
STERG
SOLAR THERMAL ENERGY
RESEARCH GROUP

ANNULAR AIR SOLAR RECEIVER

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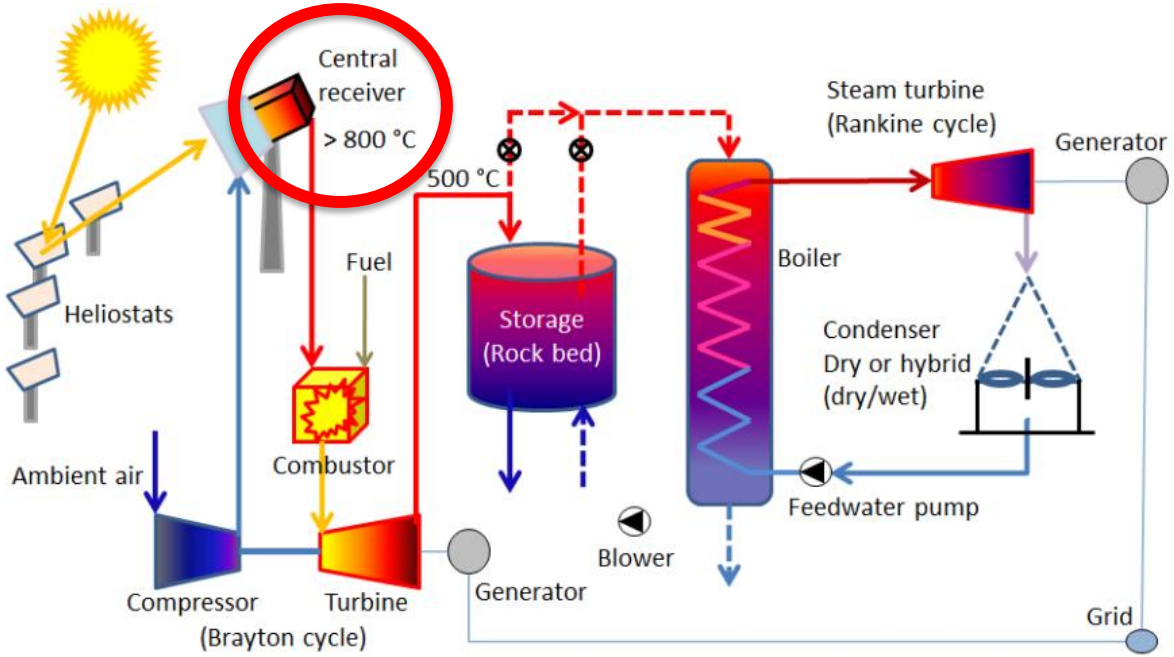
Introduction

The problem

- Load Shedding

Introduction

SUNSPOT



Scheme of the The Stellenbosch UNiversity Solar Power Thermodynamic Cycle. Source: STERG-blog

- Concept in development

<u>Central Receiver</u>

- Air as working fluid
- Storage

Introduction

Why air?

- Solar Towers – Sub-Sahara regions
- Don’t have lot of water
- Air doesn’t solidify like salt
- Freely available
- Heat up the rocks

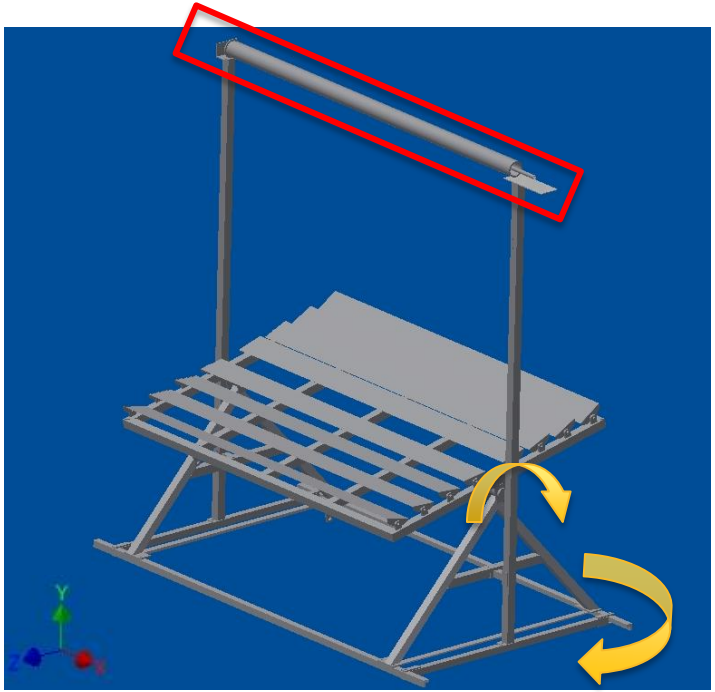
Introduction

Why not air?

