Lecture 0
Prologue

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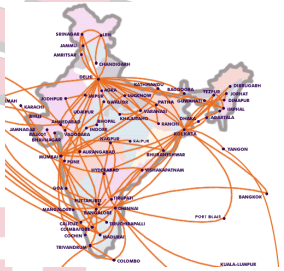
NPTEL – MOOC Course on Maintenance and Repair of Concrete Structures

Courtesy: Some images are sourced from the internet for demonstration purposes.

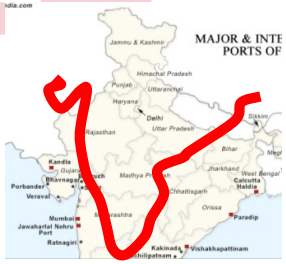
India is witnessing a construction boom

- Highways
- Seaports
- Airports
- Residential & commercial buildings
- Urban and rural projects

We need to keep them safe and usable for long period (say, several decades) without much maintenance and repair.



Housing-for-All scheme



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What is the scenario today?
- Example of bridge sector (with partial data)

- Survey of about 1.7 Lakhs bridges
  - Indian Bridge Management System (IBMS) program, the Ministry of Road Transport & Highways, Govt. of India
- Found that about 6000 bridges are ‘structurally distressed’
- Actually, this could be much more
  - because the database itself are inadequate and could be incomplete!
- What about buildings?

We have a Herculean task of maintaining
the existing concrete infrastructure and building new ones with durability and corrosion resistance in consideration.

http://www.developmentchannel.org/2017/06/16/indian-bridge-management-system-ibms-identifies-bridges-in-poor-health/;
https://currentaffairs.gktoday.in/indian-bridge-management-system-01201964000.html

Related courses in civil engineering

- Current core courses
  - Construction materials
  - Structural analysis/design
  - Concrete technology (sometimes elective)
- Many premature structural and material failures
- Need for quality repair, but, no formal course
- We need generalists and specialists

Reasons for failure of concrete repairs

- 16%
  - Incorrect diagnosis of the cause of the initial damage/deterioration of the structure
- 38%
  - Inappropriate design of intervention/repair works
- 15%
  - Inappropriate specification or choice of the materials used
- 19%
  - Poor workmanship
- 12%
  - Other factors

Zewdu et al. (2013), “Service Life Prediction of Repaired Structures using Concrete Recasting Method: State-of-the-Art”, Proced. Engg.,Vol. 57, pp. 1138-1144.

Specialists are required to do a quality repair

- Many aspects should be considered while selecting a repair methodology
- Quality repair → Number of repair = 1

Patch repair without arresting the corrosion can lead to repeated repairs

Repeated repairs/overlays on roof elements (thickness increased from 10 to 30+ cm)

https://www.quora.com/How-can-we-repair-cracks-in-concrete-columns; Sameer Surlaker

Specialists are required to do a quality repair

- Many aspects should be considered while selecting a repair methodology
- Quality repair → Number of repair = 1

Patch repair without eliminating the moisture ingress and arresting corrosion can lead to repeated repairs in just a few years

Preventive maintenance is required instead of corrective maintenance

- Prevention is better than cure
- Cost of prevention is less than that of cure
- Life cycle cost
- NACE IMPACT Report
  - Corrosion cost in India is about 3 to 4% of GDP
- We can minimise this with quality work

Risk is a function of both probability and consequences of failure

- In reinforced concrete sector…
  - Corrosion management team is missing, because the perceived risk is LOW
- But, the actual risk could be HIGH

Building/bridge collapses due to known/unrestricted corrosion and poor maintenance/repair

Risk is a function of both probability and consequences of failure

- Other sectors
  - Offshore platforms
  - Manufacturing units/plants
  - Oil and gas pipelines
- Corrosion management team is in place because the perceived and actual risks are HIGH

