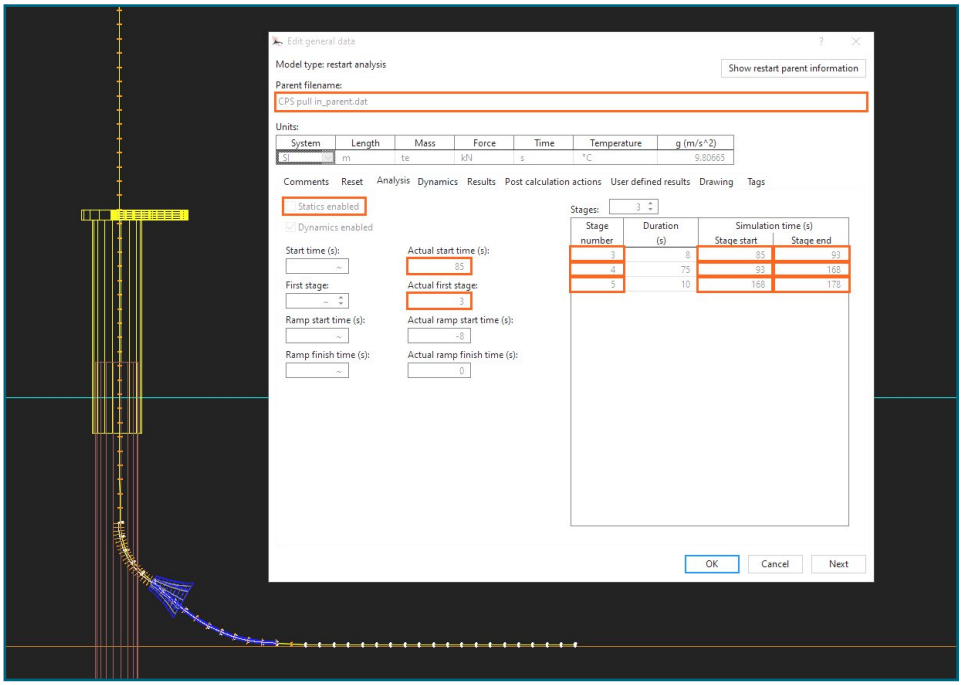
orcaflex newsletter



In this newsletter

In this edition we will introduce some of the new features in OrcaFlex 11.1, introduced in early 2021, as well as looking to future developments for 11.2 and beyond.

You can also find some information on the back page about our training and user group meetings.

OrcaFlex, now with restarts!

Restart analysis: a feature requested by users since the dawn of time! At least that's how it feels...

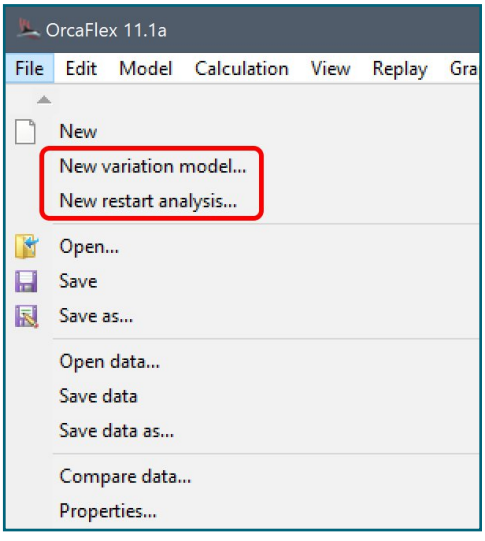
But what exactly is a restart analysis?

Traditionally, OrcaFlex analyses consist of an initial static calculation, which aims to find a good starting equilibrium for a subsequent time or frequency domain dynamic analysis.

The goal with a restart analysis is to allow its initial conditions to be determined by a prior analysis, which can be either a static or dynamic analysis.

The restart model (the *child*) only contains data that has been modified, with all other data being referenced from the prior analysis (the *parent* model). This allows you to make changes to common data in the parent model and have it flow into any child models. As part of this implementation, we have also added variation models and change tracking facilities.

More on these overleaf...



New model options

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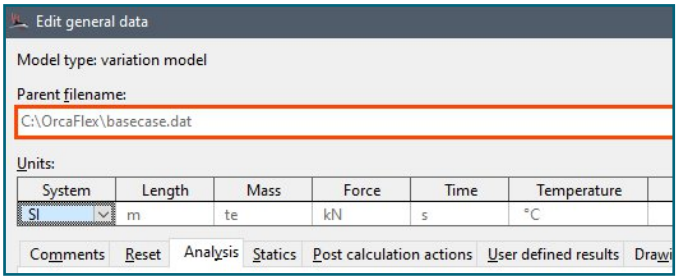
Variation models

Perhaps we don't want to perform a restart analysis, but we instead want to create some new models which have just a few changes compared with a model they are based on, for example, a base case file and a number of load cases with varying weather conditions. To do this in previous versions of OrcaFlex, you had to create the load cases manually in a text editor, or with the help of the OrcaFlex spreadsheet.

