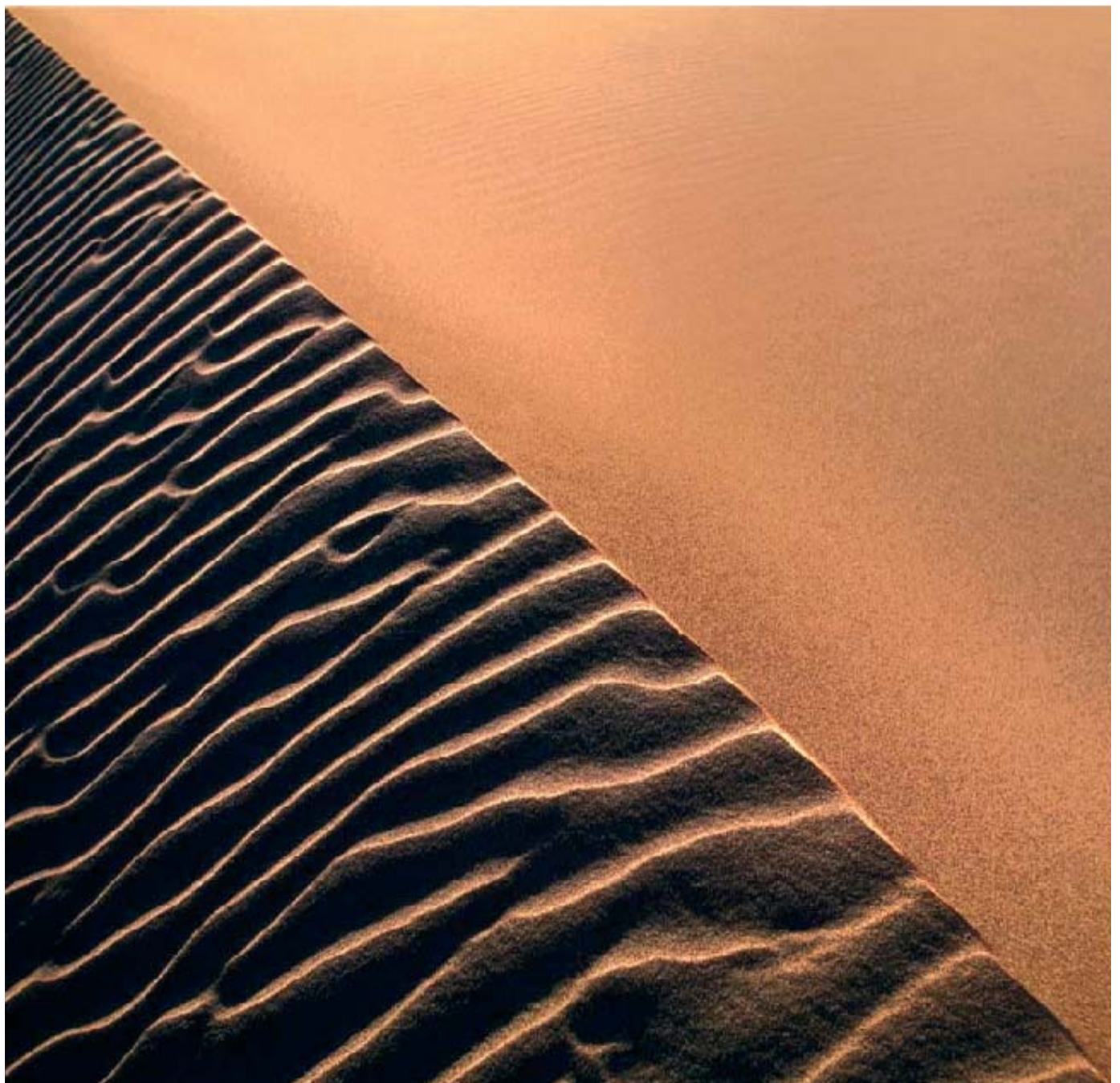




Autumn 2004

# PHOENICS

## News



News from the pioneers of computational fluid dynamics



# PHOENICS News

Designed & Edited by Peter Spalding  
Comments and articles for future publication may be sent to :-  
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PHOENICS - Student Edition

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In the time since our last issue of PHOENICS News several versions of the code have been produced, and PHOENICS V3.5.1 has been in use for almost a year.

The solver was improved with respect to PARSOL, MOFOR, IN-FORM and fine-grid-embedding and the improvements have been generally both successful and welcomed by users. PHOENICS, however, is never static and more changes and improvements have been made so that we are now testing V3.6 with the features listed on page 6.

The PHOENICS Conference in Melbourne brought Users and Agents together to exchange experiences and ideas and to have an opportunity to meet in both technical and social environments. Murray Mason and his staff from ACADS provided us with a wonderful experience outside the conference and course venues as well as interesting and challenging events within them.



In the UK we have increased our staff with the addition of David Cottrell who has joined us to sell PHOENICS and is working to expand the niche market of motor racing where he has a vested interest as he races in Formula V.

We are also extending User Support and welcome back Mick Hughes who worked with us some five years back. Mick is joining Mike Malin's team to assist with the queries received from our users.

We plan to use these newsletters as an electronic method of bringing agents and users up-to-date and into contact with each other. Please take advantage of this platform to advise us of the work you are doing with PHOENICS and to keep us informed of what is happening in your geographical or technical area in the world of CFD.

