HTT Mezzanines
Thermal Simulation

Part Two

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2. Air Flow Control Test - Modified the 150x146mm and 170x146mm Mezzanine Card models, by inserting on each card three small air deflectors, 21.5mm tall, that prevent air flow around heat sinks. Test results are presented.

3. Test of a Flipped Mezzanine Card Model - Created a new model with a 170x146mm Flipped Mezzanine Card. Test results are presented, as they compare to a similar card installed straight and with 0.5mm connectors.

Heat Sink Parameter Optimization

- Created a One-Blade Model with two 150x146mm mezzanine cards and 0.5mm connectors.
- Heat Sinks: 138x110mm with 3mm base
- 91W on both BGAs and 2-Resistor Models
- No other components on the Mezzanine Cards
- 4m/s Air Flow.

The best solution selected out of ~ 200 solutions:

- Fin Height: 7mm and 11.5mm
- Fins placed every 2.5mm
- Junction Temperature ~71C for both BGAs.

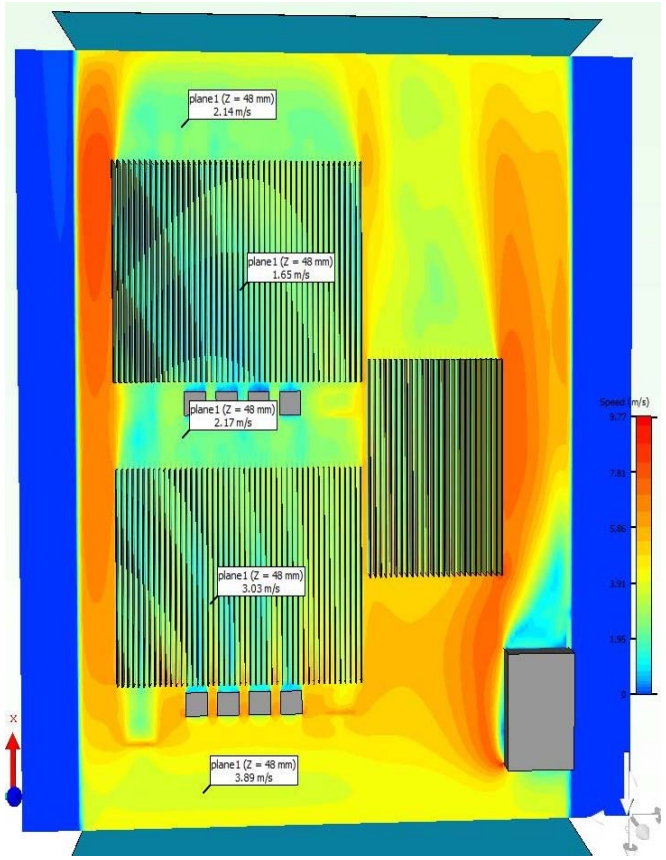
The Optimization must be redone for any different architecture.

Latest Simulation Results are posted here:

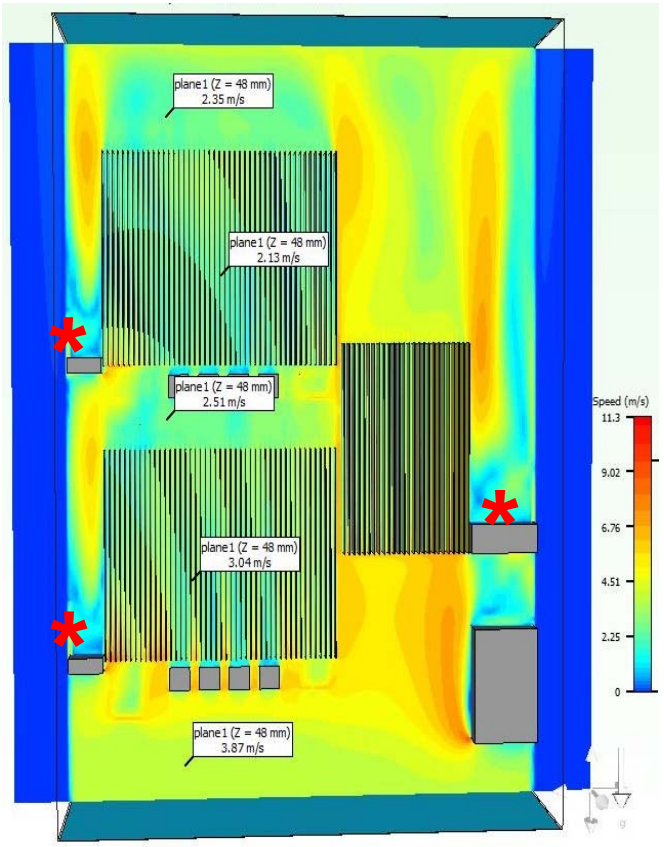
http://edg.uchicago.edu/~bogdan/HTT_TrackFitterMezzanine/FloTHERM/Scenario_Results.xlsx

