

# The Effects of Blast on Reinforced Concrete Buildings



Terrorism has become a serious threat in the world. This threat cannot be ignored. The main terrorist weapon is a bomb made from high explosives, with civilian buildings being a common target. Terrorists usually want to create chaos and maximize casualties.

A growing emphasis is therefore being placed on anti-terrorism protection of civilian buildings. In Singapore, it has been recognized that iconic structures as well as structures where mass congregation is likely, may be 'soft targets' for attack. Thus blast provisions are now an integral part of the design of major civilian facilities, e.g. hospitals, large hotels, shopping centres, stadia etc. In addition, buildings housing critical infrastructure, e.g. electrical sub-stations, are other likely targets. This course discusses the effects of blast on civilian, rather than military, structures. The latest forms of structural and glazing protection are discussed.

In practical design, extensive use of software is usually made. However, this course covers design principles. Hand-calculations are emphasized so that a 'feel' for the likely behavior of the structure under blast loading is obtained. Although the course covers only RC buildings, as these are the most common in Singapore, the principles can easily be extended to structural steel buildings.

## PROGRAMME DETAILS

Date	: 12 March 2015, Thursday
Duration	: 1 Day
Time	: 9am - 5pm
Venue	: NTU@one-north 11 Slim Barracks Rise Singapore 138664
CPD Programme	: 6 PDUs – (to be confirmed) : 6 STUs – confirmed
Fees	: \$240.00 (IES Members) \$300.00 (Non-Members)
Organizer	: IES Academy

\* Fees inclusive of 7% GST, course materials, light refreshment and lunch.

\* Certificate of Attendance will be issued to participants with at least 75% attendance.



The contents of the course are as follows:

1. Introduction to Blast  
*Nature of blast; blast parameters; importance of stand-off;*
2. Case Studies  
*Ronan Point; Alfred Murrah Building; Khobar Towers; US Embassies in Tanzania and Kenya; WTC; Pentagon*
3. Local Effects on RC Structures  
*Brisance; Contact explosion*
4. Global Effects on RC Structures  
*Concrete structures and blast; Cantilevers; Columns; Slabs; Beams; Shear walls; SDOF model;*
5. Derivations
6. Worked Example  
*Cantilever wall design*
7. Progressive Collapse Resistance  
*Statically Determinate vs Indeterminate; Catenary Action; Vierendeel Action.*
8. Façade Design  
*Façade Walls; Glazing types; Laminated glass under blast; Energy Absorbing Units; State-of-the art of blast resistant glazing.*

The course is targeted towards civil/structural engineers working on the design of civilian buildings in Singapore.

## Speaker



**Er. Dr. Niall MacAlevey** is the founder of the firm Shamrock Consultants, and is a registered Professional Engineer in Singapore.

After graduating from University College Dublin, Ireland in 1987, and completing his M.Sc. degree in “Concrete Structures” at Imperial College, London, he completed his Ph.D degree at the Nanyang Technological University in 1997 on “The Strengthening of Concrete Structures”. Later, he joined the academic staff there. He obtained a PGDipTHE (Post-Graduate Diploma in Teaching in Higher Education) from the National Institute of Education in 2001.

He has worked for a number of consulting engineering firms, and specialist prestressing subcontractors in London, Cambridge, Hong Kong and Singapore. He is the former Chief Structural Engineer at Beth-El (Asia Pacific) Pte. Ltd, a company specializes in anti-terrorism solutions for buildings.

He is the author of two books, *Structural Engineering Failures: lessons for design*, and *Preliminary Design of High-Rise buildings in Non-Seismic Regions* both available from Amazon.com.



