Why container loading on board of ships is not save.....

There is some substantially fault with container loading and lashing on board of ships, especially on ultra large container vessels. The recent MSC Zoe accident, near a unique world heritage coast, shows a very bad impact on our environment, just at the moment that people realize how unacceptable pollution through, formally plastics is!
Remarkable is also that the weather conditions where not extreme for this size of vessel! It was not necessary and this is not the first accident with lost containers.
Attention should be payed also to previous losses and accidents.
It seams to be nasty to accept the consequences of necessary measures to make this transport saver until now .
The accident with MSC Zoe should be a sign to reconsider how to convey goods across all seas without container losses! Each lost container is one to much!

There are a lot of critical questions waiting for an answer. Based on my professional interests I start with a contemplation of containers already stowed on board.
First of all we ever learned to check every allegation to be save that everything is also correctly is executed.
Nowadays in the case of container loading input for the loading calculator are the “digital loading papers”. Of course manual input is impossible with such a giant bulk of data also it made avoid human errors. But it is a big mistake that these giant numerical data are flawless! It is much worse: nobody is able to find faults:

- Is the gross weight of a container correct? The checked displacements by draft of the vessel often differs from the data on the loading calculator. From an earlier accident it's documented, that the responsible officer stated that the measurement of draft was not accurate, the displacement found by this drafts where not correct, but the loading calculator was right. **It is a big danger to believe the computer uncritically!**
- Next question is the content of the container according the loading files what it really contains? Not always, for example in a container where found drugs in stead of bananas.
- Also a good question is the securing of cargo inside a container. Unless sufficient stowage the container under consideration may damage. That it may cause failing of a whole stack or more is not imaginary
- Twist locks are mainly automatic devices on ultra large vessels. How is their working guaranteed and checked”? Manual handling and control on large stacks is nearly impossible.

What we have to believe while loading and while sailing? What is really checked? Can it be checked and how will it be done in a serious way?
Last but not least a questions about the container itself: Is the container is acceptable condition? Damages especially on the corner frames and bad corrosion are stated by containers which are still used on board. We are sure that several used containers are not save enough for use on board.

An independent expertize must lead to handle container data also on large vessels much better.

Forces on containers, stacks and bays

To calculate forces in container lashing of stacks and bays a calculation model has to be created describing the physical properties of the lashing structure including the boundary conditions
Beside a realistic weight and cog of each container, a realistic approach of the behavior at sea has to be found. The resulting dynamic forces are to determined for several points of the ship's movement.
Calculations of dynamic moment has to be done quasi static for the most critical points of movements may be taking into account additional loads from shock waves.
This is a rough description of an ideal model, but a critical view shows that it is a nasty job to create it because a lot of this previous describe is based on a lot of assumptions
To get acceptable results has be assumptions acceptable also, otherwise the results are rubbish!

It might be necessary to have a critical look on theoretical assumptions (without proof) which are made for calculation of forces and lashing:

- The COG of containers are in the center of the horizontal ground surface and at 1/3 of his hight.
- Elasticity and possible deformation of containers in extreme ship motions.
- If lashing rods are used: the exact tension is not justified while loading.
- Container fittings are fabricated with tolerances according ISO. Due to these tolerances small movements between containers or container and ships fittings are possible. This fact is neglected in calculations. Under low forces movements will be prevented by friction but just is extreme conditions movements and resulting additional forces are unpredictable!
- Twist locks are the standard now. Mainly automatic devices are applied. Theoretical the must be open or closed and it's digital to control. The exact position within the tolerances is not known
- The base of stacks is stated endless stiff in calculation models unless the knowledge of significant elastic displacements of the vessels hull and hatches under seagoing conditions.

Dynamic forces are retrieved from ship's motion described by a period and a movement
Class authorities maintain some simple empirical formula's to describe the behavior at sea assuming cyclic behavior. In general forces are based on the three movements described as heave, pitch and roll. The used parameters usually have a historical source from more than many decades ago!
Real time measurements of the movements at sea are not usable for determination of forces in the design stage of a next generation container vessel! Suggestions often are made that the related forces are to large, without any proof! But couldn't the opposite just true?
One should realize that design data are used outside the range of the history of built vessels

Of course, for a design of container vessels and it's lashing system, real time measurements on the considered vessel of ships motions are too late to contribute to the design criteria, but they could warn if the used design data are exceeded.

Not only the motions of the vessel are of interest, also the elastic or plastic reaction (and related forces) of vessel, hatches and the whole lashing system is of interest of which we know too less!
It's known that noise is going with movements of containers loads caused by heavy sea. This noises are the result of force on container stacks and bay.
In this context displacement could be

- sliding exceeding static friction and stopping at the end of sliding
- large elastic displacements caused by shock forces
- for all plastic deformations and cracks

All these displacements or deformation has a relation to theoretical assumptions as mentioned here before. This makes it irresponsible to continue to accept the most of above mentioned theoretical assumptions.

In general we differ two systems to carry containers cargo on board of vessels

- Cell guides, normally in holds
- container lashings by twist locks and roods normally used on deck/hatches exposed to wind and weather

Te major differences between this systems are that containers in cell guides should not contribute to the strength of the stowing like the containers lashed above deck! Also lashing makes the containers to a part of a model to determine the strength and force on it. It's not acceptable to assume containers as a endless stiff block within this model

For experts in advanced strength calculations, it will be clear that a model created without the document mentioned in this document will be at least 'a heel of a job' or may be impossible. Let alone the professional execution on board

In advance of further investigations already now might be considered the following:
A carriage of large number of containers on large container vessels must be subject to risk of very serious failures if these containers are exposed to wind and weather and only secured by twist locks and lashing roods! Innovations are necessary to reduce these risk to a minimum

In a follow up of this document we will have a critical view on design of these ultra large vessels, the strength of the containers themselves as well on save stowage above deck.