

Project courtesy of Imoto Lines, Ltd. and Kyokuyo Shipyard Corporation

Utilization of OCX as part of 3D Model Based Approval in ship design process

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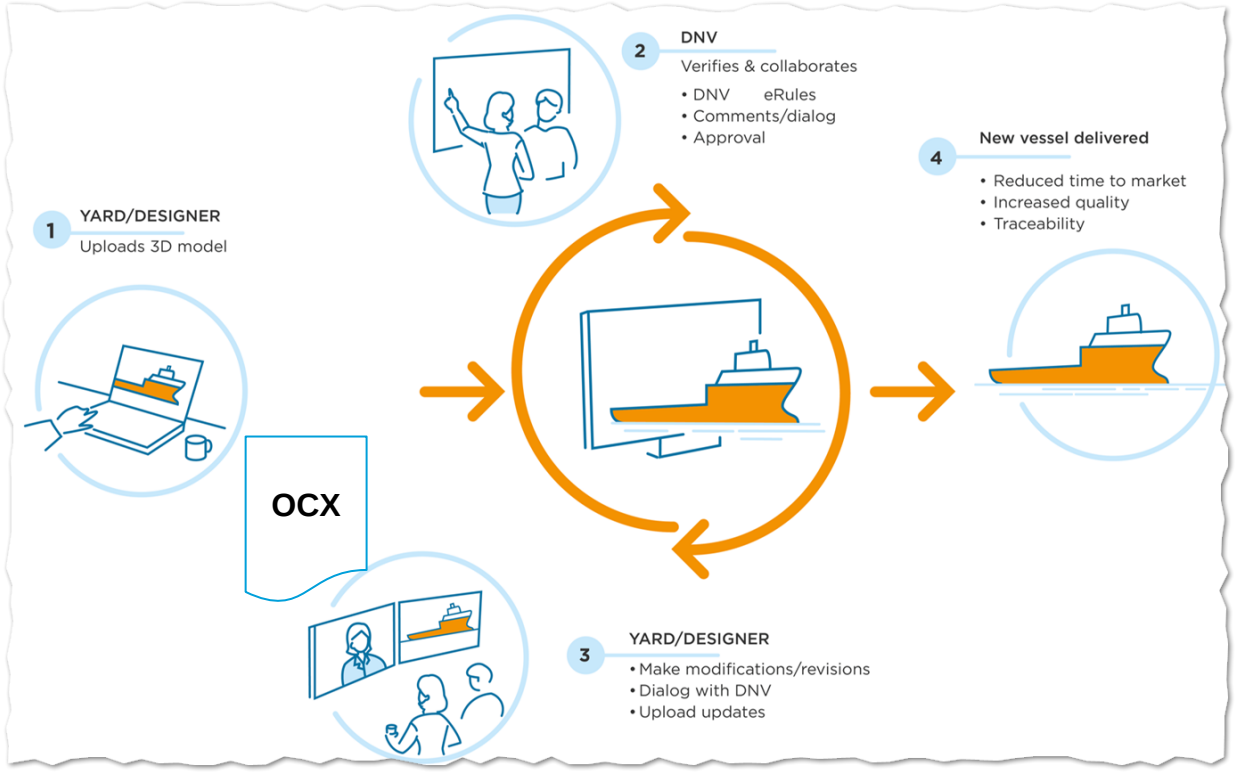
3D Model-based approval

