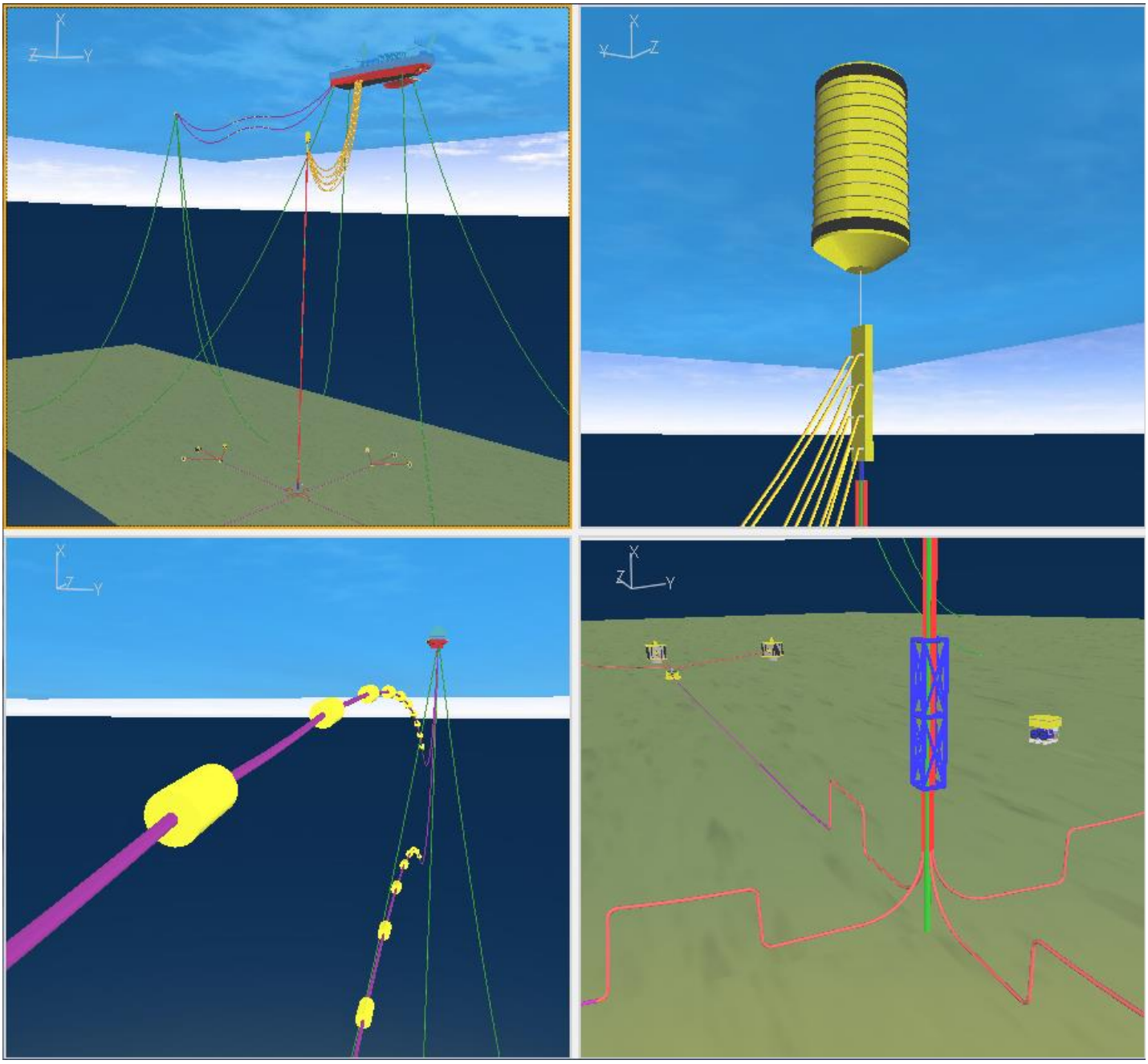
A SOFTWARE NEWSLETTER BY MCS KENNY

Flexcom NEWS UPDATE

JULY 2015



WOOD GROUP KENNY

WELCOME

Aengus Connolly
Flexcom Product Manager

I am pleased to announce the release of Flexcom 8.4. This is another exciting new release in the Flexcom 8 series, building on the solid foundation provided by earlier versions.

Our representatives have spoken to many Flexcom users of late, and our recent development cycles have been closely geared towards meeting your requirements.

Following closely after the release of Flexcom 8.3 (April 2014), and previously Flexcom 8.2 (May 2013), we believe that this latest version is a further illustration of our commitment to providing our user base with a preeminent engineering software solution.

This document summarises the latest features which are now available to your engineering teams. I hope you enjoy the read. Please feel free to contact me should you have any feedback or ideas. I would also like to take this opportunity to thank you for your continued business.

Best regards,
Aengus.

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Flexcom 8.4 Highlights

The latest version provides several important new features along with a range of practical additions which contribute to improved user experience.

Highlights include…

Usability

- Fully integrated unit systems, including standard SI and imperial options. Intrinsic conversion functions even allow you to combine various units, giving you the power and flexibility to specify inputs any way you choose.
- Enhanced model view, including multiple simultaneous views, saved camera positions, a measuring tape control, and a new “inspector” feature which allows you to examine material properties directly from the structural animation.
- Flexcom 64-bit version, designed specifically for 64-bit operating systems. The latest version offers improved run-time performance on 64-bit machines. Specifically, Flexcom 8.4 is approximately 14% faster than Flexcom 8.3.
- New documentation system, fully integrated into the software. It also incorporates extensive cross-referencing for effortless browsing.
- Reorganised examples set for ease of access, plus some interesting new examples.

