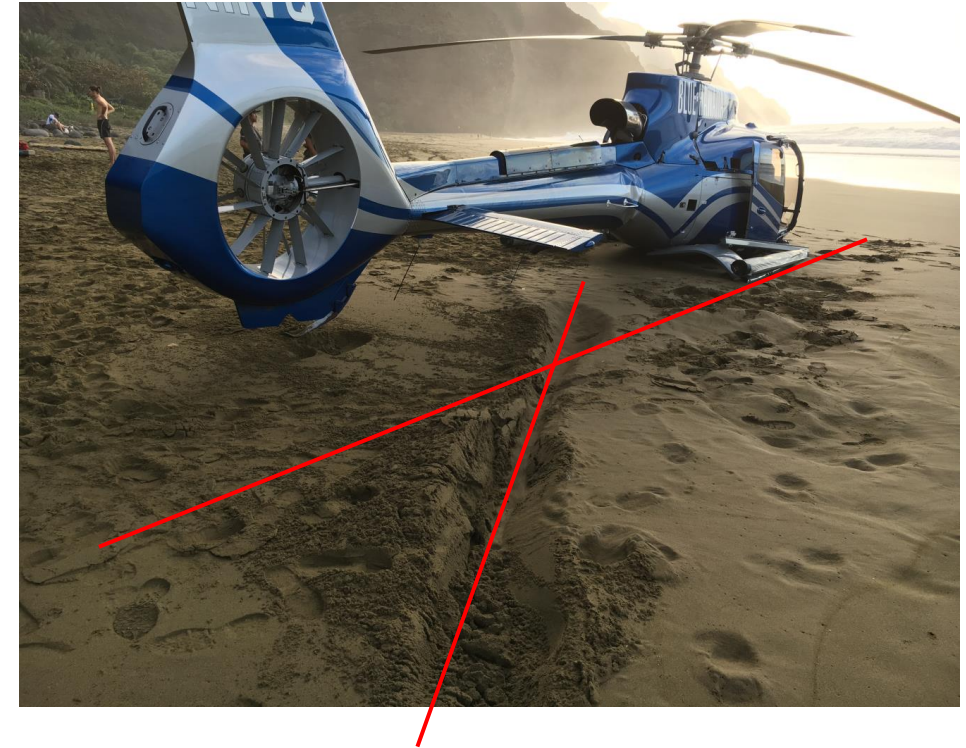
Bouncing angle :

- Mecano model : 16°
- Comparison with crash picture by superposition : good correlation

Good correlation of simulation

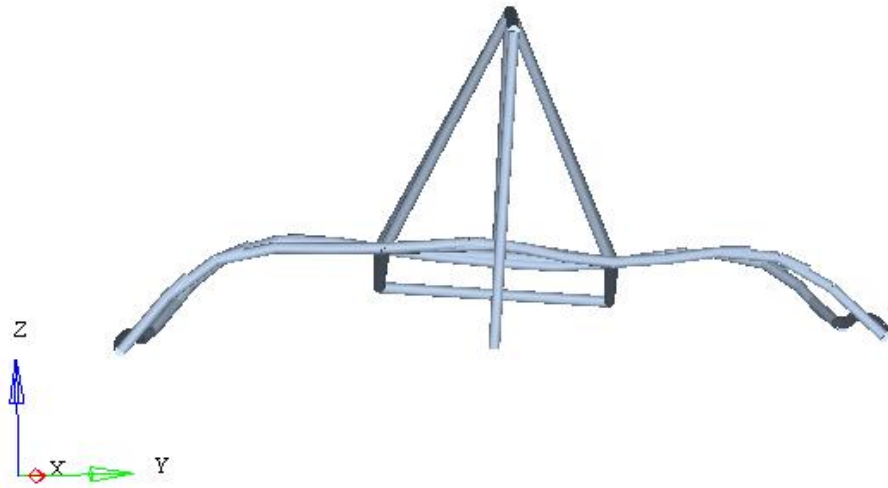


N11VQ – Landing simulation



Landing gear

Landing gear deformation:



