

CASE STUDY — STRUCTURAL FAILURE ANALYSIS

Collapse of a Rooftop Equipment Support Frame

Matter type	Personal injury / premises liability, with third-party claims against the installing contractor and frame manufacturer
Retained by	Defense counsel for the equipment installer
Issue	Whether the collapse was caused by a design deficiency, defective installation, or overloading by a later trade
Role	Testifying expert — structural and failure analysis

Background

A steel support frame carrying rooftop mechanical equipment failed approximately three years after installation, dropping the equipment and injuring a worker performing maintenance nearby. Plaintiff alleged negligent installation. The installer contended the frame had been modified after turnover to accommodate additional equipment added by a separate contractor, and that the modification, not the original installation, precipitated the failure.

Scope of work

- Site inspection and photogrammetric documentation of the failed assembly in place prior to removal.
- Development of a joint evidence protocol so that all parties could examine the fracture surfaces before any destructive testing.
- Review of shop drawings, approved submittals, the original structural design, installation records, inspection reports and subsequent permit history.
- Metallurgical examination of the fracture surfaces, including fractography, to determine failure mode and sequence.
- Independent structural analysis of the frame in three configurations: as designed, as originally installed, and as modified.

Findings

Fractographic examination showed beach marks and a distinct initiation site consistent with progressive fatigue cracking originating at a weld toe, followed by rapid overload fracture of the remaining section. The failure was therefore not a single overload event. Load analysis showed the as-designed and as-installed configurations both carried the original equipment with margin consistent with the governing code. In the modified configuration, however, the added equipment introduced an eccentric load and a vibratory input that raised the stress range at the initiation weld above the applicable fatigue threshold for that detail category. The estimated cycle count to crack initiation was consistent with the interval between the modification and the collapse.

Deliverables and use in the case

- Preliminary findings memorandum to counsel within three weeks of inspection, in time for the mediation deadline.
- Rule 26 report with calculation appendices, annotated inspection photography, and fractographic imagery.
- Rebuttal analysis addressing the opposing expert's single-overload theory and its inconsistency with the observed fracture morphology.
- Deposition testimony; the matter resolved among the remaining parties before trial.

WORKING WITH FORWARD THINKING

How We Support Counsel

Early case assessment	A candid technical read before you commit to a theory. If the engineering does not support the claim or defense, we say so early, while that information is still useful and inexpensive.
Evidence preservation	Failure evidence is fragile and often destroyed inadvertently. We advise on preservation demands, joint inspection protocols and destructive testing agreements at the outset.
Defensible methodology	Analysis is conducted to recognized consensus standards and documented so that each step, assumption and calculation can be traced and reproduced — the standard a Daubert or Frye challenge is measured against.
Clear communication	Reports, demonstratives and testimony are written to be understood by judges and juries without an engineering background, while remaining technically precise under cross-examination.
Rebuttal work	We are frequently retained solely to evaluate an opposing expert's methodology, assumptions and calculations, and to identify where the conclusions outrun the underlying evidence.
Conflict checking	Prompt conflict clearance and a written engagement scope before substantive work begins.

Practice areas

Structural and mechanical failure analysis · Product liability and design defect · Fire and explosion origin and cause · Accident reconstruction · Materials and metallurgical failure · Construction defect · Industrial and workplace incidents · Equipment and machinery failure

Discuss a matter

Initial consultations to determine whether a matter is within our expertise are without charge. Contact us with the case posture, the technical question at issue and your key deadlines.

Tara Parhizkar, Ph.D., P.E. · 310.408.6750 · expertwitness@forwardthinkingsolution.com · www.forwardthinkingsolution.com

This case study is an illustrative composite prepared for informational purposes. Party names, locations, dates and identifying details have been omitted or altered. Nothing herein constitutes an opinion on any pending matter, creates an expert–client relationship, or discloses confidential information from any engagement.