

proserve

MATTRESS EDGES FOR BERTH SCOUR PROTECTION

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3rd PIANC Asia Pacific Co



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Reference

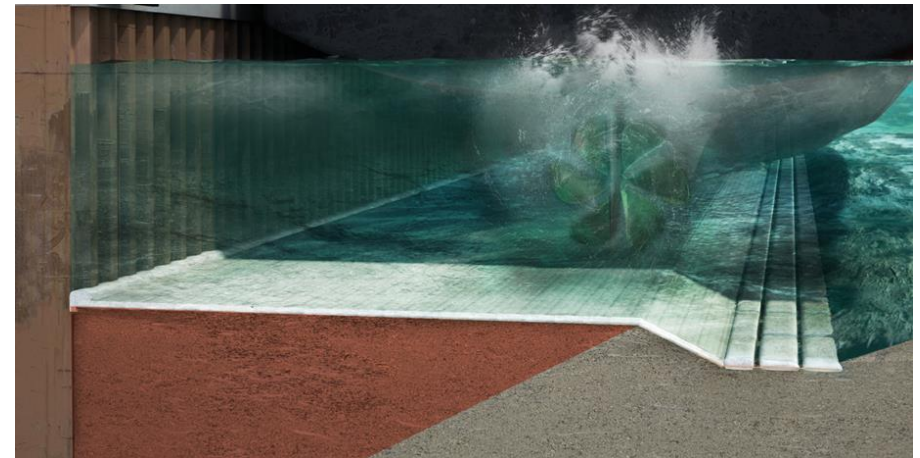
- Hawkswood *et al* (2024)
- Hawkswood *et al* (2023)

1. Introduction
2. Edge Requirements
3. Design Scour Depths
4. Types Edge Protection
 - Rock Falling Edge
 - Hinged Edge
5. Case Histories

