What's New in PHOENICS 2021

CHAM

Experts in CFD Software and Consultancy

PHOENICS 2021 released as PHOENICS turns 40

*It is four decades since Professor Brian Spalding FRS FREng finished working, with his CHAM team, on the first commercial general-purpose CFD (Computational Fluid Dynamics) Code ever offered to the market. It is **still** being used worldwide.*

Brian updated PHOENICS throughout each year. Since 2017, it has been updated annually by the CHAM team.

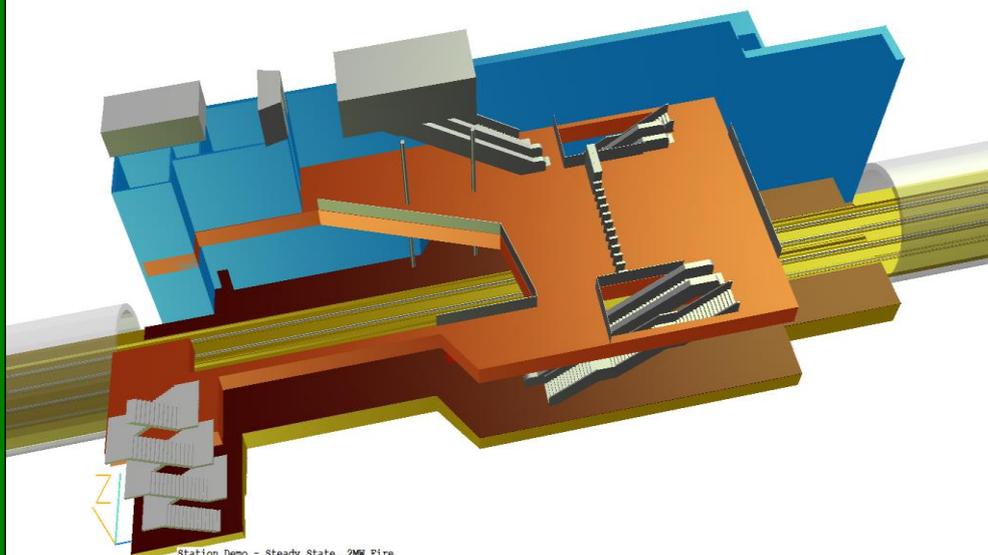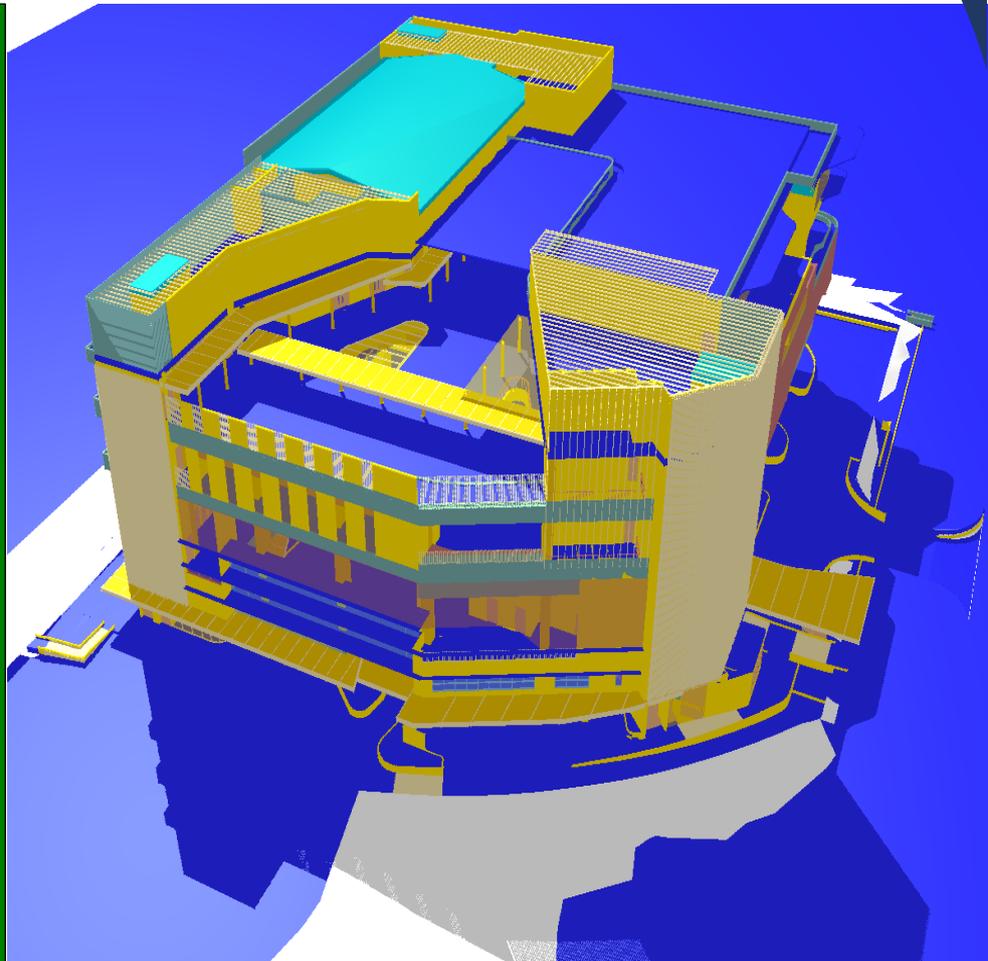*A brief outline of new features in, and changes to, PHOENICS for its 2021 iteration are contained herein.*

