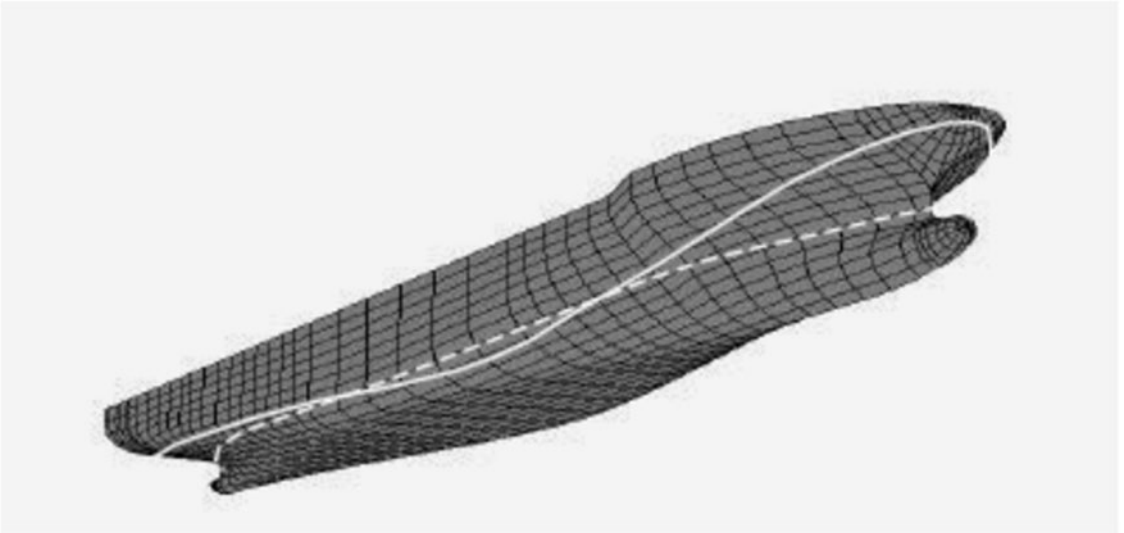
Parametric rolling

- The Physics Behind Parametric Rolling
- Parametric Rolling is a problem related to hullforms that experience considerable change in submerged volume when a wave passes longitudinally along the ship. This is significantly seen mostly in hulls having large bow and stern flares, stern overhang, and fine underwater hull form, that is mostly in container ships, fishing vessels and in some cases, roro and passanger ships too. The same problem was not encountered in full form hulls like oil tankers and bulk carriers. Why?

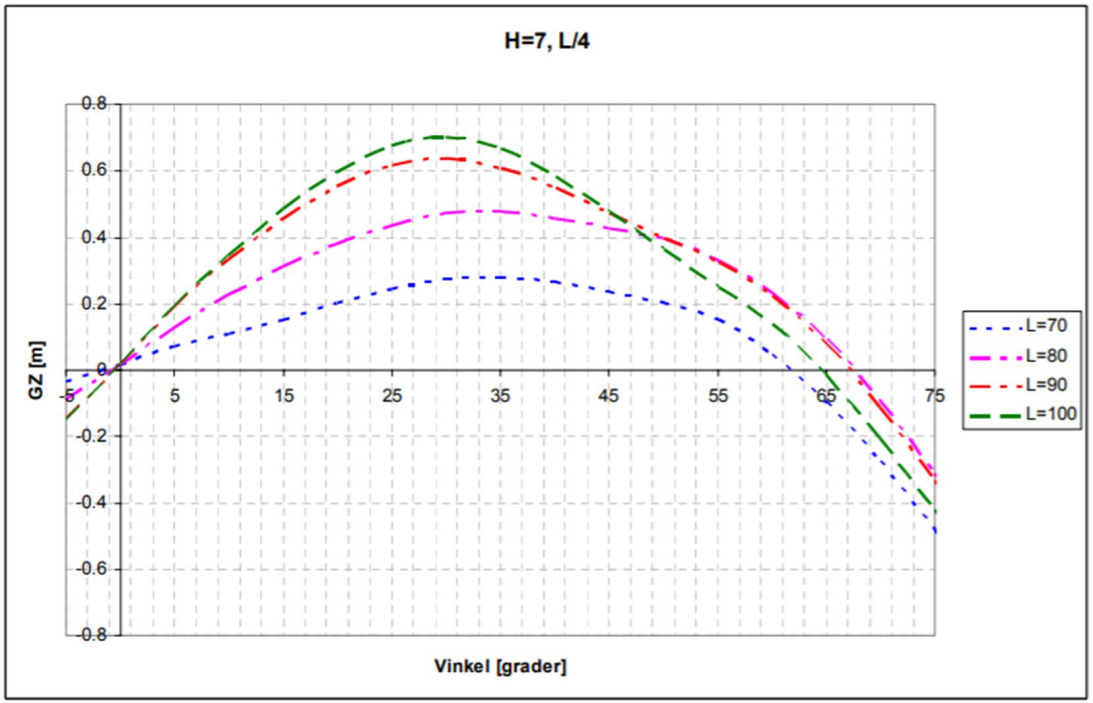
- In fine form hullforms with large flares and overhangs, the profile of waterlines when the ship experiences head seas changes rapidly as shown below:

