

# Campbell University

## *Hobson Performing Arts Center Smoke Evacuation System Design*



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RMF Project No. 220031.A0



**PROJECT TEAM**

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**SCALENE DESIGN**  
FUNCTION + STRUCTURE + FORM

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**INTRODUCTION AND OVERVIEW**

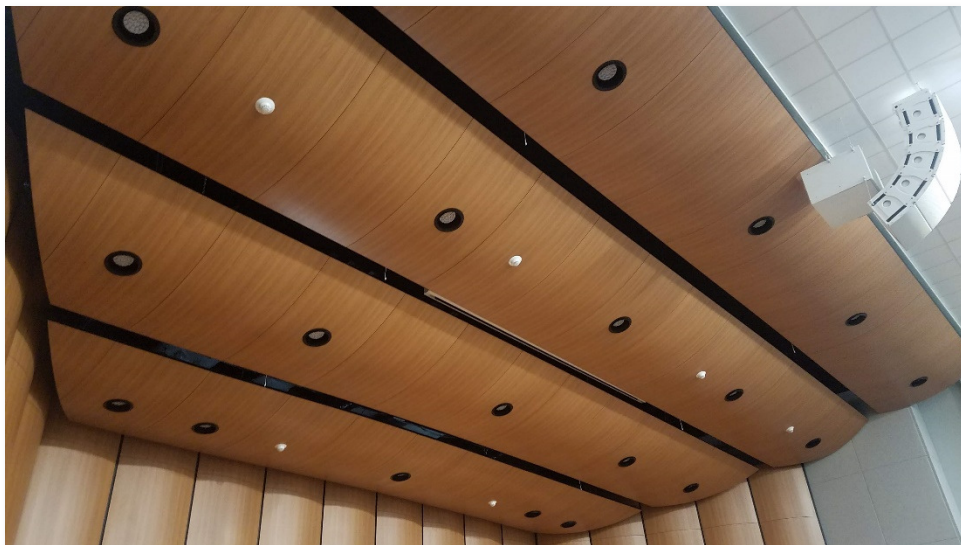
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The Hobson Performing Arts Center is located at the northern end of the Academic Circle, in the heart of Campbell University campus. The original D. Rich Hall was built in 1923 but a renovation, completed in late 2019, transformed and expanded the performance stage.



The project to enhance the stage did not include a smoke evacuation system which is a requirement of the 2012 North Carolina Building Code. The local Harnett County Inspector is requiring a system to be designed and installed, which will need to meet the requirements of the current 2018 Building Code.

The 2019 renovation to the Hobson Performance Center installed a wooden acoustical shell to the stage area to enhance the sound quality of performances. The top of the shell is made up of four panels suspended from structure above, as shown below.



## **INTRODUCTION AND OVERVIEW**

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Directly above the stage area, the space extends up to the bottom of the roof deck. The new acoustical shell is the only obstruction, unlike over the seating area, which has a lay-in acoustical ceiling installed below an existing plaster ceiling.

Chapter four of the 2018 NC Building Code provides special requirements for different space types. Section 410 is specific to performance stages and 410.3.7 defines when a stage requires a ventilation system. Any stage that is larger than 1,000 square feet must have either naturally ventilating roof vents or a powered smoke control system.

### **410.3.7 Stage ventilation.**

Emergency *ventilation* shall be provided for *stages* larger than 1,000 square feet (93 m<sup>2</sup>) in floor area, or with a *stage* height greater than 50 feet (15 240 mm). Such *ventilation* shall comply with Section 410.3.7.1 or 410.3.7.2.

#### **410.3.7.1 Roof vents.**

Two or more vents constructed to open automatically by *approved* heat-activated devices and with an aggregate clear opening area of not less than 5 percent of the area of the *stage* shall be located near the center and above the highest part of the *stage* area. Supplemental means shall be provided for manual operation of the ventilator. Curb shall be provided as required for skylights in Section 2610.2. Vents shall be *labeled*.

#### **[F] 410.3.7.2 Smoke control.**

Smoke control in accordance with Section 909 shall be provided to maintain the smoke layer interface not less than 6 feet (1829 mm) above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is provided in compliance with Section 410.3.4.