If you are a maintained PHOENICS User please get in touch to arrange your upgrade to PHOENICS-2021 without additional charge.

If you do not use PHOENICS, why not try it via PHOENICS on the Cloud? Go to www.cham.co.uk to check out access or contact sales@cham.co.uk for assistance.

If it flows, PHOENICS can model it.

Kind Regards

Colleen I Spalding
Managing Director

Station Demo - Steady State, 2MW Fire

Graphics Update

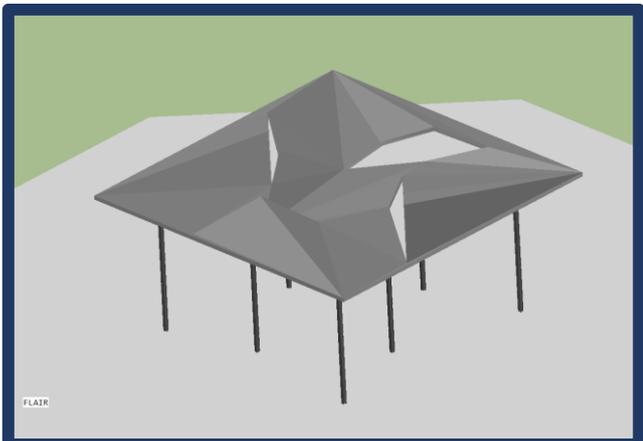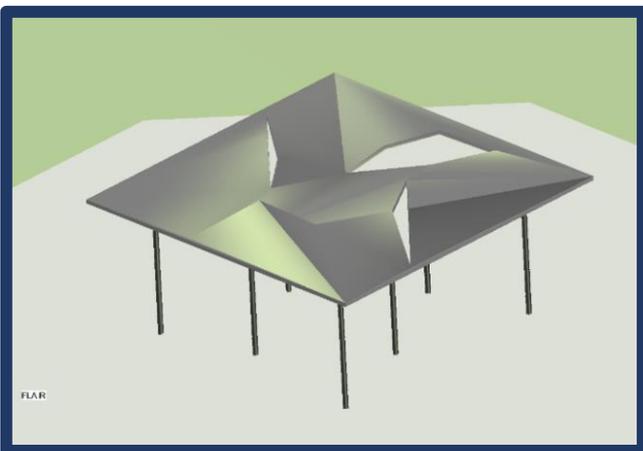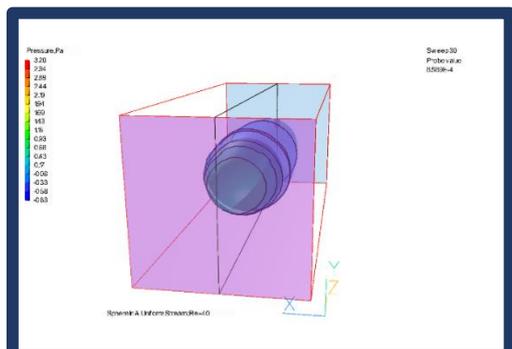PHOENICS 2021 uses Vertex-Buffer-Object (VBO) oriented graphics implementing shader programs.
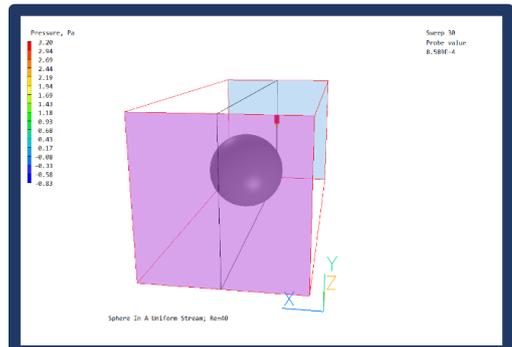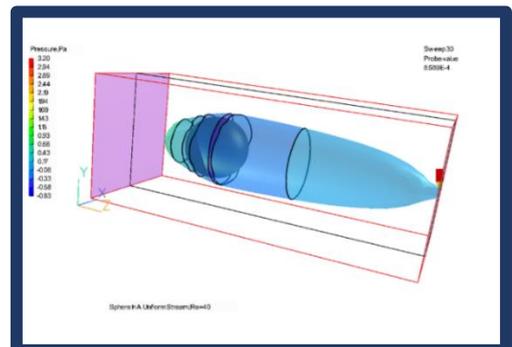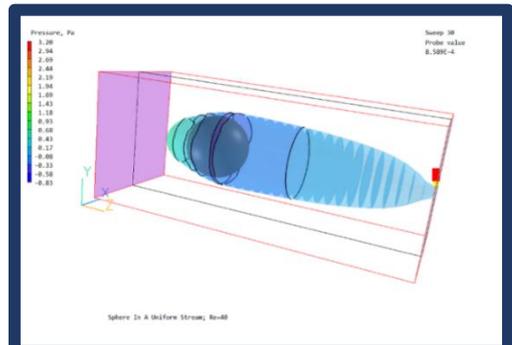
Editor and Viewer have, previously, used traditional OpenGL display lists to create on-screen graphics.

