# Managing Roofing Assets Through Life Cycle Analysis

By William Spencer

The value of a roof can actually increase if it survives its first few years without incident. This fact by itself provides some motivation for finding out what it means to manage a roof as an asset.

The explanation for this fact is that a life cycle curve often has a bump for premature mortality. If a roof survives past the time period of that bump, then the long-term outlook actually improves.

Figure 1 shows a typical maintenance cost curve created from a database of information on thousands of roofs. Problems due to errors in installation often occur in the first few years of a roof's life.

In creating maintenance cost or life cycle cost curves, the data can be indexed to include only roofs of a particular type or only roofs in a particular climate and so on. As the various "filters" are applied to the database, different life cycle curves (representing subsets of all the roofs in the database) can be examined.

This one example application gives insight into the power of using a database in conjunction with life cycle analysis to manage roofing assets. As a discipline, roof asset management is closely connected to life cycle costing. Both depend upon actual historical databases for roofing projects.

## Roofing Industry Challenges

The roofing industry faces at least two major challenges with regard to improving the quality of roofs in the United States.

The first challenge is to develop a statistically meaningful database for roof life cycles. What makes this first one especially challenging is the long lifetimes of roofs, since continuity of record keeping is difficult over long expanses of time.

The second challenge is to use the historical database to actually improve roofing materials, specifications, installation methods and maintenance procedures.

Databases are valuable only to the extent that proper data evaluation has been performed. An intelligent evaluation of the historical facts about roofing systems would contribute much to the improvement of the quality of roofing systems and application practices.

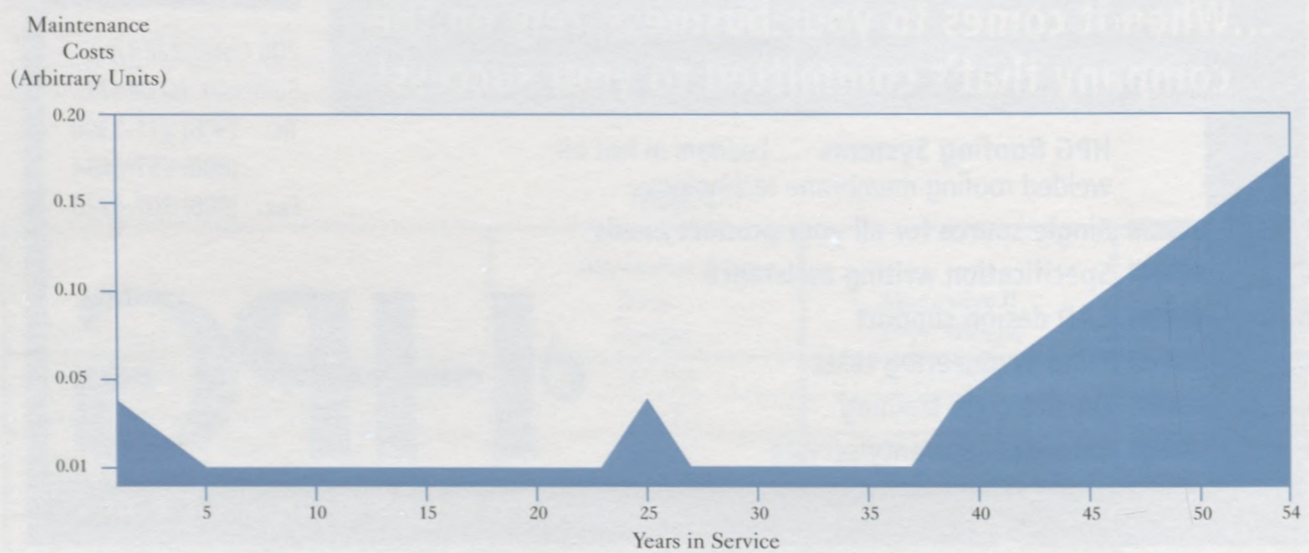


*Figure 1: Typical roof maintenance cost curve (Courtesy, Building Technology Associates, Inc.)*

## Who Should Keep the Database?

Any roofing consultant or building owner can develop a database of roofing life cycles but there is a question about the size of the database. A roofing consultant or specifier's knowledge consists of his or her experience with roofing systems. That experience can be direct or vicarious (i.e., through reading the reports of others). Often that experience is anecdotal, consisting of case histories to illustrate a point or make a comparison. Application case histories can summarize the experiences of contractors, consultants and building owners for particular roofing projects. Failure of existing roofs can be documented in cases where one roofing system is specified to replace another that failed. Such anecdotal evidence often supports the decision to specify one system over another. Information originating from manufacturers can be one-sided and self-serving. Such anecdotal evidence and announcements should be used with reservations, especially when the focus is on the new roof installations and when there is no positive proof with regard to the life cycle of the roofing system.

An objective study involving all types of roofs would be more valuable to the roofing industry. When a building owner asks a specifier for supporting data, the specifier can make a stronger case if the data are from a third party with no special interest in the outcome of the buying decision. Some roof asset management firms have accumulated large databases of performance versus specifications for all types of roofing systems (Fig. 2). This data are more reliable than scattered reports about new installations.

