What To Ask, For Roofs That Last

By John L. Pierson, Jr., P.E.

For the vast majority of applications, roofing is not a rocket science. Identifying the basic fundamentals of design and then using them as guideposts in selecting your roofing partners will maximize your potential for success.

Defining the Problem

There is so much hype about the potential for roof-related catastrophes that we often lose sight of the simple fact that, for the vast majority of applications, roofing is not rocket science. There are, in fact, some basic fundamentals of design which, when properly applied, virtually guarantee the success of all but the most highly specialized roofing projects. Identifying those principles, and using them as guideposts in selecting your roofing partners, will maximize your potential for success.
If your goal is to consistently specify watertight roofing solutions that last the critical factors of concern are:

- Code Compliance
- Weather Exposure
- Termination Details
- Thermal Expansion and Contraction
- Moisture Condensation
- Sealant Composition
- Insulation Composition
- Overflow Capacity
- Surfacing and Coating Materials

Code Compliance

Building codes generally consist of minimum standards, primarily devised to prevent the most serious types of losses. Nevertheless, they are a good place to start, and complying with them is a legal requirement.

Outside of California, The International Building Code (IBC) has been adopted most everywhere as the model code standard. It combines into a single, universal code, formerly used codes such as the Building Officials and Code Administrators International Inc. (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International Inc. (SBCCI). Also of special concern for roofing applications are local codes, which frequently impose more stringent standards than IBC, and are equally mandatory.

Determining precisely which requirements apply to your situation requires both knowledge and expertise, because every roof is its own unique design configuration. The code books comprise innumerable categories and conditions representing particular types of buildings, materials, environments, and design configurations. Correlating the code information with a real-world application is not an automatic process. Your best guarantee of performance is to make certain that your original roofing specification document reflects the precise and appropriate language found in the codes.

Remember that ignorance is no excuse. As an architect or building owner, you are responsible for knowing what laws apply to your application, and making certain that your roofing partners comply with them.

Weather Exposure

There is no such thing as a generic, one-type-fits-all roofing system. Where a building resides, and what takes place under its roof, will affect roofing system performance. So, unless you plan to over-build every project that comes across your desk, you had better make a science of understanding the environmental factors that affect performance. These include:

- Humidity
- Temperature range
- Rapidity of temperature changes
- Degree of ultraviolet (UV) exposure
- Rainfall
- Snow load
- Marine (salt water) exposure
- Elevation
- Wind

As an architect,building owner or facility manager, it is your responsibility to define each of these environmental factors, as they apply to your project. It is then the responsibility of your roofing partners to verify that your roofing solution is designed to accommodate all relevant environmental conditions.

Termination Details

Using quality roofing materials and competent contractors will vastly increase your chance of ensuring watertight details. But poorly designed details will fail, even if the materials are great and the installation proper. Due diligence must be exercised in selecting and designing flashings, trim pieces, gutters, and other detail.
Ideally, all roofing system components should be specified and war-

ranted by a single manufacturer, to ensure compatibility of materials and single-source accountability, should failure occur. Where that is not possible, every effort must be made to ascertain the composition of each component used, and their mutual compatibility.
Remember: just as there is no one-type-fits-all roof, there is no "standard" roofing detail. The standard details published by material manufacturers cannot be presumed to be appropriate for every project. Published details are guidelines, not solutions. Every roofing detail is application-unique, and requires the creative collaboration of a design professional and a proficient contractor.

Thermal Expansion and Contraction

All buildings move. What takes place under them, and what takes place in the air outside them, will determine the degree and rapidity of thermal expansion and contraction. It's also important to keep in mind that different types of materials will expand and contract at different rates. Junctions between metals and non-metals are particularly vulnerable due to the different expansion and contraction rates of the dissimilar materials.

Metal roofing solutions accommodate thermal movement in a variety of ways. Some systems are designed with free-floating panels that allow unlimited thermal movement for excellent seam integrity. Others are fully attached metal systems that require expansion joints every 200 feet to prevent expansion and contraction from unduly stressing the fasteners or seams. There are some environments where local codes or common sense may mandate a higher ratio.
Rolled roofing - whether built-up roofing (BUR), single-ply, or modified bitumen - is dependent on its tensile strength for long term performance. A roofing membrane exhibiting high tensile strength will accommodate great amounts of expansion and contraction.
For environments that are subject to frequent and severe thermal changes, cool roofing is an ideal energy-saving solution that keeps roof-top temperatures down, reducing stress related to thermal expansion and contraction and extending the life of the roof. Whether achieved through highly reflective coatings or surface minerals, cool roofs offer the greatest benefits in environments that experience frequent thermal cycling.
Moisture Condensation

The condensation of moisture between a roof and its adjoining substrates may be a cause of mold, which can then be drawn into a building via its heating and ventilation system. Mold not only damages the property within; it can threaten the health and well-being of the building's occupants.

Whether moisture is being generated from outside the building or from within it, vapor retarders are your best defense against roof-related "sick building" syndrome. Vapor retarders are impermeable membranes that are positioned, during roof installation, between the layers of insulation — generally with about 1/3 of the insulation under and 2/3 of the insulation on top.

Sometimes overlooked during new construction, they are even more commonly neglected during renovations. Vapor retarders are particularly critical for buildings that house pools, atriums, or moisture-generating processes.

When re-roofing, always determine whether a vapor retarder was part of the original design, and, if it was, make certain to include one in the roofing specification. If the building use has changed since its original construction, it's a good idea to have your roofing professional reassess the potential need for a vapor retarder before reroofing.

