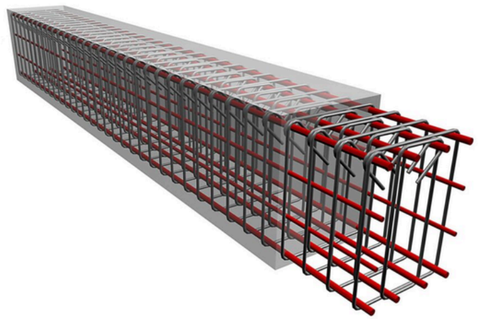
SOFT3888_TU08_04

APPLYING MACHINE LEARNING TO RC BEAMS FOR ENHANCING FIRE



Overview

1. Introduction - Project Description & Stakeholders

Project Description

Use ML to predict fire resistance time for reinforced concrete beams (RC) → support design & fire safety assessment, reduce simulation/testing costs.

Stakeholders

- Supervisor: Penghui Wen
- Client:
  - Dr. Faham Tahmasebinia
- Development Team
- School of Computer Science

Background

Fire Risk

Building fires cause massive casualties and collapses, as RC beams lose strength rapidly under heat.

Research Gap

Most studies only estimate fire resistance time but ignore failure modes, leaving design guidance too general.

Practical Impact

This gap prevents engineers from understanding how RC beams actually fail during fire events.

Real Case

Plasco Tower Fire, Tehran (2017)

A 17-story reinforced concrete high-rise collapsed after a fire, killing 30 firefighters and injuring 75 people.

Project Motivation

Our project uses machine learning to predict both resistance time and failure modes, bridging research and practical design.

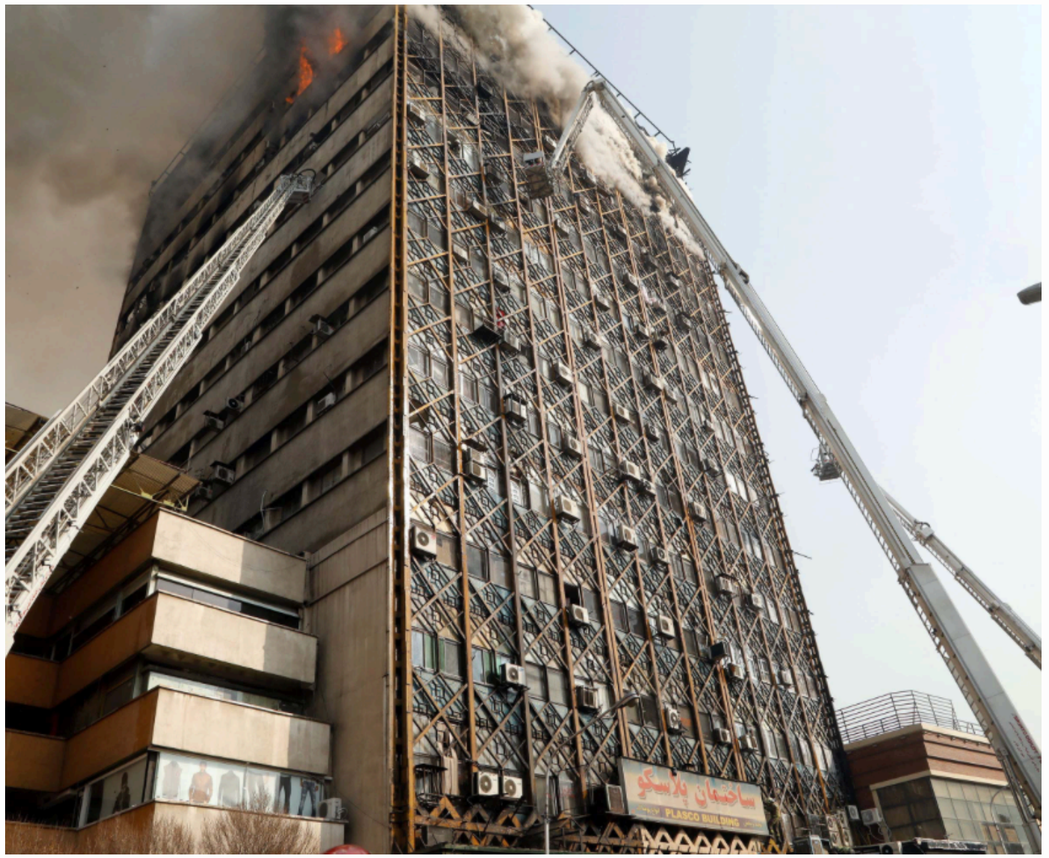


Image from [CNN, 2017]