Flow Control with Small Air Deflectors

150x146mm Mezzanine Cards with 0.5mm Connector, 4m/s Air Speed



Max. Core Junction Temperature:
Bottom: 73.68C, Top: 73.47



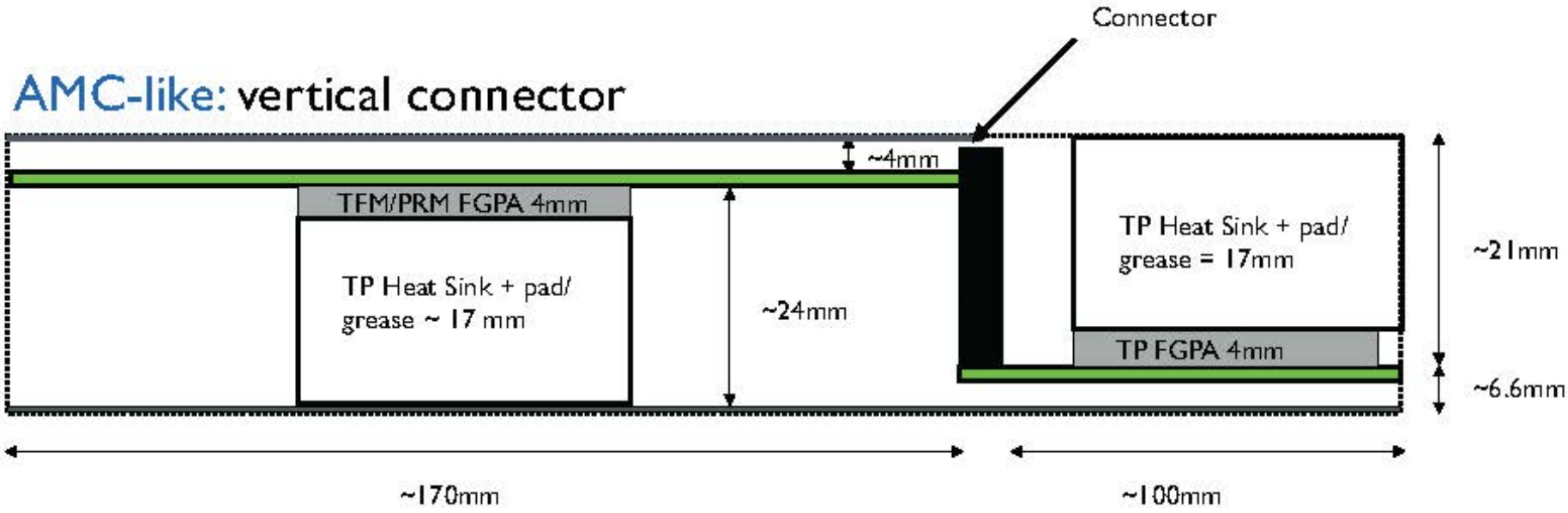
(*) - 21.5mm High Cuboid

Max. Core Junction Temperature:
Bottom: 72.12C, Top: 70.80

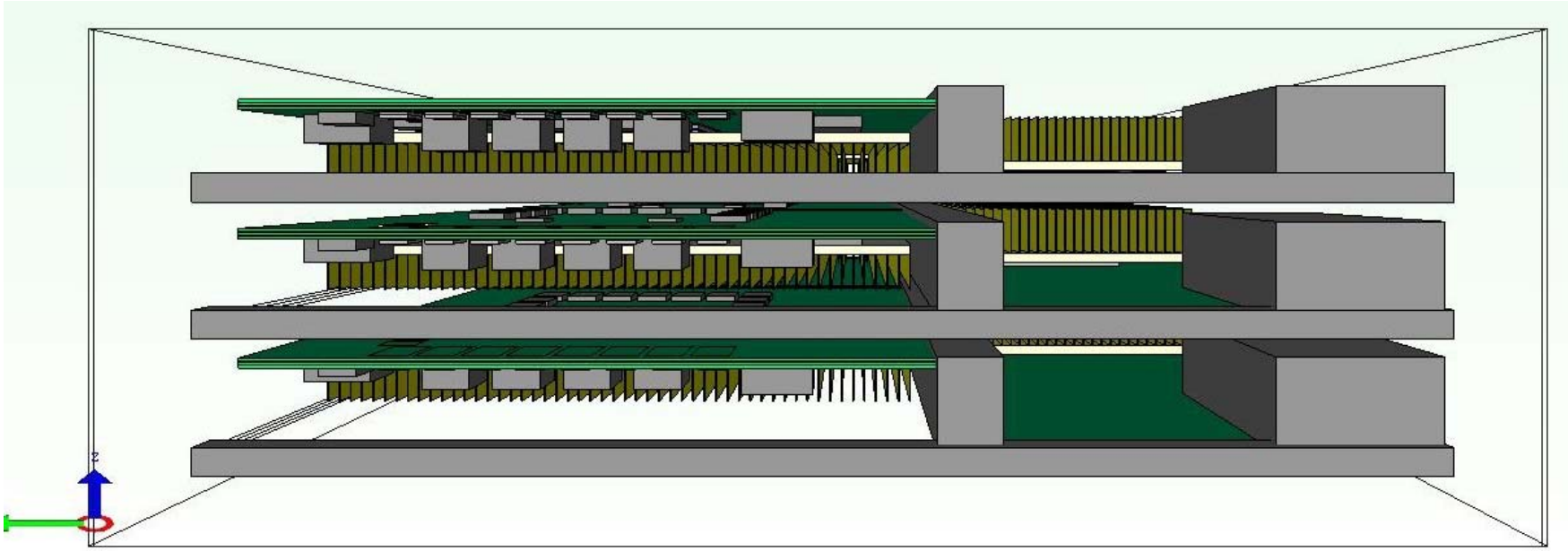
Directing air flow, by placing small deflectors, will improve cooling.
We have to redo simulations, once component placement is finished.

