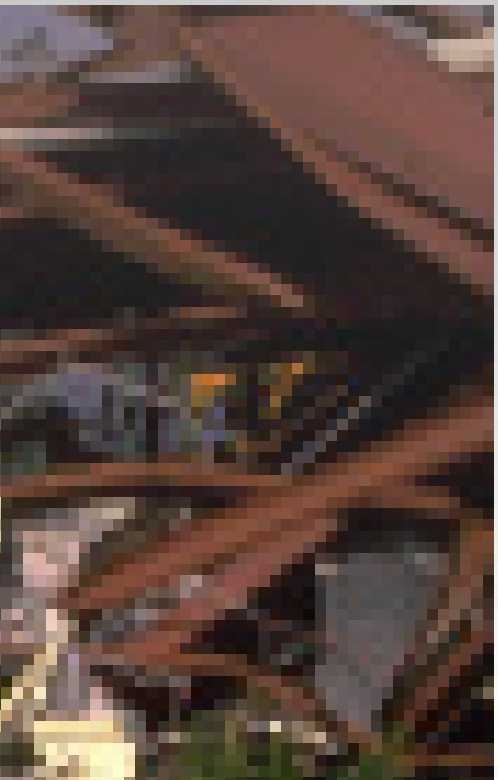
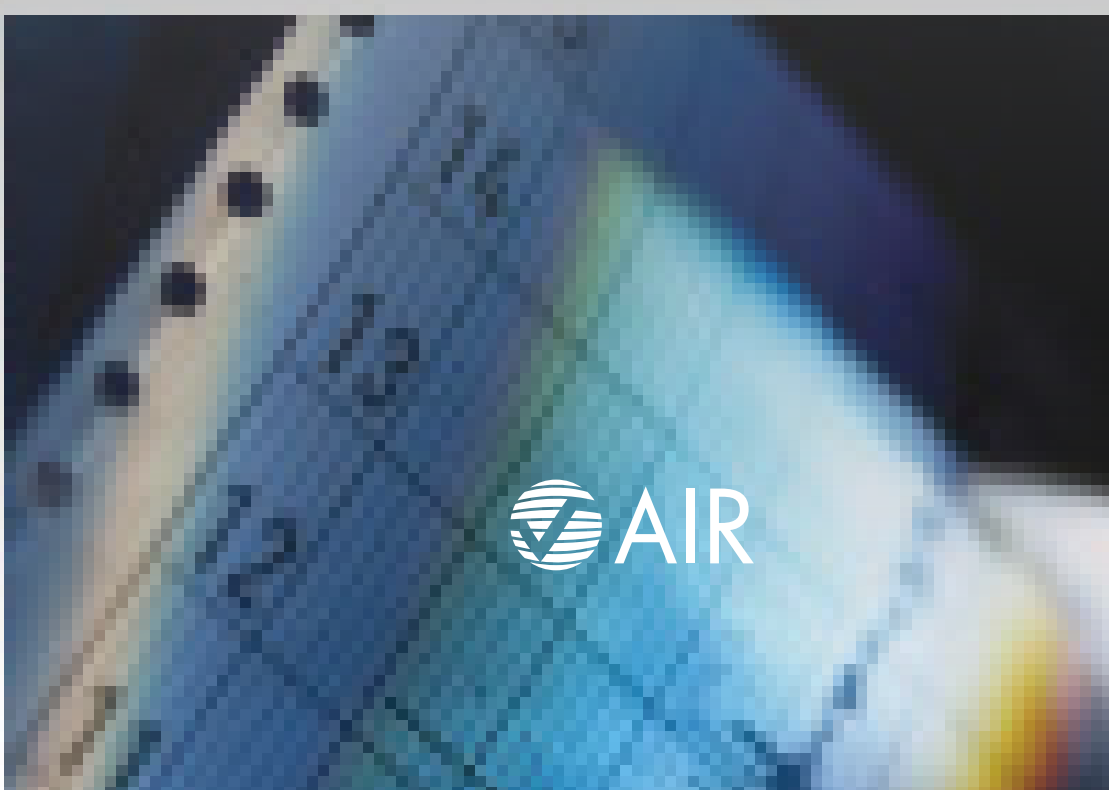
Catastrophe Risk Engineering Solutions