Skrovform

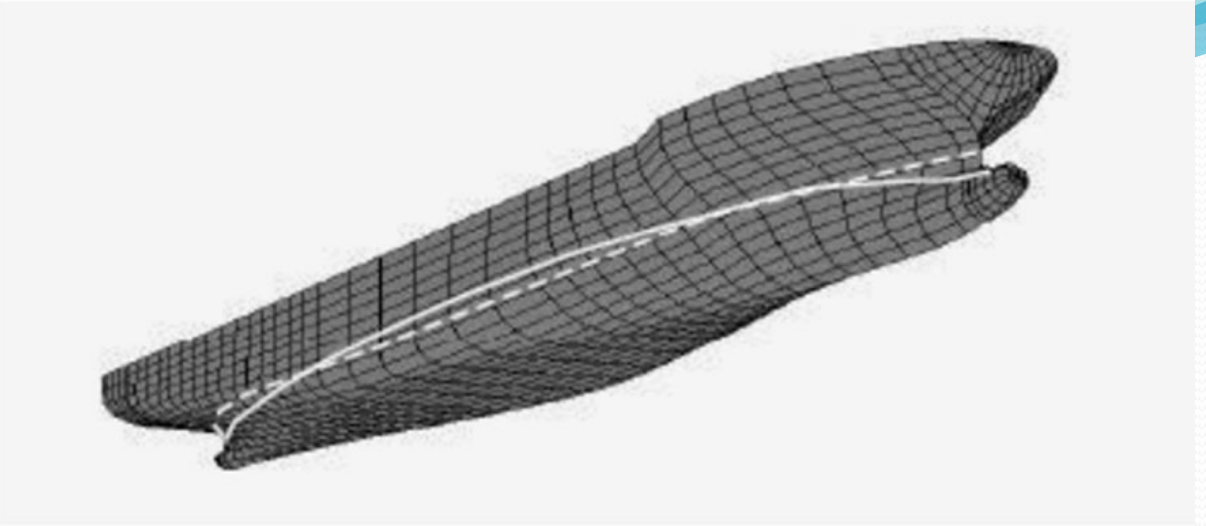
When wave trough is at midships, the water plane width is more than that in case of still water, resulting in increased stability (GM) than still water condition.



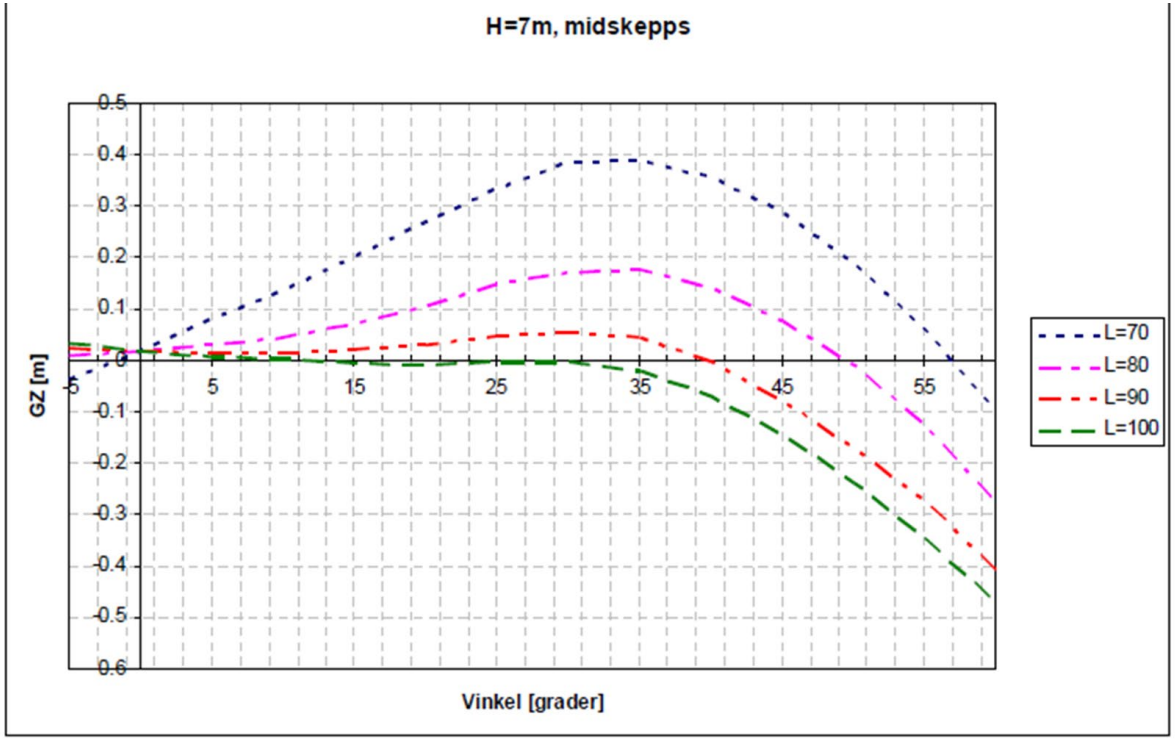
Dotted Line: Waterline in still water
Continuous Line: Waterline when wave troughs at midships



When wave crest is at midships, the water plane width is less than that in case of still water, making the stability (GM) less than that of still water condition.