Modern OpenGL graphics enhance appearance via Shader programs which can be actioned on many GPU's simultaneously.

If a graphics card does not support VBO shaders, PHOENICS will revert to legacy OpenGL and save the chosen renderer to the local CHAM.INI.
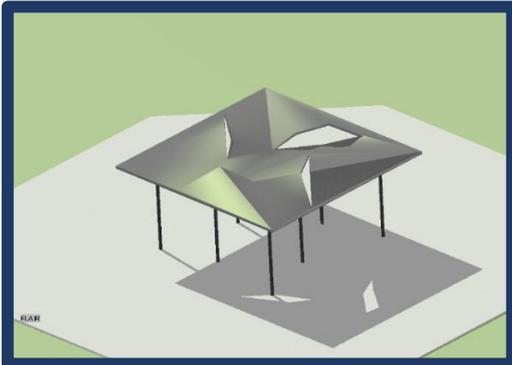
VBO-based graphics allow for smoother shading (top) than 'Legacy' OpenGL (bottom).

Use of VBO-based graphics allows better handling of transparency, especially when multiple transparent objects overlap.
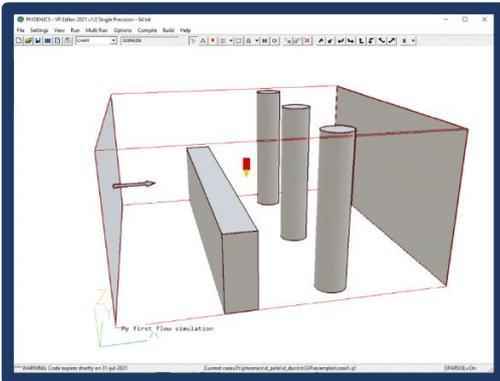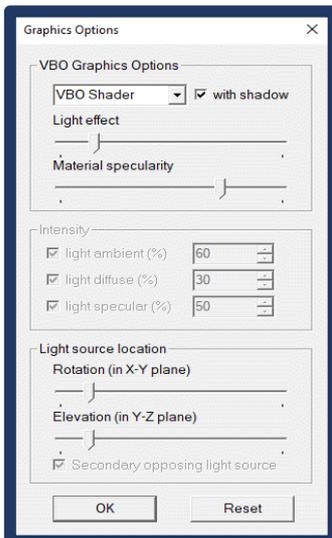
Objects can cast shadows as shown below (linked to the SUN position if a SUN object is present).
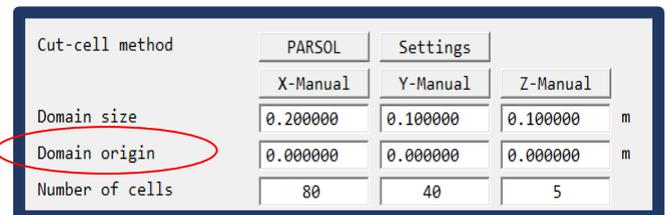

Edges of objects can be highlighted.

Graphics rendering is chosen via Settings-Graphics Options (replacing the Settings-Adjust-lighting dialog).

