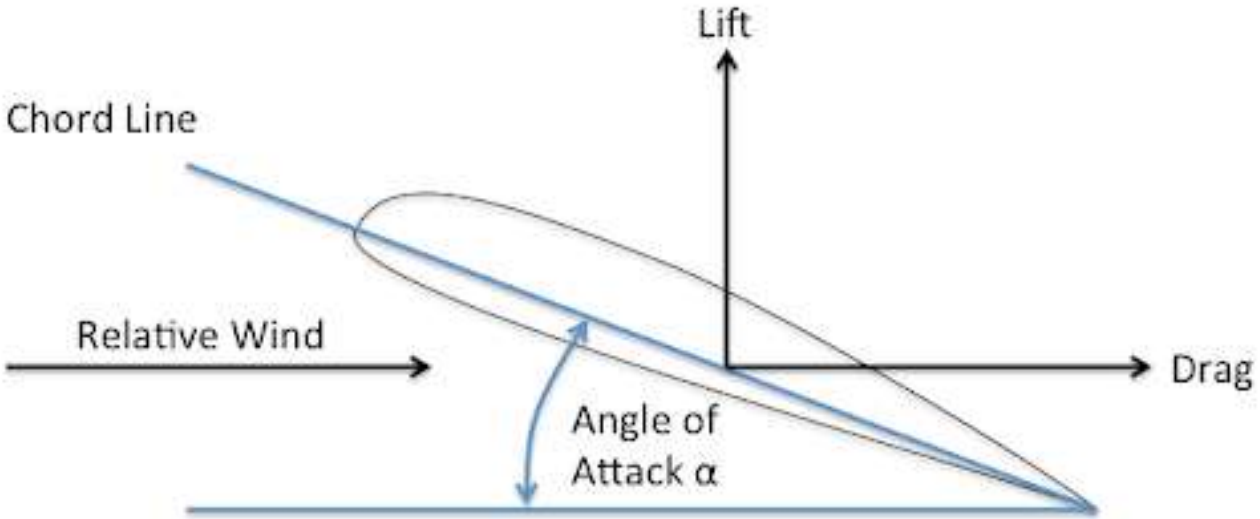
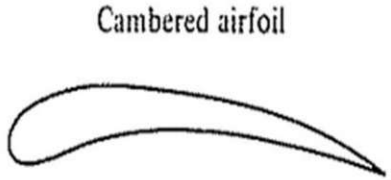
Marine Construction & Welding

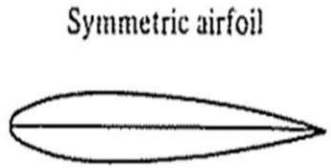
NA21003

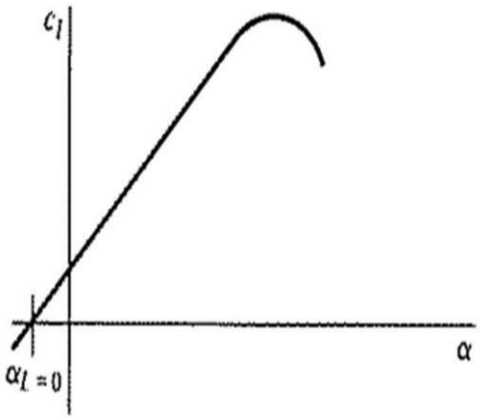
Autumn 2020

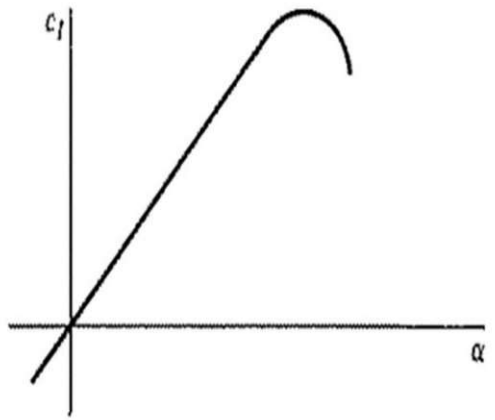
Midship Sections


Lift
Chord Line
Relative Wind
Drag
Angle of
Attack α


Cambered airfoil


Symmetric airfoil


c_l
α
$\alpha_{L=0}$


c_l
α

General cargo ship

Deliver cargo at multiple ports between port of origin and destination.

