SESAM EXAMPLE

# Code Checks using GeniE

Workshop in code check of an offshore fixed platform

Sesam Example

Code Checks of Jacket Using GeniE

Date: May 2024

Prepared by: Digital Solutions at DNV

E-mail support: software.support@dnv.com

E-mail sales: digital@dnv.com

# Contents

# 1    Introduction

This workshop goes through the code checks for an offshore fixed platform using the software suite Sesam. It includes member/tubular connection code checks. The Sesam modules GeniE, Wajac, Gensod, Splice and Sestra are used.
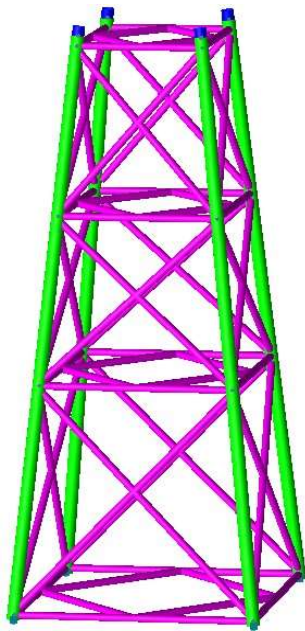
## 1.1    Program Version

GeniE V8.9-04
Wajac V7.11-01
Sestra V10.17-02
Splice V8.1-00
Sesam Manager V6.6-03
Application Version Manager V3.1-01
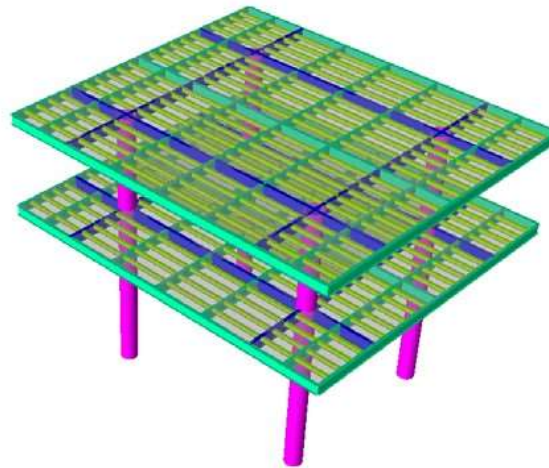
# 2    Model Information

The main jacket and deck dimensions are shown below.
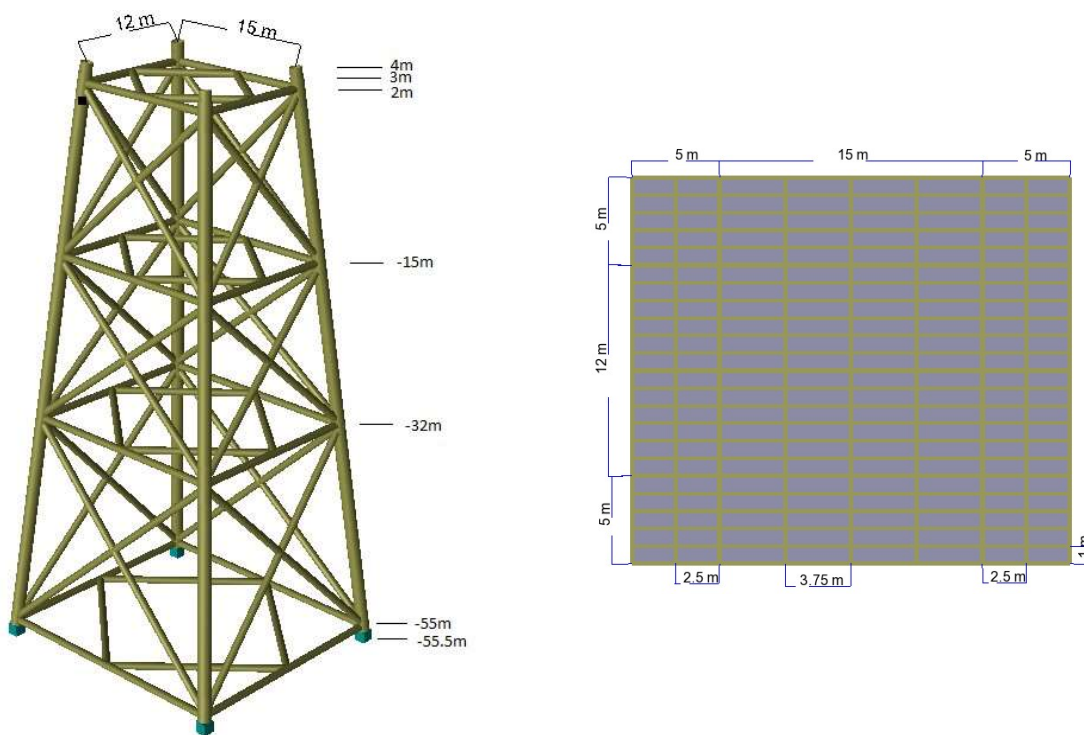
The jacket and deck beam sections are shown below.



Section
■ BRACE1
■ LEG1
■ PILE1



Section
■ DL1
■ W12X50
■ W27X114
■ W30X124

Beam sections of the jacket
Brace1 = 30 in x 0.75 in
Leg1 = 52.5 in x 0.75 in
Pile1 = 48 in x 1.25 in

Beam sections of the deck
DL1 = 48 in x 1.25 in
W12x50
W27x114
W30x124

# 3 Member and Joint Code Checking

Code Checks will be performed on members and tubular connection based on API RP 2A 22nd edition and AISC 9th addition for this workshop.

## 3.1 Create capacity model

Import GNX file named Model_Start.gnx. This model can be found in the workshop course material. The model is complete with basic load case, load combination and ready to run Analysis1. Run the analysis. Check if you have any error for the analysis. If you didn't manage to run the analysis, please consult the workshop facilitator.