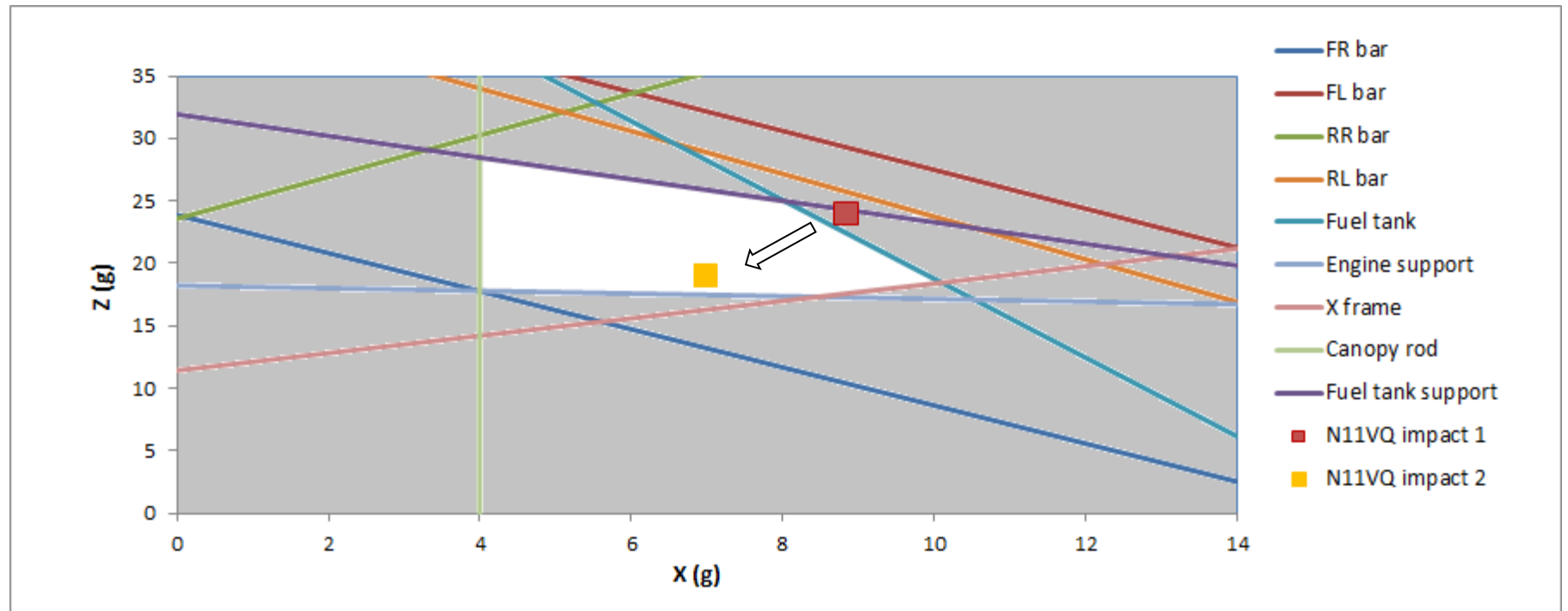
Good correlation of simulation

Load factor estimation

Maximum load factor at CoG:

- Mecano model : Impact 1 2 (bouncing)
 X = 9 g X = 7 g
 Y = 4 g Y = 1 g
 Z = 24 g Z = 19 g

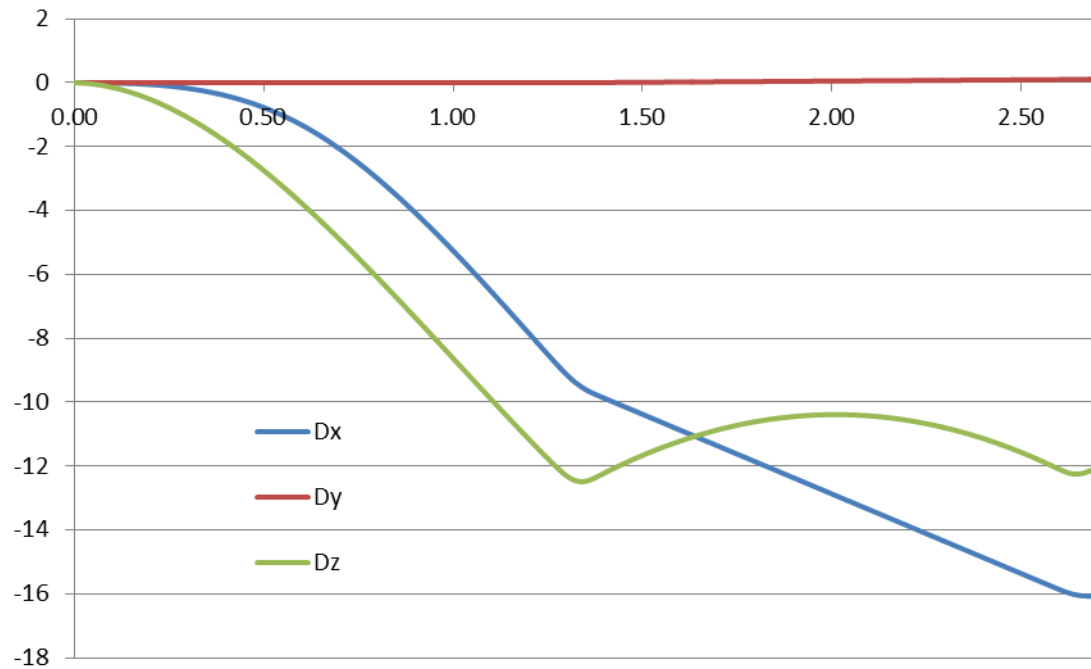
- Correlation with the damage observed on aircraft leads to following envelope:



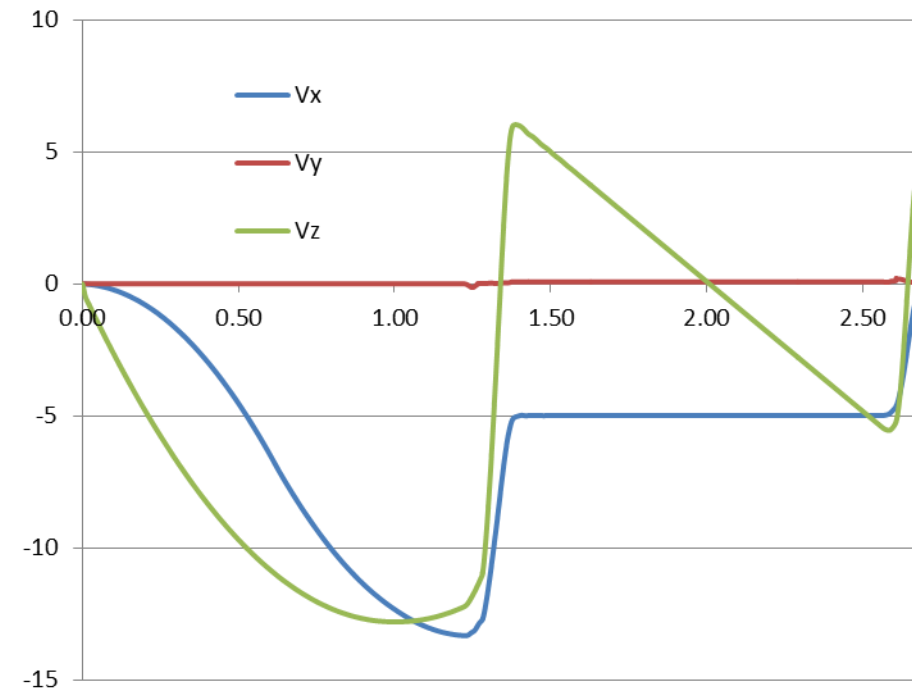
Good correlation of simulation

CoG displacements and velocity history

CoG displacement (m) in Earth coordinate system

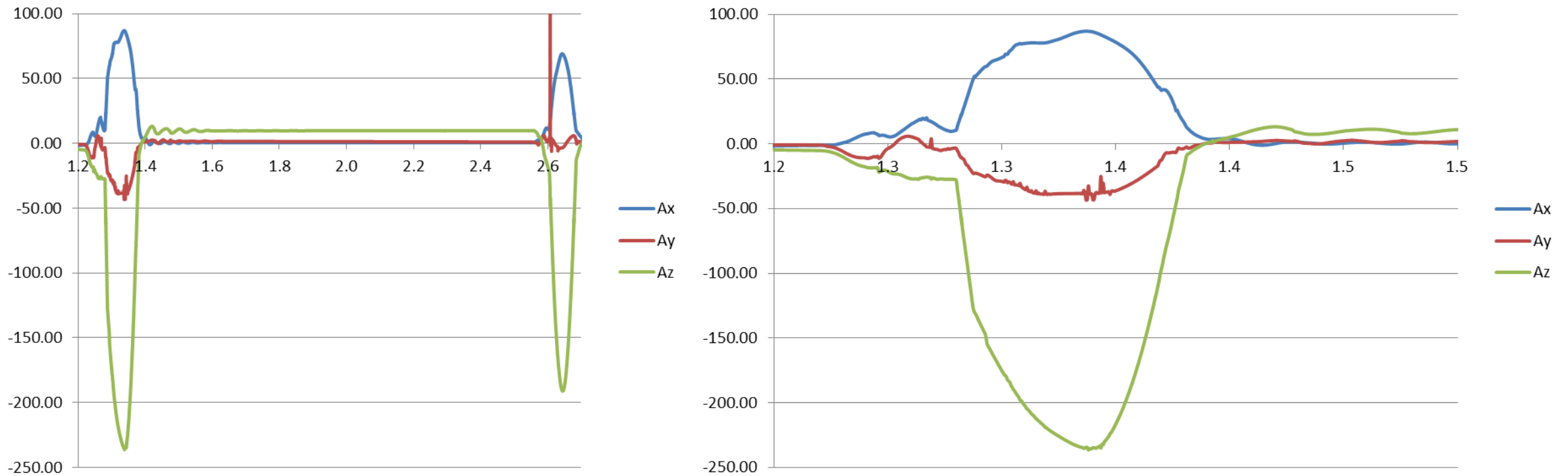


CoG velocity (m/s) in Earth coordinate system