## Course Schedule

<b>Course Title:</b>	<b>The Effects of Blast on Reinforced Concrete Buildings</b>	
<b>Duration:</b>	1 Day	
<b>Time</b>	<b>Event</b>	
8:30am - 9.00am	Registration	
9:00am - 10.30am	Introduction to Blast; Case Studies	
10:30am - 10.45am	Tea Break	
10:45am - 12.30pm	Local/Global Effects on RC Structures	
12:30pm - 1.30pm	Lunch Break	
1:30pm - 3.00pm	Derivations; Worked Example	
3:00pm - 3.15pm	Break	
3:15pm - 4.30pm	Progressive Collapse Resistance	
4:30pm - 5.00pm	Façade Design	
5:00pm	End	



## Registration Form

### **The Effects of Blast on Reinforced Concrete Buildings (2<sup>nd</sup> Run)**

Date : **12 March 2015, Thursday**  
Duration : 1 day  
Time : 9.00am – 5.00pm  
CPD Programme : 6 STU (confirmed)/ 6 PDU (to be confirmed)  
Venue : NTU@One-North (Off North Buona Vista)  
11 Slim Barracks Rise S(138664)  
Course Fee : \$240 (IES members); \$300 (Non-members)  
Lillian Seow  
Course Coordinator : IES Academy  
70 Bukit Tinggi Road S(289758)  
Tel: 6463 9211 Fax: 6463 9468  
Last Date of Registration : 2 March 2015, Monday

### **Participant Details**

Name : \_\_\_\_\_ Nric/WP No : \_\_\_\_\_  
Company : \_\_\_\_\_ Designation : \_\_\_\_\_  
Address : \_\_\_\_\_  
Postal : \_\_\_\_\_

Email : \_\_\_\_\_

Please indicate:  IES Member No \_\_\_\_\_  Non-members  Sponsored by Company  
 PEB/SIA/SILA Member No \_\_\_\_\_  Vegetarian

### **Contact Person (if different from participant)**

Name : \_\_\_\_\_ Designation : \_\_\_\_\_  
Tel: \_\_\_\_\_ Fax: \_\_\_\_\_ Email: \_\_\_\_\_

Payment: Cash / Nets / Cheque: \_\_\_\_\_ Amount: \_\_\_\_\_

- Cheque to be made payable to 'Institution of Engineers, Singapore' or 'IES'
- Cancellation or withdrawal from course must be 7 days before course date via email to Course Coordinator
- Course fee includes 7% GST

### **Acceptance of Terms & Conditions for Registration of IES Academy Courses / Events**

I agree to abide by the Terms & Conditions for Registration of IES Academy courses / events.

Name : \_\_\_\_\_ Signature : \_\_\_\_\_



## **TERMS & CONDITIONS COURSE REGISTRATION**

### **Registration**

Any registration, whether online or fax will be based on a ***first-come-first-served basis*** and will only be confirmed upon receipt of full payment by The Institution of Engineers, Singapore (IES) unless otherwise invoice to company.

All registrations must be submitted with duly completed registration form.

Email registrations will not be accepted.

### **Closing Date & Payment**

The closing date of the event will be 7 days prior to event commencement date. Cheques should be crossed 'A/C payee only' and made payable to '**Institution of Engineers, Singapore**' or '**IES**', with the ***Title of The Event indicated clearly on the back of the cheques***, and submitted with the duly completed registration forms to:

**Lillian Seow**  
**IES Academy**  
**70 Bukit Tinggi Road**  
**Singapore 289758**

### **Confirmation of Registration**

Confirmation of registration will be given 7 days prior to the commencement date via email. If you do not receive the said confirmation email, you are required to contact IESA general admin immediately at 6463 9211 (office).

IESA reserves the right to allow only confirmed registrants to attend the Event.

### **Withdrawals/Refunds of Fees**

Notice of withdrawal must be given in writing to IESA. Policy on refund of course fee is as follows:

- **FULL** refund if we receive your written notice of withdrawal at least 7 days before the commencement of the Event.
- **NO** refund otherwise.

No-show of participant would not be accepted as reason for withdrawal/refund.

Replacement is allowed but restricted to one time only. Replacement will be allowed only if written notice is received by us at least 3 days before the commencement of the event. However, when an IES member is replaced by a non-member, the participant has to pay the difference in the fees at least 3 days before the commencement date.

### **Cancellation/Postponement**

Changes in Venue, Dates, Time and Speakers for the Events can occur due to unforeseen circumstances. IES reserves the full rights to cancel or postpone the Event under such circumstances without prior reasons. Every effort, however, will be made to inform the participants or contact person of any cancellation or postponement.

Fees will be refunded in FULL if any Event is cancelled by IESA.

### **Enquiries**

For further enquiries, please contact IESA general office at Tel: 6463 9211.