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 are involved in the analysis, testing, modelling, design and assessment of structures against impact, blast and shock loads. The course will cover basic and theoretical concepts, material characterisations, analysis, modelling and design methods and the practical applications for structural protection against impact, blast and shock effects.

The University of Manchester, UK

3 Days, October 28 – 30 2019

Impact and Blast Effects: Theory, Analysis and Design

Background

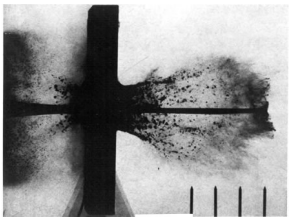
Impact and blast threats exist in a wide range of engineering, security and defence sectors, which have been frequently linked to industrial safety in the fields of surface/air/space transportations, nuclear power plant, offshore platforms, critical facilities in other industries and infrastructures,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

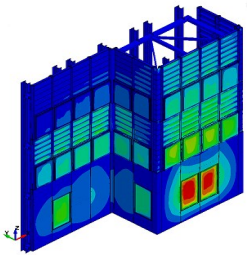
Impact and Blast Effects and the University of Manchester

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 & Explosion Laboratory in MACE is specialised on penetration mechanics, dynamic behaviour of engineering materials at high strain-rates, and structural response to impact, blast and shock loads. It hosts the Impact Facilities at high pressure, temperature & strain-rate as part of UKCRIC-National Centre for Infrastructural Materials.

Our partner, Karagozian & Case (K&C) has a unique and highly technical set of skills in science and engineering providing consulting services for analysis, test, simulation and design of structural and mechanical systems subjected to blast, impact and shock effects. K&C is recognized for its leadership role in these areas using high-fidelity physics-based (HFPB) numerical models.





Who should attend?

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, security managers, and government officers who need updating in the latest developments in this area.

Course Content

The course will consist of an introduction to impact, blast and shock 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 morning sessions of the course will cover material characterizations, impact and shock threats and their effects while the blast loading and effects will be covered in the afternoon sessions. 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

MANCHESTER 1824
The University of Manchester

K&C
Karagozian & Case

Introduction to the Speakers

Qingming Li (Ph.D, DEng, CEng, FIMechE,)

Professor in Applied Mechanics
Leader of Impact & Explosion Laboratory
School of Mechanical, Aerospace & 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, blast and shock loads and structural protection. He has more than twenty year's research experience in these fields and has published 200 peer-reviewed journal and conference papers 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. Dr Li is a Fellow of Institution of Mechanical Engineers. He serves as an associate editor of the International Journal of Impact Engineering and editorial board member of International Journal of Protective Structures and Journal of Defence Technology.

Mark Weaver (P.E., S.E.)

Principal, Karagozian & Case Inc., USA

Mark Weaver has over a decade of structural design, analysis, and testing experience that has largely focused on designing structures to mitigate the effects of blast, impact, and shock loads. In his current role at K&C, he leads structural design efforts that aim to develop innovative structural solutions capable of protecting people and infrastructure in the event of malicious man-made threats. Mr. Weaver has served as the principal investigator on efforts aimed at demonstrating the efficacy of structural components and systems to resist blast loads. Recent examples include multi-year efforts that involved blast testing on concrete and cold-formed steel (CFS) walls, concrete columns, cross-laminated timber structures, and CFS truss roof systems. He is also an experienced analyst and routinely employs high-fidelity physics-based analyses to evaluate the blast and impact resistance of his designs and test articles.

Mr. Weaver is actively involved in professional organizations and committees devoted to advancing the state-of-the-art in structural design to mitigate the effects of explosives. He is currently a voting member of the ACI 370 "Blast and Impact Load Effects" committee and an associate member of the ASCE "Blast Protection of Buildings Standards" committee.

Day 1: Monday 28 October 2019

Session	Title/Theme (Duration)	Elements	Time
Day 1			
	Registration	Tea and Coffee	9:00-9:25
	Introduction	Introduction of the short course	9:25-9:30
A1:1 QL	Dynamic behavior of ductile materials	Strain-rate and different strain-rate regimes Strain-rate effects & micro-mechanics mechanisms for ductile materials Physics-based strain-rate equations Empirical strain-rate equations Coupled thermal effects	9:30-10:20
A1:2 QL	Dynamic behavior of brittle materials	Strain-rate effects & micro-mechanics mechanisms for brittle materials Empirical strain-rate equations for concrete-like materials Implementation of strain-rate equations in material models	10:20-10:50
Morning Tea Break 10:50-11:10			
A1:2 QL	Dynamic behavior of brittle materials	Continue	11:10-11:30
A1:3 QL	Split Hopkinson bar technique	Introduction to split Hopkinson bar set-ups Basic assumptions and equations Issues that need to be concerned for the valid interpretation of SHPB measurement results	11:30-12:30
Lunch Break 12:30-13:30			
B1:1 MW	Introduction to Modern Protective Technology	Background – The Need for Effective Protective Technology Protective Technology Paradigm Hazardous Effects Associated with Terrorism Analytical Methods Overview Mitigation Measures Overview Validation Testing Overview	13:30 – 14:40
Break 14:40-14:50			
B1:2 MW	Blast load Characterization	Overview of Explosions Far-Field Blast Loads Applying Far-Field Blast Loads to Structures Near-Field Blast Loads (to include internal detonations)	14:50 –15:50
Afternoon Tea Break 15:50-16:10			
B1:3 MW	Analyzing Structures for Blast Loads – Part 1	Tools for blast load calculation. Single-Degree-of-Freedom (SDOF) Theory SDOF Analysis Applications for Blast Loads Rapid Analysis Aids (e.g., breach curves, P-I curves)	16:10 – 17:10
Discussion 17:10-17:30			