## PHOENICS Conference

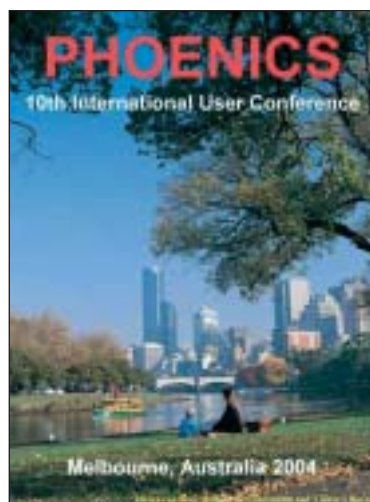


Following the successful meeting in Moscow in 2002, CHAM's bi-annual International PHOENICS Conference was held in May in Melbourne, Australia.

It was organised by Murray Mason of ACADS-BSG, and held at the Melbourne Exhibition Centre in conjunction with the Air Conditioning, Refrigeration and Building Services (ARBS) bi-annual Exhibition.

We thank Murray for a friendly welcome and the excellent facilities provided.

The event was specifically targeted towards our Pacific Rim audience, and oriented towards the HVAC / building service industry; and the programme featured many excellent presentations from participants from Australia, New Zealand, and the Far East. The 3-day conference was followed by 2 days of PHOENICS-based Workshop sessions.



A special CD was provided to all participants and some of the conference papers will be published in the PHOENICS Journal.

For further details contact Petula Smith, email: [ps@cham.co.uk](mailto:ps@cham.co.uk).

# Hevacomp Collaboration



CHAM is delighted to announce that, in early 2004, we joined forces with HevaComp Limited. The aim is to supply an add-on CFD solver to the post-processing options of HevaComp's new "Whole Building" module to supplement their successful suite of Building Services software.

Hevacomp (formed in 1981) is the firmly established UK

market leader in building services design and CAD software. Hevacomp software is acknowledged as the industry standard, with over 2000 user sites - the largest user base of any developer in the building services field.

The HEVACOMP/PHOENICS add-on is scheduled for release in May 2005. <http://www.hevacomp.co.uk>

## Windsim Update



The Norwegian company Vector AS strengthens its position as the No1 provider of CFD-based software for optimising the energy production from wind-farms. (See Page 5 for WindSim application story.)

WindSim -4.0, which uses PHOENICS as its CFD engine, is now available.

For further information click on: <http://windsim.com>

### WindSim courses and workshops:

- Hamburg, 6-7 Sept 2004, Workshop
- Rome, 27-29 Sept 2004, Training
- Tønsberg, 20-22 Jun 2005, Training

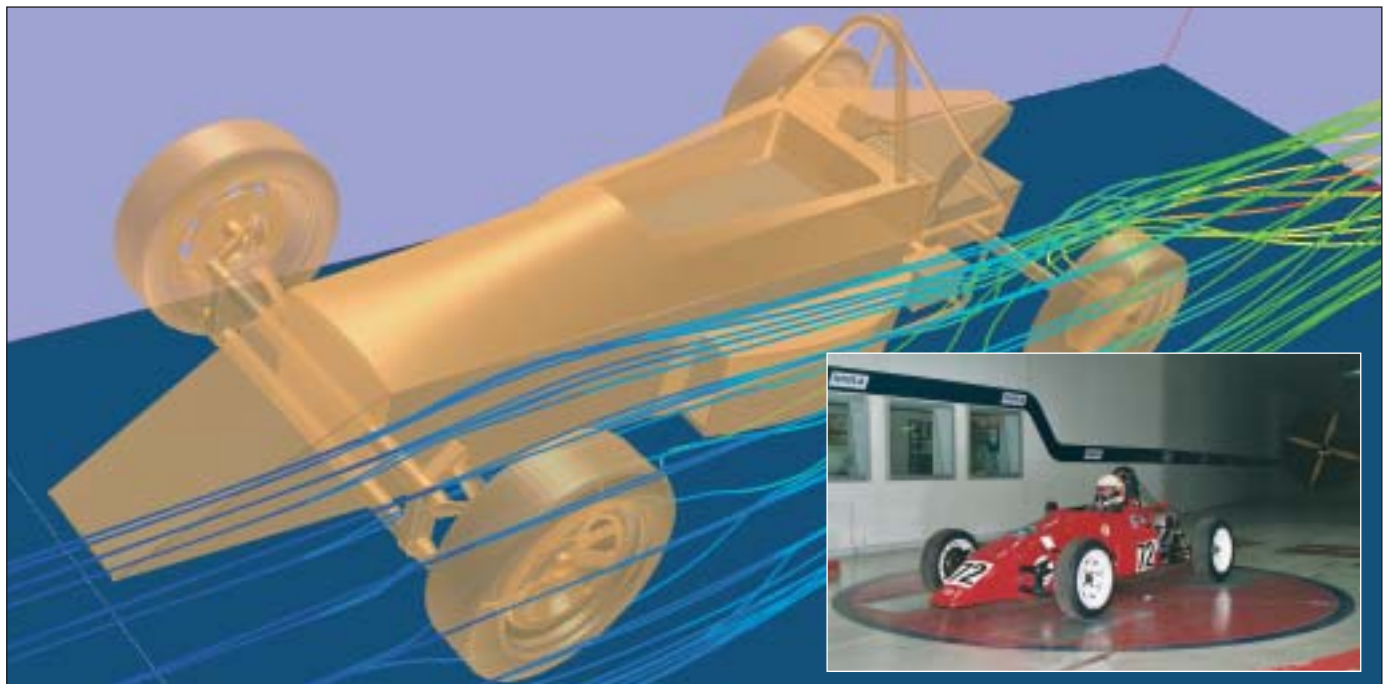
Arne Reidar Gravdahl reports: We had a course in Norway this June, which was a great success (including a sailboat trip). We will make this a yearly event. This autumn we will participate at the following exhibitions:

Zaragoza, Sept 22-24 2004, PowerExpo  
<http://www.powerexpo.org/>

Rome, Sept 30-Oct 2, Eolica Expo Mediterranean  
<http://www.eolicaexpo.com/>

London, Nov 22-25 2004, EWEC  
<http://www.ewec.info/>

## Virtual Wind Tunnel (VWT)



As a result of the popularity of the F1-VWT product created for the F1-in-schools programme, CHAM has released a commercial variant especially for the racing car industry to model aerodynamics with particular attention to lift/drag simulations.

