
Common Failure Modes in Building Maintenance Units: A Field Engineer's Perspective

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Building maintenance units fail in recognizable ways. Across the systems I have examined and tested, the conditions that produce failures cluster into a small taxonomy: the drivetrain and hoisting machinery; the wire rope and the components that guide it; the interface between the machine and the building structure; the controls and safety devices; and — the category easiest to overlook — conditions in areas of the system that no routine inspection position reaches. A failure is an event with a date. The condition that produced it has a history — one that may have begun well before that date. This article describes each category: how the conditions develop, what they look like before they become events, and what an owner or operator can watch for. It describes conditions, not culprits — and it is written for the people who live with these machines: building engineers, facilities directors, and the owners whose assets carry them.

How a BMU fails: the event and the condition

A building maintenance unit is a machine asked to do something structurally demanding — suspend working load from a moving structure at height, through weather, across decades — while spending nearly all of its life parked. That duty cycle shapes how the equipment degrades. Sudden failure of an otherwise sound component is one possible mechanism. The investigations I have conducted have more often involved progression: a condition initiates, develops through service cycles and idle exposure, and eventually intersects with a demand the system can no longer meet. The engineering significance of this is practical rather than academic. A progressive condition may create a period during which evidence of its development can be identified — if the system is examined for that purpose. The first article in this series addressed why routine periodic inspection may not be that something: an inspection verifies the system against its criteria on its day, within its scope. The categories below describe what develops between those days, and where.

Drivetrain and hoisting machinery

The hoisting machinery — motor, gearbox, brakes, drive interfaces — is where mechanical duty concentrates, and much of its condition is not directly visible from the outside. A gearmotor can present normally at rest and under brief functional test while carrying a developing internal condition: lubrication degradation from long idle periods, bearing wear, gear-face conditions, moisture ingress through seals aged by exposure. Developing drivetrain conditions can present through behavior before they present through failure — changes in sound under load, drive characteristics, temperature, behavior at starting and stopping — and the people positioned to notice such changes are the operators who run the machine.

One experience from acceptance testing is worth recounting at the level of its lesson. In pre-delivery load testing of a new machine built for a US high-rise project — testing conducted at the manufacturer's works, with an independent engineer present — a drivetrain component failed under test. The machine's documentation was in order; its components came from established suppliers; nothing in the documentation reviewed for the test identified the condition that emerged under load. The condition was found because the machine was exercised under load, with someone watching whose role was to find exactly that. The lesson is not about any manufacturer or component maker — new machinery can carry defects in any industry, which is what acceptance testing exists to discover. The lesson is about where the discovery happened: at the works, before shipment, while the machine and the resources needed to investigate and correct the condition remained together — rather than after erection or in service, under a different custody and operating environment. Acceptance testing is a subject of its own, addressed separately in this series.

Wire rope and its guidance

Wire rope is a consumable, and its wear is expected. The engineering question is whether the wear observed is consistent with the system's service life and duty — and where it is not, the significant fact may be the rate of wear rather than its presence. Rope and guide components wear against each other in patterns that record how the system is actually running: alignment, fleet angles, drum and sheave condition, loading. Where guide components show wear early relative to the system's service history, the rope is reporting something about the machine — and replacing the worn component without asking what produced the wear replaces the recording without addressing what it recorded. I have examined systems where wear patterns on guidance components were the earliest available evidence of a condition elsewhere in the machine; the components were within serviceable limits, and the pattern, not the limit, was the finding.

The machine–building interface

A BMU is half machine, half building. The track, corbels, anchor points, restraint and tie-in provisions, and the structure beneath them form the joint where the mechanical scope meets the structural scope — and a joint between two scopes creates the possibility that responsibility for examining the interface is not explicit in either. Conditions at this interface — corrosion at fixings, fatigue at connection details, sealant and drainage conditions that direct water where it concentrates — develop on the building's timeline rather than the machine's, and they sit at the edge of a machinery inspection's scope and at the edge of a façade inspection's scope. Where an owner wants confidence about the interface, the first question worth asking is not whether it has been inspected, but within whose scope it falls — and whether anyone's answer to that question is in writing.

Controls and safety devices

Controls and safety devices — overload detection, overspeed and secondary braking, limit devices, emergency functions — occupy a particular position in the system: many exist to respond to

conditions outside normal operation. A device's condition under functional test is one fact; its behavior under the demand it exists for is another, and the distance between the two facts is governed by how the device is tested, how it has aged, and whether modifications elsewhere in the system changed the demand it would actually see. This is also the category most sensitive to configuration drift — the accumulation, across years of service events, of substituted components, adjusted settings, and revised arrangements, no single one of which seemed material. A safety device set correctly for the machine as designed may be set incorrectly for the machine as it now exists. Where that reconciliation between the system's current configuration and its engineered configuration has not been performed, its absence is itself relevant to an engineering review.

The unexamined areas

Permanent access systems can contain areas that cannot be closely examined from routine inspection positions. Where those areas exist, the practical question is when they were last examined by anyone, from any position, with any purpose — and in systems I have reviewed, the honest answer, reconstructed from the records, was sometimes: not since installation. Conditions in these areas are not a different kind of condition; they are the same kinds of corrosion, wear, and fatigue found elsewhere in the system, distinguished only by the absence of eyes. They belong in this taxonomy because an owner reasoning from a clean inspection history can unknowingly be reasoning about the examined portion of the system — and the system does not distinguish between the examined and unexamined portions when it is asked to carry load.

What the categories share

Several threads recur across these categories. Many of the conditions develop progressively, which can create a period in which evidence of their development is present before failure. Some present behaviorally — through sound, movement, drive character, or wear pattern — before their significance is apparent to routine visual examination, which makes disciplined recording and review of operator observations useful engineering information. And many arise, or become difficult to see, at boundaries — between components, between scopes, between the machine as engineered and the machine as it now exists, between the examined and the unexamined — which is why examinations designed to look at boundaries can find what examinations designed for other questions may not. In failure investigation, these same threads can be followed backward: from the event to the condition, from the condition to its development period, and from the development period to the question of what looked at the system during it, and for what purpose. An owner can run the same inquiry in the other direction, before there is an event to work backward from.

What this means for an owner or operator

The practical posture follows from the taxonomy. Treat operator observations — sounds, behavior under load, anything that changed — as data, recorded and reviewed, not as noise. Where wear is found, ask about rate and pattern, not only serviceable limits. Establish in writing whose scope covers

the machine–building interface. Reconcile, at some deliberate point, the system's current configuration against its engineered configuration, particularly after years of service events or a change of service provider. And hold the distinction the first article in this series develops: a current certificate and engineering visibility into the system's condition are not the same thing, and the categories described here are precisely where the difference lives.

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