We refer to these files as variation models, and can now create them directly in OrcaFlex. When the variation model type is selected, the program requires you to specify a parent file, which is then referenced in the general data form.



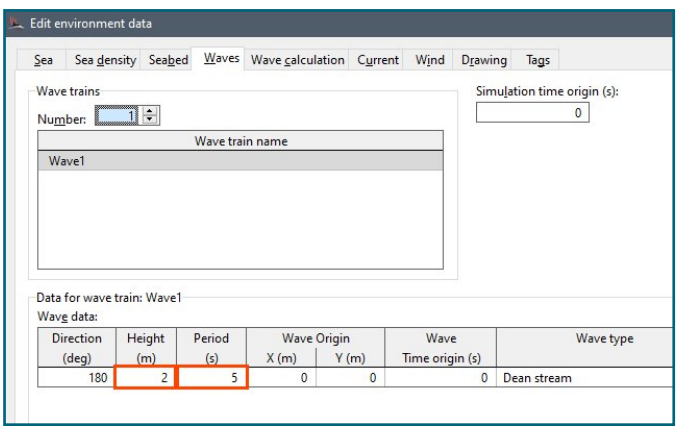
Parent file reference in a variation model

When the model is opened it is initially identical to the parent file. You can then start to make the changes necessary for that particular variation model. The variation model files contain only the changes and are saved as YAML text files.

Change tracking

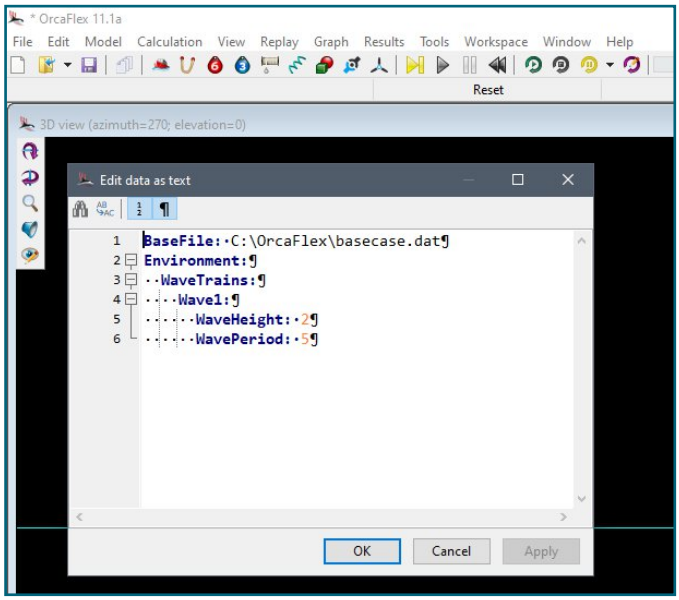
Of course, now that we have the option of directly creating a variation model which contains changes when compared with its parent file, the means of tracking those changes becomes rather important!

Change tracking in OrcaFlex variation files is done automatically, with modified data being highlighted. This can be seen in the image below, with the changes being wave height and period.



Change highlighting in a variation model

When working with a variation model, it is often beneficial to view all the changes to that model in one place, and this can be done using a new built-in text editor, available from the model menu.



OrcaFlex built-in text editor

Usefully, as well as viewing all the changes together, you can also edit the data here.

Back to restarts...

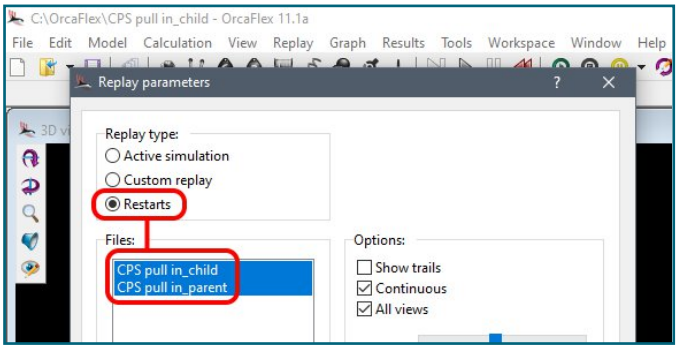
A variation model requires a parent data file which defines the input data being inherited by the variation model. Restart data files are similar to variation models, but require an additional input source. Since a restart analysis requires a completed prior analysis to determine its initial conditions, it therefore requires as an input a parent simulation file.

When a restart analysis starts, the parent simulation file is loaded, and the state at which it completed is mapped across to the restart.

