Kontinuitetsligningen:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

Navier-Stokes ligning for x-aksen:

$$\rho_0\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial x} + w\frac{\partial u}{\partial z}\right) = -\frac{\partial p}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right)$$

Navier-Stokes ligning for y-aksen:

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}\right) = -\rho_0 \cdot g\beta\left(T - T_0\right) - \frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}\right)$$

Navier-Stokes ligning for z-aksen:

$$\rho_0\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right) = -\frac{\partial p}{\partial z} + \mu\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right)$$

Energiligningen:

$$\rho_0 c_p\left(\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} + w\frac{\partial T}{\partial z}\right) = \lambda\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2}\right)$$

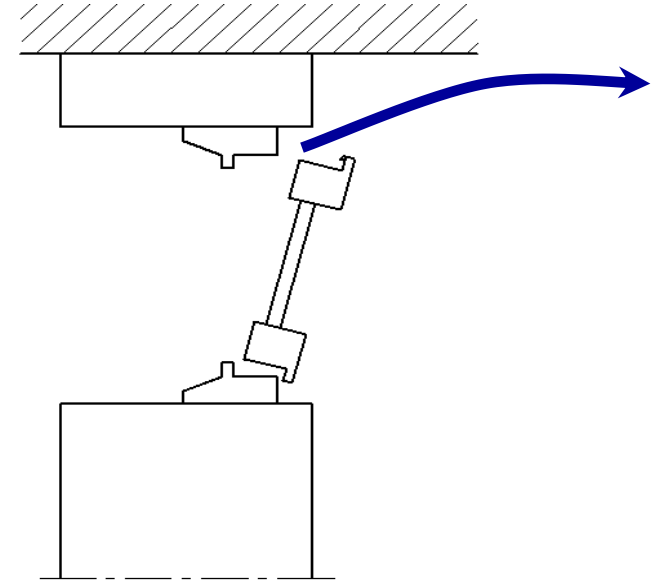
Building Simulations - CFD Examples

Kjeld Svidt

Aalborg University

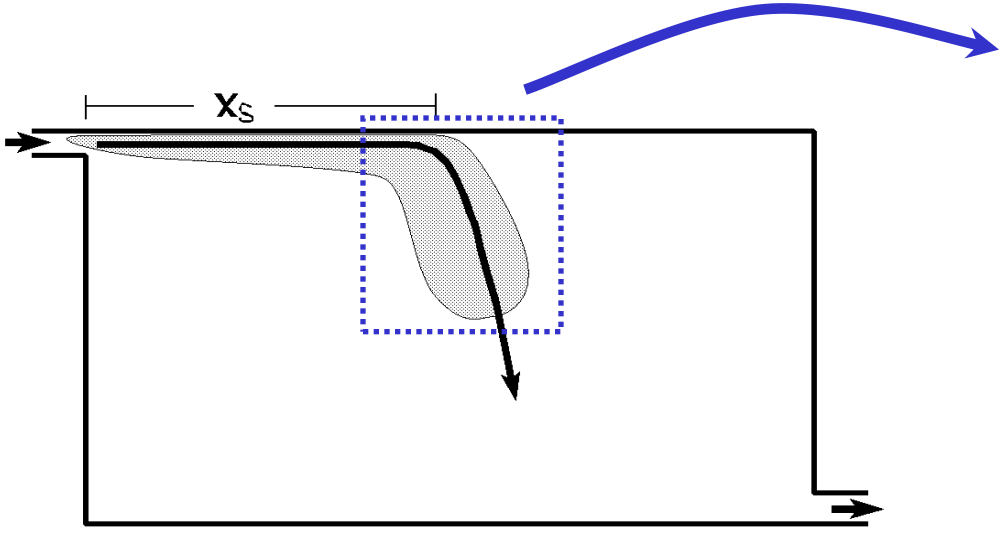
Focus on attached ceiling jet

- Jet velocity characteristics described by velocity decay constant and virtual origin of jet (isothermal flow only)
- Penetration depth of cold jet attached to the ceiling
  - 10, 15 and 30 mm slot opening
  - ΔT approximately 10 and 20 °C
  - many pressure differences



Non-isothermal measurements

Penetration depth:
55 experiments with different opening size, pressure difference and temperature difference



