

Concrete Surface Profiles: A Critical Factor in Roof System Bonding

By Peter Gross

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Introduction

In the roofing industry, the surface profile of structural concrete roof decks can significantly impact the long-term performance of roof systems. It is critical to understand how to prepare the roof deck surface in order to achieve the appropriate Concrete Surface Profile (CSP) for the attachment method. CSPs were developed by the International Concrete Repair Institute. CSPs provide a standardized scale—from 1 to 10—that describe the texture and roughness of concrete surfaces. See Figure 1. This paper will focus on the range of CSPs that are most suitable for attaching roofing materials, specifically CSPs 2 to 5, and why these levels are critical for ensuring proper adhesion and durability.



Figure 1: Photo showing physical samples of Concrete Surface Profiles 1 through 10 (R to L) as developed by the International Concrete Repair Institute

Understanding Concrete Surface Profiles

Concrete Surface Profiles (CSPs) are a way to describe the texture and roughness of a concrete surface. The scale ranges from CSP 1, which is nearly smooth, to CSP 10, which is very rough. These profiles are based on the depth from the peaks of the surface to the valleys. Achieving the appropriate CSP is crucial for the effective bonding of coatings, sealants, and roofing materials, as CSP affects how well these materials adhere to the concrete surface.

Suitability of CSPs for Roofing Attachment

When preparing concrete surfaces for roofing, the correct level of roughness is essential. This is where CSPs come into play. For roofing applications, CSPs 2 to 5 are generally recommended. See Figure 2. Here's a brief overview of each relevant profile:

CSP 2 (Smooth but Sandpaper-Like): This level provides a relatively smooth surface with a texture akin to sandpaper. It is ideal for thin coatings and membranes that require a certain amount of grip but not excessive roughness.

CSP 3 (Medium Sandpaper Texture): CSP 3 offers a slightly rougher texture, suitable for a wider variety of roofing materials. This texture helps improve the mechanical bond between the concrete surface and the roofing material, ensuring a secure attachment.

CSP 4 (Light Scarification): Achieved through light scarification, CSP 4 provides a more pronounced texture. This profile is particularly beneficial for materials that require a strong mechanical bond, as the increased surface area allows for better adhesion.

CSP 5 (Medium Scarification): This profile involves a rougher surface texture achieved through more aggressive scarification or shot blasting. CSP 5 is excellent for thicker coatings and materials that need a substantial mechanical bond to the substrate.

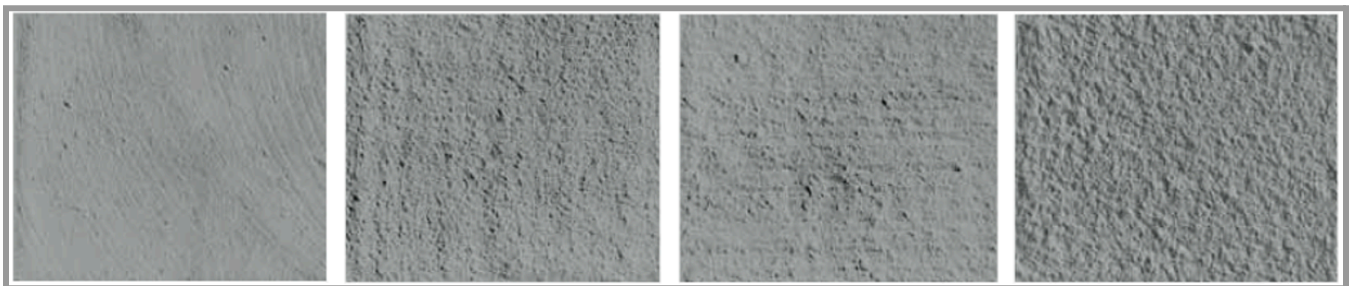


Figure 2: From left to right, photos of the individual CSP samples (as shown in Figure 1) of Concrete Surface Profiles 2 to 5

The Importance of Surface Roughness

Surface roughness of a concrete deck is a key factor in ensuring successful attachment of roof systems. The primary reasons include:

Increased Surface Area: A surface with some roughness offers the appropriate amount of surface area for roofing materials to bond, providing strength and stability of the attachment.

Improved Mechanical Bond: The irregularities on the surface create a mechanical interlock between the adhesive or roofing material and the concrete substrate, which is crucial for maintaining a strong and lasting bond.

For example, the use of low-rise foam requires the concrete roof deck has a surface profile that provides adequate “bite” for the foam to ensure proper long-term adhesion. See Figure 3. This is also true for adhesion of a self-adhering vapor retarder. See Figure 4.



Figure 3: Low-rise foam application over a concrete roof deck with a CSP of 2



Figure 4: A self-adhering vapor retarder application over a concrete roof deck with a CSP of 3

Considerations for Excessive Roughness

While a certain level of roughness is beneficial for adhesion, it's important to understand that a profile that is too rough can have drawbacks, particularly in terms of material usage and surface contact area. CSPs higher than 5, characterized by deep grooves and pronounced textures, can require significantly higher coverage rates for some materials. The rough texture increases the surface area that needs to be covered, leading to greater material consumption. This not only raises the cost of materials but can also complicate the application process, requiring more labor and potentially increasing the time needed for installation.

In such cases, careful consideration must be given to the choice of adhesive and application technique for adhesively applied materials. Using high-viscosity adhesives or those specifically formulated for rough surfaces can help mitigate these challenges. Additionally, contractors may need to adjust their application methods to ensure even coverage and adequate bonding, despite the increased roughness.