Protect Geotechnically Critical Zones



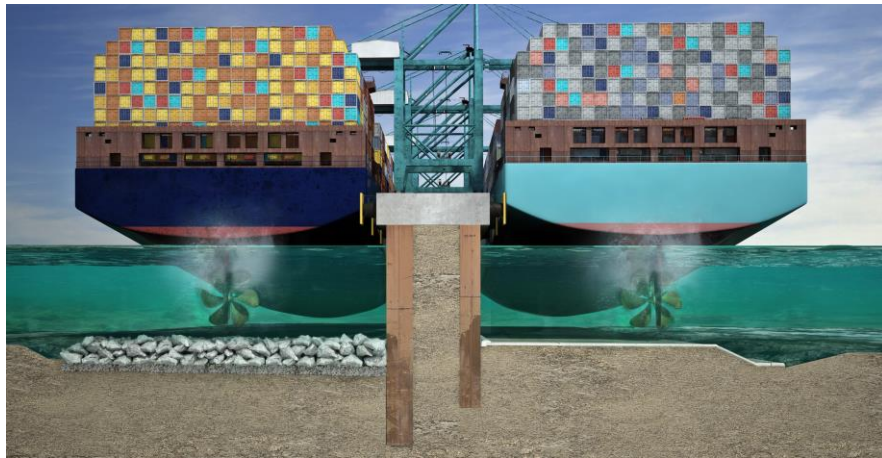
Slope Slips
Circles



Passive soil
wedge

Thin Protection

- Construction advantages
- Reduced thickness achieved by “sealed” protection

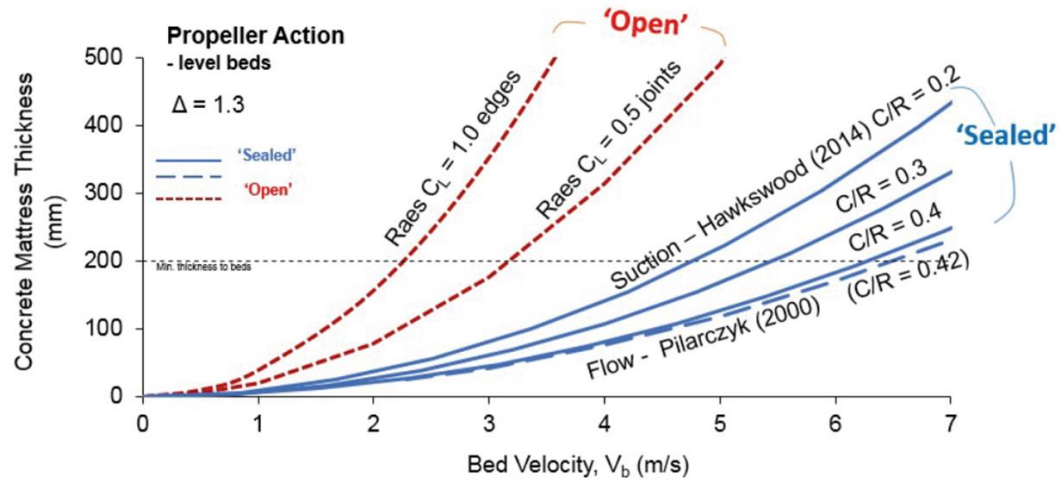


Reduced
Dredging



Berth
Deepening

Sealed Protection



Hawkswood *et al* (2016)



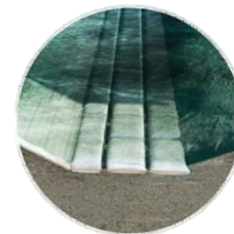
Walls



Panel Joints

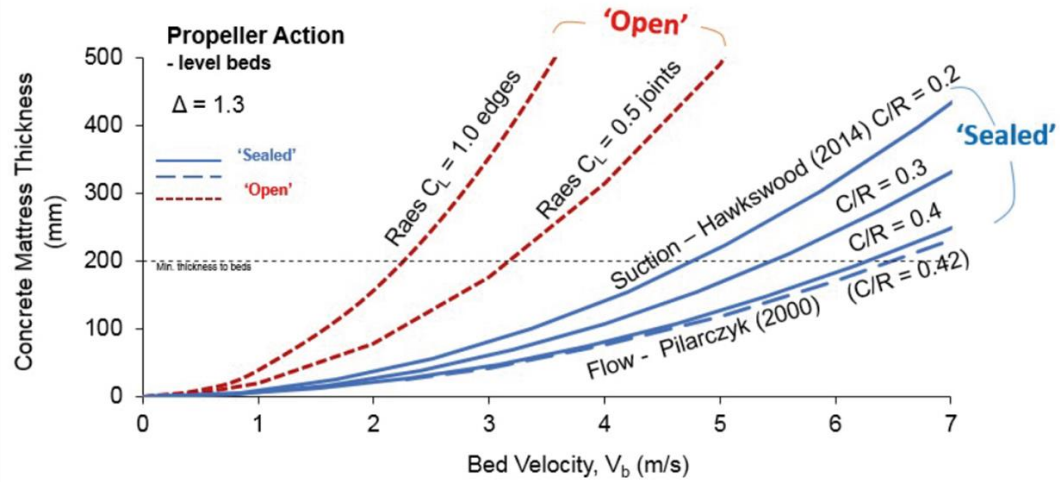


Piles



Edges

Sealed Protection



Hawkswood *et al* (2016)



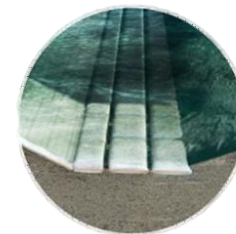
Walls



Panel
Joints



Piles



Edges

Impact of edge design



‘Sealed’

(Concrete Mattress with Rock Edge)

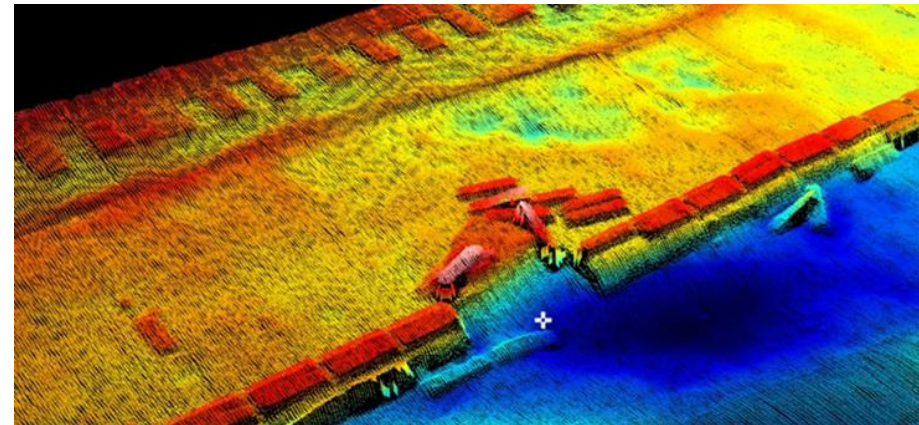


‘Open’

