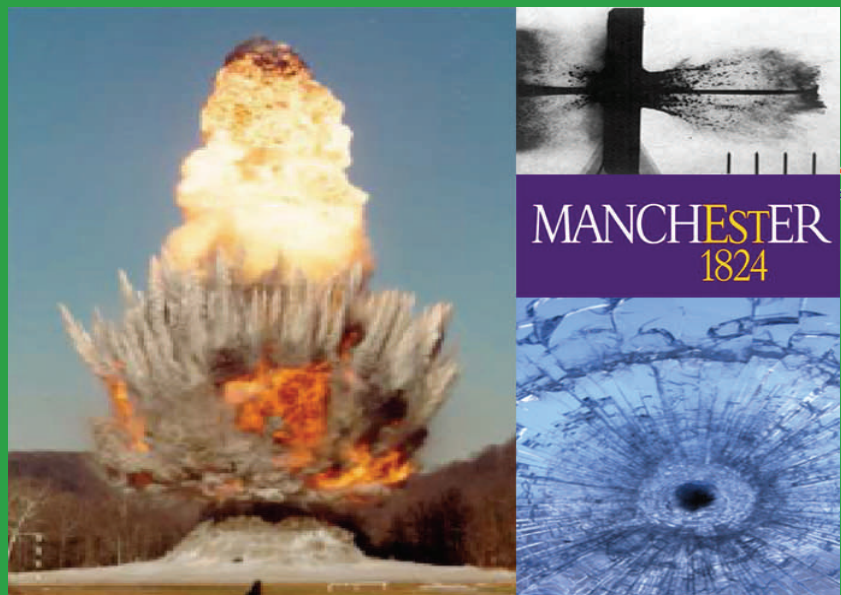


# Impact and Blast Effects: Theory, Analysis and Design

**A three-day short course**



## **Impact and Blast Effects**

The course is designed for professional engineers, consultants, researchers and graduate students, who may be involved in analysis, testing, modelling, design and the assessment of structures against impact and blast loads. It will cover basic and theoretical concepts, analytical, modelling and design methods and practical applications for structural protection against impact and blast effects.

**The University of Manchester, UK**

**3 Days, 19 - 21 September 2012**

# Impact and Blast Effects: Theory, Analysis and Design

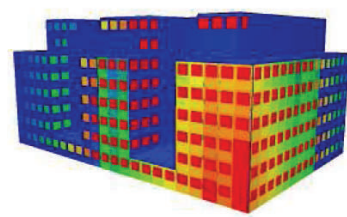
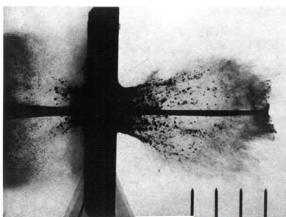
## Background

Impact and blast threats exist in a wide range of engineering, security and defence sectors, which have been frequently linked to industrial safety (surface/air/space transportations, nuclear power plant, offshore platforms and critical facilities in other industries) and protections against impact and blast effects in terrorist and battlefield events. Depending on the impact velocity and blast intensity, material and structural behaviour may become very different from their quasi-static behaviour when inertia and/or strain-rate effects become dominant in impact and blast events, which need to be considered in the design of protective structures against impact and blast loads. This short course integrates basic theory, design methodology and latest research progress and offers an introduction to professionals and researchers for dealing with impact and blast effects in various engineering fields.

## Impact and Blast Effects and the University of Manchester

Many research, teaching and consulting activities on the impact and blast subjects have been conducted in The School of Mechanical, Aerospace and Civil Engineering (MACE) at The University of Manchester.

The Impact and Explosion Expert Group in MACE is specialised on penetration mechanics, dynamic behaviour of engineering materials at high strain rates and structural response to impact and blast loads.



To register, phone Amanda Clare on 0161 275 4323

## Who is the course for?

This course will provide an introductory training for practicing engineers, consultants, researchers and research students, who may involve in dealing with impact and blast effects in mechanical engineering, civil engineering, nuclear engineering, aerospace engineering, oil and petrochemical engineering and defence engineering and industries. The course will be also suitable to architects, estate developers and security managers, who need updating in the latest developments in this area.

## Course Content

The course will consist of an introduction to impact and blast threats and their effects on structures with special emphasis on the fundamental concepts and methodologies of the practical techniques and the latest state-of-the-art developments in material property characterisation and analytical method. The first day of the course will cover impact and its effects while the blast loading and effects will be covered in the remaining two days. Details of the course content are shown in the programme outline.

## Partners

The partners involved in the delivery of the Impact and Blast Effect Course are;



## Introduction to the Speakers

### **Dr Qingming Li**

**Reader and Leader of Impact and Explosion Expert Group**

**School of Mechanical, Aerospace and Civil Engineering — The University of Manchester, UK**

Dr Li's expertise is in penetration mechanics, dynamic behaviour of engineering materials at high strain-rates, structural response to impact and blast loads and structural protection. He has more than twenty year's research experience in these fields and has published more than 100 peer-reviewed journal publications on these subjects, involving in analytical, numerical and experimental studies. He has served on relevant international conference committees and chairmanships, undertaken guest editorships, held guest professorships in several universities and provided consultancies to industries and government bodies. He is an associate editor of the International Journal of Impact Engineering and an editorial board member of International Journal of Protective Structures.

