RAY W. HERRICK LABORATORIES

Sponsor: Carrier

PIV Testing of a Residential Gas Furnace

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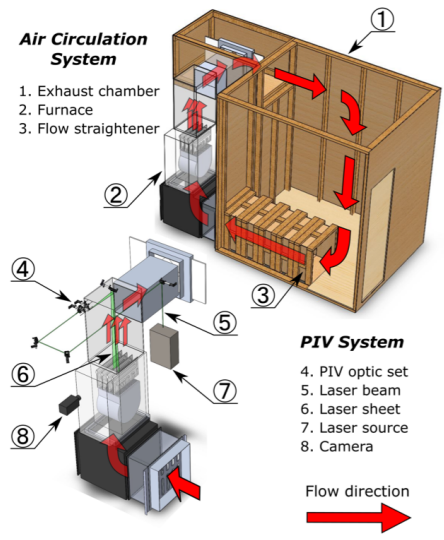Contact: wu912@purdue.edu

Project Description

- Optimizing the flow field inside a residential gas furnace is a key for a design with improved performance and energy savings.
- CFD is commonly adopted as design tools and its prediction needs validation by high-resolution experimental data, especially in off-design conditions.

Approach

- Conduct Particle Image Velocimetry (PIV) measurement of the internal flow field in a modified gas furnace model installed in a air circulation system.
- Circulate seeding (smoke) particles with air and record the particle images with laser and camera for velocity analysis.
- 100K+ snapshots are recorded for resolving the flow at different locations.

Air Circulation System
1. Exhaust chamber
2. Furnace
3. Flow straightener

PIV System
4. PIV optic set
5. Laser beam
6. Laser sheet
7. Laser source
8. Camera

Flow direction

Discussion

- Three test cases simulate the different conditions (filter contamination levels) of gas furnace (isothermal only in the present phase) and differences in flow patterns are observed.
- The off-design conditions with strong internal flow separation presents challenges to CFD.
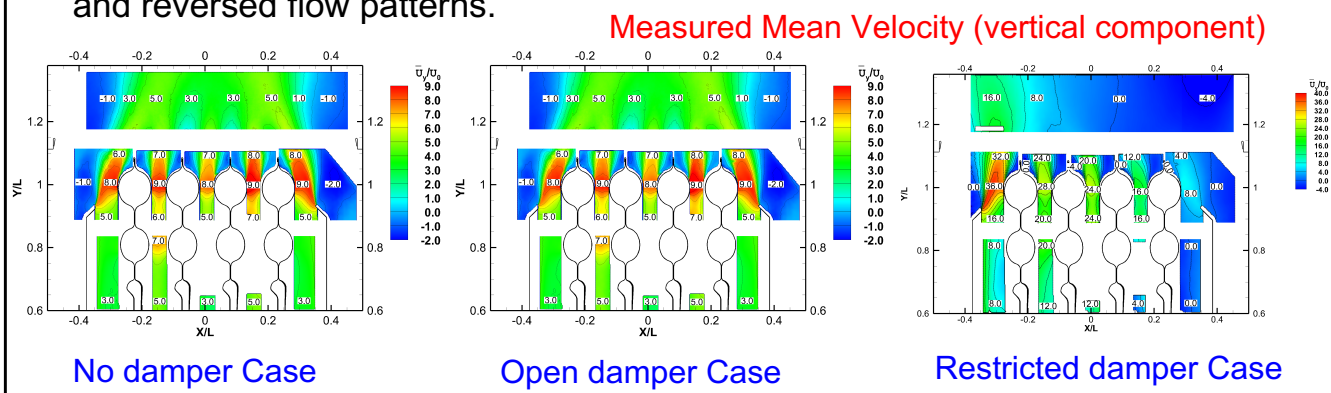- Measurements with heat transfer should be considered in Phase II.

Results

No damper case (no filter) and Open damper case (normal filter): similar flow patterns are observed. Highly restricted damper case (filthy filter): asymmetric and reversed flow patterns.

Measured Mean Velocity (vertical component)

No damper Case

Open damper Case

Restricted damper Case

The unsteady flow in off-design condition challenges design tools.

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