Orcina

Professional software for engineering professionals

Newsletter

www.orcina.com

August 2007

For the release of OrcaFlex 9.1… …more speed, more features!

The time to take stock and write a newsletter has come round again! Like many of our clients and the wider offshore oil and gas industry, we've had a very busy time since our last newsletter, now over 8 months ago. We're delighted to see that software sales continue apace, as indeed do the requests for training. The latter reflects what some have been warning about for years, and that's an industry wide skills shortage. We try to make our own small contribution to this, by continuing to develop OrcaFlex with a wealth of productivity enhancing features whilst at the same time maintaining the industry leading standard for easy-to-use, robust software.

So, featured in this newsletter: OrcaFlex v9.1 now comes with **Rayleigh damping** defined for each line type, we've made great improvements to the already very good **implicit integration,** we've added a **workspace** feature to enable the same multiple window set to be used across many different files, a new **3D seabed** facility (which needs no further comment here!), we also have **in-line drag amplification** for the wake oscillator models, **improved friction modelling** (particularly between lines and solids) and **automated hydrodynamic import** from AQWA and WAMIT.

The main articles to which a little more space is devoted are:

- The implementation of a **hysteresis model** in OrcaFlex. This gives better modelling of curvatures and bend moments, which means less conservatism is required in the design.
- Now that all the VIV tools are bundled with OrcaFlex, we also provide a summary of the **VIV validation** on which Orcina has recently been engaged. Here we report on comparisons between the four time domain VIV tools and experimental results.

We always hope our newsletter gives a helpful balance between announcing new features, more detailed technical description, hints, news and what events we're involved with. We always welcome feedback, particularly if there are specific items you would like covered, so please do get in touch.

In This Month's Newsletter

Rayleigh Damping

'structural damping' in OrcaFlex - now in commonly understood engineering parlance...

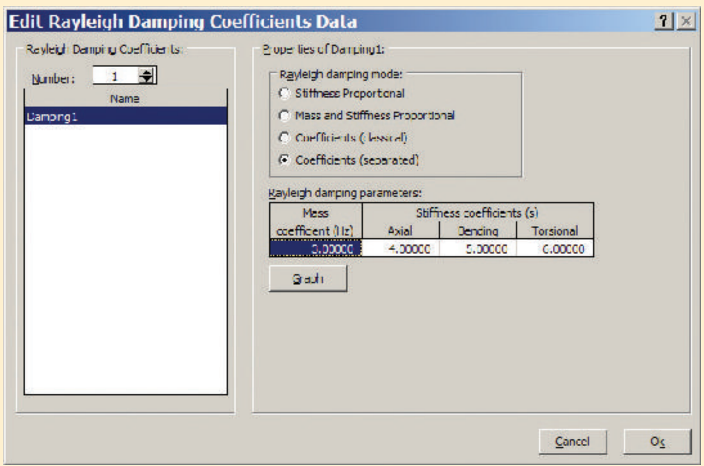
The addition of structural damping represents the next major feature in what has become known internally as the 'speed-up' project (and there is plenty more to follow from this project). Structural damping represents energy dissipation within a structure due to internal effects, both within the material and from interaction between layers of different materials / constructions. The new dataform is shown in the adjacent screenshot.

Note that multiple damping sets can be defined here. Each set can then be uniquely attached to the line type definition, so that each line type has its own set of structural damping terms.

In terms of the equation of motion ($M\ddot{x}+C\dot{x}+Kx=F$), the damping matrix C is the most difficult to determine. Consequently, it is commonly assumed that the damping is proportional to some linear combination of the mass and stiffness matrices. This approach is known as Rayleigh damping, and is expressed as: $C = \mu M + \lambda K$. In fact, OrcaFlex offers four distinct methods for specifying these coefficients:

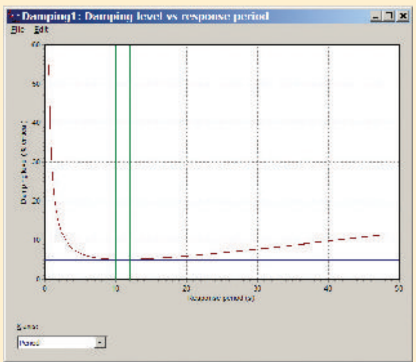
Stiffness proportional (SP) and *Mass and Stiffness proportional* (MSP): These approaches allow you to specify the damping ratio as a percentage of critical damping, and either one (for SP) or two (for MSP) response period(s) at which that damping ratio will apply.

Rayleigh damping doesn't give that same damping ratio at other response periods, so we've provided a graph (see below right) showing the damping



ratio that Rayleigh damping will give as a function of response period. Note that for either method, if '~' is entered as the response frequency, then either the regular wave period or the wave spectral period is used as the response frequency, depending on whether you're doing regular or irregular wave analysis. This is the recommended approach to setting the response periods and is very useful if you are undertaking batch runs with different wave conditions.