(Flexible Block Matt)

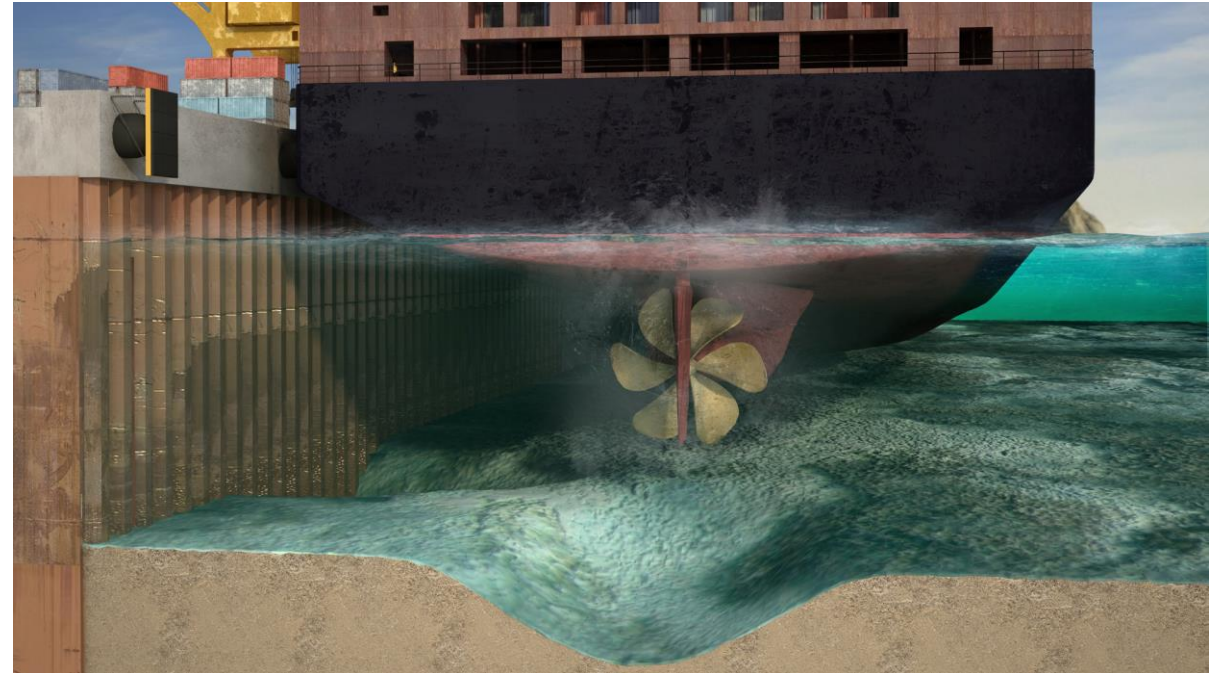
Need for edge embedment

- Edges laid flat or not suitably embedded are quickly undermined with bed lowering
- Undermined edges created trapped flow pressure which can flip protection edge
- Marine repairs are difficult and costly



Suitable edge details

- Estimated scour depth
- Design edges to prevent underscour



Estimating Scour

- Best estimated by comparison to scour behaviour for similar vessels and soils



Estimating Scour

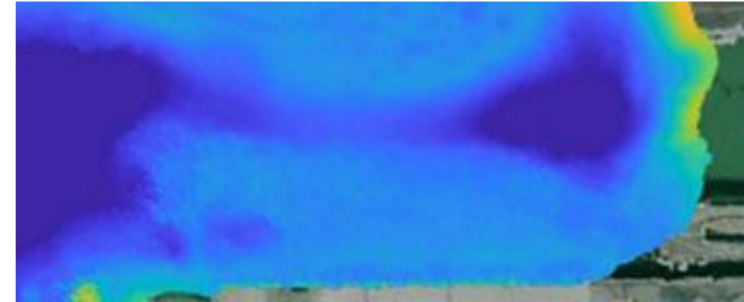
- Best estimated by comparison to scour behaviour for similar vessels and soils
- Proserve's general experience represented in Hawkswood *et al* (2024)



Definition	Design Edge Scour Depth
Container Vessels to 16m draft	4m – 5m
Ferry Vessels to 7m draft twin propellers, very frequent	5m – 6m
Cruise Vessels to 10m draft azipods, daily	4m – 5m