VR-Editor

Domain origin

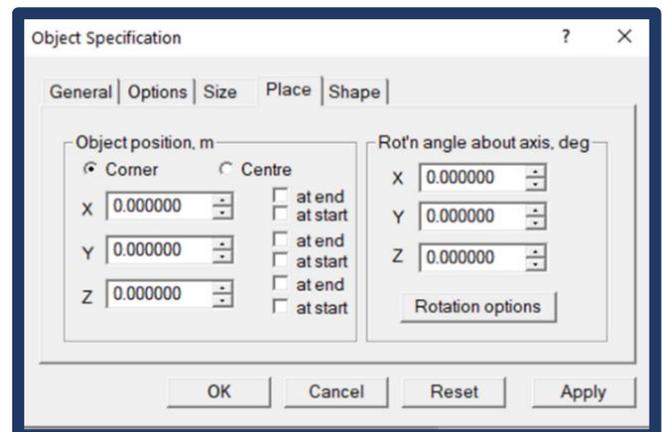Domain Origin can be set to any arbitrary location, including the negative quadrant.

Gridmesh dialog has new input boxes for domain origin. Moving objects closer, or further, is a simple task, in this version. One simply moves the origin (remembering to make the domain larger if need be) rather than grouping objects and moving the group.

Object Position

Object position can be tagged 'At start', ie at the start of the domain, irrespective of the domain origin position.

Domain-face objects created through the 'Main Menu – Domain Faces' panel are automatically tagged 'at start' (or 'at end') to ensure they stay at domain boundaries.
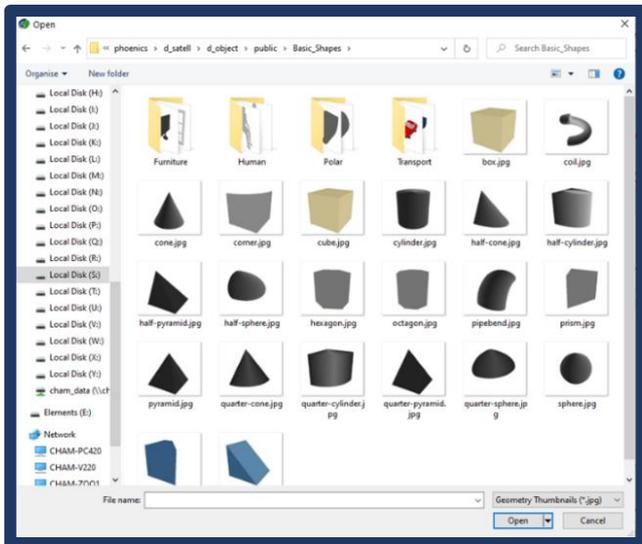

TRACK_COUNTER Object

TRACK_COUNTER, a new object, counts the number of GENTRA or Viewer streamline tracks passing through. For RAIN tracks, mass flow and droplet size of each track are also shown.

Object Geometry Library

The object geometry library gives easier access to basic primitives thus simplifying building geometries.

The 'Basic Shapes' folder containing primitives such as box, cylinder, sphere etc is the first screen displayed when searching for a shape. Other commonly-used shapes are in subfolders. More 'exotic' shapes are one level up in the 'Public' folder.

CAD Import

If object(s) are at the CAD location, which is in the negative quadrant, domain origin and (potentially) size are reset, if necessary, just to enclose new new object(s).
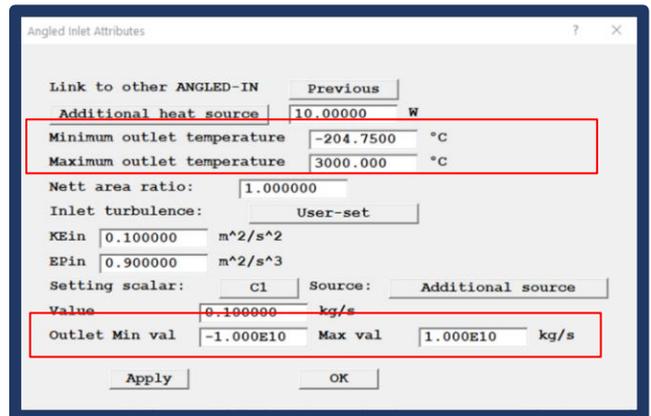
Several groups of objects can be imported maintaining relative positions between all groups. Relative positions are thus no longer influenced by the order of geometry-file selection when Importing groups of CAD geometries.
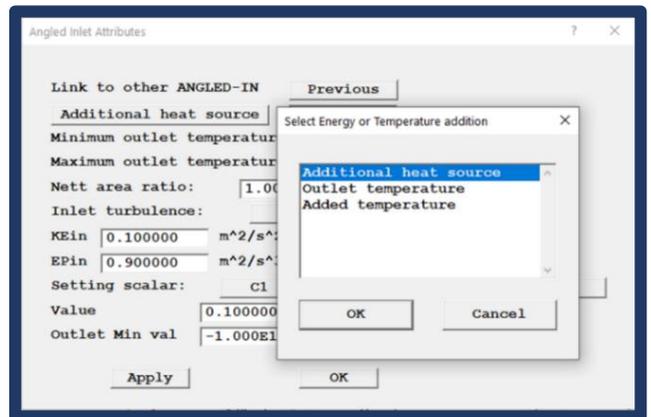
Linked Angled-in Objects