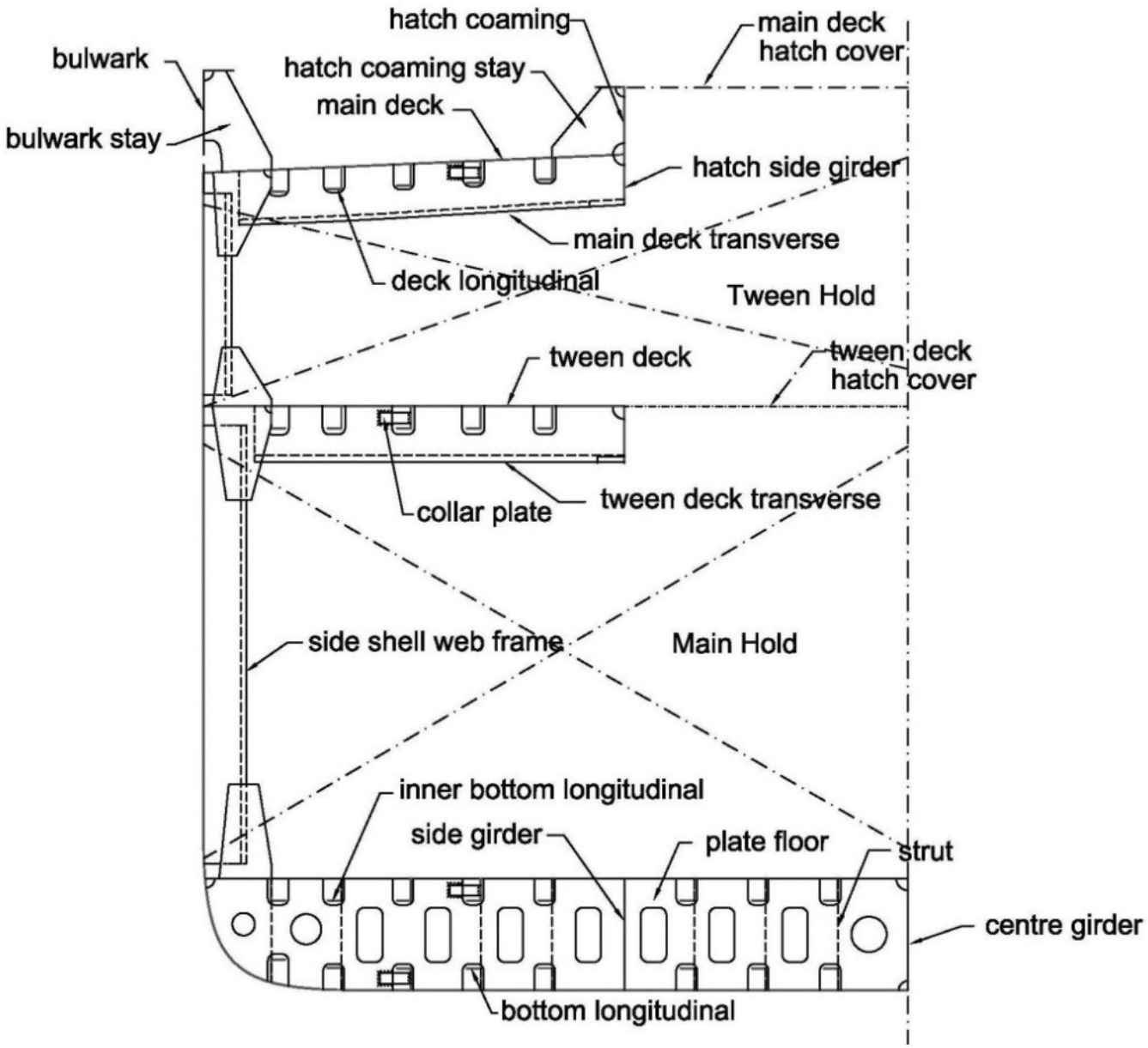
Cargo segregation is done by providing at least one lower deck. Arrangement is done based on cargo discharge schedule.

Longitudinal framing system is adopted in the decks and in double bottom.

Transverse framing system is adopted for stiffening of the side shells.

General cargo ship

General cargo vessel



Bulk carrier

Carry cargo in bulk (loose condition).

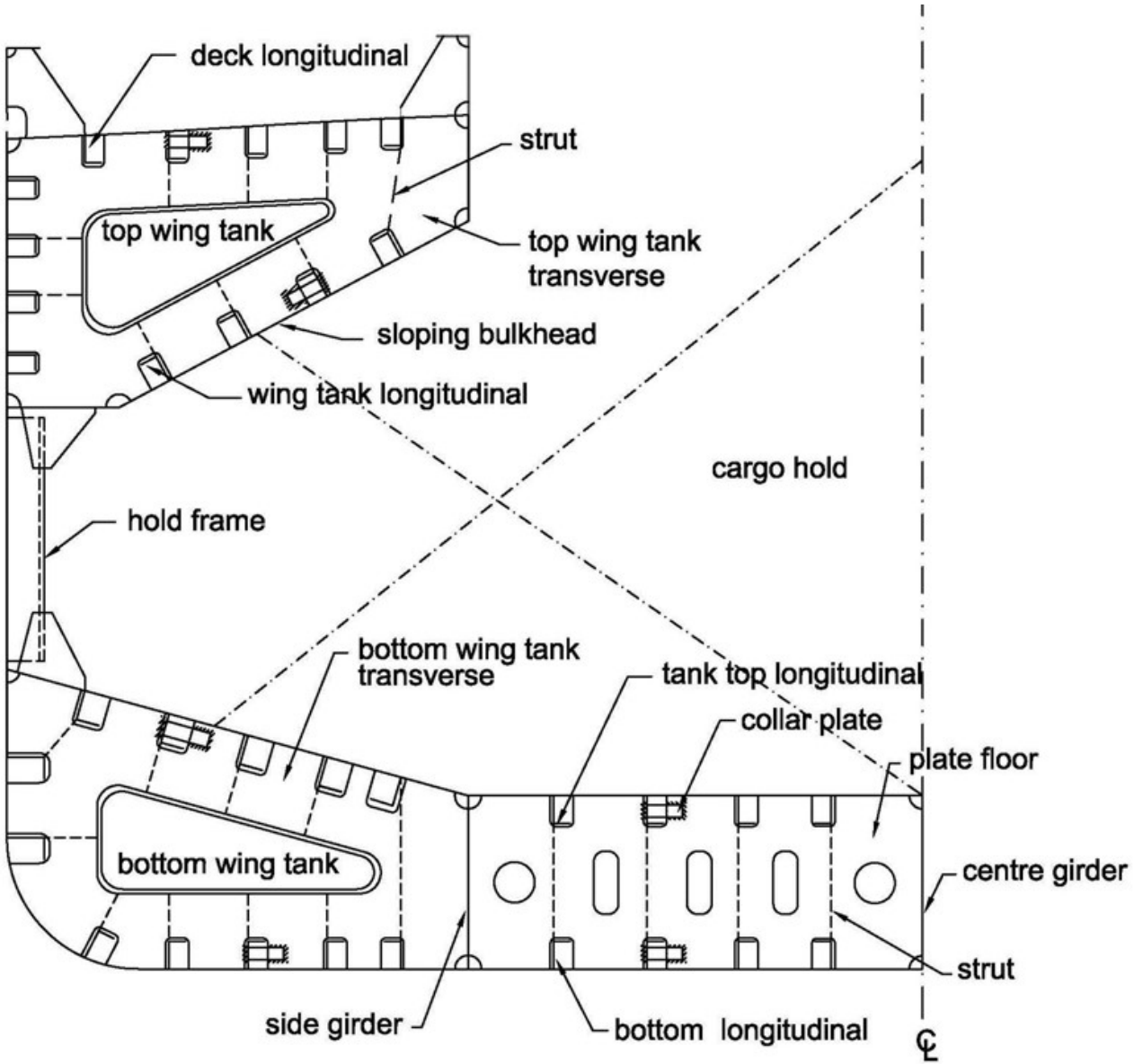
Loading is done through belt conveyor and hopper system and unloading is done by pumping out the cargo.

