Summary of Results from Recent TC Studies on HDV Boat-Tails

ecoTECHNOLOGY for Vehicles

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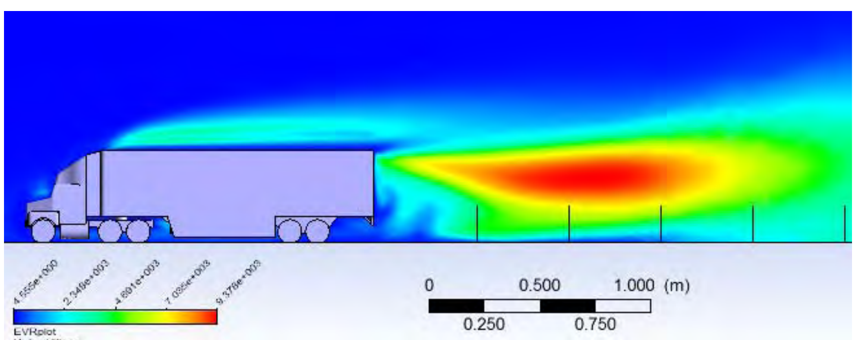
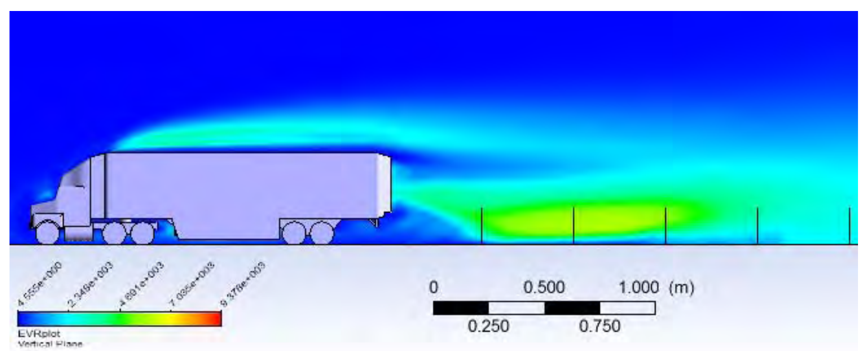
Aerodynamics of Boat Tails

- Tapering back end increases base-pressure
  - Boat-tail reduces pressure drag
- 2010 NRC report to TC:
  - 4.7% to 7.3% reduction in fuel consumption (2,500-3,800 L/year/vehicle)
  - CO_2 reductions of 6,700 to 10,400 kg per year per vehicle
  - Marginal increase in performance beyond 0.6 m (2 ft) boat tail length
  - Wake structure significantly altered by boat-tail – wake directed towards ground





Project Overview

- Multi-year project executed by NRC investigating implications of changes to the aerodynamic wake characteristics for boat-tail-equipped HDVs

- Phase 1:
  - Effect of turbulent wake characteristics from boat-tails on pursuing passenger vehicles
- Phase 2:
  - Potential of snow accumulation and shedding for a boat-tail equipped HDV

PHASE 1: Effect on Pursuing Vehicles

Wind Tunnel Test Findings (1/10 scale)

- Passenger vehicles in the wake of an HDV showed increase in dynamic wind loads with the addition of a boat-tail
- Amplified strength of vortex shedding near ground
- Addition of side skirts mitigates wake effect on pursuing vehicle
- Increased dynamic loads not excessive but show potential for stability problems

Compact Car

SUV

Transport Canada Transports Canada

PHASE 1: Effect on Pursuing Vehicles

Simulation-based Approach

- Simulation-based approach using wind-tunnel measurements as input to Simpack simulation software
- SUV and compact car dynamic models
- Evaluate response of vehicle + driver system
- Wind conditions:
  - With and without upwind truck
  - Truck with and without side skirts and boat-trails
  - Worst case dynamic side forces and yawing moments
- Road conditions – coefficient of friction (cf):
  - 0.2/0.3 – snow-covered roads
  - 0.5 – wet roads
  - 1.0 – dry roads
- Driver – steering wheel angular velocity:
  - Slow – 45 deg/s
  - Fast – 400 deg/s
  - Various intermediate conditions

