CoolCab Truck Testing Project Update

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21 CTP Meeting
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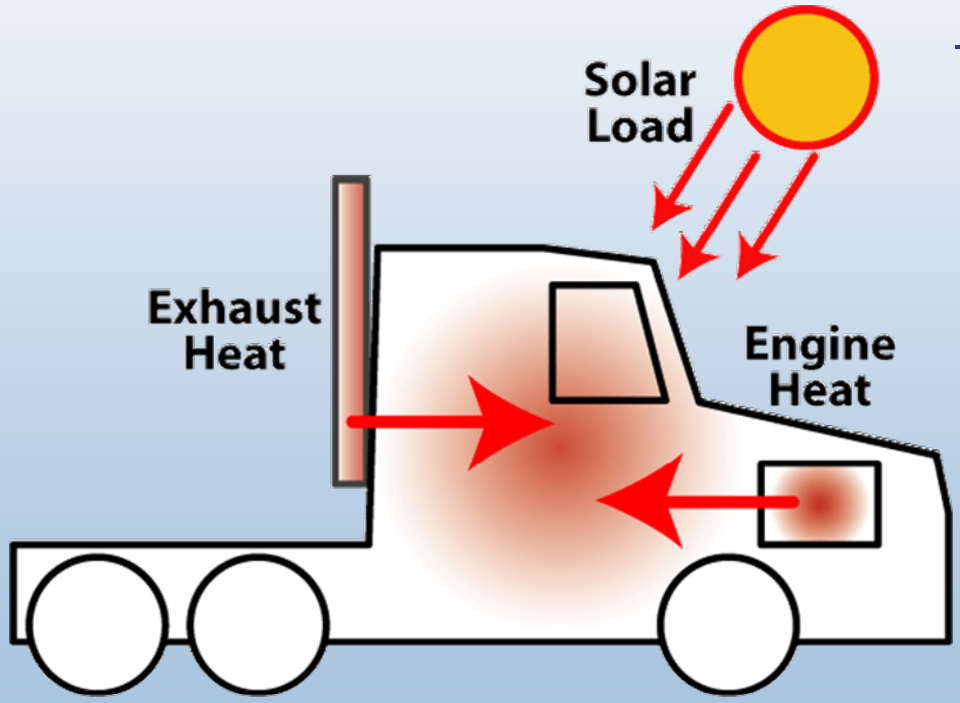
CoolCab Project

- The Problem
  - Trucks consume 2.5 million barrels of oil per day
  - Idling consumes 838 million gallons of fuel per year
  - Future emissions requirements
    - lower fuel economy
    - increase underhood temps.

Redesigning the Heavy Truck is an opportunity to reduce oil importation

CoolCab Project

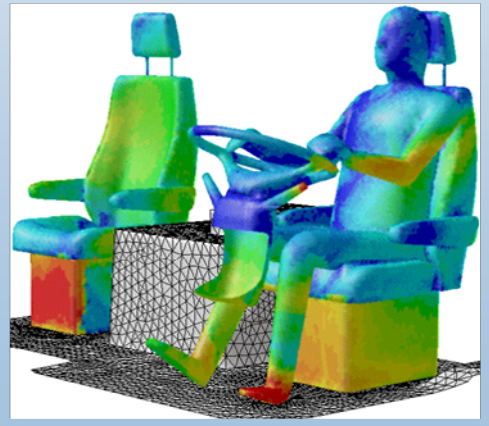
- The Challenge
  - Cab climate control requires idling to provide comfort
  - Varying thermal conditions inhibit use of idle reduction technologies