CoG acceleration history

CoG acceleration (m/s²) in aircraft coordinate system



Aircraft occupants acceleration history

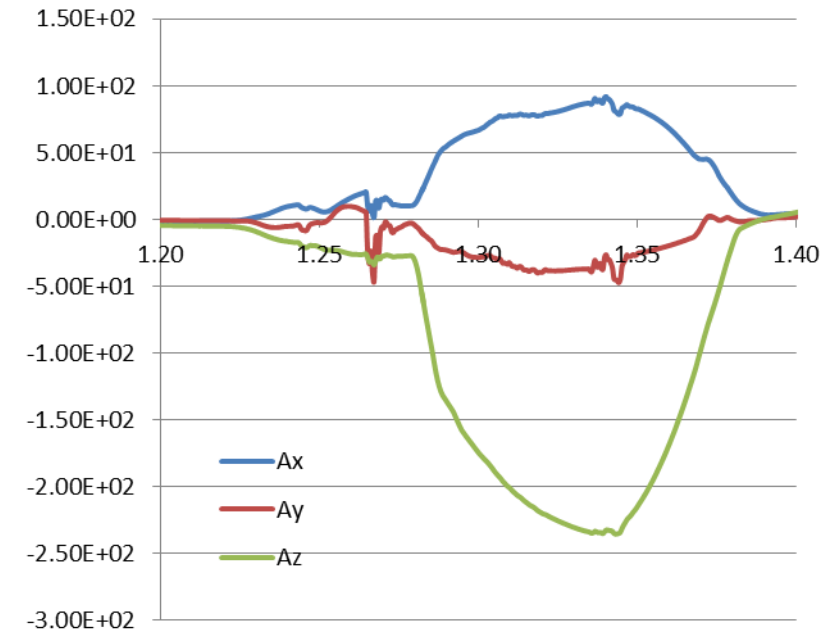
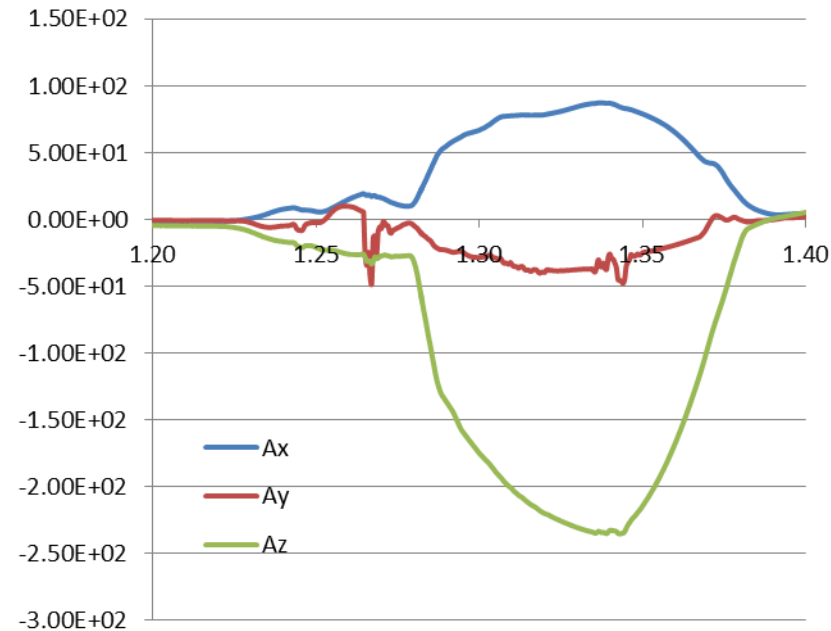
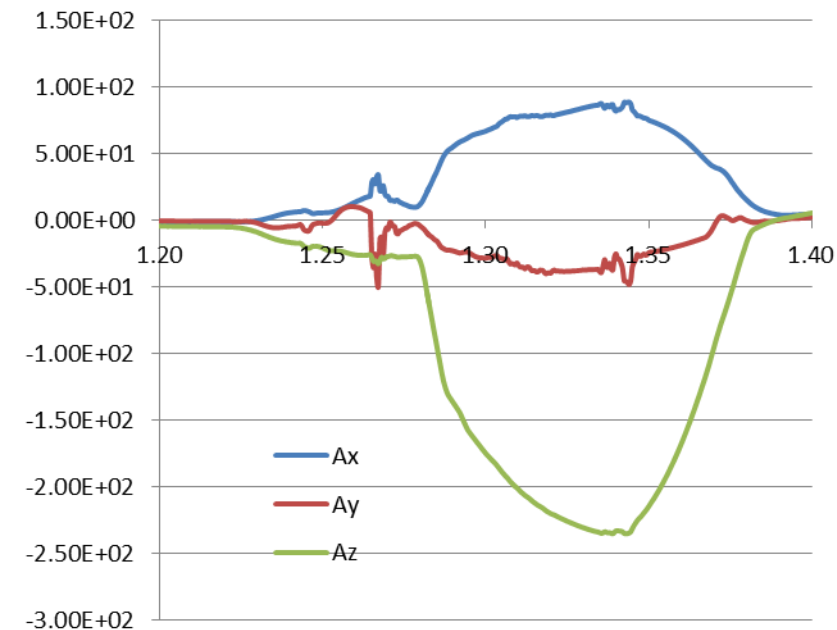