Coefficients (classical) and *Coefficients (separated)*: In this form of Rayleigh damping the coefficients are directly defined. With the classical approach, μ and λ are defined and used for axial, bending and torsional damping. With the separated form, different values of λ can be specified for axial, bending and torsional damping, as shown in the form screenshot.



Clearly this is another major milestone in the feature enhancements for OrcaFlex, allowing users to set levels of damping in a more straightforward manner than previously possible.

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Short Articles

Continued from page 1

Implicit improvements

More speed, more accuracy and more stability......

We have also been working on some major enhancements to the implicit integration scheme that we brought out in the last release of OrcaFlex (v9.0). There we used a variable step implementation of the Newmark time integration scheme - an approach which is widely used for the solution of many dynamic applications. However, we had always planned an additional review of other schemes to see if we could derive further performance gains.

Well, we completed this review and have alighted on the Generalised-α scheme. In all cases we looked at, this scheme allows much longer time steps to be used without compromising stability, which means that simulations can now be run many times faster than in v9.0. Consequently, we have removed the Newmark scheme and completely replaced it with the Generalised-α scheme.

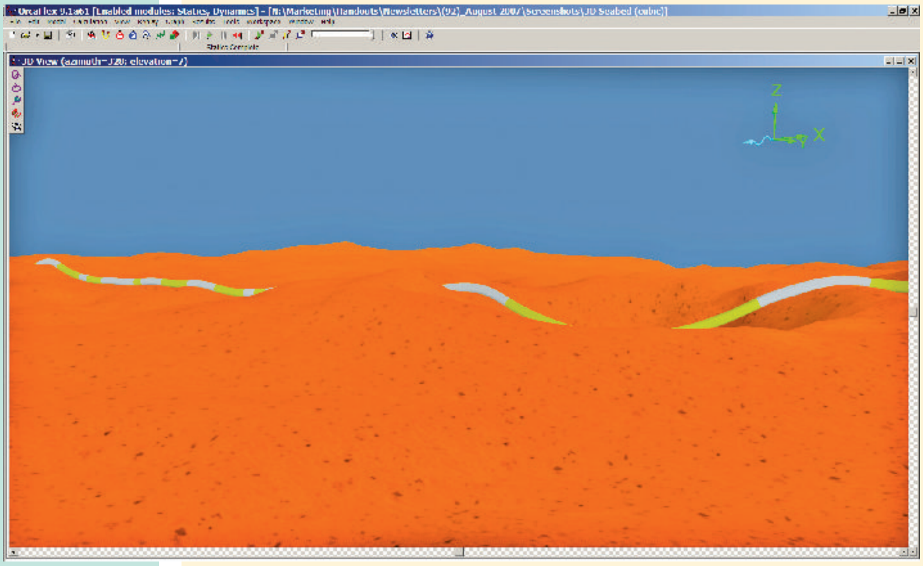
In addition, we have also added the ability to select between a variable time step and a constant time step with the Generalised-α scheme. However, we recommend that it should, in most cases, be run with the constant time step option. Variable time step schemes (in general, not just in OrcaFlex) can introduce non-physical high frequency noise in the solution. But despite this potential drawback, the variable step option does have its place, potentially giving significant performance benefits for systems with poor convergence characteristics.

As with all numerical methods, the general advice is to carry out time step sensitivity studies on your results - see the last Orcina Newsletter (Dec 2006). This allows the user to be confident that they have results which have converged as a function of time step. It should also be fairly obvious that different models will give different levels of accuracy for the same time step, so a time step sensitivity study should be repeated for each new model.

3D Seabeds

To undulate or not to undulate.........

This release of OrcaFlex now has a fully 3D seabed option. The screen shot shows an arbitrary seabed surface, with the pipeline more clearly showing the 3D nature of the seabed.



Data entry is simply a series of x, y and Z coordinates, and OrcaFlex lets the user select between Linear or Cubic Polynomial interpolation. For most situations we recommend the Cubic fitting which results in smooth interpolation. The linear method is best suited to the case where you only have depth and slope information at anchor points – you can then effectively create a series of flat sloping seabeds, one for each line.