For self-adhered (SA) roofing materials, higher CSPs may reduce the contact area between the concrete and the SA material that is being installed, reducing the ability for the two materials to adhere to each other.

Ramifications of Too Smooth Structural Concrete Surfaces

Conversely, an overly smooth concrete surface, often classified as CSP 1, can also pose significant challenges for roof system attachment. A smooth or polished surface lacks the necessary texture to provide sufficient adhesion and mechanical bonding. As a result, roofing systems may not adhere properly, leading to several potential issues:

Poor Adhesion: A smooth surface offers a reduced surface area (relative to CSPs 2 through 5), reducing the effectiveness of adhesives. This can result in a weak bond that may fail under wind uplift conditions.

Increased Risk of Separation: Without adequate bonding, roofing materials are more prone to separation, where the roofing membrane and/insulation system does not stay attached to the substrate. This can lead to lateral water migration if the membrane is breached, potentially allowing residual moisture to remain within the system. Lateral water migration may also allow water to get to the interior of the building away from the membrane breach, which can make locating the source of a leak and repair of the membrane difficult. Residual water that remains in the roof system may also reduce its overall thermal performance. Non-adhered membranes that are intended to be adhered may be significantly more vulnerable to damage from wind events due to reduced wind uplift capacity.

Shortened Roof Service Life: The lack of a strong bond may also accelerate wear and tear on the roofing system, potentially leading to premature failure and the need for costly repairs or replacement. When a roof is not properly adhered or attached it may be more susceptible to wind fluttering and continued separation. Changes in temperature cause expansion and contraction and when unadhered, may result in differential movement, which can exacerbate separation of the membrane to the substrate, and potentially cause wrinkles and buckles. Wrinkles and buckles may block drainable paths and can make the membrane more susceptible to damage from foot traffic or equipment used on the roof.

Correcting Surface Profile

To mitigate an incorrect CSP, contractors can employ surface preparation techniques to decrease or increase the roughness of overly rough or overly smooth concrete roof deck surfaces. Mechanical abrasion, such as scarifying and shot blasting, can be used to achieve a more suitable CSP. See Figures 5 and 6, respectively. Proper use of these abrasion techniques alters the surface profile and creates an appropriate texture on the concrete surface, improving the potential for proper adhesion, and helping to ensure a more durable and long-lasting roof system installation.

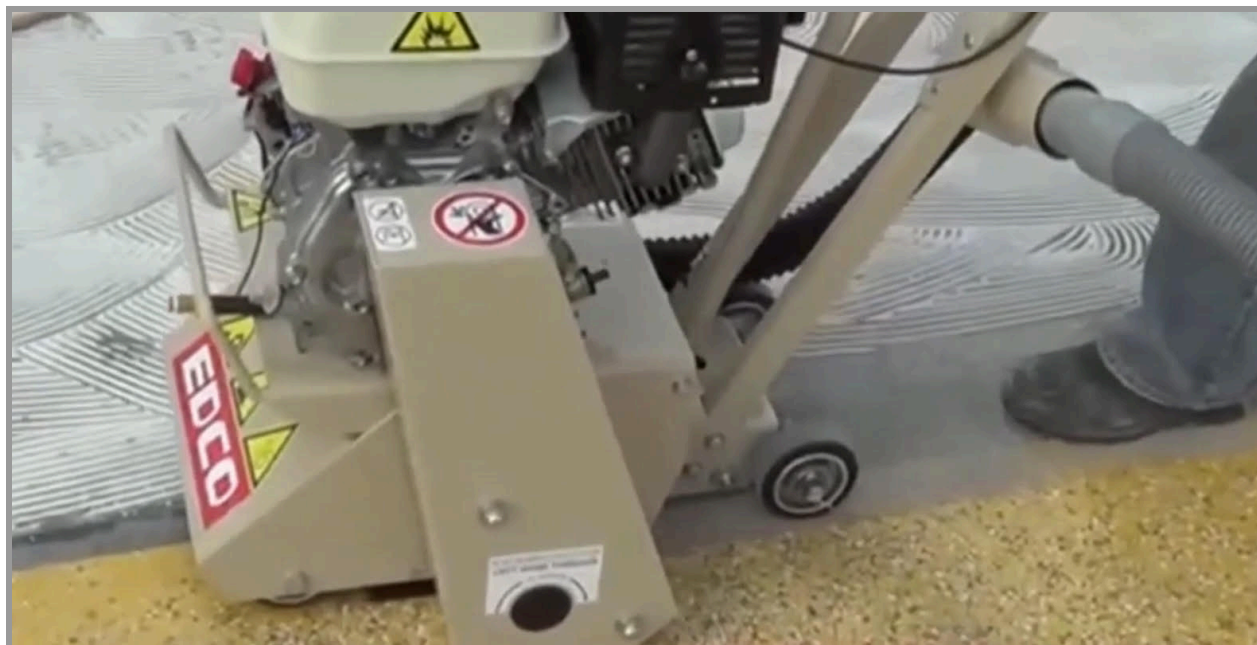


Figure 5: A photo of equipment used to scarify a concrete deck



Figure 6: A photo of equipment used to shot blast a concrete roof deck

Conclusion

In summary, achieving the correct Concrete Surface Profile is crucial when preparing concrete roof deck surfaces for roof system attachment. CSPs 2 to 5 provide the optimal range of roughness necessary for ensuring proper adhesion and durability of most roofing materials. By understanding the importance of concrete surface profiles and specifying and constructing them correctly, construction professionals can enhance the performance and lifespan of roofing systems.