CoolCab Project

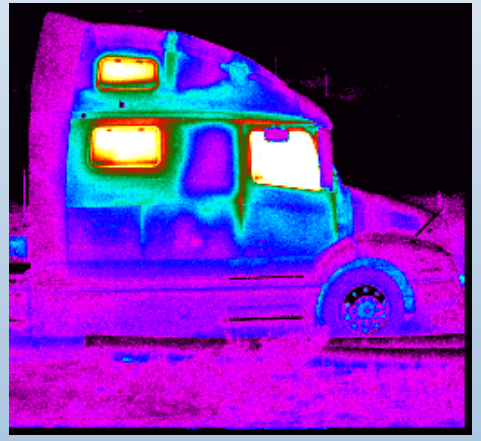
Thermal Comfort Manikin

Solar Reflective Glazings



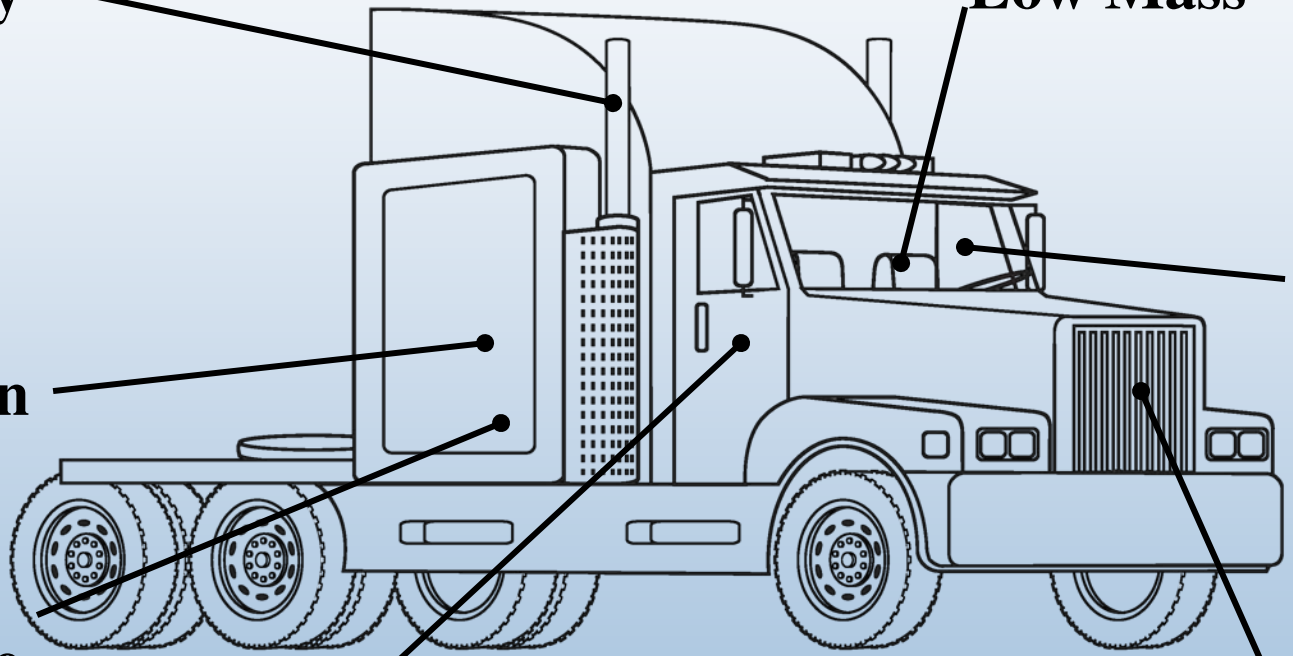
Integrated Numerical Modeling

- The Solution
  - Design efficient thermal management systems
    - Keep the cab comfortable
    - Eliminate excessive idling