Technical Features

- Powerful 3D seabed modelling facility. Flexcom can handle complex seabed topographies with ease. You simply specify an arbitrary cloud of data points, and Flexcom’s triangulation algorithm automatically generates a continuous profile via cubic spline interpolation.
- Solution criteria automation – you can now specify a required constraint (such as maximum bending moment in the touchdown zone), and Flexcom automatically adjusts the model configuration to satisfy the specified criteria.
- Streamlined interface with Shear7, allowing you to define all the required inputs through Flexcom, providing a seamless integration of the modal and VIV fatigue analysis stages.
- API-2RD code checking, allowing you to automatically check your riser designs against the very latest codes of practice.
- Standard soil models tailored towards drilling riser analysis, including sand, soft clay, stiff clay etc.

Quad-Core Processing

All Flexcom 8.4 installations provide 4-core processing as standard. Effectively this means that existing Flexcom users who are using standard licence contracts can now double their processing power at no additional cost. The changes will come into effect automatically once you upgrade to Flexcom 8.4 – simply contact the Flexcom technical support team at softwaresupport@mcskenny.com to obtain your new licence file. Note that higher performance models, such as 8-core and 16-core options, are also available as premium upgrades for use on powerful server machines.

Software Download

The Flexcom 8.4 installation pack is available for download from our website.

Download Flexcom

To install the upgrade, save the ZIP file to a temporary folder on your hard drive, unzip the contents, run ‘InstallFlexcom.exe’ to launch the Setup Wizard, and then simply follow the on-screen instructions.

Contents

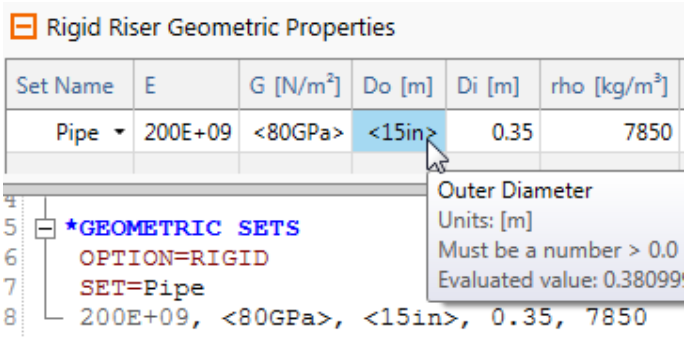
Integrated Unit Systems

Flexcom 8.4 sees the introduction of fully integrated unit awareness into the program for the first time. Existing users will know the importance of employing a consistent set of units during input specification, as earlier versions of the program did not explicitly assign units to input parameters. In this context, Flexcom 8.4 represents a major step change, both in terms of user experience, and also project management and quality assurance.

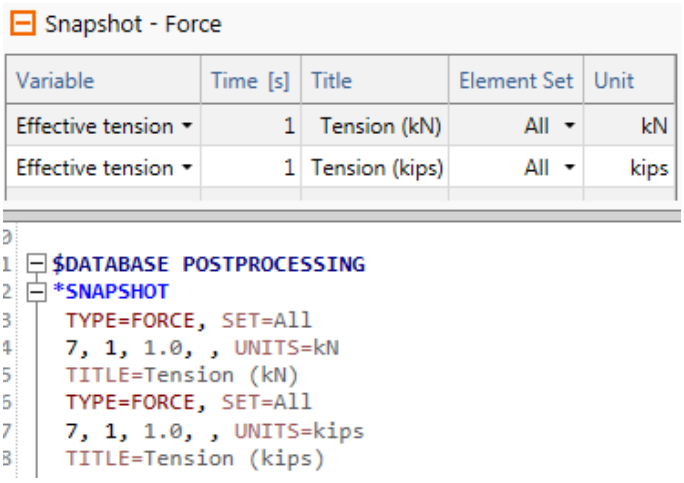
In order to invoke the new functionality, you must choose a keyword file type (keyword file extension) corresponding to the required unit system. Flexcom 8.4 now supports three keyword file extensions, whereas earlier versions only accepted one (keyx).

- ***.keyxm**. Inputs are expected to follow the base unit convention of the SI/metric system (e.g. length in metres, mass in kilograms).
- ***.keyxi**. Inputs are expected to follow the base unit convention of the imperial system (e.g. length in feet, mass in slugs).
- ***.keyx**. The program will suggest sample units in both the metric and imperial systems simultaneously.