1
A Standard Exchange format

2
Re-use 3D model for calculations

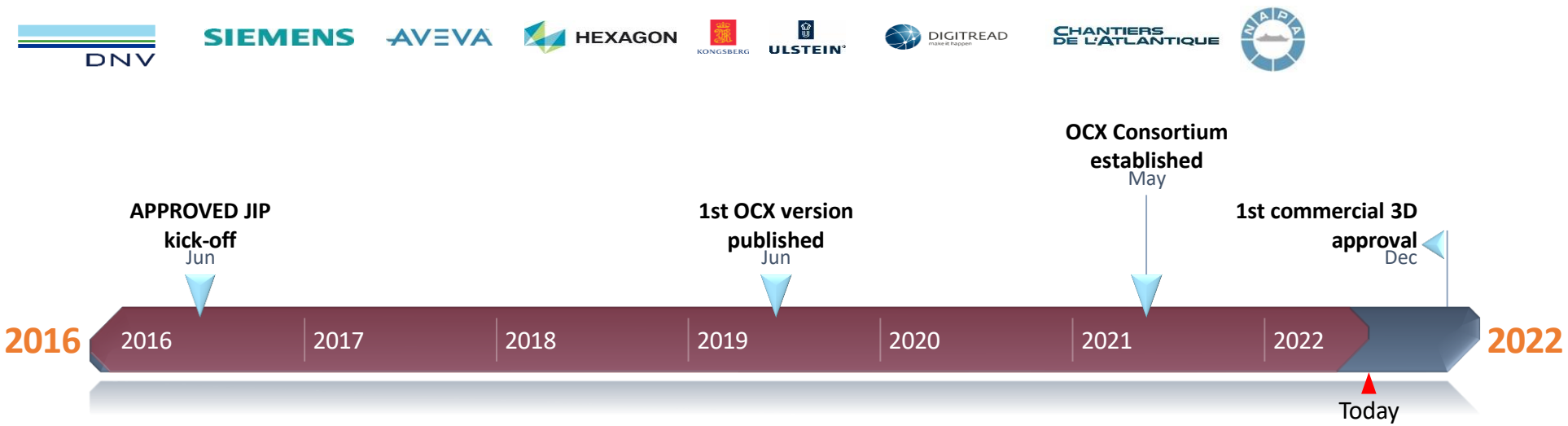
3
Efficient 3D collaboration platform

3D model as design verification



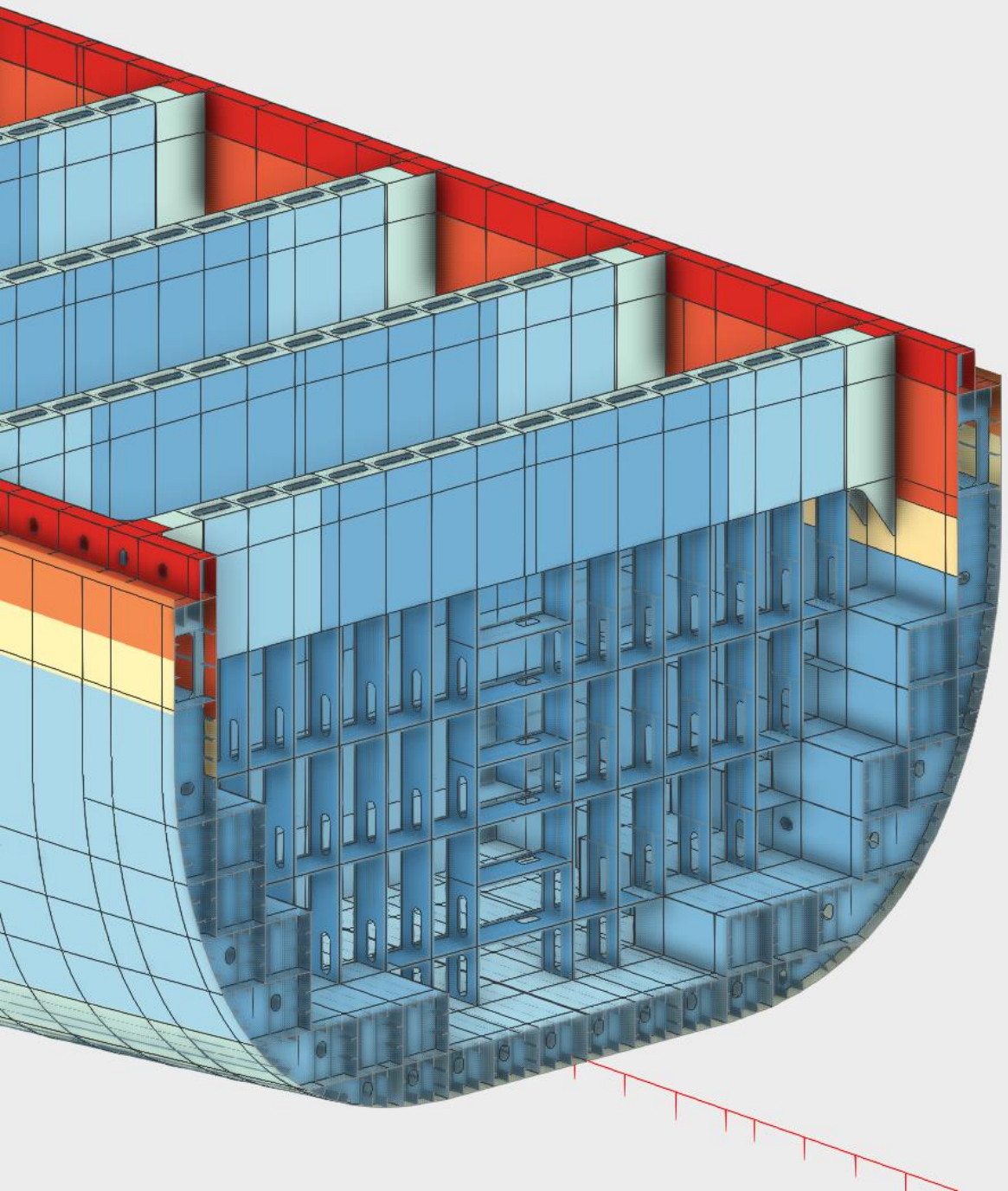
"Can we replace 2D drawings with a 3D model as design documentation?"

OCX “The Open Class 3D Exchange standard”



- https://3docx.org
- 28 Members as per June, 2022





Rule Scantling Iteration in CAD

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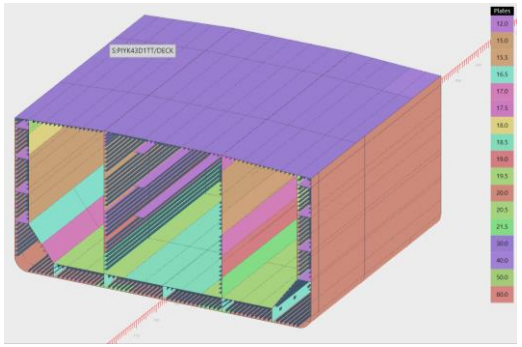
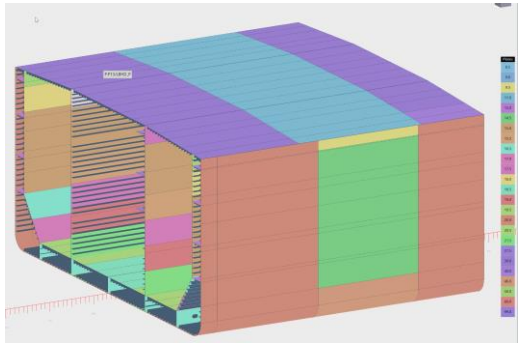
Conventional rule scantling (2dlx format)



NAPA Designer – Steel 3D model
(Before rule check)

Export cross-sections (2dlx format)