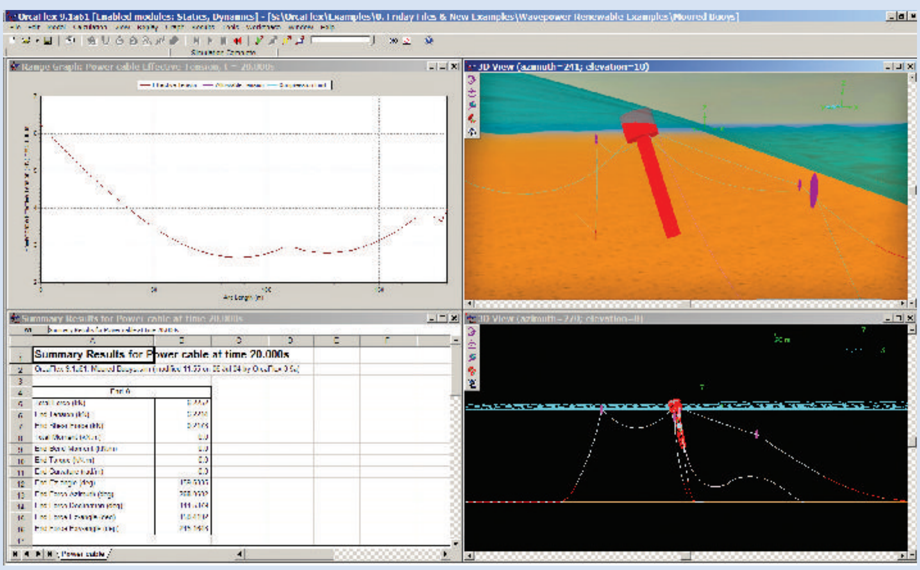
Note that the fitting of the seabed only extends as far as the edge of the dataset you have provided. Any position outside of the data is assumed to be infinitely deep. It's also worth noting that for the 3D visualisation, the seabed surface is drawn as a series of triangular panels. However, for the important bit, ie the underlying calculations, all the interpolations are smooth. This is only worth mentioning because it is possible to find parts of a model that are shown as being in contact with the seabed (in white above), but for it not to look like this is happening visually.

In pre-release discussions we've had with clients, many have said how useful this feature will be – we certainly hope so. If anyone has any nice topographical data they end up using, we'd certainly be interested to take a look.

Workspace Facility

A great way to manage all your windows between files.....

When viewing OrcaFlex results it is very common have multiple 3D views up, along with key results graphs and / or results spreadsheets (see screenshot). Of course what you then need to do is have this same window layout when looking at a second (etc) file. In the past you had no option except to set all this up manually – again, and again, and....... you get the problem!

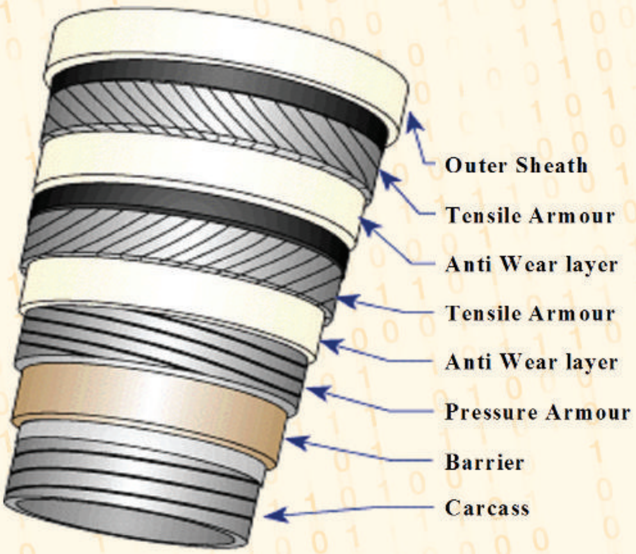


But now, once you have first (manually) set up your collection of windows, the new Workspace facility enables the user to save this layout, and then re-use the same layout with each new file. This feature is accessed through the new Workspace menu on the OrcaFlex menu. You can create and store as many workspace files as you like, using whichever is the most appropriate in a particular situation. It is also possible to set up a default workspace in a directory, and have this workspace file used whenever you open a simulation file from that directory.

This feature is great to use when inspecting lots of similar simulations, with great time saving potential. It's also very useful when sending results to discuss internally or to a client – just send the workspace file along, ask them to load it and they will see exactly the information that you need to discuss / present.........hope you enjoy this new feature as much as we have.

Bending Hysteresis

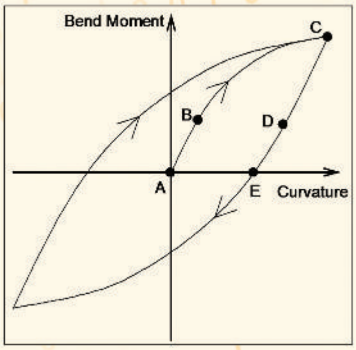
Unbonded flexible pipe structures give non-linear and hysteretic response when subject to bending, which is harder to model than homogeneous pipes. Consequently, present industry practice assumes linearity and extracts global loads to a detailed local model for stress and fatigue life assessment. This article summarises a recent OMAE 2007 paper*, where two state-of-the-art 3D mathematical models of bending response were presented – one by Orcina and one by Wellstream. Both have been implemented within OrcaFlex.