For linked ANGLED_IN objects, it is possible to set minimum and maximum values of temperature and scalars at the exit.

Default values are minimum and maximum allowed for variables in question. This prevents cooler-exit temperature dropping below cooling-coils temperature;

or temperature at heater-exit exceeding hating-element temperature.
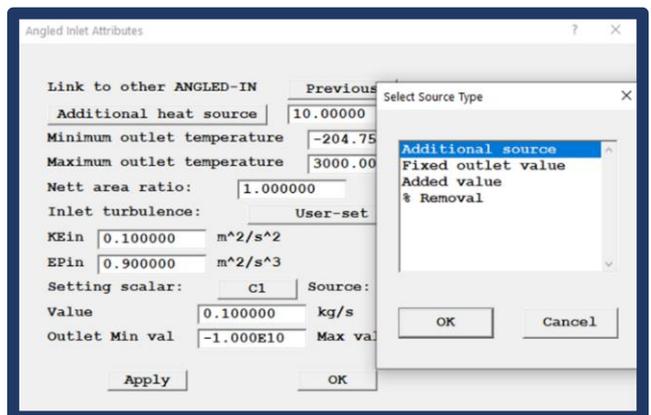

Additional sources for temperature are:

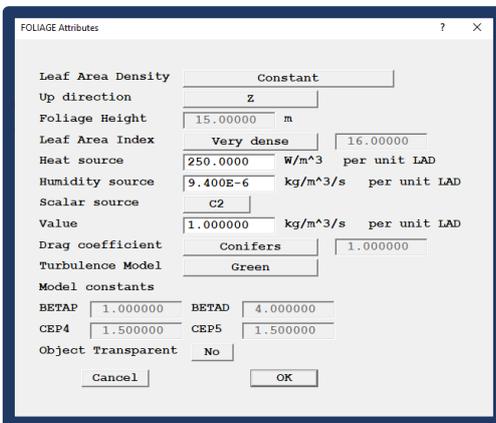Cooling can be implemented by setting negative values for 'Additional heat source' or 'Added temperature'. Additional sources for scalars are:

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FOLIAGE Object

Additional heat and moisture sources are now multiplied by Leaf Area Density (LAD) internally by the EARTH solver for compatibility with a height-varying LAD. Previously multiplication had to be done by the user before input.
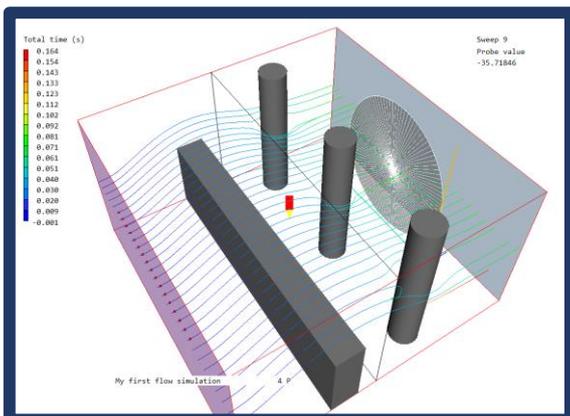

If a PHOENICS-2020 Q1 is encountered, heat and humidity sources will be divided by LAD when the Q1 is read in, thus preserving the total heat source applied.
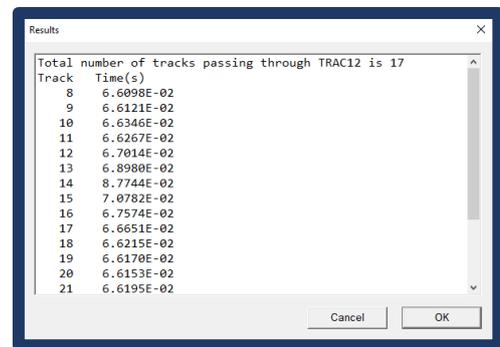
VR-Viewer

