NEUSCHNEE
EXCELLENT SNOW. MADE IN AUSTRIA.

Outcomes
Knowledge Transfer Collaboration 2015/16

Christian Mahr

We make snow!

We have developed a method to produce high quality snow. Compared to existing systems for snowmaking at ski resorts we save at least 60% water and 50% energy.

This special method is based on the model of nature - snow production in a cloud. In our cloud chamber we enable the growth of individual ice crystals to obtain snow with the same properties as natural snow.

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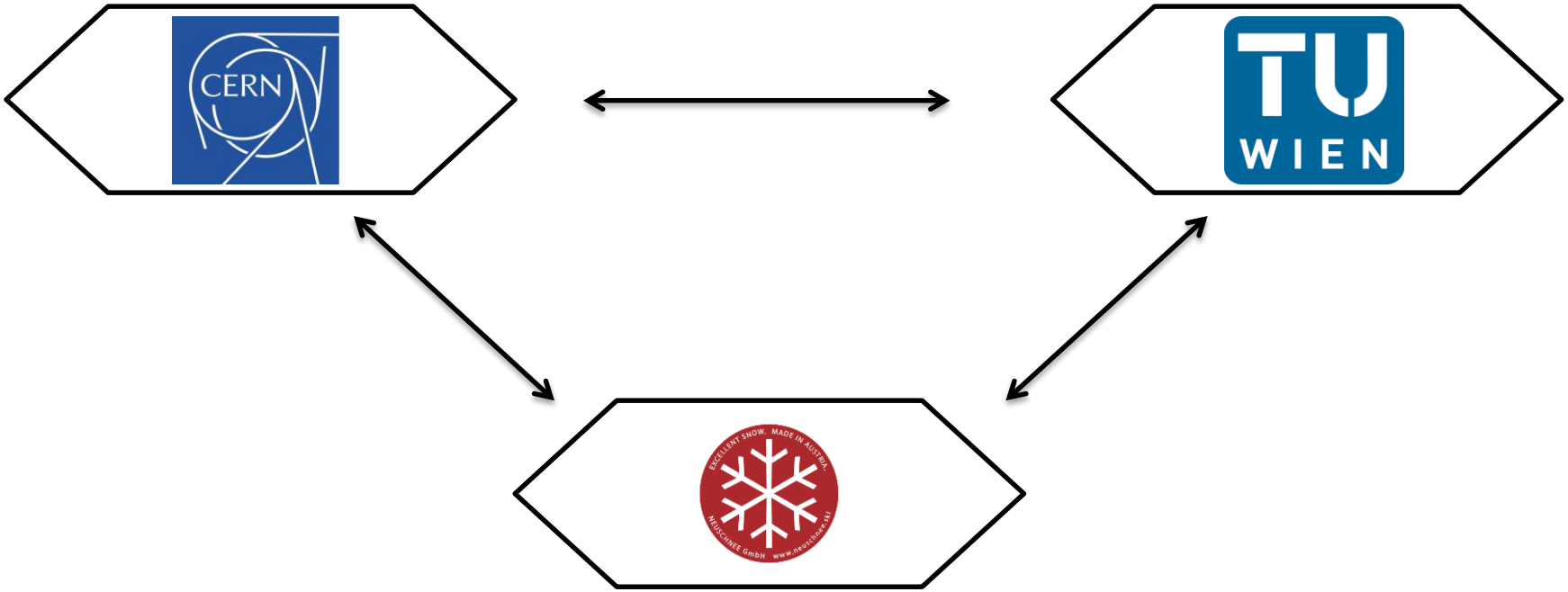

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CERN-KT

1st stay @ CERN

Remote use CERN Facilities

2nd stay @ CERN

Neuschnee activities

Planning Phase Prototype 2

Construction Steel + Membrane

Construction Hydraulic+Pneumatic+Electronics

Test Period

Data evaluation

Planning Prototype 3

July Aug Sept Oct Nov Dec Jan Feb March April May June

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Knowledge & cooperative services

- Visit of CERN's "Cloud Project"
- Meeting with Mr. Moccia – expertise in cooling tower operations
- Ongoing support by Aniko Rakai and Martin Doubek

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CERN infrastructure

- Use of licenses for ANSYS FLUENT, ANSYS Workbench, SolidWorks
- Access to CERN cluster
- Usage of 64 cores for processing simulations
- Access to CERN infrastructure from outside

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Problem formulation

- Existing process of snow-making, developed by Michael Bacher
- Implementation into a bigger “cloud chamber”
- Computational Fluid Dynamics (CFD) simulation of flow inside the chamber
- Optimization of Heat Transfer

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First steps – nozzle implementation

- Definition of physical properties
- Defining a way of implementation in the CFD model

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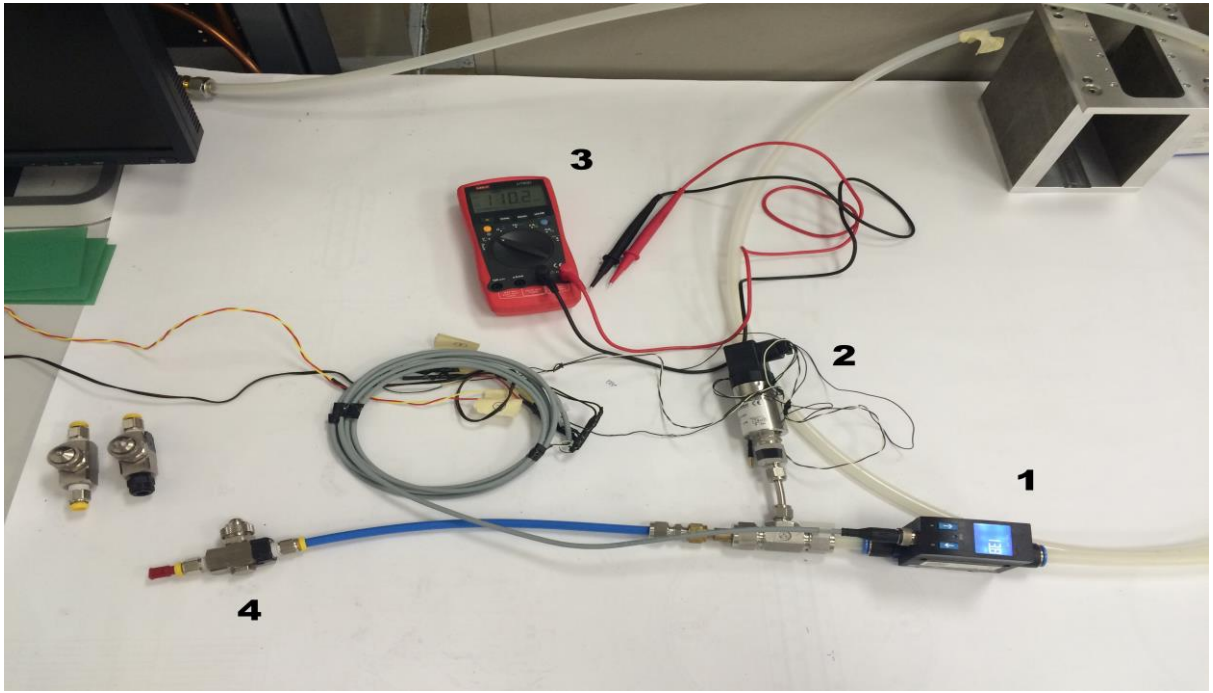
Measurements