What is Hysteresis: Unbonded flexibles have concentric layers, with some helically wound tensile armour wires. On bending, each layer contributes to the total bending moment. The non-tensile layers generally bend with the pipe with a non-hysteretic behaviour. However, bending of the tensile wires produces tension which in turn tries to slip the wires within the structure. This is resisted by friction and leads to hysteretic behaviour.

Hysteresis described: Consider an unbonded flexible pipe, initially straight and unstressed (Point A), which is then progressively bent. At low curvature, friction between the wires and adjacent layers maintains equilibrium and resists wire slippage. Here, tension and bending moments vary linearly with curvature (AB).

As curvature increases, friction cannot prevent some of the wires slipping axially within the structure. This slippage reduces wire tension (compression) increase at the outside (inside) of the bend, thereby reducing any further increases in the bending moment. This effect decreases the slope of the moment-curvature curve. (BC)



When curvature reverses the tensile wires will not immediately slip back as friction now holds them in their displaced position. Again tension and bending moment change linearly with curvature (CD). As curvature reduces further, a point is reached where friction can no longer hold the wires in equilibrium, and the wires slip back, reducing the effective stiffness (DE). Now we have a zero bending moment but with a non-zero curvature. Further changes in curvature continue the process, giving the classical hysteresis loop graph.

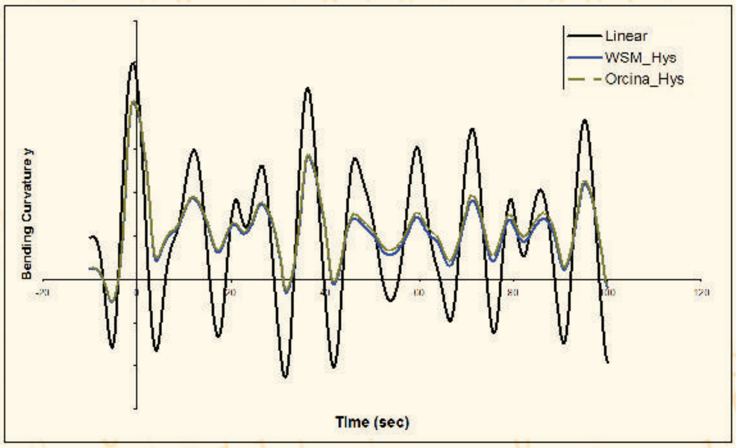
*Z. Tan, T. Sheldrake and P. Quiggin, 'Time Domain Simulation of the 3D Bending Hysteresis Behaviour of an Unbonded Flexcible Riser', OMAE2007-29315.

The **Orcina Hysteresis Model** is a 3D vector model of bending hysteresis that is built into OrcaFlex. Input data is a user-specified non-linear moment-curvature curve for single plane bending, which is used to derive bending moment response for both single plane bending and 3D bending (ie, where the plane of curvature may change).

The **Wellstream Hysteresis (proprietary) Model** is more sophisticated and is implemented as a separate software module (external function) to OrcaFlex (Wellstream theory, implemented by Orcina). At each step, OrcaFlex supplies the curvature vector and the Wellstream software returns the corresponding reacting bending moments. Critically, this model also determines the stresses in individual tensile wires which allows more sophisticated fatigue analysis than was previously possible.

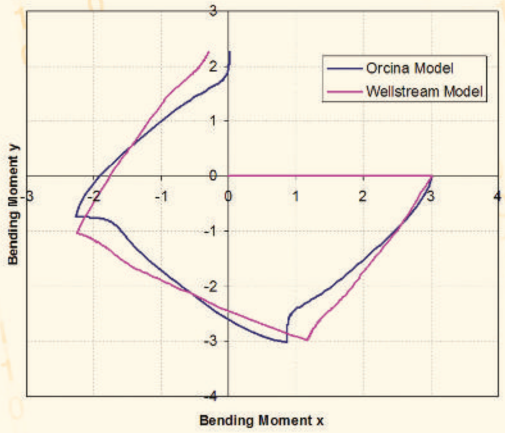
Full-Scale Tests and Model Calibration: Full scale 4-inch pipe bending (with 3 internal pressures) was performed by SINTEF. The test results were used to calibrate the Wellstream hysteresis model. These tests were replicated in OrcaFlex and numerical and experimental results compare extremely well.

Case Study: An FPSO with a free hanging catenary riser was used. Regular and irregular wave simulations were performed with linear bend stiffness, the Orcina model and the Wellstream model. Waves were applied in the plane of the riser giving mostly an in-plane response.



The Wellstream and Orcina models produced very similar responses for curvature in the TDZ (see graph above). Compared to the linear stiffness model, a considerable reduction in the curvature amplitude is predicted by the two hysteresis models, significantly impacting fatigue results.

3D Bending: For real applications, 3D bending needs to be correctly handled. Here the curvature vector varies in *direction* as well as magnitude. Experimental results are not available for 3D bending, but the Wellstream and Orcina models were compared for a simple test case of systematic curvature applied to a short section of pipe.