## Survey of Problem Areas

The National Roofing Contractor's Association (NRCA) surveys its members four times per year regarding the types of roofs installed and problem information regarding current roof projects.

The NRCA survey program "Project Pinpoint" lists the variables and "problem information" that pertain to various types of roofing systems. NRCA Project Pinpoint reported in 1993 on the results of this survey for the period from 1982-1993, and the report was updated again in 1996. (See the November 1996 issue of *Professional Roofing*.) The survey reported on variables such as insulation type, deck type or flashing specification.

While the NRCA survey is useful for pinpointing problem areas for the various roofing systems, it does not provide the detailed time-related information that is crucial for life cycle analysis. The NRCA Project Pinpoint omits the age of the roofs for which problems are reported because, in most cases, the contractors have little or no knowledge of the age of existing roofs. Roofing contractors do not always know the history of the roofs that they are called in to repair, recover or replace.

Thus, a 30-year-old coal tar roofing system with a problem of blistering is reported in the same manner as a 10-year-old asphalt roofing system with a similar problem.

Another drawback of the NRCA data is that most roofing contractors, unless they specialize in roof maintenance, hear about roofs only when there is a problem. The NRCA data thus are not representative of the actual "universe" of installed roofs, but rather are slanted toward roofs that require attention.

## Roof Asset Managers

Companies involved in roof asset management are well suited for developing unbiased databases of roofing life cycles. A good example is Building Technology Associates, Detroit, MI, a company offering a complete program of roof asset management to its clients. Because BTA manages roofs that don't need replacing as well as roofs that do, the case histories in its database are representative of the actual life cycles of roofs.

On the other hand, clients of BTA are typically corporations with a long-term interest in their physical plants. These organizations maintain a large number of commercial and institutional facilities, all of which have roofs. A systematic program of roof asset management results in a substantial savings to these large corporations. It also adds to the BTA database of roofing life cycles.

BTA has developed a systematic approach to entering data about the roofing systems of its clients. The company has monitored the conditions of its clients' roofs for decades and, as a result, its database of roof life cycles has grown steadily. Presently, the ROOFACTS database contains detailed information about hundreds of thousands of roofs. One industrial corporation retains BTA to manage 150 million sq. ft. of roofing assets (i.e., 60,000 commercial roofs).

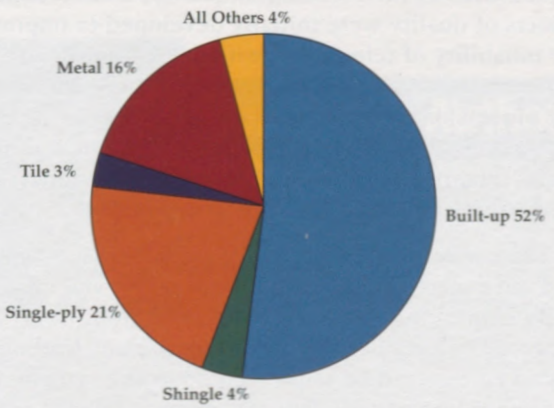


*Figure 2: A breakdown of the types of roofing systems in the ROOFACTS database. (Courtesy, BTA, Inc.)*

### Partial listing of roofing descriptions required by BTA database

Deck type
Slope
Drainage
Geographic location
Insulation type
Insulation layers
Insulation thickness
Drainage
Membrane surfacing
Membrane type
Building emissions
Building usage
Etc.

Every time a roofing project is entered in the database, that roofing system is characterized in terms of dozens of variables. In fact, about 1,238,000 different variations (or permutations) are possible. The table above lists just a few of the parameters that must be recorded for each project. In this age, where knowledge is an important asset, BTA has an important service to offer building owners and roofing specifiers. BTA maintains databases and asset management services on twelve building systems, including HVAC, electrical, walls and plumbing. The company also provides useful information to consultants who wish to provide roofing asset management services to building owners with small- to moderately-sized roofing portfolios. Information from the BTA database is available on a limited basis to clients as well as a network of roofing consultants.

## Value as a Measure of Quality

One of the great advancements of our century is the appreciation of the meaning of quality. The statistical aspects of quality were initially developed to improve the reliability of telephone switching systems and then were generalized and adapted to the improvement of any process or industrial activity. Beginning in Japan and spreading to the U.S., Europe, and the rest of the world, quality management today embraces almost any productive or administrative activity.

The easiest way to improve a process or activity is to find out exactly what needs improvement and quantify it. By monitoring those attributes, variations from expected behavior can be detected. Actions leading to improvements can be implemented or strengthened and factors leading to early failures can be corrected or eliminated from the system.

Roof asset management requires that roofing specifiers and consultants quantify their investigations and recommendations, which facilitates communication with the financial officers of corporations.

Describing a roof as a financial asset requires that technical expertise be used in combination with historical data to assign a value to a roofing system. Value is a measure of quality. It does not matter whether the value is estimated in dollars or as a relative worth compared to some reference or idealization.

The actuarial projected service life (APSL) is a figure generated by ROOFACTS for insurance purposes. APSL data shows that a membrane made with coal tar pitch has the highest APSL for a very low-sloped or flat roof.