Create new set consist of Jacket set and Deck set. Select both Deck and Jacket set. RMB click on the highlighted elements and select named set. Give the name Jacket_Deck.
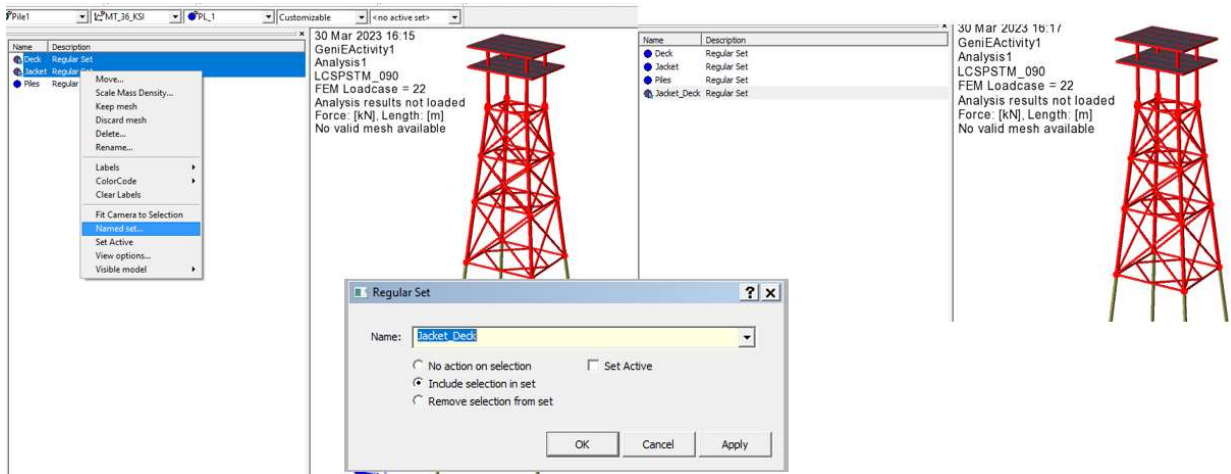
Then create a capacity manager by RMB clicking Capacity Folder in the browser and select New Capacity Manager. In the Capacity Manager dialog select the Analysis1 and API WSD 2014.
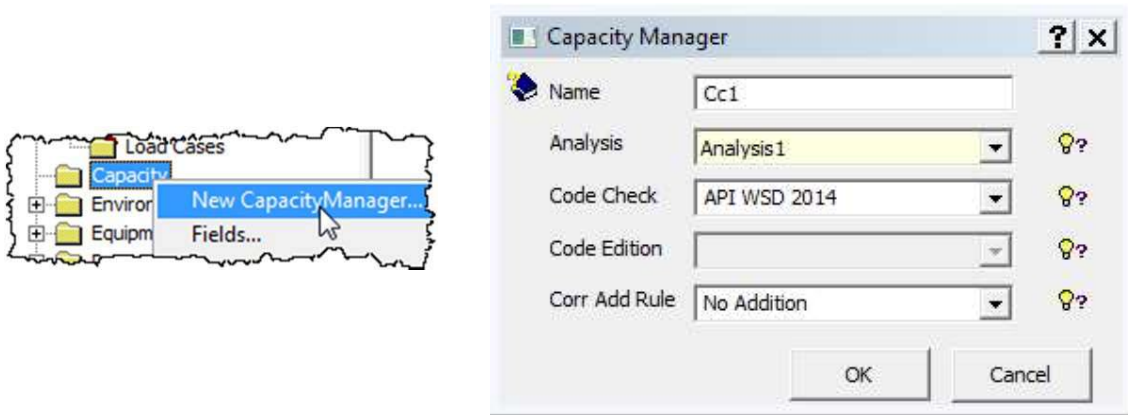


RMB click the newly created capacity manager and select Create (Update) Members to create the beam model for the code check. Check the Split at beam end option. Check Subset and select Jacket_Deck.
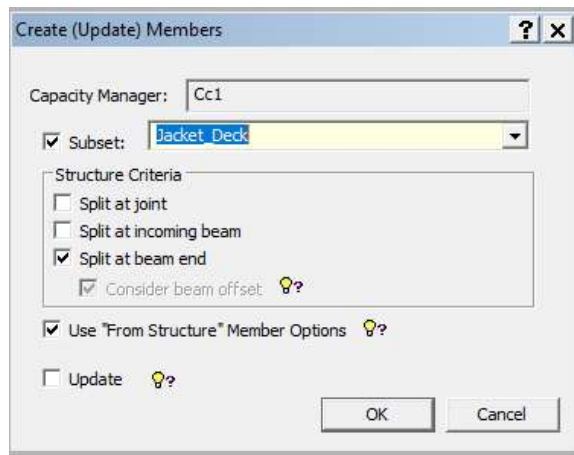


RMB click the created capacity manager and select Create Joints to create the tubular connection model for the code check.
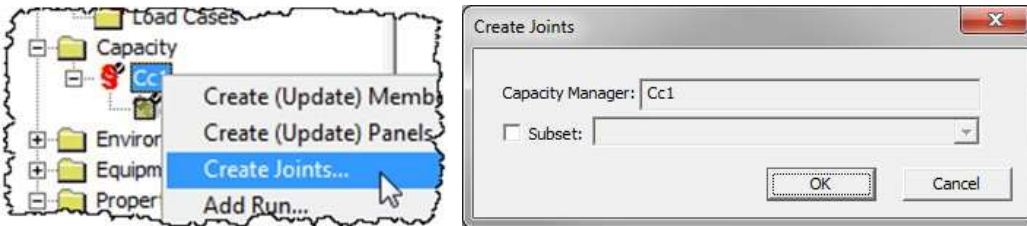
Display the capacity model by selecting Capacity Models view.
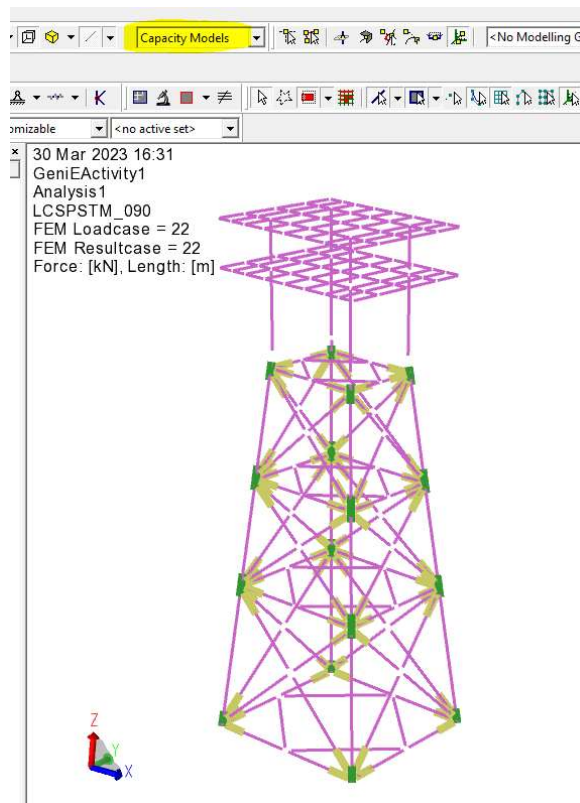


The capacity models are displayed both for members and joints.

## 3.2   Create runs

RMB click the capacity manager and select Add Run and in the dialog appearing select code of practice to be API WSD 2014. This involves that API RP2A 22nd will be used for tubular members and AISC 9th will be used for non-tubular members. Uncheck Joints, the joints will be code checked in a separate run.