Non-isothermal measurements

Penetration depth:
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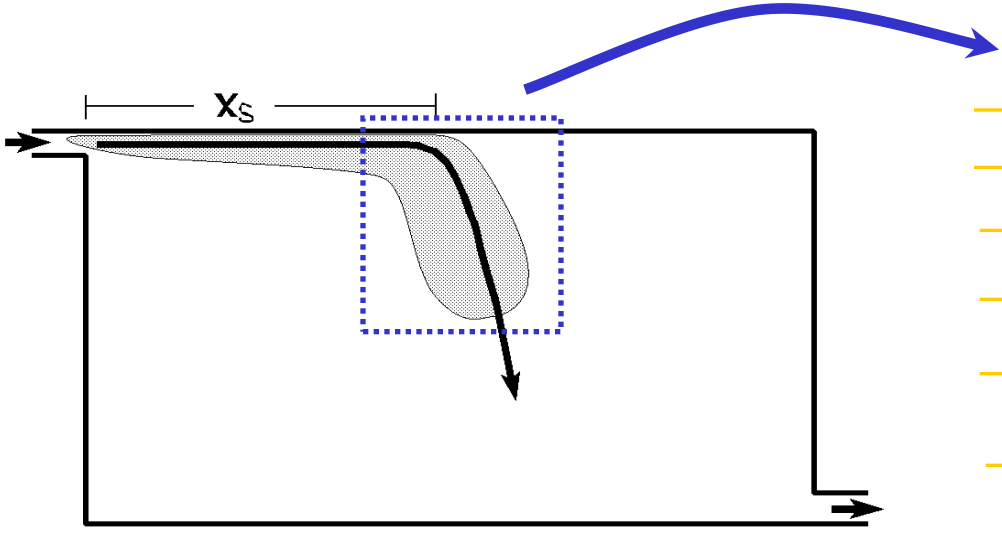
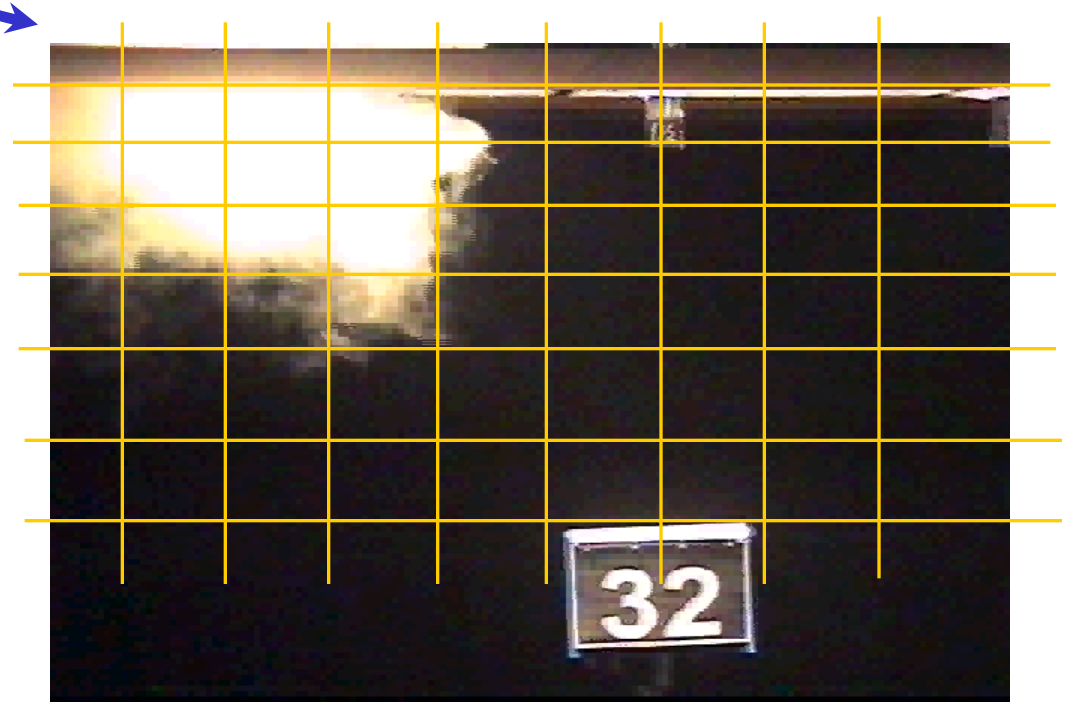
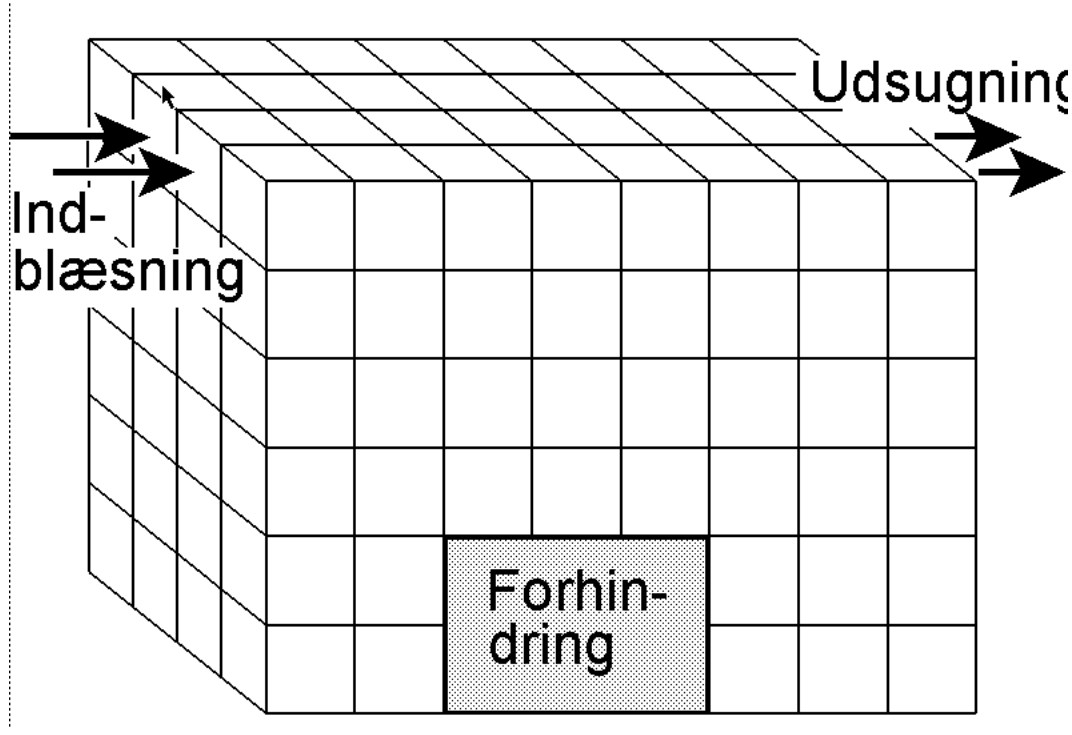
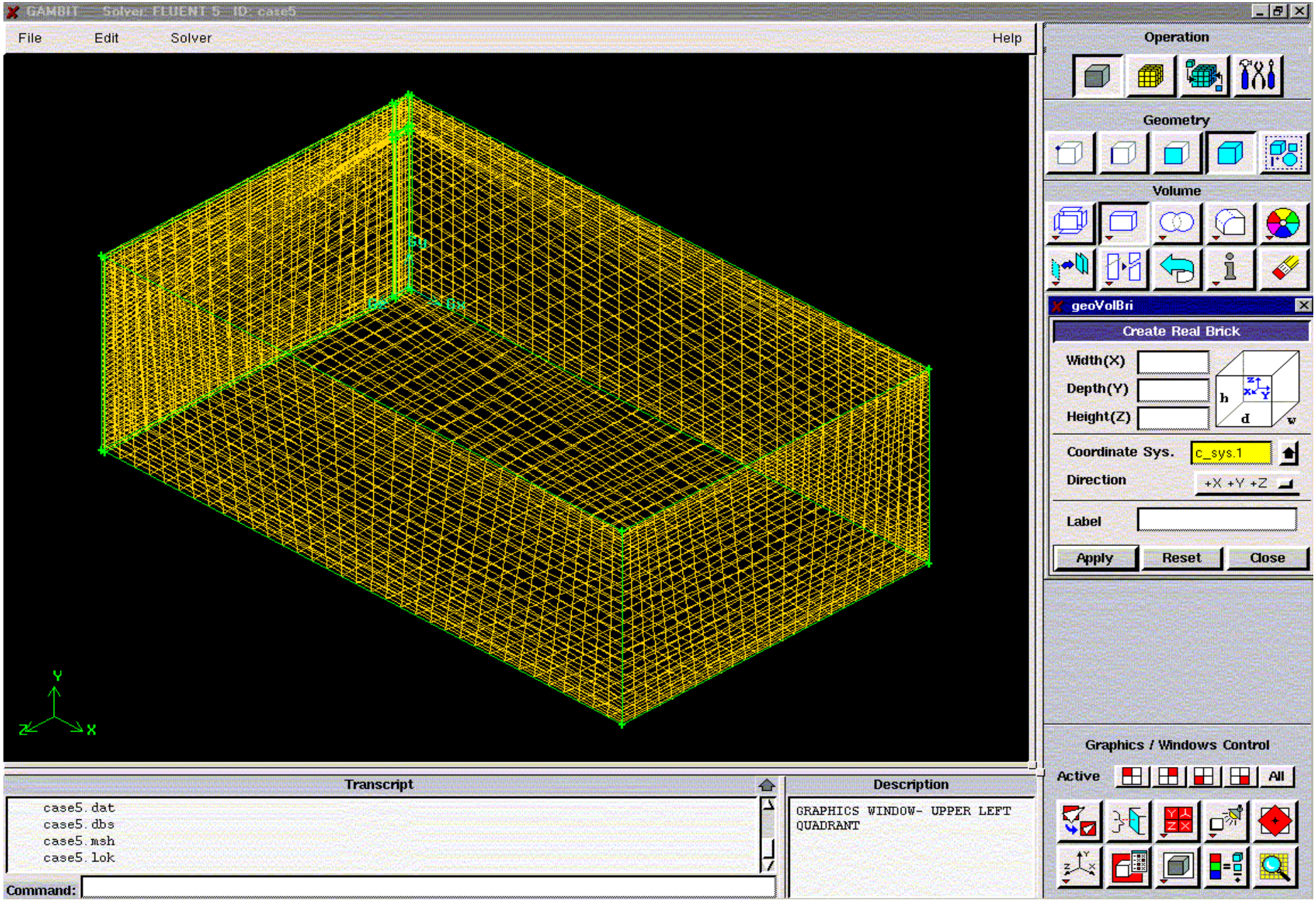
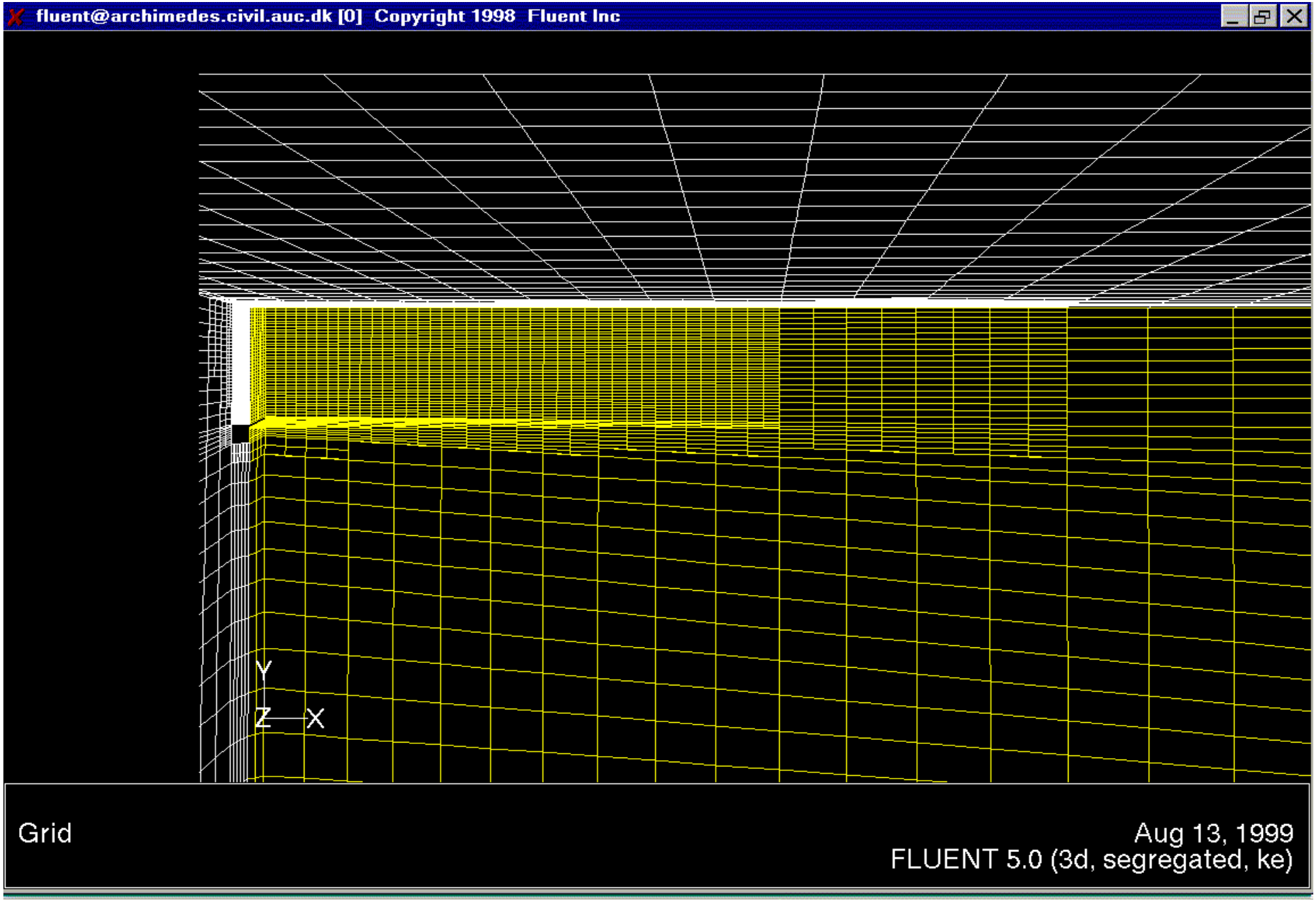


