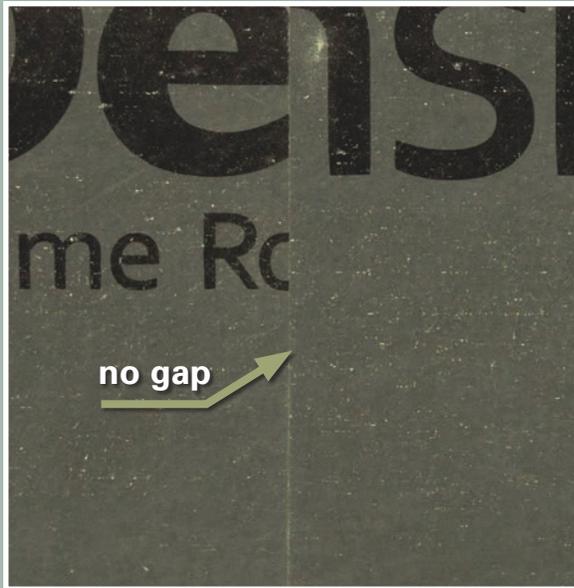


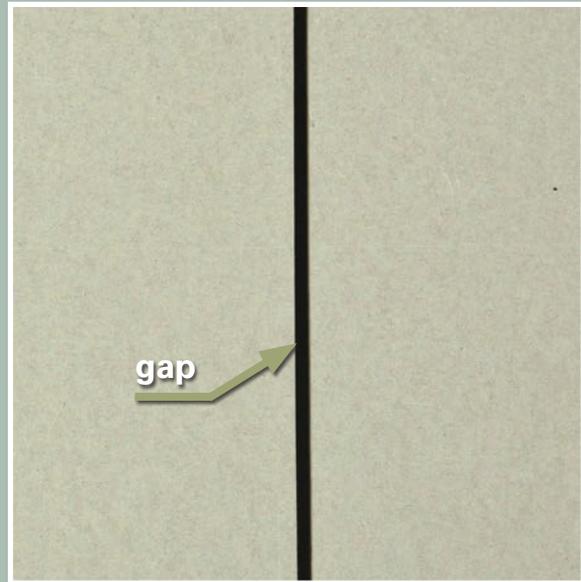


## To Gap or Not To Gap: That is the Question!

CJ Sharp, DensDeck® Technical Manager  
Georgia-Pacific Gypsum



*DensDeck® Roof Boards*



*Gypsum Fiber Roof Boards*

Roofs, just like the entire structure, are designed to be dynamic. The effects of temperature extremes, and internal and external forces, have significant impacts on performance. It's important to understand the dynamics of the roof cover board *in situ* and the effects of temperature extremes on the entire roofing assembly.

DensDeck® Roof Boards have been used for nearly thirty years as thermal barriers and cover boards. Billions of square feet of DensDeck panels have been placed in roofs all over the world due to their versatility, durability and dimensional stability.

### **Dimensional Stability Means No Gapping**

A key point when comparing DensDeck roof boards with competitive gypsum fiber roof boards is that DensDeck panels have superior dimensional stability due to a low coefficient of **thermal expansion** (approx. 0.0000085 in/in/°F) combined with a low coefficient of **hygrometric expansion** (approx. 0.00000625 in/in/%RH). Materials that are dimensionally stable show limited expansion with rising temperatures and increases in relative humidity—and the panels can be butted tightly together, avoiding the need to

install the panels with gaps, which affects installation procedures.

***No gapping is required when using any thickness of DensDeck panels as a cover board. Gypsum fiber boards require a minimum 1/16" gap on all sides and the gap could be up to 1/4", depending on temperature and humidity considerations. DensDeck panels are the "no gapping" solution.***

The use of DensDeck roof boards allows the contractor to install the cover board layer in the most efficient way (i.e. with all joints butted tightly together) and gives the owner, architect and roofing consultant the peace of mind that expansion issues will not arise as the roof ages.

### **What Causes Thermal and Hygrometric Expansion and Why Does It Matter In Commercial Roofs?**

Most materials expand when heated due to greater vibration of the atoms that make up the material. Also expansion occurs as the relative humidity changes and the material absorbs moisture from the environment.

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The linear coefficient of thermal expansion and the coefficient of hygrometric expansion describe the relative change in *length* of a material per degree change and per change in relative humidity, which is shown in the following equations:

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**Thermal Expansion:**

$$\alpha_t = \frac{\Delta l}{l_i \Delta T}$$

where:  $\alpha_t$  = coefficient of thermal expansion  
 $\Delta l$  = change in length  
 $l_i$  = initial length  
 $\Delta T$  = change in temperature

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**Hygrometric Expansion:**

$$\alpha_h = \frac{\Delta l}{l_i \Delta \%RH}$$

where:  $\alpha_h$  = coefficient of thermal expansion  
 $\Delta l$  = change in length  
 $l_i$  = initial length  
 $\Delta \%RH$  = change in % relative humidity

The equations show that the expansion of the material is linearly proportional to the initial length of the material (i.e. the length or width of the roof assembly) and the temperature change (i.e. the difference between the temperature during installation to the maximum and minimum temperatures the roof system is exposed to during the service life of the roof.)

Thermal expansion and contraction must be taken into account when designing high-performance roof systems, particularly where long runs are required. To avoid significant stresses in the roofing materials, there are two approaches that can be employed.

**First Approach**

The first and much less complicated approach involves the selection of roofing components with sufficient dimensional stability to prevent the need for gaps between and around each board. Cover boards such as DensDeck® and DensDeck® Prime panels eliminate gapping requirements.

**Second Approach**

The second is to calculate the amount of expansion that is expected across the range of conditions the roof will experience and design the appropriate gaps to allow the materials to expand without generating excessive compressive stresses.



Since the roofing contractor is responsible for the proper installation of roof boards, among many other components, he needs to calculate the amount of expansion that is expected across the range of conditions the roof will experience to allow the materials to expand or contract without affecting roof performance. This can be done by gapping cover boards in the length and width directions. Gapping, however, can be problematic for a number of reasons, such as:

- Estimating the amount of expansion the roof materials will experience requires that the correct formulas are used with the correct expansion coefficients. An understanding of the maximum temperature and percent relative humidity is also required to assess the extreme condition the roof system will experience over time.
- Once the gap requirements have been determined, the installation process must ensure the gaps are maintained appropriately across the entire roof assembly, placing added responsibility on the installer.
- In fully adhered applications, adhesive will flow into the gaps between the boards and be wasted. This means more adhesive is required to complete the job which increases the cost of installation.
- Wasted adhesive that runs into the gaps means longer wait times until the pooled adhesive flashes. Additionally, possible damage to the insulation layer below may occur,

and there is the potential for blistering of the membrane above, at board joints, due to trapped solvents.

- Other important performance attributes may be adversely affected like fire resistance, sound resistance, and the total effective R-value of the assembly. This is particularly important in cold conditions when the initial gaps become larger as the materials contract.

*\*\*3 in. insulation plates and #12 fasteners*



### In Summary

Understanding the dynamics of thermal expansion is critical when choosing a roof cover board. Consider dimensional stability, gapping requirements, adhesive use, durability and performance when making the decision between fiberglass mat gypsum cover boards and gypsum fiber boards. With almost three decades of proven performance, DensDeck® Roof Boards are the clear choice for cover boards that are easy to install, dimensionally stable, and will provide resistance to fire, foot traffic, hail damage and sound intrusion.



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