Cab Insulation

CoolCab – Advanced Technologies



Exhaust Heat Recovery

Advanced Seating – Low Mass

Advanced Glazings or Shades

Insulation

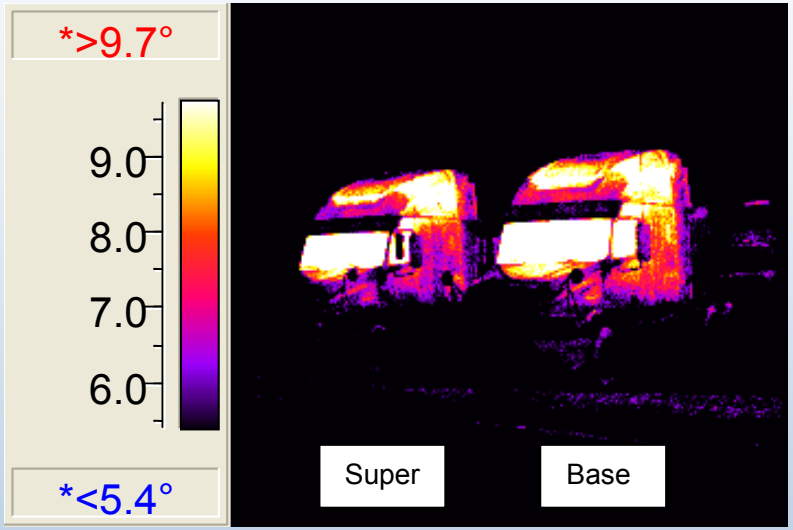
IR Reflective Materials

Comfort Based Air Distribution

Efficient HVAC Equipment

Infrared Image Test – Schneider National

- Investigate potential for improving cab efficiency
- Qualitative comparison
  - Identify high heat loss areas
  - Note areas with greatest potential for improvement



CoolCab Testing with Volvo

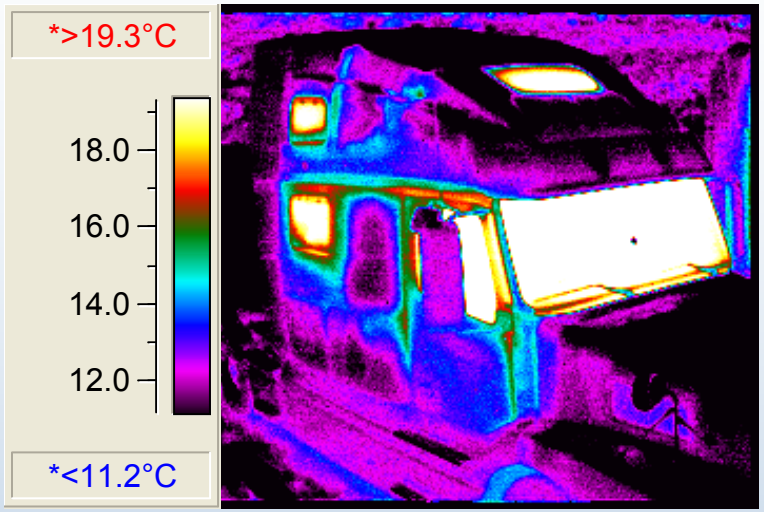
- Volvo Truck at NREL for testing
  - 77” sleeper cab
  - On-board idle reduction technologies
    - Bergstrom battery electric AC
    - Airtronic diesel-fired heater
- Objectives
  - Quantify truck cabin heat transfer
  - Identify potential areas for improvement

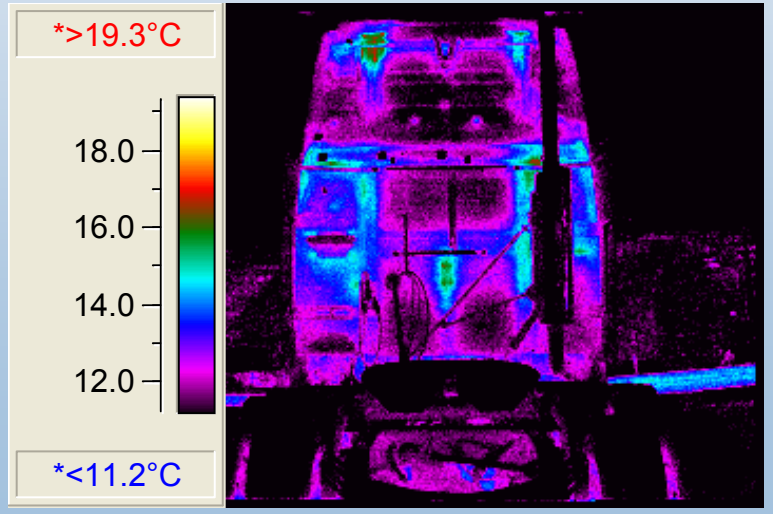
Testing Approach

- Co-heat tests to determine UA
  - Measure effect of sleeper curtain and window shades
  - Insulate windows to quantify loss
- Measure air exchange rate
- Solar soak tests to determine solar effects
  - Soak with windows insulated
- Infrared imaging to examine high heat loss areas
  - Hot spots