- Bad heat transfer characteristics
- Higher heat fluxes needed
- Higher material temperatures needed than air itself
- High temperatures – high losses

The Concept

The designed system

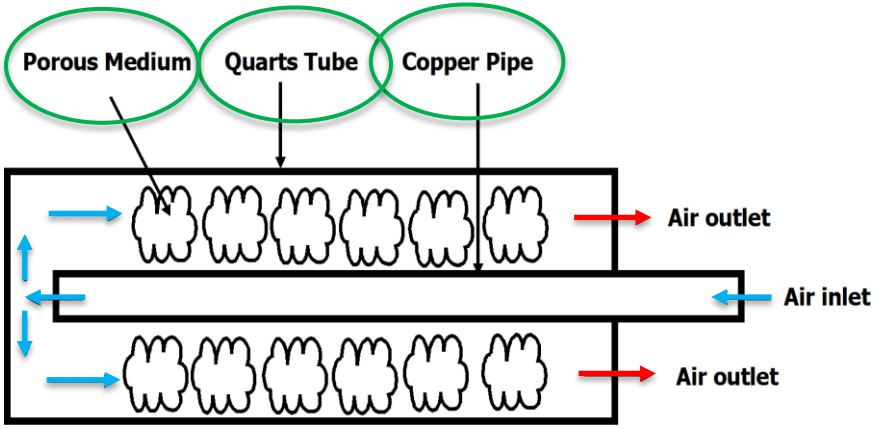


- Linear mirror system
- Manual Tracking
- Rotates around y-axis
- Swivel around x-axis
- Low temperature & pressure - safety

The Concept

The receiver itself

Vertical section cut



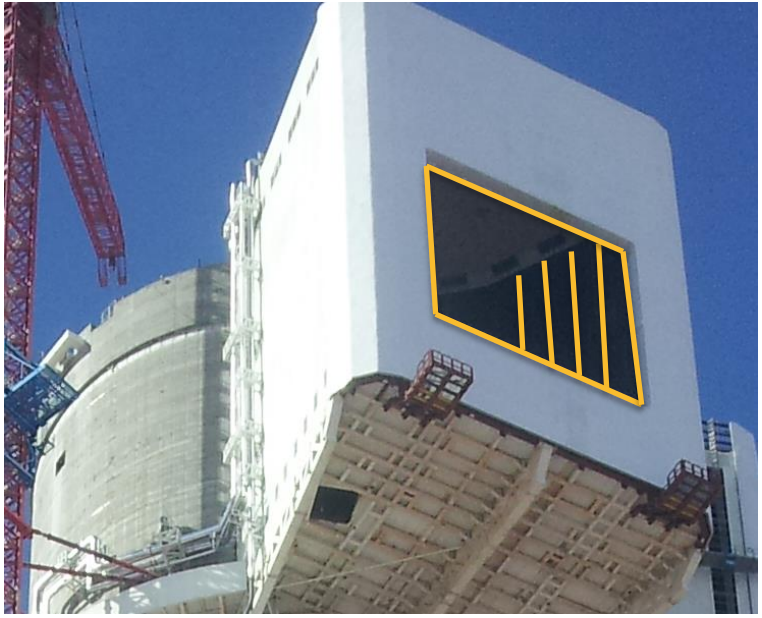
- Air enters through copper pipe and makes 180° change
- Return through porous medium

- Porous medium – high heat transfer coefficient
- Absorb the radiation
- Increase surface area for heat transfer to the air

