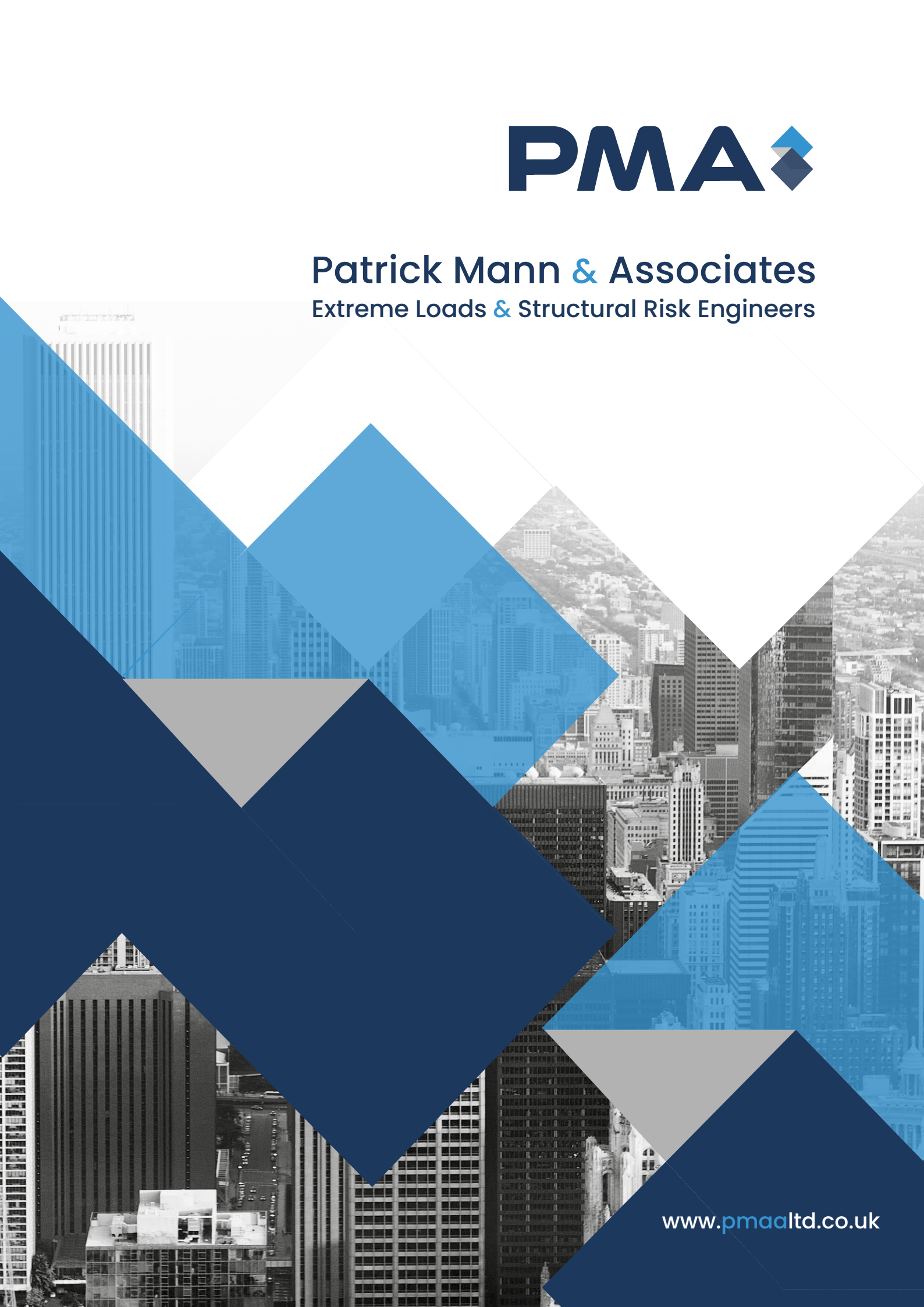
PMA

Patrick Mann & Associates

Extreme Loads & Structural Risk Engineers



www.pmaaltd.co.uk

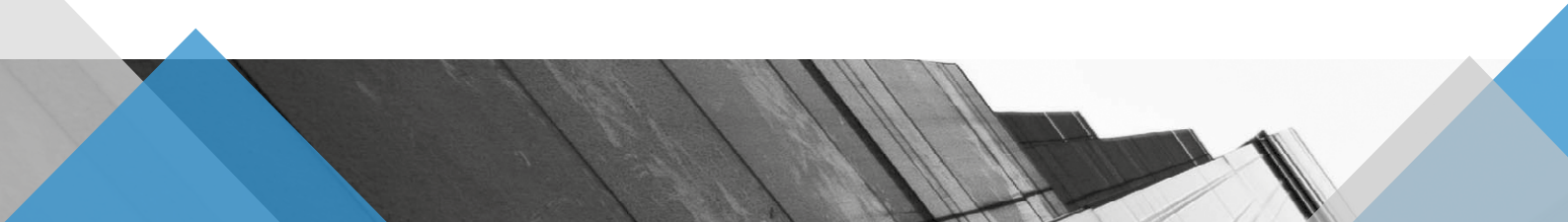
Extreme Loads & Structural Risk Engineers

Patrick Mann & Associates was founded in 2011 as an independent specialist structural engineering consultancy. We have now become one of the UK's leading blast engineering consultancies, supporting over one hundred separate clients across the Insurance, Defence, Government, Nuclear, Oil & Gas and Transport sectors within the UK and internationally. Clients includes government agencies, architects, security consultants, engineering consultants, building contractors and manufacturers.

Our mission is to work with our clients to provide tailored risk management solutions to extreme load events based on a solid foundation of engineering, science, and technology. We aim to build relationships with our clients such that, for many, we are the preferred partner for blast assessment and design. Consequently, we have completed multiple projects for many, and are often introduced to new clients via referrals. Current active blast and protective design projects include:

- Blast design of new stands at three Premiership football clubs.
- Blast design of the six railway stations.
- Feasibility studies for the security enhancement of more than 20 separate events arenas.