Estimating Scour

- Best estimated by comparison to scour behaviour for similar vessels and soils
- Proserve's general experience represented in Hawkswood *et al* (2024)
- Formulas to predict scour have been found unreliable previously by authors

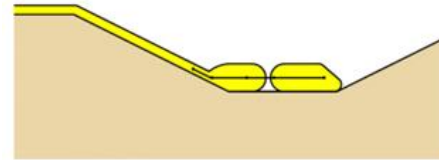


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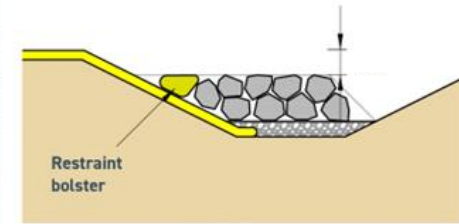
Best Practice

- Underscour prevented by a combination of
 - Passive embedment

Hinged Edge



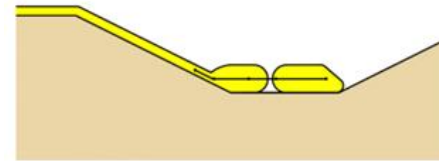
Rock Falling Apron



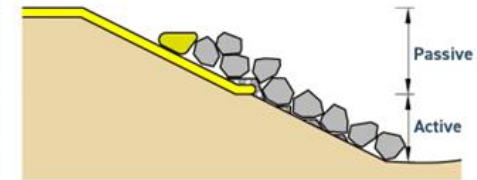
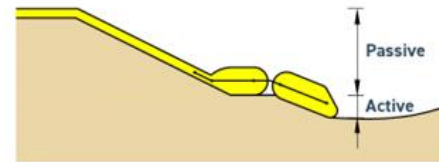
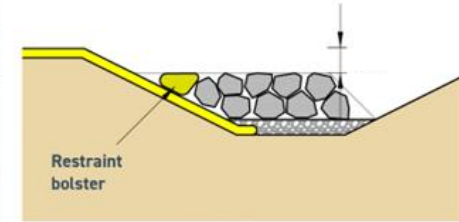
Best Practice

- Underscour prevented by a combination of
 - Passive embedment
 - Reactive deployment