The models show different predicted trajectories for the bend moments. But these, and the final bending moment values predicted, are quite similar. This gives confidence in the way 3D bending is handled, as only the moment-curvature data is common to both models.

Conclusions: The measured bending hysteresis behavior of an unbonded flexible pipe has been reproduced well by OrcaFlex using both the Orcina and Wellstream hysteresis models. As expected, a reduction in pipe curvature response is clearly seen. The use of bending hysteresis models, correctly accounting for 3D curvature, is a significant advance in the prediction of the response of flexibles.

VIV Validation

Orcina have spent much effort implementing and further researching time domain wake oscillator (WO) and vortex tracking (VT) models for the prediction of VIV. We have recently published VIV validation reports on our website* and this article summarises those reports, which give the most complete validation of these approaches available to date.

Nonetheless, it is clear that deterministic understanding of the VIV phenomena is not complete and work remains to develop and/or calibrate robust and reliable models.

Introduction

In OrcaFlex there are four different time domain VIV models (2 x WO and 2 x VT), as well as interfaces to the 3rd party programs SHEAR7 and VIVA. Here, we are only concerned with validation of the time domain models (model details and references in the OrcaFlex User Manual, v9.0 or later):

Wake Oscillators: The Milan (MWO) and the Iwan and Blevins (IBWO) models come with user-adjustable parameters. However, in this work, the parameters from the original papers were used.

Vortex Trackers: VT(1) uses special techniques to group new vortices into sheets and decide when a sheet detaches and a new one forms. VT(2) does not group vortices, but sheets appear naturally in the vortex pattern generated by the model.

Results from the VIV models were compared against real-world results from 3 different tests: (i) Delft model tank tests, (ii) DeepStar Lake Seneca tests, and (iii) Measurements on a real full-scale drilling riser in the Schiehallion field. A separate report for each test exists (see the validation page of our website), including descriptions of the test and comparisons between measurement and prediction. This article is a summary of this work, the details of which can be found on our website*. Here the results are summarised and general conclusions drawn on the validity and range of application for each model.

Basis for Comparisons

Test results were RMS values (over time) of one or more time varying quantities at a number of locations. To assess the comparisons we use Bias Ratio, defined here as Predicted RMS/Measured RMS.

As RMS values were available at a number of different arc lengths, the average and maximum values were found over the length of the riser. Averages give the best overall measure of accuracy; maxima are an indicator of worst fatigue damage. The mean gives an average measure of the extent the model over or under predicts response; the standard deviation gives a measure of consistency. An ideal model would give a mean Bias Ratio of 1.0 with standard deviation zero.

Comparison Cases

The **Delft tests** were at small scale in closely controlled conditions in a model basin. Flow was constant over the riser lower half and zero over the upper half. Hence the riser was only subject to excitation at one Strouhal frequency – effectively a zero shear case with half the riser providing damping rather than excitation. Curvature and acceleration were measured over the whole length, with derived displacement and curvature distributions.

DeepStar Seneca tests were conducted on a model scale riser in a lake with no natural currents. Flow was generated by moving the top end at constant speed. Horizontal flow speed was therefore constant over the riser, but riser deflection due to drag meant that normal flow speed was not exactly constant. However, this is very close to a slab current (zero shear) condition. About half the measurements were missing, due to instrument failure or logging difficulties. Remaining data were fairly evenly distributed over the length, but were not closely spaced enough to define riser shape completely.

Schiehallion measurements were made on a full scale drilling riser working on the Schiehallion field. Current profiles were measured, showing a near-linear sheared profile, with small variation with depth. Acceleration normal to the riser was measured at five locations over the lower 30% of the length.

Accelerations were measured in local x and y directions, but these were not aligned with the flow. Consequently, measured accelerations contain in-line and transverse components of VIV response.

The results from the comparisons between OrcaFlex and these test cases are shown in the table below.

Conclusions

a) The WO models work well over all the cases considered, with the exception of the Y accelerations for Schiehallion. We have been unable to identify a clear reason for this.

b) The MWO is generally more accurate than the IBWO and shows less scatter.

c) The two VT models substantially over-predict everywhere. VT(1) performs particularly poorly with the Seneca comparisons. The reasons for this are not clear.

d) The VT models are the only ones to offer predictions of in-line VIV, but the Delft results show these over-predict in-line curvatures by a factor of 2 to 2.5. However, the models may nevertheless have some qualitative value.

e) The Delft and Seneca cases are effectively zero shear cases. Schiehallion tests are all unidirectional with linear shear profiles. There are no cases with highly nonlinear shear or with depth varying current, so no conclusions can be drawn on how the VIV models behave in these conditions.

f) The Delft and Seneca cases show that the WO models work well in zero or low shear conditions over a wide range of modes.

g) The Schiehallion cases have current speed varying by a factor of two from top to bottom. The models show VIV in low mode shapes – typically mode 3 or 4. We conclude that the WO models work well in this amount of shear for low mode VIV, but it would not be safe to assume that they will work equally well at higher modes where modes are more closely spaced in frequency.