PHOENICS results were favourably compared with wind-

tunnel tests carried out at MIRA using a private Formula-V race car shown above.

Additional cases have been run on Formula-3 and Formula-Student variants.

For further information contact [sales@cham.co.uk](mailto:sales@cham.co.uk).

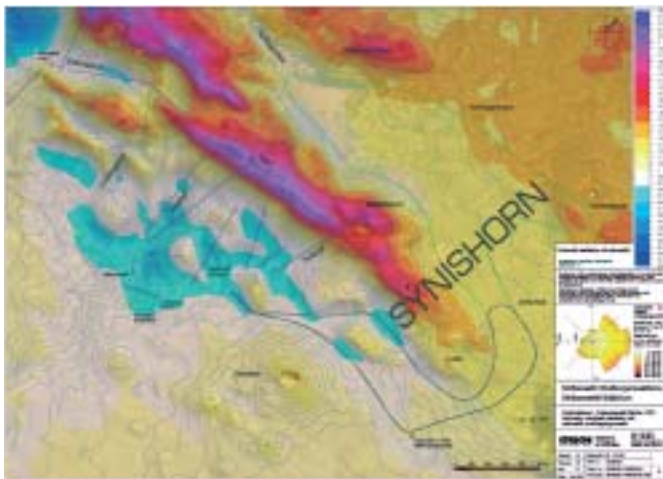


# Windfield Simulation for Alpine Skiing Area

Orion Consulting Engineers have completed a set of wind maps for the Blafjöll Skiing Area near Reykjavik, Iceland. The maps are based on wind field simulations using the PHOENICS-based WindSim product developed by Vector AS.

Blafjöll Skiing Area is exposed to frequent and strong winds during the winter, which in turn makes it difficult to operate ski lifts. Also due to strong winds, the relocation of snow due to drifting is a problem.

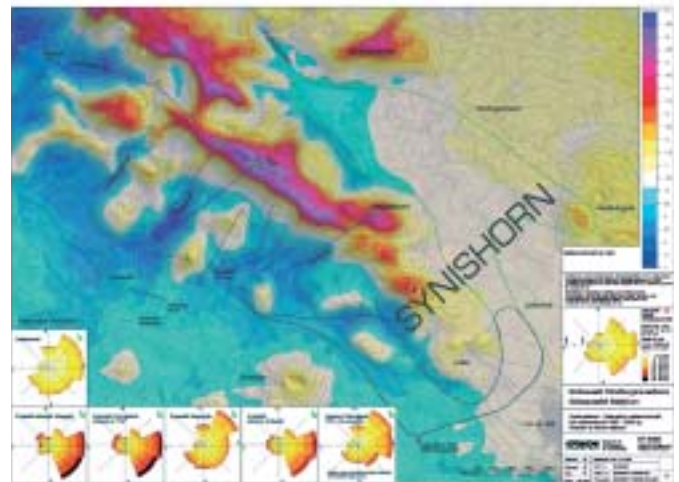
The objective of the project was to create a comprehensive overview for wind climate in the area. This includes the preparation of maps showing the spatial distribution of wind speed in the area as well as the compilation of climatologies (windroses) for strategic spots.



## Map Description

A series of nine maps was produced. Maps no. 1 through 8 are dedicated to a certain wind direction. Each map presents results for a sector of 45°, the first centred around the North (°), the second at NNE (45°), the third at East (90°) and so on. The velocity scale is normalized according to the registered wind speed at an automatic weather station inside the area (marked with a red circle, no. 1486 on the maps).

Map no. 9 displays the calculated average wind speed distribution in the terrain during the winter. The map is based on the preceding simulations for each sector and the climatology from station no. 1486. This map also displays a selection of transferred climatologies located e.g. in ski-lift paths on mountain crests.



## Application

The maps are useful for area authorities when estimating down-time for each facility due to strong winds and for real-time monitoring of weather conditions.

The data are also useful for the future development of the area, that is for planning locations for future ski-lifts and ski-routes and for planning snow fences for snow collection.

Orion Consulting Engineers  
Email: [skuli@orion.is](mailto:skuli@orion.is)

REF:

*Wind maps for Blafjoll Skiing Area, nine maps: "Skíasvæi Höfuborgarsvæisins – Skíasvæi Bláfjöllum" (Map legend in Icelandic).*

## CFD Online



To date, the PHOENICS forum on CFD On-Line, hosted by [www.cfd-online.com/Forum/phoenics.cgi](http://www.cfd-online.com/Forum/phoenics.cgi) has been deliberately allowed to operate without interference or input from CHAM, to permit a free exchange of ideas from PHOENICS users world-wide.

A recent review has shown that this policy may be counterproductive and, from 1 September 2004, CHAM will monitor the postings, participate in the exchange of information and contribute to users queries and opinions.