- Copper pipe – carry weight

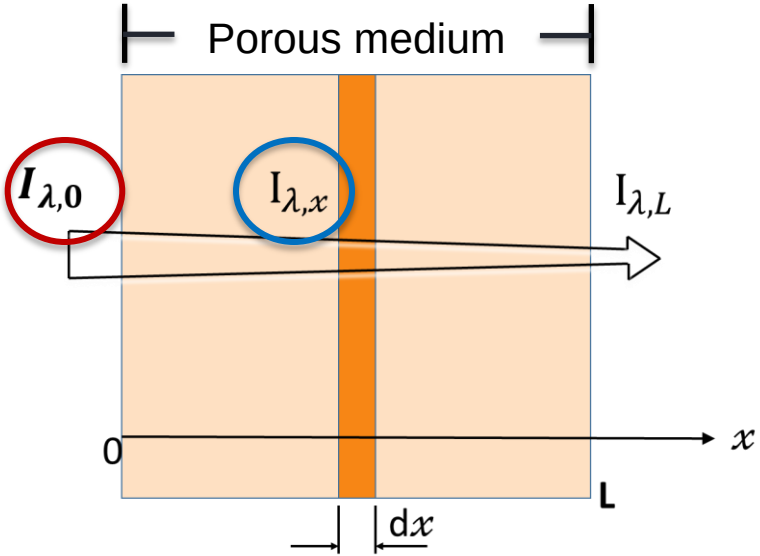
The Concept

Where it fits in



Aims of Project

Absorption coefficient



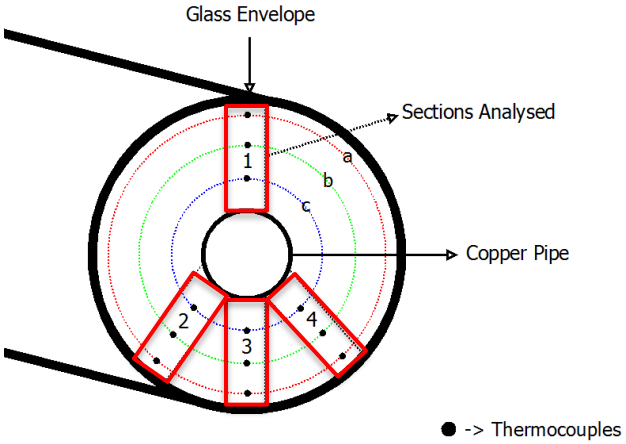
- To determine the absorption coefficient
- $I_\lambda(x) = I_{\lambda,0} e^{(-\kappa x)}$
- Will be variable in Matlab model
- To get the specific solar irradiance