The renovated stage area is approximately 1,415 square feet with the acoustical shell in place which requires the smoke removal system. Option 1 (automatic roof vents) is the design team and Campbell University's preferred method for meeting the building code requirements as it is the least disruptive to the building.

Option 2 requires a system to be designed in accordance with Section 909 of the 2018 NC Building Code, Smoke Control Systems. This section provides guidance for calculating and designing different smoke control systems. Section 909.8 is provided below.

### **[F] 909.8 Exhaust method.**

Where approved by the fire code official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. Smoke control systems using the exhaust method shall be designed in accordance with NFPA 92.

#### **[F] 909.8.1 Smoke layer.**

The height of the lowest horizontal surface of the smoke layer interface shall be maintained not less than 6 feet (1829 mm) above a walking surface that forms a portion of a required egress system within the smoke zone.

**INTRODUCTION AND OVERVIEW**

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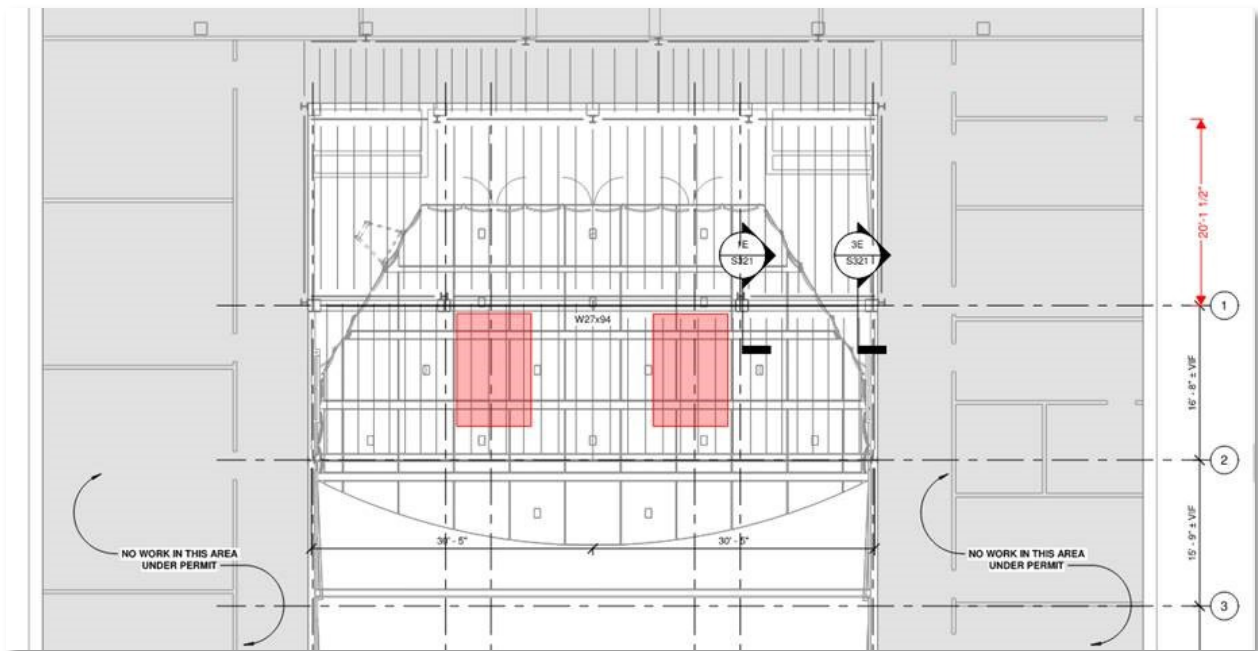
The 2018 NC Building Code references the 2015 version of NFPA 92 (National Fire Protection Association). Should option 2 be required by the local authorities, methods and calculations would follow the recommendations and requirements defined in this standard. The 2012 ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) Handbook of Smoke Control Engineering would also be referenced as this handbook is written in conjunction with the International Code Council (ICC), the SFPE (Society of Fire Protection Engineers), and the National Fire Protection Agency (NFPA).

It has been determined that option 1 is an acceptable method of smoke evacuation during an onsite meeting on March 10, 2020 with Brad Sutton, Harnett County Manager of Building Services, and Banks Wallace, Chief Deputy Fire Marshal. It was determined that the acoustical shell has enough separations of sufficient size to allow heat and smoke to collect above and trigger an automatic smoke vent to open in the event of a fire. The following report is supplemental to separate design documents and specifications and is intended to document the calculations and decisions made during design.

