Vamsee Achanta

From: Orcina <orcina@orcina.com>
Sent: Friday, June 6, 2025 5:38 AM
To: Vamsee Achanta
Cc: Scott McClure

Subject: RE: Orcaflex | Understand Fender Force vs. Displacement
Attachments: simplified RAOs.dat; results.wrk

Dear Vamsee,

Thank you for your emails. I'll start by mentioning that definitions of the results for constraint objects can be found in the documentation here: Modelling, data and results | Constraints | Results. Constraint in-frame and out-frame results can sometimes be a little difficult to understand, so, after reading the documentation, if you have any further questions on this or would like a more thorough explanation of these then do let us know.

I've not done a full check of your model, but I can see that you are mainly looking at results for the constraint 'fenderFST1L1', so I will focus on this constraint in my explanation. This constraint is free in its local x direction and fixed in all other degrees of freedom. The non-linear translational stiffness is therefore applied in the constraint's local x direction and the out-frame is rigidly fixed to the in-frame in all other DOFs.

To understand the constraint forces and interaction between the fender and shape in your model, I found it helpful to simplify your model and isolate just one fender i.e. I copied the fender objects, contact shape, and vessel FST1 into a blank OrcaFlex model, fixed the shape and changed the vessel from calculated to displacement RAOs. I have attached this model to this email (*simplified RAOs.dat*) in case this is also helpful for you. I've also attached a workspace file (*results.wrk*) with some results that may be of interest.

In your screenshot, it appears that you have plotted the constraint x result and the in-frame connection force for fenderFST1L1. As stated on the help page linked above, the in-frame connection force is the *magnitude* of the total force applied to the in-frame by the object to which it is connected, i.e. this will include the contribution of force components in all directions. Instead, you can plot the In-frame Lx connection force result to give you the component of the total force in the local x direction of the constraint. This should give connection force results that are consistent with the non-linear translational stiffness that you have defined. You can plot an X-Y graph of 'x' against 'In-frame connection Lx force' to check that the simulation results match the non-linear translational stiffness data that has been defined.

You might notice that the x displacement result is positive whilst the in-frame connection Lx force is negative. In your model, when the displacement is positive, the in-frame moves (with the displacement of the vessel FST1) and gets pushed into the elastic solid shape, whereas the out-frame gets pushed away from the in-frame, in the positive local x direction, due to contact between the 6D buoy and the surface of the elastic solid shape. At this time, the in-frame connection Lx force is negative. You can see from the above help page that the in-frame connection Lx force is the "x component of the total force applied to the in-frame by the object to which it is connected". This implies that the force on the in-frame of fenderFST1L1 from the vessel FST1 is in the negative x direction. This is to be expected when the FST1 vessel is pushing the fender into the elastic solid shape.

I can see that the approach followed in your model is similar to the C09 example which models 'cell type' fenders using constraints. I can also see in your model that you have used a cylindrical drawing type shape to visually represent your fenders, yet the 6D buoy used for contact between the FST1 fenders and LNGC_contact shapes is a flat surface. Based on the drawing object in your model, these look more like Yokohama fenders. If you want to model cylindrical fenders, then you may choose to do this without using constraints - simply by modelling the interaction between the fenders and the vessel using contact between buoys/lines and elastic solids (and perhaps a non-linear normal shape stiffness?). If this is something you would like to explore further, then please let us know and we would be happy to send some example models that demonstrate how to do this.

I hope this helps you to confirm that the non-linear translational stiffness is acting as you expect. Please do let us know if you have any more questions on this or if you'd like to discuss anything further.