An example of this might be the pull-in of a cable and its CPS (cable protection system). The first part of a CPS pull-in consists of the cable and its CPS being pulled into a J-tube together. The CPS is then fixed to the J-tube and the cable continues to be pulled through both. Because of the need to transfer the connection of the CPS from the cable to the J-tube, this type of analyis would traditionally be performed in two distinct stages. The use of restarts allows the first stage to flow into the second, with the parent analysis concluding at the point at which the CPS is fixed to the J-tube, and the restart analysis continuing from that point.

While this results in separate simulation files for each stage, the parent and all child models are linked through the use of restarts.

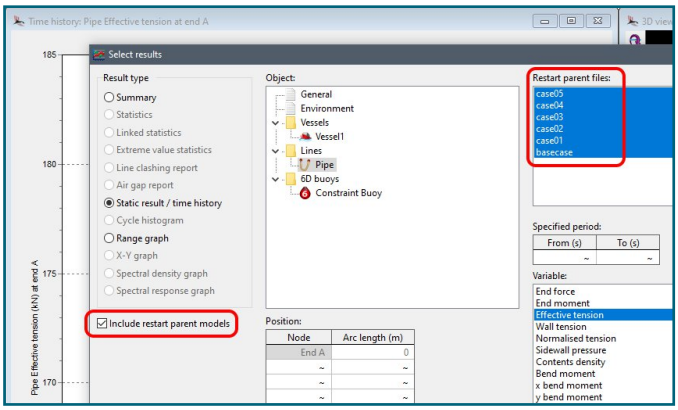
One of the benefits of this is that you can choose to view (and export) a simulation replay which blends some, or all, of the restart files into one seamless replay.



Linked restart replays

In the same way, results for parent and child models can also be collated and presented as one graph.

This feature can also be used for static restarts, making it possible to view the progression of chosen results variables through a chain of static simulations



Linked static restart results

Examples of restarts

Static convergence can sometimes be challenging for specific applications of OrcaFlex, and restarts can be useful in avoiding the need to repeat a difficult static analysis which is common for a number of load cases. For example, you might use the same parent static calculation for a number of load cases, running multiple dynamic-only restarts to apply different environmental conditions.

We can also use restarts to simulate the changing response of a system when a mooring breaks. We would create a restart file at the point when we want to simulate the break occuring, and simply delete the 'broken' line from the restart file.

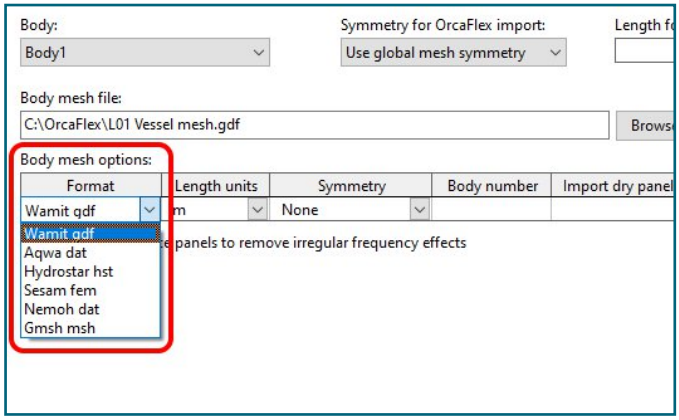
These are only a couple of examples, and we are confident that our users will find many other applications for restarts that we haven't even considered yet!

OrcaWave enhancements

Last year we introduced OrcaWave, our radiation / diffraction code. We have continued to actively develop it, and have a number of enhancements in version 11.1.

Mesh file formats

When OrcaWave was first released, we supported mesh formats for Wamit gdf and Nemoh dat. Over the course of the 11.0 minor updates, and version 11.1, we now additionally support mesh formats for Hydrostar, Aqwa, Sesam and Gmsh.

