



### Services:

- Structural failure investigations
- Existing condition assessments
- Construction defects
- Code compliance analyses
- Structural design reviews
- Design defects
- Structural consulting
- Forensic expert consulting
- Legal & litigation support

### Types of structures:

- Industrial
- Commercial
- Corporate
- Residential
- Healthcare
- Educational
- Non-building structures
- Special structures

## Structural. Forensic. Engineering.

### Structural failures

When the intended design criteria are not met, a structural failure will likely occur. Examples of a structural failure include excessive deflections, perceptible or unacceptable levels of vibration, visible structural distress, partial collapse and total structural collapse. Failures may occur at any time during the life of a structure and can be caused by one or several of the following:

- An unexpected or unintended overload during construction or on the completed structure
- The lack of proper and timely maintenance and repair
- A materials durability or strength issue
- A construction defect
- A design defect

For completeness, the investigation into the cause of a structural failure typically follows a defined sequence of activities and tasks including:

- Observation and documentation of the physical evidence including photographs, field measurements and field notes.
- Collection, documentation and preservation of physical evidence, if possible.
- Review of pertinent project construction documents including contracts to establish scope of work, applicable codes and regulations, design drawings, design specifications and field observation reports.
- Working theories as to the cause of the failure are developed based on the physical evidence and the construction documents.
- Each working theory is tested against the observed physical evidence and the results from engineering calculations and in situ or lab tests.

By working through the sequence of activities, the structural engineer will typically be able to identify the most plausible working theory and the most likely cause or combination of causes of the structural failure. Once the failure mechanism is identified, the results will be communicated, simply and in a way to promote understanding, to the client.

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## Services related to structural failures

- Rapid response when notified of a failure to assist with the stabilization of the distressed, partially, or totally collapsed structure, documentation of site conditions and documentation and preservation of physical evidence.
- Failure investigation, including determination of the most likely cause or combination of causes.
- Documentation of the extent of damage and development of structural repair options.
- Clear and understandable communication of the investigation results through written, visual, and verbal means.

## Examples of failure investigations

- **Cedar Hill, Texas.** Conducted investigation of the collapse of a 1,500 foot-tall TV transmission tower. Performed field investigation and documentation, observed and documented the preservation of the collapsed debris, interviewed eye witnesses, performed a code-based design review of the tower, generated a 3-D working model of the tower that included the most likely cause of the collapse, and, with the aid of the 3-D model, verbally communicated all investigation results and most likely cause of the failure.
- **Oahu, Hawaii.** Investigated the collapse during construction of a 120 foot span of a precast concrete girder bridge being built as part of the US interstate highway system in Hawaii. Performed field investigation and documentation, performance the structural analyses, including the response to differential temperatures, of the subject precast girders, verbally communicated all investigation results and most likely cause of the failure.
- **DeKalb, Illinois.** Investigated the cause of structural distress for a concrete grain storage facility. Performed field investigation and documentation, performed structural analyses and design code review, developed preliminary repair designs, including a cost estimate, testified at deposition.
- **USAF Base, Thule, Greenland.** Investigated the collapse of a 60-foot diameter fiberglass dome used to protect a satellite communication antenna. Performed field investigation and documentation, performed structural analysis, and summarized all observations, analysis results, and most likely cause of the failure in a written report.
- **Iatan, Missouri.** Investigated the collapse of a 360-foot tall crawler crane at the Iatan Power Plant. Performed field investigation and documentation, performed structural analysis of the crane structure, and testified at deposition.
- **Traverse City, Michigan.** Investigated allegations of structural design defects, excessive vibrations and excessive deflections of the structural steel framing used to construct a mixed-use office, commercial, and residential development. Documented existing conditions, performed a review of the structural design, reviewed pertinent design drawings and specifications, completed a project report, and participated in the settlement mediation.

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