**DESIGN PROCEDURE**

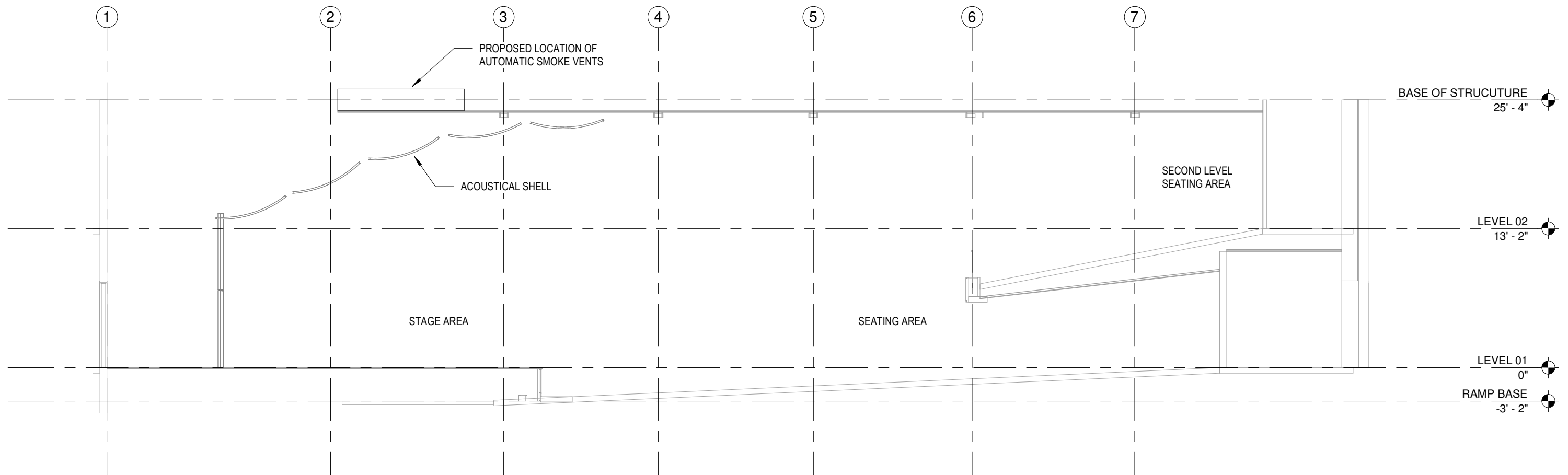
The smoke evacuation system design incorporates the full size of the renovated stage and back of house areas as the acoustical shell walls could be removable. This design area is equal to 2,100 sq-ft. The 2018 NC Building Code mandates the installation of automatic smoke vents with an opening area of at least 5% of the stage area. This equates to 105 sq-ft. The proposed design will install two (2) automatic smoke vents 144"x66" (66 sq-ft) to achieve this requirement, which is roughly 25% more than necessary. Smaller vents were considered but creating fewer roof penetrations and installing non-custom sizes were important for a quicker construction schedule.