- Blast and protective design studies for multiple separate police / government buildings.

The business is accredited to ISO 9001: 2015, ISO 14001: 2015, ISO 45001: 2018 and PAS 99: 2012.
We are also a Construction Line Gold Member. All our technical staff are professionally qualified and have appropriate memberships of professional bodies including the Register of Security Engineers and Specialists (RSES), the Institution of Civil Engineers (ICE) and the Institution of Structural Engineers (IStuctE). We are a founding member of Energetic Materials Blast Information Group (EMBIG).



Our clients include:

Balfour Beatty

INEOS

Lindner PRATER

FK

bam

KIER

GallifordTry

GRAHAM

BURO HAPPOLD

AECOM

ARCADIS

Capita

LIVE NATION

Gallagher

Jacobs

Turner & Townsend

Blast Analysis & Design

Our team is one of the leading UK blast engineering consultancies with extensive experience in blast analysis and design, and includes Members of the Register of Security Engineers and Specialists (RSES).

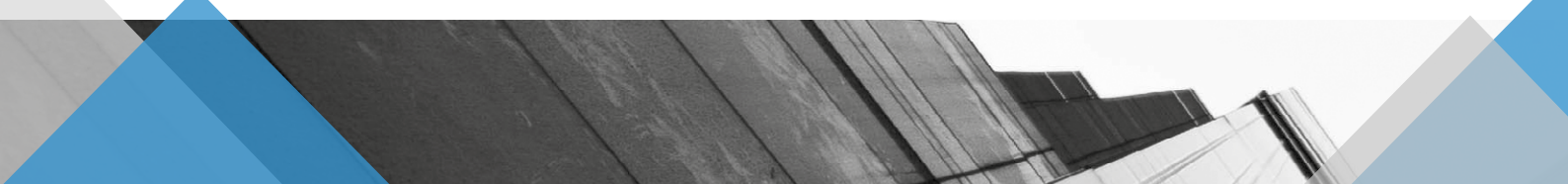
We work with a range of clients from concept design to site implementation..
This may include proof-of-concept reviews, writing performance specifications or undertaking detailed technical design. During the construction stage we can provide assurance that the works are completed as designed, and assist with resolving any site-related changes.