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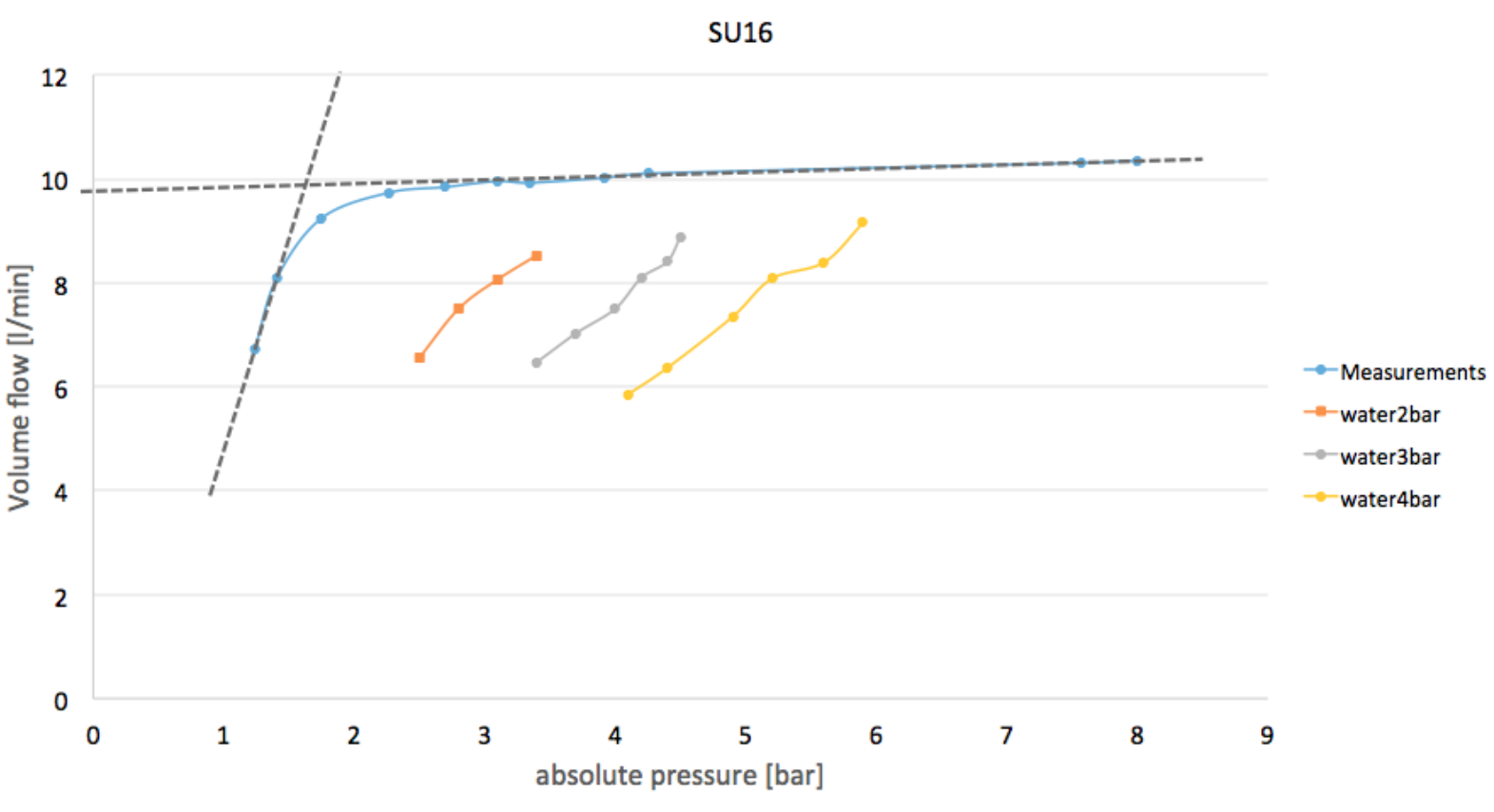

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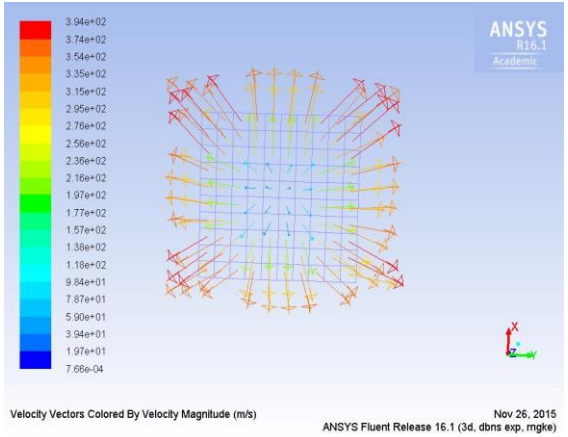