Email: [support@cham.co.uk](mailto:support@cham.co.uk)

# What's New in PHOENICS-3.6

The many changes made in PHOENICS since the release of V3.5.1 include:

- Extension of the PHOENICS object concept to permit non-geometric and geometric attributes to be stored together
- Provision of a 'guaranteed convergence' feature
- Further generalization of the solid-stress feature
- Provision of numerous new features in the graphical user interface
- Many improvements to FLAIR, the special-purpose program for HVAC and fires in buildings
- Extensions to the PHOENICS Commander
- A re-working of Shapemaker which can now add and store non-geometric objects, as well as creating their shapes
- Use of dynamic memory allocation in all modules
- Restoration and extension of parallel-PHOENICS capabilities.

The following object types have been added to the existing list:

- "General\_plate" (zero thickness, flat or curved)
- "Drag\_lift" object (drag and lift calculation, 3D)
- "Assembly" object (master and related components structure)

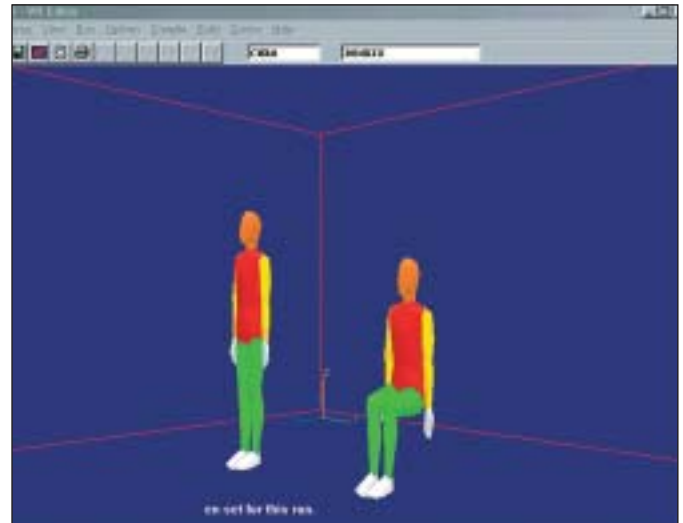
[The new "Assembly" object has been introduced to act as a 'container' for any number of other objects.]

PHOENICS-3.6 is available in Beta form, with more widespread release expected during Autumn 2004.

## Flair Enhancements

Many new and improved features have been added to the special-purpose FLAIR (building services) module of PHOENICS:

- A "Person" object was created for a single person acting as source of heat, humidity and any solved scalars.



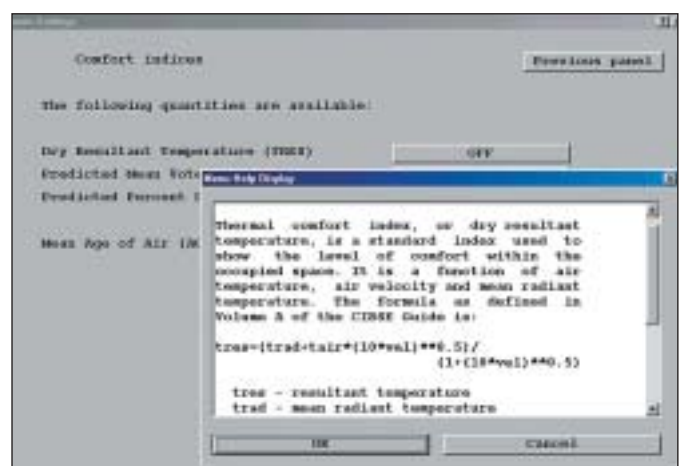
*Standing - and sitting - person objects*

- Similarly, the "People" object was created to represent large numbers of people.
- Diffuser (mass and heat source/sink, 3D)
- Fire object (piece-wise linear heat, mass and smoke sources for transient calculations)

The Comfort-index calculation: PPD, PMV, TRES, Mean Age of Air.

FLAIR provides for three comfort index calculations:

- Dry resultant temperature (TRES) (CIBSE Guide)
- Predicted mean vote (PMV) (ISO 7730)
- Predicted percentage dissatisfied (PPD) (ISO 7730)



*Help entry on comfort indices*

# What's New in PHOENICS-3.6 - continued

FLAIR provides a humidity calculation, including output of humidity ratio and relative humidity. The solved-for specific humidity equation,  $MH_2O$ , has units of kg water vapour/kg mixture. It is a mass fraction of water vapour. Several derived quantities can be displayed. These are:

- Humidity ratio, which has units of (g/kg)
- Relative humidity (%)

[In this case, the water-vapour saturation pressure, partial pressure and mole fraction are also made available for storage.

The units used to specify boundary sources (inlets, openings, volume sources) can be set on the dialogs for the individual objects.

The options are:

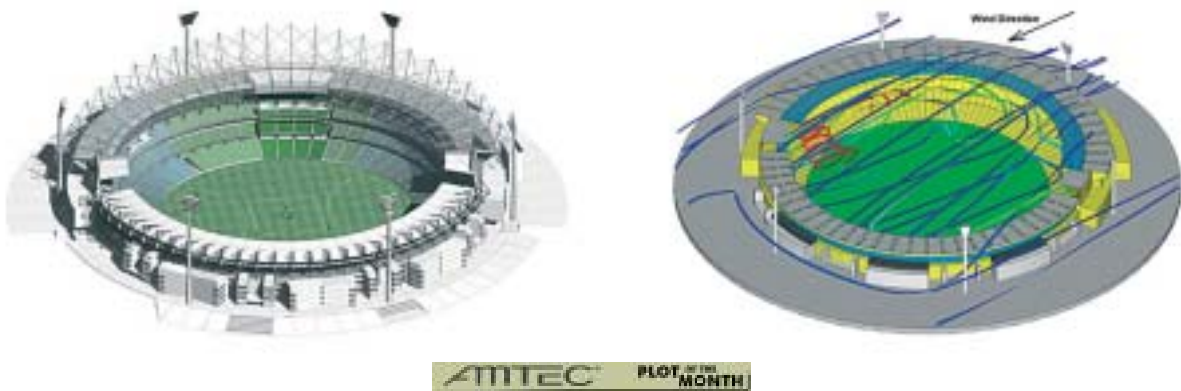
- Specific Humidity (Mass fraction) (kg/kg, kg/s)
- Humidity ratio (g/kg, g/s)
- Relative humidity (%)

[The default is Specific Humidity]

The default Up direction is set to Z instead of Y as in earlier versions.

