Subject: [Cares-members] Fwd: Orbiter report produced in 2007 by HSL/HSE
From: "Magdy Guirguis" <MagdyG@gw.doa.state.ri.us>
Date: Wed, 09 Sep 2009 08:21:07 -0400
To: <cares-members@uscancares.org>

Good Day CARES:

I am forwarding a response from Matthew Birtles from the Health and Safety Laboratory in the UK, with regards to comments I sent on the UK Tivoli Orbiter ergonomics report NAFLIC forwarded to CARES a while ago. As it turned out, there is a slight typo in the report summary, and Mr. Birtles also provided thorough insightful explanations, as well as a photo to clarify one of the issues questioned, FYI.

MAG

<Matthew.Birtles@hsl.gov.uk> 9/9/2009 7:28 AM >>>

Dear Megdy

Your email dated 27th August, this has come through to me as the original
author of the work. Apologies in the delay replying to you. I have been
away from the office recently, most recently looking at a 100 year old
steam yacht ride which was very interesting.

Thank you for showing an interest in this work involving the ergonomics
assessment of the Orbiter , and for your comments and correction. I will
go through each of the points you made and try to provide you with an
explanation of my thinking which hopefully will clarify.

You wrote:

"peak forces around 22000 N pushing force may be applied, and around 234 NM
torque ...". The 22000 Newton pushing (positive x) force
is clearly a typo because it means a person may push with an active force
forward equal to 16 times his/her weight, no matter how hard they
push their back against the seat. Most likely the intent was 2200 Newton,
as may be seen by comparing to Table 1, where the average
maximum Horizontal pushing force forward is 2000 Newtons, and with the
third bullet under "Conclusions" on the last page. Please confirm

I can confirm that this is indeed a typo in the executive summary, and

should read: "peak forces around 2000N pushing force may be applied....[to the restraint bar]". This is based on there being two large males both in the seat at the same time, and both pushing the bar with equal, maximum strength of 1000N each. Table 1 introduces details of the maximum forces that could potentially be exerted on the main handrail (main bar) by passengers and suggests this figure of 2000N as an estimated maximum forces for passenger combinations (N). Thank you for pointing this out.

You wrote:

b) Under Figure 10, first paragraph, fifth line down, " .. rendered heavier due to the g-force vector from combination of positive accelerations in the z and x directions..." . The most likely intent is " .. accelerations in the z and y directions", because the "g-forces" are in the z and y directions as a result of centrifugal forces, which does not exist in the x direction. Please confirm.

In this case I do actually mean to refer to the forces in the z and x directions. I agree, that the centripetal force will act in the y-axis, and this will also play a part in an occupants ability to 'hang on', by 'sending' them sideways to the right hand side with varying degrees of magnitude. As this section of the report was focussing on the risk of ejection underneath the lapbar, and then forwards out of the ride I didn't initially refer to the sideways forces acting on the occupant.

With my reference to the accelerations in the z and x directions, the peak x-axis acceleration is occurring when the ride is facing downwards and so gravity contributes to a net resultant force acting to 'push a person' away from their seat back, sliding them forwards. In the image below (taken from an internet image of an orbiter as my own are not great quality), the moment in time that I am referring to here is displayed in the car circled. This ride photographed is capable of becoming more vertical than the one I measured (i.e. the arms raise higher) so the z-axis forces (acting downwards toward the floor) would no doubt be less.

(Embedded image moved to file: pic04827.jpg)

2. The conclusion of the study recommends that the height limit be increased to 4'-6". However, in the summary last bullet the study indicates to "Revert the height limit to 4'-6"". The height limit I have for the Tivoli Orbiter is 4 feet. Could you please confirm that the original height limit for the Orbiter was 4'-6" and was subsequently reduced by Tivoli?

On this point, the HSE Inspector who I accompanied on this investigation has kindly been in contact and confirms that the height limit operating on the ride that we looked at was 4 foot and also that was the height limit specified in the Operators manual that the operator had from Tivoli. There is further confirmation as the Inspector had a copy of an email from another contact, who visited Tivoli confirming that the height limit actually used to be 43" but was changed to 48" at the suggestion of the "American authorities" but the company had no scientific basis for this available at the time.