PHASE 1: Effect on Pursuing Vehicles

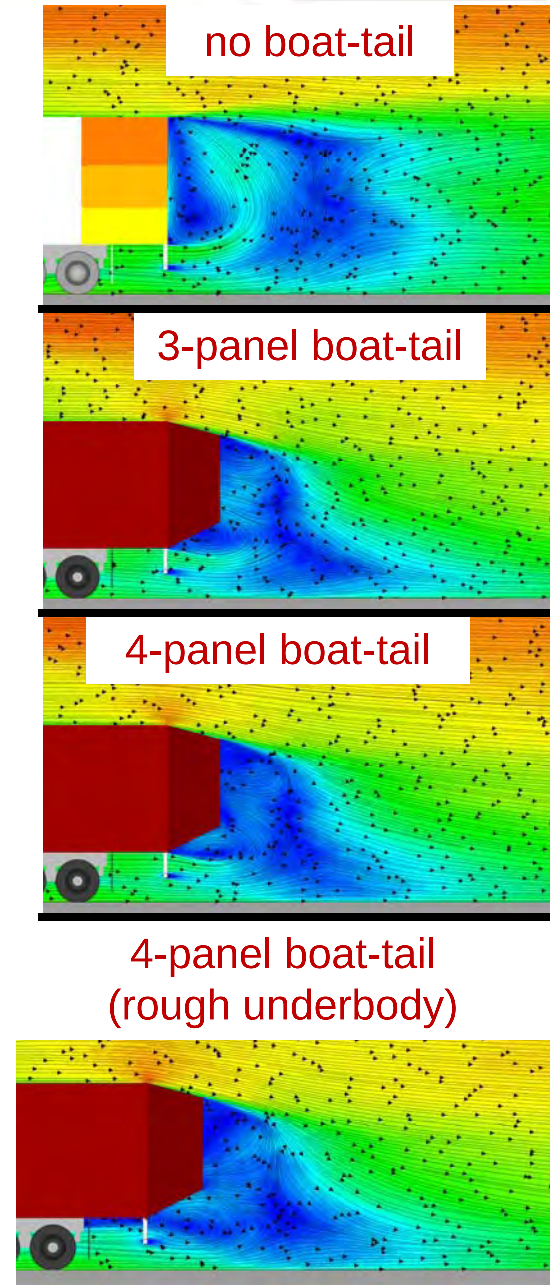
Conclusions of Simulation Tests

- Vehicle-dynamic simulations performed for a compact car and an SUV to investigate response to amplified vortex-shedding from boat-tail-equipped HDVs
- Simulations were performed for different levels of road friction and driver-steering rates, to simulate worst-case dynamic-wind-load conditions
- **Simulations results did not reveal any stability issues, based on accepted stability criteria**
- The amplified wind loads due to the vortex-shedding did not significantly affect the vehicle-driver response → influenced most by low-frequency turbulent cross winds in the absence of an upwind HDV

PHASE 2: Snow Accumulation

Simulation Approach

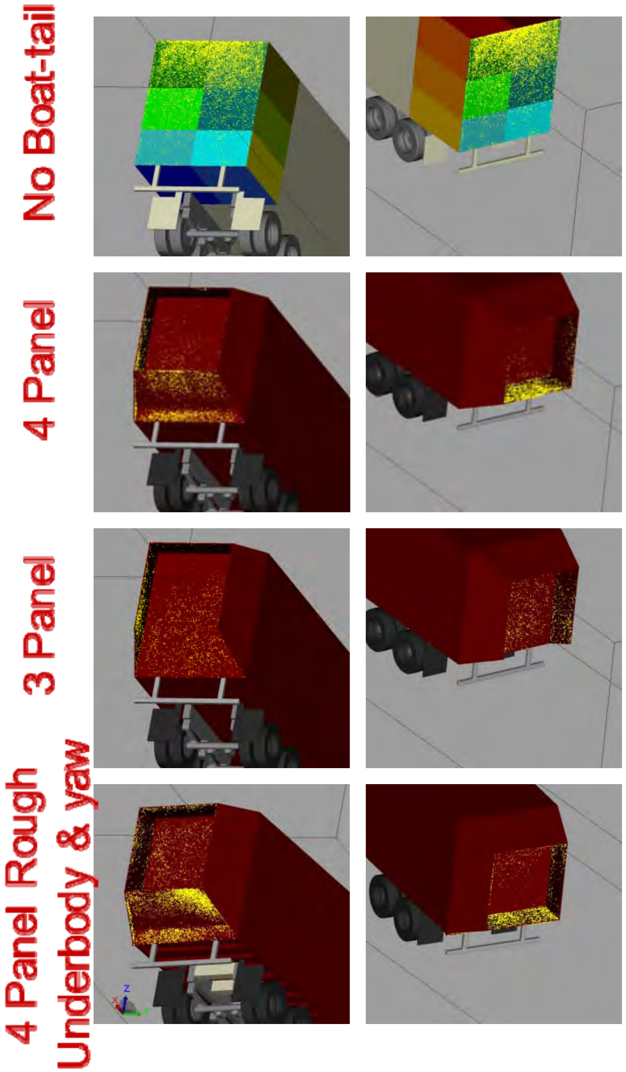
- PowerFLOW software model
- Approach selected after literature survey of related work
- 3-panel and 4-panel boat-tails
- Rough underbody (corrugated) for some cases
- Wind speed of 100 km/h
- Cross wind of 14 km/h (8° wind angle) for one case
- Ground speed of 100 km/hr
- Small-and-heavy or large-and-light particles are of greatest interest



PHASE 2: Snow Accumulation

Conclusions of Simulation Tests

- **Highest impingements without boat-tail**
- **Lowest impingements from 3-panel boat-tail**
- Source of impinging particles is from below trailer
- Rough (corrugated) underbody moves impingements from within boat-tail cavity to bottom surface of lower pane
- 4-panel boat-tail shows potential for 4 kg/hr snow accumulation in model scenarios



Thank You

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