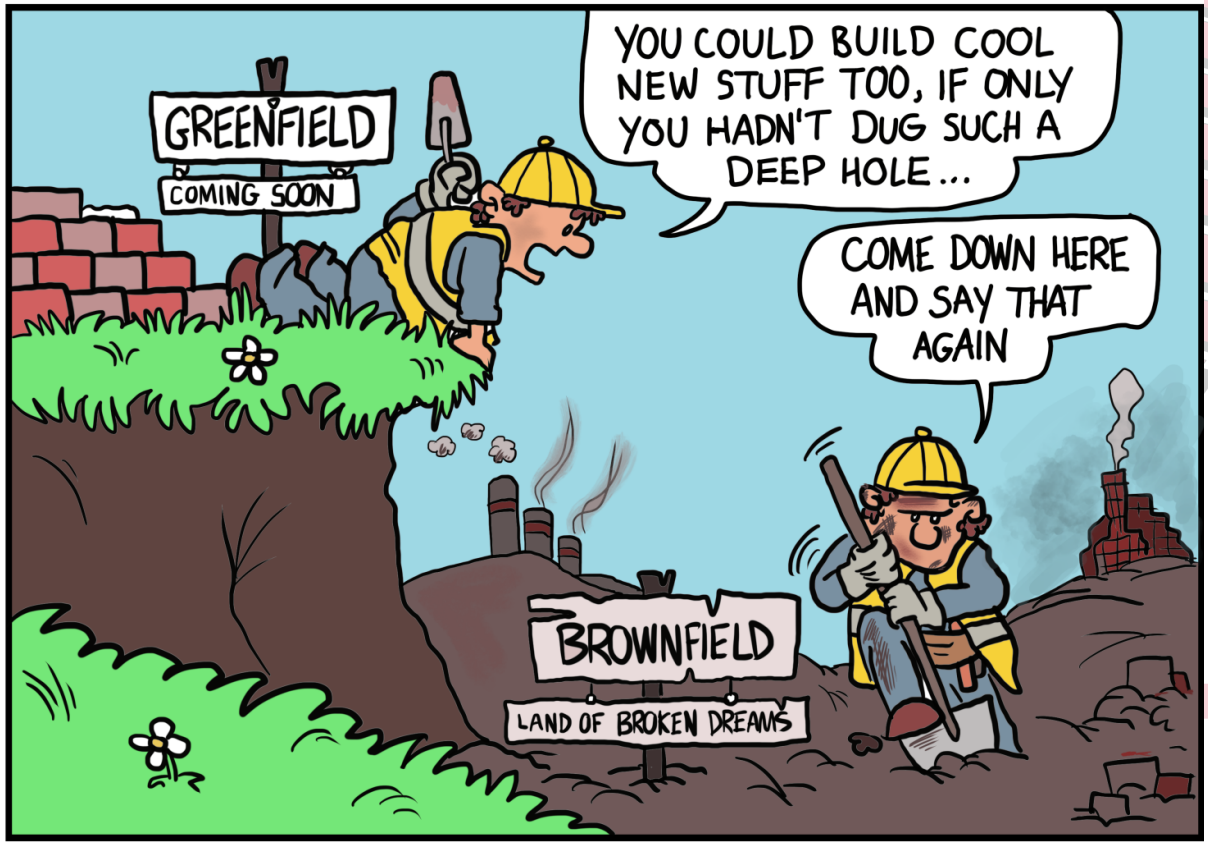
Major questions to ask while selecting a good repair methodology

- Will the root-cause of distress be addressed?
- Will the repair materials be compatible with the substrate concrete?
- Will it need frequent maintenance?
- Will it ensure safety, durability, cost effectiveness & aesthetics?

A transformation of mindset and specialists are required to be able to think outside the box and come up with the best possible and durable repair solution

Most often, the maintenance and repair are more complicated than ‘new construction”

- Greenfield → New construction
- Brownfield → Maintenance/repair work



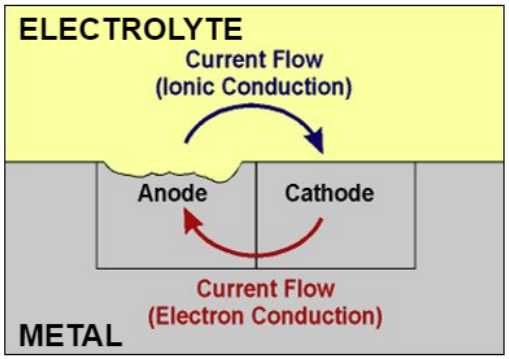
In case of brownfield, the constraints imposed by prior work or existing infrastructure and its functionality are significant