In the case of the ride we investigate, the ride had previously been operating with a 4' 6" height restriction which was lowered by the operator to 4'. We obviously suggest that this should be increased back to 4' 6" after looking at this with a more scientific approach.

I hope this information is useful, and clears up any of my omissions in me previous work.

If you have any more questions, please feel free to contact me directly, and I will ensure to pass on any of your points to the relevant people here in HSE.

Kind regards

Matthew

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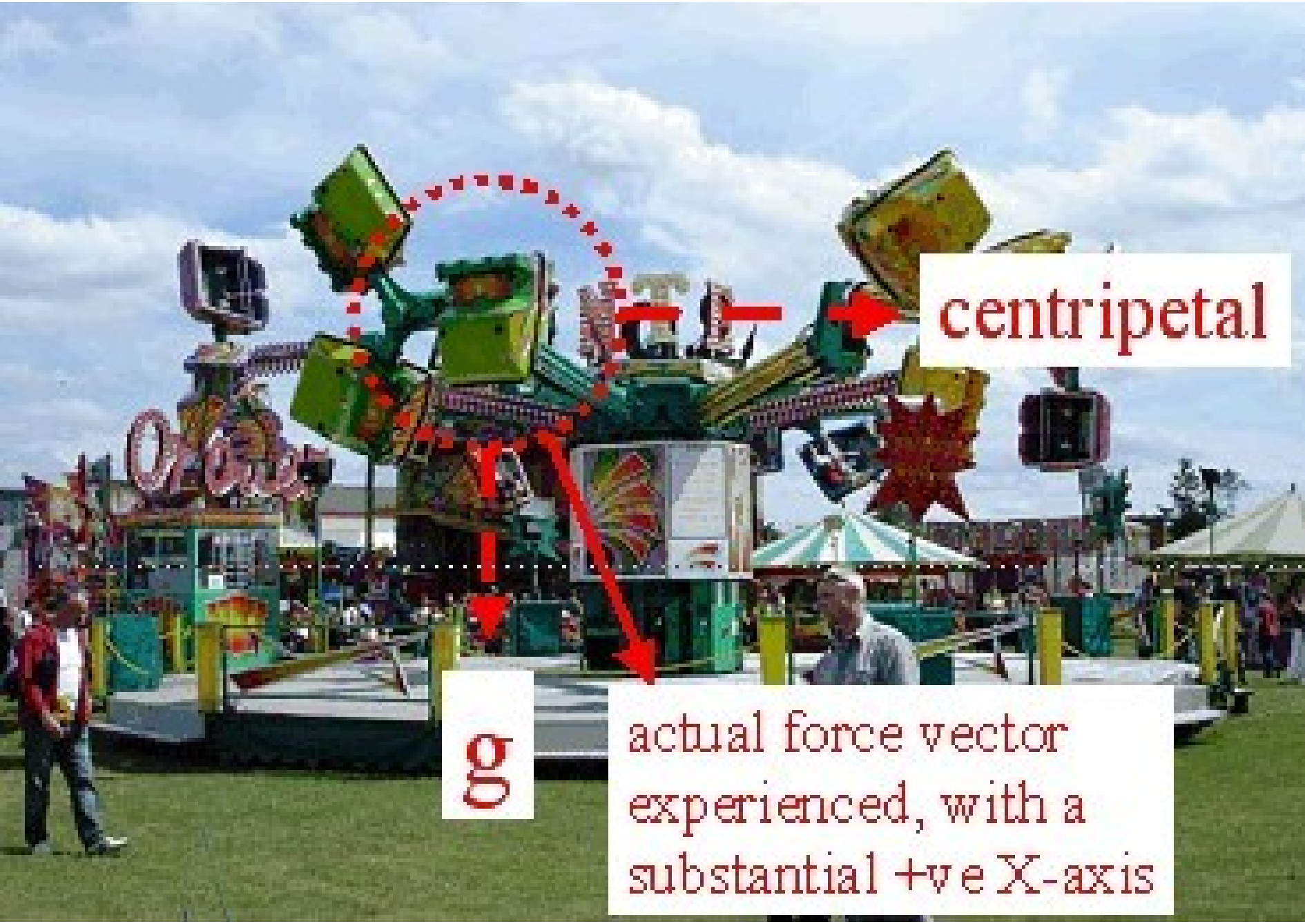
centripetal
g
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substantial +ve X-axis