TRACK_COUNTER Object

TRACK_COUNTER has been added to objects created in Viewer and Editor. In Viewer start points and track intersections are displayed as green and red balls. TRACK_COUNTER counts tracks passing through, reports arrival time of each, and displays track numbers and flight times, in the 'Show results' window.
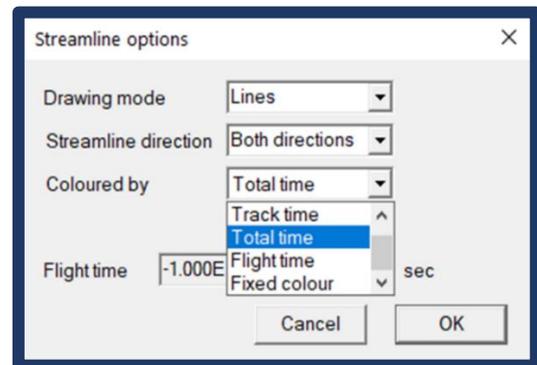

Green balls mark where tracks pass through the counter; red mark track start points. To display arrival times right-click required tracker object and select 'Show net sources'; or open Attributes dialog of the required tracker and press 'Show'.
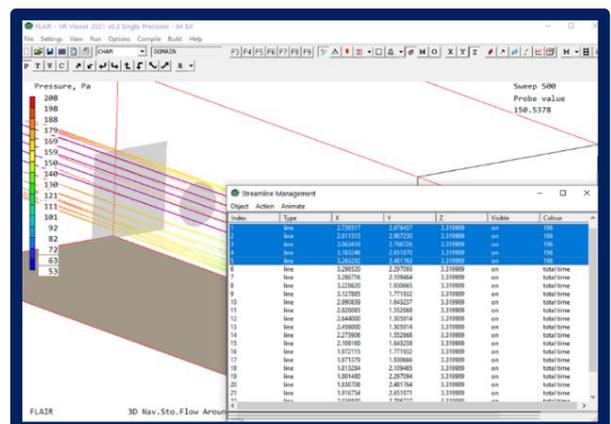

Streamlines

Individual streamline/selected tracks can be coloured by flight time, current plotting variable or fixed colour.
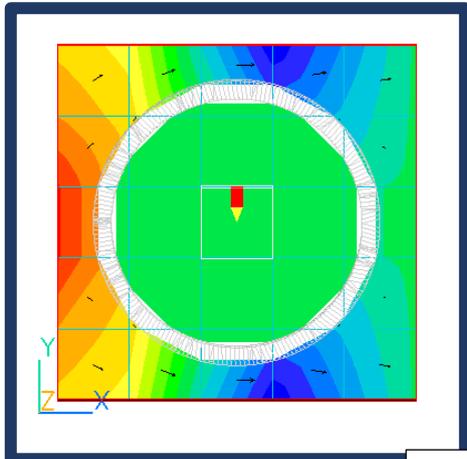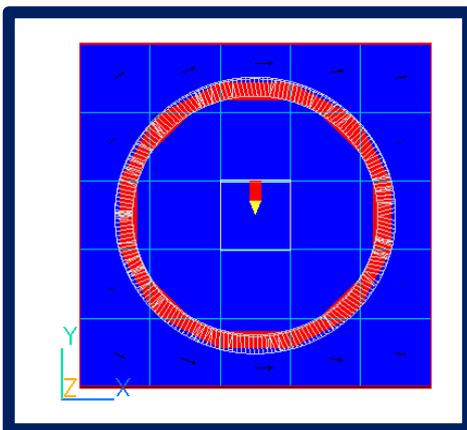

Previously generated streamline colours can be altered individually, or by selected groups.
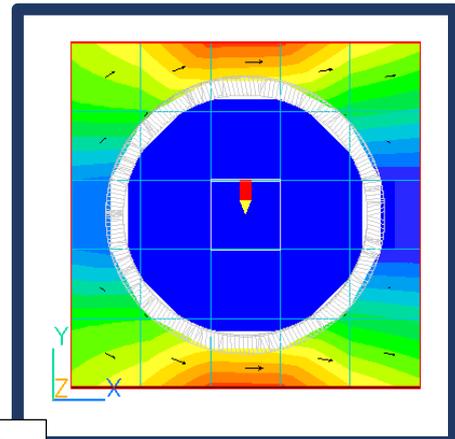
Plotting in Double-cut cells

The PARSOL cut-cell method has an optional extension for double-cut cells. Images show flow past an impervious ring on a very coarse grid.

Velocity

Pressure

A revised algorithm for obtaining surface temperatures of participating solids in Viewer has been implemented when double-cut detection is active. In PARSOL, the normal way to obtain surface temperatures (for Viewer display only) is to average surrounding values. This leads to a blurring of the contours at a solid-fluid interface.