Move only the combinations from Available LoadCases to Included LoadCases, and in the General tab uncheck Cap-end forces included. This is consistent with the choice of unchecking Include end forces in the Buoyancy tab when editing the wave load analysis.
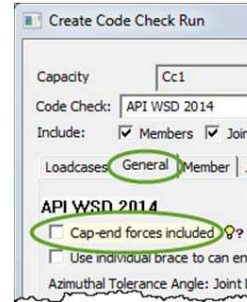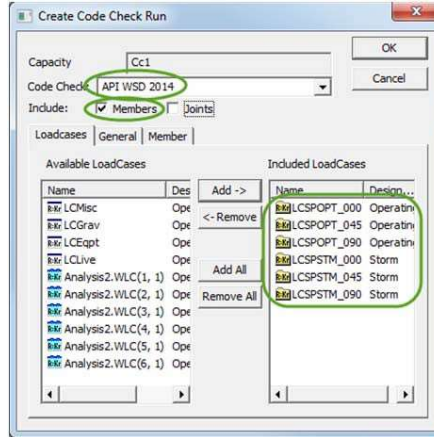
Add another run, this time checking Joints and unchecking Members. Go to the Joint tab of the same dialog (stretch the dialog horizontally) and set Joint Grouting to From Structure. This means that information on grouting is taken from the concept model.
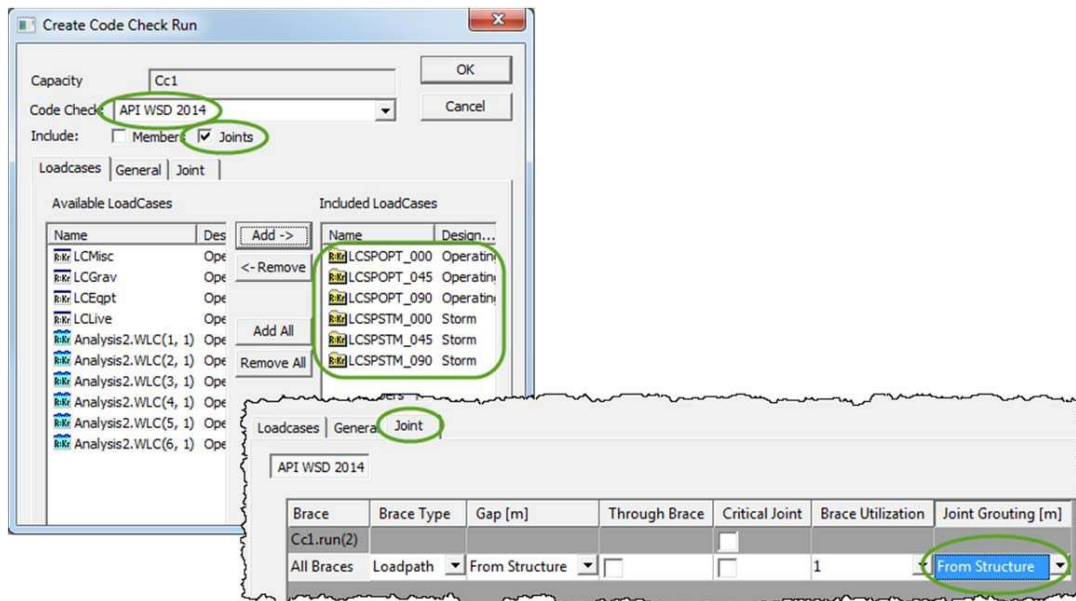


Set the first run (code checking members) as active:
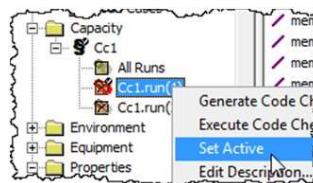


Change the descriptions for the two runs to 'Member code check' and 'Joint code check', respectively, by RMB clicking and selecting Edit Description as shown below.
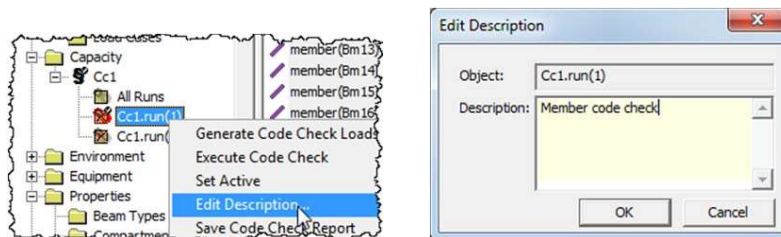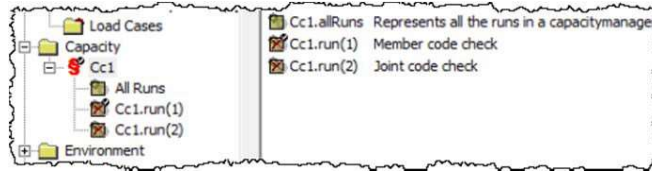
## 3.3   Perform code checking

Perform the code checking by two steps. RMB click All Runs and select first Generate Code Check Loads and then Execute Code Check.
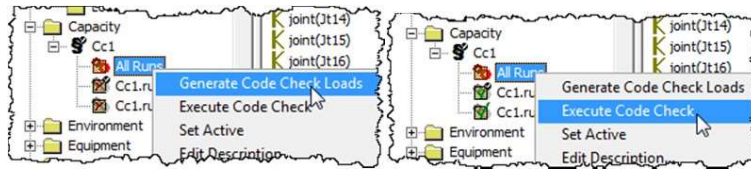


The forces and moments are computed at the positions where the code check will be performed.

## 3.4   View code check results

Tabulated code check results are found in the browser by selecting All Runs or the two runs individually.

The results are shown for the selected load combination or the worst ( Worst Case (CC) ) meaning whichever combination is the worst one for each member/joint. Stretch the browser pane to see the full table. The selected capacity member/joint will be highlighted also in the display. Click a header, e.g.UfTot (the highest usage factor of all relevant checks), to sort the table in decreasing/increasing order.