Flipped Mezzanine Card Side View

From Mechanical Options and other power cooling info presentation

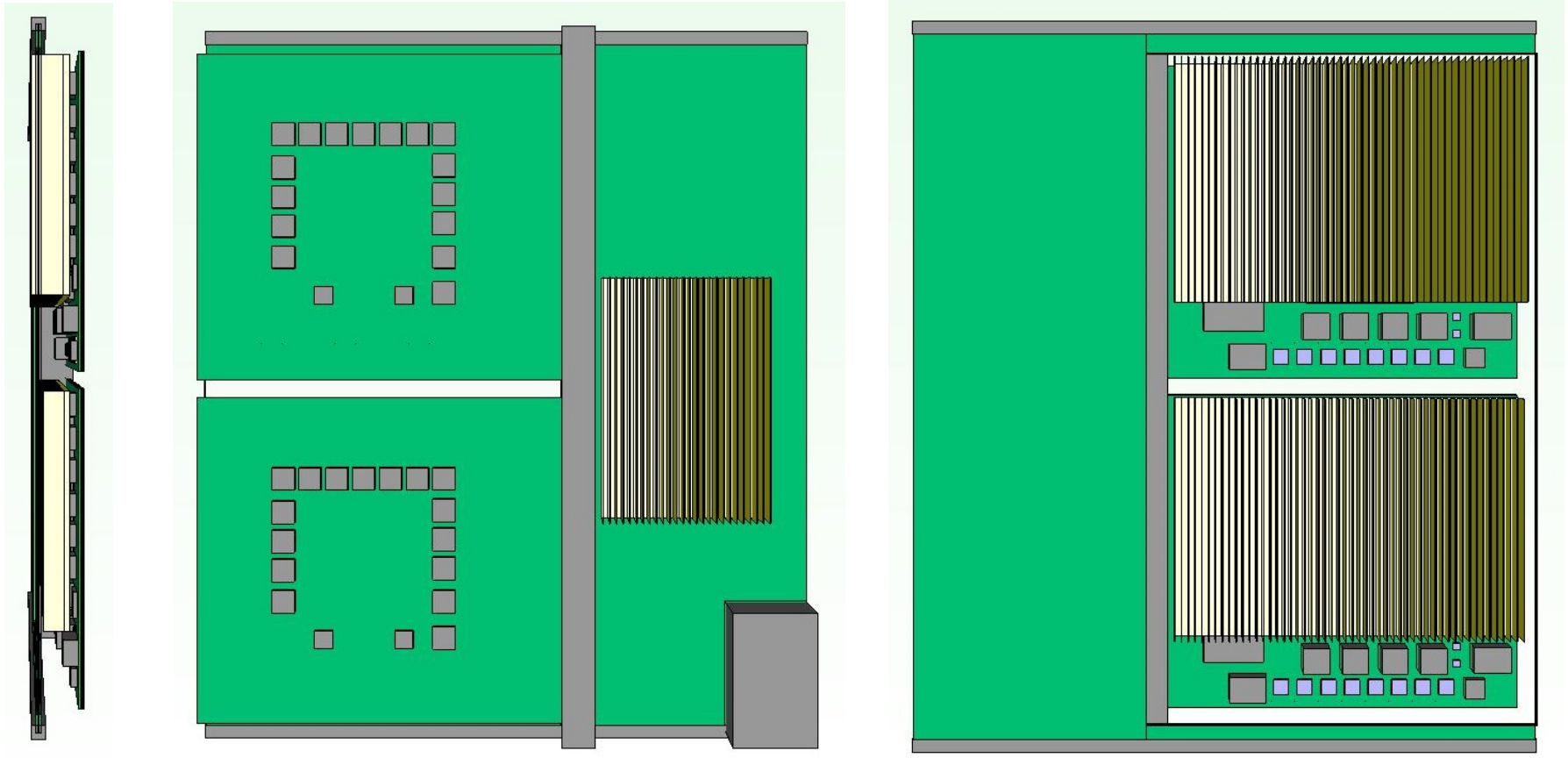


Flipped Mezzanine Card Side View
Model with 3 Blades