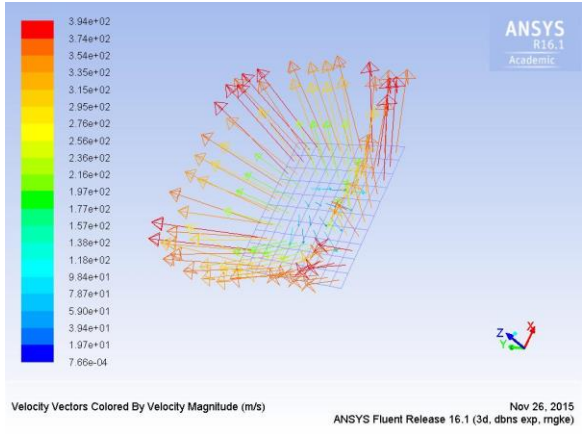

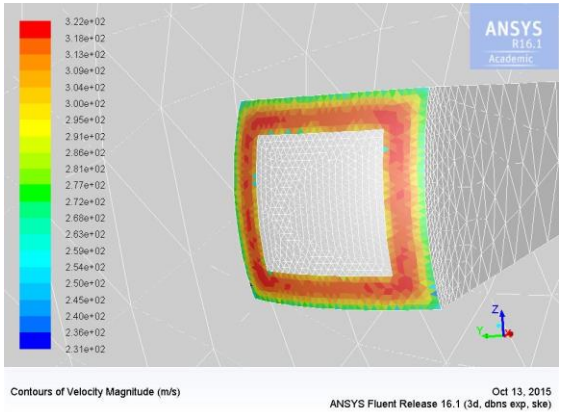

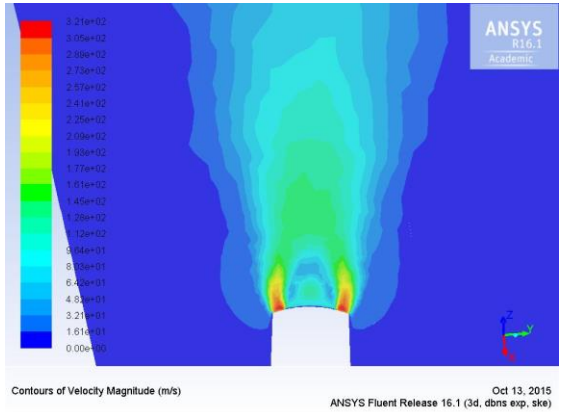

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CFD – 4 Steps

- Geometry (CAD Model)
- Discretization of the fluid domain
- Definition of boundary conditions and material properties
- Numerical solution of the Navier-Stokes-Equations

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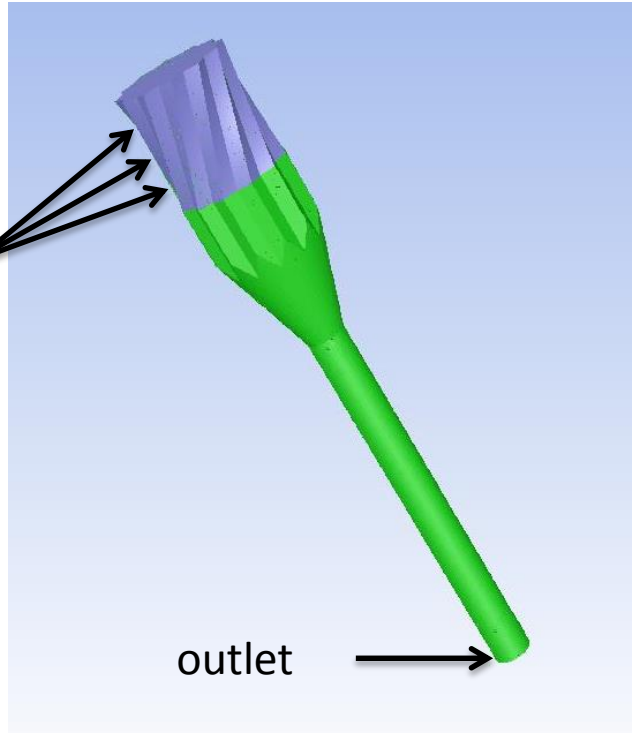
12 x 3 inlets



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Simplifications of the CFD model

- Air flow model
- Sonic shocks at nozzle outlets neglected
- Water atomization process not included
- Heat transfer not included

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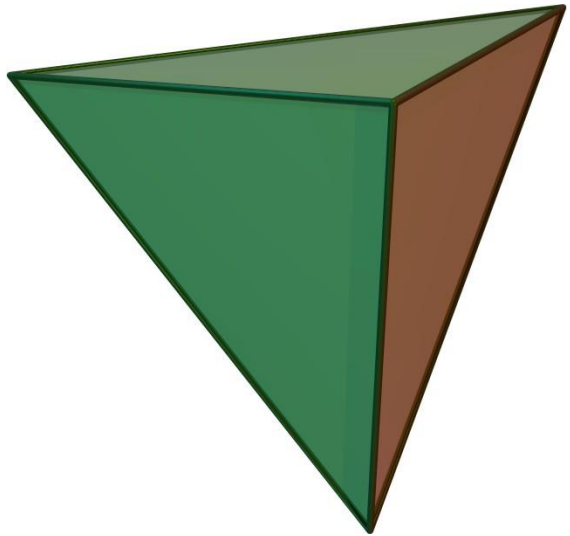
Meshing

- Computing volume: 27.46 m3
- Cells: 472150
- Faces:1017036
- Biggest cell volume: 9.41e-3 m3
- Smallest cell volume:4.95e-14 m3
- Unstructured Tetrahedral Mesh