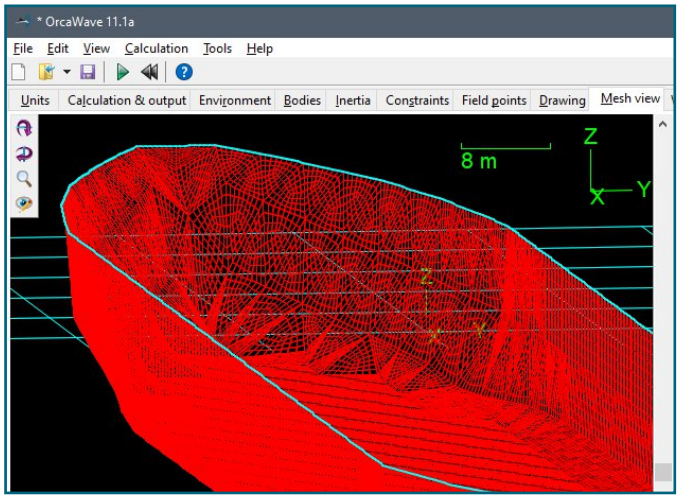


OrcaWave mesh format options

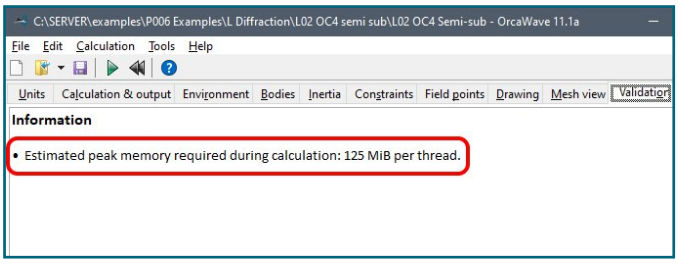
If there are other mesh formats which you think should be included in future releases, please let us know. As long as we understand how the format is structured and what its rules are, adding another format is relatively straightforward.

Performance

The introduction of an iterative linear solver in 11.0d brought big performance improvements. In 11.1 we have further improved the performance of both the iterative and direct linear solvers. The direct solver tends to be faster now for most meshes, with the iterative solver generally only becoming useful for larger meshes of, say, 20,000 or more panels.



An example of a large panel mesh (approx 16,000 panels)

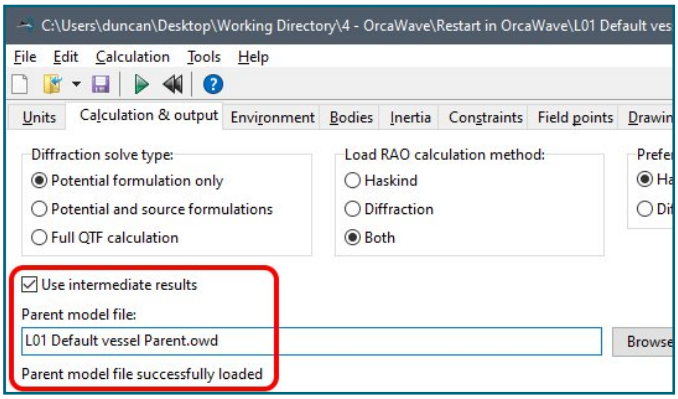


Estimated memory usage report

In addition to the solver work, we have also resolved a number of other performance bottlenecks. Further to this, we have been able to reduce memory usage and add a report of expected memory usage.

Intermediate results

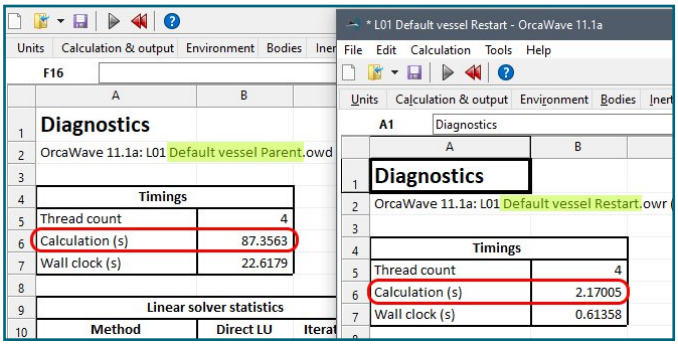
It is now possible for OrcaWave to make use of previously performed calculations in order to save time in a new analysis. First-order calculations can be reused from a prior analysis if the input data on which that calculation depends is the same, potentially saving valuable time.



The option to use intermediate results

An example of this is an assessment of the effects of different external damping values on the displacement RAOs for the OrcaFlex default vessel.

The initial diffraction analysis takes around 90 seconds. When changing the damping value, we can reuse the first order results, meaning the new analysis takes a fraction of the time, a little over 2 seconds in this case!



Diffraction analysis time comparisons

Target roll damping

Roll damping results have been added which show the level of roll damping, relative to critical, for each body. A new data item allows you to specify a target percentage, in which case OrcaWave will increase the external roll damping coefficient to meet the target.

Interior surface panels

Interior surface panels are required if you wish OrcaWave to remove irregular frequency effects. In addition to the existing radial method for adding these panels, there is now a new triangulation method, which is able to handle moon pools and highly concave waterlines, as well as performing better for waterlines with a large aspect ratio (e.g. a typical ship).