Model includes 2mm Rails on each side of the ATCA Blade
Any other Air Flow Obstruction to Consider?

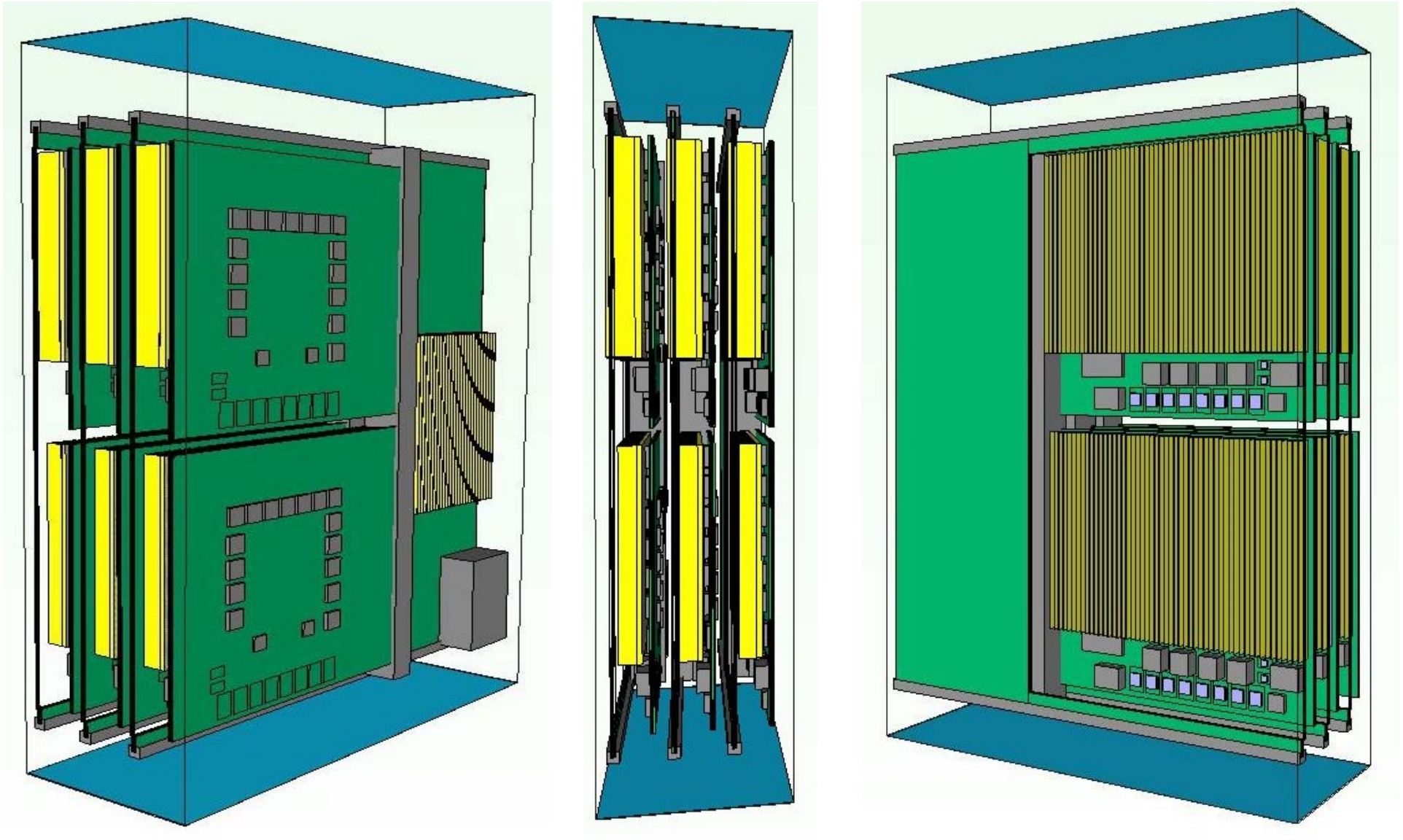
ATCA Blade with Flipped Square Mezzanine Cards