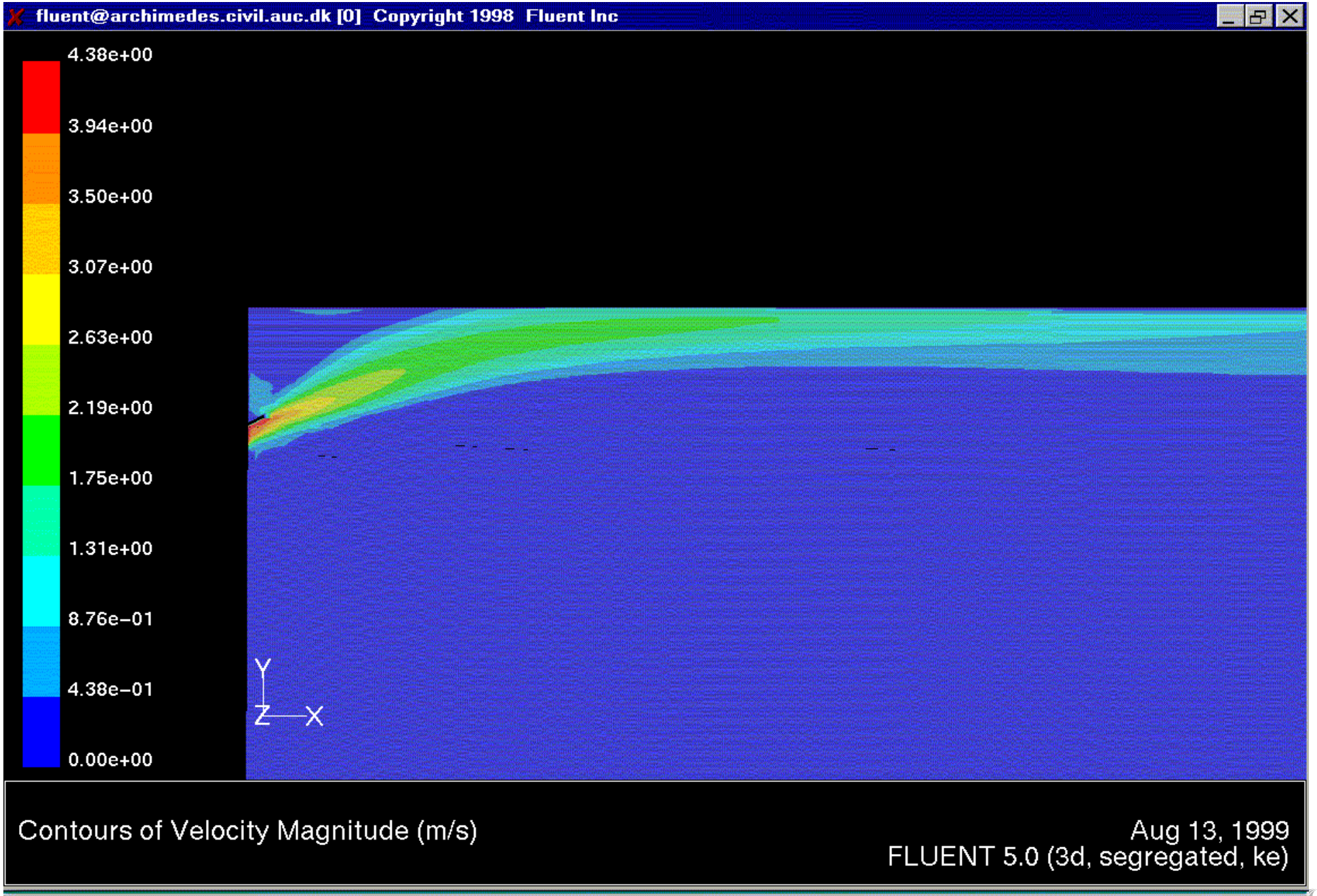


Computerberegning af luftbevægelser




GAMBIT Solver: FLUENT 5 ID: case5
File
Edit
Solver
Help
Operation
Geometry
Volume
geoVolBri
Create Real Brick
Width(X)
Depth(Y)
Height(Z)
h
d
w
Coordinate Sys.
c_sys.1
Direction
+X +Y +Z
Label
Apply
Reset
Close
Graphics / Windows Control
Active
All
Transcript
case5.dat
case5.dbs
case5.msh
case5.lok
Command:
Description
GRAPHICS WINDOW- UPPER LEFT QUADRANT


fluent@archimedes.civil.auc.dk [0] Copyright 1998 Fluent Inc
Y
Z
X
Grid
Aug 13, 1999
FLUENT 5.0 (3d, segregated, ke)


fluent@archimedes.civil.auc.dk [0] Copyright 1998 Fluent Inc
4.38e+00
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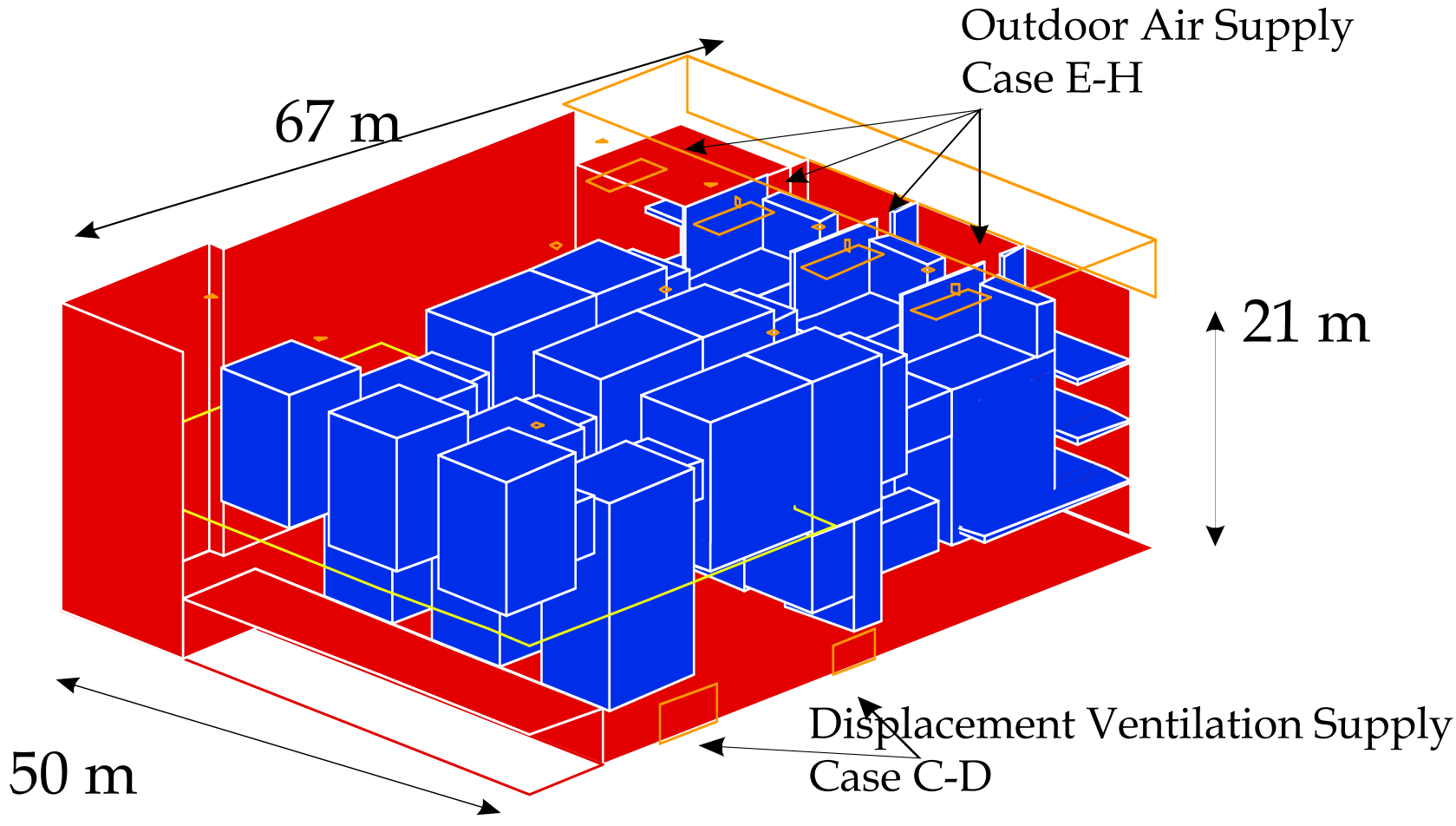
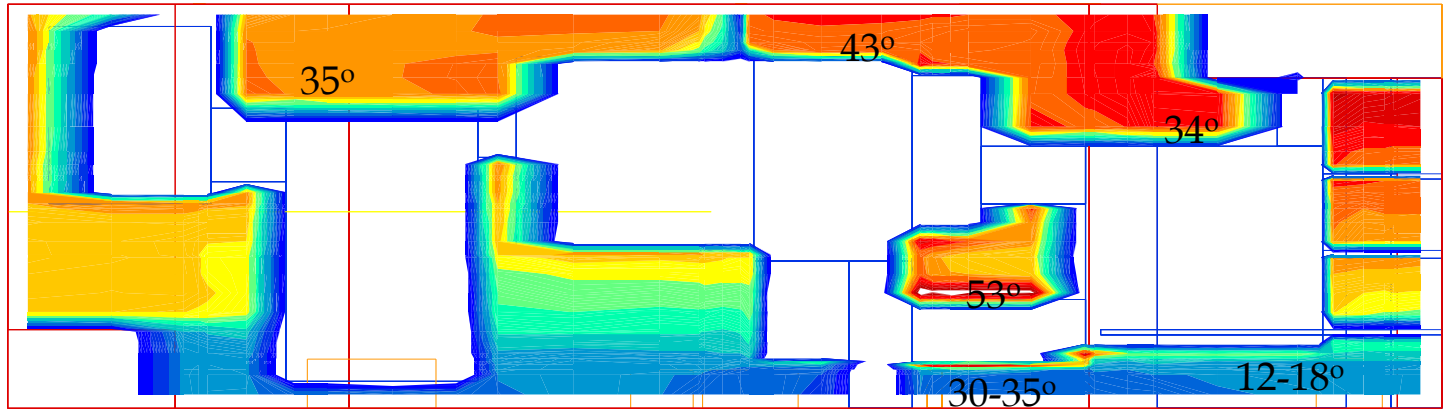
1.31e+00
8.76e-01
4.38e-01
0.00e+00
Y
Z
X
Contours of Velocity Magnitude (m/s)
Aug 13, 1999
FLUENT 5.0 (3d, segregated, ke)