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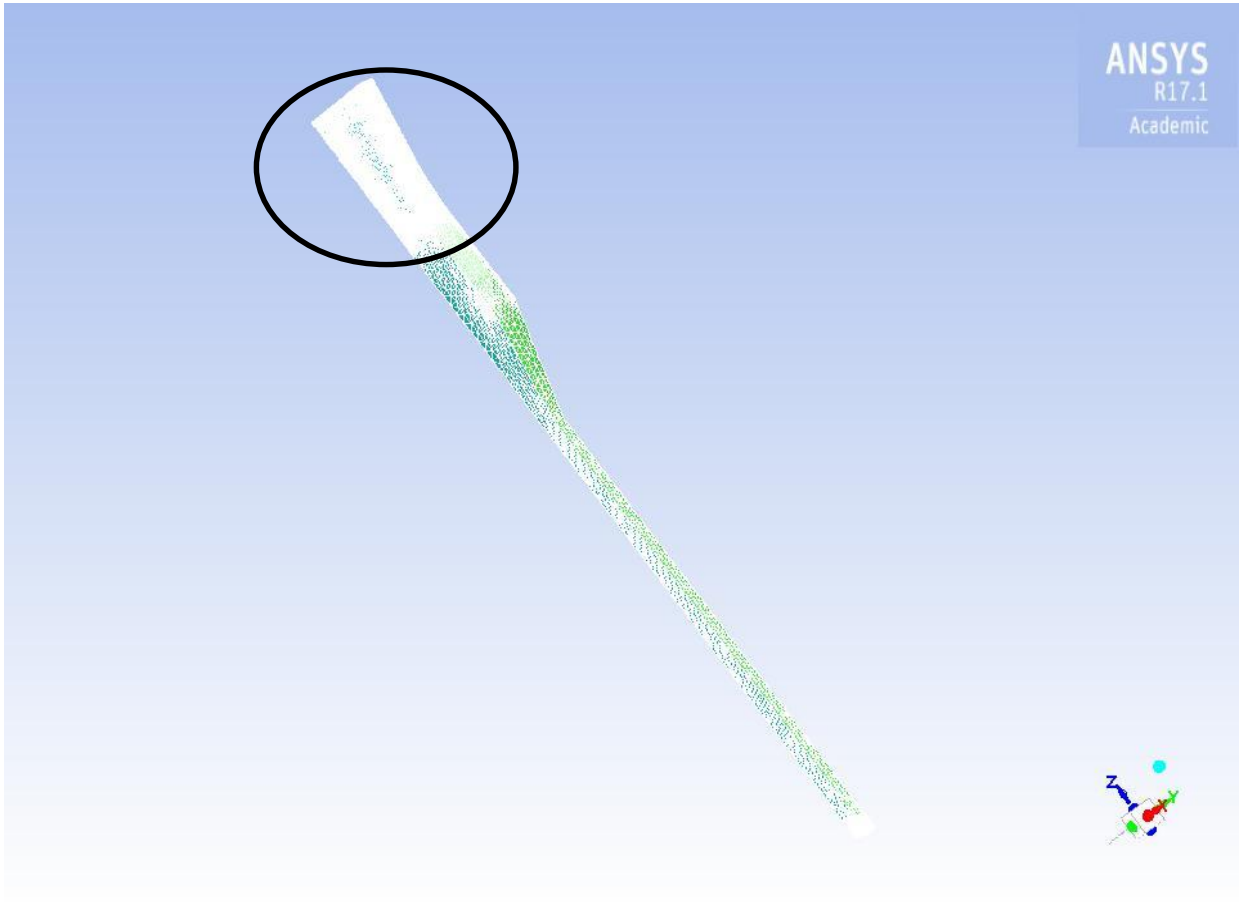

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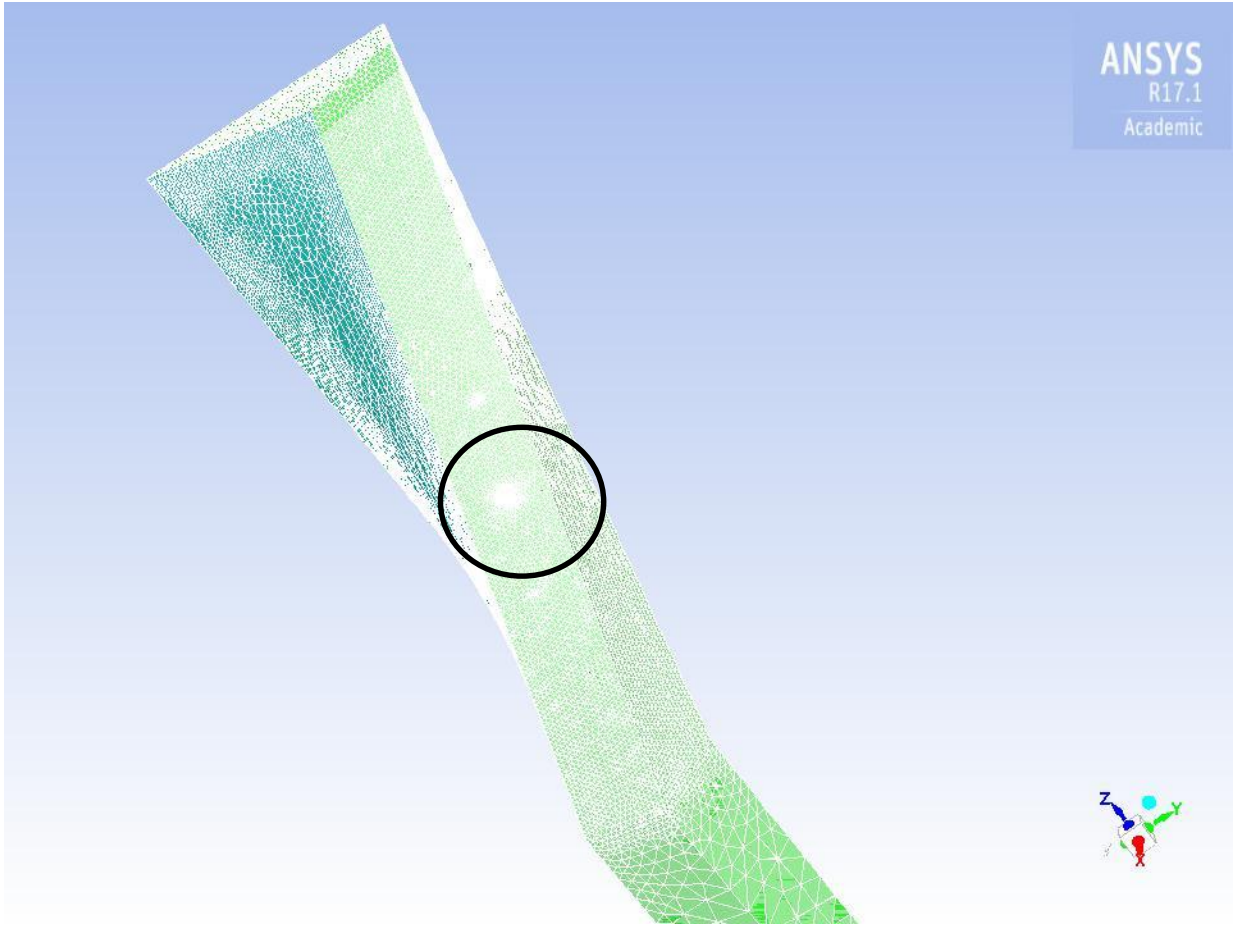