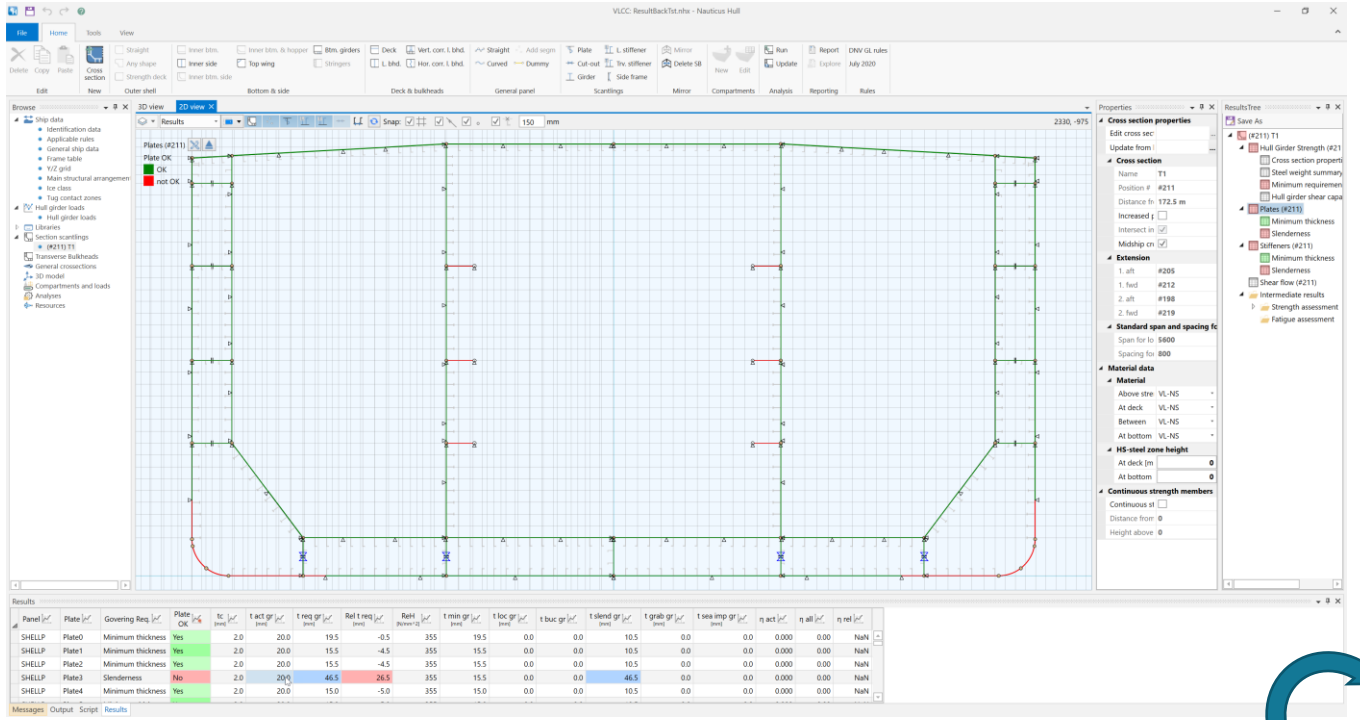
Export compartments data (.csv)



NAPA Designer – Steel 3D model
(after rule check)

Manual update 3D model scantling

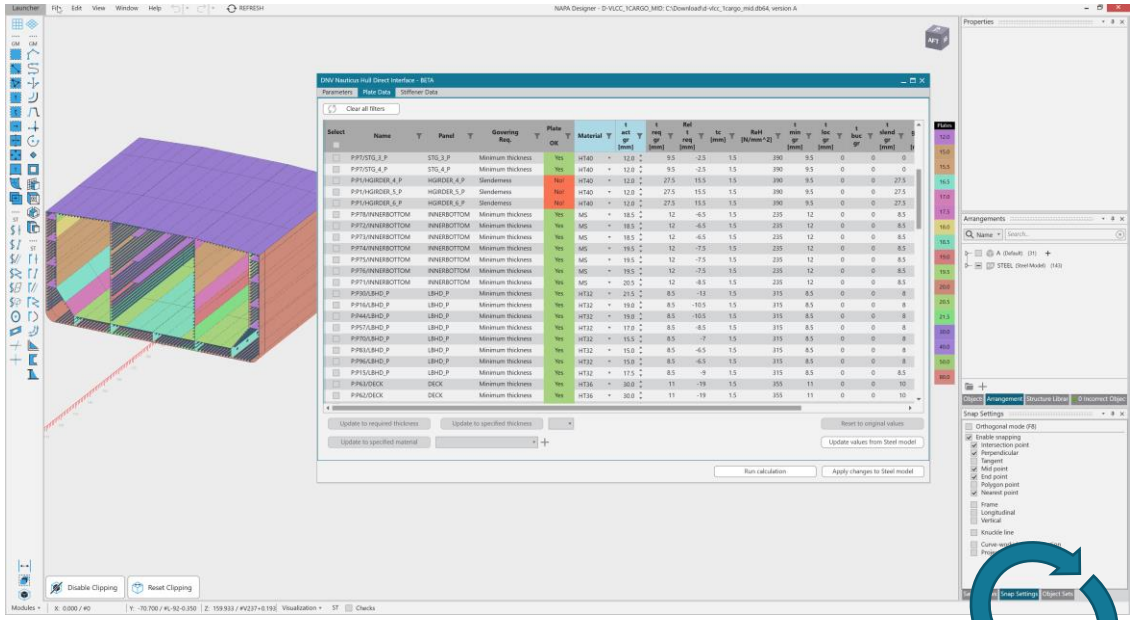
Update with 2dlx+Napa Script



DNV Nauticus Hull – Workspace
(general info, rule, hull girder loads, compartment manual mapping for section)

Scantling Changes+Run

NAPA-DNV Nauticus Hull direct interface

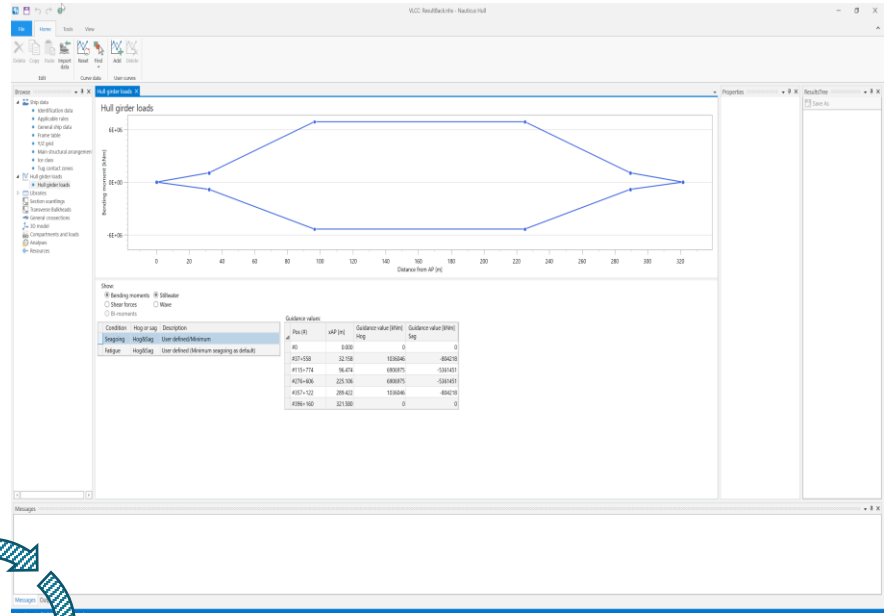


NAPA Designer – Steel 3D model
(rule check + model change/update)

3D Model (OCX) Section and setting(.js)

Result (xml)