To avoid cargo accumulation at corners, they are cut off from the hold region by providing what is known as sloping bulkheads.

In the midship section this arrangement forms the upper wing and lower wing tanks

Bulk carrier

Bulk carrier



OBO carrier

The concept of ore and bulk oil (OBO) carriers came for carrying high density cargo, like coal, iron ore, etc.

Major part of the cargo hold will remain empty.
Shifting of cargo can cause loss of directional stability of the vessel.

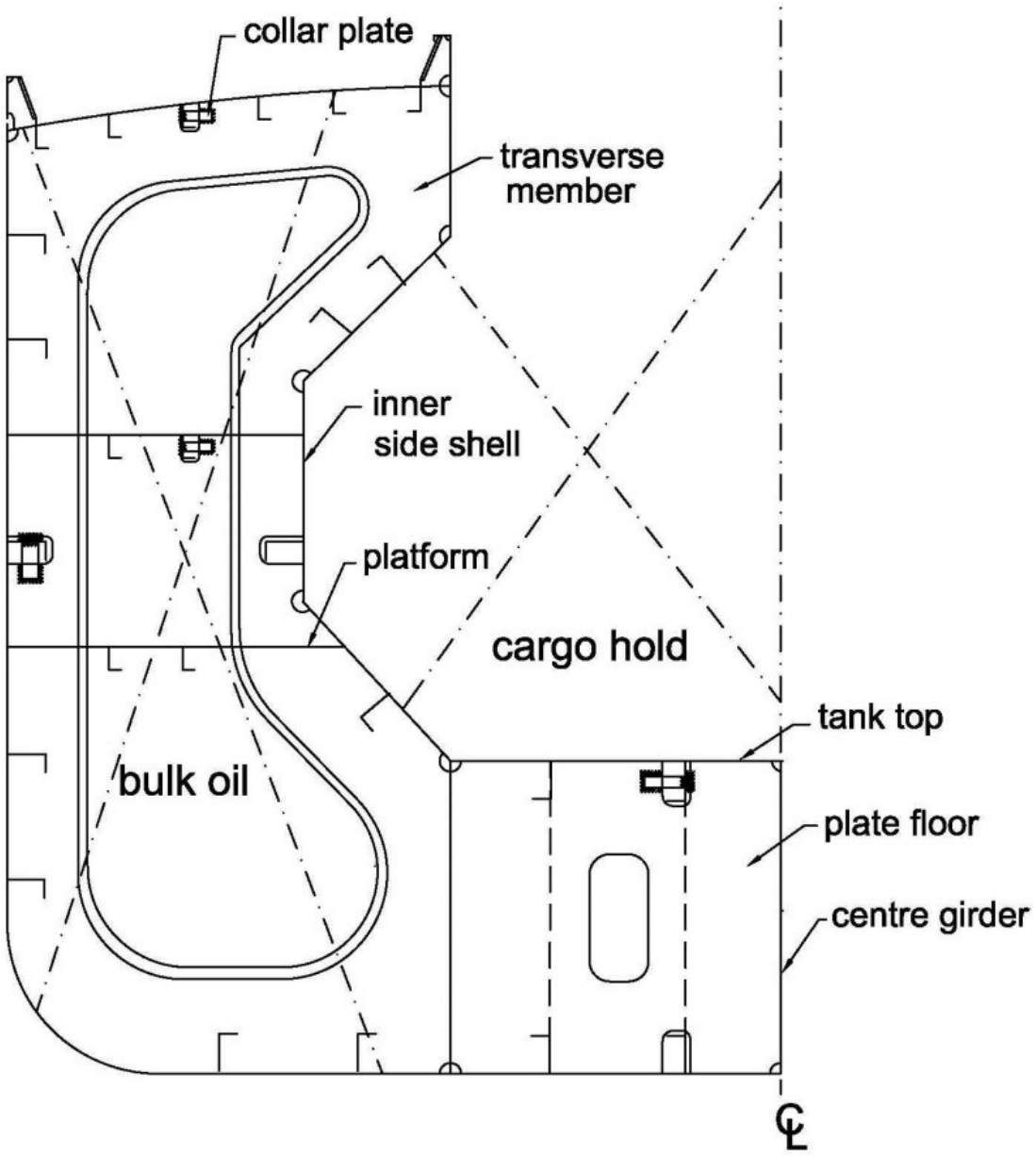
The centre of gravity of the loaded vessel remains very low, causing the metacentric height to increase substantially.

The double bottom height is increased, causing the CG to rise. Also an inner side shell is provided.

High density cargo carried in central hold, and in return voyage, the space between the side shells is used for carrying oil, preferably edible oil.

Ore carrier

OBO carrier


collar plate
transverse member
inner side shell
platform
cargo hold
tank top
bulk oil
plate floor
centre girder
CL

Container ship

Significant structural feature of container ships: Very large hatch openings.