Volvo Test Results

- Heat transfer
  - UA = overall heat transfer coefficient = 65 W/K
  - 15% reduction (improvement) with sleeper curtain closed
  - 20% reduction with windows covered
- Solar heat soak
  - ΔT = temperature rise above ambient = 15ºC
  - ΔT = 5ºC with windows covered
- Air leakage rate
  - ~1 air change per hour



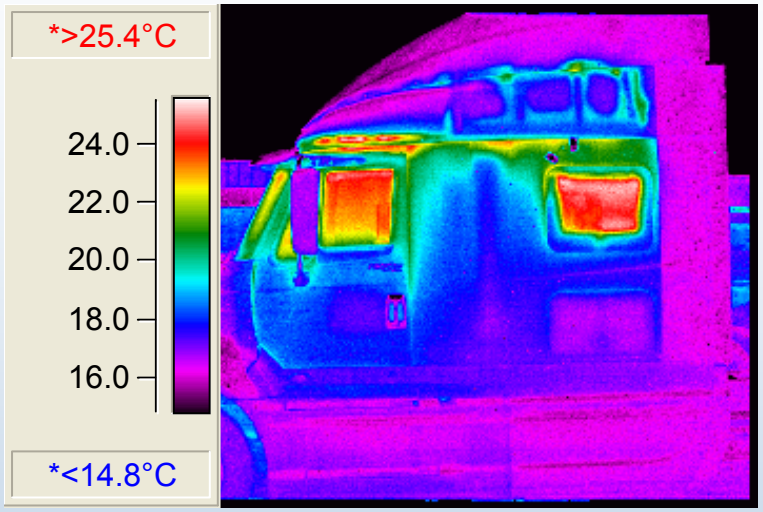


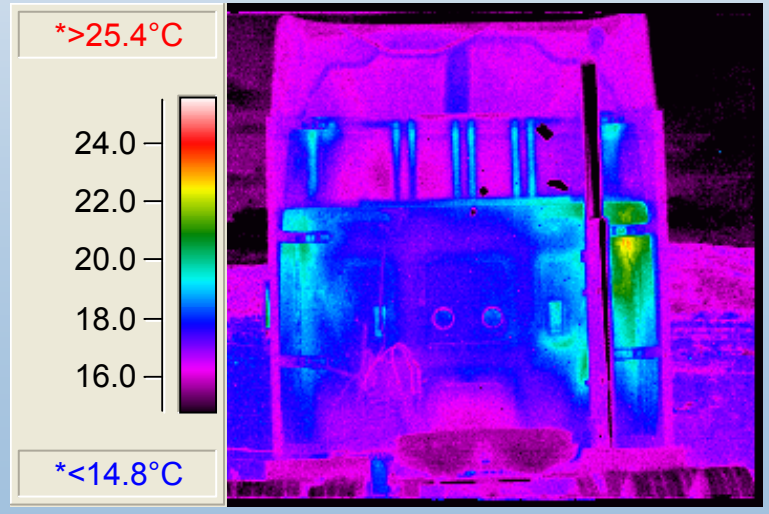
CoolCab Testing with International

- International Truck at NREL
  - ProStar sleeper cab tractor
  - Electric HVAC system with battery APU
- Objectives
  - Quantify truck cabin heat transfer
  - Predict HVAC system load requirements
- Began spring 2007