The default domain size is set to 10 x 10 x 3m to be more representative of an average room or office shape and size. The automatic convergence control is set as the default option.

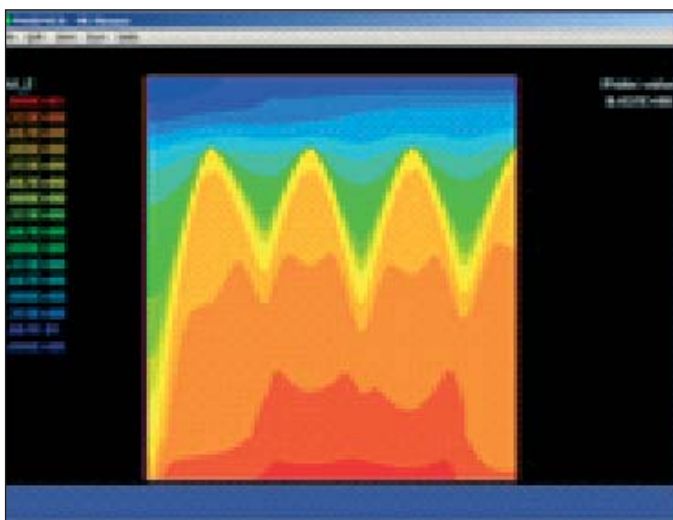
A more comprehensive description of these, and other improvements, can be found by clicking on: [www.cham.co.uk/phoenics/d\\_polis/d\\_docs/tr006/item6.htm](http://www.cham.co.uk/phoenics/d_polis/d_docs/tr006/item6.htm)



*Melbourne Cricket Ground*

*Pictures featured in plot of the month - TECPLOT Inc - [www.tecplot.com](http://www.tecplot.com)*

## Thermal Exchange in Empty Spray-Section of Vacuum Towers



*Distillation tower results*

On 29th June, two recent projects undertaken by CHAM's Brazilian agents, CHEMTECH, were presented at the II Seminar on Fractioning Innovations at "Cenpes", the Petrobras Research Center.

Continuing on from a previous project on thermal exchange in empty spray sections, CHEMTECH has started a project to evaluate the effect of distributor height in the GOL region, as well as to improve model prediction - already developed and validated by experimental data - through the increase of pseudo-components used in simulation and through integration with "Petrox" (Petrobras process simulator) to calculate mixture properties. Such improvements allow for model application in all tower sections.

# CFD Application in Refinery Coke Oven

The coke oven at a refinery in the State of São Paulo experienced over heating in some pipes, causing various problems such as excessive coking and corrosion. Using PHOENICS, CHEMTECH evaluated the distribution of gases and temperatures in the oven. They also evaluated different operational conditions and the effect of geometry in the distribution of temperatures and heat exchange.

The operational conditions were thus identified and modifications in oven geometry were suggested to guarantee better heat distribution in oven ducts, and reduce the excessively high temperatures in some pipes.

For more information on both projects, click on: [www.chemtech.com.br/english](http://www.chemtech.com.br/english)

## PHOENICS - Only One Click Away

**PHOENICS On-Line, launched in 2003, has attracted an ever-increasing and international client base.**

The service, which currently provides low-cost interactive access to PHOENICS-3.5.1 via the Internet, has proven to be particularly attractive to customers wishing to make infrequent or project-based use of the code, and for those wishing to gain access from multiple locations.

Click on [www.in2itive.biz/cham](http://www.in2itive.biz/cham) to find out more, or email: [sales@cham.co.uk](mailto:sales@cham.co.uk) to arrange an on-line demonstration or a free trial evaluation period.



*Log On to PHOENICS On-Line*

## F1 VWT



**The "F1 Virtual Wind Tunnel" sub-set of PHOENICS, is now in widespread use by schools and colleges competing in the F1-in-Schools Challenge.**

Andrew Denford, founder of F1-in-Schools Ltd, announced "After four outstanding years of continued growth and development within the UK, the 'F1-in-Schools Challenge' spread its wings eighteen months ago to overseas countries.

Representing an important milestone in the development of the 'F1-Team-in-Schools CAD/CAM Design Challenge', the first ever International Final will be held on 5 October 2004, with representatives expected from over ten countries competing from around the world. The Final will take place at the home of Jaguar Cars, Castle Bromwich, Birmingham, UK."

CHAM will shortly be releasing the Mk3 version of the F1 VWT to incorporate the rules and regulations associated with new 'R' class model, as well as some improved graphical options.

<http://www.f1inschools.co.uk>

## PHOENICS Award

CHAM offers its hearty congratulations to Mr Kevin Chow winner of the PHOENICS Award for the best project of the 2003/2004 academic year. Kevin, who studies in the Aerospace Dept of the University of Hertfordshire, won the prize for his final year project entitled: "Novel Hypersonic Concept - Stage 1 'Nose Design'".





# CHAM Consultancy Update

This year and last, CHAM's consultancy team has been busier than ever and involved in an increasingly broad spectrum of applications. Here are just a few examples:



*Stricken Oil Tanker 'Prestige'*

## Prestige Oil-tanker project

During 2003, CHAM was contracted to model the plume and slick scenarios following the potentially environmentally disastrous sinking of the Prestige oil tanker off the coast of Spain in November 2002.