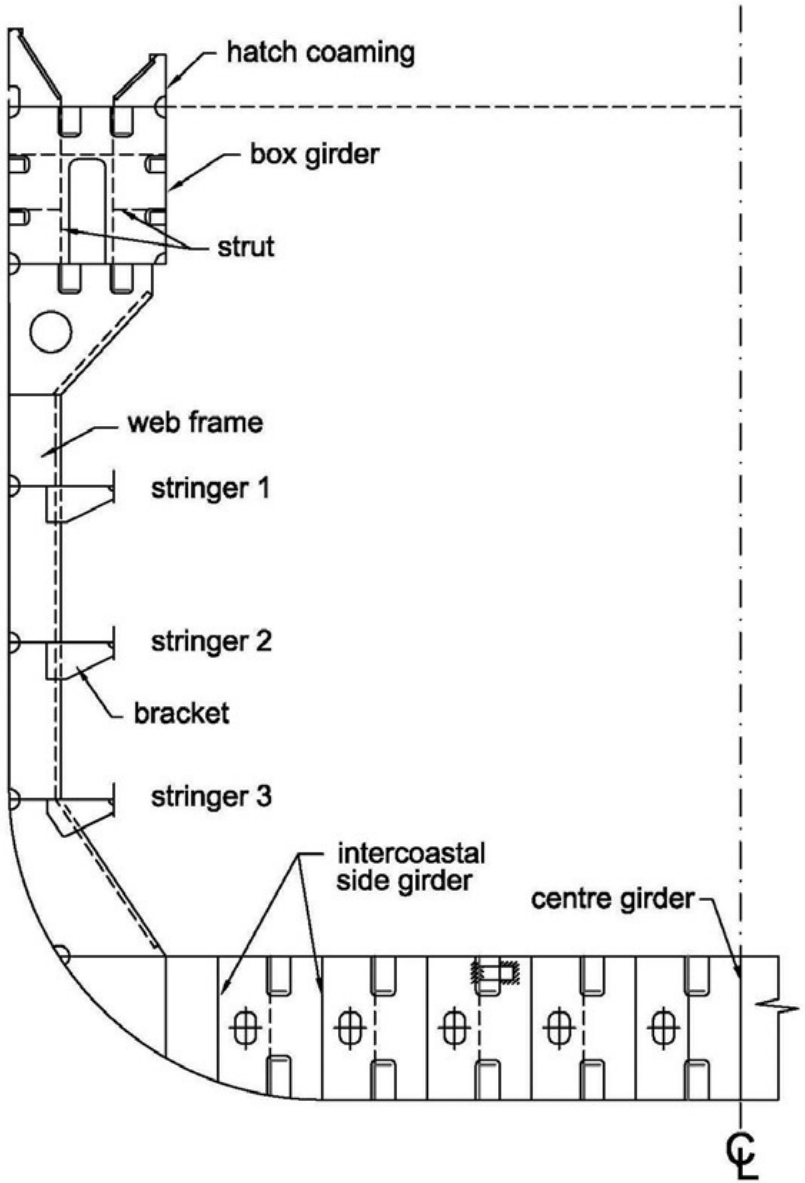
These ships are also referred to as open deck ships.

Efficient loading and unloading of containers.

Large openings in deck result in a structural challenge for providing adequate longitudinal and torsional strength to the hull girder.

Container ship

Container ship



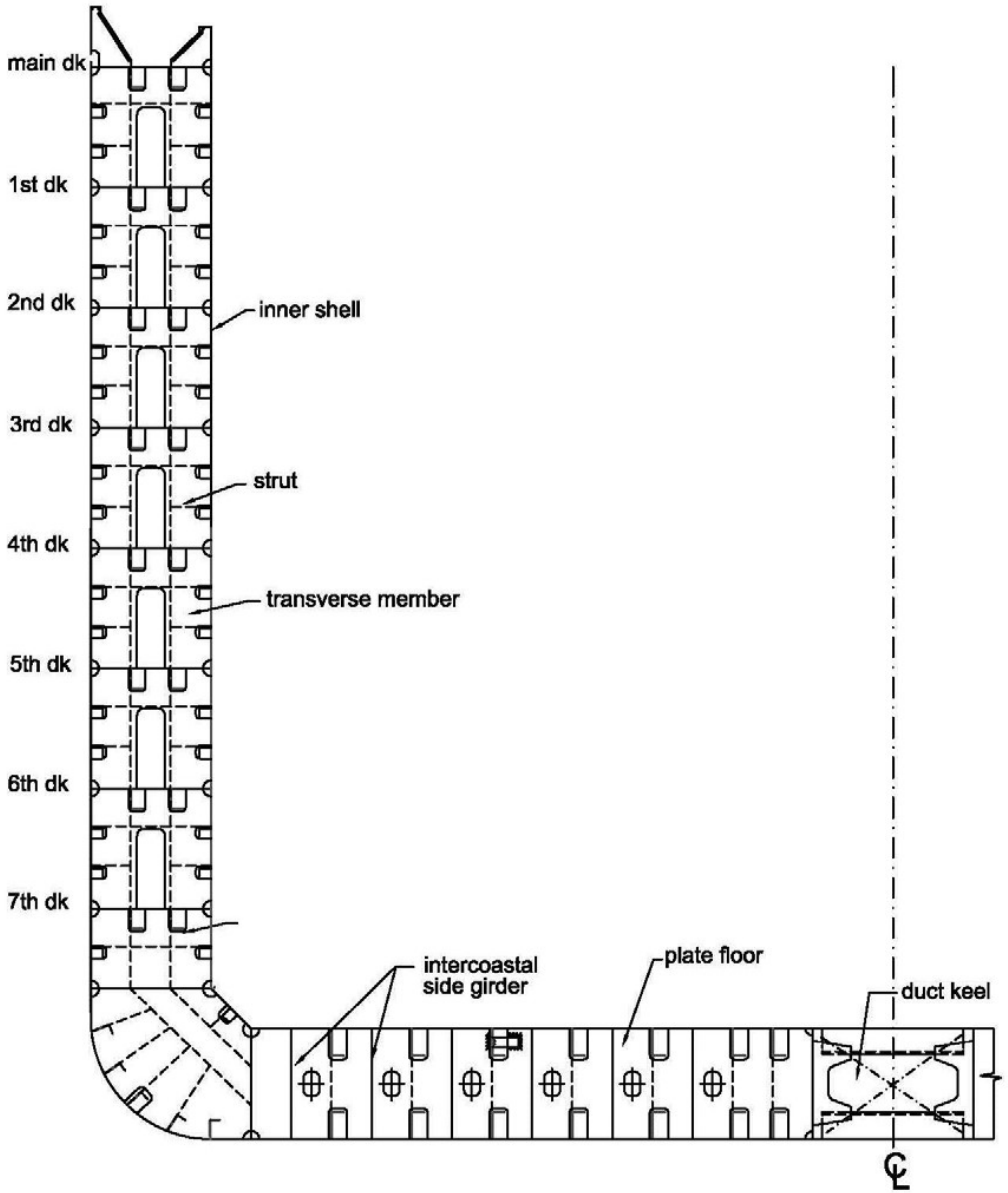
Container ship

For smaller container ships, box girder and transverse framing of side shell are used to provide the necessary torsional strength.