### **Mr John Crawford, PE,**

**President**

**Karagozian & Case, USA**

Mr. Crawford has provided engineering services related to blast effects to a variety of US Government agencies, building developers and owners, as well as commercial engineering and architectural firms for over 30 years. This work includes designing structural and mechanical systems to resist blast loads; developing engineering tools and first principle finite element codes for predicting the response of structural and mechanical systems to airblast and high velocity impacts; and testing full-scale and scaled structural systems under small to very large blast loads. In recent years, much of his work has been focused on the antiterrorist programs of various US Government agencies, performing blast effects analyses of a variety of buildings and structures, and developing design concepts for new construction and retrofit of existing buildings to protect them from blast and impact loads.

### **Dr. Shengrui Lan**

**Principal Engineer / Head of Computation Group, Karagozian & Case, USA**

Dr. Lan has 25 years experience in structural engineering, focusing on finite element analysis of structures under static, dynamic, blast and impact loads. He has performed numerous high-fidelity physics based (HFPB) finite element analyses for blast and impact effects on various protective structures/systems for evaluating their blast/impact resistance and determining their design parameters. His HFPB models have been validated by many full-scale blast field tests and vehicle crash tests.

Dr. Lan has managed/involved numerous projects in blast effects analysis and design for blast protection of airport facilities, blast mitigation retrofits of office buildings including perimeter protection, window upgrade, column retrofit, progressive collapse mitigation and internal explosion isolation. He has been a key member in developing a series of anti-ram devices for DOS K4 to K12 ratings and a K50 anti-ram wall, which passed the vehicle crash tests.

## Day 1: Wednesday 19 September 2012

Session	Title/Theme (Duration)	Elements	Time
<b>Day 1</b>			
	Registration	Tea and Coffee Short course materials	9:00-9:30
I:0 QL	Introduction	Introduction of the short course	9:30-9:40
I:1 QL	Impact threats and penetration mechanics (60 minutes)	Impact threats in civil and military applications Projectile and target descriptions Penetration regimes	9:40-10:40
<b>Morning Tea Break 10:40-11:00</b>			
I:2 QL	Local impact effect on metallic target (60 minutes)	Local and global effects Penetration and perforation Ballistic limit and testing method Empirical formulae	11:10-12:10
<b>Lunch Break 12:10 – 13:10</b>			
I:3 QL	Local impact effect on concrete target (60 minutes)	Perforation and scabbing limits Analytical models and predictive tools Empirical formulae	13:10-14:10
I:4 QL	Soft missile impact (60 minutes)	Soft missiles Aircraft impact	14:10-15:10
<b>Afternoon Tea Break 15:10-15:30</b>			
I:5 QL	An introduction to “R3 -impact assessment procedure” for nuclear industries (30 minutes)	Outline of R3-Impact assessment procedure Examples	15:30-16:00
I:6 QL	SHPB technique (60 minutes)	Development and principles of split Hopkinson pressure bar (SHPB) technique. Description of strain-rate effects on the strength of various engineering materials.	16:00-17:00
I:7 QL	Discussion (20 minutes)	All relevant issues covered in Day-1	17:00-17:20

To register, phone Amanda Clare on 0161 275 4323

## Day 2: Thursday 20 September 2012

Day 2			
2:1 JC	Introduction (90 minutes)	<p>Overview: the state-of-the-arts in protective technology</p> <p>Protection plan and design for buildings</p> <p>Perimeter protection</p> <p>Mitigation of debris hazards</p> <p>Mitigation of progressive collapse of a building</p> <p>Mitigation of internal explosion</p>	9:00–10:30
<b>Morning Tea Break 10:30-10:50 am</b>			
2:2 SL	Blast loads and Engineering Tools (90 Minutes)	<p>Blast loads on structures</p> <p>Calculating tools for predicting blast effects.</p> <p>P-I Curves for components, range to effects curves for components.</p> <p>Dynamic theory—lumped mass versus continuum models</p> <p>SDOF: shape function, resistance function, stiffness versus mass, ductility, algorithm</p> <p>UFC 3-340-02 / TM 5-1300 / P397, dynamic increase factors, SDOF charts, PI tools for predicting building response</p> <p>K &amp; C and other design/assessment codes.</p>	10:50–12:20
<b>Lunch Break 12:20 – 13:20 pm</b>			
2:3 JC	Blast-resistant design (100 minutes)	<p>Blast-resistant design concepts.</p> <p>Design process</p> <ul style="list-style-type: none"> <li>• Standoff</li> <li>• Structural system</li> <li>• Walls and glazing</li> <li>• Equipment</li> <li>• Detailing</li> </ul>	13:20–15:00
<b>Afternoon Tea Break 15:00-15:20 pm</b>			
2:4 SL	Windows response and retrofit (60 minutes)	<p>Blast response of windows, glazing façade</p> <p>Test data and retrofit methods</p> <p>Retrofit using polymer films and clear sheets</p> <p>Fabric catcher system</p> <p>Cable catcher system</p>	15:20–16:20
2:5 JC	HFPB models, use and theory (70 minutes)	<p>Continuum versus structural FEM modelling</p> <p>Formulations: CFD CSD, explicit, implicit, Lagrangian, Eulerian, etc.</p> <p>Material models for blast effects: concrete, steel, soil, polymers</p> <p>Advanced modeling: fracture, meshfree, adaptive, coupled</p> <p>Calculation/simulation examples</p>	16:20-17:30
<b>Course Dinner in the Evening</b>			19:30