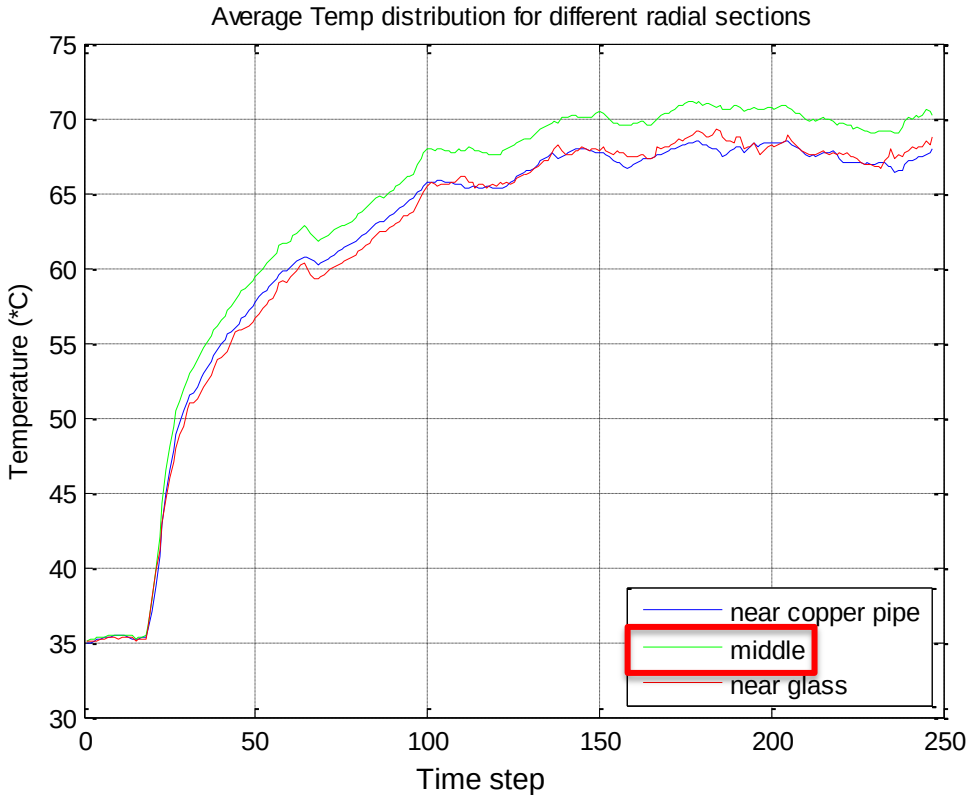
The Real Deal

Sunroof Eng. Building

Results

Measured data



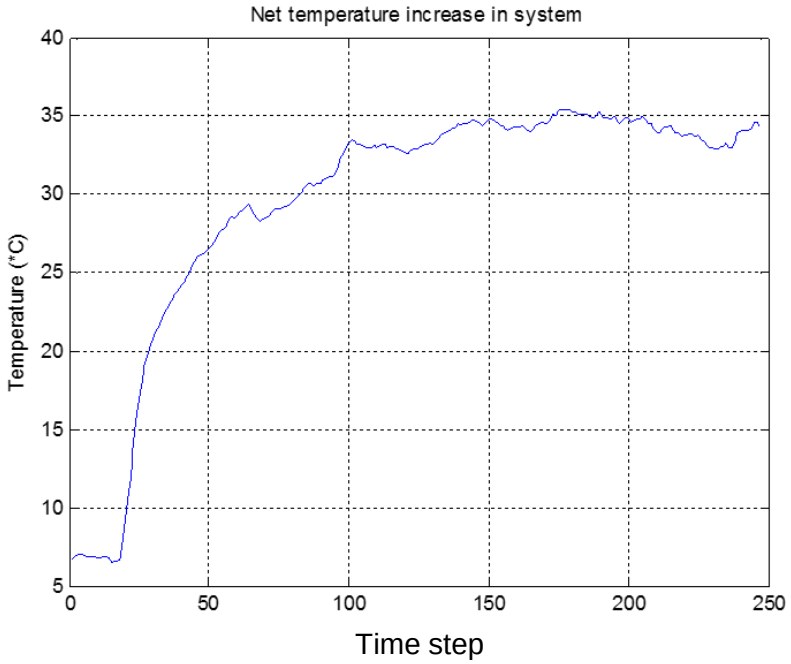


Results

Measured Data

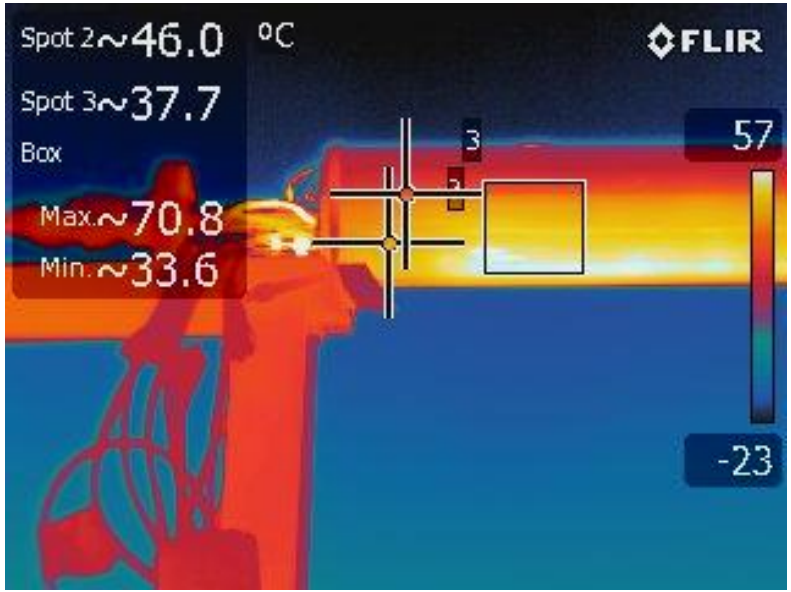
- Variation due to:

- DNI variation
- Human errors



Results

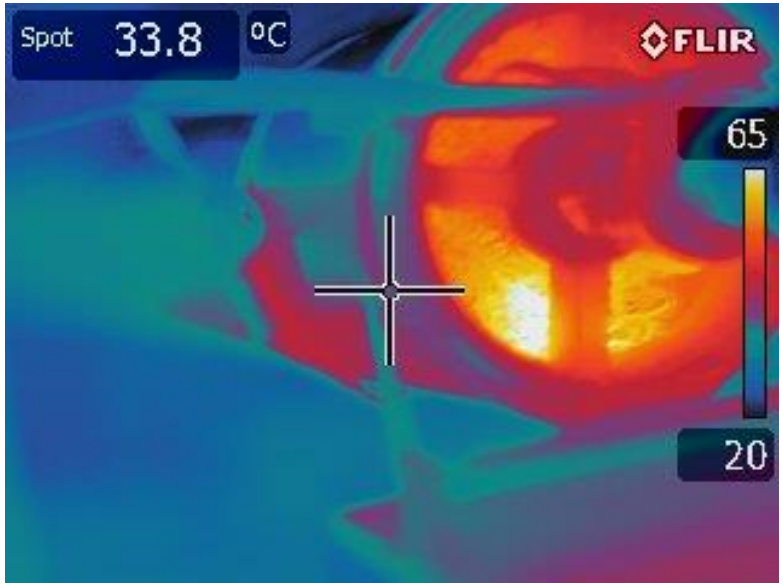
Thermal imaging – glass tube



- Using infrared
- Measure the surface temperature
- To determine the losses in the system

Results

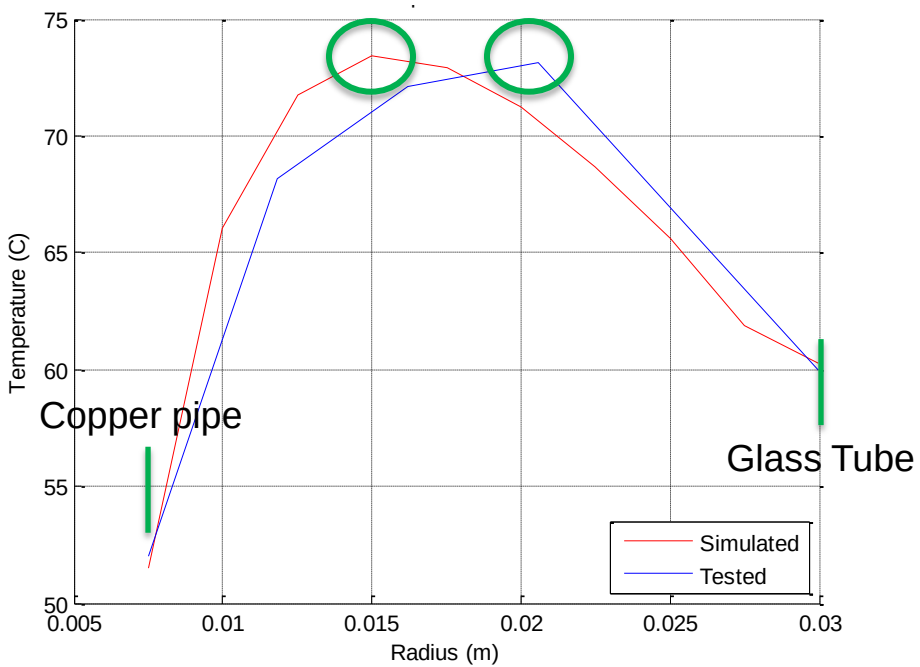
Thermal image – outlet



- Temperature of porous medium
- Higher than air temperature of 58°C

Results

Matlab



- Using a conduction model
- For absorptions coefficient of 3,95
- Experimental test reaches a maximum closer to glass
- Additional modelling by CFD

Conclusion

And where we going

- Results is very promising- expected lower net temperature increase
- I believe there is place in the market for air receivers
- The structural and thermal analyses must be studied at high temperatures
- CFD model to verify results (myself)
- Separate study to test other materials

Thank you

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