Scantling Changes+Run



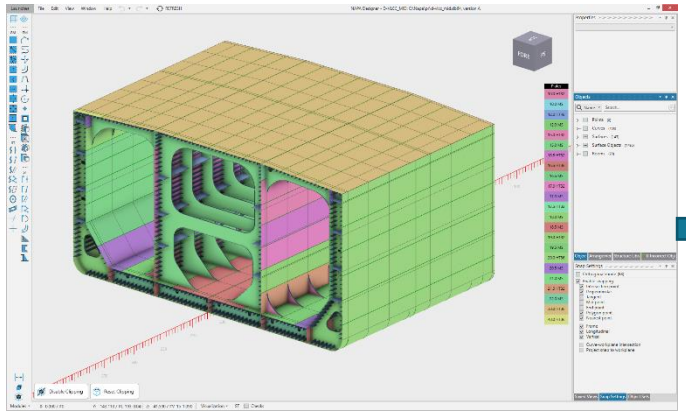
Background Rule check

DNV Nauticus Hull – Workspace
(general info, rule, hull girder loads, compartments)

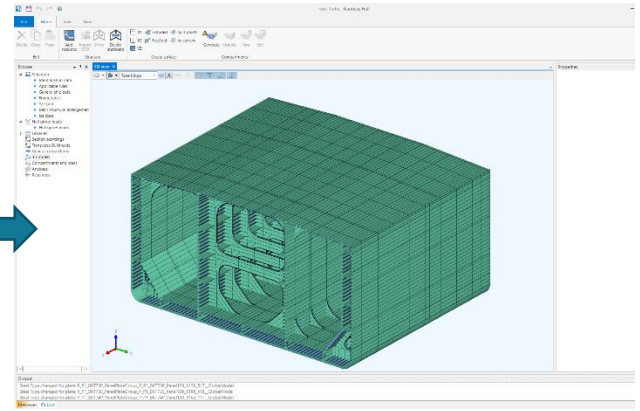
✓ Rule calculation in NAPA Designer based on DNV Nauticus Hull
✓ Design iteration of scantling can be possible without leaving NAPA Designer until it satisfies the rule requirement

OCX as ship structural 3D model transfer

- **NAPA Designer: OCX export**
  - ✓ Panels, stiffener, plates, bracket, pillars
  - ✓ Catalogue: material, profiles, hole
  - ✓ Principal particulars and frame systems
  - ✓ Compartments, mapping of purpose
  - ✓ Structure types to OCX function types
  - ✓ End connections of stiffeners
  - ✓ Units
  - ✓ **Update file with the changed properties only**
  - ✓ Export **only limited by clipping box** (Efficiency in data transfer)
  - ✓ GUID synchronization btw OCX in the same project (Revision control)

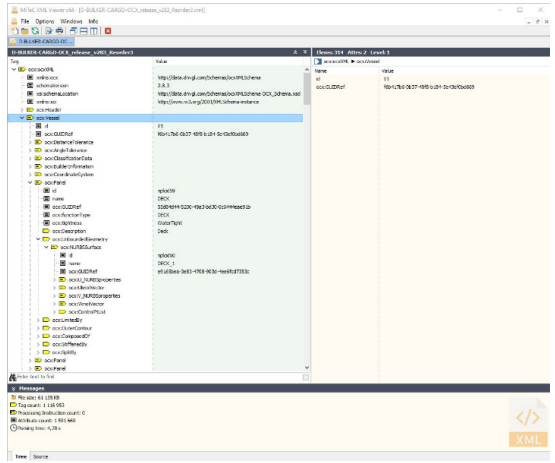


NAPA Designer

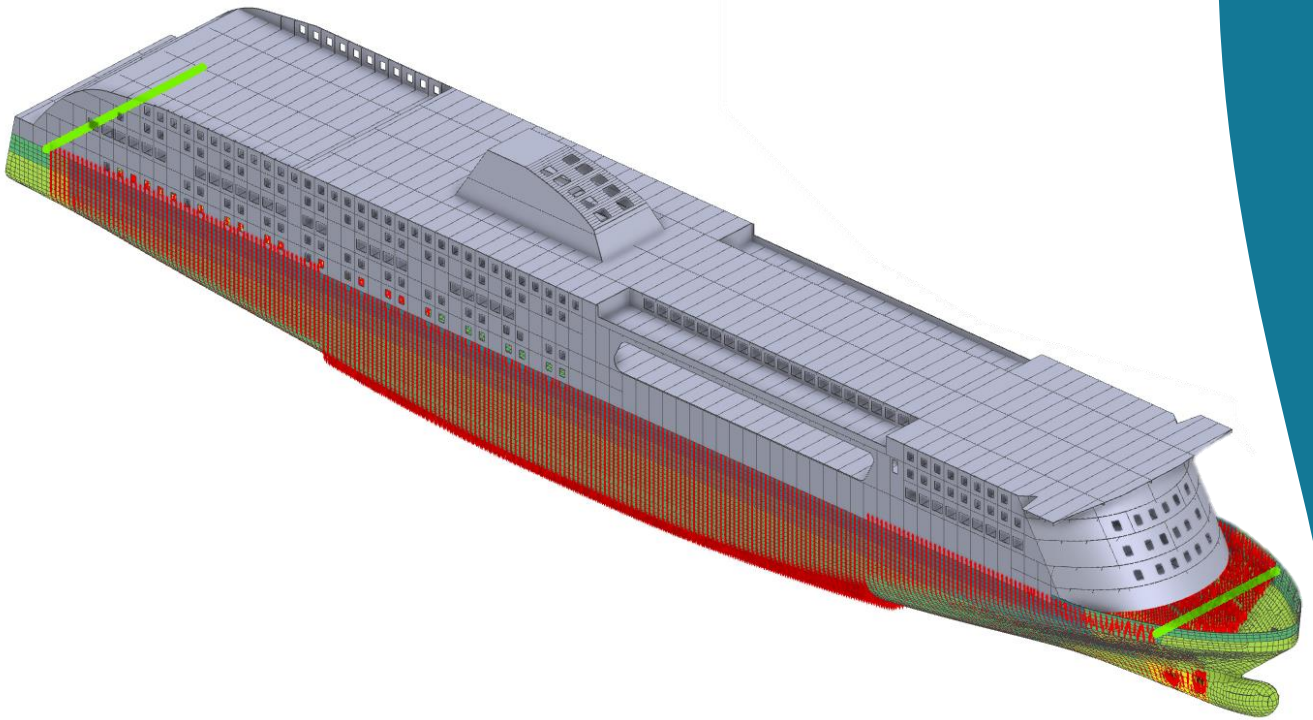


DNV Nauticus Hull

- **DNV Nauticus Hull: OCX import**
  - ✓ Reconstruct 3D structural model
  - ✓ Import all relevant general information
  - ✓ **Capability to create cross-sectional model**
  - ✓ To export local scantling result with original ID in OCX file