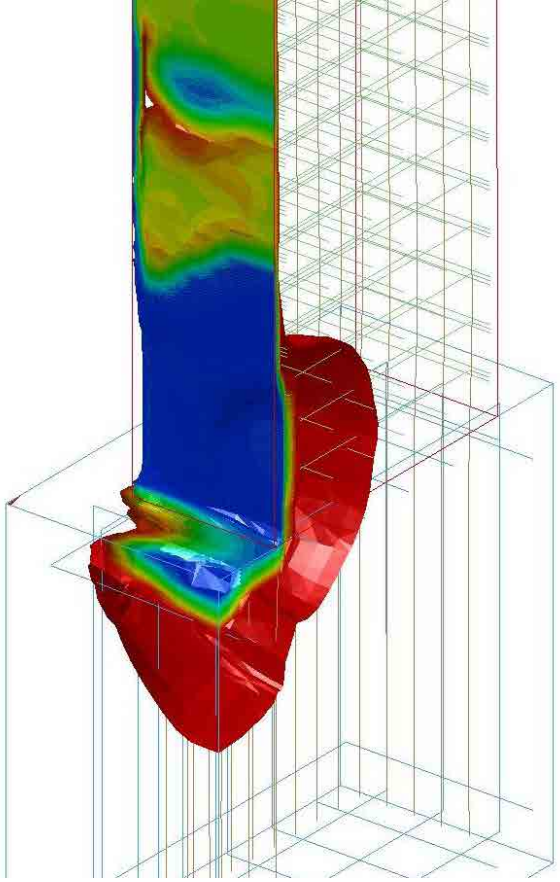
As industry leading experts, our work often involves working with facade product manufacturers, multidisciplinary engineering consultancies and architects to enhance their designs to incorporate the blast resilience whilst maintaining the architectural design intent.

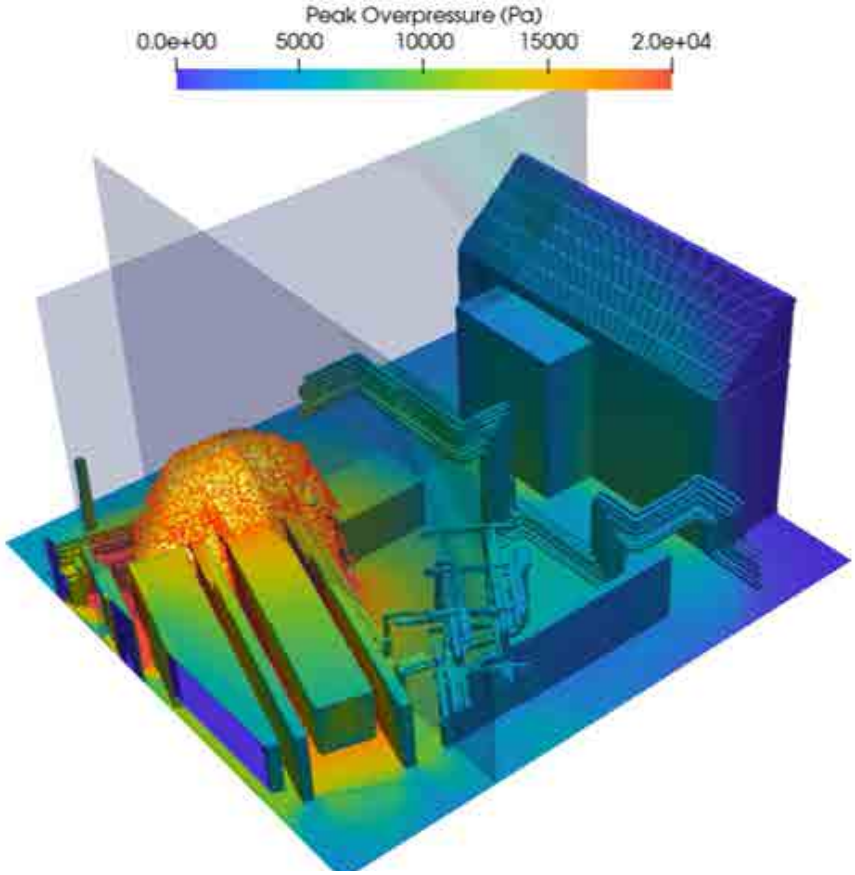
We are involved in the development of international best practice. This includes being a founding member of the Energetic Materials Blast Information Group (EMBIG), which aims to improve the knowledge available to those involved in assessing the safety of sites for the storage, manufacturing and handling of explosive materials by providing a forum for the development and exchange of best practice..

An overview of our blast related services includes:

- Site inspection / site surveys.
- Incident investigation.
- Explosion modelling and blast load prediction.
- Blast consequence assessment.
- Blast vulnerability analysis.
- Glazing hazard analysis.
- Structural integrity analysis / progressive collapse analysis.
- Blast ppgrade feasibility studies.
- Design of blast resistant structures.
- Design of blast doors and windows.
- Blast testing.
- Explosives safety structural justification reports.
- Implementation support / project management.