International Test Results

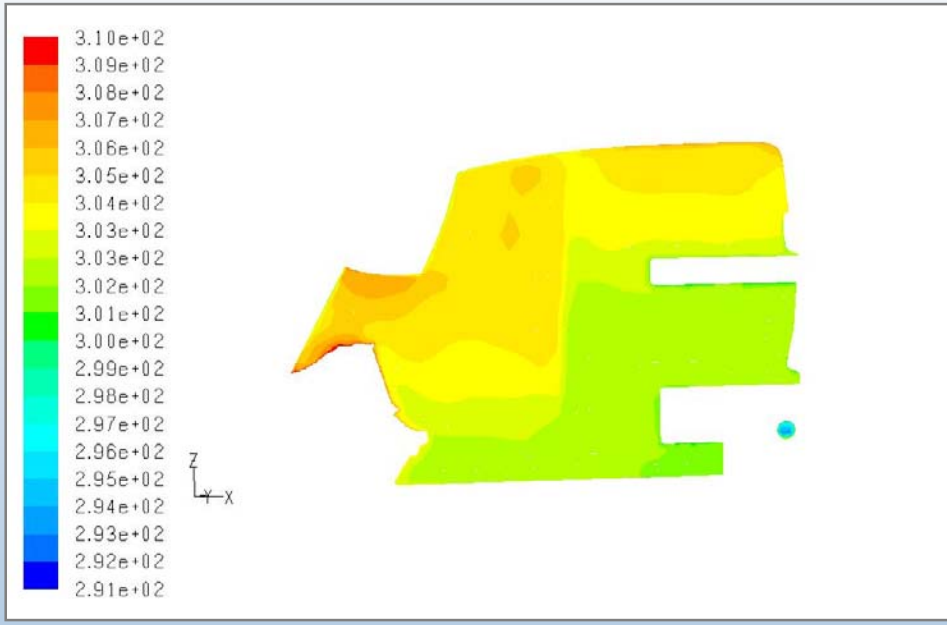
- Heat transfer
  - UA = overall heat transfer coefficient = 50 W/K
  - 20% reduction (improvement) with sleeper curtain closed
  - 25% reduction with arctic curtain
  - 13% reduction with windows covered
- Solar heat soak
  - ΔT = temperature rise above ambient = 11ºC
  - ΔT = 7ºC with windows covered
- Air leakage rate
  - ~0.5 air change per hour





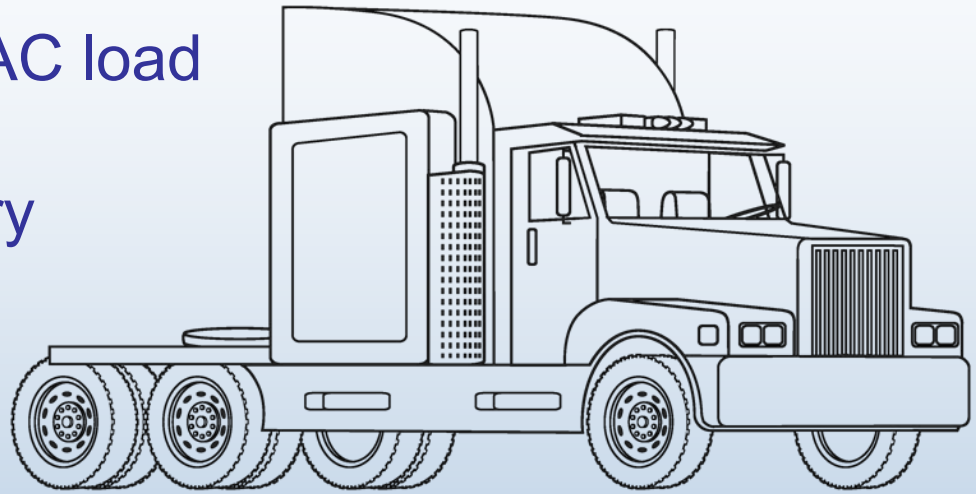
Thermal Modeling

- Previously developed model for International
  - Fluent CFD
  - Radtherm
- Validate with test data
  - Solar soak air temperatures predicted within 3ºC
  - Apply multiple configurations
- Simulation runs
  - Baseline A/C case
  - Increased cab insulation
  - Solar reflective glass



Next Steps – FY08

- Begin development of HVAC load calculation tool
- Generic truck cab geometry
- Input key parameters
  - Climatic conditions
  - Vehicle geometry
  - Material properties
- Estimate potential load reduction
- Work with industry to define requirements
  - Truck OEMs
  - Idle reduction technology manufacturers



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