The expected units for every input parameter are now clearly labelled in the both the Keyword and Table Editors. It is also possible to override the expected units with your own, should you wish to use more meaningful units (e.g. to specify a diameter in millimetres rather than metres). It's even possibly to combine metric and imperial inputs within a single input file (e.g. to specify a diameter in inches, even when the keyword file is designated as metric). Learn More >



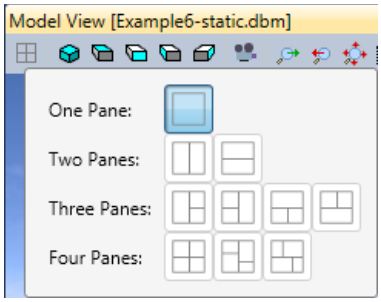
Another very useful feature is the ability to postprocess results into any desired units, regardless of the unit system used for the actual analysis. For example, if a system was modelled by an engineer in the US using imperial units, a colleague in the UK can still take those results and examine tension in Kilonewtons and stress in Megapascals. Learn More >



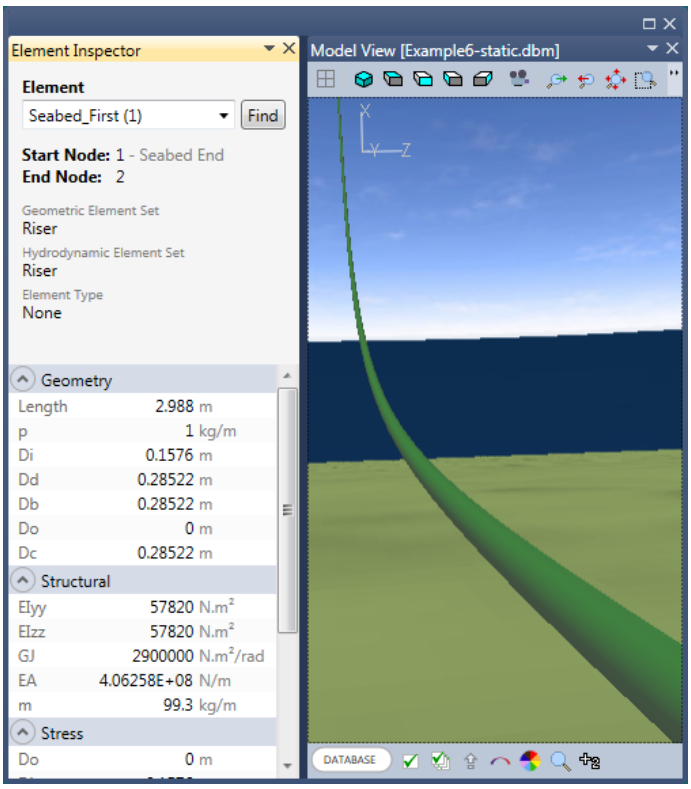
It is very easy to transition between Flexcom 8.3 and Flexcom 8.4. A dedicated importer tool is provided with the software, which allows you to automatically incorporate units into your existing projects. Old KEYX input files still work perfectly in Flexcom 8.4, but you are encouraged to avail of the new functionality. Note that all of the standard examples which accompany Flexcom 8.4 explicitly utilise the metric or imperial unit systems. Learn More >

Enhanced Model View

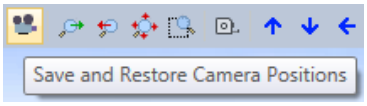
The *Model View* has been upgraded significantly in Flexcom 8.4 to provide enhanced user experience. Firstly, it is now possible to examine up to four different views of the model simultaneously, and each view may be assigned its own customised settings. The cover page of this newsletter shows a complex offloading system modelled using Flexcom. The split views allow the offloading lines, buoyancy tank, and flowlines, to all be examined simultaneously. Learn More >



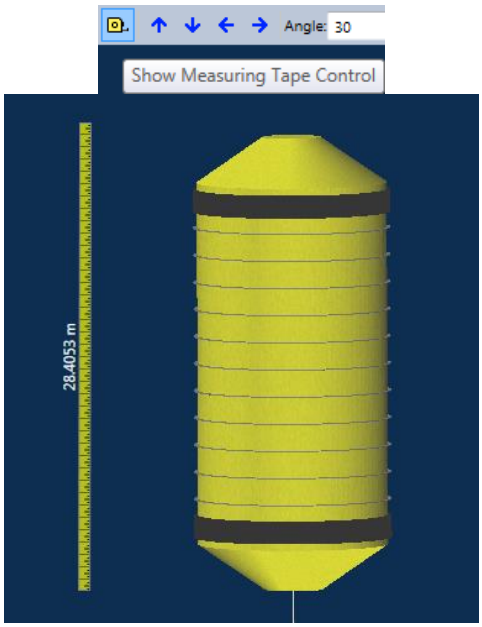
Very complex models are sometimes difficult to interrogate, particularly ones with numerous different components and thousands of elements. The new *Element Inspector* is a very helpful utility feature which allows you to inspect structural properties. You can launch the *Element Inspector* window from the *View* menu, and it should be left open alongside the *Model View*. To select an element from the display, press and hold the CTRL key, move the mouse cursor over the region of interest, and then press the left mouse button to select. The information window then displays local element properties such as length, diameter, bending stiffness etc. Learn More >



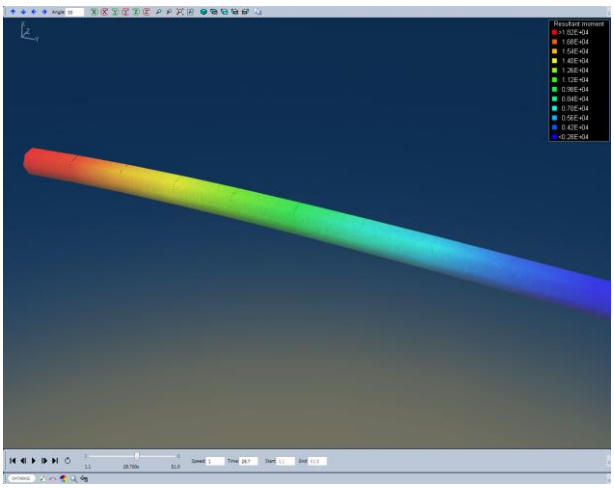
You may also save a list of favourite views, any of which may be retrieved instantly via the *Camera* button. This can be particularly useful for complex models. Learn More >