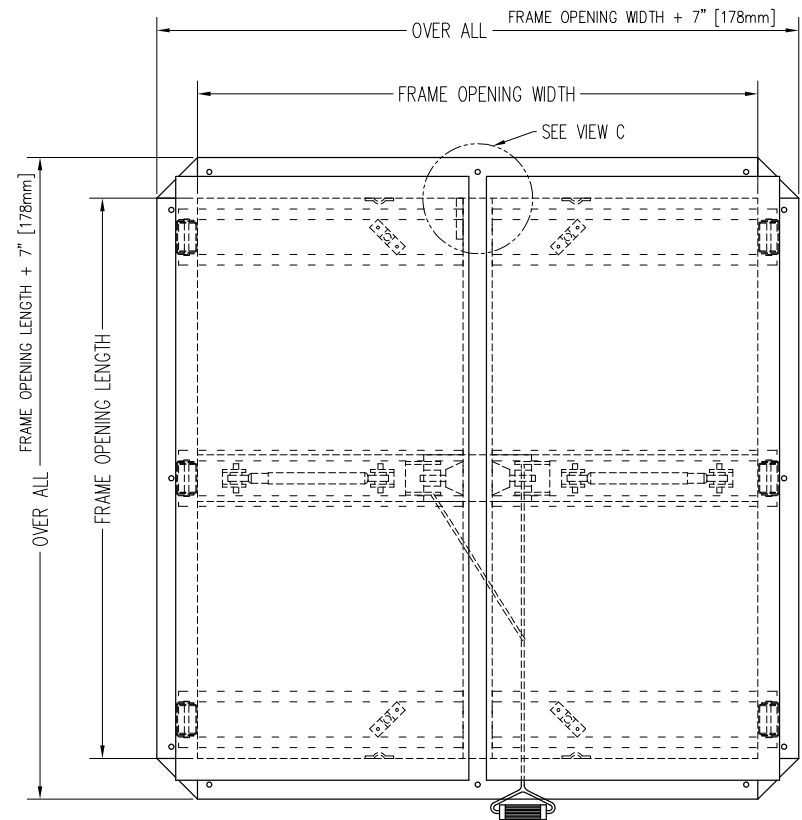
The smoke vents will be installed directly above the stage area as indicated on the following drawings. The basis of design for the equipment is the Bilco DSH66144B, which is aluminum to reduce the overall weight, and comes with an integral roof curb. Additional structural supports will be installed as required to support the roof mounted equipment. A permanent means of access to the roof is required and will be installed under this project. A fixed uncaged ladder will be installed on the side of the building.



Luke Richards, PE

RMF Engineering, Inc.





| DSH-SIZE CHART |            |                  |                                       |  |  |
|----------------|------------|------------------|---------------------------------------|--|--|
| MODELS         |            |                  | SIZE                                  |  |  |
| STEEL          | STEEL/ALUM | ALUM             | WIDTH x LENGTH                        |  |  |
| DSH4848        | DSH4848A   | DSH4848B         | 4'-0" x 4'-0"<br>[1220mm] x [1220mm]  |  |  |
| DSH4872        | DSH4872A   | DSH4872B         | 4'-0" x 6'-0"<br>[1220mm] x [1830mm]  |  |  |
| DSH4890        | DSH4890A   | DSH4890B         | 4'-0" x 7'-6"<br>[1220mm] x [2285mm]  |  |  |
| DSH4896        | DSH4896A   | DSH4896B         | 4'-0" x 8'-0"<br>[1220mm] x [2440mm]  |  |  |
| DSH6060        | DSH6060A   | DSH6060B         | 5'-0" x 5'-0"<br>[1525mm] x [1525mm]  |  |  |
| DSH6072        | DSH6072A   | DSH6072B         | 5'-0" x 6'-0"<br>[1525mm] x [1830mm]  |  |  |
| DSH6084        | DSH6084A   | DSH6084B         | 5'-0" x 7'-0"<br>[1525mm] x [2135mm]  |  |  |
| DSH6096        | DSH6096A   | DSH6096B         | 5'-0" x 8'-0"<br>[1525mm] x [2440mm]  |  |  |
| DSH60120       | DSH60120A  | DSH60120B        | 5'-0" x 10'-0"<br>[1525mm] x [3050mm] |  |  |
| DSH6666        | DSH6666A   | DSH6666B         | 5'-6" x 5'-6"<br>[1675mm] x [1675mm]  |  |  |
| DSH66144       | DSH66144A  | <b>DSH66144B</b> | 5'-6" x 12'-0"<br>[1675mm] x [3660mm] |  |  |
| DSH7272        | DSH7272A   | DSH7272B         | 6'-0" x 6'-0"<br>[1830mm] x [1830mm]  |  |  |