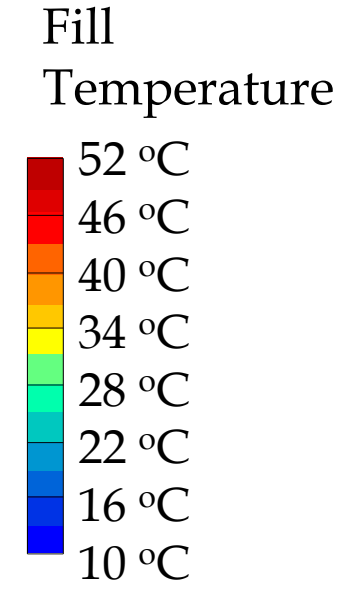
CFD Model of Incineration Hall, Amagerforbrænding



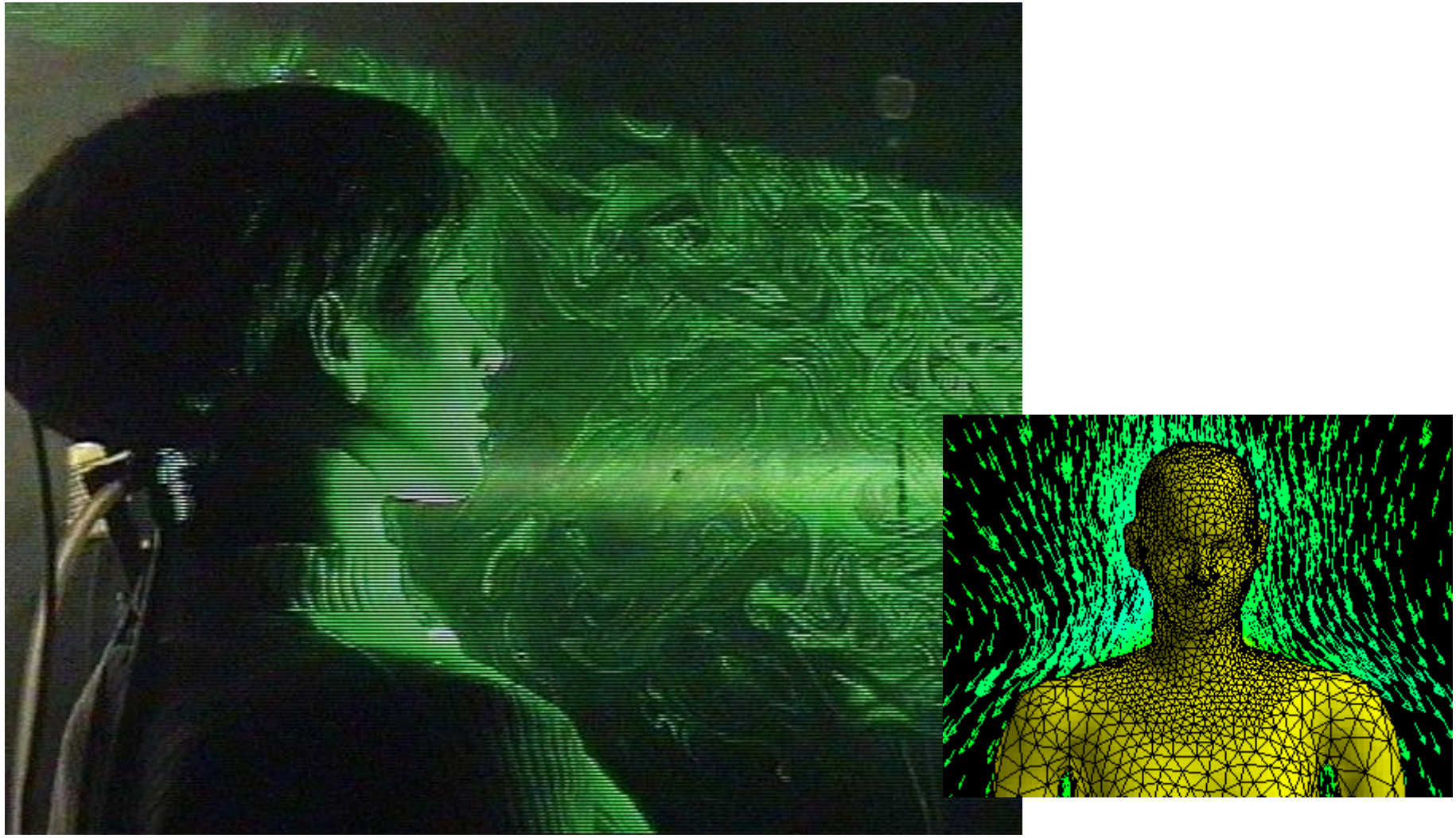
Comparison between Calculated and Measured Results - Amagerforbrænding