With 70,000 tonnes of oil retained in its holds, the Prestige has the potential to cause unsurpassed damage to the environmentally sensitive Spanish coastline. CHAM was contracted to simulate the escape of oil under various assumptions regarding the aperture size.

The "parabolic option" of PHOENICS proved to be extremely useful in simulating the "plumes" or "clouds" of oil-contaminated water that were postulated to rise from the tanker.

Some of the results proved truly surprising, for example that the pressure of a warm-water layer near the surface caused much of the oil to spread out laterally well before it reached the surface.

## Current Projects

Fire studies are being undertaken on behalf of Dutch consultants, Novenco, involving the use of combined forced ventilation and sprinkler systems within a car park complex. As a direct consequence of this project, a new generic sprinkler option will be created within the FLAIR user interface for PHOENICS-3.6.x.

CHAM is working with Italian company, Centro Sviluppo Materiali (CSM), to determine the representative flow characteristics of a curved-domain steel casting process. In essence, this "state-of-the-art" project, involves 3D eddy current simulations, and focuses upon the continuous casting of a solidifying strand of steel that is subjected to electromagnetic forces.

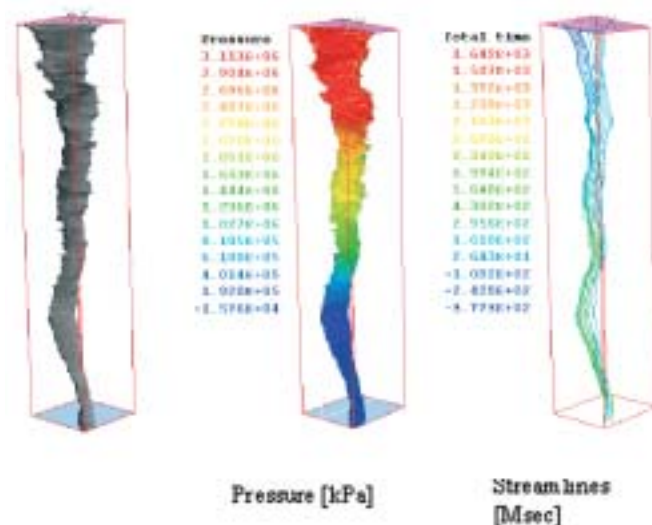
## Smooth as Silk for CHAM Japan



*Silkworms*

Concerned by the quality of silk produced by your average silk worm? Well, it's big business!

CHAM Japan, in conjunction with the Tokyo University of Agriculture & Technology, investigated the highly viscous flow and tensile strength of silk produced from a silkworm spinneret.



*Bio-Geometry from Electron Microscope to CAD  
& from CAD to PHOENICS*

Japanese industry is studying the complex geometry and production processes involved with this tiny animal in order to produce artificial silk of the same quality.

The emphasis thus far has been concerned with the maximum shear velocities associated with the transition from liquid protein to fibre and the pressure loss in the spinneret.

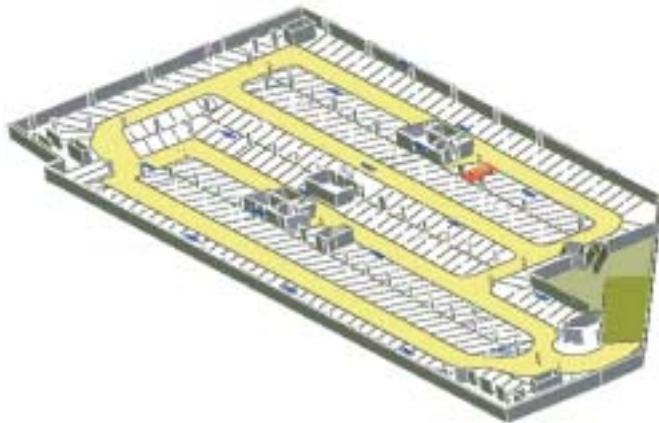
Email: [support@cham.co.jp](mailto:support@cham.co.jp)

# Ventilation of a Car Park

PHOENICS has become increasingly popular for car park ventilation and fire hazard studies. The following case, by Van Hooft BV, concerns the air and smoke flow in a car park using mechanical ventilation under maximum ventilation conditions, with and without a car fire.

## Description of the model

At one side of the garage, ventilation shafts have been provided. One is used for regular ventilation while the others are used during a fire-alarm emergency. The open entrance of the garage is opposite. To support air-flow and to hold smoke flowing freely through the garage, a ventilation system is installed and switched on according to the event. The fans used are bi-directional.



*Floor plan with car (fire) and fans*

In addition to the shaft fans, under-ceiling fans are distributed for regular ventilation and to stop further smoke-movement.

In this case, the garage is free of parked cars, considered as a worst-case scenario as the ventilation system has to handle a larger air volume. The car fire has been represented at the moment that the fire size and smoke supply are at their maximum.

## Calculations

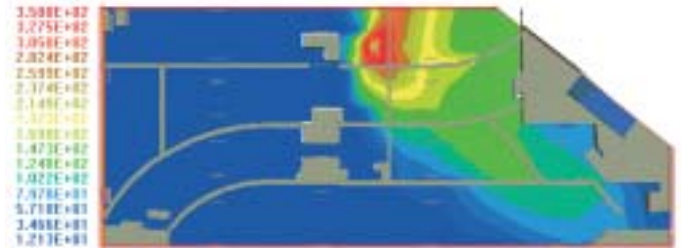
Two cases have been calculated:

- 1) fire alarm with maximum ventilation, and
- 2) regular ventilation.