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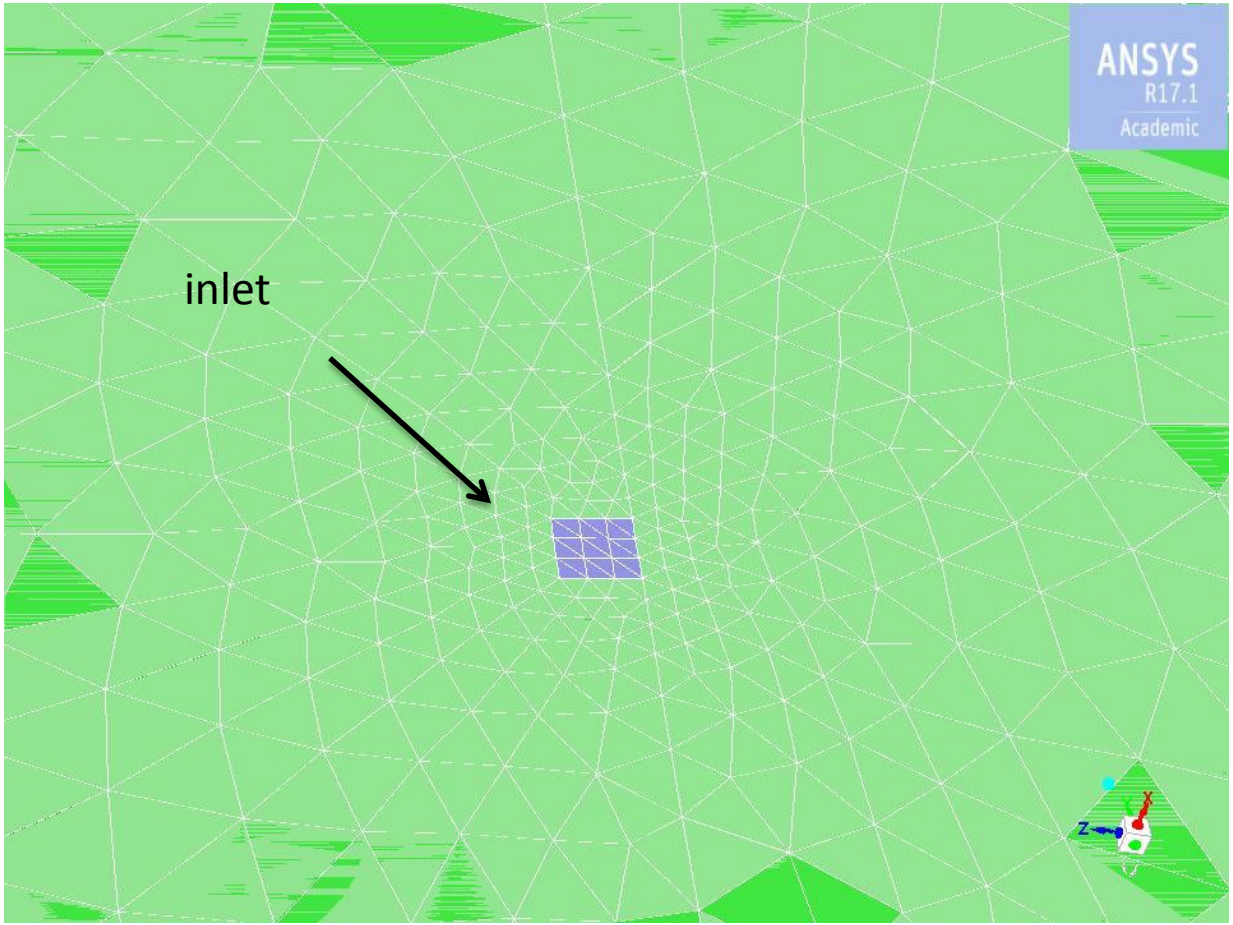
ANSYS
R17.1
Academic
Z
Y
X


ANSYS
R17.1
Academic
inlet
Z

Mesh refinement study I

- Meshing program not capable of structured mesh on skew geometry
- Improvement of outcomes via cell increase
- Further aim – mesh-independent solution

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Mesh refinement study II

Mesh	# of Cells
Wall refinement 1	400 000
Wall refinement 1 + Sphere	650 000
Wall refinement 2	950 000
Wall refinement 2 + Sphere	1,25 Mio
Wall refinement 3	4 Mio
Wall refinement 3 + Sphere	4,2 Mio

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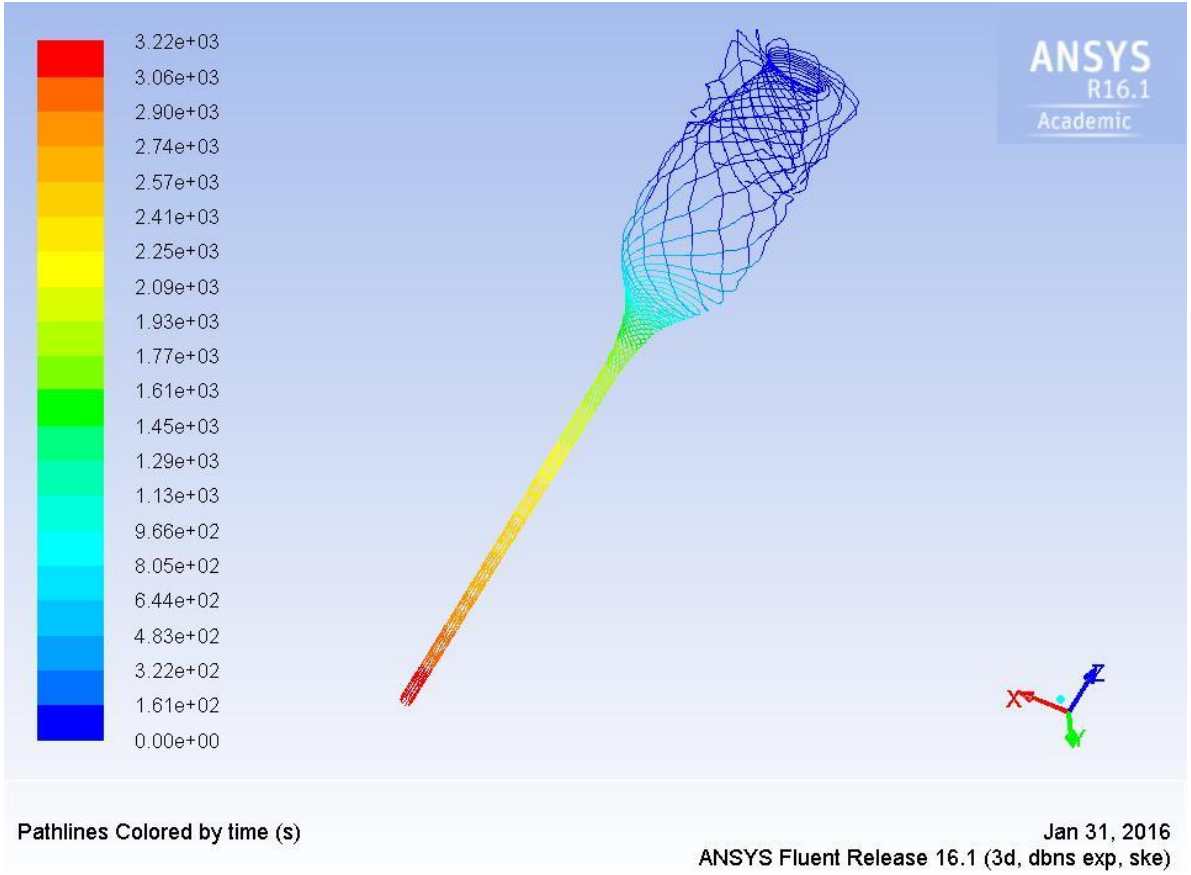