EMBIG

Energetic Materials Blast Information Group

RSES

Register of Security Engineers & Specialists

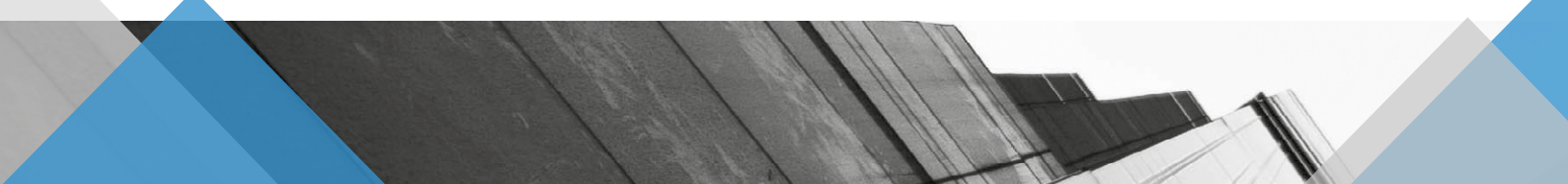
Security & HVM Design

Our team is one of the leading UK security engineering consultancies with extensive experience in performing security risk assessments for buildings and facilities.

As a consequence of the new Protect Duty (Martyn's Law), we are working with our clients to better understand the risk to the public from terrorism in any crowded place or space that they are responsible for. This includes theatres, music venues and football stadia. For each venue, we work with our client to understand the risk and what risk mitigation options are available and are proportionate. We will then work with the clients to undertake the detailed design of the measures and support them through the implementation phase.

An overview of the security services that we provide includes:

- Criticality assessment.
- Threat assessment.
- Determination of operational requirements.
- Vehicle dynamics assessments.
- Vehicle as weapon risk assessments.
- Hostile vehicle mitigation analysis and design.
- Weapons affects analysis and design – ballistics, rockets, mortars.
- Risk mitigation feasibility studies / cost-benefit studies.
- Anti-terrorism / force protection (AT/FP) assessment and design.
- Detailed design of protection systems.
- Implementation support / project management.



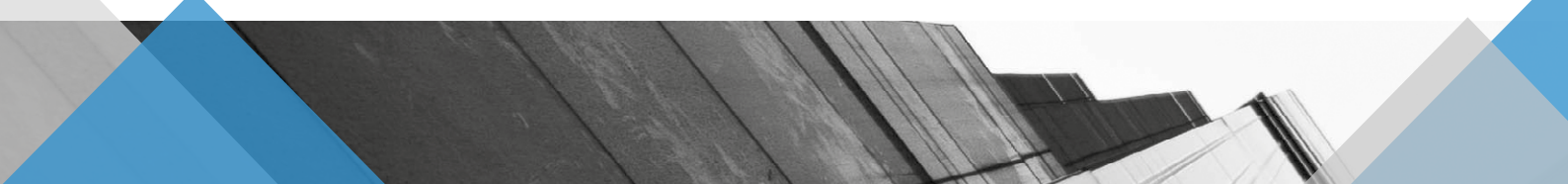
Loss Assessment Studies

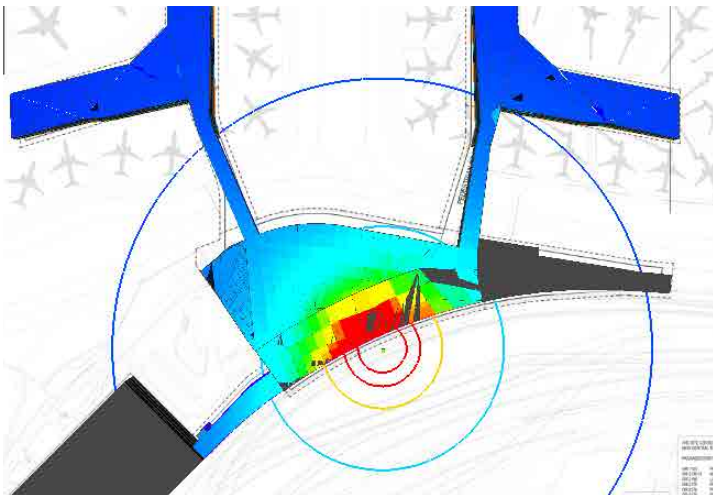
We work with corporations, brokers, insurers and lenders understand their loss exposure from natural hazard and terrorist events. Typically this involves probable Maximum Loss (PML) and Estimated Maximum Loss (EML) studies. We tailor these to suit the requirements of the client and have completed manufacturing facilities, petrochemical facilities, retail complexes as well as some of the world's landmark structures.