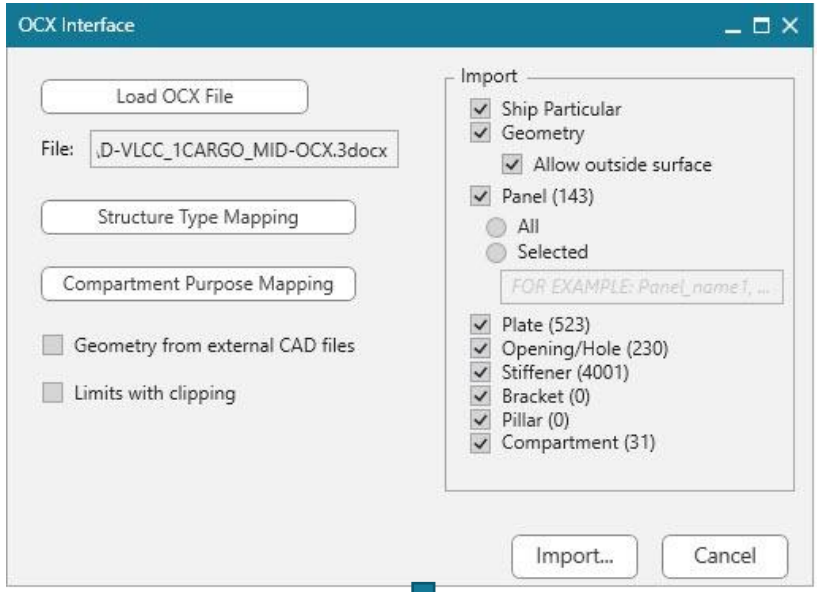


OCX File (3DOCX; Xml)