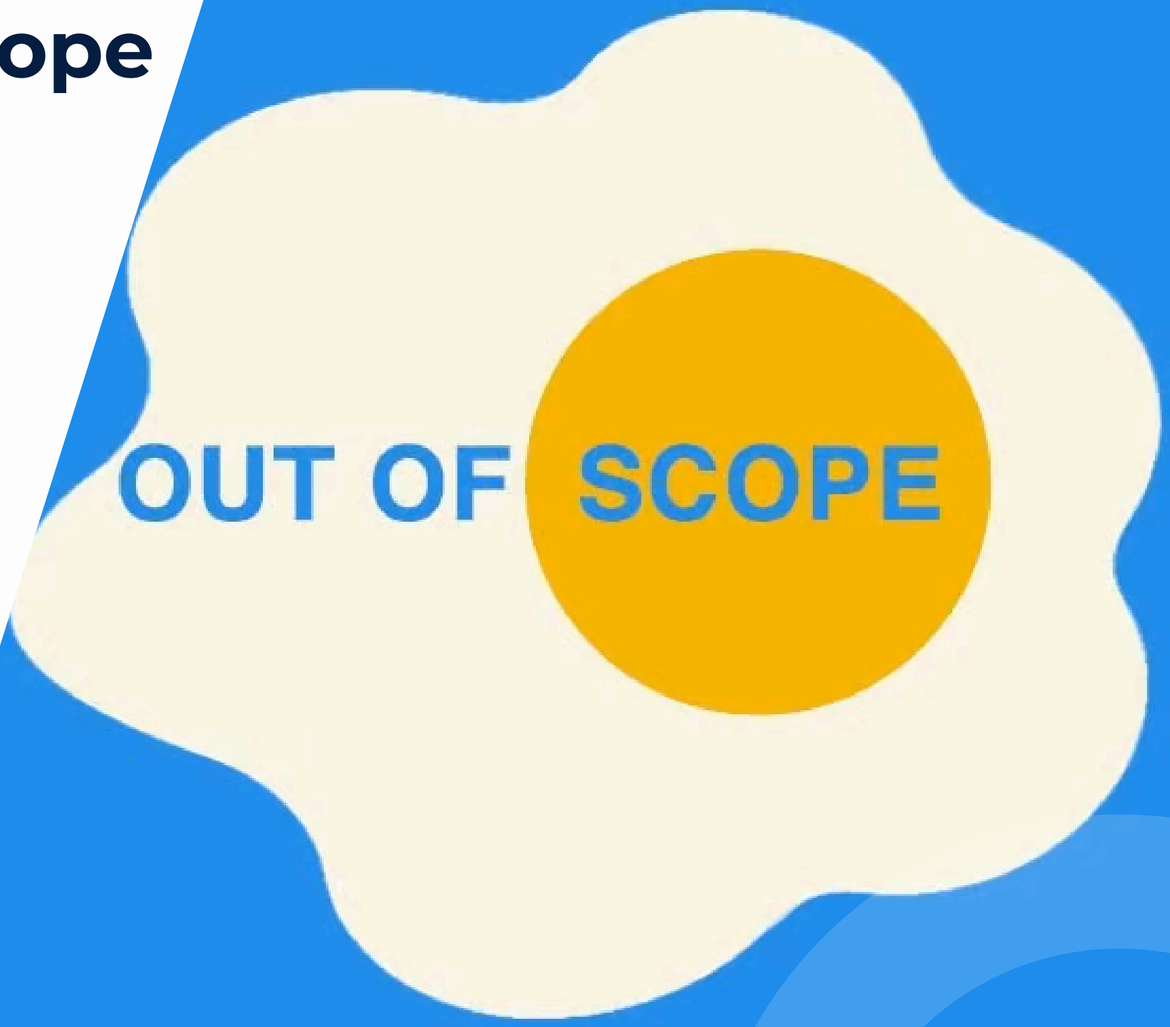
2. Project Scope - In Scope

In Scope

- Collect and curate published experimental + numerical data on FRP strengthened RC beams under fire.
- Develop a machine learning model to predict fire resistance and classify failure modes.
- Apply feature importance analysis to identify critical design factors (concrete strength, cover, load ratio, insulation).
- Translate insights into practical design recommendations, aligned with Eurocode 2 fire provisions.
- Deliver a working demo tool where users input beam parameters which gives instant predictions and design recommendations.
- Produce a final report (data, methods, limitations, applications) and reproducible codebase.

