Scope of Work
An Investigation of the Factors Leading to Ridge Vent Failure and Possible Mitigation Solutions

Proposal to Florida Department of Business and Professional Regulation
Florida Building Commission

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1. Introduction

Figure 1: House with significant interior damage from water intrusion (FEMA, 2019)

Ridge vents are common natural ventilation methods to introduce fresh air into an indoor space through natural forces, such as wind and/or thermal buoyancy, instead of mechanical energy [1]. Combined with a good intake vent, ridge vents let hot air be pushed up and out of the structure. There are two primary types of ridge vents: shingle-over vents and aluminum vents. A shingle-over vent is installed over the ridge of a roof and is covered by asphalt shingle caps that match the surrounding roof shingles. An aluminum ridge vent has a mushroom-shaped profile combined with a wide flange on both sides that sits on top of the roof shingles. This aluminum cap is the finished product and does not require additional asphalt shingle ridge caps. The ridge of the roof is prepared similarly for both types of ridge vents [2].

Wind-driven water intrusion can cause catastrophic damage to the walls, ceilings, interiors, and possessions of homes, leading to significant disruption. The main sources of water intrusion into houses (aside from floods) arise from windows and doors, attic vents (including the ones on the roof, vents on gable end walls and soffits (eave and gable end), wall penetrations for utilities, cracks in wall siding. Especially, the loss of ridge vent can expose large openings in the roof deck to water infiltration. Therefore, it is important to understand to causes of ridge vent failure. *Figure 1* shows the interior of a home that suffered extensive interior water damage due to the failure of ridge shingles and the ridge vent.

We propose to perform computational fluid dynamics (hereinafter CFD) simulations to study factors leading to ridge vent failure. The proposed study complements the **Recommendation FL-16a** of the research topics proposed by the FEMA, which states:

"2) Recommendation #FL-16. Industry groups and academia should perform research on commonly used ridge vent products to better determine the causes of ridge vent failure and develop solutions.

More research should be considered by industry groups (e.g., manufacturers, insurance organizations—IBHS, builders, trade associations—NRCA) to determine why ridge vent failure was observed to be widespread and whether these failures were the result of design, installation, testing (including for wind-driven rain infiltration), inspection, manufacturing, or other issues. Information to help improve the performance of ridge vents in high-wind areas can be found in Hurricane Michael in Florida Recovery Advisory 2, Best Practices for Minimizing Wind and Water Infiltration Damage (in FEMA P-2077, 2019a).

- *Clear definition of the problem to be researched: What causes ridge vents to fail and what can be done to mitigate these failures to prevent water-infiltration?*

Conclusion FL-16 The failure of ridge vents contributed to significant water infiltration at many sites.

The loss of ridge vents can expose large openings in the roof deck to water infiltration. Water infiltration can cause extensive interior damage, contribute to the growth of mold and mildew, and result in degraded building function or downtime until repairs are made."

2. Relevant Sections of the Code

a. Chapter 12 of the Florida Building Code: Interior Environment; Section 1203, Ventilation.

3. Tasks

Task 1 – House and Ridge Vent Model

Numerical simulations will be used to investigate how the design parameters of ridge vents affect the efficiency of natural ventilation. A model of the house and the vent is needed to perform such simulations. An example building model created using CFD software [3] is shown in *Figure 2*. We will use a similar approach in the present study, where we will model a house with a shingle-over ridge vent.

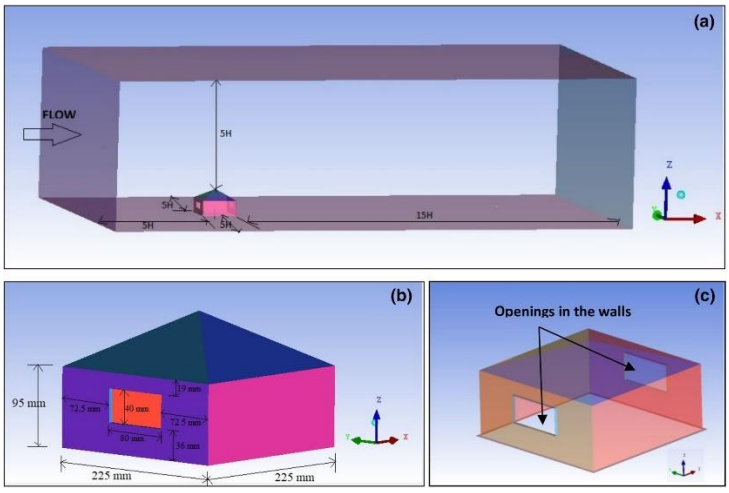

Figure 2: Example CFD model domain [3].