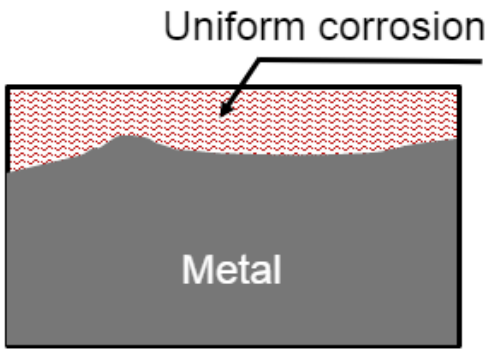
https://images.app.goo.gl/XRS6qbxHmcSWRA4k8

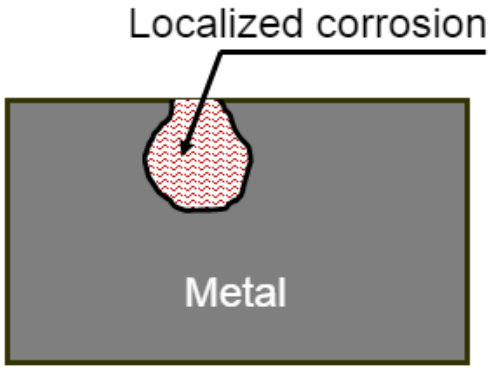
Modules in this course

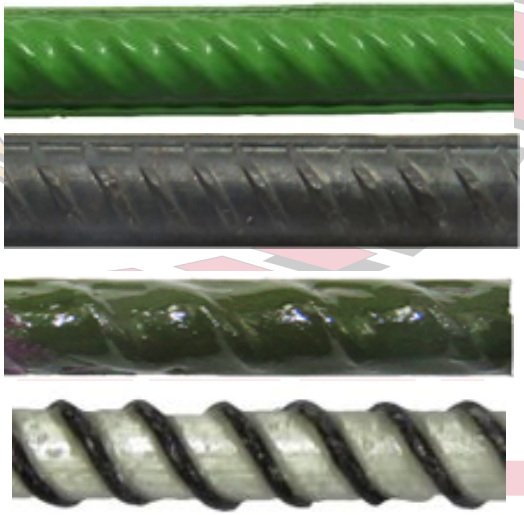
1. Embedded metal corrosion
2. Deterioration of cementitious systems
3. Condition assessment
4. Strategies and materials for surface repair
5. Surface preparation and protective treatments
6. Waterproofing
7. Concepts on structural repair
8. Tender specifications and Case studies