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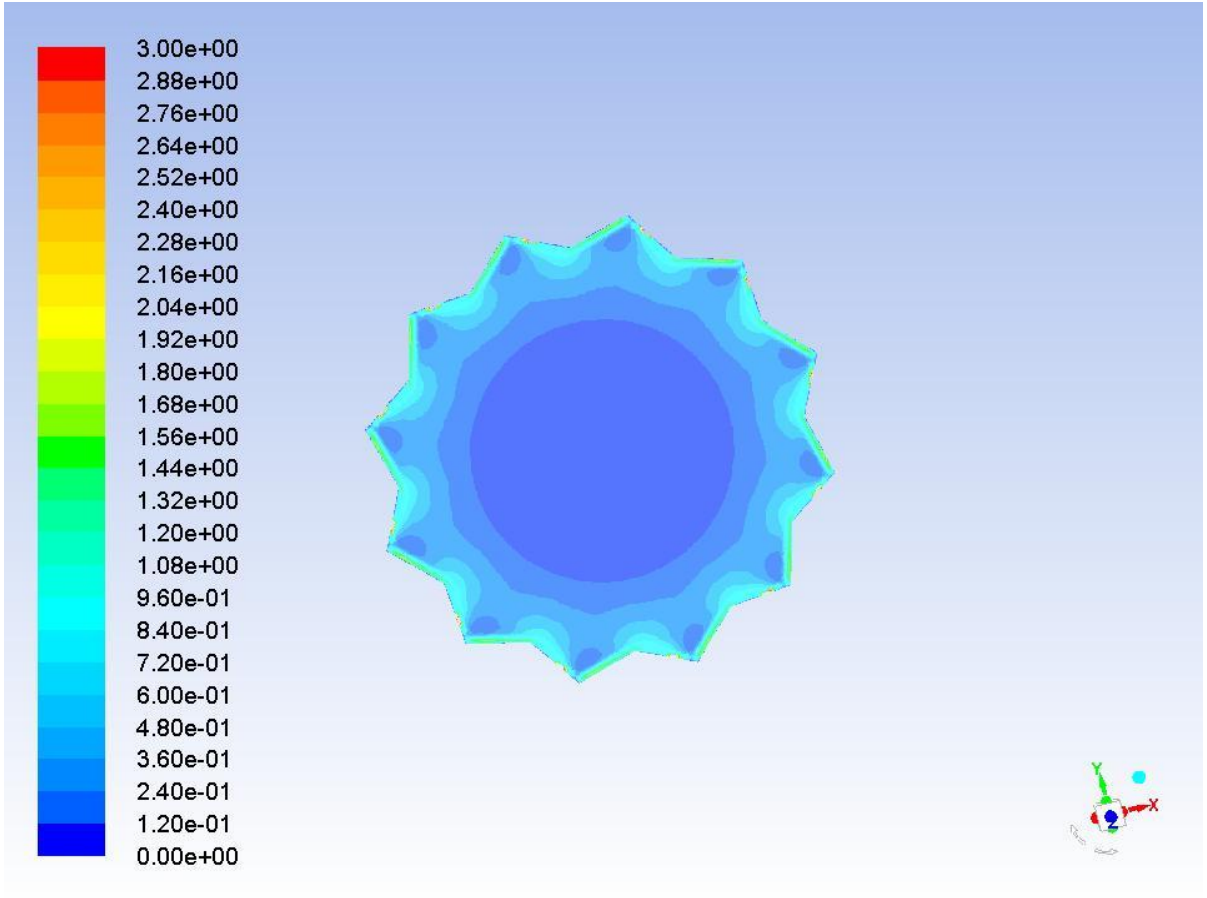