| Capacity Model | Run | LoadCase | Position | Status | UfTot | Formula | SubCheck | GeomCheck | Idealization Method |
|---|---|---|---|---|---|---|---|---|---|
| joint(Jt1) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt2) | Cc1.run(2) | LCSPSTM_000 | Bm64_1 | OK | 0.20 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt3) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt4) | Cc1.run(2) | LCSPSTM_090 | Bm58_1 | OK | 0.21 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt5) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt6) | Cc1.run(2) | LCSPSTM_090 | Bm62_1 | OK | 0.21 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt7) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt8) | Cc1.run(2) | LCSPSTM_090 | Bm57_1 | OK | 0.20 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt9) | Cc1.run(2) | LCSPSTM_045 | Bm64_2 | OK | 0.26 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt10) | Cc1.run(2) | LCSPSTM_045 | Bm72_2 | OK | 0.21 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt11) | Cc1.run(2) | LCSPSTM_090 | Bm80_2 | OK | 0.28 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt12) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt13) | Cc1.run(2) | LCSPSTM_090 | Bm62_2 | OK | 0.24 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt14) | Cc1.run(2) | LCSPSTM_090 | Bm80_1 | OK | 0.19 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt15) | Cc1.run(2) | LCSPSTM_090 | Bm79_2 | OK | 0.25 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt16) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt17) | Cc1.run(2) | LCSPSTM_090 | Bm57_2 | OK | 0.23 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt18) | Cc1.run(2) | LCSPSTM_090 | Bm68_2 | OK | 0.18 | uf7.6 | API WSD 2014 joint | | |
| joint(Jt19) | Cc1.run(2) | LCSPSTM_090 | Bm76_2 | OK | 0.25 | uf7.6 | API WSD 2014 joint | | |
| joint(Jt20) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| joint(Jt21) | Cc1.run(2) | LCSPSTM_045 | Bm59_2 | OK | 0.25 | uf7.6 | API WSD 2014 joint | | |
| joint(Jt22) | Cc1.run(2) | LCSPSTM_090 | Bm76_1 | OK | 0.19 | uf7.6 | API WSD 2014 joint | | |
| joint(Jt23) | Cc1.run(2) | LCSPSTM_090 | Bm75_2 | OK | 0.22 | uf7.6 | API WSD 2014 joint | Geom OK | |
| joint(Jt24) | Cc1.run(2) | LCSPOPT_000 | | | | | | | |
| member(Bm9) | Cc1.run(1) | LCSPOPT_000 | 0.00 | OK | 0.20 | uf6.13 | API WSD 2014 member | Geom OK | |
| member(Bm10) | Cc1.run(1) | LCSPOPT_000 | 0.00 | OK | 0.20 | uf6.13 | API WSD 2014 member | Geom OK | |
| member(Bm11) | Cc1.run(1) | LCSPOPT_000 | 0.00 | OK | 0.20 | uf6.13 | API WSD 2014 member | Geom OK | |
| member(Bm12) | Cc1.run(1) | LCSPOPT_000 | 0.00 | OK | 0.20 | uf6.13 | API WSD 2014 member | Geom OK | |
| member(Bm13) | Cc1.run(1) | LCSPOPT_000 | 0.00 | OK | 0.12 | uf6.13 | API WSD 2014 member | Geom OK | |
| member(Bm14) | Cc1.run(1) | LCSPSTM_000 | 0.00 | OK | 0.14 | uf6.27 | API WSD 2014 member | Geom OK | |
| member(Bm15) | Cc1.run(1) | LCSPSTM_045 | 0.00 | OK | 0.18 | uf6.27 | API WSD 2014 member | Geom OK | |
| member(Bm16) | Cc1.run(1) | LCSPSTM_090 | 1.00 | OK | 0.16 | uf6.27 | API WSD 2014 member | Geom OK | |
| member(Bm17) | Cc1.run(1) | LCSPSTM_090 | 1.00 | OK | 0.17 | uf6.21 | API WSD 2014 member | Geom OK | |
| member(Bm18) | Cc1.run(1) | LCSPSTM_000 | 0.00 | OK | 0.16 | uf6.21 | API WSD 2014 member | Geom OK | |

| Capacity Model | Run | LoadCase | Position | Status | UfTot | Formula | SubCheck | GeomCheck | Idealization Method |
|---|---|---|---|---|---|---|---|---|---|
| member(Bm84_6_6) | Cc1.run(1) | LCSPOPT_000 | 0.00 | Failed(uf) | 5.43 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm84_10) | Cc1.run(1) | LCSPOPT_000 | 0.00 | Failed(uf) | 2.45 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm85_3_7_1) | Cc1.run(1) | LCSPOPT_000 | 0.00 | Failed(uf) | 2.24 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm85_1_2_1) | Cc1.run(1) | LCSPOPT_090 | 0.00 | Failed(uf) | 2.22 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm84_7_1) | Cc1.run(1) | LCSPOPT_000 | 0.80 | Failed(uf) | 2.16 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm84_6_6_1) | Cc1.run(1) | LCSPOPT_090 | 0.00 | Failed(uf) | 2.01 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm84_6_5_1) | Cc1.run(1) | LCSPOPT_000 | 0.83 | Failed(uf) | 1.99 | ufH1-1 | AISC 9th member | Geom OK | |
| member(Bm85_3_6) | Cc1.run(1) | LCSPOPT_090 | 0.00 | Failed(uf) | 1.91 | ufH1-1 | AISC 9th member | Geom OK | |

Display the code results in color by selecting the model (drag rubberband), RMB clicking and selecting ColorCode > Results > UfTot. Click outside the model to unselect it or else the model will still be selected and therefore red. Select a member of interest, RMB click and select Labels > Results and then select a result of interest, for instance UfTot_LC meaning the usage factor and load combination corresponding to the color.
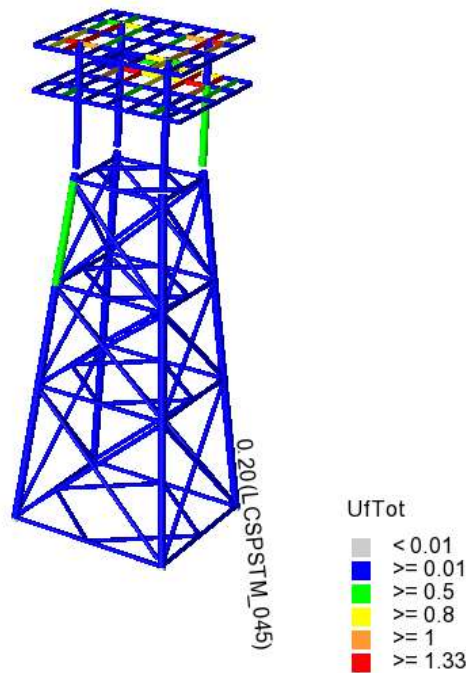


RMB click a member and select Redesign to open the dialog below in which redesign of the member can be done by selecting e.g. new section or material. The new utilisation (UfTot) of the change will immediately appear. Such a change is, however, based on the assumption that the change will not redistribute any loads. Any detail about the member and results can be found by clicking the Details button to the right.



10

Code check results can also be tabulated for members individually by RMB clicking and selecting Properties followed by clicking the Object Properties tab as shown below.
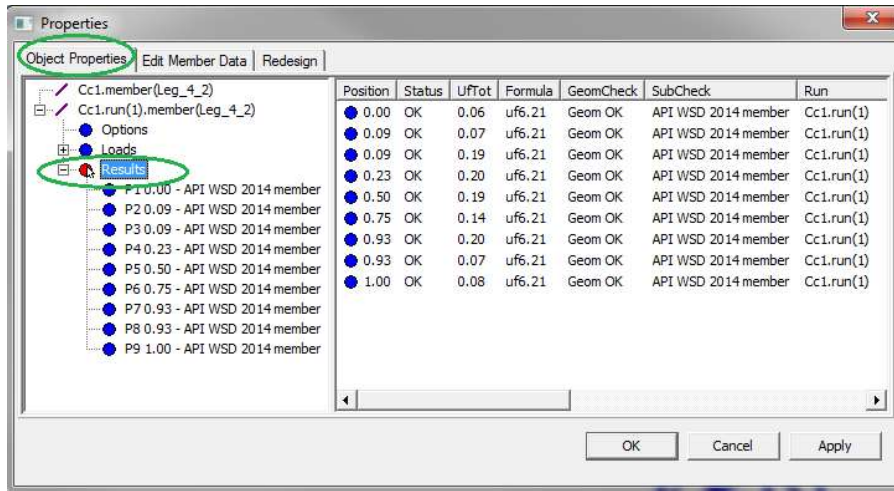


## 3.5 Create a report of code check results
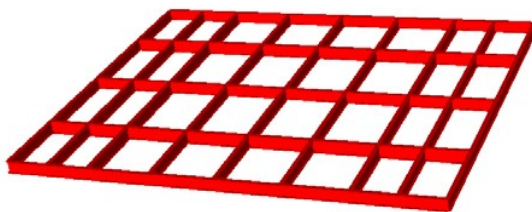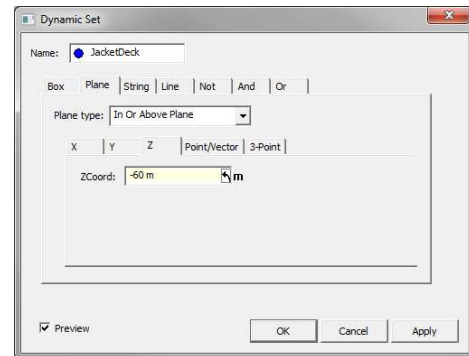
First create a Dynamic sets.