2. Project Scope - Out of Scope

- No new laboratory fire tests; only existing published datasets will be used.
- No large-scale finite element simulations beyond available studies.
- No development of new fire curves alternatives to ISO 834.
- No creation of new FRP or insulation materials.
- Tool will remain a research prototype, not a certified commercial design software.



ASSUMPTIONS AND LIMITATIONS

01 Assumes that past experimental and numerical data accurately represent real fire behavior in RC beams.

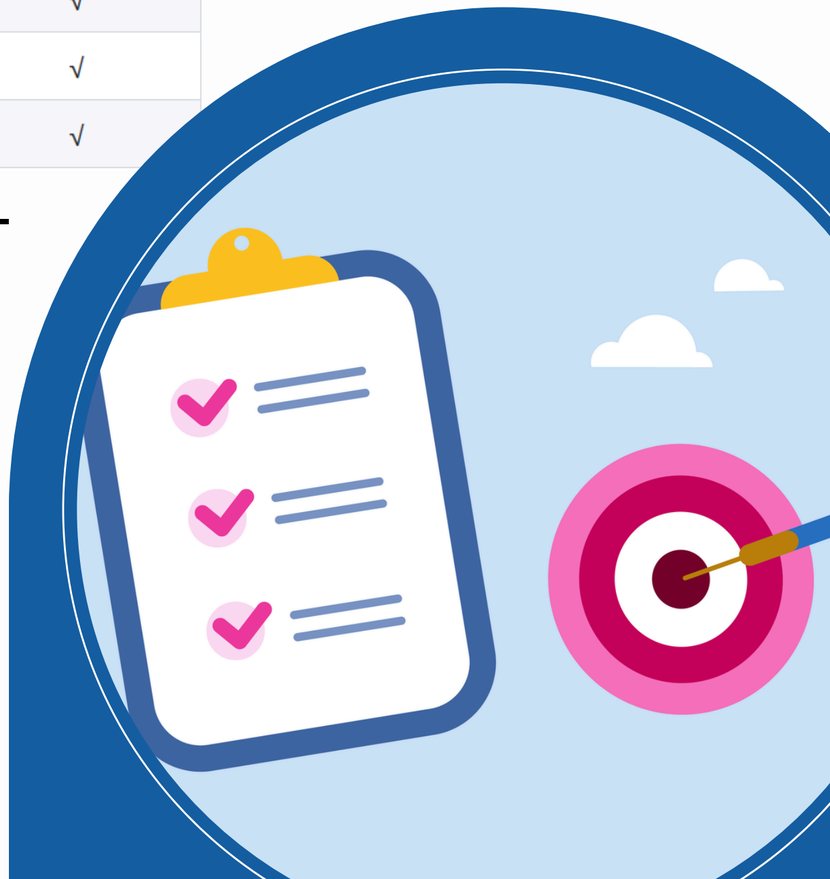
02 Current dataset does not directly map to Eurocode 2 or other design provisions, so extra work is needed to translate predictions into actionable guidance

03 Limited to FRP strengthened beams , may not generalize to all RC beams.

04 No failure mode labels dataset only gives FRT, not how failure occurred.

3. Communication Schedule

	Week 3		
Group Members	In-tutorial Group Meeting	Out-tutorial Group Meeting	Client Meeting
Pranav	√	√	√
Tran Duc Manh	√	√	√
Shengyuan Nie	√	√	√
Zhiyuan Na	√	√	√
Guanchen Pan	√	√	√
Zihan Liu	√	√	√



Meeting minutes

Subject: Client Meeting 1
Project Name: Applying machine learning to rc beams for enhancing fire
Facilitator: Faham, Senior Lecturer, School of Civil Engineering
Prepared by: Shengyuan Nie (Alex)
Mode: Zoom meeting
Date: 15/08/2025
Time: 19:00
Attendees: Shengyuan Nie(Alex), Pranav, Tran Duc Manh, Zhiyuan Na, Guanchen Pan, Zihan Liu
Absent: None