Hinged Edge

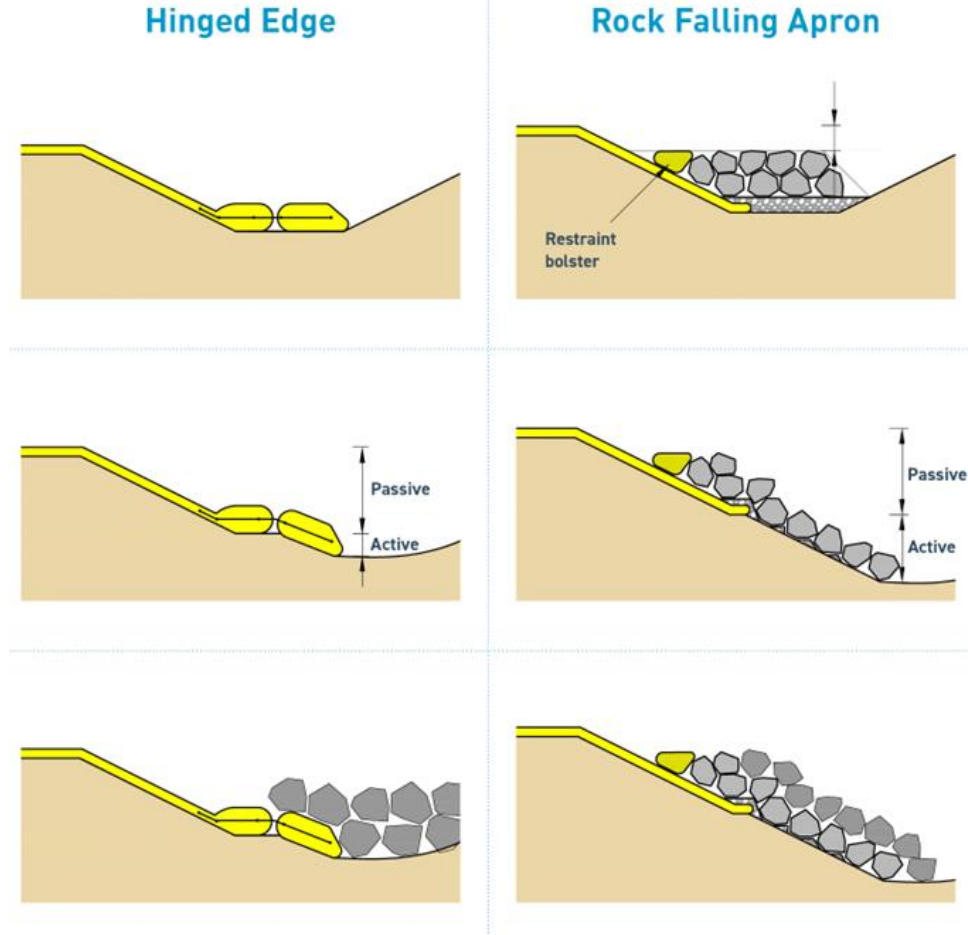


Rock Falling Apron



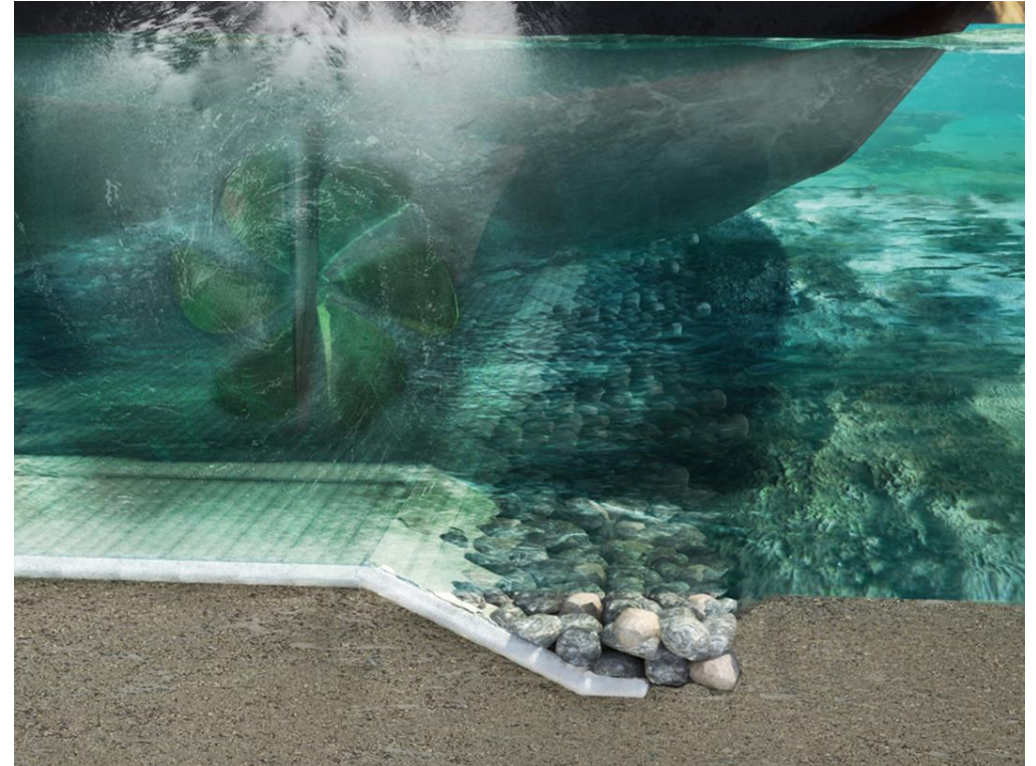
Best Practice

- Underscour prevented by a combination of
 - Passive embedment
 - Reactive deployment
- Embedment allows for future maintenance typically with placement of rock