Vertical Plane at Incineration Line

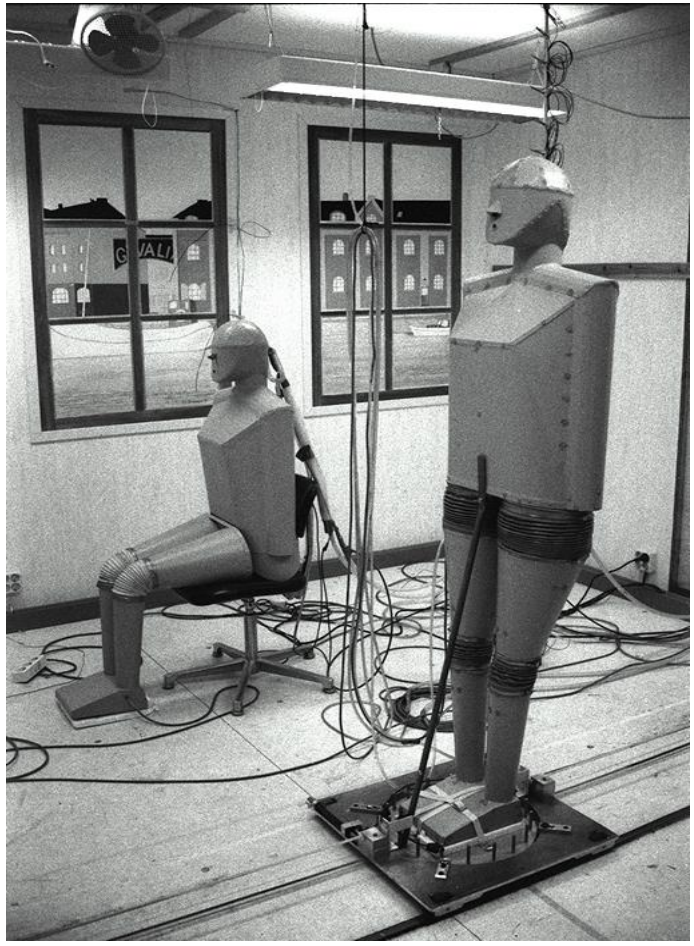


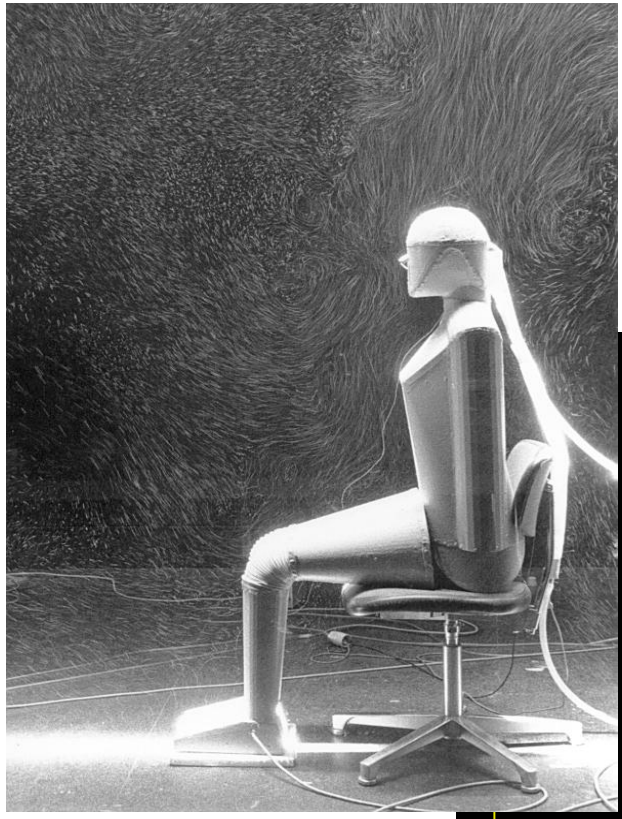


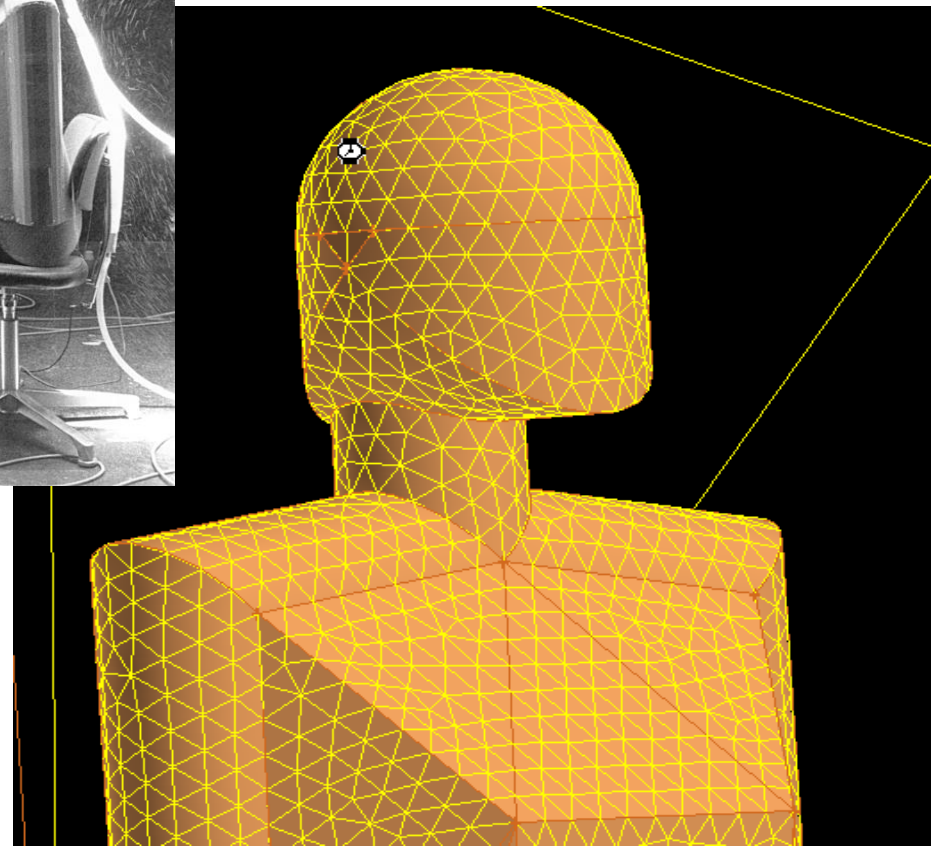
Strømningsforhold
- lokale strømninger omkring personer



Simulering af termiske mannequinner (1)