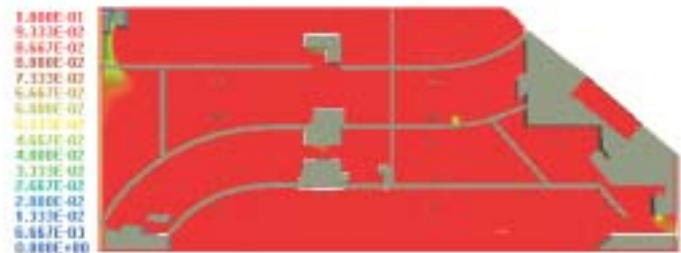
Regular ventilation - In relation to the health of human beings, an excess of exhaust gas concentration has to be avoided. There has to be an adequate air movement to avoid the existence of dead zones as much as possible. The amount of air movement is determined by the calculated velocity.

## Fire alarm

During a fire alarm, the ventilation system has to keep the garage free of smoke in such a way that suppression by the fire brigade is possible. The chosen flow direction for emergency ventilation depends upon the location of the fire.



*Top-view smoke temperature (°C) -car fire and maximum ventilation-*



*Top-view air movement (m/s) -regular ventilation*

## Valuation

The cases are evaluated by means of the calculated smoke temperature, flow direction, the spread of smoke and the air velocity. The result shows the movement of the smoke in the planned direction. Smoke leaves the garage by the entrance. Just a small amount moves in the opposite way. A big part of the garage is without smoke and permits the fire brigade to enter the garage. Also the temperature is within acceptable limits. The second calculation shows the air movement by means of the velocity. Except in one small part of the garage, the air movement is acceptable.

Willem-Jan Franssen  
Adviesbureau Van Hooft  
Email: [WjFranssen@vanhooft.nl](mailto:WjFranssen@vanhooft.nl)

# New Agents

## **CHAM has appointed new agents to supplement its distribution network.**

In the Far East we are now working with UIT Inc. UIT was founded in 1997 as a sales and marketing firm for advanced computer solutions.

Headed by Dr ST Kim, UIT Inc is the largest independent engineering solution provider for the region.

Email: [uitinc@uitsolutions.com](mailto:uitinc@uitsolutions.com)

For the Middle East region, we are pleased to welcome Locke-Carey Fire Consultants (LCFSC) operating out of Dubai. Long-standing users of PHOENICS here in the UK, LCFSC has readily grasped the opportunity to add a PHOENICS distributorship to its portfolio of services throughout the Middle East.

During October a fire-related conference will be held in Sharjah with involvement of the Society of Engineers. It will feature PHOENICS-applications material presented by LCFSC.

Email: [lcpsc@emirates.net.ae](mailto:lcpsc@emirates.net.ae)

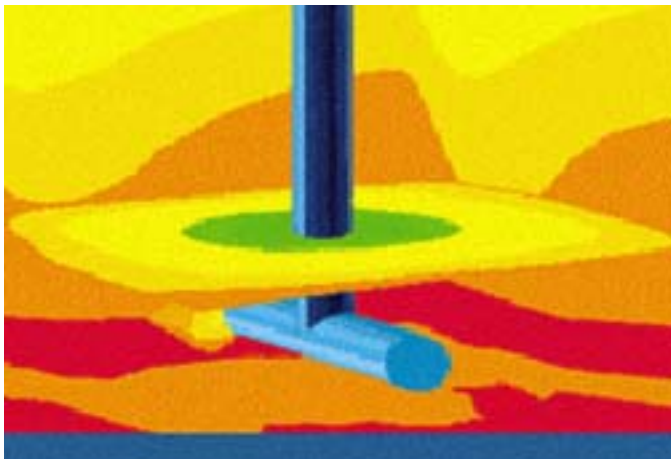
# Agents' News

## **CHEMTECH will be exhibiting at "Rio Oil & Gas" taking place at Riocentro, from October 4 - 7 2004.**

At the event, CHEMTECH will promote the "First CFD CHEMTECH/PHOENICS Challenge" - a pioneering initiative that has been arousing great interest.

Chemical-engineering graduate students from different universities of the State of Rio de Janeiro will use PHOENICS to solve a real industrial problem set by CHEMTECH,

CHEMTECH itself has used PHOENICS for over nine years in its solutions for major oil, chemical, and petrochemical industries.



This is a unique experience for students to access an effective, high-functionality tool and to be able to count on CHEMTECH technical support and training material. Prizes will be awarded for the three winning teams.

CHEMTECH's next training course dates are October 18 to 22. Everyone can participate, whether a university student or a commercial client.

Contact: Rebecca Ratto, Marketing  
CHEMTECH - A Siemens Company  
Email: [rebecca.ratto@chemtech.com.br](mailto:rebecca.ratto@chemtech.com.br)

## **C-DAC (Centre for the Development of Advanced Computing)**

**During May 2004, CHAM agents, C-DAC, recruited Mr L Umashankar to provide sales and technical support services for its Indian customer base.**

From 23-27 August 2004, a 5-day CFDworkshop & training course was held at C-DAC Pune in association with the Indian Institute of Technology, Bombay (IITB).

Over the first 2 days the programme covered fundamental lectures on CFD. This was followed by a demonstration of PHOENICS cases and tutorials and IITZeus (a CFD grid generation package developed by IITB). Multi-block BFC grids were generated using IITZeus for use with the PHOENICS solver.

Email: [cfd@cdacindia.com](mailto:cfd@cdacindia.com)



**CHAM Agent Ingenieurbüro a-CFD invites users and interested persons to a PHOENICS-Day on Numerical Simulations in Buildings and the Environment**

Date: 26/10/2004, Time: 10a.m. to 7p.m.