To compensate for the loss in longitudinal strength due to large hatch opening, stringers are used in the side shell along with longitudinally stiffened box girder.

In large container ships, cellular configuration is used. In these vessels generally duct keel is provided to facilitate laying of cables and pipes.

Container ship



Oil Tanker

Tanker structure is of closed form without hatch openings.

Structural design considerations:

Longitudinal and transverse strength, fatigue, local strength (slamming) etc.

****Sloshing**

Critical for: $L_{tank} > 0.1L$ and/or $B_{tank} > 0.5B$

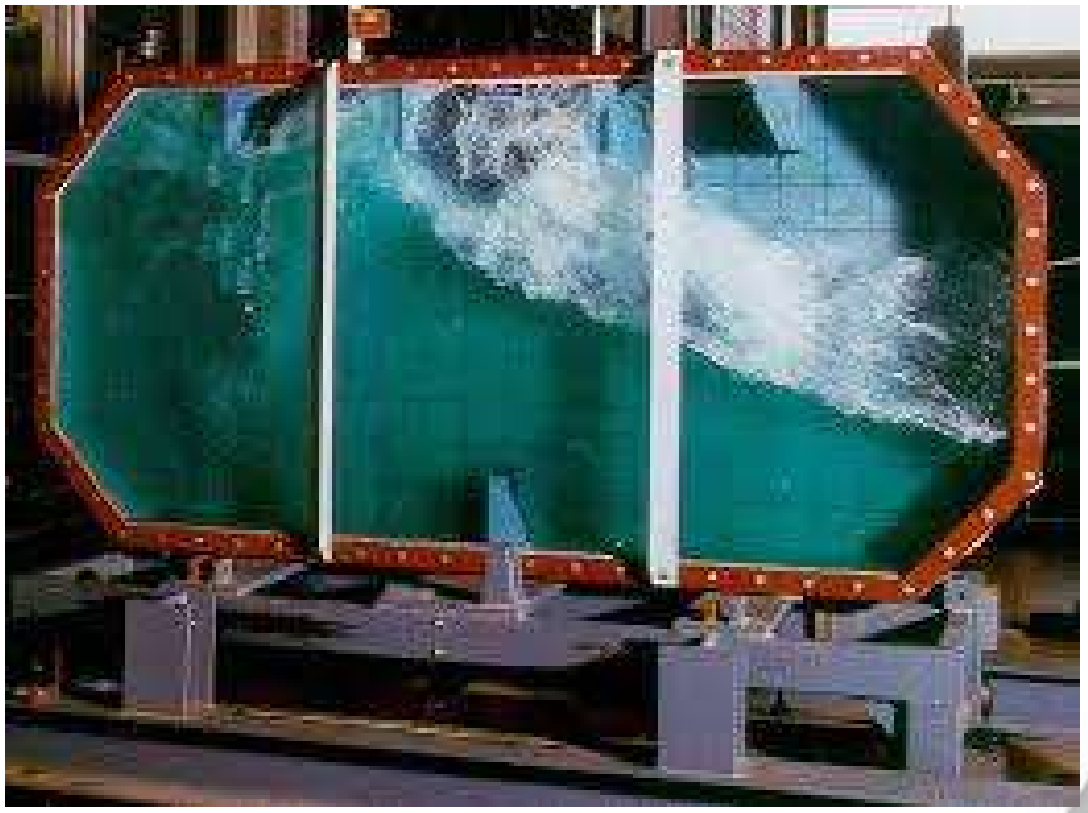
Oil Tanker

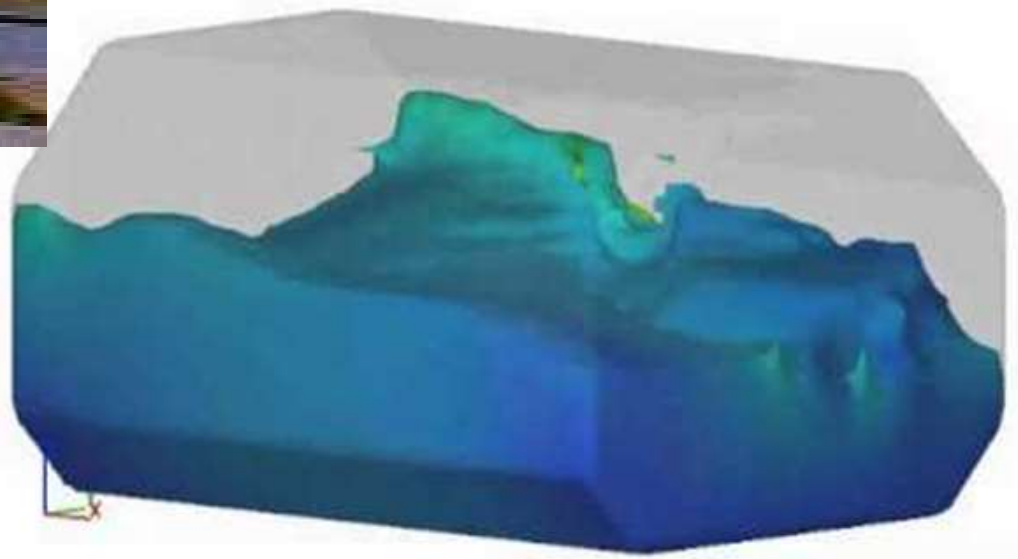
Oil Tanker

Pollution prevention requirement as per MARPOL convention: Double wall construction with double bottom is mandatory for all types of oil tankers.