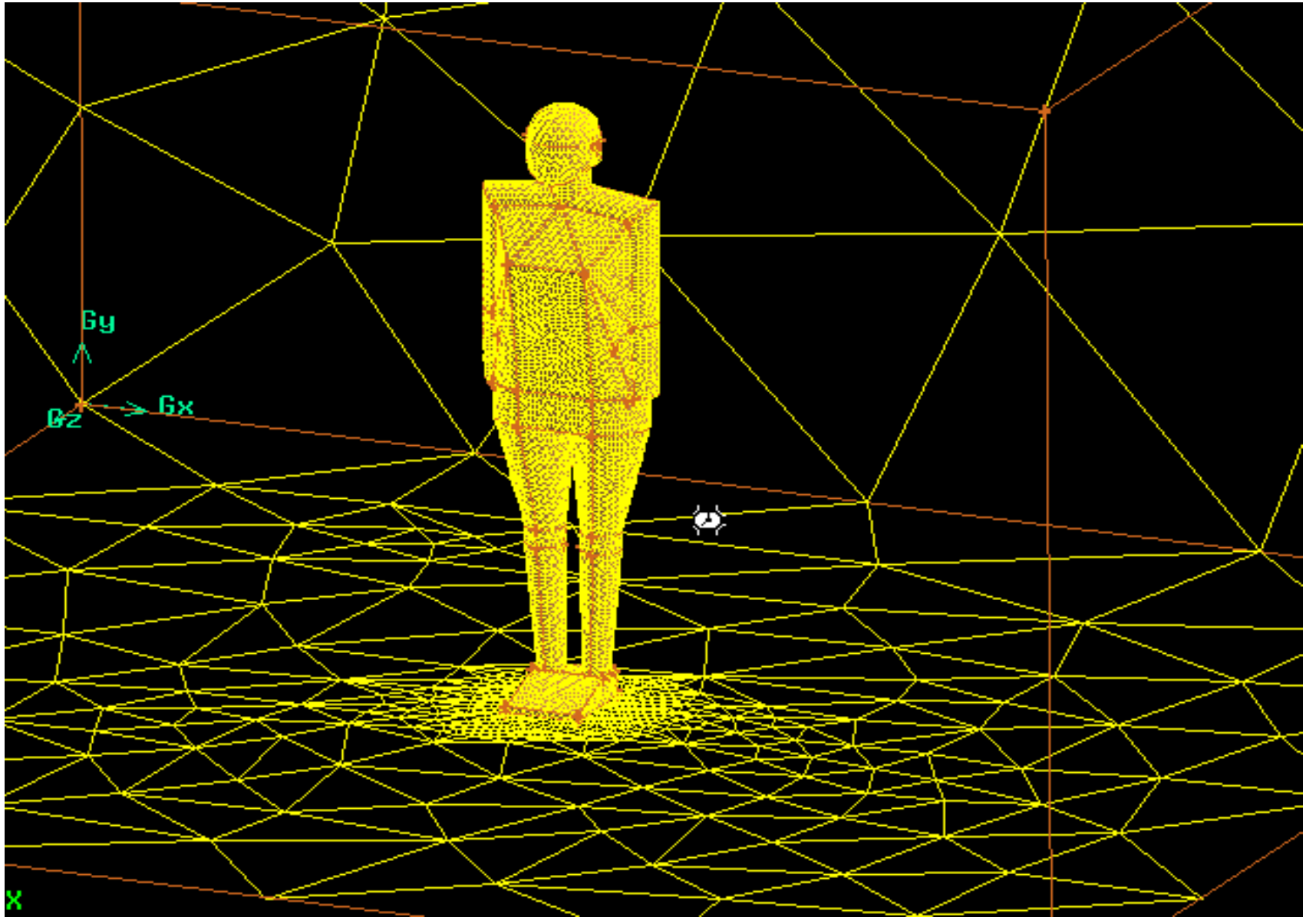






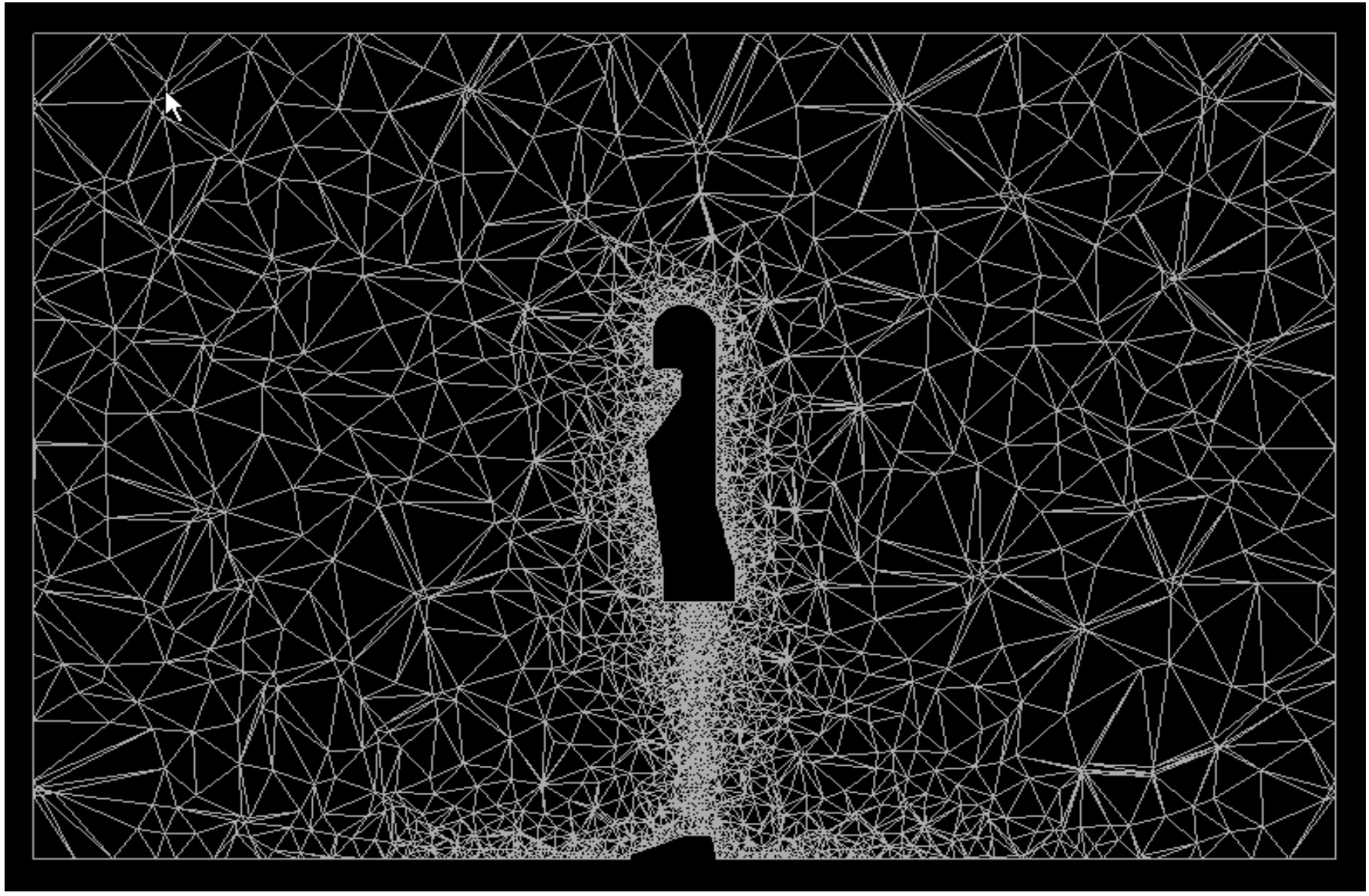
Kilde: Erik Bjørn

Simulering af termiske mannequinner (2)



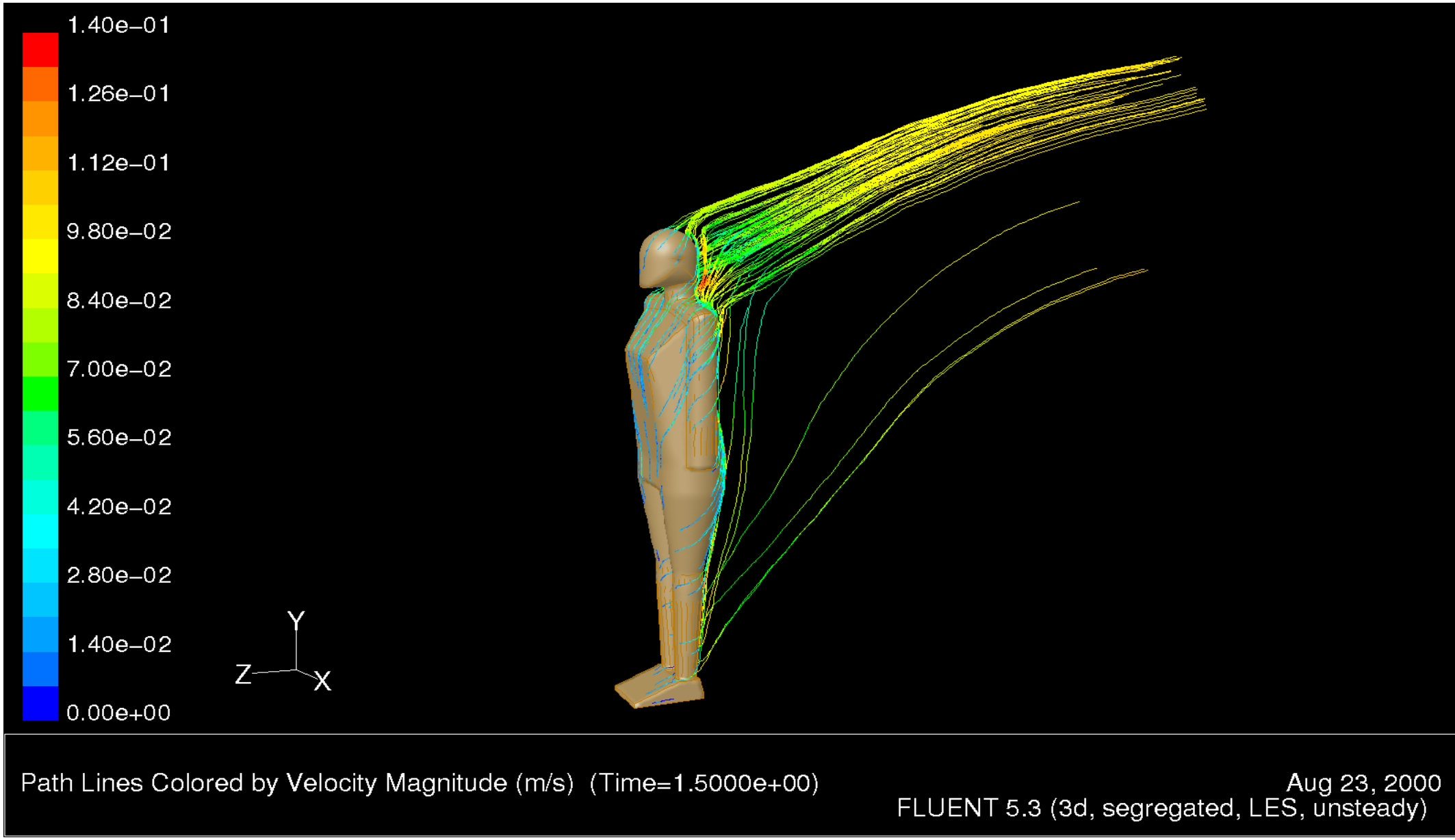
Kilde: Erik Bjørn

Simulering af termiske mannequinner (3)



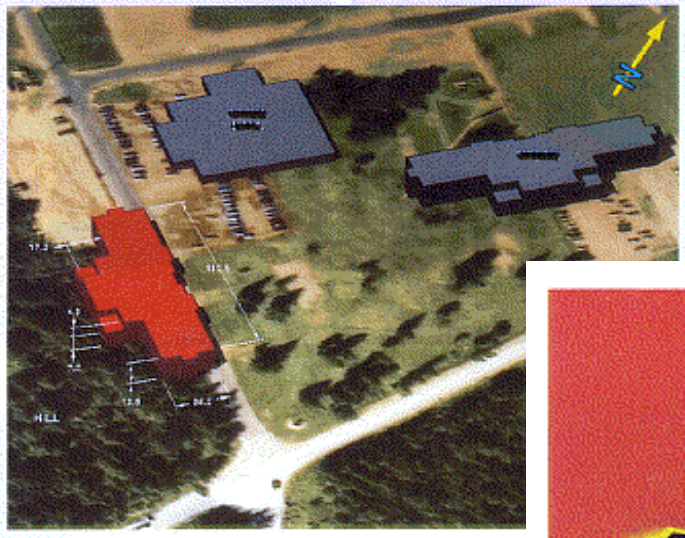
Kilde: Erik Bjørn

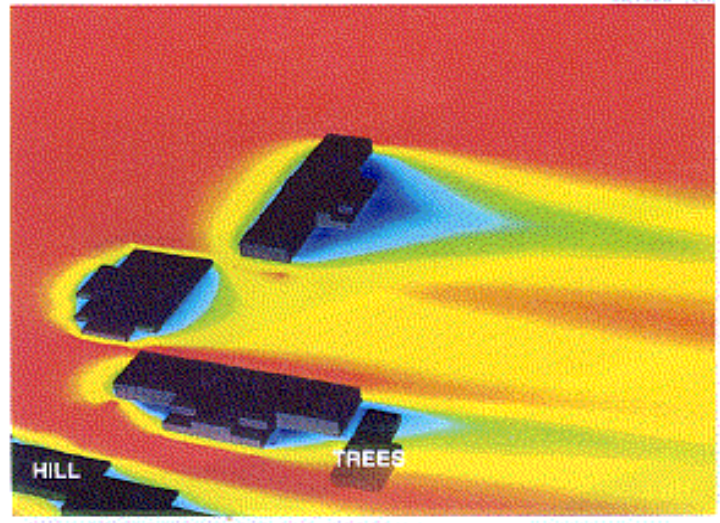
Simulering af termiske mannequinner (4)