Distances can be quickly measured on screen. You simply press the *Measuring Tape* button to activate the measuring control, and then click and drag to measure approximate distances between objects on screen. Learn More >



Ranges/extremes may be explicitly defined for stress colouring in the *Model View*. Default values are still based on values experienced during the analysis. Several different colour palettes are now available also. Learn More >

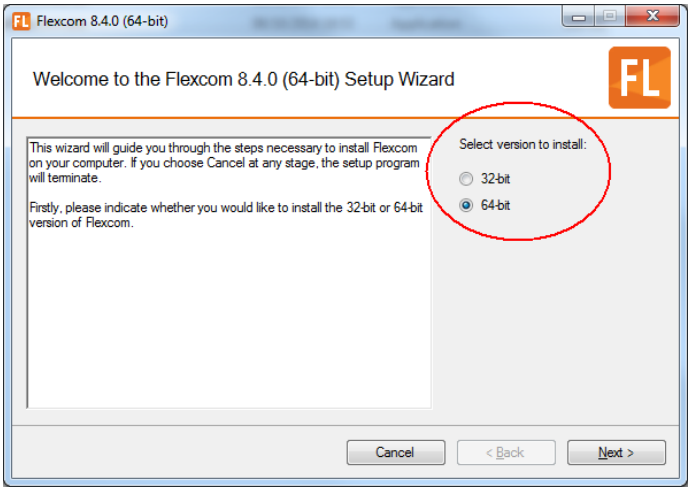


Node and element labels, as well as numbers, are now searchable in the *Model View*.

Flexcom 64-bit

Flexcom is now available as both 32-bit and 64-bit applications. Many machines come with 64-bit operating systems as standard nowadays, so the majority of Flexcom users will be able to avail of increased computational efficiency and improved RAM access for the software.

To install the 64-bit application, simply select the relevant option during the Flexcom 8.4 installation process…

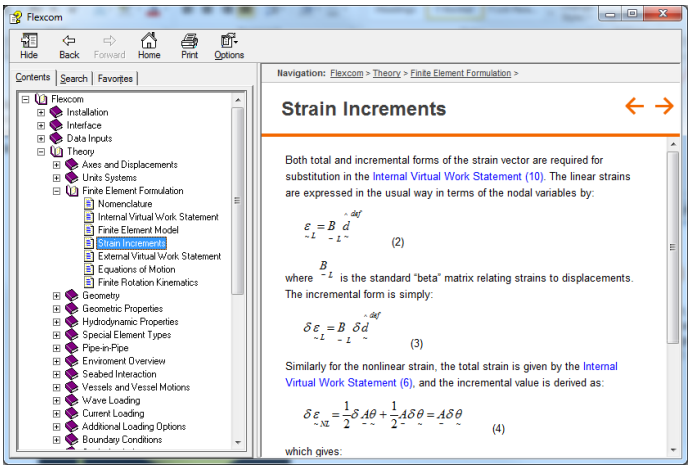


You will notice a significant improvement in run-time performance with Flexcom 8.4. Based on benchmark tests across a range of sample analyses, The 64-bit version of Flexcom 8.4 has shown to be roughly 14% faster on average than Flexcom 8.3 for time domain dynamic analyses. Even the 32-bit version of Flexcom 8.4 has shown a 4% speed increase over Flexcom 8.3, following source code optimisations.

Run-time benchmarks were performed on a standard 64-bit machine with a Windows 7 operating system. The test cases include a selection of the standard examples which accompany the software, plus some real-world models received from external clients.

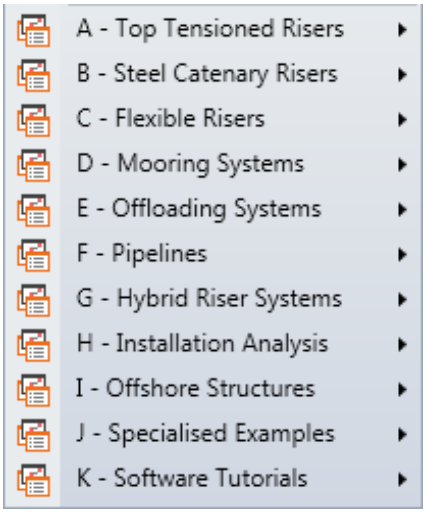
Integrated Documentation

Flexcom 8.4 comes with a new documentation system, fully integrated into the software. One centralised system now encompasses all of the various sub-components, such as keyword syntax, background theory, and sample models. It also incorporates extensive cross-referencing for effortless browsing. The documentation is also available online.