Recommendations

a) As a general rule, use more than one VIV model for any investigation.

b) Use the MWO model as the principal analysis tool for low to moderate shear conditions, with the IBWO model as back up for confirmation.

c) VT can be used for in-line VIV in low to moderate shear conditions, but the amplitudes are probably substantially overpredicted.

d) In conditions not covered by these validation cases, use several models and treat all results with caution.

			Milan WO		IBWO		VT(1)		VT(2)	
Test Series	Measured Parameter	VIV Measure	MBR	SD. BR	MBR	SD. BR	MBR	SD. BR	MBR	SD. BR
Delft	Transverse Displacement	Av. RMS	1.02	0.18	0.90	0.37	2.00	0.28	1.74	0.36
		Max. RMS	0.94	0.21	0.84	0.36	1.72	0.27	1.51	0.28
	Transverse Curvature	Av. RMS	1.10	0.23	1.14	0.44	1.58	0.28	1.81	0.36
		Max. RMS	0.98	0.23	1.01	0.41	1.31	0.25	1.57	0.41
		Dom. Freq.	0.98	0.05	1.09	0.06	1.07	0.05	1.27	0.09
	In-Line Curvature	Av. RMS	(-)	(-)	(-)	(-)	2.01	1.33	2.29	1.34
		Max. RMS	(-)	(-)	(-)	(-)	2.05	1.60	2.47	1.67
DeepStar Seneca	Transverse Acceleration	Av. RMS	0.80	0.11	1.35	0.22	37.53	13.59	4.00	0.55
		Max. RMS	0.96	0.20	1.58	0.35	49.26	11.02	4.14	0.74
		Dom. Freq.	1.00	0.10	1.17	0.13	18.14	1.32	7.40	0.42
Schiehallion	X Acceleration	Av. RMS	0.93	0.31	1.14	0.62	4.95	1.73	5.45	1.66
		Max. RMS	0.93	0.30	1.12	0.59	4.04	1.41	4.60	1.43
	Y Acceleration	Av. RMS	1.54	0.59	1.94	1.16	4.36	1.73	5.26	2.02
		Max. RMS	1.35	0.43	1.67	0.92	3.04	1.09	3.70	1.22
		Dom. Freq.	0.70	0.09	0.80	0.12	2.12	0.77	2.88	0.78

MBR = Mean Bias Ratio; SD. BR = Standard Deviation of Bias Ratio; Dom. Freq. = Dominant Frequency

Acknowledgements: Orcina wishes to thank BP, the Norwegian Deepwater Programme, the DeepStar project and Southampton University for access to the VIV measurements used in this comparison.

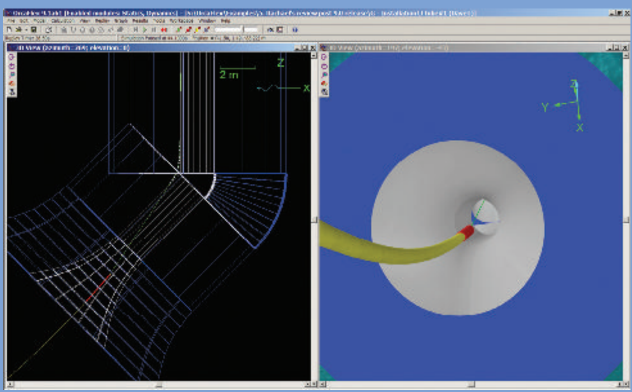
* See R648#01#02 OrcaFlex VIV Validation Summary at www.orcina.com/SoftwareProducts/OrcaFlex/Validation

Continued from page 2

Major Enhancements to Friction Modelling

Friction between solids and Lines, 6D and 3D Buoys, and between Buoys and the seabed….

Now it's possible to have friction between the Elastic Solid object and any of the Line, 6D and 3D Buoy objects. Why do we want to do this? J-tube pull-in is a classic situation requiring friction - a curved hollow cylinder (came in v8.7) is all well and good, but friction between the line and the inside face of the tube is a major factor – see the screenshot:



Other applications include pull-in to manifolds and wellheads, pull around turning points or anything else that might generate a capstan load. Another key application is to model the frictional forces between a line and a mid-water arch. A novel application is the ability to create a seabed with a number of shapes. Each shape can then have different friction coefficients representing different areas of seabed soil with different friction coefficients.

With this new feature, any line, 6D or 3D buoy can interact (with friction) with any elastic solid. In order to handle the full generality of this there is a new form 'Solid Friction Coefficients' (found on the model browser just under the Environment dataform). Here the friction coefficients between any two named objects (ie, a Solid and one of line type, 6D, or 3D Buoy) can be individually specified. Alternatively you can specify one friction coefficient for the interaction of all Solids with 6D Buoys, and so on.