Under Utilities-> Sets-> Dynamic Sets RMB click and select New Dynamic Set.
Name: JacketDeck
Plane Type: In Or Above Plane Select Z and input -60m
Apply

Select the Top deck main members only and click Alt-S to show these members only.





Create another Dynamic Set.

Under Utilities-> Sets-> Dynamic Sets RMB click and select New Dynamic Set.
Name: Top_Deck
Plane Type: In Plane
Select 3-point and select the 3 outside points of the deck
Apply
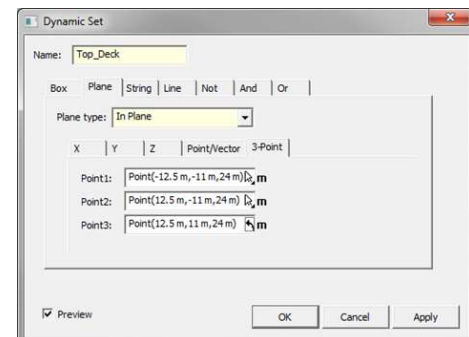


To Create the report use File > Save report to open the dialog below and select FEM Results then "Add Selected", Select Graphics then "Add Selected", Select Graphics again then "Add Selected", and Select Frame Code Check then "Add Selected" to put these results only into the report.
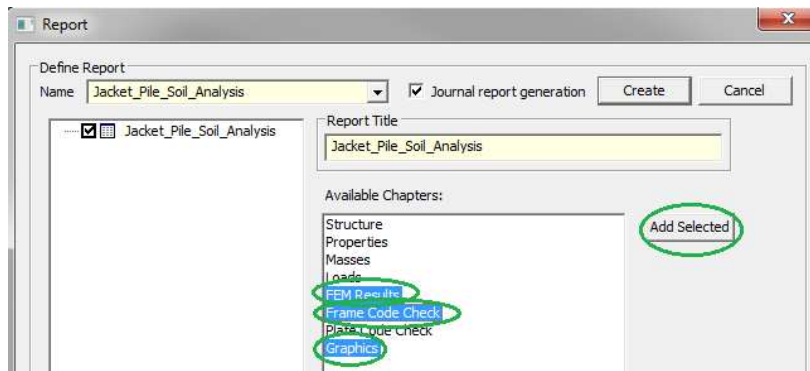
Clicking Add Selected puts several types of results into the field to the left. These will be chapters in the report. The selection of results to put into the report may be further refined by checking only certain boxes as shown. Moreover, only a selection of load combinations may be included. Limit the amount of data in the report to avoid an excessively large report demanding a long time to be created!

Under FEM Results: Check "FEM Beam Force" & "FEM Beam Stress". For Loadcases select "LCSPSTM_090"
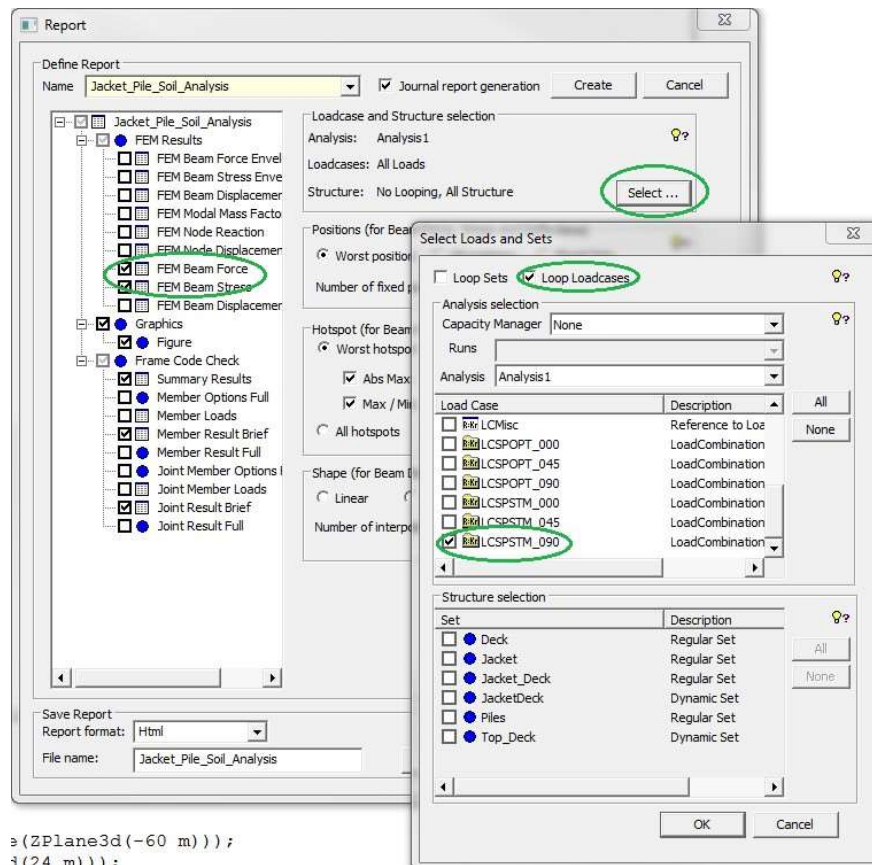


Under Graphics: Check Loop Sets and check Jacket_Deck.