To register, phone Amanda Clare on 0161 275 4323

## Day 3: Friday 21 September 2012

Day 3			
3:1 JC	Protective Design of RC/ Masonry wall (90 minutes)	Overview of mitigation of blast effects on masonry walls Material models and validation Simulation of blast mitigation effects on retrofitted masonry wall Catcher systems for walls P-I curves for retrofitted masonry wall	9:00-10:30
<b>Morning Tea Break 10:30-10:50 am</b>			
3:2 SL	Progressive Collapse Part I (80 minutes)	Definition & histories Current standards and practices Overview of UFC 4-023-03 , July 2009 Occupancy category Tie force / Alternate path / Enhanced Local Resistance Linear static / nonlinear static / nonlinear dynamic procedures Analysis examples of progressive collapse	10:50-12:10
<b>Lunch Break 12:10 -13:10 pm</b>			
3:3 JC	Progressive Collapse Part 2 (80 minutes)	Issues in current standards Criteria used in progressive collapse analysis Performance based design New generation analysis tools Test data	13:10-14:30
3:4 SL	Anti-Ram Barrier (70 minutes)	DOS rating / ASTM standard for anti-ram barriers Aesthetics Design concept HFPB simulations Field Tests	14:30-15:40
<b>Afternoon Tea Break 15:40 -16:00 pm</b>			
3:6 JC	Blast retrofit concepts, test data and design (90 minutes)	Retrofit concepts: walls, columns, windows Lab and blast effects data Blast retrofit design using HFPB modelling	16:10-17:40
3:6 All	Q&A (20 minutes)	Blast and impact testing data Questions & Discussions for all sessions  <b>End of Course</b>	17:40-17:50

To register, phone Amanda Clare on 0161 275 4323

## Organisational details

### Date / Duration

Three days in Manchester UK, Wednesday 19 September to Friday 21 September 2012

### Location

The course will be held in the School of Mechanical, Aerospace and Civil Engineering on Sackville Street in Manchester. The University is close to the city centre (a five minute walk). Piccadilly railway station and the central Chorlton Street bus station are also within walking distance.

### Language

English

### Delegate Fee

The total fee for the three days of the course including lunches and the evening course dinner on Day Two is **£690**. (Plus VAT if applicable)

### Cancellation of payments

Up to three weeks before the event: free of charge; up to one week before; 50%. Non-attendance will not receive a refund. Cancellation must be in writing to the Course Administrator in advance.

### Cancellation by the University

The University reserves the right to cancel the course 10 days before if there are not sufficient delegates registered.

### Food

Lunches will be provided on each day with breaks for tea and coffee in the morning and afternoon. A Course Dinner will be arranged for the second evening of the course in a local restaurant.

### Accommodation

Delegates are asked to make their own arrangements for overnight accommodation. There are a number of hotels close to the University in central Manchester. Please contact the Course Administrator for further details and there is information on our website.

### In and around Manchester



# Impact and Blast Effects: Theory, Analysis and Design

## Course booking form

3 days 19 - 21 September 2012

Please reserve me a place on the above course

Title. Name

Organisation

Address

Post Code

Telephone Contact (Work)

Telephone Contact (Mobile)

Email address

Preferred method of payment

Invoice to my organisation

Please invoice the following contact person & dept.

Personal cheque enclosed (payable to - The University of Manchester)

I would like to pay by credit card

Bank Transfer

Pay Online with our Online Store.  
See our CPD page  
[www.mace.manchester.ac.uk/business/cpd/index.html](http://www.mace.manchester.ac.uk/business/cpd/index.html)

Follow the Online Store link.

Signature Date Other Information.

Please delete where appropriate.

For assistance, please contact:

**Amanda Clare, CPD Course Administrator**

Telephone: 0161 275 4323

**The School of MACE**

**The University of Manchester**

**George Begg Building - Room B15**

**Sackville Street**

**Manchester**

**M13 9PL**

Fax your complete application form to: 0161 306 3755

e-mail booking: [amanda.clare-2@manchester.ac.uk](mailto:amanda.clare-2@manchester.ac.uk)

<http://www.mace.manchester.ac.uk/cpd/>

I will / will not require vegetarian meals (or other please state).

I will / will not need special facilities for a disability (please give details)

Please send me details about accommodation close to the venue.

The course will be held on the University Of Manchester Campus and location maps will be sent to delegates three weeks before the event.

I found out about this course from:

The University of Manchester, UK