- Two 170x146mm Mezzanine Cards with “AMC-like vertical connector”
- Max. Height from Motherboard Top Side : 21.5mm
- Heatsink Sizes:
  - Bottom Heatsink: Base = 159x110x2.7mm; 52 Fins = 0.3x110x9.3mm
  - Top Heatsink: Base = 159x110x3.2mm; 52 Fins = 0.3x110x14.3m

Mezzanine PCB Height=2.5mm, FPGA Height=4mm

Chassis with Three Blades



4m/s Push-Pull Air Configuration

Max. Junction Temperatures for Middle Blade

2mm and 0.5mm Z-Ray Connectors, Flipped Mezzanine Cards

All Simulations Solved with three Blades in Chassis, two Mezzanines on each Blade.

Mezzanine Size / Air Flow / Heat Sink Height	170x146x21.5 2mm Interposers No Holes		170x146x21.5 0.5mm Interposers With Holes		170x146x22.5 0.5mm Interposers With Holes		170x146x21. Flip Mezzanines Wit Cut Out	
	Bottom 9.0mm	Top 12.5mm	Bottom 10.0mm	Top 14.5mm	Bottom 10.7mm	Top 15.5mm	Bottom 12.0mm	Top 17.5mm
4m/s Push-Pull			71.25	70.60	69.28	69.32		
4m/s Push-Pull and 3 small air deflectors	72.75	72.01	70.35	69.53			65.68	65.70

Note for the 2mm Connector with No Holes Solution:
Active Components on Mezzanine Bottom Side must be placed between PCBs, with No Air Flow.
Placement of Active Components on Mezzanine Bottom Side Must be Carefully Analyzed.

All Simulation Results are posted here:

http://edg.uchicago.edu/~bogdan/HTT_TrackFitterMezzanine/FloTHERM/Simulation_Results.xlsx