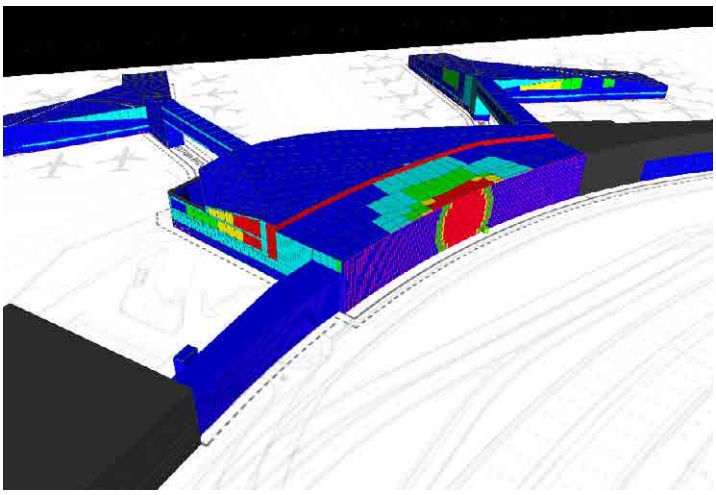
Typical study scopes comprise:

- Portfolio Studies – high-level desktop studies to estimate and profile the risk across the entire asset portfolio.
- Facility Loss Assessment Studies – site specific studies that evaluate the facilities loss potential for a given hazard.
- Business Impact Analysis – site specific studies that evaluate the assets/functions that pose the greatest loss potential, irrespective of initiating hazard.
- Due Diligence Studies – high-level studies undertaken as part of acquisition, mergers.

Identify Risk	Quantify Risk	Manage Risk
Human Error	Business Interruption	Securitisation
Equipment / Prcoess Failure	Physical / Operational Loss	Emergency / Recovery Planning
Security/Terrorism	Environmental Damage	Capital Improvements
Fire / Explosion	Legal / Political Ramifications	Retrofit Design
Impact	Due Diligence	Staff Training & Development
Hazardous Materials	Financial Loss	
Earthquake		
Extreme Weather Events		







Quantitative Risk Assessment Studies

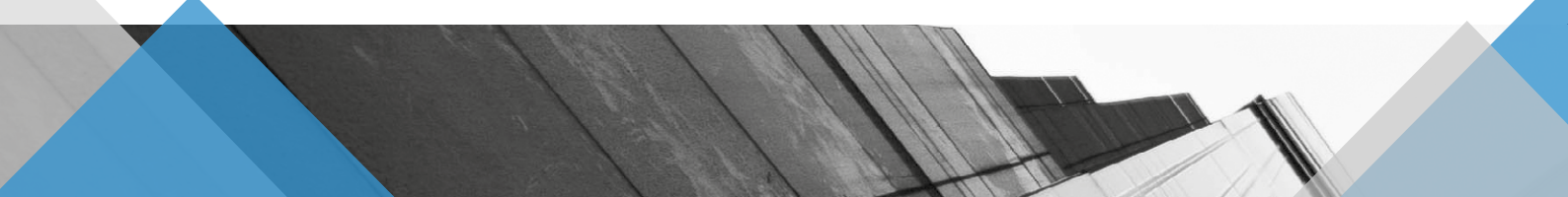
Our team is one of the leading UK risk engineering consultancies with significant experience in performing consequence and risk assessment studies on chemical and petrochemical facilities. Our engineers have a detailed working knowledge of all of the main international best practice documents and standards.

