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Roofing System Selection Criteria

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Abstract

The following document on roofing system selection criteria was adopted from a monograph, published in 2001 by the National Council of Architectural Registration Boards (NCARB).[1] The author prepared the monograph and it received a Special Publication Commendation from the Construction Specifications Institute (CSI). There are two monographs – Low-Slope Roofing I and Low-Slope Roofing II. Low-Slope Roofing I focused on built-up roofing systems, and included discussions on roof decks and insulation. Low-Slope Roofing II focused on other types of low-slope systems and included the following chapters:

- Membrane Materials
- Design Considerations
- Reroofing Considerations
- Sustainable Design Considerations
- System Selection Criteria
- Warranty Considerations
- Key Elements of Specifications and Drawings
- Construction Contract Administration
- Problems after Job Completion

1. Introduction

Not long ago, roof system selection was simple. Built-up roofs were specified for almost all low-slope roofs. In North America, selection issues were primarily limited to the type of bitumen to use (asphalt or coal tar), the ply reinforcement material, the type of membrane surfacing and the type of insulation (with the choices being very limited). This began to change in the 1970s with the emergence of plastic foam insulations, the introduction of modified bitumen and thermoplastic membranes from Europe, and the growth of thermoset membranes, sprayed polyurethane and low-slope metal roofing. By the 1980s, the diversity of systems made the selection of the most appropriate roof system for a specific project a daunting task. The selection process is difficult because of the large number of factors, many of which are unrelated or conflict with one another, and the lack of key data (such as realistic design service life). A computer-integrated knowledge-based (also known as *expert*) system would greatly benefit the selection process, but such a system has not been developed for roofs.

For most roofs, several different types of systems could serve quite well. But some roofs have unique characteristics that lend themselves to perhaps only a few systems. In order to select the most appropriate system for a project, ideally the architect should have at least a general understanding of the membrane options described in the "Membrane Materials" chapter, as well as a general understanding of built-up roofing. Unless the architect is aware of all the different options available, he or she may overlook the most appropriate system for a particular project.

If the architect lacks a general understanding of low-slope system options (particularly if the project is complex, unusual, very expensive or is a reroofing project), the architect should seek system selection input from a professional roofing contractor or professional roof consultant who is knowledgeable about all system options.

In the context of this chapter, system selection refers to selection from the primary system types discussed earlier in the "Membrane Materials" chapter (modified bitumen, single-ply, sprayed polyurethane foam, liquid-applied, and metal panels) and BUR. It also refers to selection of

[1] *Copies can be obtained from NCARB using the order form available in the handout folder.*

Adapted from Low-Slope Roofing II (National Council of Architectural Registration Boards), 2001

membrane materials within system types (type of bitumen or modified bitumen, type of single-ply membrane, type of surfacing on an SPF, or type of metal panel profile) and, where applicable, the attachment configuration (fully adhered, ballasted, mechanically attached, PMR, or loose-laid air-pressure equalized).

In this chapter, system selection criteria are discussed first. The selection of the manufacturer is addressed thereafter.

2. System Selection

With a general understanding of the available system options, consideration of the following technical and non-technical criteria can lead to the selection of the most appropriate system and details for a project:

2.1 system demise

2.2 contractor familiarity and availability

2.3 maintenance intensity

2.4 owner familiarity

2.5 technical considerations

2.6 cost

2.7 warranty

2.8 implications of sustainable roof design.

The first seven criteria have been listed in order of importance, per the author's opinion. If the architect is interested in emphasizing sustainable design principles, sustainable design criteria would move up on the list (perhaps to third place). It is critical that the selected system sufficiently satisfies all of the criteria.

2.1 System Demise

The first step in the selection process is to determine what will likely cause the death of the roof system. Is the project, for example, located in an area that experiences frequent and damaging hailstorms? Will the roof experience constant or extremely strong winds? Does the roof have numerous HVAC units, the service of which will generate perpetual abusive foot traffic? Will the roof be exposed to intense solar radiation throughout most of its life? In some cases, one factor will likely cause system death. In other cases, perhaps two or three factors may be nearly equally as likely to end the roof's life. After identifying the likely causes of death, it is incumbent upon the architect to select a system with characteristics that can combat these destructive forces.