For the ridge design, standard ridge vent specifications will be used. For example, *Figure 3* below shows a ridge vent available at Lowe's [4]. These specifications could be used to model the ridge vent in the numerical

simulation. An unstructured, tetrahedral mesh will be used once the building and the ridge vent model is completed.

Figure 3: Example of an actual ridge vent [4].

Task 2

The present study will use the commercial CFD code, ANSYS FLUENT 2022 R1, to simulate the airflow around the house and the ridge vent. The simulations will be split into two different groups:

1. Different wind speeds and directions will be used as boundary conditions to investigate the impacts on the ridge vent.
2. Ridge design parameters such as angle will be changed to investigate the tendency of the ridge vent to fail.

The results obtained from the aforementioned simulations will be analyzed to determine the effect of the wind directions and speed and design of the ridge vent.

4. Deliverables

A detailed report will be submitted and will include the following:

a. Model and mesh setup.
b. Airflow dynamics and study design.
c. CFD simulations with different wind and ridge vent parameters.
d. Analysis of the results.
e. Recommendations for mitigating ridge vent failure as indicated by the study.

5. Contract Details

Personnel

PI: Cigdem Akan, University of North Florida, USA
Graduate Student: TBD, University of North Florida, USA
Undergraduate Student: TBD, University of North Florida, USA
Undergraduate Student: TBD, University of North Florida, USA

Method of Payment

A purchase order will be issued to the University of North Florida. This project shall start on the date of execution of the purchase order and end at midnight on June 15, 2023, and shall not exceed $77,616 and will cover all costs for labor, materials, and overhead. Payment will be made for the study after the Contract Manager and the Florida Building Commission's Hurricane Research Advisory Committee have approved the final report.

6. Performance Measures and Financial Consequences

TERI at UNF is solely responsible for the satisfactory performance of the tasks and completion of the deliverables as described in this Scope of Work.

7. Contract Manager

The Contract Manager for this purchase order is Cheresa Boston and the Program Manager is John Kantner.

8. References

[1] C.-M. Chen, Y.-P. Lin, S.-C. Chung, and C.-M. Lai, "Effects of the Design Parameters of Ridge Vents on Induced Buoyancy-Driven Ventilation," *Buildings*, vol. 12, no. 2, p. 112, Jan. 2022, doi: 10.3390/buildings12020112.

[2] "How to Install a Ridge Vent on a Shingled Roof." https://www.thespruce.com/ridge-vent-installation-2902123 (accessed May 02, 2022).

[3] J. Singh and A. K. Roy, "Effects of roof slope and wind direction on wind pressure distribution on the roof of a square plan pyramidal low-rise building using CFD simulation," *Int J Adv Struct Eng*, vol. 11, no. 2, pp. 231–254, Jun. 2019, doi: 10.1007/s40091-019-0227-3.

[4] "Owens Corning Roof Ridge Vent." https://www.lowes.com/pd/Owens-Corning-Roof-Ridge-Vent/50114120?cm_mmc=shp-_-c-_-prd-_-bdm-_-ggl-_-PLA_BDM_103_Roofing-Gutters-_-50114120-_-online-_-0-_-0&ds_rl=1286981&gclid=CjwKCAjwgr6TBhAGEiwA3aVuIR5JnLijctx7Zmnw4VOX1YOSr5b7RUfBamZE_pCQEzl7YkqenpZGsBoCIlAQAvD_BwE&gclsrc=aw.ds (accessed May 02, 2022).