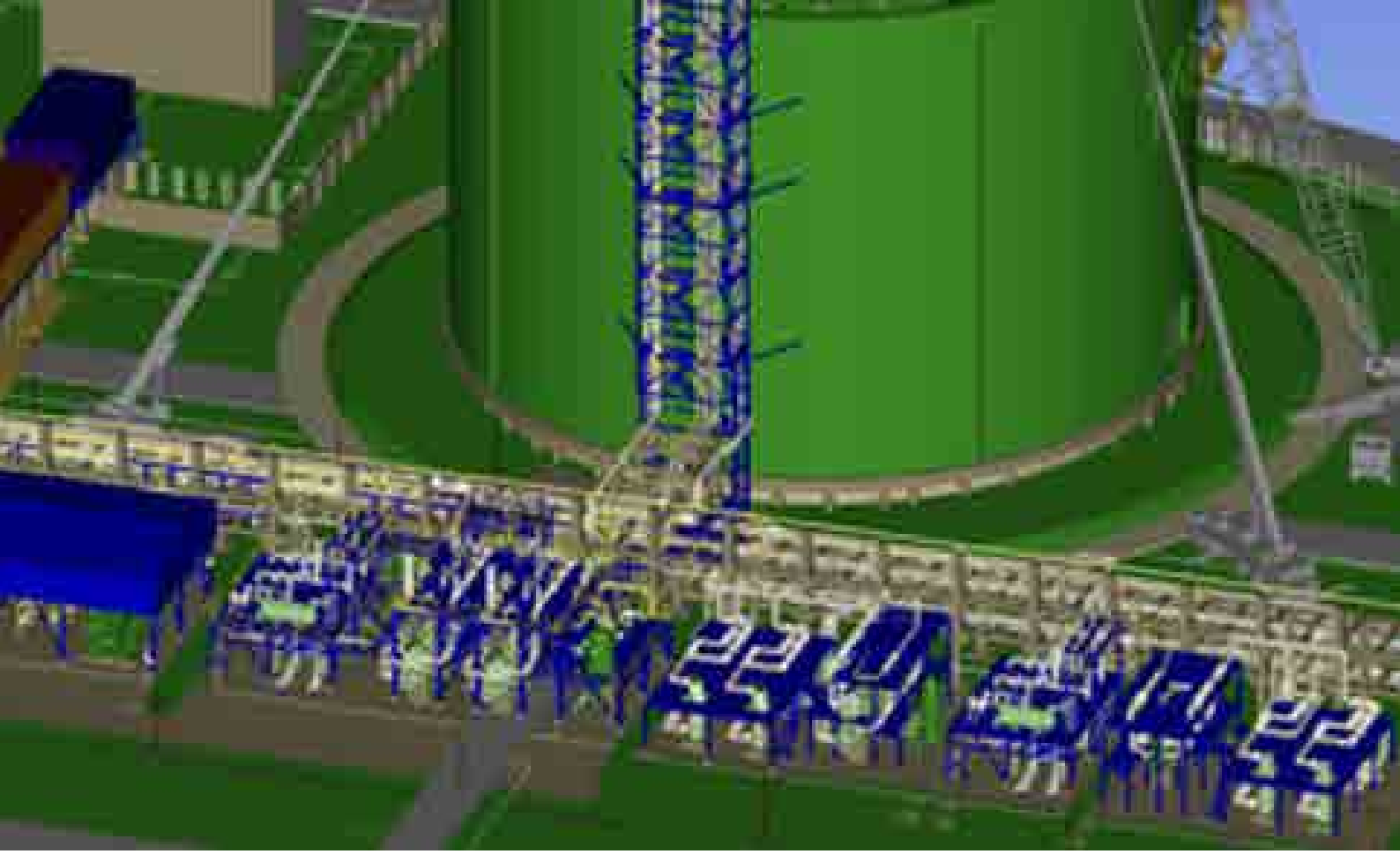
Our particular expertise is working with the process safety team to refine the blast loading associated with the site. This may include refined blast load prediction through the use of the GAME Modified Multi-Energy Method or CFD to further refine the hazard assessment and capture the benefit of features that could provide shielding. The output from these studies is then combined with our advanced blast assessment and design capability to provide an enhanced understanding of the structural performance.