As part of the general enhancement to friction modeling, Buoys can now have frictional interaction with the seabed, set through new data items on the Buoy data forms. To achieve this previously, dummy lines had to be attached to the Buoy, relying on the friction contact between the line and the seabed to transmit the friction force to the Buoy. Note that the data covering friction between a line and the seabed is still specified on the line types dataform.

Although we've thought of several instances where this is really useful, we are sure that there are many more applications that we have not anticipated but that OrcaFlex users will easily spot. Hope that this feature is a great help and if you have any interesting examples, we'd love to see them.

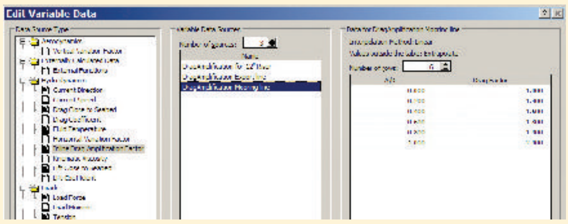
In the Next Orcina Newsletter

At the moment it is too soon to tell what is going to make the cut for the next newsletter. There will be the usual new features to report on, and we have recently been working on some interesting applications of OrcaFlex with clients – we will attempt to get the necessary permissions to write about these.

In-Line Drag Enhancement for Wake-Oscillator Models

Now the wake oscillators go both ways…..

The usual treatment of VIV decomposes the 'full response' into in-line and transverse directions - Shear7 and VIVA, for example, estimate the participating modes for a transverse response. However, transverse line oscillations also have the effect of increasing the steady in-line force – it's as if the vibrating line now presents a greater 'area' to the in-line flow. So Shear7 and VIVA also return updated in-line drag coefficients to account for this effect.



Full CFD, or the Vortex Tracking options in OrcaFlex, do not 'suffer' from the in-line/transverse decoupling idea. They return the total VIV force vector acting on the line which the structural solution can then just include and solve accordingly.

However, the time domain wake oscillator models in OrcaFlex only operate in the transverse direction, returning the behaviour of the line normal to the flow. This is very useful in determining line transverse displacements, and hence the proximity to other structures and for fatigue. But these models say nothing about the resulting in-line behaviour. However, this new feature in OrcaFlex now allows the user to enter a table of in-line drag enhancement factors as a function of A/D (amplitude of transverse oscillation divided by line diameter). OrcaFlex then simply interpolates this table to select the appropriate in-line drag enhancement factor for the prevailing amplitude of transverse oscillation.

Wake oscillator models have been shown to be remarkably good at identifying VIV behaviour, with the main drawback to date being the lack of in-line performance. This new feature is a very neat way of allowing the in-line behaviour to be captured, significantly improving the usefulness of wake oscillator models.

Automated AQWA & WAMIT hydro import

Full hydro import now makes what should be easy, really, really easy….

For calculations involving vessels, OrcaFlex has always relied on importing data from hydrodynamic diffraction programs. This is nominally a straight forward process, but causes an unbelievable amount of difficulty (not just for our clients!!). For many years, it has been possible to import RAOs through the 'Import RAOs..' button on the vessel types form. This allows import once the RAOs have been manually re-formatted in a manner expected by OrcaFlex. In v9.0, we added a facility to automatically import frequency dependant added mass and damping data from AQWA and WAMIT.

Now, new in v9.1, is the ability to automatically import ***all*** the hydrodynamic data from AQWA and WAMIT. This includes: Displacement and load RAOs, QTFs, added mass and damping and the hydrostatic stiffness. In addition, the data on the conventions page will be automatically set to match the convention for AQWA or WAMIT.

All this is done through the new 'Import Hydrodynamic Data..' button on the vessel types form. OrcaFlex will attempt to import as much data as possible to the corresponding OrcaFlex data items listed above (mass & inertia, and hydrodynamic equilibrium positions are not always generated by these programs, but will be imported if available).

If, for any reason, the import fails, or anything noteworthy occurs, OrcaFlex will report this. The remaining data (hydrodynamic drag and wind drag) are not typically calculated by these programs, and need to be found from other sources.

So why have we selected WAMIT and AQWA? Simply because we found that this would satisfy a significant proportion of our user base. Clearly there are many other diffraction programs out there and we could have added auto import from these. However, time constraints limited us to these two for the moment - naturally we hope that this feature takes a lot of the strain out of importing hydro data.

News in *Short...*

User Group Meetings and Training

It's come to that time of year again. We are finalising our presentations and the logistics for the forthcoming round of user group meetings (UGMs) between September and December (precise schedule is shown below).

For those not in the know, the **UGMs** are a free one day event hosted by us. We aim to give attendees a tour through all the new functionality in OrcaFlex and explain the whys and wherefores for it being there. In response to feedback from previous meetings, we have arranged to have a guest speaker presenting a relevant topic. This will obviously be a different speaker at each venue, and we must express our thanks to these colleagues for giving their time.