Benchmarking or "best practices" give baselines against which to compare roofing systems. Completely different roofing systems can be compared by placing a dollar value on a roof. (The dollar value of a roof should not be confused with the installed cost of the roof.)

Climate is an important factor to monitor. Roofing materials take the brunt of the effects of weather. Different specifications are needed in different climates. Some roofs work fine in one area of the country and perform poorly in another. Roofing specifiers need to compare performance in different climates.

In summary, roof asset management is not just a financial tool. Using life cycle analysis as a measure for quality, roof asset management helps isolate factors that contribute to better roofs and to sort out the best practices from the many options available to a roofing specifier. It is a tool for the technical evaluation of roofs.

This approach can be applied to the development of better commercial roofing systems and materials by manufacturers; to the selection of better roofing systems by a roofing specifier; and to the optimal management of roofing assets by a facilities manager or building owner.

## Using Roof Data in Physical Modeling

Modern science is driven by experiment. Reasoning based on accurate observations leads to the discovery of unexplained patterns which emerge from the data. Theories can be formulated to explain the facts and, in some cases, if the hypothesis is good, proactive measures can be taken to increase the life cycles of roofs.

For a roofing specifier, the theory could simply provide guidelines for selecting the best roof for a given building in a given climate. For roofing system designers, the theory could also lead to a physical model that describes why a specification works. The standard specification for coal tar roofing has been around for nearly 100 years. The basic coal tar pitch specifications already were developed in the early part of this century,[1] probably by pioneers after watching a significant number of roofing systems in service. When these specifications

were developed, roofs were already surviving through the first critical years of service and in many cases much longer. However, the continued existence of many old roofs (over 40 years) is a fact. The specifications used on these very long-lived roofs should be used in modern-day roof selection.

Applying the coal tar roofing system directly onto a concrete deck seems to be a key factor. The Times Plaza in Kansas City has just turned 50 years old. It is a benchmark roofing system. It received regular maintenance and monitoring, as well as a timely repair about eight years ago. According to the contractor monitoring this roof, Chris Boland, president of The Quality Roofing Company, Kansas City, the primary reason for its long life is the fact that it was applied directly on a concrete deck.

Another example is the effect of insulation thickness on life cycle, which is modeled with ROOFACTS data. With insulation between the interior of a building and the roofing membrane, the roof doesn't benefit from the temperature stability of the building interior. It is subjected to various extremes of temperature cycling.

Life cycle costing puts the wealth of information about roof histories to immediate practical use. Best practice may come down to a matter of economics but one has to know what one is buying.

As in any industry, quality must be based upon measurable attributes via statistics. For a roofing system, there are many factors to measure, including installation cost, time before maintenance is required, frequency of maintenance, cost of monitoring, cost of failure, cost of tear-off, cost of reroofing (labor and materials), value of warranty versus time and so on. Of course, the simplest scenario applies to a low maintenance roof that is installed once and needs no repairs for many decades.

## The Truth About Warranties

Warranties can be an asset to a company and an important part of a roof asset management program. However, warranties can also be misleading and lead to a false sense of security.[2] Since flat commercial roofing accounts for 55-70 percent of all construction litigation, it is not surprising that warranties more often are a loophole for manufacturers than an asset for building owners. It is important for building owners to carefully review warranties to ensure that the warranty is issued with good intent and that the manufacturer has sufficient financial resources to back it up.

A warranty is more valuable if it is properly managed from the day the roof installation begins. Inspection and certification of the quality of the installation, specifications and materials are a prerequisite to the issuance of the warranty. Responsible manufacturers cooperate with roofing professionals to ensure that their roofing warranties are, in fact, of value to the building owner.

## Summary and Conclusion

Like most things, a roofing system has a characteristic lifetime. The "average life" of one type of roof in one climate is a statistical device for summarizing data available about many roofs. There are several ways to summarize such data. By simply marking down the installation and tear-off dates, the average lifetime for a group of similar roofs can be computed after many years of experience. The analysis can be carried to a deeper level by also taking into account maintenance costs.

A profound knowledge of roofing is required to guide a building owner or facilities manager into the right decisions. In some cases, owners have personal preferences. In many cases, roofing consultants should consider that the owner may in fact be speaking from fact-based knowledge and experience. But, in cases where the owner does not have fact-based experience, the owner should defer to an unbiased professional who offers the best solution and has the facts to back up the decision.

When called on to outline in detail the reasoning behind any decision on any roofing project, the consultant should be armed with hard statistical information and detailed historical facts.

Roof asset management companies can provide the statistical information and act on the owner's behalf to generate performance-based recommendations and monitor the installation to ensure that it lives up to expectations.

[1]Knobloch, Philip G., "Good Practice in Construction," *The Pencil Points Press, Inc.*, New York, 1923.

[2]Schauffele, Roy, "Roof Warranties: Panacea or Loophole?" *Construction Specifier*, February 1995.

## About The Author

William Spencer *is Manager of Marketing and Technical Services with AlliedSignal Incorporated's Commercial Roofing Systems office in Cary, North Carolina.*