Under Figure: Display- Capacity Models, Background- Paper, View- Auto, Color Coding- Results, Name- UfTot, Labels- None
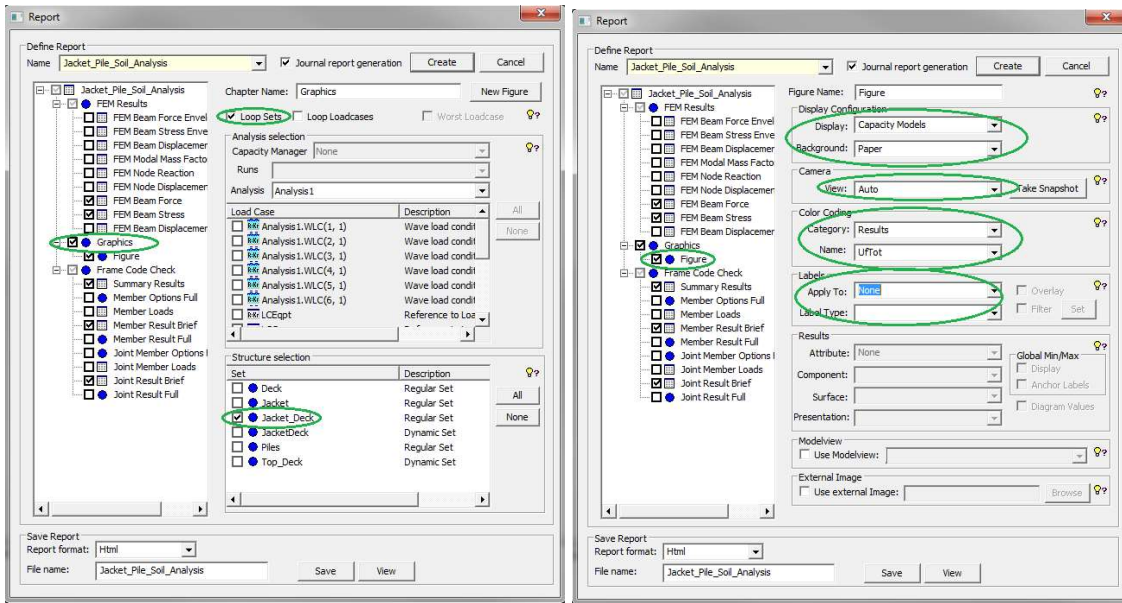
Under Graphics: Check Loop Sets and check Top_Deck.

Under Figure: Display- Capacity Models, Background- Paper, View- Auto, Color Coding- Results, Name- UfTot, Labels- Apply To: Capacity Members, Labels Type- UfTot



Under Frame Code Check: Check "Member Result Brief", "Joint Member Loads", & "Joint Result Brief". Check Worse Loadcase and Worst Position.
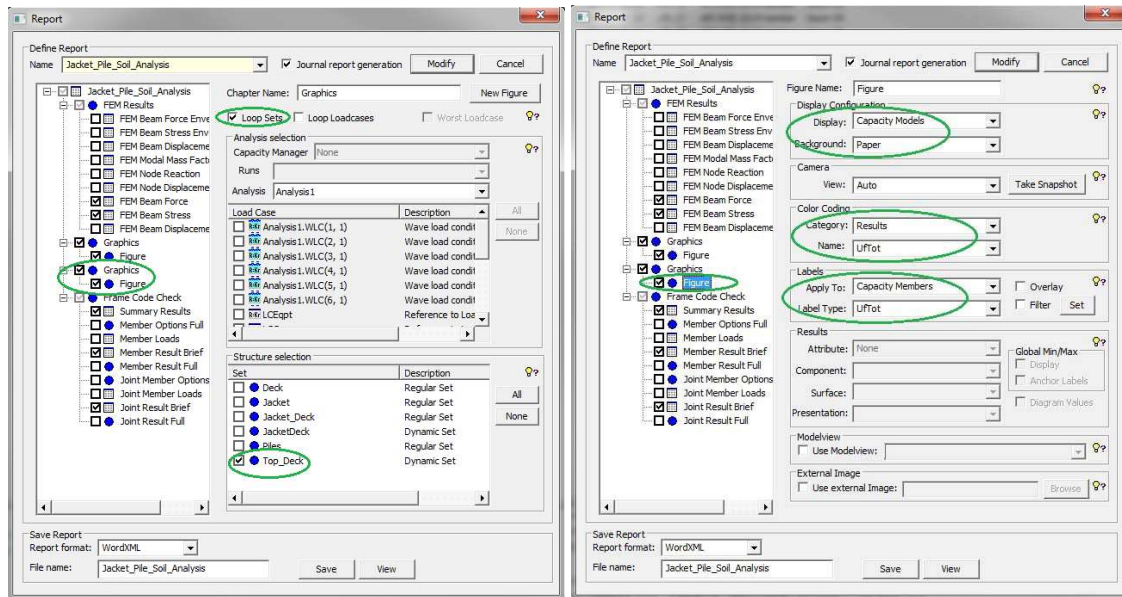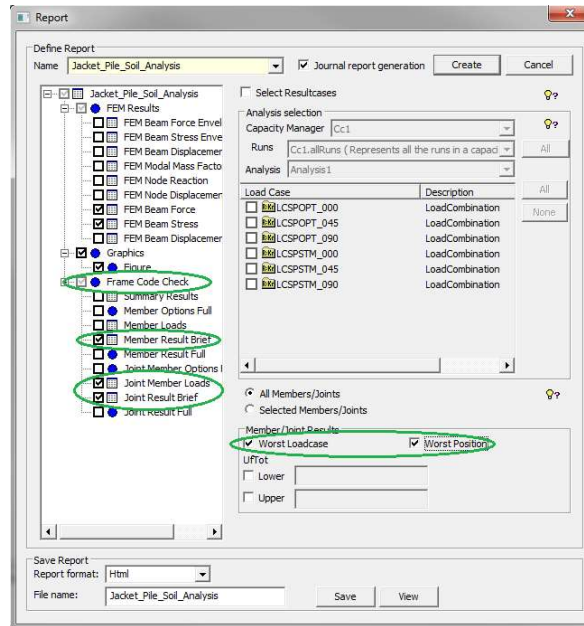
Click first Save and then View. The report will open in a web browser, Word or Excel depending on the chosen report format.

An extract of the word formatted report is shown below.



### 1.2.1 LCSPSTM_090 : FEM Beam Force

**LCSPSTM_090 : FEM Beam Force**

- Sorted by Name (Ascending)

- Analysis : Analysis1

Parameters :
Name : Name of beam
Position : Position relative to end1 of beam
Length [m] : Distance from end1 of beam
NXX [kN] : Axial force (Positive gives tension)
NXY [kN] : Shear force in local Y-direction (Positive rotates an isolated piece anti-clockwise when viewed in direction of local Z-axis)
NXZ [kN] : Shear force in local Z-direction (Positive rotates an isolated piece anti-clockwise when viewed in direction of local Y-axis)
MXX [kN*m] : Torsional moment (Positive produces a right-handed screw)
MXY [kN*m] : Bending moment about local Y-axis (Positive gives tension at local negative Z-axis side of profile)
MXZ [kN*m] : Bending moment about local Z-axis (Positive gives tension at local negative Y-axis side of profile)
Comment : Comment

