Commercial Inspection Tips

Expand your business with commercial building information from Carson Dunlop Weldon

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PROBABILITY OF FAILURE

Welcome to Commercial Inspection Tips, a monthly feature providing technical and business information on commercial building inspections. We're contributing to the ASHI Reporter with the hope of stimulating your interest in diversifying into the field of commercial building inspections as a way to expand and grow your business.

Probability of failure is a concept used to prepare capital replacement or reserve fund studies for facility managers and condominium corporations, as well as to plan maintenance and replacement schedules for equipment in large facilities.

Probability of failure compensates for the fact that visual inspections are often imperfect, in that the critical components may not be visible. Even if the critical component is visible, predicting accurately when failure will occur is often difficult.

The concept of probability of failure is simple: The probability of failure of any mechanical component or mechanical system increases as the component ages. Although a new component can fail, it's just not likely. For example, of the 1,000 computers sold by a computer manufacturer every day, one or two will have a major failure within the first day or two of use. The odds are that any one computer will not fail, but in the extreme minority of cases, it does.

Figure 1 illustrates a typical distribution of failures of a specific number of mechanical components over a period of time. From this graph, we can make several observations:

1. The likelihood of a failure in the first few years is low; nevertheless, some failures will occur!
2. The typical life of this component is 20 years. This means the greatest number of component failures occurs in year 20. However, in terms of overall number of failures, the typical lifespan is better represented by "15 to 25 years."
3. After year 25, the number of failures drops dramatically because there are few components from the initial group left in service. This also illustrates that while some components may last 30 years or more, these are as exceptional as components that lasted only 10 years.

Assigning a probability of failure to a system involves the following:

1. Identifying the critical component of the system (such as the heat exchanger in a heating system or the compressor in an air conditioning system).
2. Identifying the age of the critical component. We can identify the age of the entire unit readily from the serial number. We can do the same for a compressor in an air conditioning system. However, it is more difficult to determine if and when a heat exchanger was replaced.
3. Determining the expected life (from personal, historic and/or statistical experience).
4. Assigning a probability of failure in general terms (low, medium, or high).
5. Adjusting the probability of failure, if necessary, based on the site conditions.

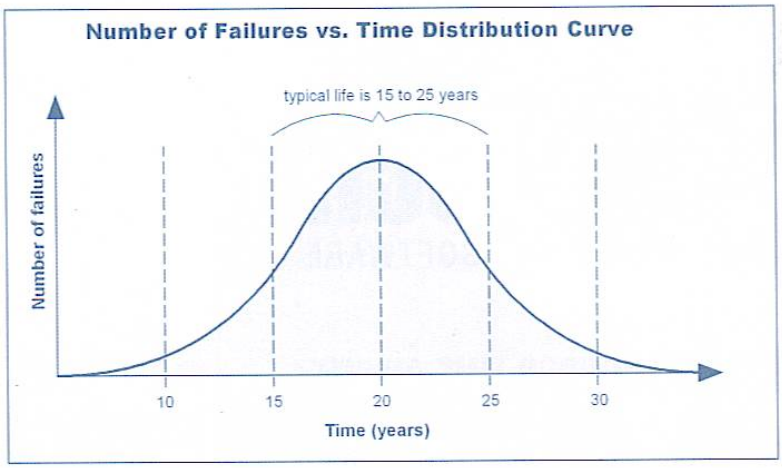

Figure 1. Number of failures of a specific number of components over a period of time.

Take, for example, a hot water boiler with a copper heat exchanger. Statistically, this component may have a life expectancy of 20 years. The following table is an example of how we could categorize the probability of failure based on different conditions:

Operating Condition	Normal			No water treatment; poor maintenance			Has water treatment; good maintenance		
Age (years)	<10	10 to 15	>15	<8	8 to 13	>13	<12	12 to 17	>17
Probability of failure	Low	Medium	High	Low	Medium	High	Low	Medium	High

Table 1: Probability of failure for hot water boiler with a cooper core heat exchanger under different operating conditions.

While it is important to understand how mechanical systems work and to be able to identify common deficiencies, the most important part of the mechanical system inspection is identifying the ages of the main systems or components and assigning a probability of failure for your client. Describing all the minor repairs necessary to the 25-year-old boiler is not as important as identifying the likelihood for boiler replacement in the short term and, of course, the associated replacement cost.

Additional information can be found in the ASHRAE Pocket Guide available on www.ashrae.org in the store. For $42, you can't go wrong. Also there's the RS Means Facilities Maintenance and Repair Cost Data Book available from the bookstore on www.rsmeans.com. At $296, it's a bit pricier, but covers more components. ■

Carson Dunlop Weldon & Associates is a leading provider of commercial inspections and commercial inspection training, author of the Technical Reference Guide and the CommQuot™ Commercial Fee Quoting and Proposal Writing System. This article and accompanying diagrams have been taken from a new, not-yet-released Commercial Building Inspection Training Module written by Carson Dunlop Weldon & Associates Ltd. Visit www.cdwengineering.com.