Reorganised Examples Set

The range of sample models which accompany Flexcom 8.4 has been reorganised for ease of access. Learn More >



There are also some interesting new examples, including:

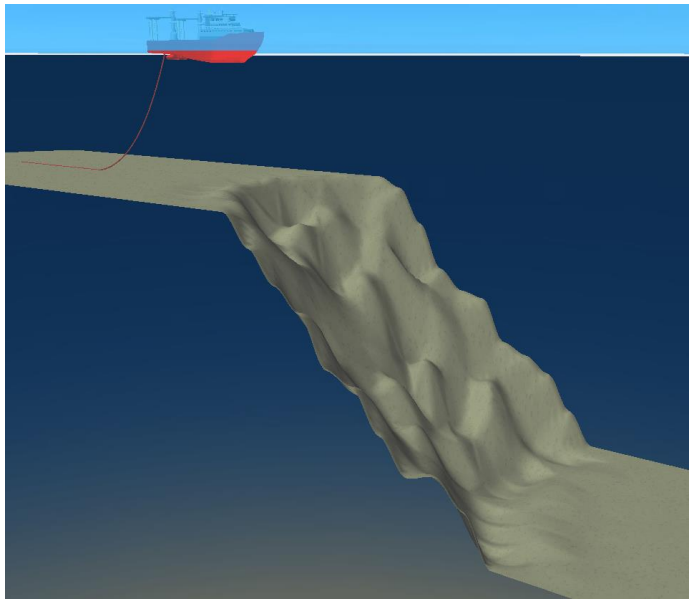
- Turret Disconnect, considering a turret disconnect scenario for an internal turret moored FPSO.
- Floating Hose, considering a floating hose system which connects a semi-submersible to an FPSO.
- Rigid Spool, considering a rigid spool subjected to internal fluid and slug flow.
- Pipe Laying, considering the installation of a pipeline over an arbitrary seabed topography.
- Dropped Object, which illustrates a dropped object scenario modelled using Flexcom.

3D Seabed Model

Flexcom 8.4 possesses a powerful new 3D seabed modelling facility which can handle complex seabed topographies with ease. You simply specify an arbitrary cloud of data points, and Flexcom's triangulation algorithm automatically generates a continuous profile via linear or cubic spline interpolation. Learn More >

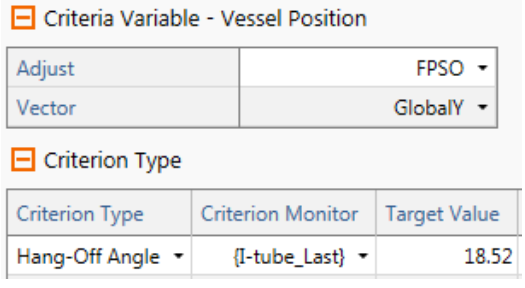
Seabed profile data is specified in terms of arbitrary {x,y,z} data points in a standard text file. This generic input style offers complete flexibility, and means that Flexcom can readily accept seabed data from a range of third party software. Flexcom 8.4 is accompanied by a helpful *Seabed Utility* application. This performs the required seabed meshing, and passes a compiled seabed data file to the main Flexcom program.

Refer to *H04-Pipe Laying* from the standard Flexcom examples set for an illustration of the new 3D seabed model. Learn More >



Solution Criteria Automation

Flexcom 8.4 now allows you to specify desired values of critical solution parameters, and the program automatically adjusts the model configuration to satisfy the specified criteria. For example, you could specify the maximum allowable bending moment in the touchdown zone for an SCR, or the desired hang-off angle at the vessel connection. You also have control over how the model is to be adjusted, for example using a vessel offset or a change in line length. The increased automation provided by this new feature will expedite model set-up and improve engineering productivity. Learn More >



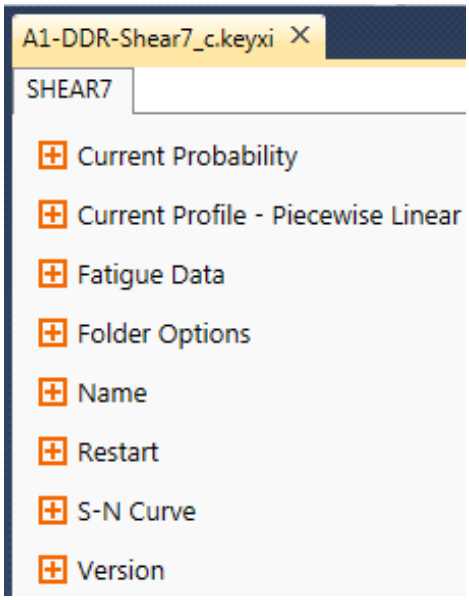
Refer to *B01 – Steel Catenary Riser* from the standard Flexcom examples set for an illustration of the new solution criteria automation feature. Learn More >

Shear7 Interface

All of the inputs required by Shear7 may now be input directly into Flexcom (via several new keywords), and this information is used to create the main input file to Shear7 (.dat file). Previously, assembly of this input file could be a time consuming and error-prone process for software users, whereas the new keyword style inputs are intuitive and user friendly. Learn More >

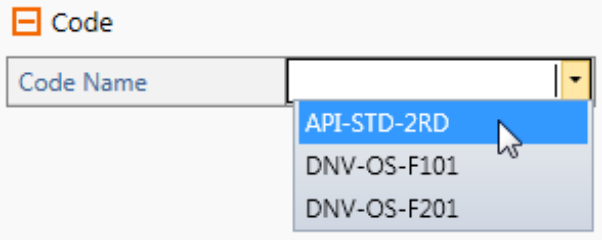
The modal analysis operates in the same manner as previous versions, producing a data file (.mds file extension) which summarises the modal frequencies and corresponding curvature distributions at each frequency. Equipped with all of this information, Flexcom is in a position to run Shear7 automatically following the modal analysis, providing a seamless integration of the modal and VIV fatigue analysis stages.