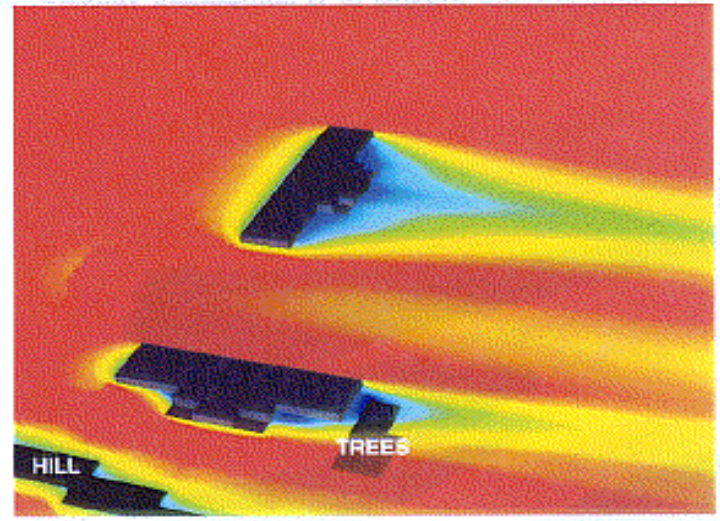
Kilde: Erik Bjørn

Strømning omkring bygninger



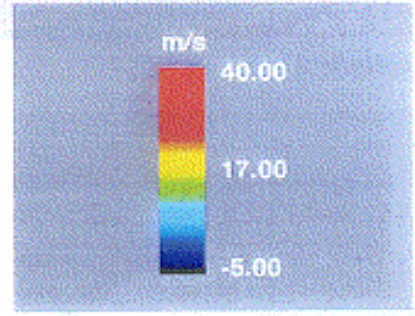


Altitude 2.0 m



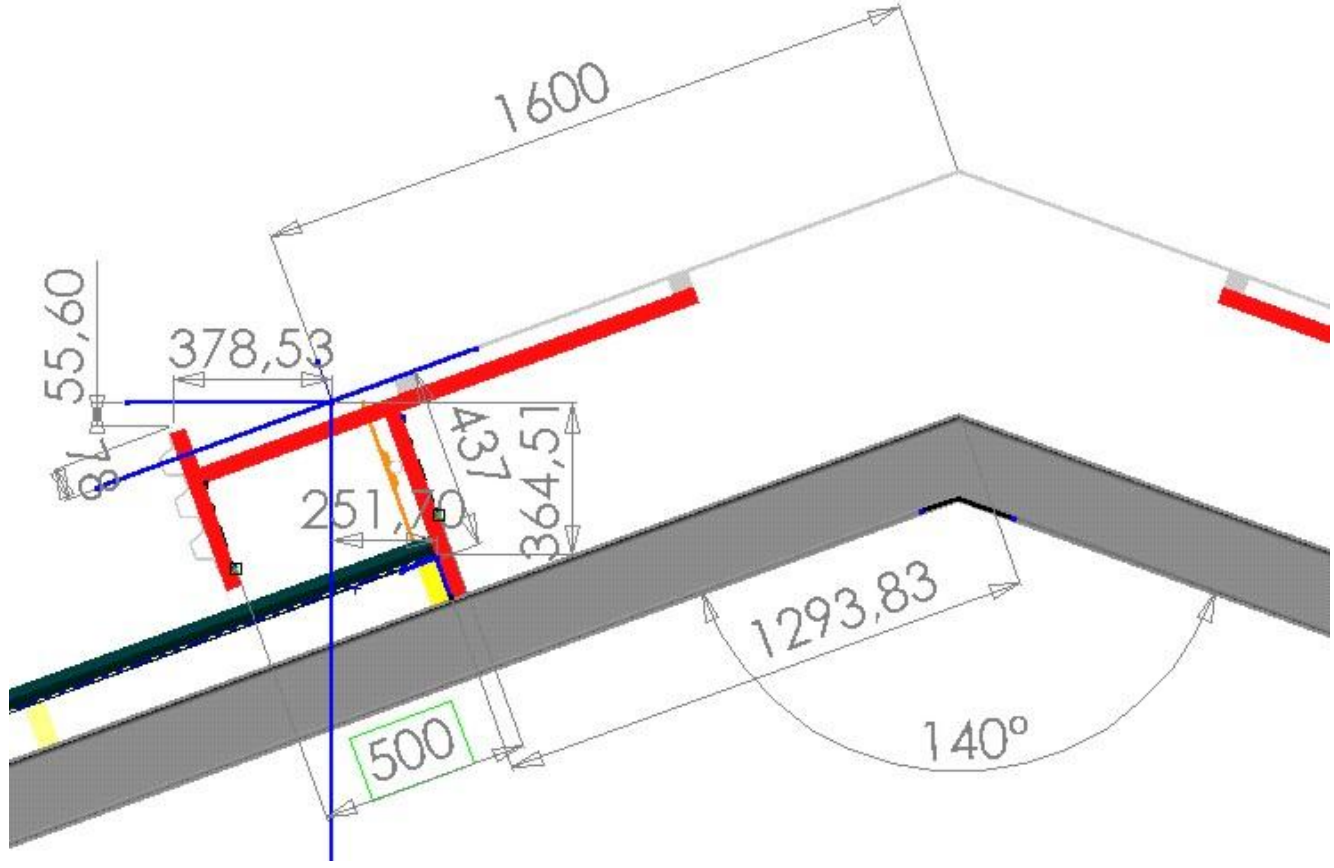
Altitude 7.7 m

SOUTH WEST wind speed 23 m/s



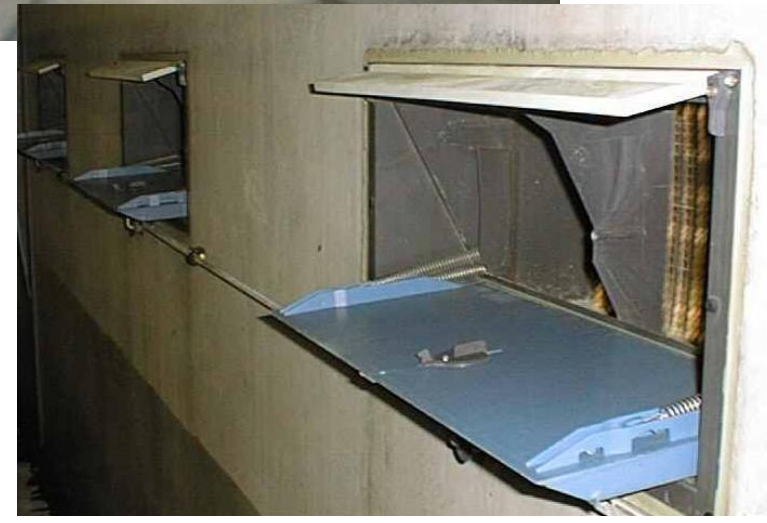
Legend

Strømning omkring bygninger
- åbning i kip, staldbygning

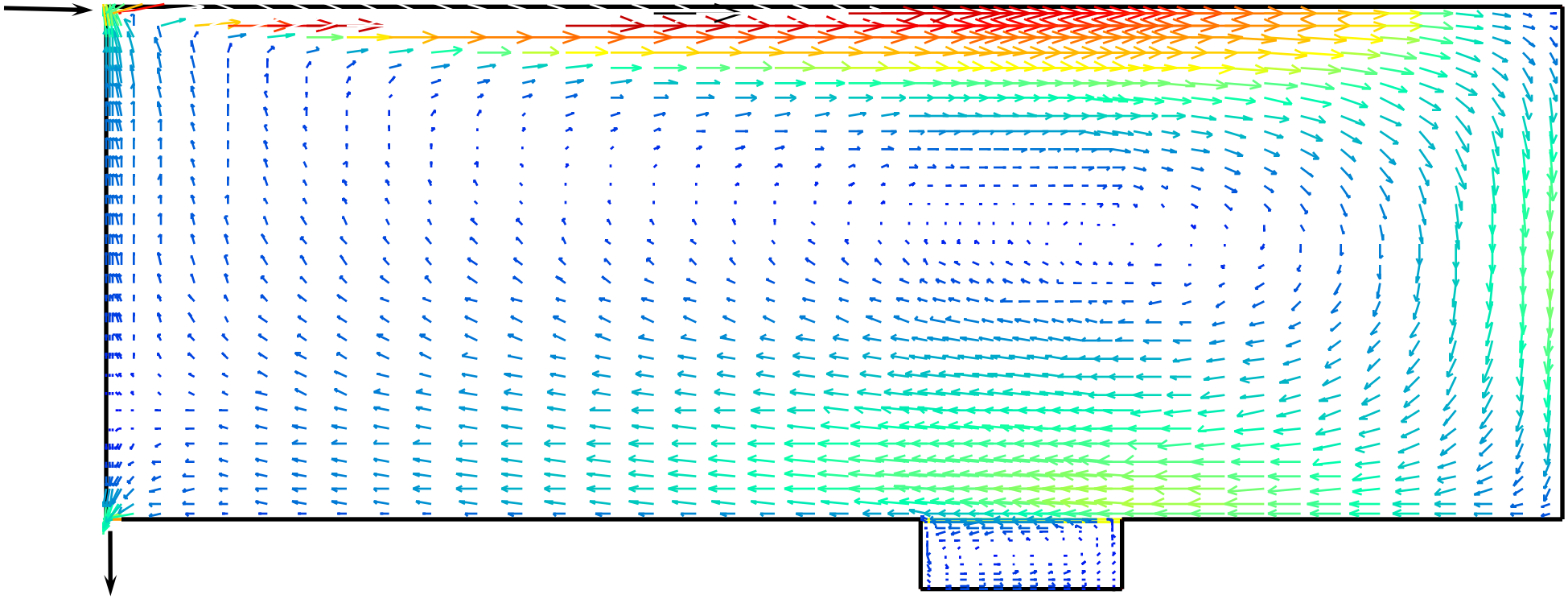


Kyllingestald opført 1997

- **gulvareal ca. 2000 m^2**