2.2 Contractor Familiarity and Availability

Good application is crucial to the long-term success of a roof. During the system selection process, therefore, the architect should consider the following:

- **Contractor familiarity with proposed system**

  Are contractors in the vicinity of the project site familiar with the systems being considered? If not, either a system should be selected that the contractors are familiar with, or a contractor should be brought in from outside of the project vicinity (this last option has downsides, as noted below). It is important to avoid having a contractor install a system that he or she is not extremely familiar with.

- **Contractor proximity to project site**

  It is preferable to have a contractor that has an office relatively close to the project site. The contractor will be familiar with the weather conditions, will be available to provide periodic inspection and maintenance if the owner desires to contract for this service (refer, "key elements of specifications and drawings" chapter), and will be readily available to provide repairs if needed. In some instances, because of size or complexity, the project demands may be beyond the capabilities of the local contractors. In this case, it may be prudent to have the work executed by a contractor outside of the project locale.

2.3 Maintenance Intensity

Maintenance is discussed in the "Design consideration" chapter. Maintenance intensity is listed as a separate system selection criterion because it is a factor that architects frequently overlook when selecting a roof system. It is important for the architect to try to determine how committed the building owner will be to having periodic inspections and maintenance performed. If the owner is likely to devote little or no attention to the roof, a roof system should be selected that has limited maintenance demands.

2.4 Owner Familiarity

If the building owner has only one or two buildings, owner familiarity with different types of roof systems generally is not an issue, although it is still wise to determine if the owner has a preference (or dislike) for a specific system, and why the owner has such a preference. Be cautious of discarding a system from consideration simply because the owner has had problems with it. The problems may have been caused by poor design, materials or application. It is important to try to avoid discarding an appropriate system from consideration because of poor work quality, unless it is believed that poor quality of work will be experienced again.

If the owner has multiple buildings, as in the case of a school board, the architect should request information on the type of systems, number of roofs within each system type, and the experience that the owner has had with the

various types. If a specific system has been a good performer, it is probably best to use that system on the upcoming project, unless the new project has unique characteristics that another system would be better able to accommodate. If the owner has periodic inspection, maintenance and minor repairs performed by in-house maintenance personnel, one advantage of keeping with the same type of system is that they will not have to become familiar with another system type. There have been many instances where owner maintenance personnel have inappropriately used BUR repair techniques on a single-ply membrane because they did not know better.

2.5 Technical Considerations

When selecting a system, it is important for the architect to determine whether the proposed system should more than just meet the minimum requirements. For example, if external fire resistance is particularly important for a project, then specifying a system that requires a field-applied coating to achieve the rating is probably not the best choice, as the fire resistance declines as the coating weathers away unless the owner is diligent about re-coating. A better choice would be a system that achieves a Class A rating without a coating. If enhanced protection is desired, a metal roof or paver-ballasted system could be the best choice.

2.6 Cost

Many architects and building owners select a roof system primarily on initial cost. Obviously cost is an important element of a project, but the ramifications should be understood when cost is a governing factor in system selection. If a less expensive system is selected, invariably something suffers in comparison with the systems that fell from consideration because of the greater cost. The cheaper system generally will not have the reliability or durability of other systems, it may be more maintenance intensive or it may not be as energy efficient. Over the life of the roof, the system with the lowest initial cost often is more expensive than other options that were discarded because of their higher initial cost.

In evaluating cost, it is important to look at the life-cycle cost (LCC). In addition to the initial construction cost, LCC includes energy consumption (for building heating and cooling), maintenance, repairs, length of design service life, and disposal at the end of the roof's life. Of these factors, the most difficult to assess is the design service life.

The service life can have a dramatic impact on the LCC analysis. For example, if a 40-year service life is assumed, but the roof fails after 15 years, the owner's true roofing costs will be much higher than calculated. Lack of good data on design service life is often a significant limitation to developing a reliable LCC. For example, it is difficult to have confidence in a manufacturer's claim of a 30-year life for products that have been in the marketplace for only a few years. Accelerated aging testing is of limited help, as it has not progressed to the point where credible estimates of service life prediction can be made. The selection of a predicted service life should be conservative. For most low-slope systems, use of a service life in excess of 20 years should only be done with caution, evaluation and justification. If the roof lasts five or 20 years longer than estimated, the building owner will be less concerned than if it fails in half of the estimated time.