Refer to *A01 – Deepwater Drilling Riser* from the standard Flexcom examples set for an illustration of the new Shear7 functionality. Learn More >



API Code Checking

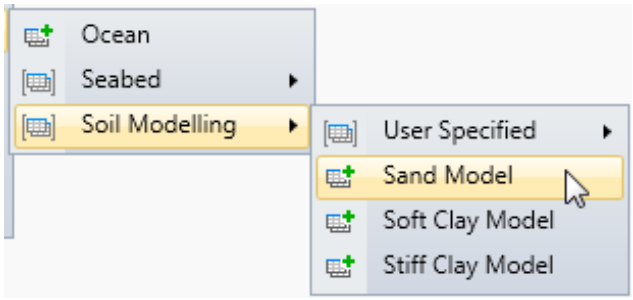
Flexcom 8.4 allows you to automatically check your riser designs against the very latest design codes. API-STD-2RD (*Dynamic Risers and Floating Production Systems*), the successor of API-RP-2RD, provides four distinct methods of calculating utilisation based on environmental loads.
Learn More >



Soil Modelling

Flexcom 8.4 now provides a range of standard soil models, including sand, soft clay, stiff clay etc. Rather than explicitly defining non-linear soil resistance-deflection relationships via P-y curves, you can now simply select from a range of pre-defined models. This expedites the model building process and minimises effort on the part of the user. Learn More >

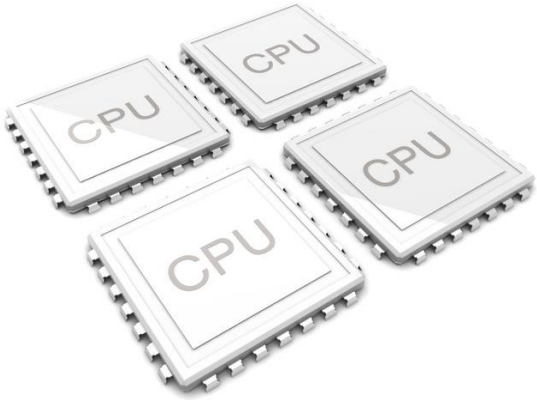
The soil models are typically defined using parameters such as soil weight and shear strength. You are invited to define these inputs for a range of soil depths. Flexcom then automatically generates a series of explicit P-y curves in the background using an interpolation scheme.



Refer to *A01 – Deepwater Drilling Riser* from the standard Flexcom examples set for an illustration of the new Shear7 functionality. Learn More >

Quad-Core Processing

All Flexcom 8.4 installations provide 4-core processing as standard. Effectively this means that existing Flexcom users who are using standard licence contracts can now double their processing power at no additional cost. The changes will come into effect automatically once you upgrade to Flexcom 8.4 – simply contact the Flexcom technical support team at softwaresupport@mcskenny.com to obtain your new licence file. Note that higher performance models, such as 8-core and 16-core options, are also available as premium upgrades for use on powerful server machines.



Another very helpful feature of Flexcom's licence model is that the user interface does not require a dongle or network licence. A licence is only required while the software is performing finite element computations. This means that model construction, and certain post-processing operations (e.g. inspecting structural animations, post-processing via Excel or VBA), may be undertaken without occupying a licence seat from the pool of available network licences. This licencing model is a distinctive feature of Flexcom (most software packages require a licence to open the user interface), and one which assists in maximising the productivity of engineering teams.

Miscellaneous Features

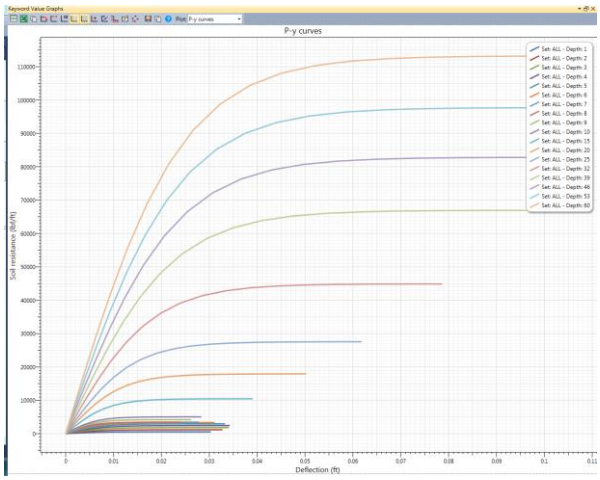
Aside from the major new features listed above, Flexcom 8.4 also provides numerous helpful additions, including...

- Table Editor. Several usability enhancements have been made to the *Table Editor*, a feature which has proven very popular amongst new users of the software. Units are now clearly labelled for every entry as noted earlier. Prompting for defined items (such as element set names) is now available. There is also a fully functional undo/redo function. Tables are now listed in alphabetical order for ease of reference.