Conclusions

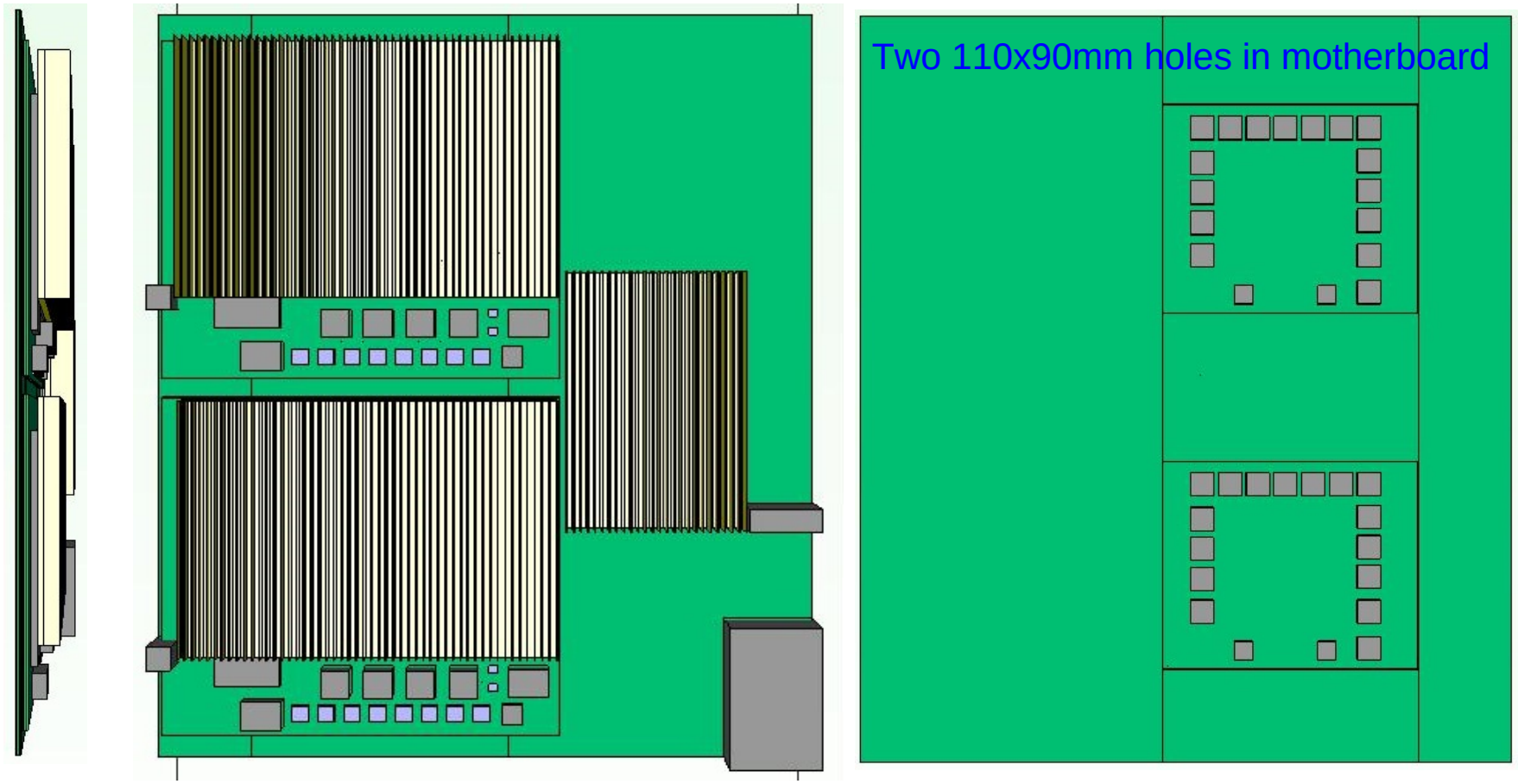
- Heat Sink Parameters should be optimized for each architecture (big differences).

- Air Flow Deflectors should be designed and simulated, once component placement is done (1 to 2C difference)

- Flipped mezzanine cards allow for ~26% extra fin height, and will run cooler than same size cards installed with 0.5mm connectors (4 to 5C difference)

REFERENCE from 9/18/2018 Slides

Square Mezzanines with 0.5mm Connectors:



- Two 170x146mm Mezzanine Cards with 0.5mm Connector
- Max. Height from Motherboard Top Side : 0.5+2.5+4+3.2+11.3=21.5mm
- Heatsink Sizes:
  - Bottom Heatsink: Base = 159x110x2.7mm; 52 Fins = 0.3x110x7.3mm
  - Top Heatsink: Base = 159x110x3.2mm; 52 Fins = 0.3x110x11.3m

Mezzanine PCB Height=2.5mm, FPGA Height=4mm