The new algorithm produces an image similar to SPARSOL, clearly delineating fluid and solid.

Solver

Double-cut cells for PARSOL

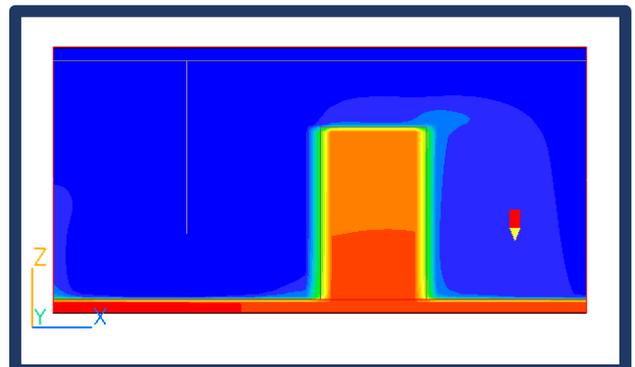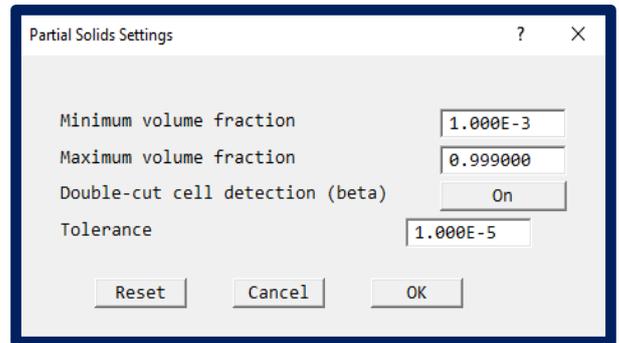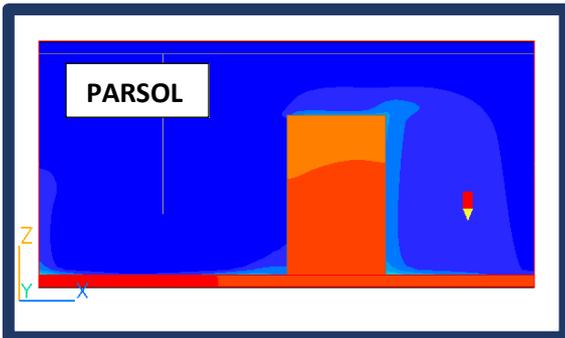Improved detection of double-cut cells for PARSOL is activated by selecting 'PARSOL' on the Grid Mesh Settings dialog and 'Double-cut detection' on the Settings dialog.

By extending PARSOL treatment to double-cut cells, a fluid sub-cell on either side of a thin solid, or two solid sub-cells on either side of a thin channel, is allowed for. This creates a locally-unstructured grid, which is handled using solvers introduced in PHOENICS-2019.

Activating double-cut detection switches default solvers to AMG for pressure and energy, and Conjugate-Gradient-Residuals Solver (CGRS) for all other variables.
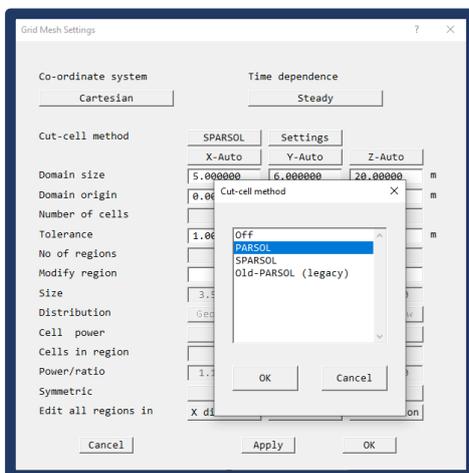
Present treatment of double cut cells does not:

- Run in parallel.
- Distinguish two parts of a cut cell when setting a source that should only affect one side.
- Activate full IMMERSOL boundary conditions on either side.

Thinplt

Solar-heat load has been added to heat balance to obtain surface temperatures of the THINPLT object for temperature and enthalpy treatments of the energy equation (with and without IMMERSOL) and P1T3 radiation models. Thermal capacity effect has been added for transient cases.

Parallel

File Handling on Startup

Sending facetdat and phida files to slave processors for restarts is changed. Each slave checks to see if it can open a shared copy of the file on the master. If so, each reads the parts relevant to it. There is no file transmission.

If slaves cannot 'see' the file on the master (perhaps because they are in a cluster and not on the same PC) the entire file is sent to each processor.