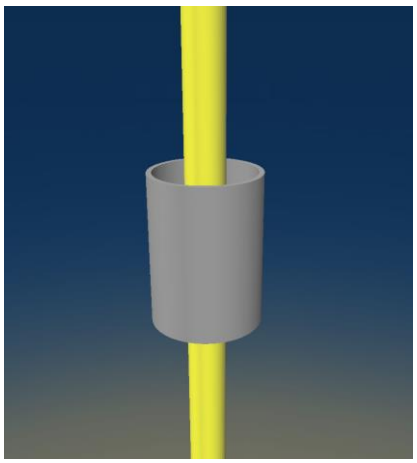
Ocean - Properties

Water Depth [m]	=[WaterDepth]
Water Density [kg/m^3]	1025
Acceleration due to Gravity [m/s^2]	9.81
Water Kinematic Viscosity [m^2/s]	[0.0000013]

- Curve Preview. Any non-linear relationships (e.g. stress-strain curves for non-linear materials, P-y curves for soil modelling) may be previewed and visually inspected within the Flexcom user interface. To invoke this new feature, press the *Input Value Graphs* option under the *View* menu, and then select the parameter of interest from the *Plot* drop-down list. Learn More >



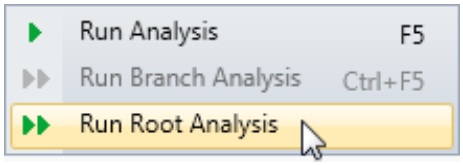
- Curved Guide Surfaces. Contact may now be modelled with both the outer (convex) or inner (concave) surface of a curved guide surface. This may be useful for modelling a component such as a diverter housing in a drilling riser analysis. Contact surfaces may also be assigned names, to facilitate ease of subsequent post-processing. Learn More >



- Set Length Timetrace. Element set lengths may now be plotted as a function of time, which can be very helpful for monitoring winch payout. Learn More >

```
$DATABASE POSTPROCESSING
*TIMETRACE
 TYPE=LENGTH, SET=Payout Winch
 START=1, END=178
 1.0, UNITS=m
 TITLE=Payout Winch Length
```

- Run Root. A new *Run Root Analysis* option has been introduced. This allows you quickly run an analysis, without having to concern yourself with input file dependencies. The software automatically runs any preceding analyses in a restart chain, before executing the required simulation.



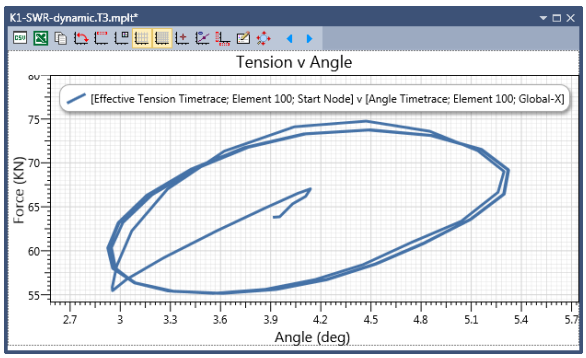
- CSV Output. The *Plot Viewer* already has a facility to export data from individual plots to Excel or CSV (comma seperated value) files. This is very useful if you wish to process the plot data further or present it differently. When working with a large number of plot files, perhaps through a script, this export procedure can get tedious. With Flexcom 8.4 you can now request an additional CSV file to accompany all plot files. It should be straightforward to extract the data from these CSV files into another application or through a script of your own. Learn More >

```
46153855E+00, 0.2251725578E+0
46153855E+00, 0.2251718903E+0
23077059E+01, 0.2277738953E+0
61538553E+01, 0.2303759003E+0
```

- Smart Select. When selecting text in the Flexcom 8.4 *Keyword Editor*, all other instances of that selected text in the file are also highlighted. This is very useful when inspecting a model to quickly identify where named items are used. For example, simply select an element set name to quickly see all the places in the file where that element set is referenced. This is also very useful for tracking parameters used in equations. Similarly, all instances of the search text are highlighted when using *Find* in the *Keyword Editor* (CTRL+F).

```
C Tension lines
 NumTensionLines,    8
 TensionAngle,       =[360/NumTensionLines]
 TensionHeight,      47
 OldFleetAngle,      5.297732119
 TensionOffset,      =[SlipRingR+TensionHeight*(tan(ra
 TensionTop,         =[TensionHeight+SlipRingTop]
```

- Variable-Variable Plots. These plots have been improved for Flexcom 8.4 and it is now possible to combine any two timetrace plots to create a variable-variable plot such as tension-angle.



- 64-bit Excel. The *Excel Add-in* is now compatible with both 32-bit and 64-bit versions of Microsoft Excel.

Fault Corrections

Flexcom 8.4 also corrects a number of program faults identified in the preceding version, Flexcom 8.3.9. The fault corrections are as follows:

1. *Soil Modelling*. The effects of soil resistance (modelled using P-y curves) may be incorrectly applied to inner sections of pipe-in-pipe configurations. For example, in drilling riser analysis, lateral soil resistance should be applied to outer sections such as the outer conductor, but not to inner sections such as the inner casing. Correct operation of the soil model may be ensured by explicitly specifying the name of the outer section via the SET= input under the *P-Y keyword, but this approach may not be obvious to all users. Flexcom 8.4 removes any possible ambiguity in this respect, and inner sections are automatically identified via the `*PIP SECTION` keyword and subsequently ignored in terms of soil modelling.

2. *Bend Stiffeners & Curvatures*. Two minor issues relating to curvature outputs for elements which include bend stiffeners have been noticed and rectified.

   - *Issue 1: Curvature Output*. When non-linear bend stiffeners are used in combination with non-linear or hysteretic elements, curvatures were calculated incorrectly. Note however, that this issue only affected reported curvatures. This issue has been rectified in Flexcom 8.4.