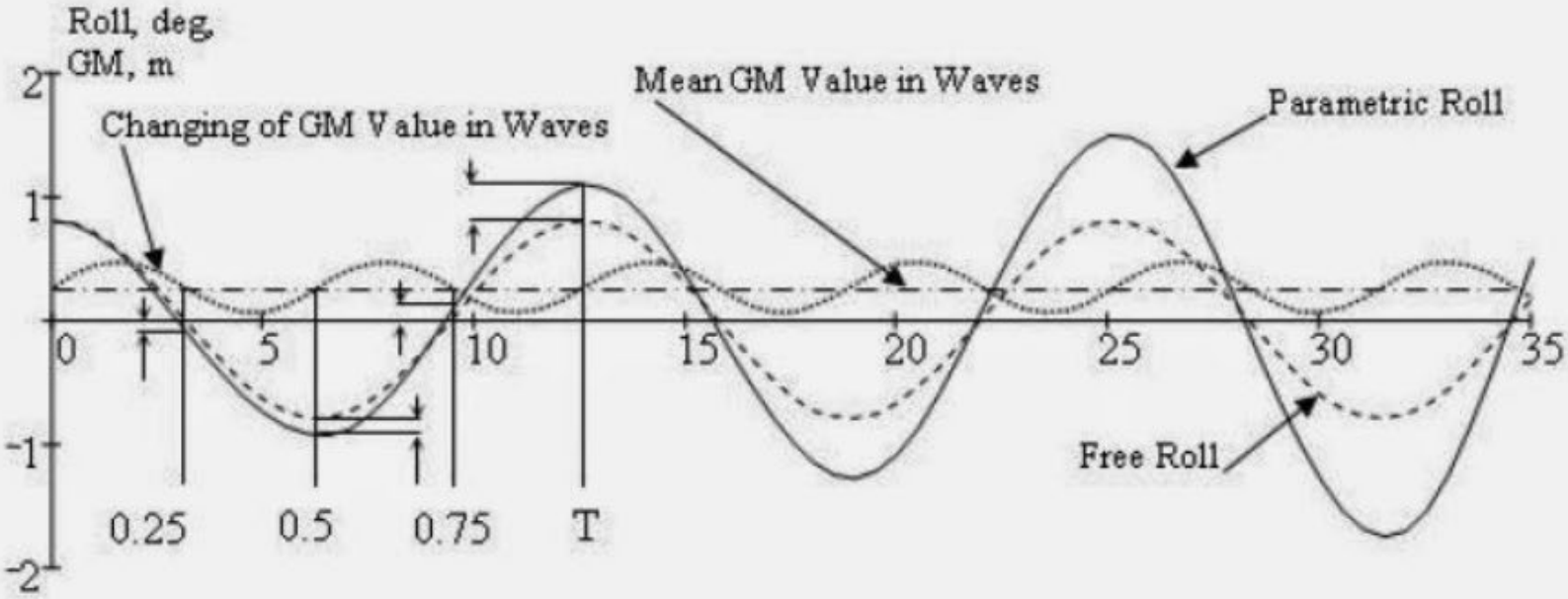


Dotted Line: Waterline in still water
Continuous Line: Waterline when wave crest at midships



- This results in periodical increase and decrease in metacentric height of the ship. In one complete passage of a wave along the ship's length the GM increases and decreases once; that is, stability variation occurs twice in once wave period

In the first quarter (T = 0 to T = 0.25), when the midship experiences a wave trough, the GM increases (obviously, periodically varying according to the wave profile). So the roll angle decreases (initial roll degree was present due to small rolling motions in the ship). Had the ship been in still water, its roll angle at the end of the first quarter would have been zero. But a higher righting lever now actually causes the ship to end up with a slight roll angle to the other side! (just concentrate in the first quarter in the figure below)



•Curse inertia, because of which the ship begins its roll to the other side. Don't forget, you've entered the **second quarter (T=0.25 to T=0.50)** i.e the midship now experiencing a wave crest. You're right! Decreased stability. And that means reduced righting lever compared to still water condition. By the end of this quarter, your ship's roll angle to the other side is more than what it would have been in still water. *(refer to the second quarter in the above diagram)*

In short, your ship is in trouble, as this phenomenon will only keep increasing untill it achieves a resonating condition. Goodbye to containers on the deck!

Containerfartyget One Apus 14000 TEU, 364 meter långt, byggt 2019 tappade 1816 containrar 30 november 2020, i hårt väder.

https://www.youtube.com/watch?v=zL1HBYDIRBo