Day 2: Tuesday 29 October 2019

Day 2			
A2:1 QL	Impact threats and penetration mechanics	Impact threats in civil and military applications Projectile and target descriptions Penetration regimes Jet impact	9:00-10::00
A2:2 QL	Local impact effects on metallic target	Local and global impact effects Penetration and perforation Ballistic limit and testing method Empirical formulae	10:00-10:30
Morning Tea Break 10:30-10:50			
A2:2 QL	Local impact effects on metallic target	Continue	10:50-11:20
A2:3 QL	Local impact effects on concrete target	Local impact effects Perforation and scabbing limits Analytical models and predictive tools Empirical formulae	11:20-12:30
Lunch Break 12:30-13:30			
B2:1 MW	Analyzing Structures for Blast Loads – Part 2	High-Fidelity Physics-Based (HFPB) Modeling: When is it Necessary? HFPB Modeling Issues (e.g., element formulation, hourglass, boundary conditions) Material Models (e.g., concrete, steel)	13:30 – 14:40
Break 14:40-14:50			
B2:2 MW	Blast-Resistant Design – Steel	Blast Design Overview for Steel (e.g., hot rolled, cold-formed) Design Considerations (e.g., far-field, near-field) Modeling Blast Effects Response of Steel Structures Validation Testing of Steel Structures Exposed to Blast Loads	14:50 –15:50
Afternoon Tea Break 15:50-16:10			
B2:3 MW	Blast-Resistant Design – Concrete	Blast Design Overview for Concrete (e.g., cast-in-place, tilt-up, post-tensioned) Design Considerations (e.g., far-field, near-field) Modeling Blast Effects Response of Concrete Structures Validation Testing of Concrete Structures Exposed to Blast Loads	16:10 – 17:10
Discussion 17:10-17:30			
Course Dinner 18:45-20:45 (Venue to be confirmed)			

Day 3: Wednesday 30 October 2019

Day 3			
A3:1 QL	Soft missiles and aircraft impact	Soft missiles Impact dynamics of cellular materials Aircraft impact	9:00-10:00
A3:2 QL	R3 impact assessment procedure	Outline of R3-Impact assessment procedure Missiles generated by pressure vessel failure Missiles generated by rotation machine failure	10:00-10:30
Morning Tea Break 10:30-10:50			
A3:2 QL	R3 impact assessment procedure	Continue	10:50-11:20
A3:3 QL	Structural response and damage under shock environment	Shock environment Shock response spectrum (SRS) Damage boundary Industrial standards & guidelines	11:20-12:30
Lunch Break 12:30-13:30			
3:1 MW	Design to Prevent Disproportionate (Progressive) Collapse	Design Approaches (e.g., Tie Force, Alternate Path) Analytical Model Complexity (e.g., linear static, nonlinear static, nonlinear dynamic) Validation Testing of Structural Systems Exhibiting Disproportionate Collapse	13:30 – 14:30
3:2 MW	Windows Response & Retrofit	Historical Review of Glazing Hazards Window System Response to Blast Loads Mitigation Measures (e.g., laminates, catcher systems) Validation Testing of Window Systems Exposed to Blast Loads	14:30 –15:30
Afternoon Tea Break 15:30-15:50			
3:3 MW	Perimeter Protection & Anti-ram Barrier	Historical Review of Vehicular Impact Hazards Barrier Response to Vehicular Impact Mitigation Measures (e.g., bollards, planters, active barriers) Validation Testing of Anti-Ram Barrier Systems Exposed to Vehicular Impact	15:50 – 16:40
Discussion and closure of the short course 16:40-17:00			
17:00 Departure			

Organisational details

Date / Duration
Three days in Manchester UK, Monday 28 October to Wednesday 30 October 2019

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). Manchester International Airport is located about 10 miles (16km) south of the University. 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 hardcopy lecture notes, lunches and the evening course dinner on Day Two is **£940**.

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 28-30 October 2019

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 give the purchase order number:

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

Signature Date

For general inquiry and registration:
Course Administrator, ConferCare
The University of Manchester
Oxford Road, Manchester, M13 9PL
Tel: +44 (0) 161 306 4082
Email: confercare-online@manchester.ac.uk

Fax your complete application form to: 0161 275 2223
e-mail booking: confercare-online@manchester.ac.uk
http://www.mace.manchester.ac.uk/study/cpd/short-courses/impact_blast/

Other Information.
Please delete where appropriate.

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:

To register, phone 0161 3064082