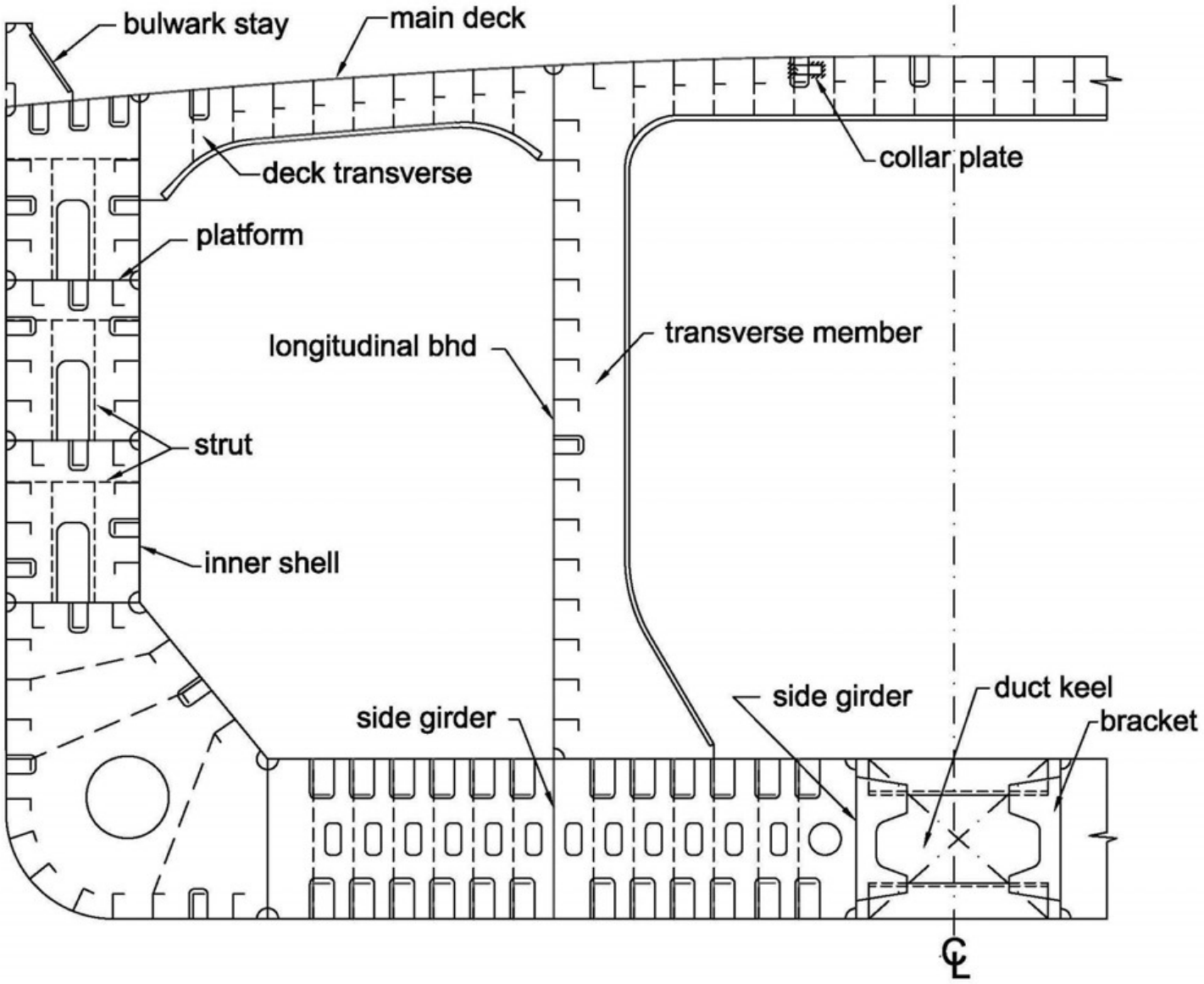
Depending on the breadth of the vessels, one or more longitudinal bulkheads are used in oil tankers to reduce free surface effect.

Sloshing





Oil Tanker


bulwark stay
main deck
deck transverse
collar plate
platform
longitudinal bhd
transverse member
strut
inner shell
side girder
side girder
duct keel
bracket
CL

Structural Alignment

Structural Alignment

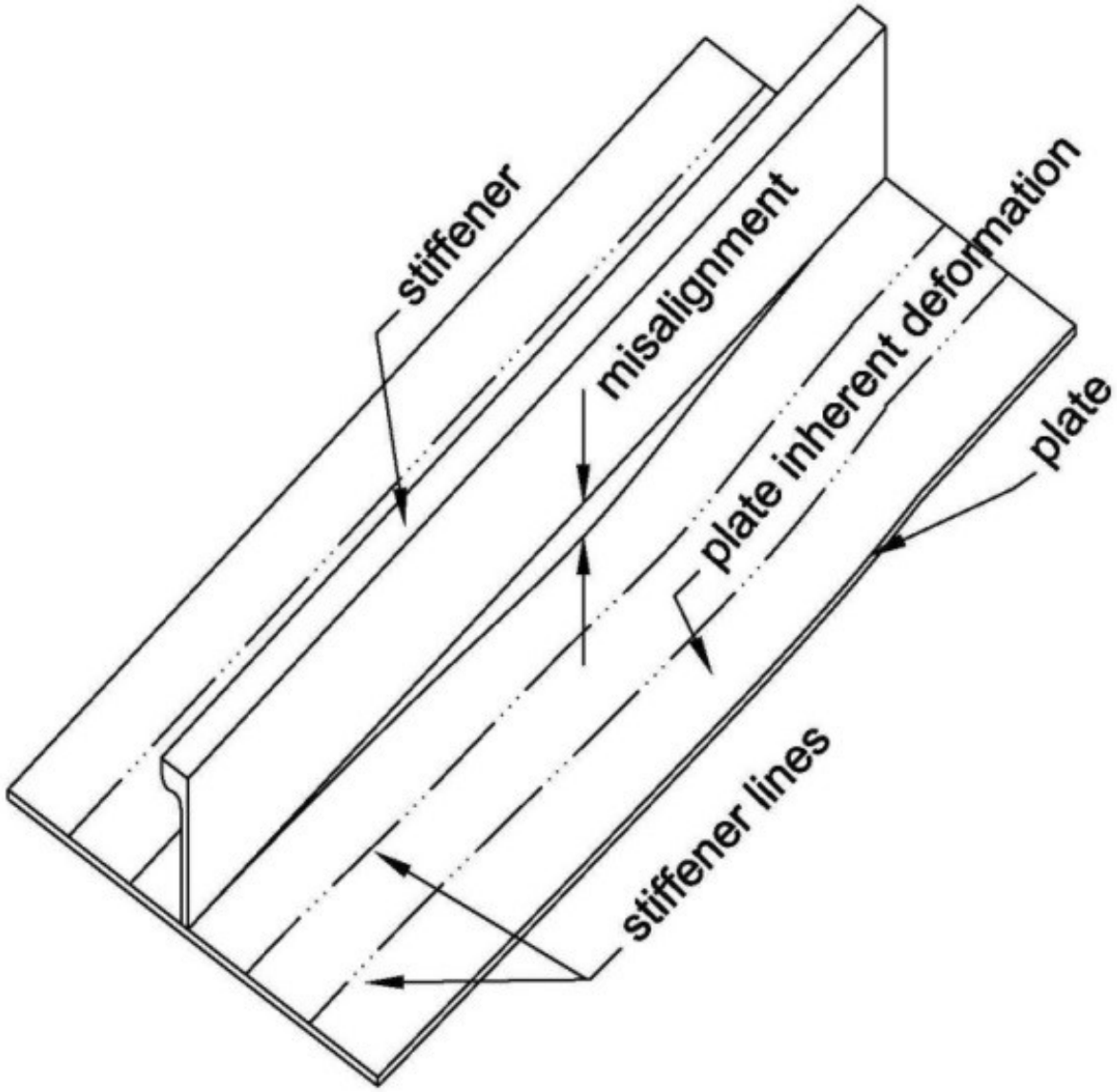
A ship structure is essentially a product assembled from various structural components.

