The University of Queensland - IIT Delhi Academy of Research (UQIDAR) Joint PhD Project Proposal Template

1. Project details

Project title

Novel hybrid testing for studying seismic and fire behaviour of beam-column joints in reinforced concrete structures

Project ID

UQIDAR-00162

2. Supervision team

Please visit the IITD website www.iitd.ac.in and UQ website http://researchers.uq.edu.au/ to highlight potential collaborators that would be best suited for the proposed project. Complete where possible – advise if you'd like assistance establishing contacts.

	University of Queensland	IIT Delhi	External/Industry (if applicable)
Supervisor name and title	*Dr Cristian Maluk*	*Prof. Dipti Ranjan Sahoo*	*Prof Asif Usmani*
School or department (or company, if applicable)	*School of Civil Engineering*	*Department of Civil Engineering*	*Department of Building Services Engineering, The Hong Kong Polytechnic University*
Phone number	*+61 7 336 53518*	*(+91) 11 2659 1203*	*(852) 2766-5842*
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URL for more info	*https://researchers.uq.edu.au/researcher/12949*	*http://web.iitd.ac.in/~drsahoo/*	*https://www.bse.polyu.edu.hk/People/asusman*

3. Other supervisors

Please provide information about other associate supervisors below.

Full name and title(s): Dr David Lange
School/department/company details: UQ School of Civil Engineering
Phone: +61 7 336 56646
Email: d.lange@uq.edu.au
URL: https://researchers.uq.edu.au/researcher/20572

2. Field Of Research (FOR) codes

Specify up to four four-digit FOR codes for your project – see **here** for more detail on FOR codes.

1. **0905**	3. **1204**
2. **1202**	4.

3. Keywords

Please choose up to 4 keywords for your project. E.g. Nanotechnology, data science, novel batteries, etc. Keywords will assist in classifying project and presenting projects to students on the applications portal.

1. **Structural Engineering**	3. **Seismic design**
2. **Reinforced concrete**	4. **Fire safe design**

4. Discipline background of candidate

Please outline the preferred background of your student. E.g. Organic chemistry, physiology, topology, CFD, etc. This will assist in presenting projects to applicants on the apps portal.

1. **Civil Engineering**	3.

UQ IITD Academy of Research

The University Of Queensland AUSTRALIA

Indian Institute of Technology Delhi

2. **Structural Engineering**	4.

5. Project description

Beam-column joints are considered key elements to ensure appropriate performance against severe damages or complete collapse of reinforced concrete (RC) structures during a seismic event and/or during fire. The very complex axial-flexure-shear stress-state in these joints under load reversals requires a detailed investigation to understand their failure mechanism and overall response of these structural systems. Currently, the numerical modelling of beam-column joints is developed based on the findings of quasi-static tests in which the variation in the flexural and axial forces of beams and columns under seismic loading or during fire has not been considered. The present study is focussed on the evaluation of seismic and fire behaviour of beam-column joints by considering the influence of adjoining beams and columns during transient loading through hybrid testing. In this testing technique, the beam-column joint subassemblies will be tested physically in the laboratory and the remaining frame members will be numerically modelled using a numerical analysis tool. The measured data from laboratory test will be synchronized with those obtained from numerical modelling so as determine the next step of loading involved in the numerical integration. The obtained test results will be used for updating the numerical models in the subsequent steps; this novel test method is known as “hybrid testing”. It is proposed to conduct hybrid testing on beam-column test specimens with reinforcement detailing in accordance with the relevant Indian and Australian design standards. A parametric study shall be conducted numerically considering the findings of the hybrid testing so as to include the influence of various reinforcement detailing schemes adopted in practice. The findings of developing the novel hybrid testing and parametric studies will be used to propose new design guidelines for RC beam-column joints.

6. Project deliverables/outcomes

The expected outcomes of this project are:

1. Validation of model updating techniques in hybrid testing
2. Development of a simplified numerical modelling approach for seismic and fire behaviour of beam-column joints
3. Recommendation for a simplified reinforcing detailing scheme for design standards

7. Research impact themes

Highlight the research impact theme(s) this project will address. Feel free to nominate more than one. For more information, see http://www.uq.edu.au/research/impact

1. Healthy Ageing
2. Feeding the World
3. **Resilient Environment** ✓
4. **Technology for Tomorrow** ✓
5. Transforming Societies

8. Type of student

This project is best suited for an:

i-student	✓
a-student	
i- or a-student	

Please note that:

- an i-student will be expected to spend year-1 at IIT-D, year-2 at UQ and the remaining time at IIT-D.
- an a-student will spend year-1 at UQ, year-2 at IIT-D and the remaining time at UQ.
- All students will be required to complete some amount of coursework in their first year.

9. Student capabilities and qualifications

Essential capabilities:

Knowledge in structural and/or fire safety engineering with high grades in academics.

Desirable capabilities:

Experience in experimental testing and/or numerical simulations

Knowledge in earthquake or structural fire safety engineering. In case the student does not have the relevant experience, the student will be encouraged to undertake additional studies in this field at UQ and/or IIT Delhi.

Expected qualifications (Courses, degrees, etc.):

Masters Degree in Structural Engineering or a related discipline.