Improved waterline detection

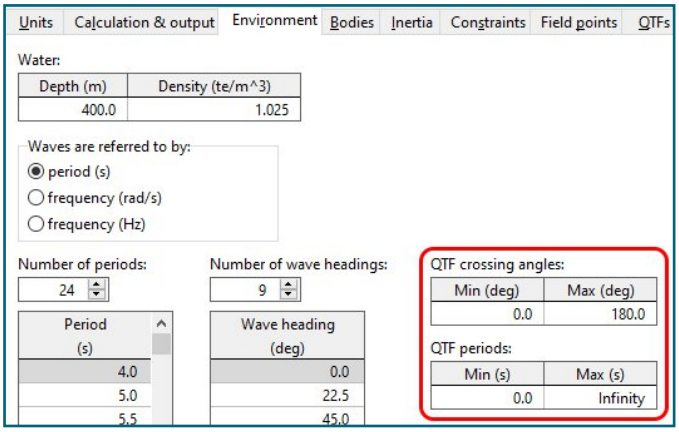
We have made a number of improvements to the waterline detection algorithm.

Dividing non-planar panels

When importing them from a mesh file, OrcaWave can, optionally, divide non-planar quadrilateral panels into two triangular panels, to improve the quality of the mesh.

QTF crossing angle range and QTF period or frequency range

These new data items allow you to reduce the number of second-order loads that OrcaWave will compute.



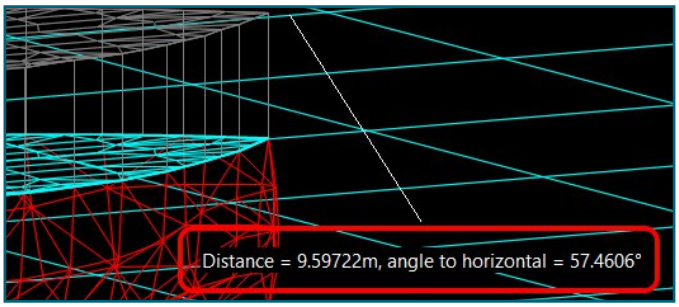
QTF crossing angle and period range

Improvements to drawing options

The following improvements have been made to the OrcaWave drawing options:

- Body axes can be drawn.
- Wave heading directions can now be shown in the mesh view.
- Free surface quadrature zone points and outer circle points can now be drawn.

- The measuring tape tool, familiar to OrcaFlex users, is now available in the mesh view. It is presented as a tool tip next to the cursor (previously in OrcaFlex, the data was shown in the status bar)



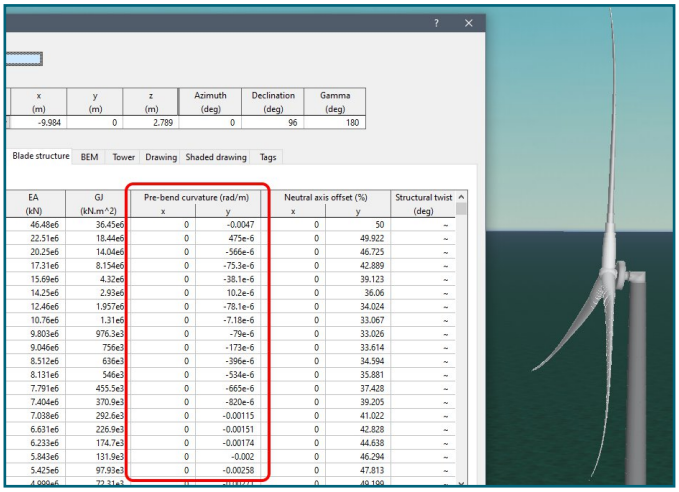
OrcaWave measuring tape tool

Turbines

We have made a number of enhancements to the turbine object:

Blade pre-bend

Turbine blades can now be pre-bent to model blades which are not straight in their unstressed state. Modelling pre-bend can have a significant impact on the dynamic response of a turbine and so this is an important enhancement.



Turbine blade pre-bend

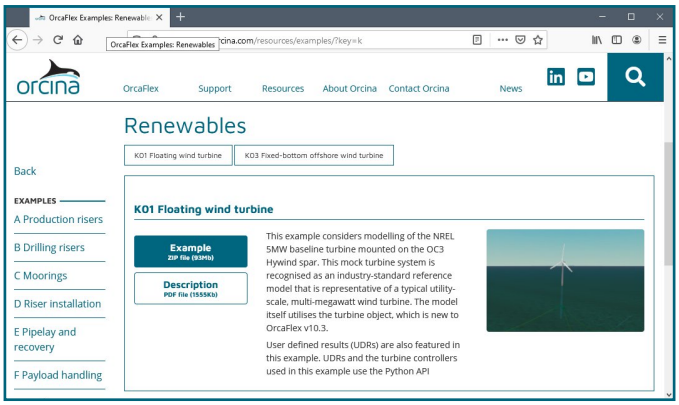
Range graph results

Range graph results are now available for turbine blades. This allows you to plot the variation of a result variable over the length of a blade, in exactly the same way as line range graphs.