Module 1 : Embedded Metal Corrosion

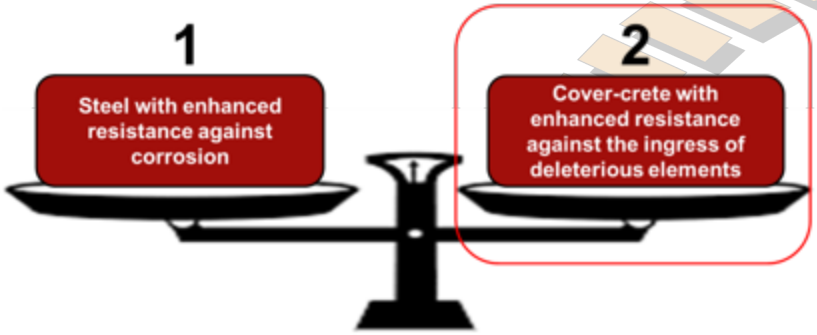


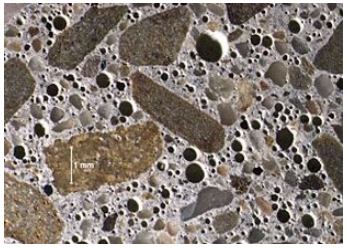


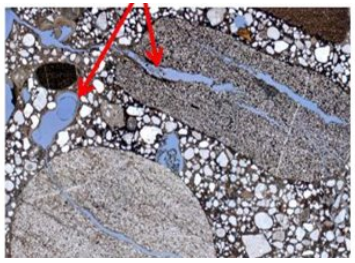


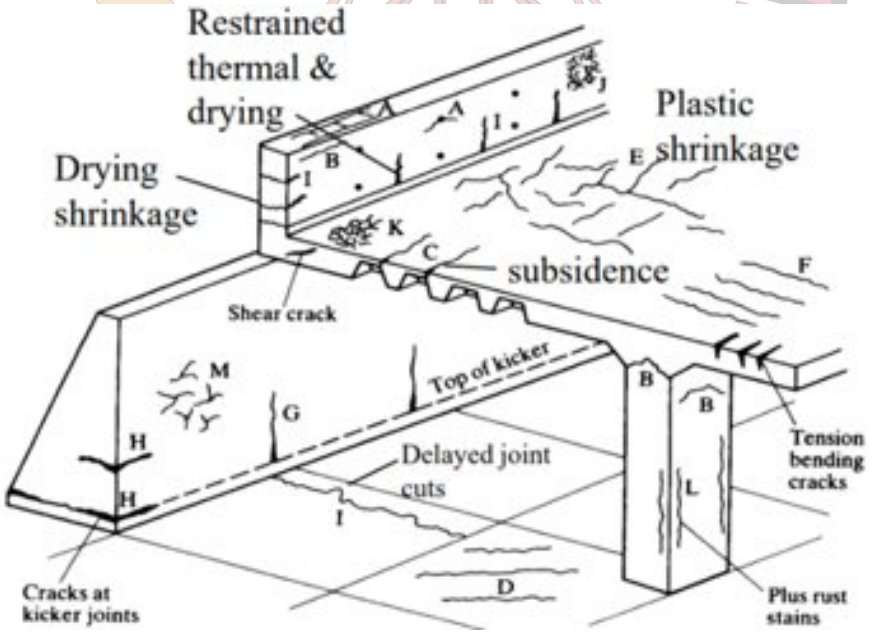


Module 2 : Deterioration of cementitious systems

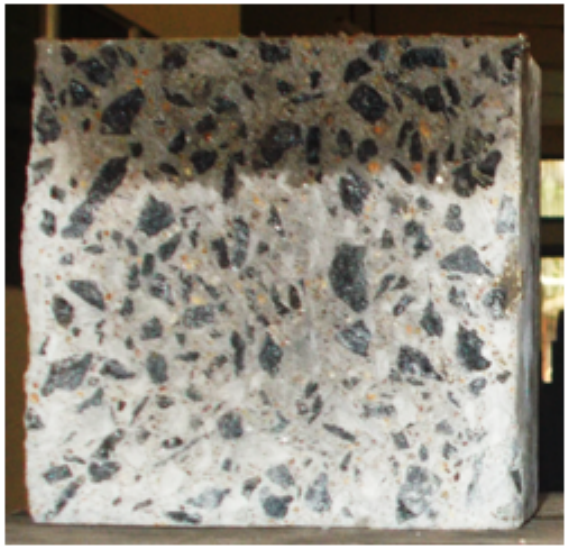




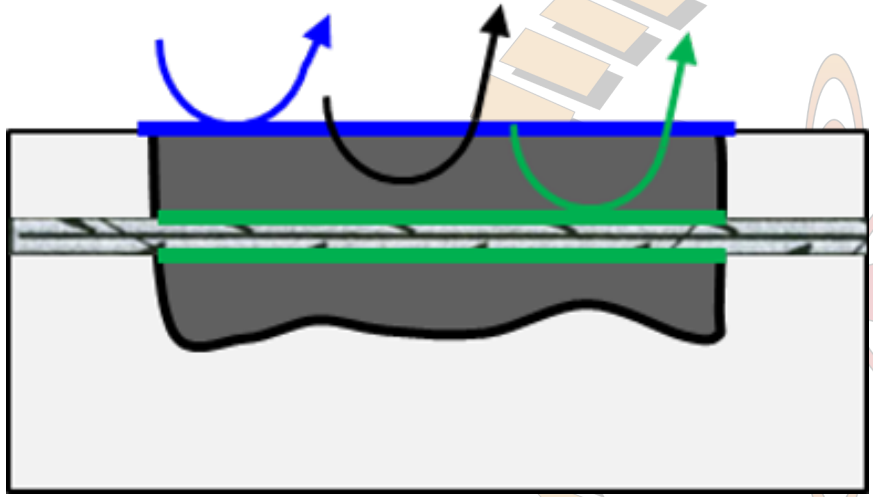


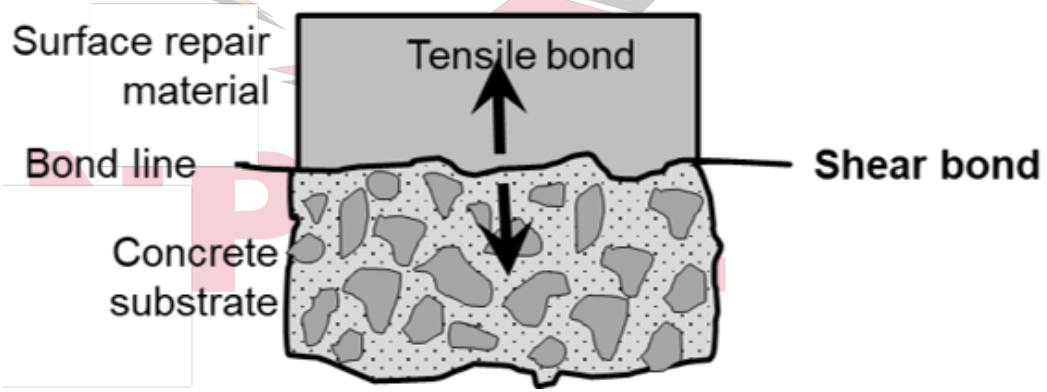


Module 3 : Condition Assessment of Concrete Structures