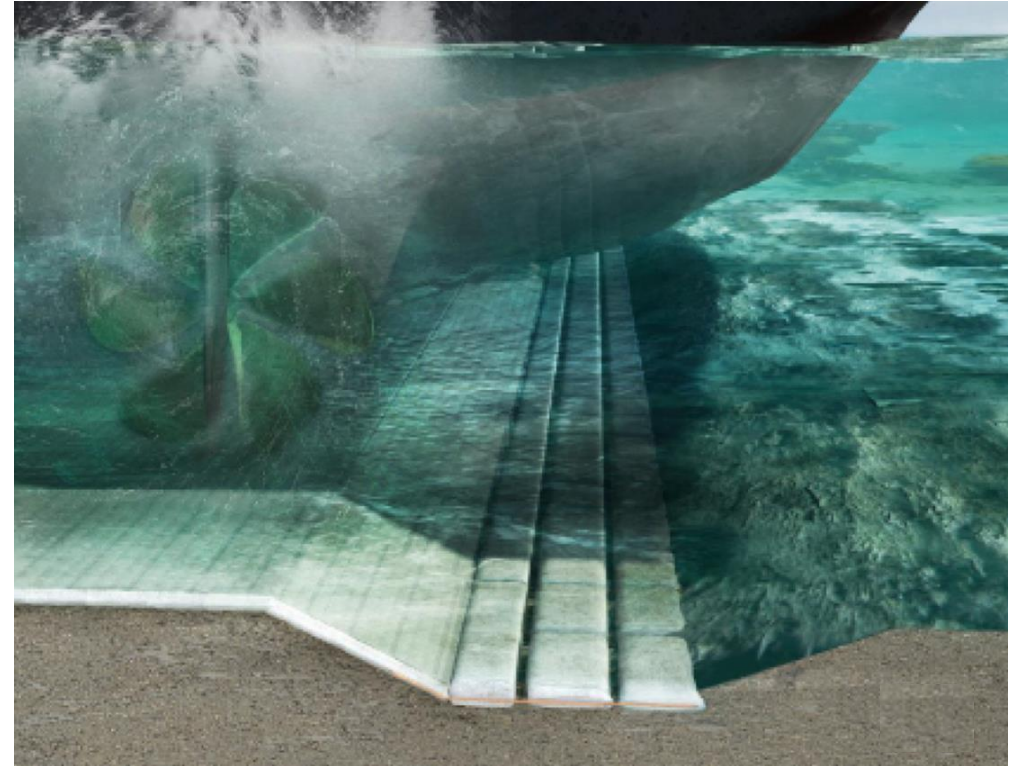
Rock Edge

- Detail well understood with proven performances
- PIANC Report 180 - designed following as German or Dutch method
- Proserve scale model testing aligned with German method



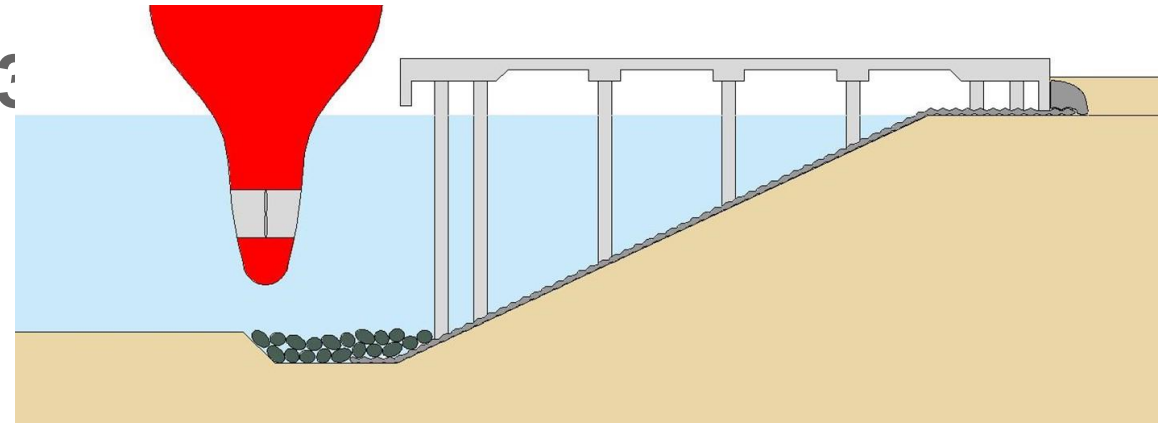
Hinged Edge Protection

- Developed in response to contractor preference to avoid the use of additional marine plant needed with rock falling edge aprons
- Scale model testing and design method in Hawkswood *et al* (2023)
- Testing for granular materials



Port of Belawan, Indonesia 1983

- 41 years of performance
- Case history in PIANC WG22 (1997)
- Protection from Container vessels
- 100mm general mattress thickness
- Filterpoint mattress to wave zone
- $H_s < 0.5\text{m}$
- Rock Edge protection