- **13 udsugningsventilatorer i taget**
- **samlet luftydelse 180.000 m^3/h**

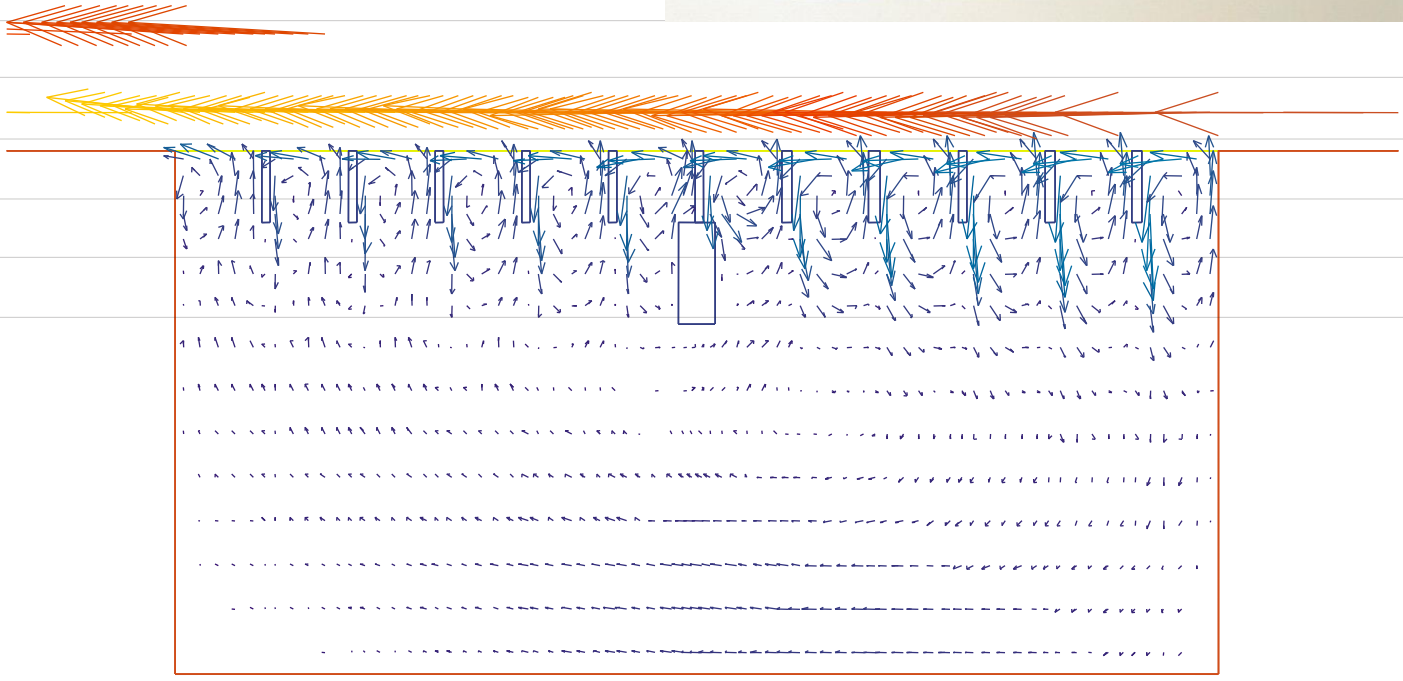


Luftindtag i ydervæg



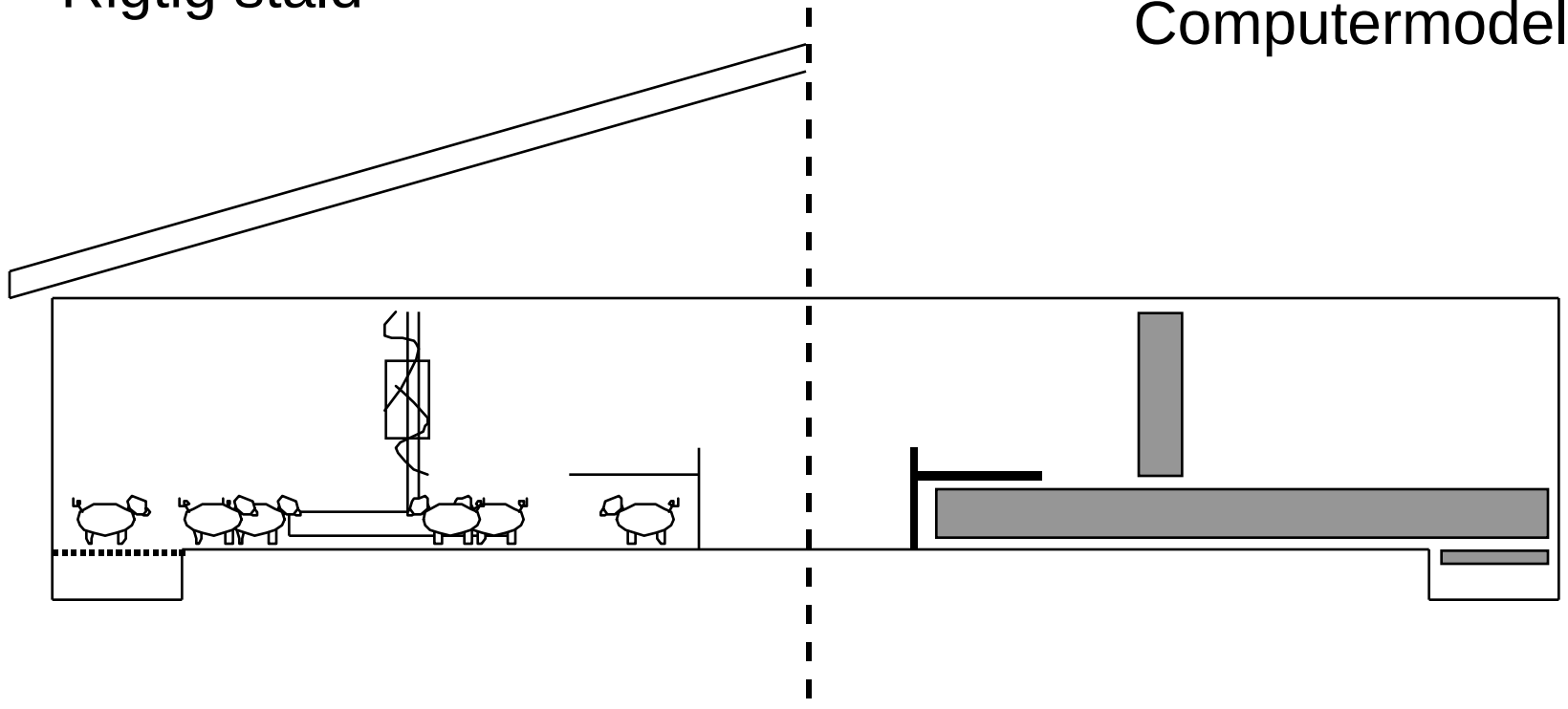
Computersimulering af strømningsforhold.
Laboratorieopstilling med spaltegulv over gyllekanal.

Detaljer af spaltegulv
og beregnede strømningsforhold



Rigtig stald

Computermodel



Elementer med en kompliceret geometri ønskes
beskrevet som mere enkle elementer af hensyn til computerkraften