Updated turbine examples

With the introduction of some new turbine features, we have taken the opportunity to reorganise all of the renewables examples to provide a more logical set based on current industry expectations.

The revised set of examples will be available soon from here: orcina.com/resources/examples/?key=k



Website renewables examples

We expect the new set to be as follows:

- K01 - NREL 5MW floating spar wind turbine
- K02 - NREL 10MW floating semi-sub wind turbine
- K03 - NREL 15MW fixed-bottom offshore wind turbine

Note: these examples are our interpretation of the NREL specifications, and as with all our published examples, their primary purpose is to demonstrate possible applications of OrcaFlex. It goes without saying that if you perform analyses using these models as a basis, you should carry out the appropriate checks to verify that the data used is suitable for your requirements.

Other developments

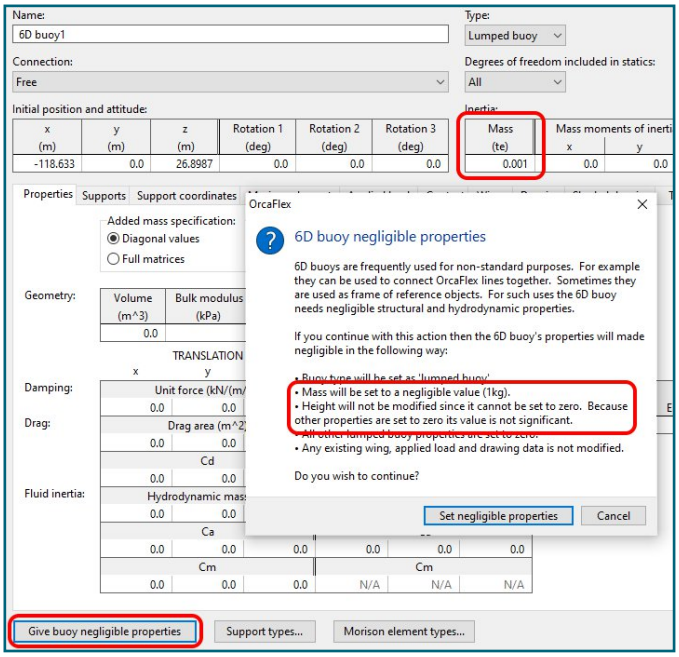
Those are the headlines, now here are a few other improvements we've made to enhance your workflow in OrcaFlex.

Hysteretic and externally calculated axial and torsional line stiffness

Axial and torsional line stiffness, previously only available with linear or non-linear elastic data options, can now be specified as non-linear hysteretic or by an external function.

Zero mass for Vessels, lines, turbines & buoys

An apparently simple option, but something that hasn't been possible until now. Occasionally you may want to use, say, a 6D buoy for some purpose such as a non-physical connection. You might be familiar with the option in previous versions called *give buoy negligible properties*. This assigned a small value for the mass of 0.001te, allowing you to use the buoy in this way with only a negligible effect on the overall properties of the system .

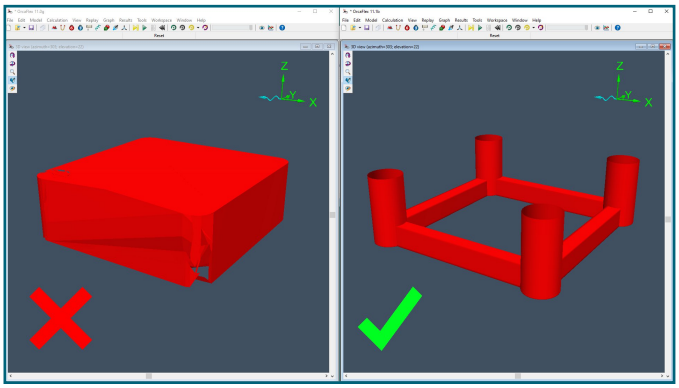


Give buoy negligible properties

If you were to try to set the mass to zero, the program would object due to the issues it would cause for the equation of motion. Given the fairly frequent use of objects like buoys for non-physical purposes, we have now allowed this. This option is available in vessels (via vessel types), lines (via line types), turbines, 6D buoys and 3D buoys.

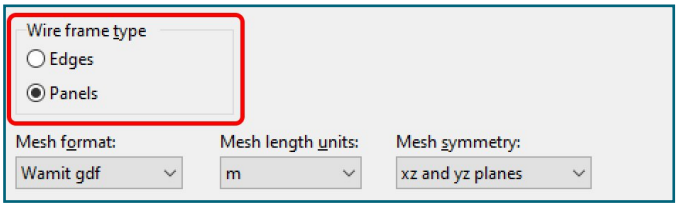
Wire frame drawings specified by panels

Previously only specified by edges and vertices, the shaded graphics views of buoys and vessels were sometimes sub-obtimal, due to the way the program converted the wire frame data.