The file is read in a single read statement, sent in a single MPI-send operation, then written with a single write. This process is immensely faster than previously. The same process applies to the BFC grid file XYZDA.

In a similar fashion, any other files required to be on all processors, such as InForm, PWLF files or transfer object import files, are transmitted using the new single-read, single-send, single-write, method for speed.
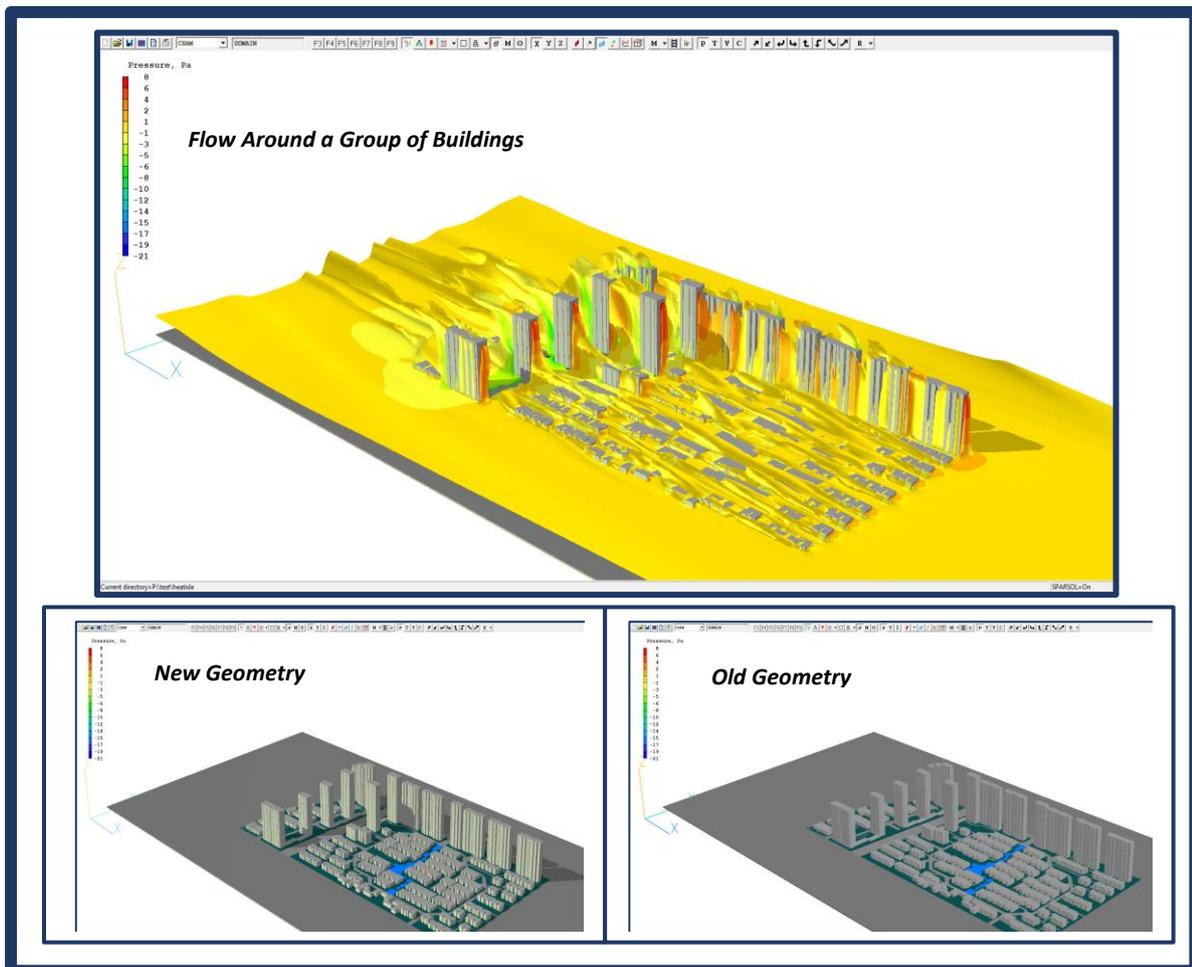
Memory allocation

The main Earth storage array, F, is saved to cham.ini to prevent unnecessary array 'stretching' when the case is next run. Maximum memory allocated by all processors is limited to 80% of free memory available at runtime.

FLAIR

Apparent temperature with radiation

A constant relative humidity can now be user-set if it is not required to solve for humidity whereas the TAPR comfort index was always set to use the solved humidity equation (MH2O) to derive relative humidity.

Flow Around a Group of Buildings

New Geometry

Old Geometry