Alignment is closely connected with structural continuity.

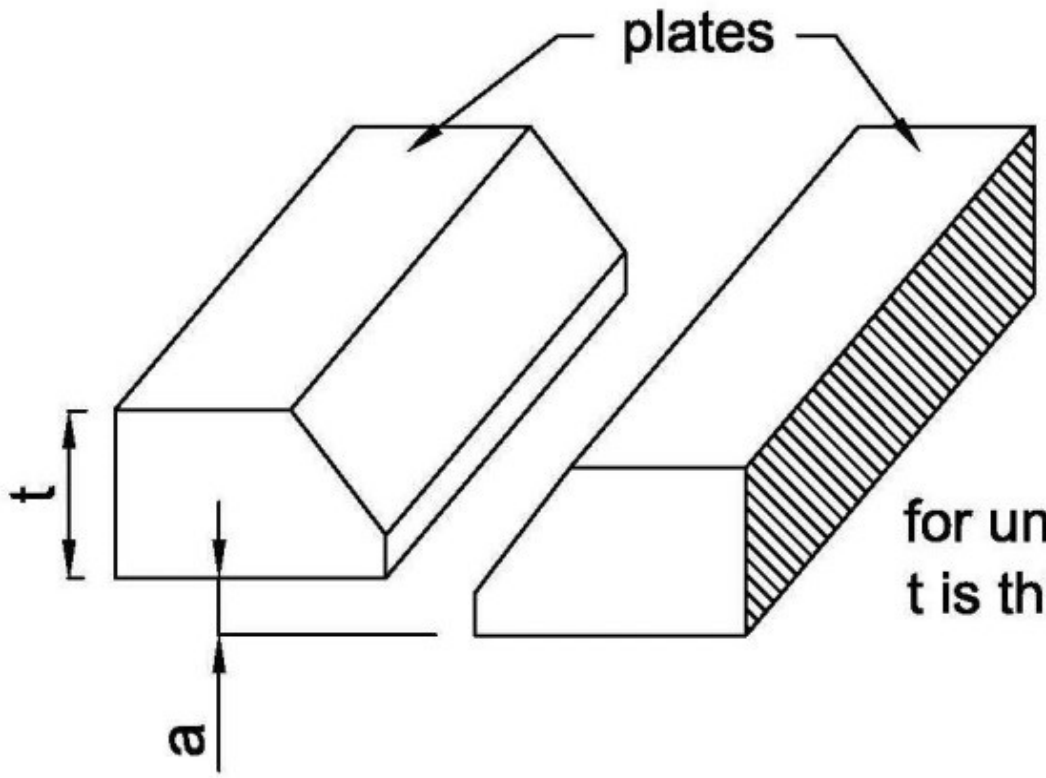
Alignment is a production aspect whereas continuity needs to be implemented in the design stage. However, a structural misalignment during production will lead to a case of structural discontinuity.

To achieve structural continuity or to avoid serious discontinuities, precision structural alignment is a necessity.

Structural Alignment (plate deformation)



Structural Alignment (butt joints)



for strength members

$a \leq 0.15t$

for other members

$a \leq 0.2t$

for unequal plate thickness,
t is thickness of the lesser thick plate

Structural Continuity

A continuous load path through the structure

For a ship, the deck load is transmitted through the stiffened side shell to the bottom shell structure, which is eventually supported by buoyancy forces.

