We have recently received a copy of a highly technical paper: An Investigation of Head Sea Parametric Rolling and its Influence on Container Lashing Systems. For those Members operating large container ships (C11's in particular) and RO-RO's the paper is well worth reading in full (see below).

In late October 1998 a laden post Panamax (C11 Class) container ship was overtaken by a violent storm in the Pacific Ocean. The Master of the vessel attempted to 'heave to' in extreme conditions, despite his efforts the ship rolled to 35° to 40° and as a result several hundred containers were lost over the side and several hundred more were severely damaged. The Master observed that during the worst storm conditions the ship was out of control.

During investigations that followed on the C11 hull shape (extensive bow and stern flare) the results indicated that if the model was pitching at angles of about 4° with, negligible roll response, a small excitation such as introduced by a rudder movement would cause the vessel to take a small roll to one side and roll angles would then increase rapidly to over 90° in only five roll cycles. This behaviour is known as parametric rolling.

Parametric rolling is an unstable phenomenon which can quickly generate large roll angles that are coupled with significant pitch and yaw motions when the following requirements are satisfied:-

1. The ship is in head or near head seas
2. The natural period of roll is equal to about twice the wave encounter period.
3. The wave length is of the order of the ship length.
4. The wave height exceeds the critical level (the height which will allow the ship's natural pitch/roll cycle to harmonise with the period of oncoming waves.)
5. The roll damping is low.

Roll damping is dependent on speed. Bow seas result in lower speeds, thus lower roll damping and this results in larger roll motions.

Naturally parametric rolling has a very large effect on container securing systems and result in cross-deck accelerations that are 35% to 80% higher than anticipated. The increase in loads on containers and container lashings were found to be sufficient to induce failure in stacks loaded in the C11 lashing criteria.

The issue of cargo stowage and securing was addressed in the Steamship Mutual Management Highlights for both 2000 and 2001 (p38 for both years) which were sent to Members with the Report and Accounts for those years.

The full report is available here for download in the Adobe PDF format:

An Investigation of Head Sea Parametric Rolling and its Influence on Container Lashing Systems