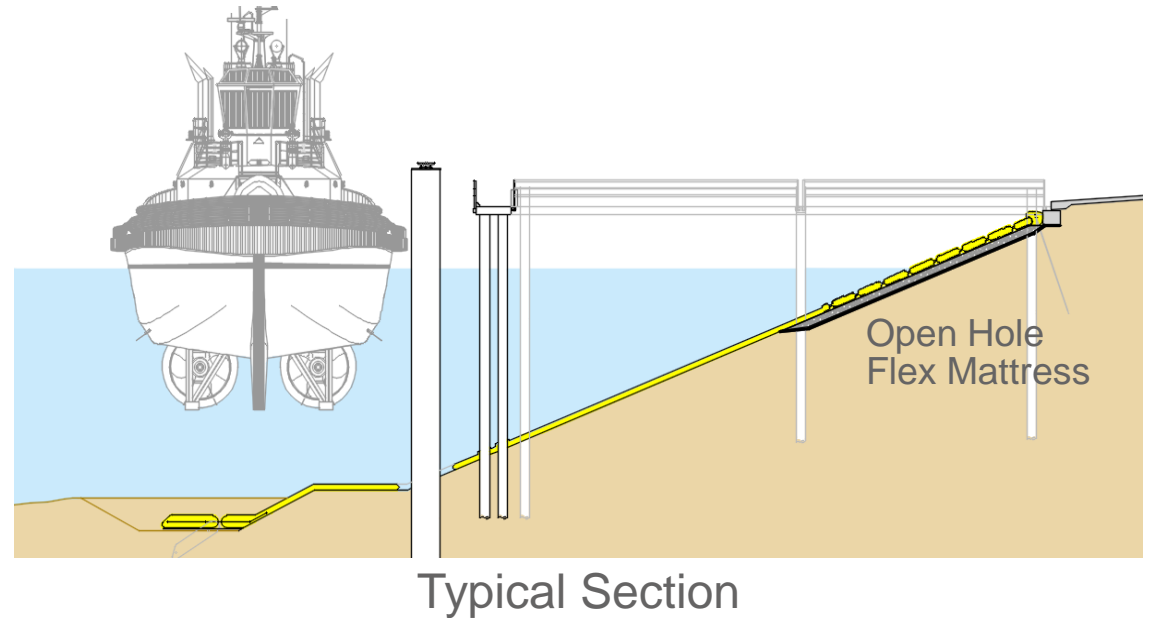
Typical Section



Site inspection 2015

Freeport, Texas, USA 2021

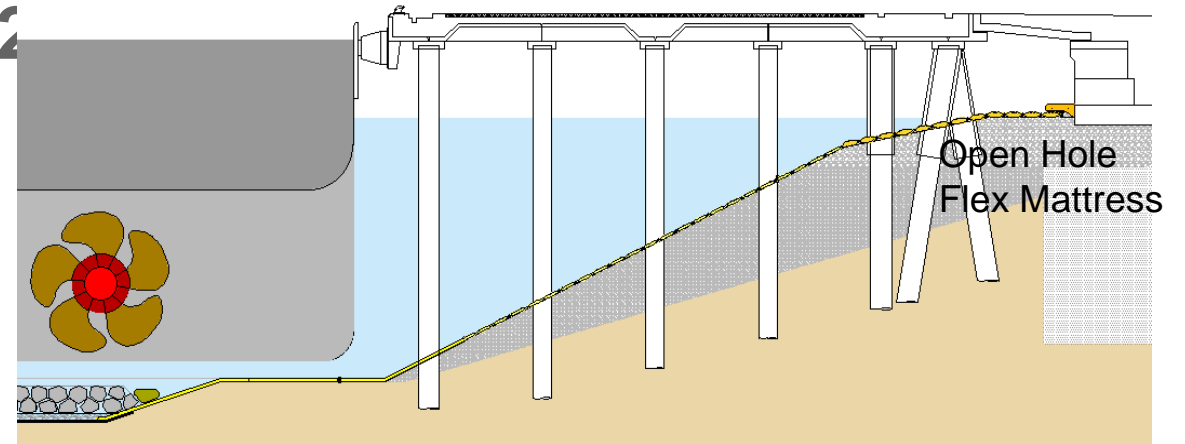
- First use of Hinged Edge
- Protection against tug boats
- 300mm general mattress thickness
- Flexible Open Hole Mattress in wave zone
- $H_s < 1\text{m}$
- Hinged Edge gave construction efficiencies
- Client previously had undersized stones sucked into propulsion and damaged vessels