Semi-sub mesh file specified by edges (L) and panels (R)

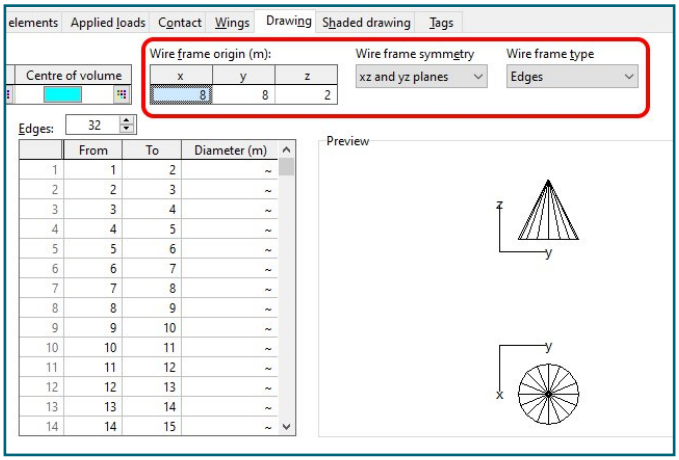
These can now optionally be specified by panels, typically resulting in a more robust conversion to the shaded graphics mode.



Wire frame now optionally specified by panels

Wire frame origin and symmetry

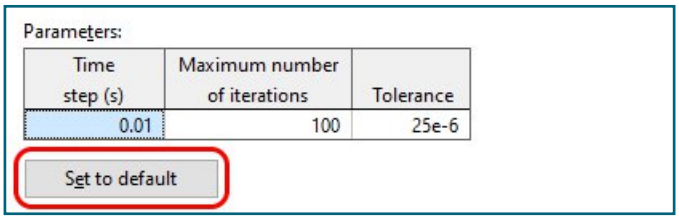
In an effort to reduce the amount of information stored in a data file we have now included the option to specify planes of symmetry for the wire frame drawings of vessels and buoys. To support this, it is also possible to specify a non-zero wire frame origin.



Buoy wire frame origin and symmetry options

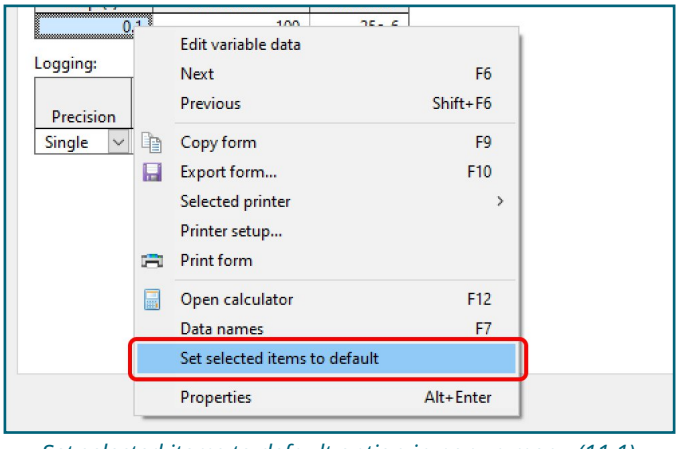
Set selected items to default

We have, in the past, provided a button on certain data forms to set items to their default values: the dynamic calculation parameters, for example.



Set to default button (11.0 and earlier)

These bespoke buttons were littered around the program, and in an effort to neaten up the UI a little, we have now embedded the functionality into the popup menu on the relevant data forms.



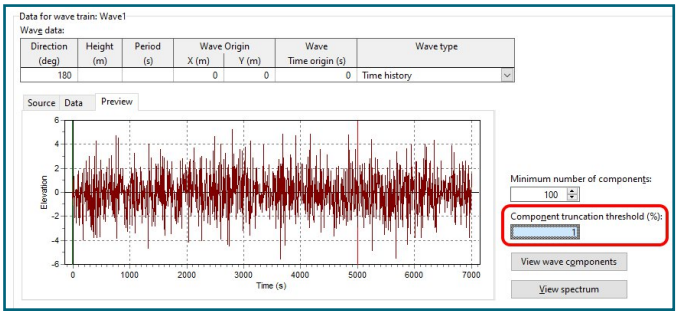
Set selected items to default option in popup menu (11.1)

You can now highlight a data item, or range of data items, right click, and use *Set selected items to default*.

Performance improvements for wave time history analysis

When a wave is specified by a time history of elevation, OrcaFlex performs a Fourier transform to create a set of linear wave components from that time history text. For long time histories, this can result in a high number of wave components and consequently a slow simulation. The vast majority of these components are high frequency with very small amplitude, and so, can be removed, significantly boosting speed without adversely impacting results.

This removal of high frequency components was a manual process until now, with the introduction of a truncation theshold on the wave data page.