For most projects, the costs associated with eventual tear-off and disposals are seldom considered. Because some systems are inherently more difficult to tear-off than others, LCC analysis should consider this issue. Also, it may be possible to salvage or reuse some of the system components. For example, with a ballasted single-ply, it would be reasonable to assume that the ballast could be reused on the replacement roof. Although there are difficulties and limitations with the LCC approach, economic decisions based on LCC are preferable to those that only consider initial system cost.

2.7 Warranty

Architects and building owners often give considerable weight to a manufacturer's warranty when considering a roof system and a specific manufacturer. As will be discussed in more detail in the next chapter, many limitations are associated with most warranties. The warranty itself should not be the basis for selecting a system or a manufacturer.

Consider the following real-life example of the pitfalls of warranty criteria over-riding other selection criteria: An engineering firm was retained to evaluate wind damage to a roof, recommend a system for reroofing, and prepare specifications and drawings for the new roof. In selecting the replacement system, the engineer stated that consideration was given to the warranty, initial cost, maintenance cost and service life. He made no mention of the selected system's wind resistance. About a year after the new roof was installed, a major portion of the roof experienced another partial blow-off. That area was replaced. The following year, extensive wind damage occurred again and the entire building was reroofed again. Had the engineer devoted attention to wind, which caused the demise of the original roof, the outcome of the new roof would likely have been much different.

2.8 Implications of Sustainable Roof Design

If an emphasis on sustainable roof design is desired, sustainable design criteria can become major factors in the selection process, depending upon the degree to which sustainability is pursued. At the very least, the selected system should be thermally efficient, with consideration given to both R-value and reflectivity. And for those buildings that are intended to have a service life in excess of 20 years, a system with enhanced durability should be selected to reasonably maximize the life of the roof to the extent that the budget allows.

3. Manufacturer Selection

After the system has been selected, often it is desirable to specify one or more manufacturers. It is recommended that the following be considered:

3.1 General Considerations

- **Product quality**

  The manufacturer's current products being considered should have a successful track record of at least five years. On some jobs, commodity (good) quality is desired; on others, top-of-the-line quality is expected. In either case, the manufacturer should have a good record of consistently producing the specified quality. Avoid manufacturers that periodically produce products below their normal quality level.

- **Technical support**

  The manufacturer should be capable of offering adequate support to the architect during design and to the architect and contractor during application. Support services include adequate product testing and adequate literature (such as complete test data, typical details, application instructions, and maintenance and repair instructions). Probably most important, the manufacturer should have an ample technical staff that fully understands the capabilities and limitations of its products and systems.

- **Distribution**

  Verify that the manufacturer distributes its products to the project location. Many manufacturers provide products throughout the country; however, some are regional. If a manufacturer does not distribute into an area, it may not be worth the additional cost to ship in its products.

- **Problem resolution**

  It is important to select a manufacturer that is willing to assist in resolving a problem that arises during or after construction. This does not mean that the manufacturer should pay for a problem that is not theirs. But it does mean that the manufacturer should be willing to offer technical expertise in identifying the causes of the problem and to provide input into how the problem can be solved. Some manufacturers are very good in assisting with problem resolution. Others are disruptive during the resolution process. They seek to blame others for the problem, and they offer little, if any, help in resolving it. If a problem develops, regardless the cause of the problem and who is at fault, it is very beneficial to be working with a manufacturer that provides good meaningful input.

Adapted from Low-Slope Roofing II (National Council of Architectural Registration Boards), 2001