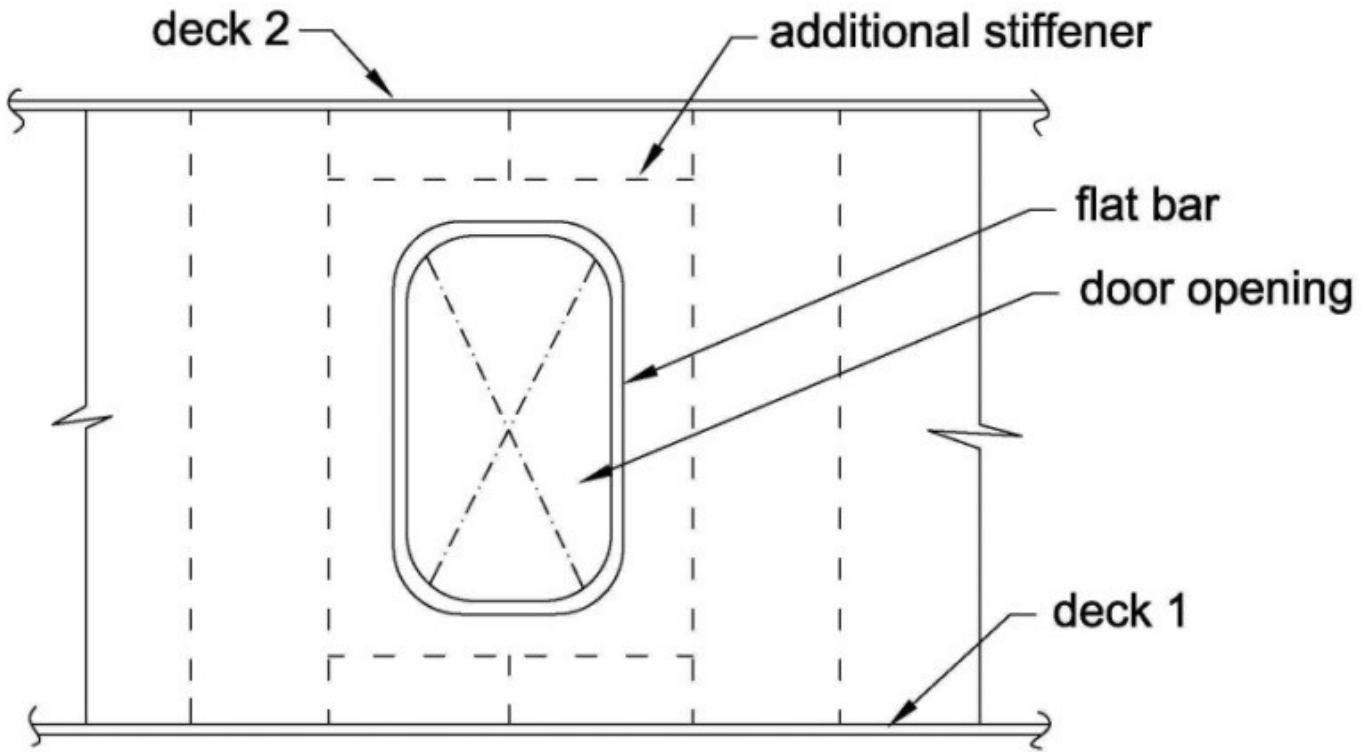
Any discontinuity in this will result in stress concentration locally.

In ship structure there are several unavoidable structural discontinuities for functional requirement. Hence adequate measures are to be taken to compensate for these structural discontinuities.

Structural Continuity

Welding flat bar

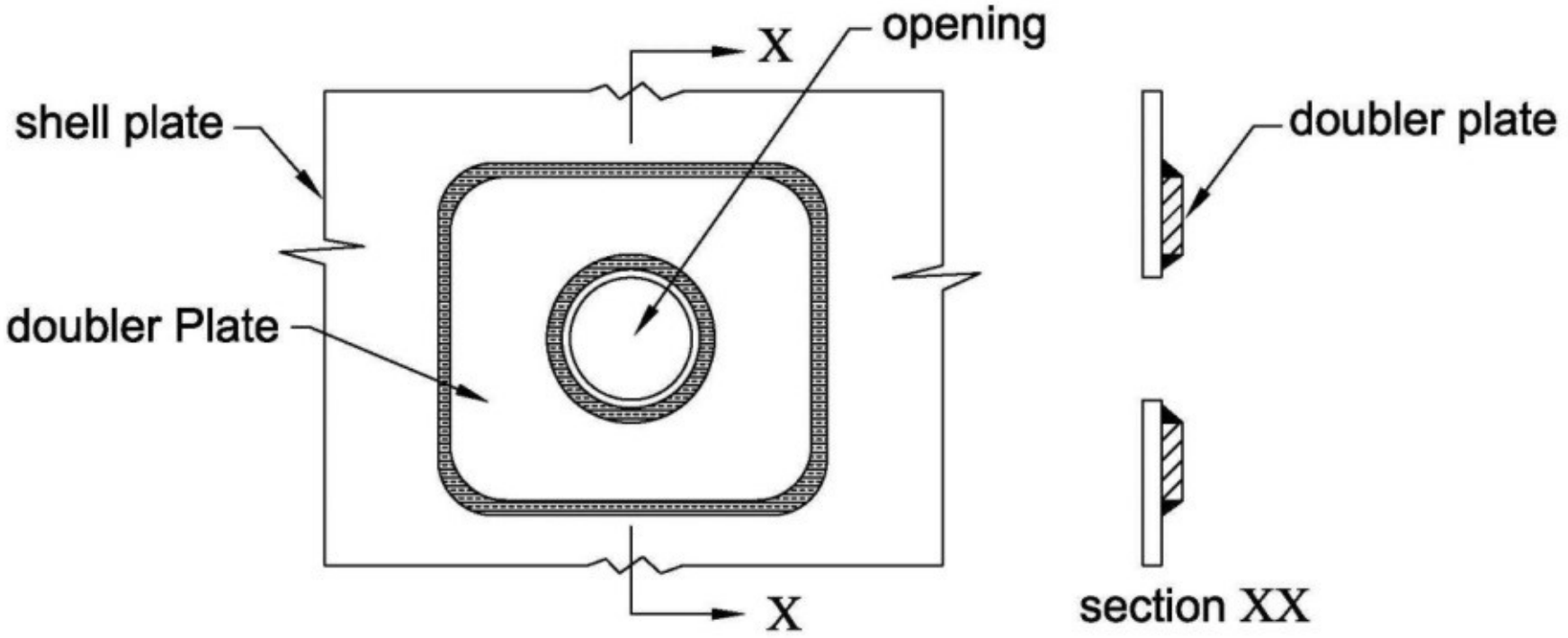
For medium sized openings like doors, additional stiffeners are used and a flat bar is welded all around the opening



Structural Continuity

Doubler plate

For small openings on the shell side, a doubler plate is welded on the inner side of the shell plate



Structural Continuity

Insert plate

For large openings like cargo hatch opening, stress concentration is likely to occur at the corners of these openings because of sudden change in sectional area of the deck plate. An 'insert plate' of higher thickness compared to the adjacent plates is inserted at the corners.