Open Hole FLEX Mattress

Al-Faw Grand Port, Iraq 2023-2024

- New 1.75km piled platform
- Protection against Triple E-class vessels
- 300mm average mattress thickness
- 260mm estimated settlement
- Flexible Open Hole Mattress in wave zone
- $H_s \sim 1.4\text{m}$
- Rock Edge selected with surplus rock to minimise future maintenance over 100 year design life



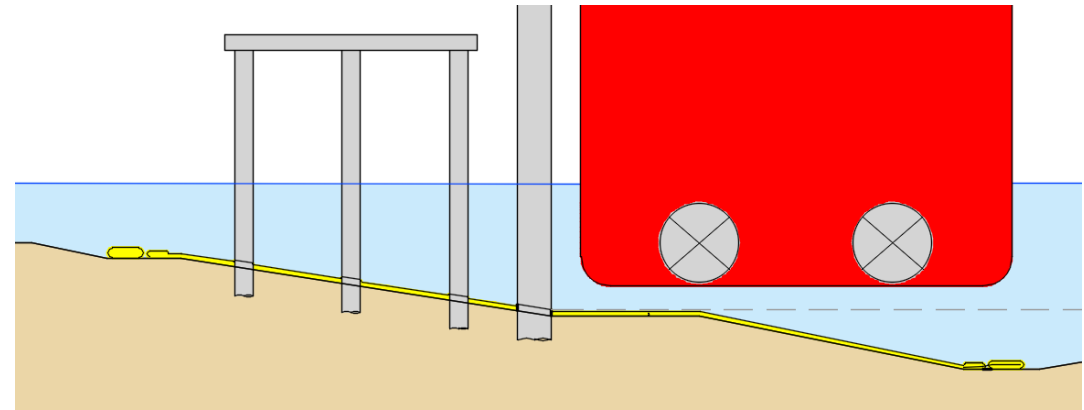
Typical Section



During Construction

RORO6, Dunkerque

- New Ferry Terminal
- Protection against large ferry vessels
- Up to 10 visits per day
- 250mm average thickness
- 5.5m design scour depth
- Hinged Edge Detail used with large edge embedment



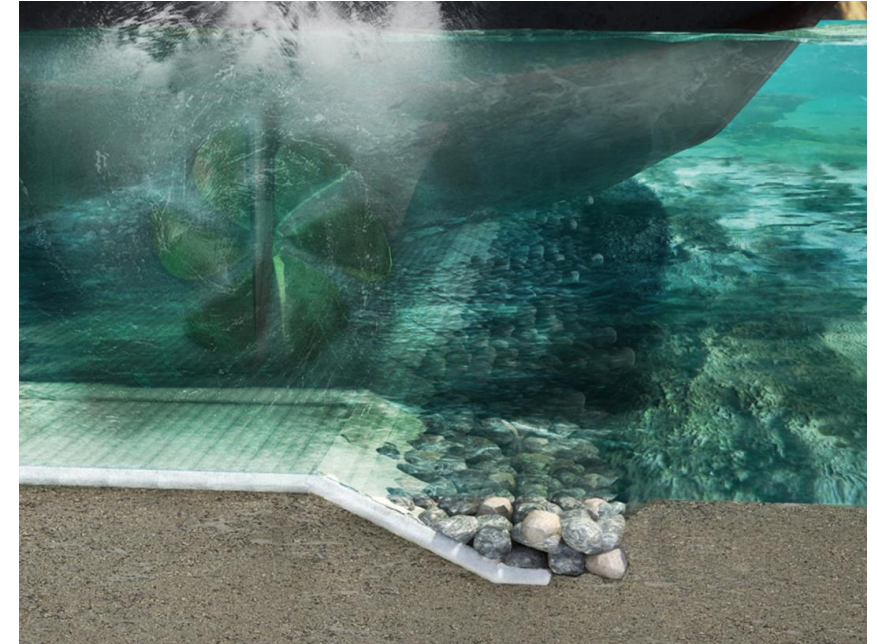
Typical Section



Mattress Installation

MATTRESS EDGES SUMMARY

- Suitable edges needed for thin “sealed” protection
- Design scour depth estimated through combination of experience and local information
- Combination of embedment and reactive detailing to achieve design scour depth
- Rock Edge has proven performance
- Hinged Edge offers savings by reducing



THANK YOU