Sealant Composition

There are two main categories of roofing system sealants: exposed and unexposed. Within each of these categories are a number of sealant compositions, with varying performance characteristics.
As a general rule, sealants that remain exposed to UV will eventually crack and dry out, regardless of their composition. Exposed sealants should be avoided except for the most temporary roofing applications. Manufacturers use a variety of methods for protecting their sealants from UV exposure.

To evaluate whether a sealant used is appropriate for your application, you need to consider:

- The material compatibility between the sealant used and the materials being sealed
- The application's level of UV exposure
- The possibility of surface ponding

For modified asphalt roofing, the sealant is the combination of membrane and adhesive. The type of rubber used in the cap-sheet is a major factor in longevity. Ideally, the cap-sheet should use high-performance polymers that remain flexible as they age, and should be coated with a reflective surfacing or gravel to improve UV-resistance.
For metal applications, high-performance systems use a butyl rubber compound to seal the seams or joints between panels. Commodity metal systems frequently rely on through-fastening systems capped with neoprene washers, a lower-cost solution that should only be used when system longevity is not a major consideration. For a long-term metal roof solution, a design should be chosen that completely hides the panel sealants from UV exposure.

For non-metal roofing solutions, a layer of surfacing is used to protect both the membrane and its sealants from UV exposure. In addition, for terminations such as flashings, where some exposure is inevitable, high-grade urethane sealants should be used.

Insulation Composition

The R-value of insulation is of primary consideration when determining what materials should be specified. For BUR systems, it is equally critical to consider whether the insulation specified can be compatibly adhered with the specified insulation adhesive. For example, expanded polystyrene (EPS) insulation is not compatible with solvent based adhesives. However, newer urethane asphalt-based adhesives are compatible with most insulations including EPS. It is also important to know if the roof material specified is compatible with the insulation.
The International Energy Conservation Code (IECC) (the energy-conservation portion of IBC) includes ASHRAE standards related to heating, ventilation, and air conditioning. ASHRAE 90.1 defines the required R-values and the amount of insulation required to achieve

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certain R-values in specific geographical areas. Other insulation-related concerns are application category, local fire code regulations, UL, FM, and other performance-related ratings for materials used.

Overflow Capacity

A roof system's overflow capacity is another design consideration that is too often overlooked. The installation of secondary drains may be required during retrofit, especially with older buildings that may have been built prior to today's more stringent codes. Overflow scuppers that allow water overflow to drain directly through a hole in the perimeter may also be viable alternatives, if installing secondary drains is impractical.

As with so many roofing design considerations, ensuring overflow capacity is the responsibility of the designer during building construction, and is frequently overlooked when renovating existing roofs. A properly installed roof should accommodate not only the rainfalls typical of your region, but also those occasional, excessive rainfalls that may occur. Building codes typically require overflow drainage systems to double the capacity of the primary drainage system.

Surfacing and Coating Materials
Surfacing Methods

Since the surface of a roof takes the most direct hit from UV, weather, and effluents, protective surfacing or coating materials should be used to extend roof longevity. A good surface protector will keep the waterproofing layers of your roof viable longer, keeping the roof below watertight.

Where coal tar is used in a conventional built up roofing configuration, gravel surfacing is always required for long-term performance. In fact, gravel, with a flood coat of coal tar, is probably the most durable roof surfacing available for non-metal roofs. For BUR applications using coal tar, the IBC allows a minimum slope as low as one-eighth inch and 12 inches. That means that using a coal tar pitch roof with gravel surfacing in retrofit applications may help you reduce costs associated with adding tapered insulation.

A mineral-surfaced modified bitumen cap sheet is a more attractive, less expensive solution that is popular for roofs that are visible from the ground or from surrounding buildings or have slopes greater than 1:12. Somewhat less durable than gravel, it is nevertheless a popular alternative for many applications.

Fire Retardant coatings made of either acrylics or urethane allow for Energy Star compliance and unsurpassed aesthetics while providing complete UV protection.

Coatings

Coatings are the preferred means of surface protection for metal roofing systems. Today, all metal roofs are metallic-coated at the factory for corrosion protection. Afterwards, they are typically protected with an additional surface coating, which may be either clear or colored.

A variety of metallic coatings are available, offering distinct performance characteristics. Depending on whether or not the metal will eventually be painted, and whether the metal application will require significant bending, some metallic coatings will be more effective than others.

For metal applications that will eventually receive a paint finish, Galfan is the metallic coating of choice, offering optimum performance. For applications that are going to remain unpainted, Galvalume with a clear topcoat is the preferred choice. Where economy is a major consideration, galvanized coatings offer excellent paint adhesion properties and present a viable alternative.

The most commonly recommended paint finishes are Polyvinylidene Fluorides (PVDFs), sometimes identified by the trade name Kynar®). These surface coatings typically offer a 20-year warranty. Although polyester-based paints are also available for metal systems, they typically do not have the color retention of PVDFs. Polyester paints offer a durable paints system at a cheaper price than most PVDF's.

For specialty applications - such as food processing, marine applications, and some chemical processing facilities - high-performance materials such as aluminum, stainless steel, copper, and zinc may be appropriate. Such surfaces may last 100 years or longer.

Conclusion

Although some basic principals in roofing such as positive slope are logical, roof design with the myriad of code requirements, system types and details can be confusing. The best way to insure design and installation success is to partner with a manufacture that offers up front design assistance and follows through with the project through construction and punch list completion. The Garland Company has over 200 dedicated professional representatives in the US, Canada and the United Kingdom who are committed to you in the office and on the roof looking out for the best interest of the building owner. Garland offers a variety of roof systems including metal, asphalt and coal tar built up roofing and modified bitumen systems That allows us to make recommendations that take into account the needs, expectayions and budgets of the owner.

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