The planned series of **Open Training** events occur on the 2 days immediately following each UGM. These are paid courses, and we recommend that you book early!

Up-to-date details including costs and venues can be found at: www.orcina.com/UpcomingEvents

Webinars – Orcina in the 21st Century 😉

We've had a feeling that we should have been doing this a long time ago......well now we've got round to it – not that it's hard, but it just took a bit of willpower! Initially, we envisage that this will be really useful in 2 situations:

- For those wanting to know a little more about our software: We can give a remote demonstration of all the features and functionality, and
- For those wanting some technical support: Here our consultants can demonstrate the finer points of using OrcaFlex, show how to approach an analysis, or illustrate how particular features can be turned to your advantage.

A picture, as they say, is worth a lot of typed emails! Just let us know if you would like a demonstration or technical support through this medium and we'll happily oblige. All done in the hope of bettering the already excellent technical support we offer. 🙂

Recruitment

We're still delighted to say (there's an ongoing theme here!) that demand for our products and services continues to be strong. The latest product features – particularly speedup – has got many people talking, and we're confident that this will continue to drive our sales growth. A happy consequence of this is the need for more staff, and we're delighted to say we have been successful in attracting a new consultant with a first class maths degree and high end engineering experience. We plan to make more appointments in the near future.

Licensing Terms

We thought that it might be worth explaining in high level terms the main elements of our licensing terms. Noting that we also offer a maintenance, upgrade and support (MUS) contract, there are 2 ways to purchase Orcina software:

Perpetual licence: There is a one off purchase price which includes MUS for 12 months following purchase. Thereafter MUS is optional (although about 85% or our licences are maintained) and charged as a proportion of the prevailing list price. We also have a very favourable stepped multi-copy discount schedule. These discounts also apply to the MUS on each licence – basically the more you buy the cheaper it gets!

We also run **Group Software Supply Agreements** – in return for a single nominated coordinator in the Client company, a Group agreement lets a legal group entity count any existing licences in the group for the purposes of multi-copy discounts (both on purchase and MUS). Many companies have availed themselves of this facility, even those with relatively few licences, but where these are spread in different locations.

Leasing: We have a single monthly charge for leasing, which includes MUS, and with the minimum lease period being 1 month. If you lease continuously and then decide to purchase, we offset 80% of the lease charges from the purchase price. Both month-by-month leasing and lease-to-purchase conversion are extremely popular with our clients.

Shipping: All s/w is shipped by courier within 24hrs of receiving a PO (weekends excepted). This high level of service is appreciated by many, especially those with last minute requirements!

Did You *Know...*

a) ...that displacement, velocity and acceleration results for 6D Buoys and Vessels can now be reported at user specified positions on those objects.

b) ...that the Line setup wizard now allows line length to be changed for specified line sections. The target variables have been extended and now include End A tension and declination, End B tension and declination, and the layback distance. Also, the convergence parameters are now exposed.

c) ...that line results can optionally be excluded from the log. This feature is very useful where only the global motions of the floater and / or a subset of lines are of interest. For very long random sea simulations with lots of lines, this can significantly reduce the size of the simulation file. Found on the Results page of the Line Data form.

d) ...that Prescribed Motion for vessels can now specify a velocity in a direction *other* than the vessel heading. This direction can be relative to the vessel heading or the Global X direction.

e) ...that results for normalised tension and curvature have been in for a while. Here the effective tension and curvature results are normalised with the maximum tension and min. bend radii data from the line types limits page.

f) ...that defining a time history for current as input can be used to model tidal variations. Together with user defined time history of direction, this is a very straight forward way of modelling loop currents.

Orcina - out and about

Exhibitions, User Group Meetings and Training Courses:

In the next few months we will be running our annual round of User Group Meetings and associated Open Training sessions:

- **11 to 13-Sept-07: UGM and Open Training in Paris, France.**
- **24 to 26-Sept-07: UGM and Open Training in Perth, Australia.**
- **01 to 03-Oct-07: UGM and Open Training in KL, Malaysia.**
- **23 to 25-Oct-07: UGM and Open Training in Houston, USA.**
- **06 to 08-Nov-07: UGM and Open Training in Stavanger, Norway.**
- **20 to 22-Nov-07: UGM and Open Training in Rio, Brazil.**
- **04 to 06-Dec-07: UGM and Open Training in Aberdeen, UK.**

We are also exhibiting at the forthcoming **Offshore Europe show (04 to 07-Sept-07, Stand 672, www.oe2007.co.uk)**. This is always an excellent opportunity to showcase the latest developments, meet with existing friends and make new acquaintances. We look forward to seeing you there.

For all these events please see the Orcina website (www.orcina.com/UpcomingEvents) for the most up to date information.

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