Occupants acceleration (m/s²) in aircraft coordinate system

Pilot

Front central passenger (injured)

Front right passenger

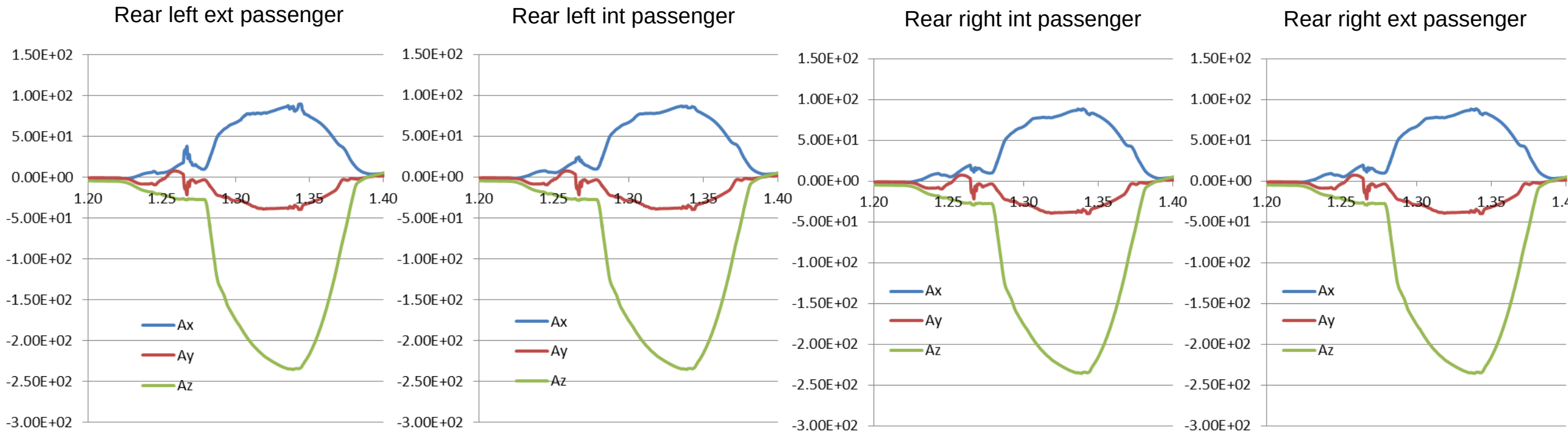


Due to low level of rotation acceleration at CoG, accelerations are not significantly impact by position

Aircraft occupants acceleration history



Occupants acceleration (m/s²) in aircraft coordinate system



Due to low level of rotation acceleration at CoG, accelerations are not significantly impact by position

Thank you