| Name | Position | Length [m] | NXX [kN] | NXY [kN] | NXZ [kN] | MXX [kN*m] | MXY [kN*m] | MXZ [kN*m] | Comment |
|------|----------|------------|----------|----------|----------|------------|------------|------------|---------|
| Bm9 | 0.00 | 0.0127116 | 105.114 | -6.71255 | 10.7017 | 34.7298 | 53.5741 | -84.1113 | Max MXY |
| | 1.00 | 12.6981 | 105.114 | 38.9787 | 3.92717 | 34.7298 | -39.2123 | 120.543 | Max MXZ |
| Bm10 | 0.00 | 0.0112116 | 37.8345 | 20.3005 | 35.5341 | -8.48591 | 289.659 | -152.248 | Min MXZ, Max MXY |
| Bm11 | 0.00 | 0.0112116 | 64.37 | -20.5897 | 34.3929 | 8.72961 | 277.226 | 154.548 | Max MXZ, Max MXY |
| Bm12 | 0.00 | 0.0127116 | -144.851 | -8.85257 | 11.6868 | 26.8818 | 54.4693 | -85.4178 | Max MXY |
| | 1.00 | 12.6981 | -144.851 | 40.5494 | 4.74982 | 26.8818 | -49.7831 | 115.626 | Max MXZ |
| Bm13 | 0.00 | 0.0104108 | 396.5 | -2.06896 | 0.394093 | 11.3113 | 6.58836 | -129.312 | Max MXY |
| | 1.00 | 10.4004 | 396.5 | 54.6064 | 1.10258 | 11.3113 | -1.18683 | 143.62 | Max MXZ |
| Bm14 | 0.00 | 0.00891079 | -7.08543 | 34.4275 | 12.0615 | -5.65884 | 82.815 | -213.6 | Min MXZ, Max MXY |

### 1.2.2 LCSPSTM_090 : FEM Beam Stress

**LCSPSTM_090 : FEM Beam Stress**

- Sorted by Name (Ascending)

- Analysis : Analysis1

Parameters :
Name : Name of beam
Position : Position relative to end1 of beam
Length [m] : Distance from end1 of beam
Algo : Algorithm for deciding worst stress (max/min)
Compo : Component that is searched (max/min)
Hotspot : Hotspot of worst stress (max/min)
VonMises [KPa] : VonMises stress
Sigxx [KPa] : Normal stress
SigNxx [KPa] : Axial stress (from Nxx only)
SigMxy [KPa] : Bending stress about local Y-axis (at hotspot)
SigMxz [KPa] : Bending stress about local Z-axis (at hotspot)
TauMxx [KPa] : Torsional stress (at hotspot)
TauNxy [KPa] : Shear stress in local Y-direction (at hotspot)
TauNxz [KPa] : Shear stress in local Z-direction (at hotspot)
Comment : Comment

| Name | Position | Length [m] | Algo | Compo | Hotspot | VonMises [KPa] | Sigxx [KPa] | SigNxx [KPa] | SigMxy [KPa] | SigMxz [KPa] | TauMxx [KPa] | TauNxy [KPa] | TauNxz [KPa] | Comment |
|------|----------|-----------|------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Bm9 | 1.00 | 12.7107 | AbsMax | VonMises | 12 | 18620.5 | 18134.9 | 2364.04 | 1261.16 | 14509.7 | 2155.15 | 454.312 | -170.338 | Worst |
| | 1.00 | 12.7107 | Min | sigxx | 24 | 14056.7 | -13406.8 | 2364.04 | -1261.16 | -14509.7 | 2155.15 | -454.312 | 170.338 | Worst |
| | 1.00 | 12.7107 | Max | sigxx | 12 | 18620.5 | 18134.9 | 2364.04 | 1261.16 | 14509.7 | 2155.15 | 454.312 | -170.338 | Worst |
| Bm10 | 0.00 | 0.000112108 | AbsMax | VonMises | 21 | 41498.6 | 41488.2 | 850.91 | 31175.6 | 9461.74 | -526.592 | -790.795 | 799.306 | Worst |
| | 0.00 | 0.000112108 | Min | sigxx | 9 | 39797.2 | -39786.4 | 850.91 | -31175.6 | -9461.74 | -526.592 | 790.795 | -799.306 | Worst |
| | 0.00 | 0.000112108 | Max | sigxx | 21 | 41498.6 | 41488.2 | 850.91 | 31175.6 | 9461.74 | 526.592 | 790.795 | 799.306 | Worst |

## 2 Graphics

### 2.1 Figure_Jacket_Deck

19 Oct 2017 10:23
GeniEActivity1
Analysis1



UfTot
< 0.01
>= 0.01
>= 0.5
>= 0.8
>= 1
>= 1.33

Figure ( Set: Jacket_Deck )

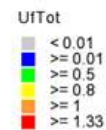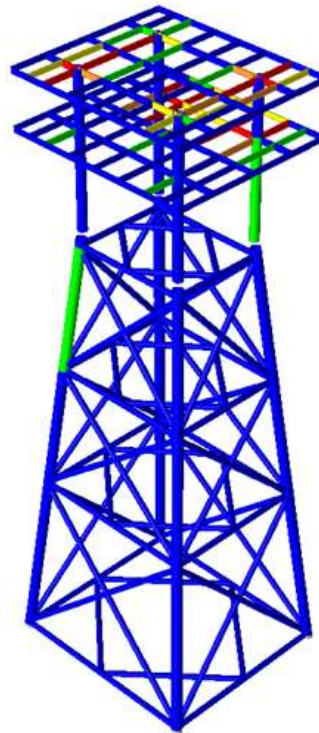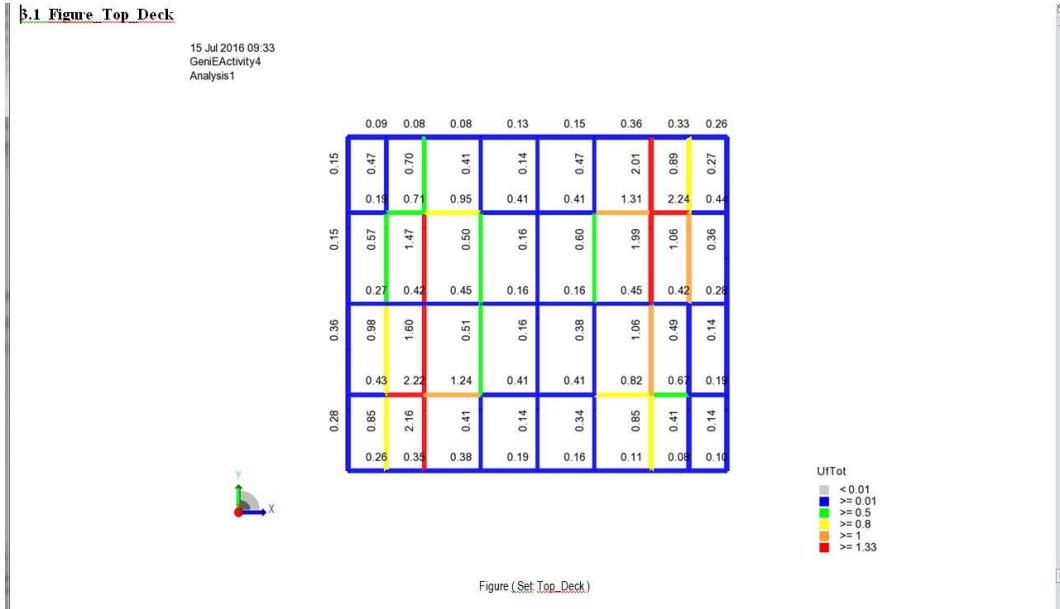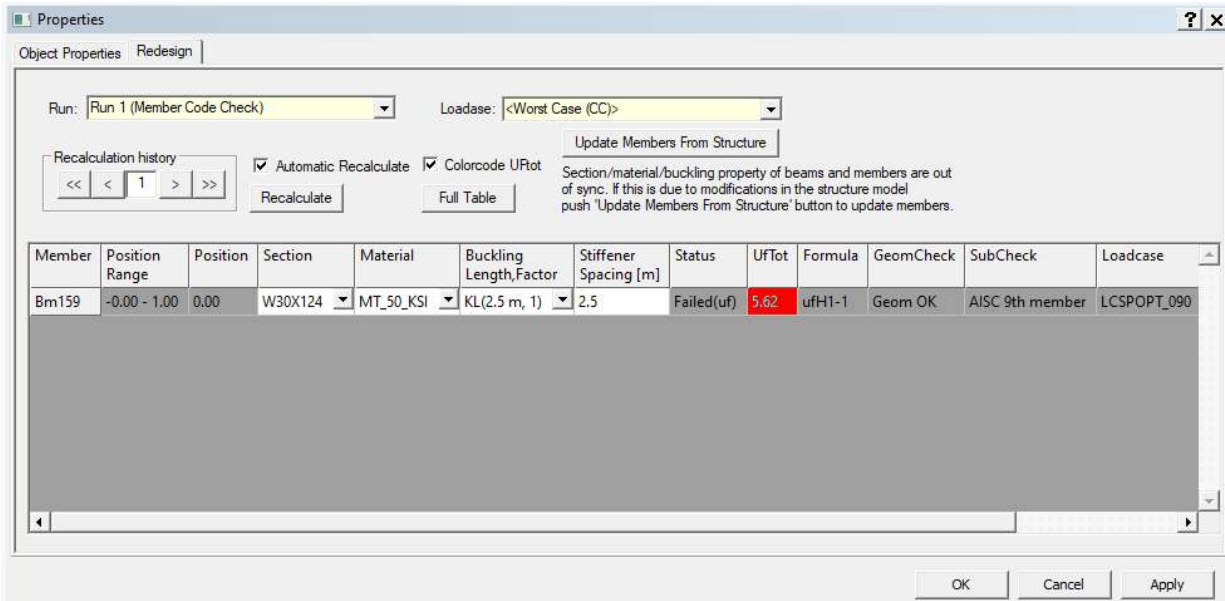Figure ( Set: Top_Deck )