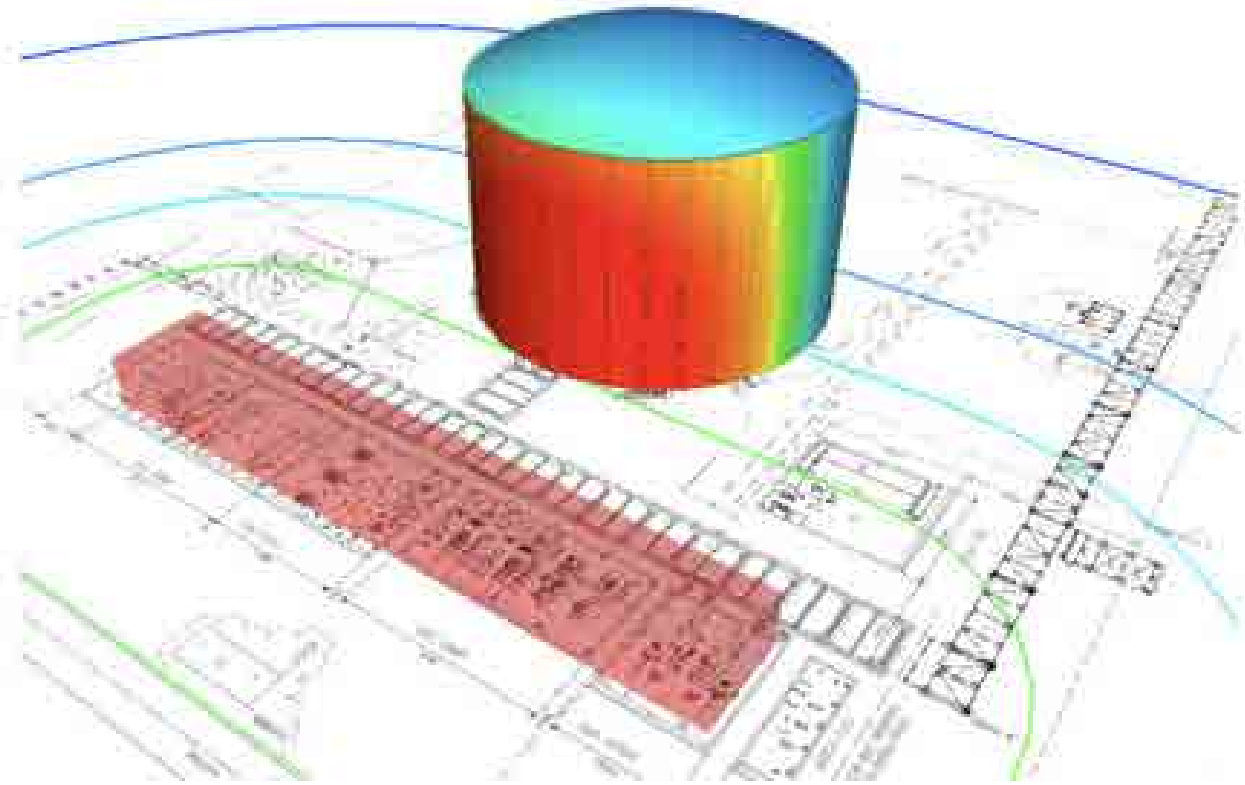
The adjacent images illustrate a typical example where we used blast modelling techniques to refine the magnitude of the blast loading onto the tank. Advanced non-linear modelling was then used to refine the blast load withstand of the tank. The combination of both parts demonstrated that the tank was safe against the explosion hazard.

An overview of the safety related services that we can provide includes:

- Incident investigations.
- Load and performance criteria development.
- Dispersion analysis.
- Explosion modelling and blast load prediction using BST, MEM and CAM methods.
- Computational fluid dynamic (CFD) modelling.
- Facility siting studies.
- Building vulnerability screening.
- Occupied building risk assessments (OBR).
- Building risk assessments (BRA).
- Quantitative risk assessments (QRA).







Seismic Analysis & Design

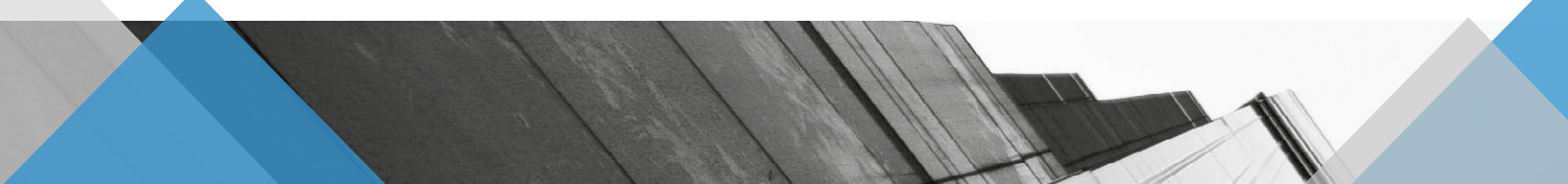
Our team is one of the leading UK risk engineering consultancies with extensive experience in seismic analysis and design. We have a detailed working knowledge of the international best practice seismic design and detailing criteria including: ASCE 7, FEMA 356, ASCE 43-05, ASCE 4-98, EC8, AISC 341, ACI 349.