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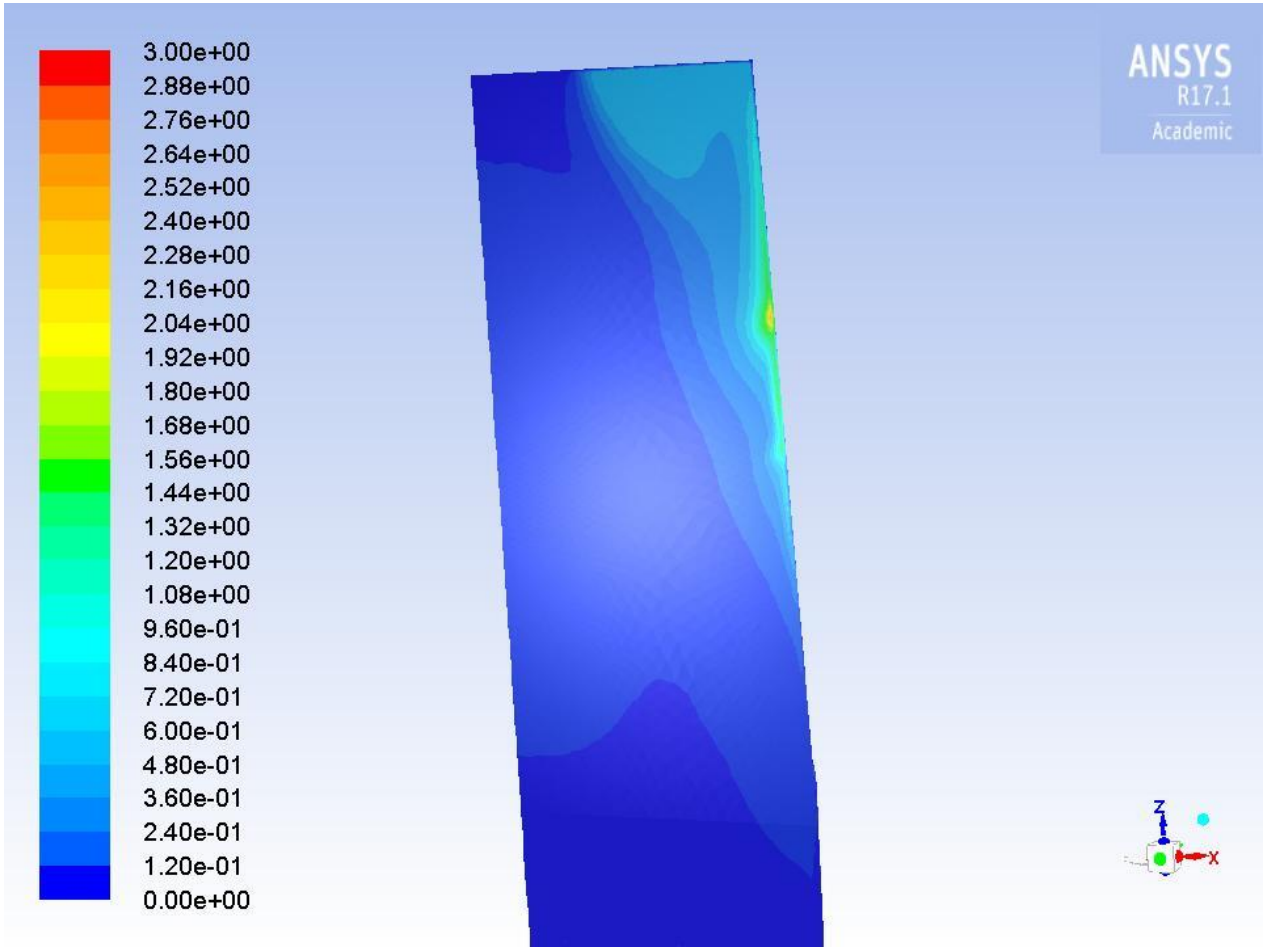

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Heat Transfer

- No Heat Transfer in CFD simulations
- Analytical proposal
- Further development of the cloud
- Meeting – Cooling Tower Department

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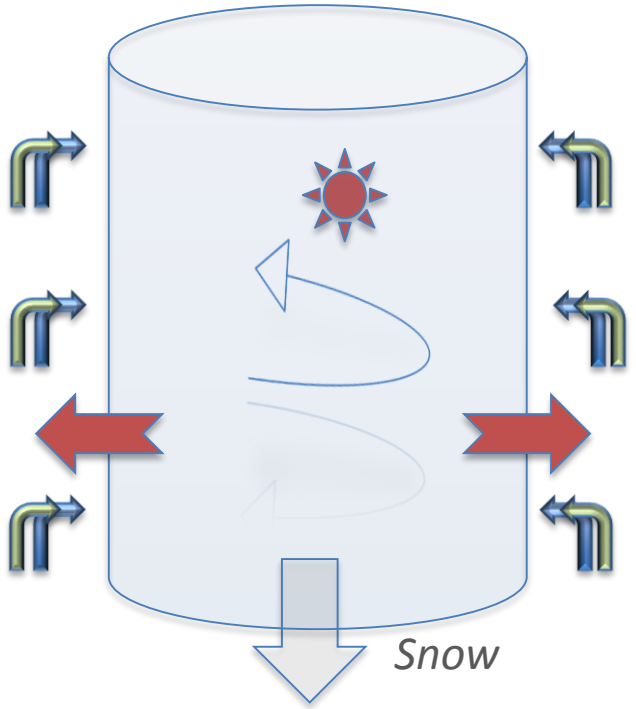
Prototype 2015/16

- m_{air} = 86 kg/h
- m_{water} = 660 kg/h

q_{gen} = 333 kJ/kg

- **Q_{gen} = 61 kW**

- **Q_{wall} = 7 kW**



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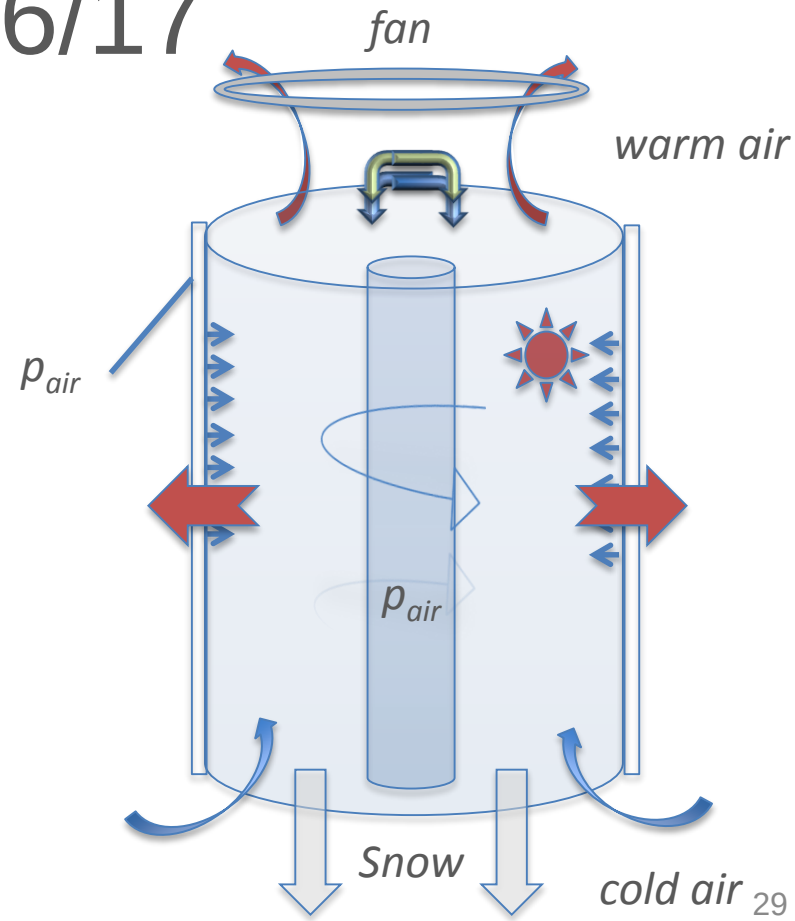
Prototype 2016/17