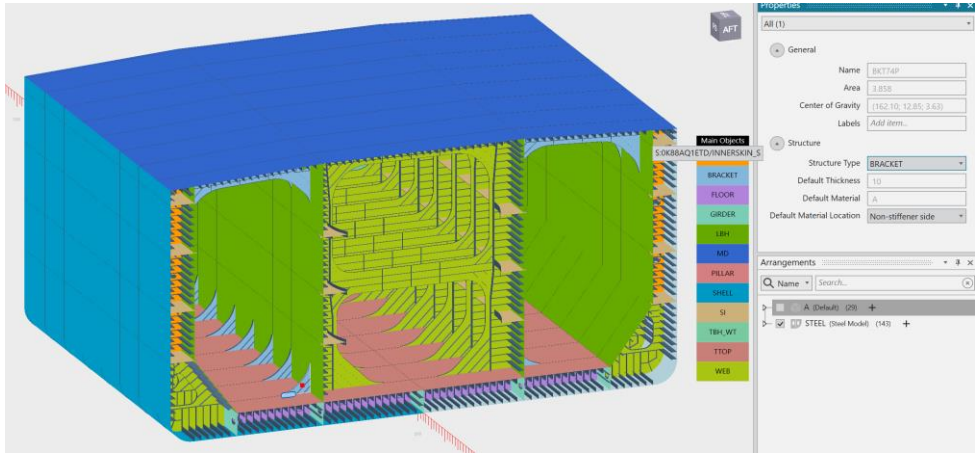


OCX Import / Further Utilizations for 3D MBA

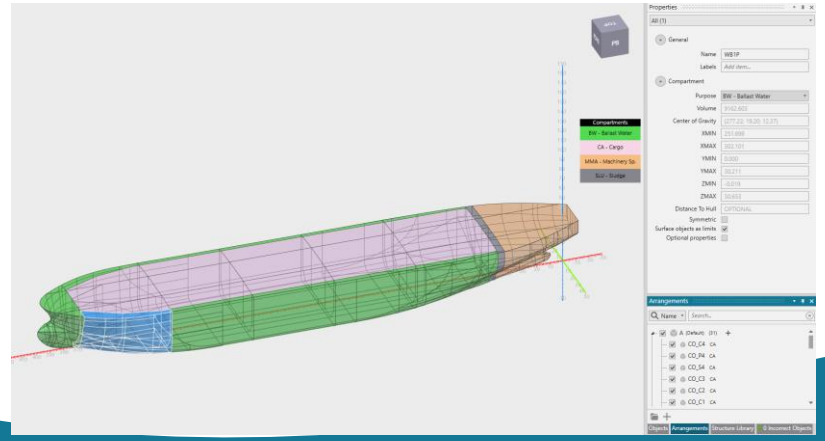
OCX Import to NAPA Designer



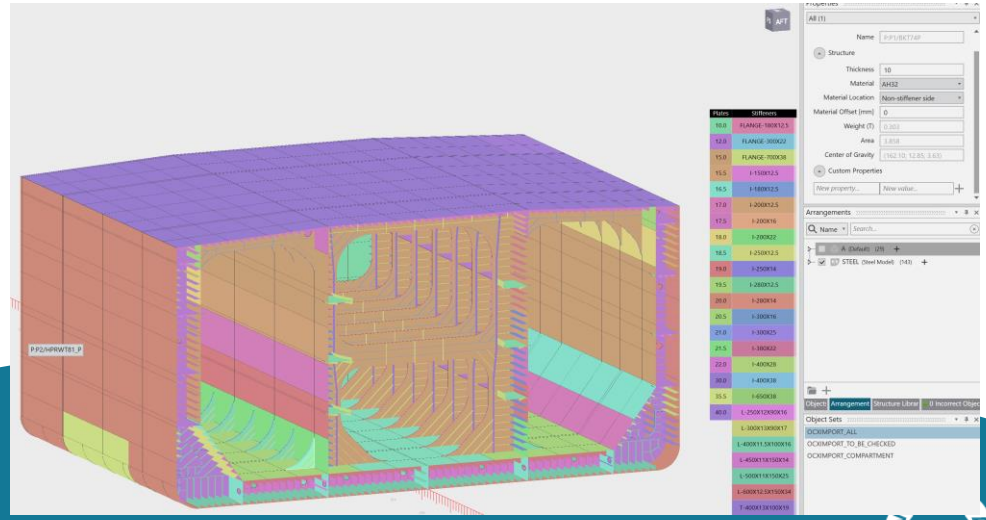
Main Objects



Compartments

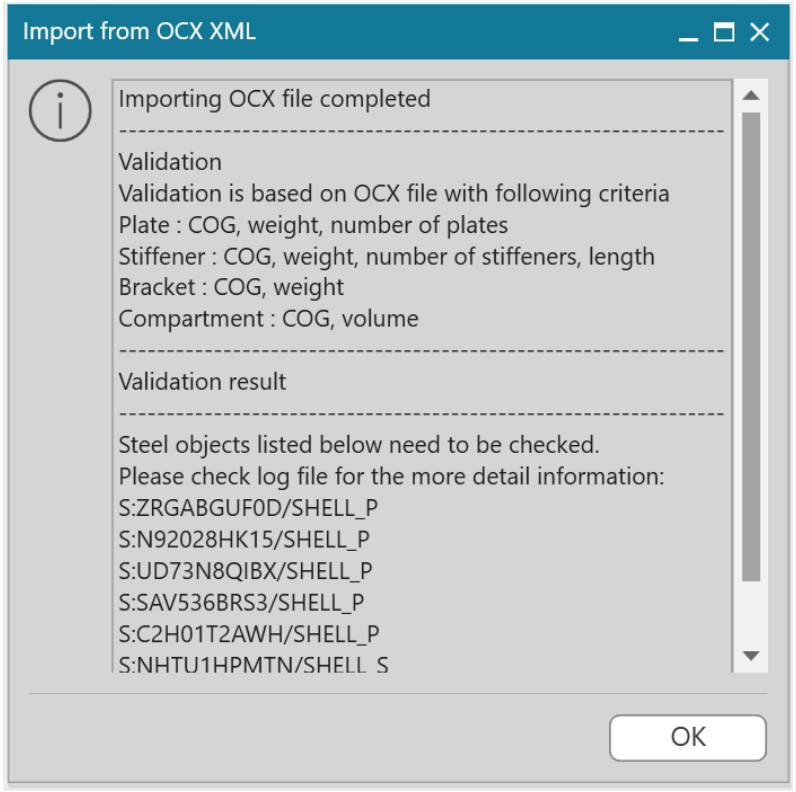


Structural Parts (Plates, Stiffeners, Brackets)

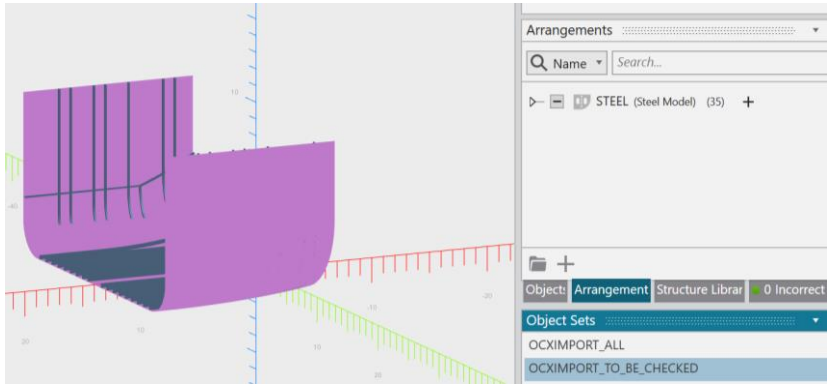


OCX Imported model validation

Import validation summary



Object Set



Import log

```
------------------------------OCX Link-import(02/15/2022 11:56:34)------------------------------

OCX Schema version : 2.8.6
Error. HMD has been skipped, INFO: principal paricular cannot be set (NaN : 15 : Real expected)
[Modeling]-S:C3GDACZIGR/SHELL_P, S:WXUCN7OYI6/SHELL_P, number of stiffeners S_BMFMZ16SDC_SHELL_P: 1 | Imported: 2
[Length ]-(S:C3GDACZIGR/SHELL_P, S:WXUCN7OYI6/SHELL_P), S_BMFMZ16SDC_SHELL_P: 8.2105 | imported: 13.3308736803029.
[C. O. G]-(S:C3GDACZIGR/SHELL_P, S:WXUCN7OYI6/SHELL_P), S_BMFMZ16SDC_SHELL_P: (3.01; 9.80; 5.50) | imported: (3.60; 9.83; 3.62).
[Weight ]-(S:C3GDACZIGR/SHELL_P, S:WXUCN7OYI6/SHELL_P), S_BMFMZ16SDC_SHELL_P: 219.1359 kg | imported: 355.801.
[Modeling]-S:5JPXN128AG/SHELL_P, S:1UEX0D7V2W/SHELL_P, S:A4CSDMLUBX/SHELL_P, number of stiffeners S_56ZN2LXWR2_SHELL_P: 1 | Imported: 3
[C. O. G]-(S:5JPXN128AG/SHELL_P, S:1UEX0D7V2W/SHELL_P, S:A4CSDMLUBX/SHELL_P), S_56ZN2LXWR2_SHELL_P: (1.51; 9.76; 5.47) | imported: (2.93; 9.78; 3.77).
[Modeling]-S:YHZKW4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S, number of stiffeners S_BMFMZ16SDC_SHELL_S: 1 | Imported: 2
[Length ]-(S:YHZKW4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S), S_BMFMZ16SDC_SHELL_S: 8.2105 | imported: 13.3308736803029.
[C. O. G]-(S:YHZKW4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S), S_BMFMZ16SDC_SHELL_S: (3.01; -9.80; 5.50) | imported: (3.60; -9.83; 3.62).
[Weight ]-(S:YHZKW4LDHO/SHELL_S, S:CVFSLEL3KT/SHELL_S), S_BMFMZ16SDC_SHELL_S: 219.1359 kg | imported: 355.801.

------------------------------OCX Link-import(02/15/2022 11:56:45)------------------------------
Time Elapsed: 00:10.685
```

- Before import: schema version, critical errors
- On importing: geometry error, data errors or missing
- After import: OCX model validation check