Catastrophes, whether natural or man-made, can damage structures, disrupt process flows and supply chains, devastate a workforce, and financially cripple a company—sometimes irreparably. Despite their relative infrequency, the magnitude of the potential losses from these high-consequence events obligates owners and insurers alike to prepare for their occurrence. But how does one accurately quantify and adequately prepare for the impact of these relatively rare events before they occur?





And how does one recover in the aftermath of a catastrophe? Informed decision-making requires reliable, defensible and transparent information about catastrophes and their potential effects on one's business, and an understanding of practical risk mitigation strategies.

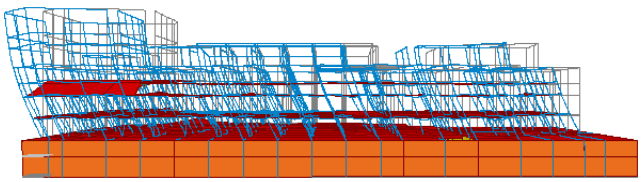
To prepare for the consequences of earthquakes, hurricanes, floods, terrorist attacks and the like, stakeholders need to be armed with a thorough understanding of the hazards involved, their likelihood of occurrence, and the unique vulnerabilities of their facilities and business operations. Preparation also calls for the identification of appropriate risk mitigation approaches with respect to both physical improvements (facility repairs, upgrades) and insurance protections, and the development of emergency response and recovery plans. In the aftermath of a catastrophe, the path to financial recovery involves assessing the nature and extent of the damage sustained, and identifying and implementing appropriate repair strategies.

AIR Worldwide Corporation (AIR) has been providing global catastrophe risk assessment technologies and services to the financial and insurance industries for more than twenty years. Through its unique Catastrophe Risk Engineering (CRE) practice, AIR works one-on-one with stakeholders from a broad range of industries and organizations to help them quantify, understand, and mitigate the physical and monetary losses associated with these low-frequency, but high-impact events.

Decision–Making Using CRE

AIR's CRE practice integrates probabilistic hazard modeling with on-site investigations, detailed earthquake and wind engineering, and state-of-the-art structural evaluations to provide reliable, defensible, and transparent answers to questions such as:

- What is the vulnerability of my buildings and other structures to natural and man-made hazards?
- What is the probability that my facilities will experience various levels of physical damage, business interruption, and financial loss?
- What can I do to mitigate my risk? Which risk mitigation strategy or strategies are the most cost-effective? Are my limited resources better spent on insurance, structural retrofit, self-insurance, relocation, or some combination of the above?
- If a catastrophe has occurred, what is the true nature and extent of the damage, and what repair strategies should I undertake that will be both cost-effective and mitigate the damage from future such events?



Advanced computer modeling of complex structures (Source: AIR)

To help decision-makers answer these questions, AIR's CRE Consultants work one-on-one with our clients to develop effective risk management strategies, whether for single sites—including high-value and business-critical facilities—or for portfolios of similar properties. The detailed engineering expertise of AIR's CRE Consultants extends well beyond residential, commercial, and industrial buildings

to include highly specialized industrial structures, including equipment, tanks, silos, wind turbines, transmission lines and offshore platforms, among others. AIR's CRE Consultants help clients make informed business decisions concerning physical improvements to their properties, plan appropriate insurance purchases, and determine advantageous tradeoffs between physical improvements and insurance. Specific services include:

- **PRE-EVENT RISK ASSESSMENT AND MITIGATION:** Includes the development of appropriate and effective physical risk mitigation strategies (facility repairs, upgrades) supported by detailed cost-benefit analyses and evaluation of tradeoffs between different risk mitigation options.
- **POST-EVENT DAMAGE ASSESSMENT AND REPAIR STRATEGIES:** Includes determination of the nature, cause, and extent of catastrophe-induced damage, and the development of appropriate repair strategies; AIR's CRE Consultants also serve as engineering experts in matters debated in courts of law.
- **ANALYTICAL SUPPORT:** Includes the application of state-of-the-art wind and earthquake engineering, structural evaluations (including advanced modeling and computer analysis, effects of construction vibrations, fire damage, and other risks), and research to solve complex engineering problems.