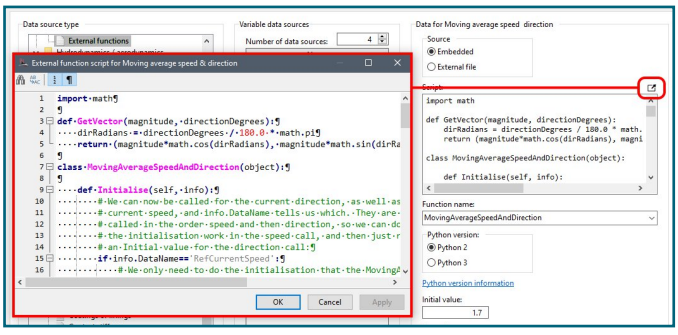


Wave component truncation threshold

As always, we recommend you perform sensitivity studies to ensure your results aren't affected.

Embedded Python scripts

Python scripts can be used for a number of features in OrcaFlex, including external functions, post calculation actions. Previously, this has required an external script file to be referenced. Well, the good news is that these scripts can now optionally be embedded in the model data! In addition, we have also provided a pop-out editor to help with script creation. This includes some basic features such as syntax highlighting and code-folding.



Embedded scripts, including pop-out editor

There will still be occasions where an external script file is more useful (for example, if multiple files are referencing the same script), so this option is still available.

Software licensing update

We previously let you know that we have been working on integrating FlexNet software-based licensing into OrcaFlex to allow us to offer dongle free and time limited licensing.

The work on this continues, with internal trials and external beta testing having been undertaken. The final hurdle remaining is to make sure our own internal systems are adapted to be able to manage the new licensing method. We hope to put this significant new tool in the hands of users very soon.

Coming up

As always, we have an extensive list of developments we hope to be working on in the near future. It is too early to say exactly what will appear in the next version, but our current priorities are as follows:

OrcaWave further development

We are delighted with the popularity of OrcaWave since it was introduced and continue to receive regular feature requests. We will continue its development in this cycle.

Turbines further development

We are actively working on new and improved features such as dynamic stall and more advanced blade structural modelling.

Lateral soil modelling

One of the motivations for implementing restarts was to aid the use of OrcaFlex for on bottom stability analysis. Improved lateral soil modelling is another way we can assist in this application area.

Pipe temperature and pressure effects

Currently only possible using an expansion factor, another major piece of the on bottom stability analysis puzzle will be to allow for pipe thermal and pressure effects.

Improved mooring analysis tools

We still intend to work towards making mooring analysis easier in OrcaFlex, including tailored workflows, better extremes results, etc.

Remember, our development of OrcaFlex thrives on the feedback and input from you, the user. Please continue to let us know what you would like to see in future versions, and we will do our best to accommodate your requests!

the back page

News

Well, what a year that was! This is the part of the newsletter where we would typically reflect on where we've been around the world, what exhibitions we've attended, what our plans are for the coming year, etc.

Of course, 2020 was no ordinary year, as we don't need to remind anyone. We are now well past the 12 month anniversary of our decision as a company (just prior to the first UK lockdown) to move the majority of employees to working full time from home. We didn't imagine then that we would still be working from home more than a year later, and that none of us would have had any need to use our passports in that time.

Training

One of the biggest changes to the way we work has been in the delivery of training courses. These have, in the past, been responsible for a significant proportion of our global travel activities. When lockdown began, we quickly adapted our introduction to OrcaFlex course to suit the online format, and we have been successfully delivering courses via Zoom ever since. In fact, remote training has allowed us to reach clients in far-flung locations for whom it would otherwise have been logistically challenging to reach. It also removes the added expense of travel and accommodation that the client has to pay, and of course is better for the environment.

Find out more about training here: orcina.com/support/training

User group meetings

Another significant impact of the travel restrictions was the necessary decision to present our annual user group meetings online. We definitely missed the opportunity to introduce this year's new software developments to clients in-person, but believe that going online has actually given more people an opportunity to see what's happening with OrcaFlex. We had over 800 attendees across all six sessions, with nearly 30 countries represented, from as far afield as Israel, Japan, Canada and Vietnam! We were delighted with how interactive the Q&A sessions were, with a total of 195 questions asked – thank you everybody for taking part and making the events such a success.

The recordings from the UGM sessions are available online for those who couldn't make it. You can find them on our videos page here: orcina.com/resources/videos/whats-new

Since the online format was so successful, we plan to do this again with the next user group season in Q4 of 2021. Keep an eye on our website for more information: orcina.com/support/ugm

Stay in touch

One of our main ways of keeping you up to date with what we're doing is via our LinkedIn page, so please go and follow us if you haven't already: linkedin.com/company/orcina-ltd

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