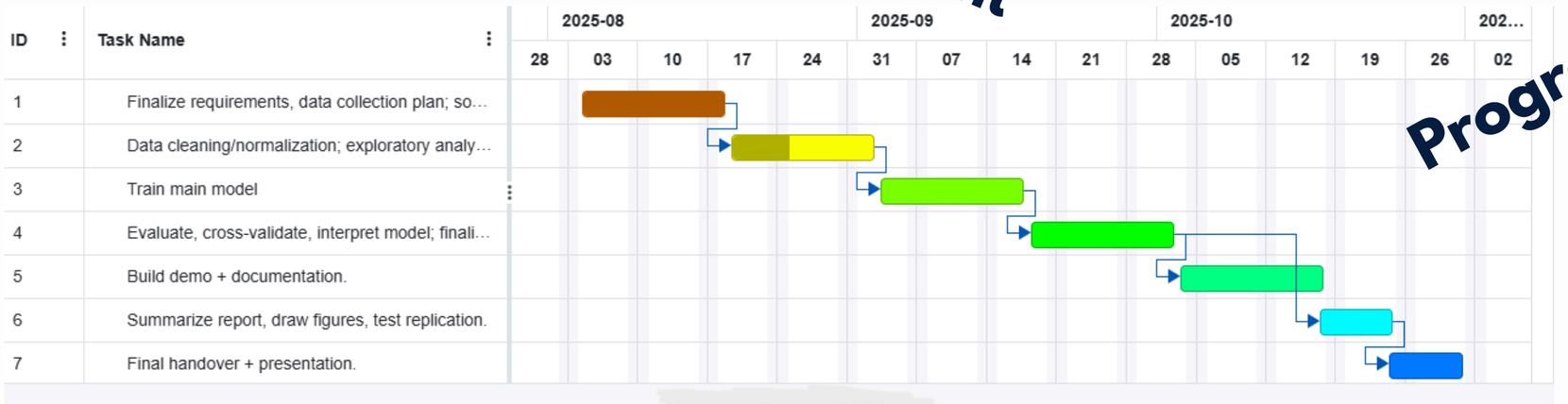
4. Timeline

Project planning and progress visualization

Task breakdown and management

Gantt Chart

Progress tracking and control



5. Role and Responsibility

🗂️ Manager

📅Tracker

💻 Programmer

✅Tester

🤝Customer Liaison

⚠️Doomsayer

Our Team

Pranav

Product Manager

Issac

Customer Liaison

Alex

Tracker

Zhian Liu

Lead Programmer

Johnathan Na

Tester

Tran

Doomsayer

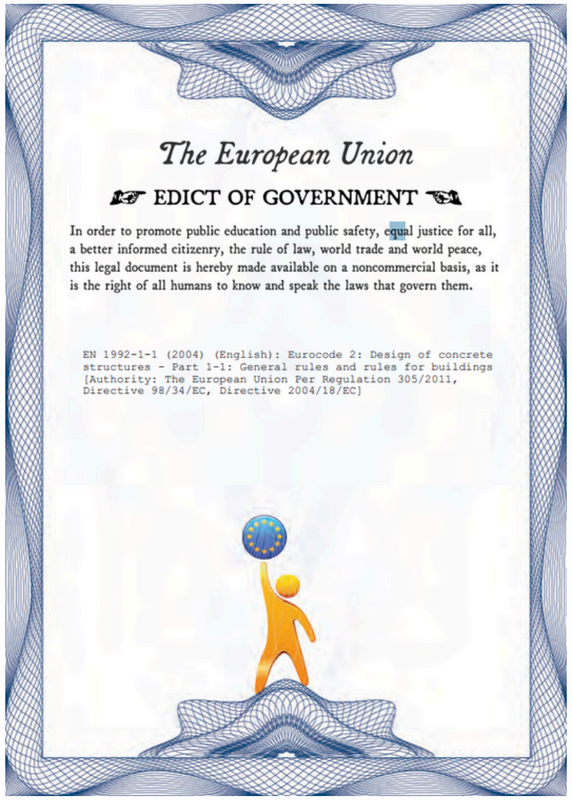
6. Project Expected Outcomes & Deliverables

Expected Outcomes

Innovative Machine Learning Model:
Original architecture, improved accuracy & fills research gaps

RC Beam Fire Performance Insights:
Focus on material degradation, geometry, load ratio;
link predictions to Eurocode 2.5 design provisions

Publication Potential:
Work at journal paper level



Deliverables

Final Scientific Report:
Model design, dataset, experiments, results & innovation

Weekly Progress PPTs:
Progress report every week

Dataset Compliance:
Use only open access licensed datasets (CC BY, CC-SA) with no combining or manipulating

Innovation Demonstrations:
NLP or Manual review to identify the failure modes;
SHAP values for the case by case analysis

THANK YOU!

Team member

- Shengyuan Nie(snie9428/530211565)
- Zhiyuan Na(zhna4143/530002077)
- Guanchen Pan(gpan0427/530301202)
- Zihan Liu(zliu7315/500176757)
- Tran Duc Manh(dtra3691/510000079) + COMP3888_M09_02
- Pranav Anand (pana0377/530606093)