DSH66144, DSH66144A & DSH-66144B HAS (4) COVERS

- SPECIFICATIONS**
- FRAME W/ CAPFLASHING (CORNERS FULL WELDED)
    - DSH - 14 GAUGE PAINT BOND GALV. STEEL
    - DSH A - 14 GAUGE PAINT BOND GALV. STEEL
    - DSH B - 11 GAUGE ALUMINUM
  - PINTLE HINGE
  - EPDM GASKET (ALL AROUND FRAME)
  - COVER GAUGE
    - DSH - 14 GAUGE PAINT BOND GALV. STEEL
    - DSH A - 11 GAUGE ALUMINUM
    - DSH B - 11 GAUGE ALUMINUM
  - COVER LINER
    - DSH - 22 GAUGE PAINT BOND GALV. STEEL
    - DSH A - 18 GAUGE ALUMINUM
    - DSH B - 18 GAUGE ALUMINUM
  - GAS SPRINGS WITH INTEGRAL DAMPER & HOLD OPEN FEATURE
  - 1" RIGID FIBERBOARD INSULATION
  - FIXED CENTER DRAIN
  - 165° FUSIBLE LINK (EXTRA LINK PROVIDED)
  - THERMOLATCH II® POSITIVE HOLD/RELEASE MECHANISM
  - COVER RESTRAINT CABLE
  - 1" FIBERGLASS COVER INSULATION
    - DSH60120A - 2" FIBERGLASS COVER INSULATION
    - DSH60120B - 2" FIBERGLASS COVER INSULATION
  - HOLD OPEN PIN RELEASE
  - PULL GRIP TO OPEN FROM INSIDE 1/8" DIA. STEEL CABLE
  - PULL GRIP TO OPEN FROM OUTSIDE 1/8" DIA. STEEL CABLE
  - COVER LATCH BRACKET
  - BILCLIP® FLASHING SYSTEM

SHOP FINISH:  
 STEEL: RED OXIDE PRIMER  
 ALUMINUM: MILL FINISH  
 HARDWARE: ZINC PLATED & CHROMATE SEALED  
 (UNLESS OTHERWISE SPECIFIED)

THIS PRODUCT MAY BE INSTALLED ON EITHER A FLAT OR SLOPING ROOF. WHEN INSTALLED ON A SLOPE, THE HINGE SIDE MUST RUN PARALLEL WITH THE SLOPE. IF SLOPE EXCEEDS 30°, ADVISE FACTORY FOR MODIFICATION.

CUSTOMER: \_\_\_\_\_

P.O. N° \_\_\_\_\_

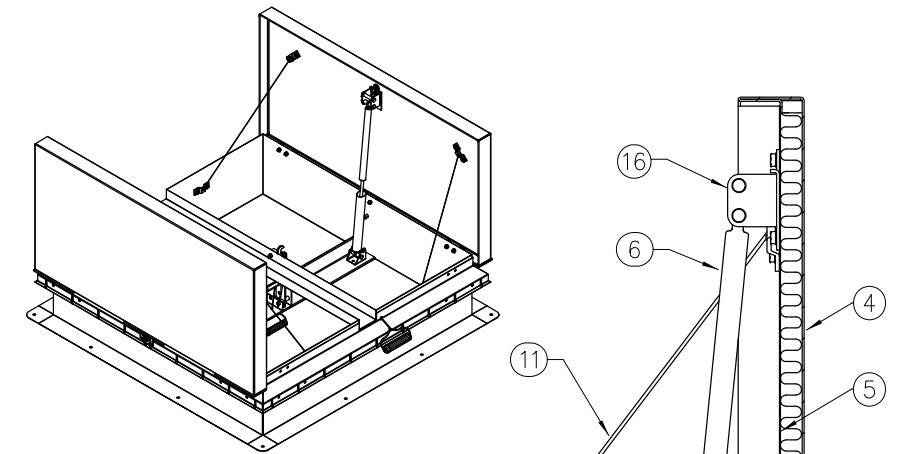
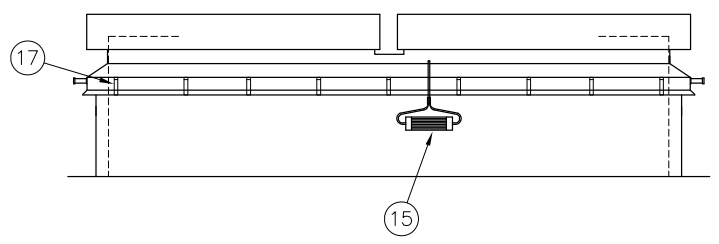
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SALES REP: \_\_\_\_\_