   - *Issue 2: Curvature Extrapolation*. When bend stiffeners are used in combination with non-linear elements, curvatures were calculated incorrectly if the moment value lay outside of the range of moments specified on the non-linear material curve. Note that this issue only affected reported curvatures, and material properties were modelled correctly in the finite element solution. This issue has been rectified in Flexcom 8.4.

3. *Modal Displacements*. Occasionally when performing a modal analysis using the TTR option for Shear7 output, the sign of reported displacement would fluctuate between positive and negative numbers. The problem stems from eigenvectors which lie on or close to the global XZ plane, resulting in a sudden change in sign of both displacement and/or rotation. This issue has been rectified in Flexcom 8.4.

4. *DNV Code Checking*. For pipelines/flowlines, DNV-OS-F101 specifies the use of a resultant bending moment in calculating a design moment, whereas for risers, DNV-OS-F201 specifies the use of the individual moment components in calculating a design moment. However, in the unity calculations, resultant bending moments were inappropriately used in the calculation of DNV-OS-F201 unity (risers), and conversely the component moments were used in the DNV-OS-F101 unity (pipelines/flowlines) calculation. This issue has been rectified in Flexcom 8.4.

5. *Internal Fluid*. Three minor issues relating to internal fluid and slug flow have been noticed and rectified.

   - *Issue 1: Constant Slugs.* For slug flow at constant velocity, the inputs include a start time and a time lag. However, the first slug doesn't enter the system until the start time plus the lag time. This has been corrected in Flexcom 8.4.

   - *Issue 2: Slug Flow Timetrace Files*. Where several input files are used to define time varying slug flow properties, the program required the same number of time entries to be specified in each file. This was unnecessarily restrictive, and the issue has been rectified in Flexcom 8.4.

   - *Issue 3: Input Data Confirmation*. Effects of internal fluid are modelled correctly in Flexcom 8.3.9. However, the data inputs for some fluid-filled element sets may be incorrectly echoed to the output file as "None". This error affects the data confirmation alone, and internal fluid effects are correctly captured in the finite element model. This has been rectified in Flexcom 8.4.

6. *Modal Analysis User Interface*. Despite a successfully run modal analysis, the user interface would indicate it was uncertain of its status. This issue has been rectified in Flexcom 8.4.

7. *Point Buoy*. The local axis system for point buoys should update automatically based on the nodal rotations of the attached node. The realignment happens correctly for 6D buoys which are explicitly defined with a local axis system. For all other definitions (e.g. 3D buoys, or 6D buoys which are initially aligned the global axis system), the buoy remains aligned with its initial axis system and is not updated subsequently. This issue has been rectified in Flexcom 8.4.

8. *Line Modelling*. Based on the length of a line, and the straight line distance between its start and end locations, Flexcom automatically determines whether the line should be modelled internally using a curved (cable) or a straight section. However, for lines which are very close to being straight, cables were sometimes used unnecessarily. This issue has been rectified in Flexcom 8.4, which incorporates a small tolerance value when checking the specified line length against the straight line distance between the start and end locations.

9. *Vessel Drift Velocity*. Vessel drift velocity was based solely on the user-specified constant vessel velocity (`*VESSEL VELOCITY`), and did not include any velocities which derive from second order drift motions (`*DRIFT`). Although the issue may appear significant, it is relatively self-contained, and only affects computations in two areas. Firstly, hydrodynamic loading within the moonpool (`*MOONPOOL`) is incorrectly modelled, given that the water particle velocities are incorrect. Secondly, the accelerations of zero-gap guides which are attached to drifting vessels are calculated incorrectly (they are derived from vessel velocities), resulting in incorrect contact reaction forces. This issue has been rectified in Flexcom 8.4.

10. *Seabed Modelling & Frequency Domain Analysis*. There are two issues related to seabed modelling in the frequency domain.

    - *Issue 1: Reaction Forces.* For a sloping or arbitrary seabed profile in the frequency domain, the reaction force was sometimes transformed incorrectly, resulting

in an incorrect reaction force being applied to nodes on the seabed. This issue has been corrected in Flexcom 8.4.

- *Issue 2: Seabed Friction*. The stiffness terms which model friction in the frequency domain, were rotated incorrectly before being added to the global stiffness matrix. This means that both friction stiffness and lateral stiffness are modelled incorrectly. This issue has been corrected in Flexcom 8.4.

11. *Moonpool Hydrodynamics*. Any normal added mass coefficients specified for moonpool elements (`*HYDRODYNAMIC SETS, TYPE=MOONPOOL`) are ignored, and assigned default values based on the corresponding normal inertia coefficients. This issue has been corrected in Flexcom 8.4.

Running Flexcom on Windows® XP

As you may be aware, Microsoft have ceased providing support for the Windows XP operating system. Window XP was originally released back in 2001 and has since been replaced in many organisations by more modern systems such as Windows 7, 8 etc.

All recent versions of Flexcom, such as Flexcom 8.1, 8.2 & 8.3, are fully supported on Windows XP. However, future support for Flexcom running on Windows XP has naturally been impacted by Microsoft's decision to discontinue its support for XP.

I would like to take this opportunity to communicate our decision to phase out Wood Group Kenny support for Flexcom running on Windows XP. The advent of Flexcom 8.4 is an opportune time to bring this change into effect. Specifically, technical support will no longer be provided for any instances of Flexcom 8.4 running on Windows XP.

If your computer is still running Windows XP, I would encourage you to consider migrating to a more modern operating system.