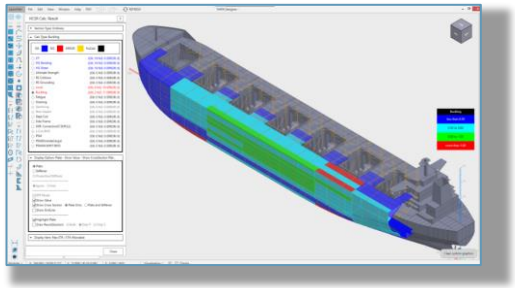
OCX Model further utilizations in NAPA Designer

- Modeling Changes
- Structural drawings
- Interfaces to other CAD systems
- Interfaces to Class Society rules
- FEM meshing
- Web viewer

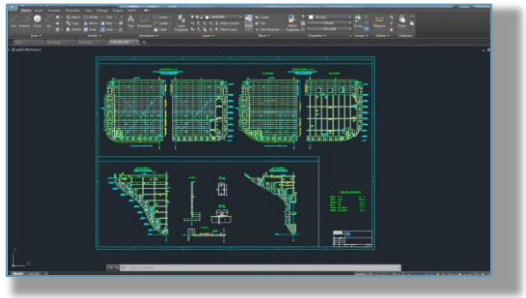
MODELING CHANGE



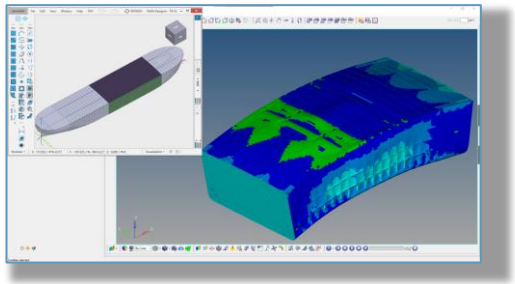
RULE INTERFACES



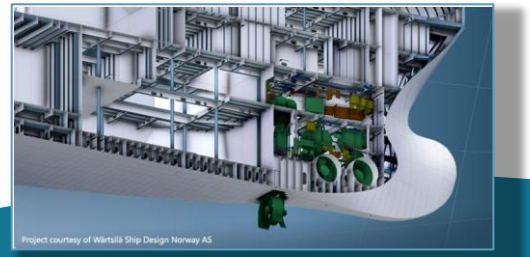
DRAWINGS



FEM



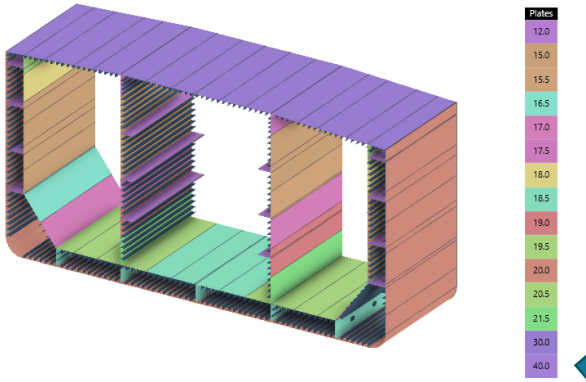
CAD INTERFACES



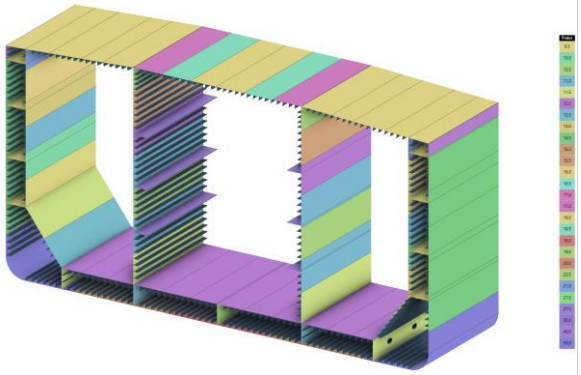
WEB VIEWER



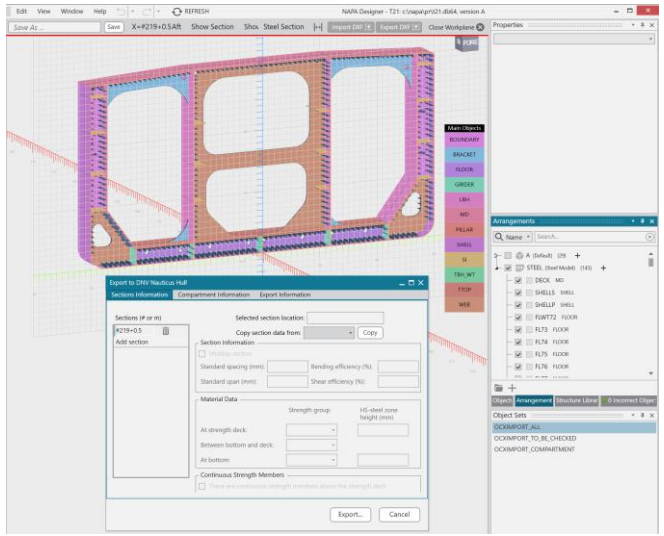
Rule scantling



Initial scantling



Rule scantling



OCX-imported model
Exported to…

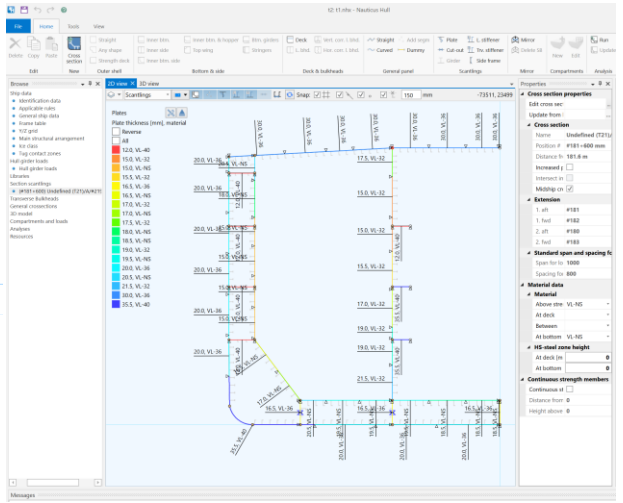
(T21)_#219+0.5_HALF.2DLX

Rule Check Interfaces

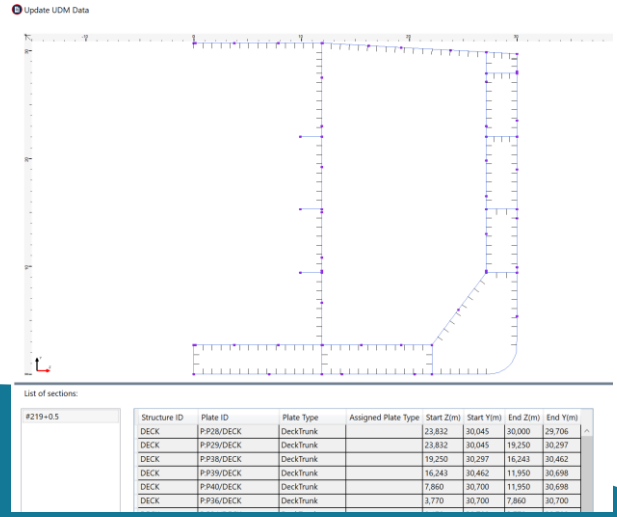
BUREAU VERITAS · KR KOREAN REGISTER · ClassNK · LR · ABS · DNV