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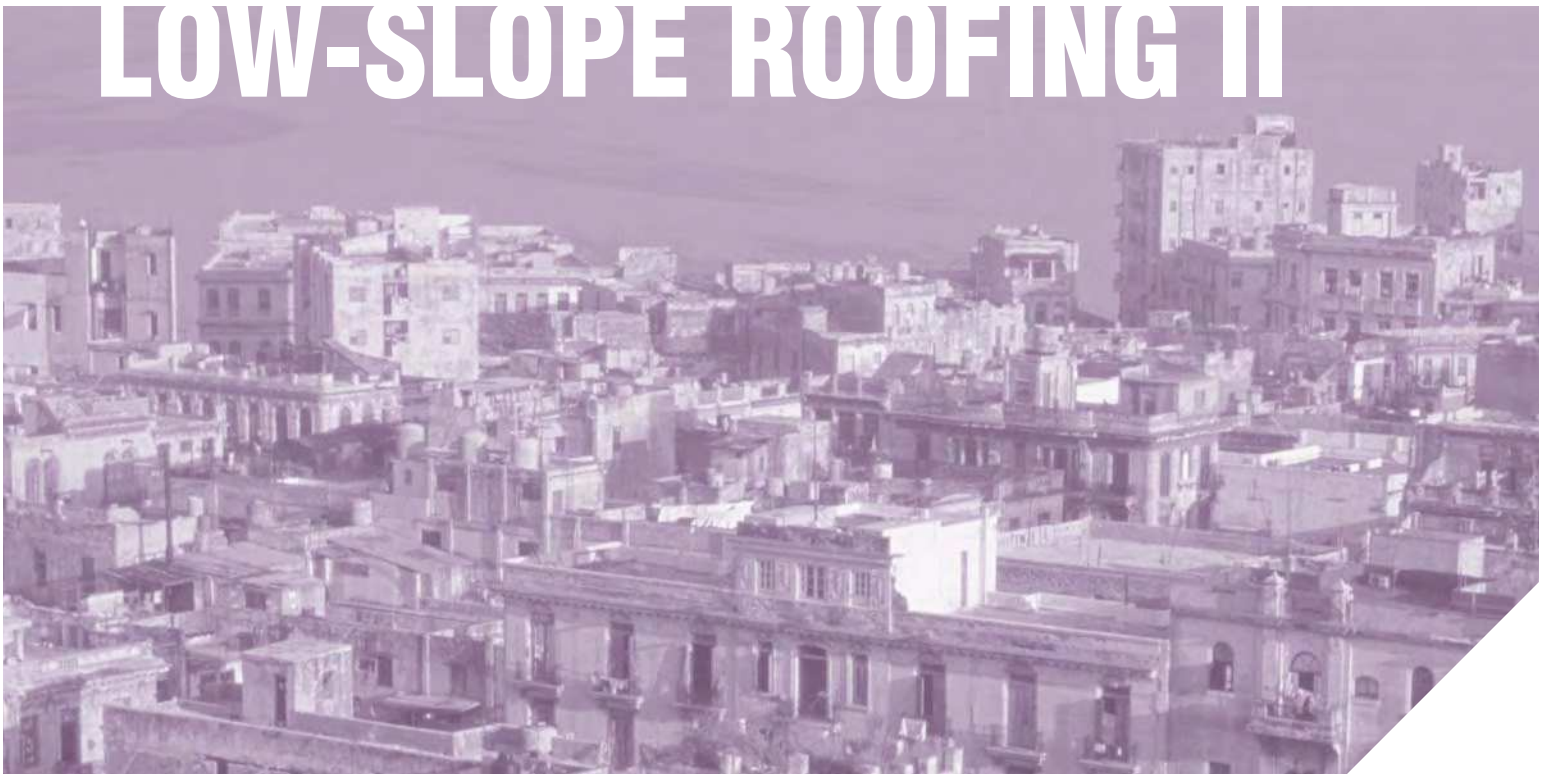

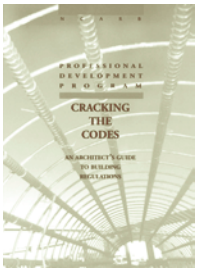

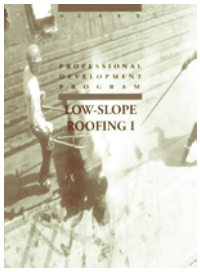

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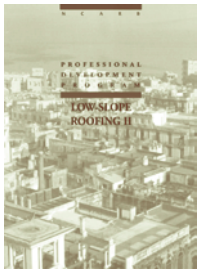

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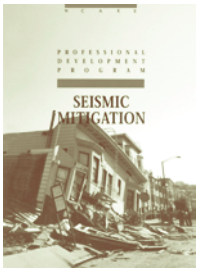

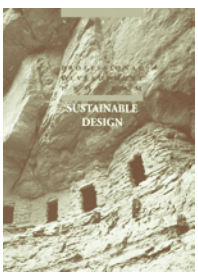

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