Who Can Benefit from AIR's Catastrophe Risk Engineering Solutions?

AIR's CRE Consultants help develop strategies that best fit a client's specific risk mitigation or damage assessment needs, budget, and tolerance for risk. Clients who can benefit from the application of CRE services include:

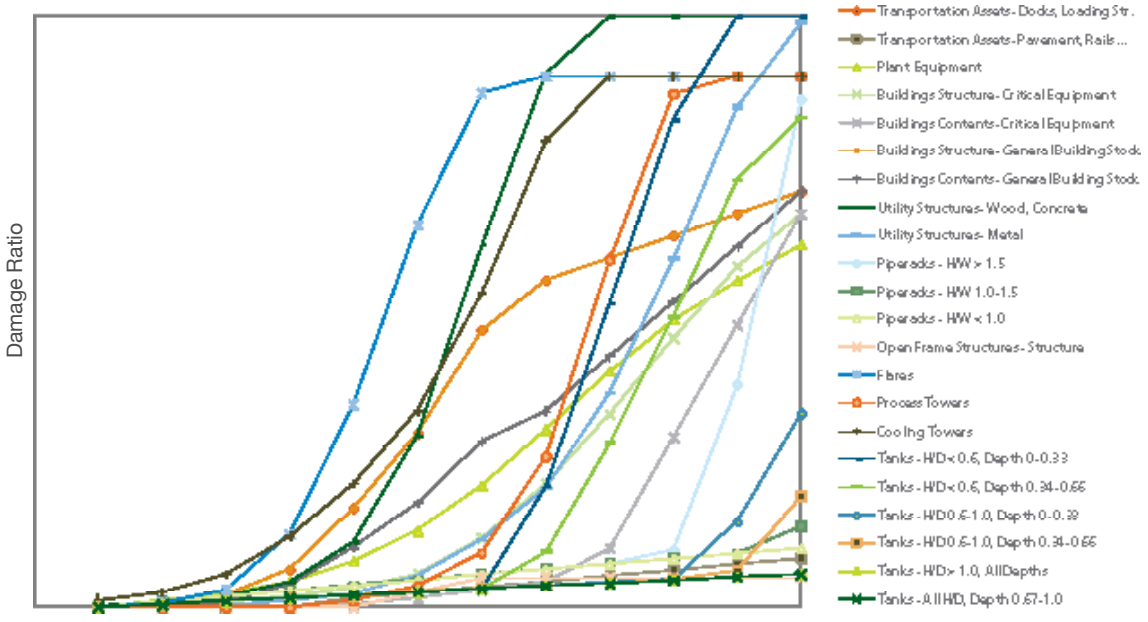
CORPORATIONS with at-risk facilities that are critical to company operations, that house high-value contents, or that generate substantial revenue.

OWNERS AND RISK MANAGERS who need to evaluate risk mitigation investments against other means of loss-reduction or financial investment, or who need to bring a facility back to its pre-catastrophe condition.

PROSPECTIVE OWNERS wanting to evaluate potential acquisitions beyond simple due-diligence.

BROKERS who have existing risk management practices or who would like to expand their range of services in both pre- and post-catastrophe situations.

INSURANCE COMPANIES deciding whether and at what price to insure a property; loss-control departments working to reduce loss potential, whether their own or



Wind damage functions for various industrial facility components (Source: AIR)

their clients'; adjusters seeking to determine the cause and extent of damage in a post-catastrophe situation, and recommend appropriate repairs.

ATTORNEYS working on the resolution of insurance claims. Financial institutions deciding whether or not to underwrite a loan or whether to require insurance to protect an investment.

