53

From: "Ammerman, Douglas J" <djammer@sandia.gov>
To: "'Shah, Mahendra'" <MJS3@nrc.gov>
Date: 10/28/02 6:04PM
Subject: RE: Cask exit velocity

Mahendra,

For high-speed impacts the shear strength of the fuselage is small relative to its momentum. The change in momentum due to this force is equal to the magnitude of the force times the time of application (actually the integral of the force vs time curve), since the shear area of the fuselage does not vary much with time. The initial total momentum of the airplane is (158,416)[redacted] kg*m/s. I do not have a good estimate for the shear strength of the fuselage, but 1,000,000 pounds (= 4.4E6 N) is probably much too high. Using this force times the 0.15 seconds of simulation time results in a change of momentum of only [redacted] or about 2% of the total momentum due to shear transfer from the airplane components outside of the cask cross section. Ex 2

Your comment about mass of people, seats, etc. is correct. In the CTH model and my hand calculations, the mass of these components is smeared into the mass of the fuselage.

I agree that we should assume the jetliner only impacts a single cask, because it is possible to envision a scenario in which that applies.

> ----------
> From: Mahendra Shah
> Sent: Monday, October 28, 2002 11:58 AM
> To: djammer@sandia.gov
> Cc: Bernard White; Daniel Huang; Jack Guttmann; Robert Shewmaker; Ron
> Parkhill; gcbesse@sandia.gov; jasmith@sandia.gov; jlsprun@sandia.gov
> Subject: Re: Cask exit velocity
>
> Doug:
>
> I have reviewed your simplified calculation of the cask sliding velocity
> due to a jetliner impact, prepared to verify the CTH analysis results.
> Even though I agree with the overall details used in the calculation, I
> have a question about the assumption that the only mass effective in the
> momentum transfer is the impacted center fuselage mass of approx.[redacted] Ex 2
> (including Front wheel and center fuel tank). Mass of the wing and other
> components (approx. 110000 Kg), and the non-impacted center fuselage mass
> are also attached to the fuselage, and thus must be considered in the
> conservation of momentum equation.
>
> If we consider the other masses and even assume that part of the mass of
> the fuselage (people, seats etc.) do not remain in the fuselage as a
> result of the impact, we would still have a significant mass of the
> jetliner sliding with the cask, yielding the cask velocity significantly
> greater than what is computed by the CTH program.
>
> In reality, the jetliner impacts more than one cask, which may reduce the
> cask sliding velocity to values close to the velocity predicted by the
> CTH. However, we are attempting to verify the CTH analysis case, which
> considers only one cask being impacted by the jetliner.

E/54

Portions Ex 2

>
> I appreciate your help. If you have some other suggestions to demonstrate
> that the CTH analysis results are reasonable, please let us know.
>
> Thanks.
>
> Mahendra
>
>
> >>> "Ammerman, Douglas J" <djammer@sandia.gov> 10/23/02 10:50AM >>>
> Mahendra,
>
> The attached document has a discussion of the method I used to derive an
> exit velocity for a cask being impacted by an airplane.
> The resulting exit velocity of [redacted] agrees fairly closely to the Ex 2
> results
> from the CTH analysis. I think that this method could also be used to
> estimate the velocity at partial crush distances.
>
> Let me know if you have any questions or comments.
>
> Doug
>
> <<cons_momentum .doc>>
>
> Doug Ammerman
> Sandia National Laboratories
> Transportation Risk and Packaging
> MS 0718
> PO Box 5800
> Albuquerque, NM 87185
> phone: (505) 845-8158
> fax: (505) 844-0244
> email: djammer@sandia.gov
>
>
>

CC: "Bernard White" <BHW@nrc.gov>, "Daniel Huang" <DTH@nrc.gov>, "Jack Guttmann" <JXG@nrc.gov>, "Robert Shewmaker" <RES@nrc.gov>, "Ron Parkhill" <RWP@nrc.gov>, "Bessette, Gregory Carl" <gcbesse@sandia.gov>, "Smith, Jeffrey" <jasmith@sandia.gov>, "Sprung, Jeremy L" <jlsprun@sandia.gov>

Portion Ex 2