## 3.6 Redesign

In the capacity model click on Cc1.run(1) and select a member with the highest UfTot (5.62).

Create a new section W40x179 (from library). We will use this section for redesign of the worst UfTot member. RMB click on the respective beam and choose Redesign. Properties box will be prompted:
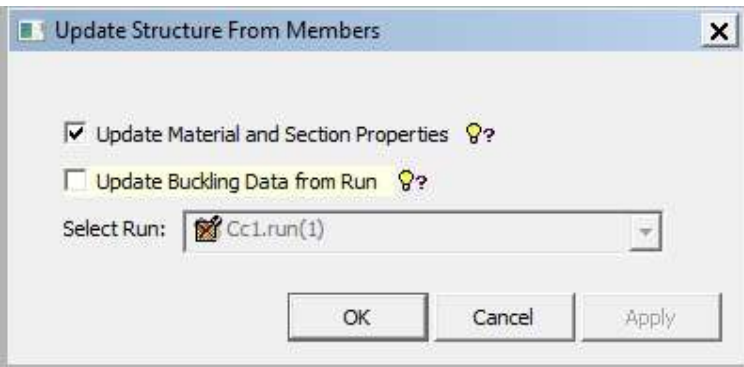


Change the section to W40x149. Notice that the UfTot is now reduced to a new estimation value.
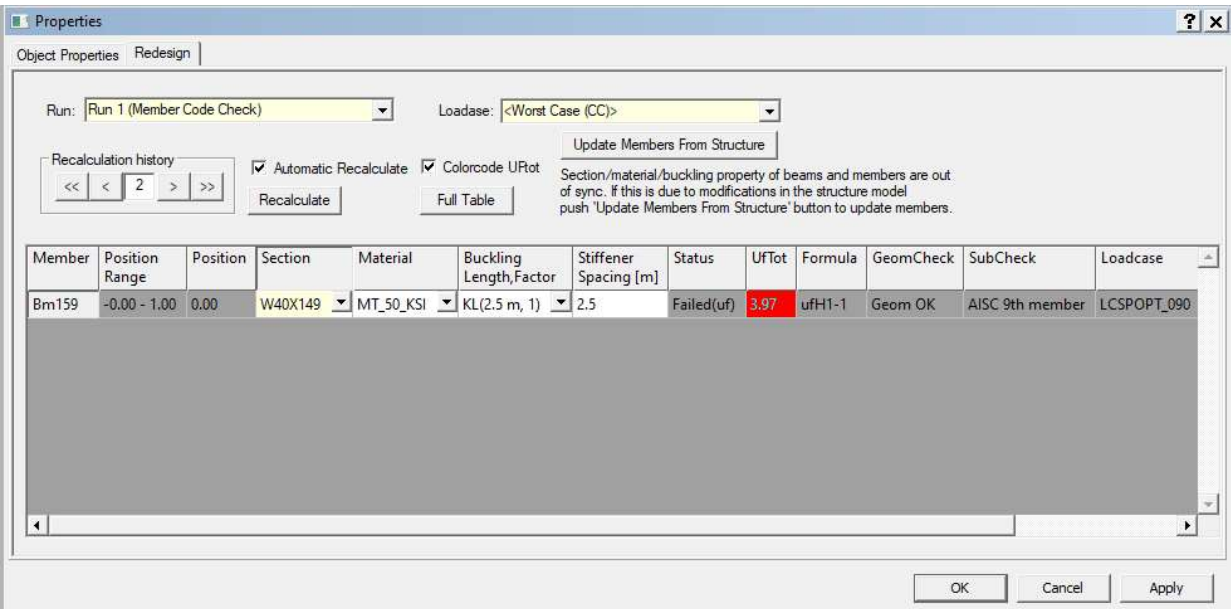
Click OK. Then RMB on Cc1 and click on Run All. Click OK when prompted with Update Structure From Members. This will update the structure with respect to the redesigned section.



Check the result and decide whether further redesign is needed or not.

## 3.7    Save the model

GeniE workspace can be saved using CTRL+S or File > Save Workspace. It is also advisable to back up the model by exporting them into GNX and XML format.

## About DNV

We are the independent expert in risk management and quality assurance. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.

## Digital Solutions

DNV is a world-leading provider of digital solutions and software applications with focus on the energy, maritime and healthcare markets. Our solutions are used worldwide to manage risk and performance for wind turbines, electric grids, pipelines, processing plants, offshore structures, ships, and more. Supported by our domain knowledge and Veracity assurance platform, we enable companies to digitize and manage business critical activities in a sustainable, cost-efficient, safe and secure way.

DNV  |  digital@dnv.com  |  dnv.com/digital