GOVERNMENT AGENCIES that have responsibility for or ownership of large infrastructure lifelines such as transportation, power distribution, and water distribution networks.

Unparalleled Expertise

Soft story collapse during the Bhuj, India Earthquake (Source: AIR)

Damage to a refinery during Hurricane Katrina (Source: Wikipedia)

AIR's CRE Consultants include scientists and engineers who are experts in a broad range of technical specialties, including earthquake and wind engineering, structural evaluations and dynamics, geotechnical engineering, meteorology, seismology, risk and decision analysis, and probability and reliability theory. It is this mix of expertise that allows the AIR CRE team to holistically address all aspects of the performance and reliability of structures in an uncertain dynamic loading environment, whether natural or man-made.

The experience of the CRE team at AIR includes extensive work in the probabilistic quantification of natural and man-made hazards, and engineering investigations and analyses of a broad range of physical assets including development of appropriate physical repair and design concepts. Their experience ranges from risk and damage assessment of a single residential property to risk analysis for entire countries—and post-catastrophe damage assessments of thousands of structures. Team members' specific expertise includes:

- **RESIDENTIAL, COMMERCIAL, INDUSTRIAL STRUCTURES:** Residential and office buildings, malls, airports, ports, manufacturing facilities, high-tech facilities, chemical plants, power generation and distribution facilities, refineries, nuclear power plants, and water treatment plants, among others.
- **SPECIALIZED STRUCTURES:** Offshore platforms, tanks, silos, flares, turbines, dams, pipelines, transmission systems, amusement park rides, unique structures.
- **HAZARDS:** Earthquakes, hurricanes (including storm surge), floods, fires, explosions, construction vibrations.
- **GEOGRAPHICAL REACH:** North and South America, Caribbean, Europe, Asia, Africa.

Damage to building envelope from high winds during Hurricane Jeanne (Source: AIR)

CRE Highlights

- Advanced probabilistic site-specific hazard analysis (for earthquakes, hurricanes, storm surge, extreme wind, precipitation); deterministic evaluation of fire, explosions, and terrorism hazards.
- Site inspections to assess the physical condition of assets, both in pre- and post-catastrophe situations.
- Advanced modeling and analysis of structure response under a full range of possible hazard scenarios to determine structural vulnerability and the likely nature and extent of physical damage.
- Engineering solutions for observed or projected damage, including strategies for risk mitigation and repair.
- Network analysis that explicitly examines the interconnectivities among the components of a facility to evaluate potential business interruption, as well as the interaction between facilities in order to evaluate supply-chain risk.
- Structure and content damage expressed in engineering and financial terms, and days of downtime (determined using component cost models, repair cost databases, repair strategies, and time schedules).
- Loss analysis carried out for each engineering retrofit option considered and the cost/benefit evaluation of the various loss mitigation and structural retrofit strategies examined (with decision analysis techniques applied to each loss mitigation option so as to identify optimal strategies that conform to a client's risk tolerance).
- Transparency in analysis methodology and in the delivery of results.

COVER IMAGE SOURCE
Pipe rack failure during the Bhuj, India Earthquake, AIR Worldwide
Aftermath of Hurricane Andrew, AIR Worldwide
Hurricane Alex, NASA's Earth Observatory
Seismograph, Stock Photography
Damage from Northridge Earthquake, FEMA

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ABOUT AIR WORLDWIDE

AIR Worldwide (AIR) provides risk modeling solutions that make individuals, businesses, and society more resilient to extreme events. In 1987, AIR Worldwide founded the catastrophe modeling industry and today models the risk from natural catastrophes, terrorism, pandemics, casualty catastrophes, and cyber attacks, globally. Insurance, reinsurance, financial, corporate, and government clients rely on AIR's advanced science, software, and consulting services for catastrophe risk management, insurance-linked securities, site-specific engineering analyses, and agricultural risk management. AIR Worldwide, a Verisk (Nasdaq:VRSK) business, is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.

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