Location: Essen Technology and Research Centre, Kruppstr. 82-100 (ETEC), 45145 Essen, Germany.

Topics:

- Flow-Simulation in Buildings:
- Flow-Simulation around Buildings
- Wind-Simulation in Environmental Studies
- Integrating geographic information systems (GIS) with CFD
- Overview of radiation models for HVAC and environmental applications

Conference fee: 70 EUR incl. VAT for meal, refreshments and conference proceedings.

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# Your Frequently Asked Questions

**YOUR FAQ's – by Dr Mike Malin, CHAM User Support –**  
 Email: [support@cham.co.uk](mailto:support@cham.co.uk)

**Question:**

*How do I use INFORM to define an inlet boundary layer profile?*

**Answer:**

As an example, consider a logarithmic boundary layer profile (in the z direction) generated by a wind whose velocity vector is aligned with the x-coordinate direction. For the present simulation, the k-e turbulence model is used, the reference wind speed is 1m/s at 10m above the ground surface, and the roughness height of the ground terrain is 0.03m. The task is to use INFORM to define a mass inflow boundary condition that reflects the logarithmic inlet velocity profile.

In the VR Environment, create a USER-DEFINED object to cover the y-z inlet plane, and then provide a PATCH for this object named, say INLET1, with geometry type WEST. Next, insert the following INFORM commands into Group 13 of the Q1 file by means of the INFORM Editor:

```
*****
Echo InForm settings for Group
13inform13beginREAL(WREF,REFH,POWER,RHIN,WTAU,
ROUGHH,AKAP,ZRFDRH)WREF=1.0;ROUGHH=0.03;AKAP
```

```
=0.41;REFH=10.0ZRFDRH=REFH/ROUGHHTAU=WREF/L
OG(ZRFDRH)RHIN=1.189CHAR(FORM1,FORM2,FORM3)FO
RM1=WTAU/AKAPFORM2=WTAU^2/0.3FORM3=WTAU^3/
AKAP(SOURCE OF P1 AT INLET1 IS
RHIN*(FORM1*LOGE(ZG/:ROUGHH:)) WITH
IM$AT<100)(SOURCE OF U1 AT INLET1 IS
RHIN*(FORM1*LOGE(ZG/:ROUGHH:))^2 WITH
$IMAT<100)(SOURCE OF KE AT INLET1 IS
RHIN*(FORM1*LOGE(ZG/:ROUGHH:))*FORM2:$WITH
IMAT<100) (SOURCE OF EP AT INLET1 IS
RHIN*(FORM1*LOGE(ZG/:ROUGHH:))*FORM3:$ZG
WITH IMAT<100)inform13end
*****
```

In the foregoing, the expression  $:FORM1*LOGE(ZG/:ROUGHH:)$  is simply the local inlet velocity, UIN, given by:  
 $UIN=(WTAU*LOGE(ZG/:ROUGHH:))/AKAP$  where WTAU is the friction velocity, AKAP is von Karman's constant, ROUGHH is the roughness height, and ZG is the vertical distance from the surface. It therefore follows that the source per unit west area is:  $RHIN*UIN$  for P1,  $RHIN*UIN*UIN$  for U1,  $RHIN*UIN*KIN$  for KE, and  $RHIN*UIN*EPIN$  for EP, where  $KIN=(WTAU^2)/0.3$  and  $EPIN=(WTAU^3)/(AKAP*ZG)$ . These inlet values for the turbulent kinetic energy and its rate of dissipation are consistent with the assumption of a constant shearing stress.

## PHOENICS - Student Edition

**The early DOS-only release of PHOENICS-1.5, known as Shareware, has been withdrawn permanently. However, the current release is both supplied and supported at universities and other academic institutions at highly preferential rates.**

NOW, a special Student Edition of PHOENICS has been specifically created for individual PhD Students to use for the duration of their PhD studies.

Attractively priced at £500 (750 euros, \$900)‡, a small fraction of the commercial equivalent, the PHOENICS - STUDENT EDITION package offers students unrivalled performance in a PC environment.

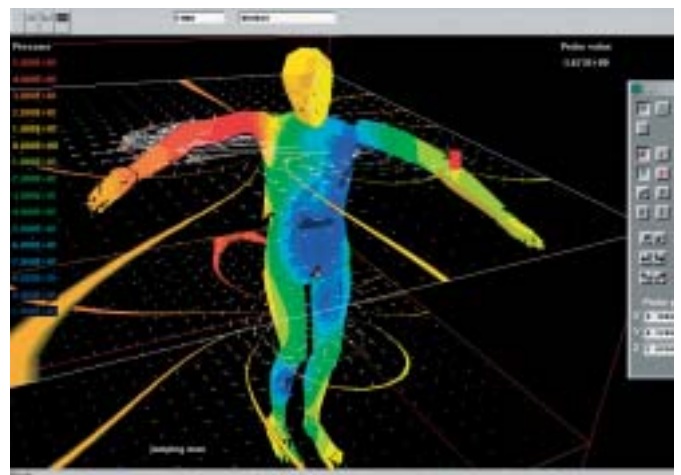
Comprehensive technical support is not included within this price, though from 1 September 2004, advice and assistance will be forthcoming through CFD-Online

<http://www.cfd-online.com/Forum/phoenics.cgi>

PhD students can further benefit by getting the results of their endeavours published in the PHOENICS Journal.

For more information contact [sales@cham.co.uk](mailto:sales@cham.co.uk).

‡ excludes taxes and FORTRAN compiler



*Example of solution of velocity vectors around a "moving" mannequin*