T21-ABS.xml

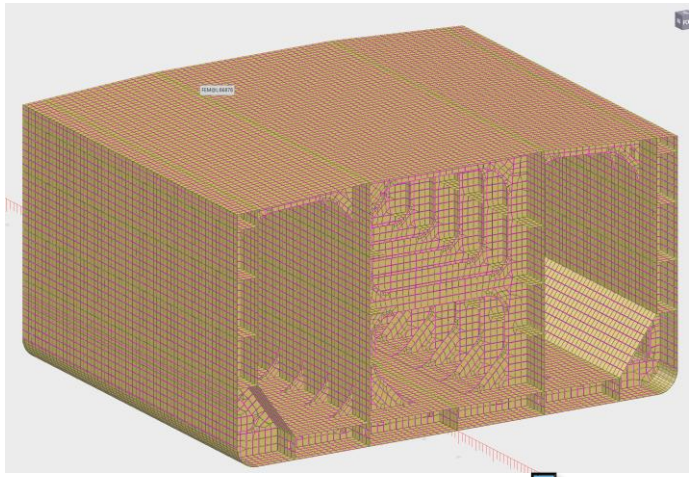
DNV Nauticus Hull



ABS Eagle UDM



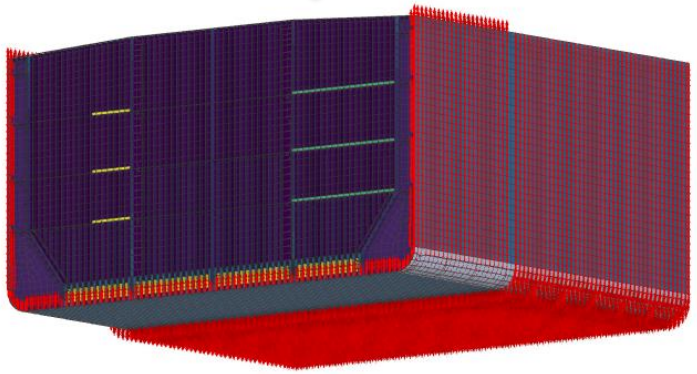
FEM with OCX imported model



FE model creation from **OCX** model

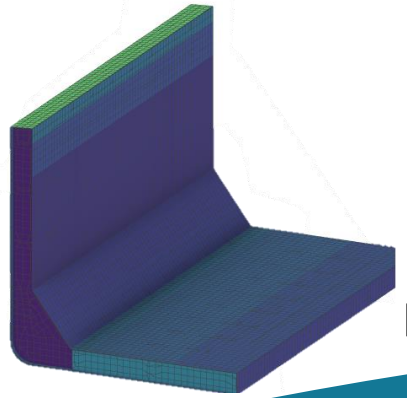
Load

Constraints



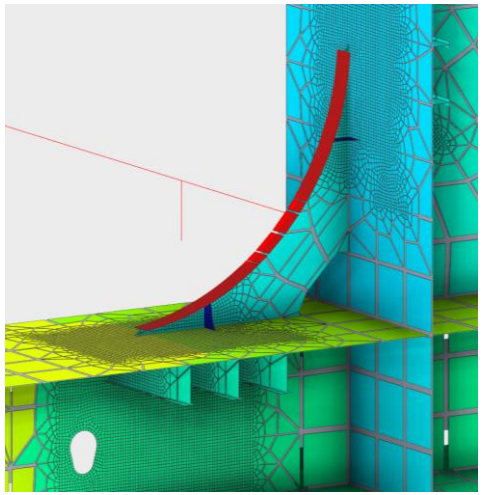
FEA **Solvable** model

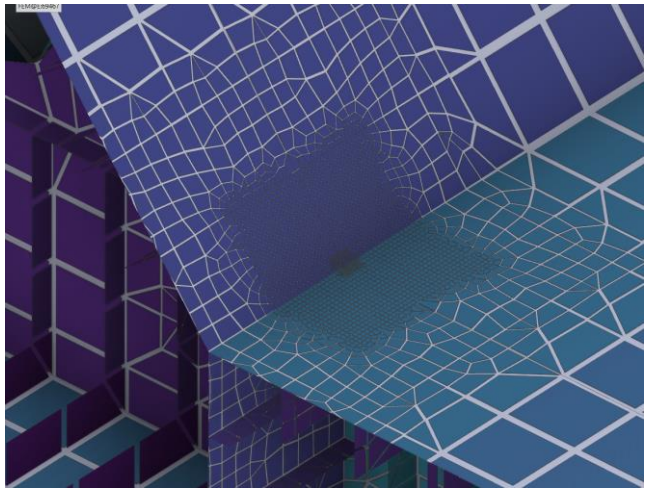
OCX compartment



FEM **Compartment grouping**

Opening/Bracket toes with real geometries





Fine-Mesh model for local analysis

Conclusion

- OCX as **standard format for 3D MBA**
- NAPA-DNV, took efforts to bring benefits by **reusing 3D model**
  - ✓ Rule scantling interface
  - ✓ Rule scantling iteration in design tool
- OCX import, for **further utilizations for 3D MBA**
  - ✓ Rule scantling
  - ✓ FEM
  - ✓ 2D drawings
  - ✓ 3D model review and Information sharing
  - ✓ Model translator
- Future works:
  - ✓ **Commenting interface** between NAPA, DNV
  - ✓ OCX extension : FE loads & constraints



Thank You!

Son, Ph.D.

Senior Software Developer

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