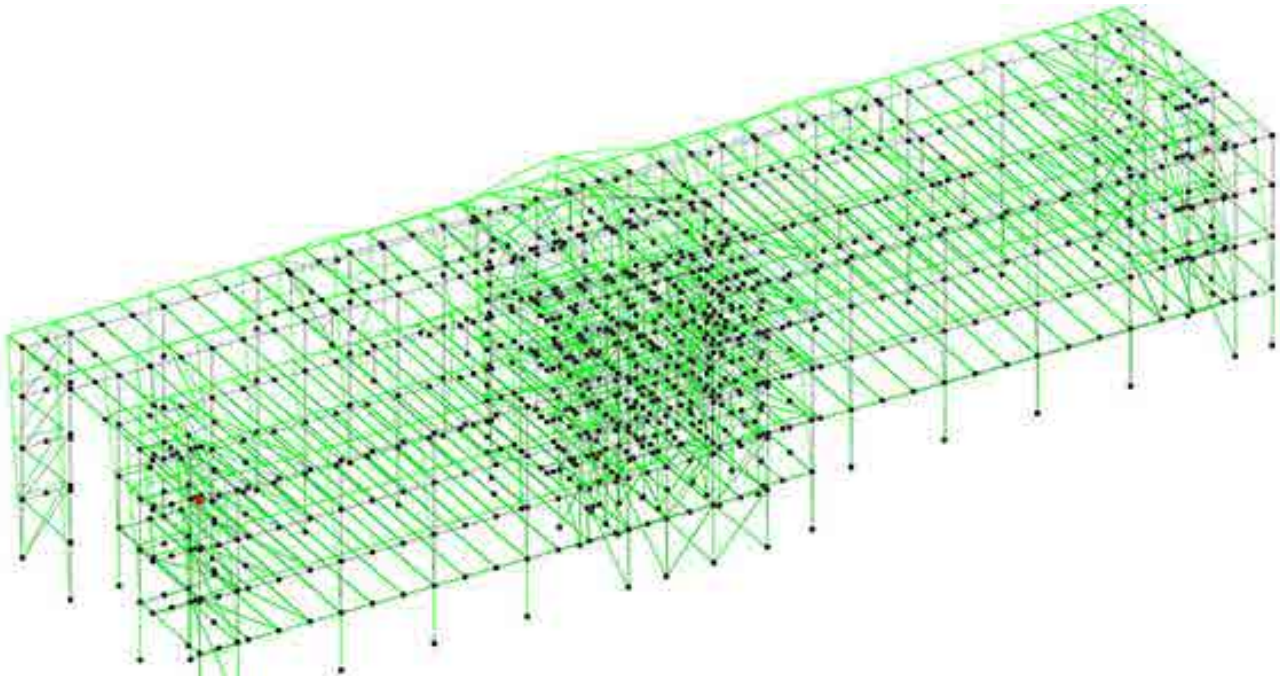
We have extensive experience of performing nuclear safety assessments for earthquake loading. We are experienced at working with the safety teams to translate their safety objectives into engineering performance requirements, enabling the seismic assessments to be targetted at the safety functional requirement. We have then liaised with the regulator to gain safety acceptance.

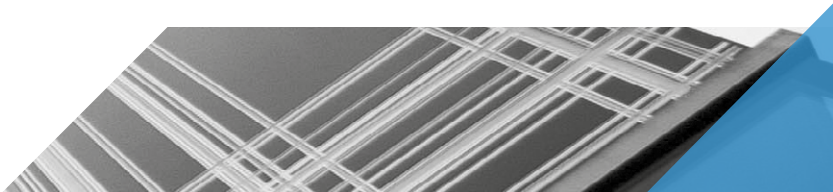
We have also used this seismic experience within other industries to quantify the impact of ground shock on critical assets from weapon strikes.

An overview of the seismic analysis and design services that we can provide includes:

- Site inspections.
- Incident investigations.
- Walkdown surveys for seismic assessment.
- Seismic analysis - elastic, non-linear, push-over.
- Retrofit feasibility studies / cost-benefit studies.
- Seismic design of buildings.
- Seismic qualification of safety-critical plant.
- Design justification of safety related buildings and plant.
- Shake table testing.







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