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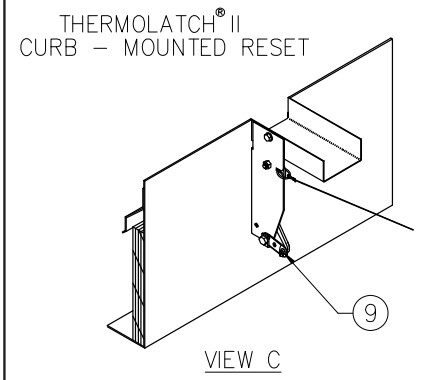
**DOUBLE LEAF FIRE VENT - TYPE DSH**

| QTY | MODEL     | SIZE           |
|-----|-----------|----------------|
| 2   | DSH66144B | 5'-6" x 12'-0" |

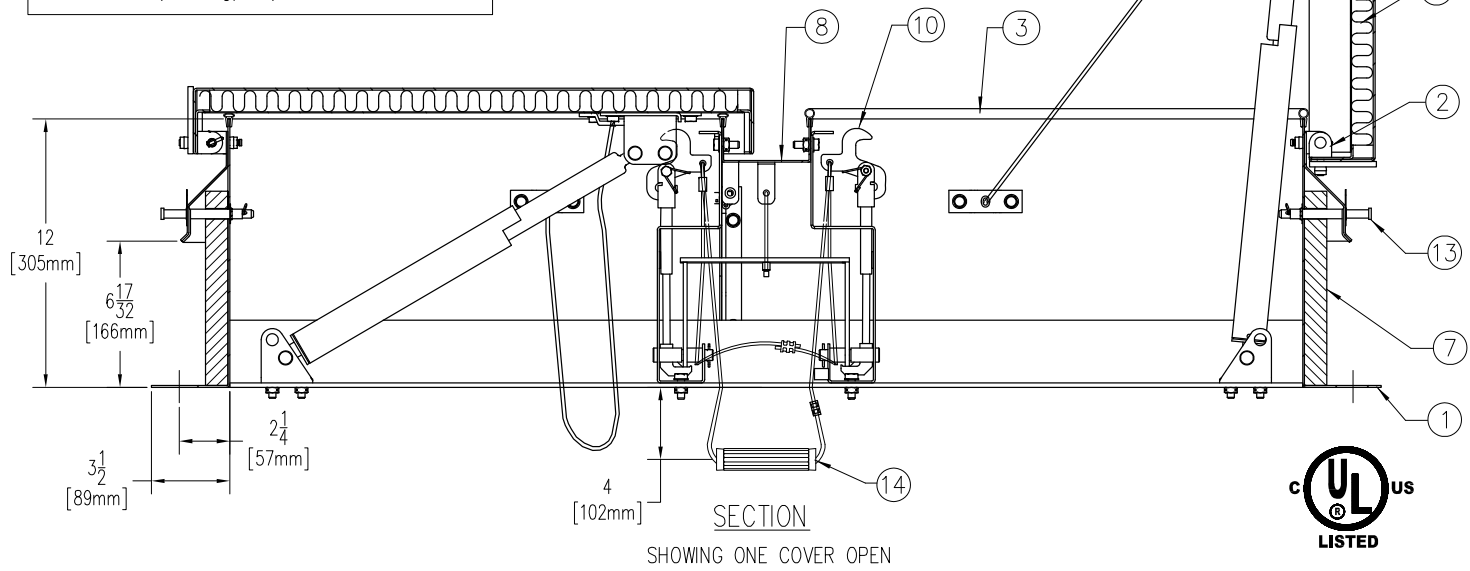


**NOTE**

- COVERS SHALL OPEN AGAINST 10 PSF (49 kg/m<sup>2</sup>) SNOW/WIND LOAD
- VENT ASSEMBLY RATED FOR 40 PSF (195 kg/m<sup>2</sup>) LIVE LOAD
- COVERS WILL REMAIN CLOSED UNDER 90 PSF (438 kg/m<sup>2</sup>) WIND UPLIFT FORCE



- THERMOLATCH MECHANISM - COVERS WILL OPERATE ONLY WHEN ACTIVATED
  - MANUALLY
  - BY HEAT AT 165° FUSIBLE LINK
- MANUFACTURER TO PROVIDE LABEL WITH INSTRUCTIONS TO RESET LATCH ON INTERIOR OF FRAME



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