Best regards,

Caitlin Fawkes

orcina@orcina.com
+44 (0)1229 584742
www.orcina.com

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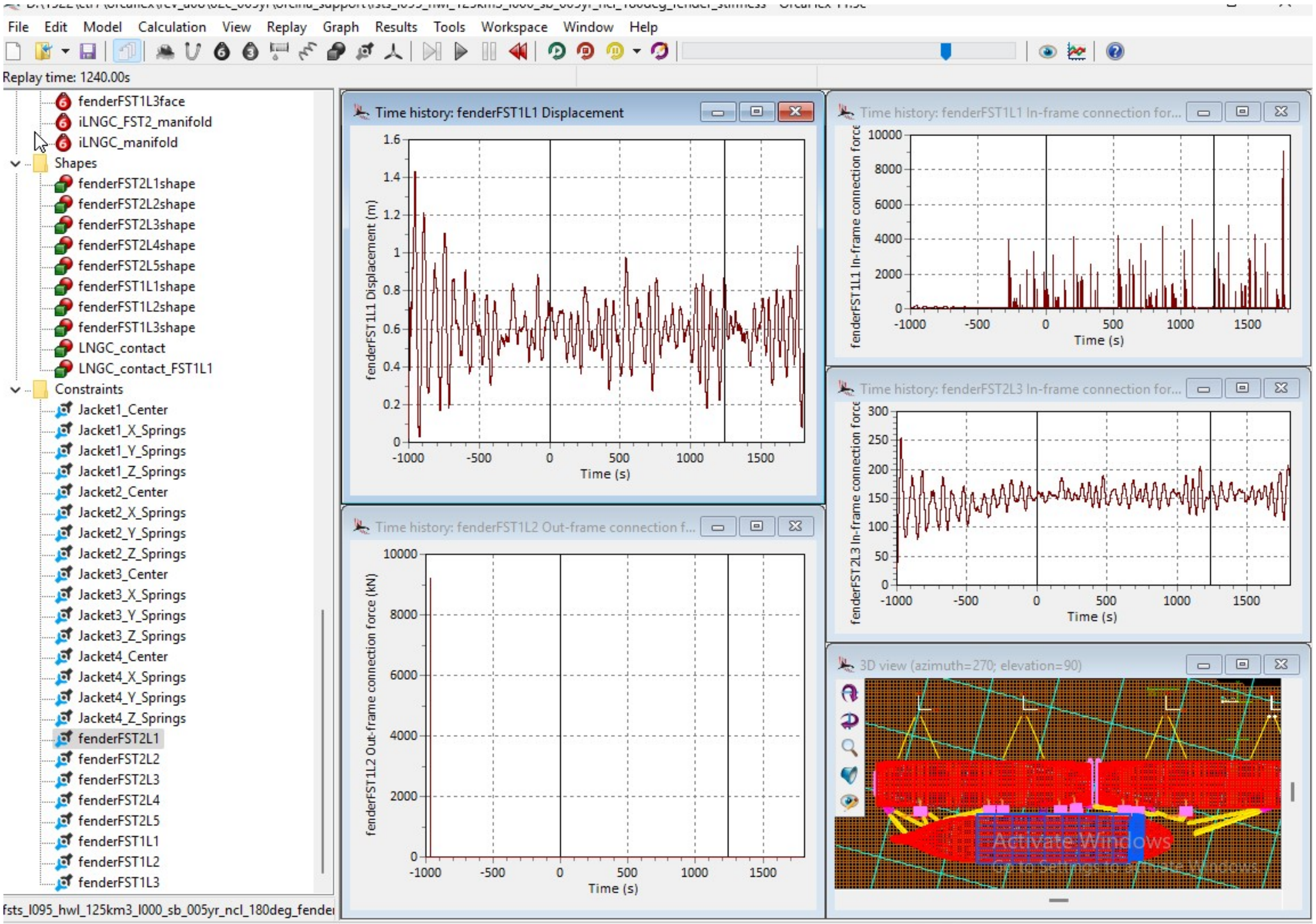
From: Vamsee Achanta
Sent: 06 June 2025 05:01
To: Orcina
Cc: Scott McClure
Subject: RE: Orcaflex | Understand Fender Force vs. Displacement

I reduced the stiffness curve force by 10 times and it seems to be changing the displacement and force curves.

I probably got the non-linear curve definition. Please provide an example or documentation so that I can correct my input data.



Thank you,

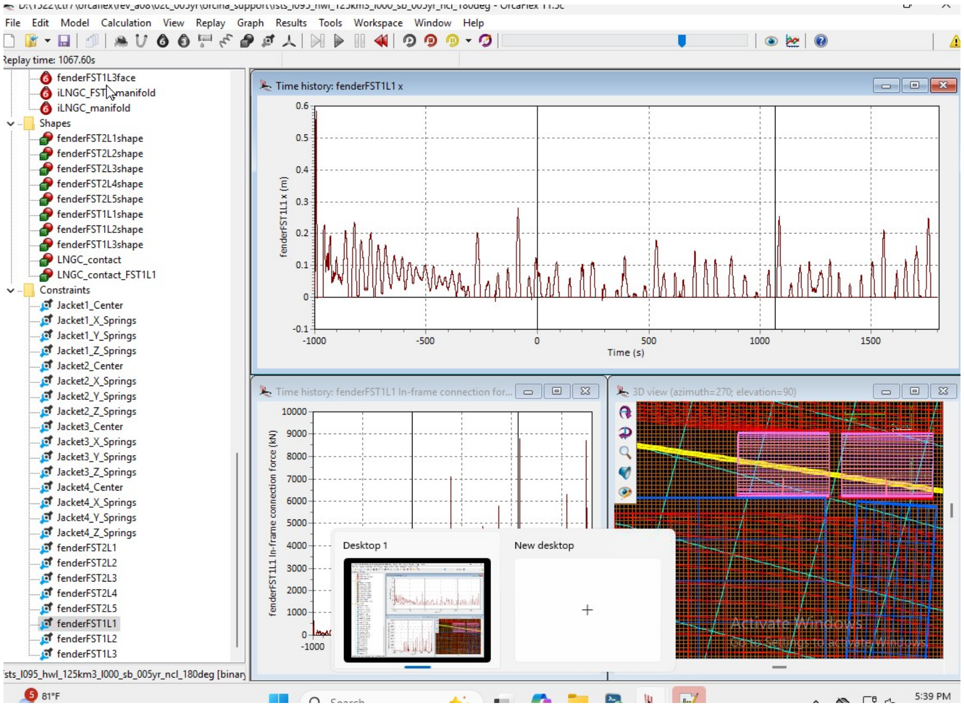
Vamsee

From: Vamsee Achanta
Sent: Wednesday, June 4, 2025 5:43 PM
To: Orcina <orcina@orcina.com>
Cc: Scott McClure <scottm@acma-inc.com>
Subject: Orcaflex | Understand Fender Force vs. Displacement

Dear Support Team,

Please can you help understand the fender displacement vs. force for this model. For Fender we get a force of ~8000 kN for a displacement of 0.3 m (see schematic below). However, based on the translational stiffness curve we gave, we should get a displacement of 3.3 m. Please help understand if we did anything wrong in defining the input data or interpreting the output etc.?

Also, please send documentation to understand the difference between inframe and outofframe quantities?



As always, thank you for the fast response,

Vamsee