- m_{water} = 3000-5000 kg/h
- q_{gen} = 333 kJ/kg
- **Q_{gen} = 185 kW**



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Cooling Tower Analogy

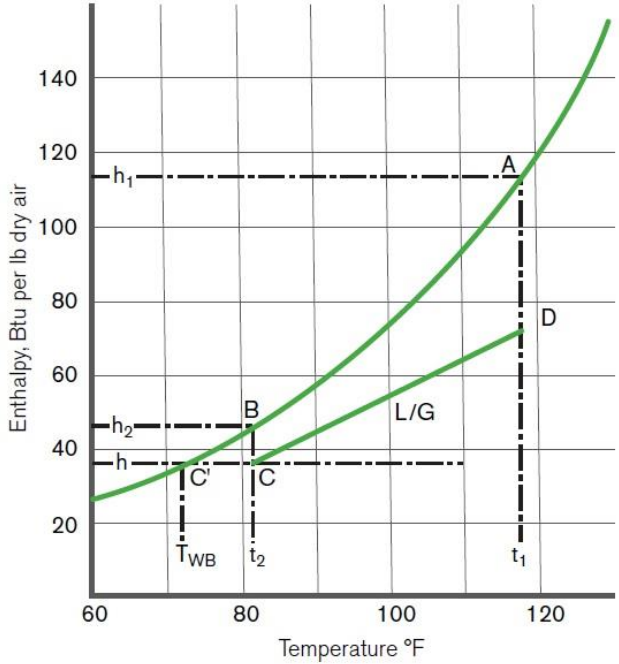
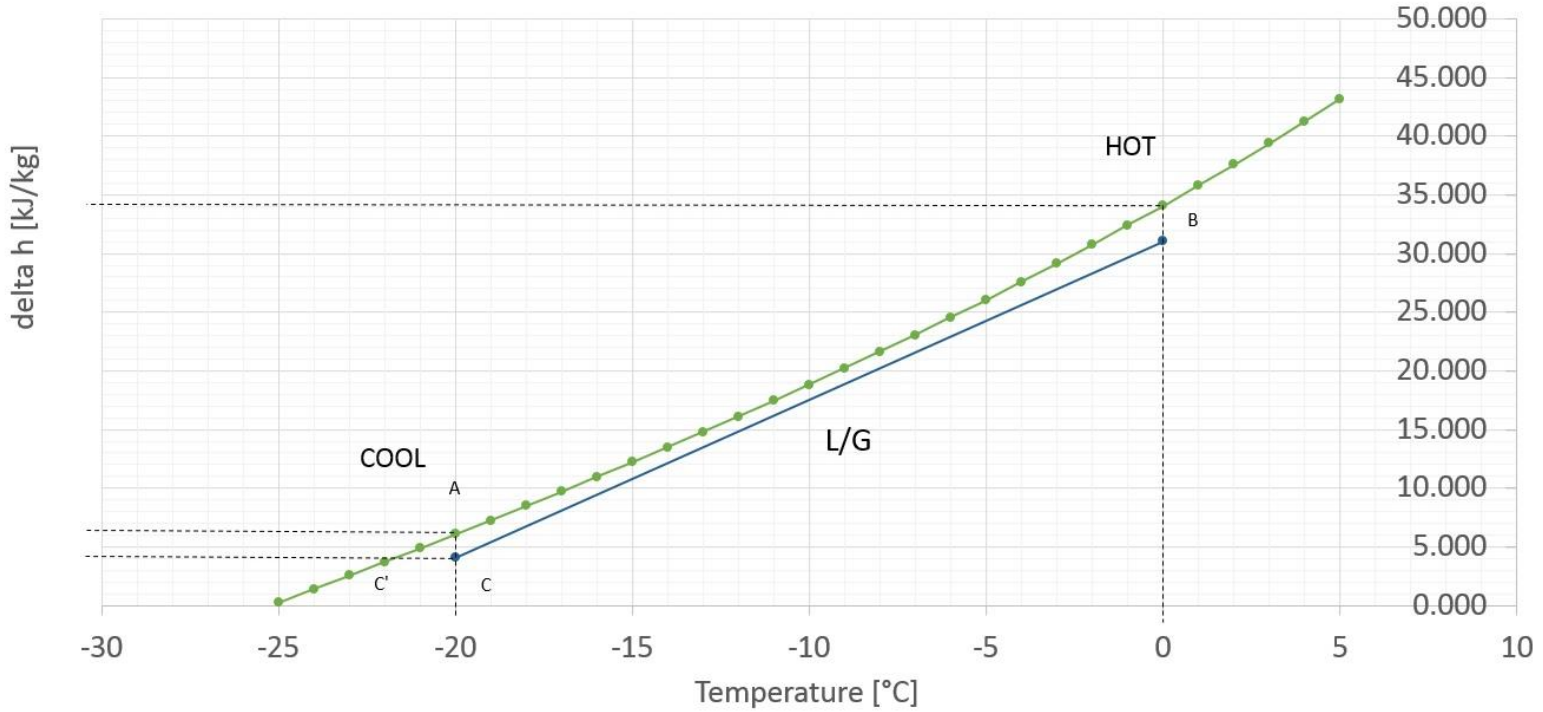


FIGURE 2 *Counterflow cooling diagram*

Cooling Tower Analogy



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Outlook

- Particles
- Documentation of work – Master's Thesis
- Construction of new cloud concept

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