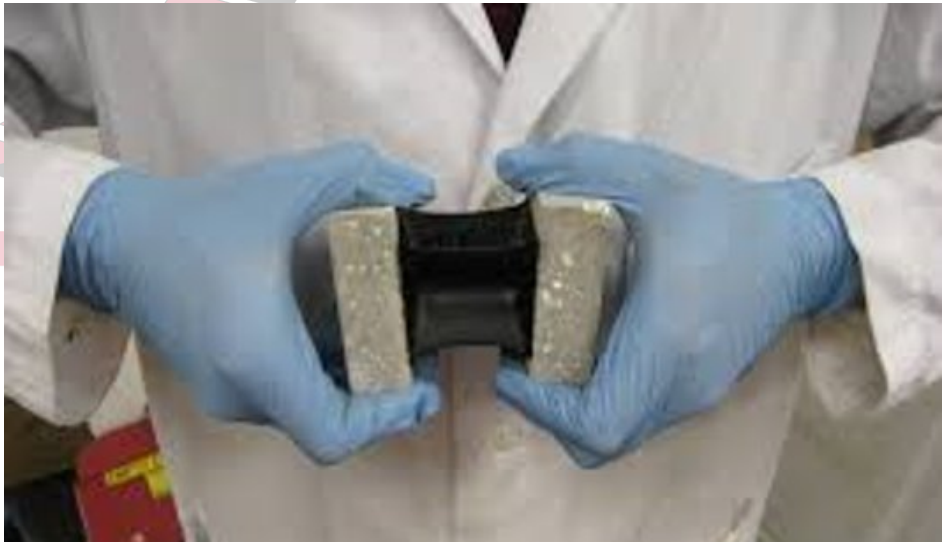
Module 4 : Strategies and materials for surface repair



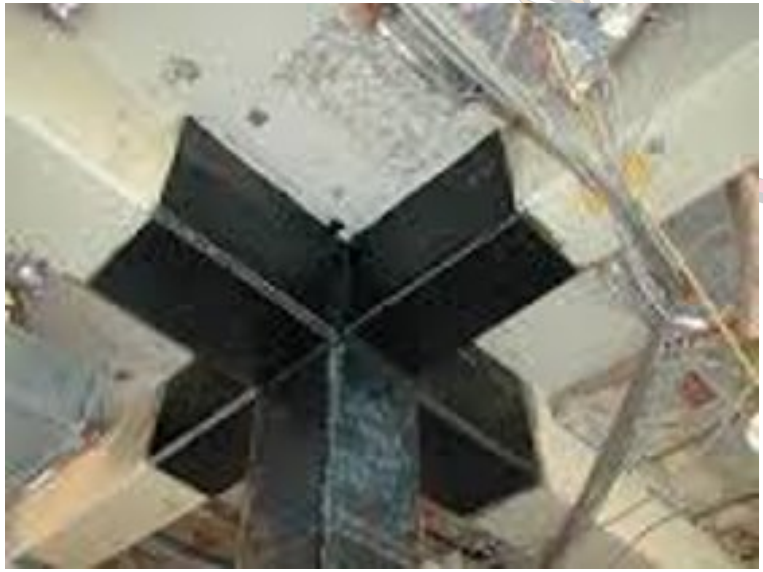


Module 5 : Surface preparation and protective treatments

Module 6 : Waterproofing of concrete



Module 7 : Concepts on structural repair



Module 8 : Tender specifications and case studies

- Tender specifications with durable repair in mind

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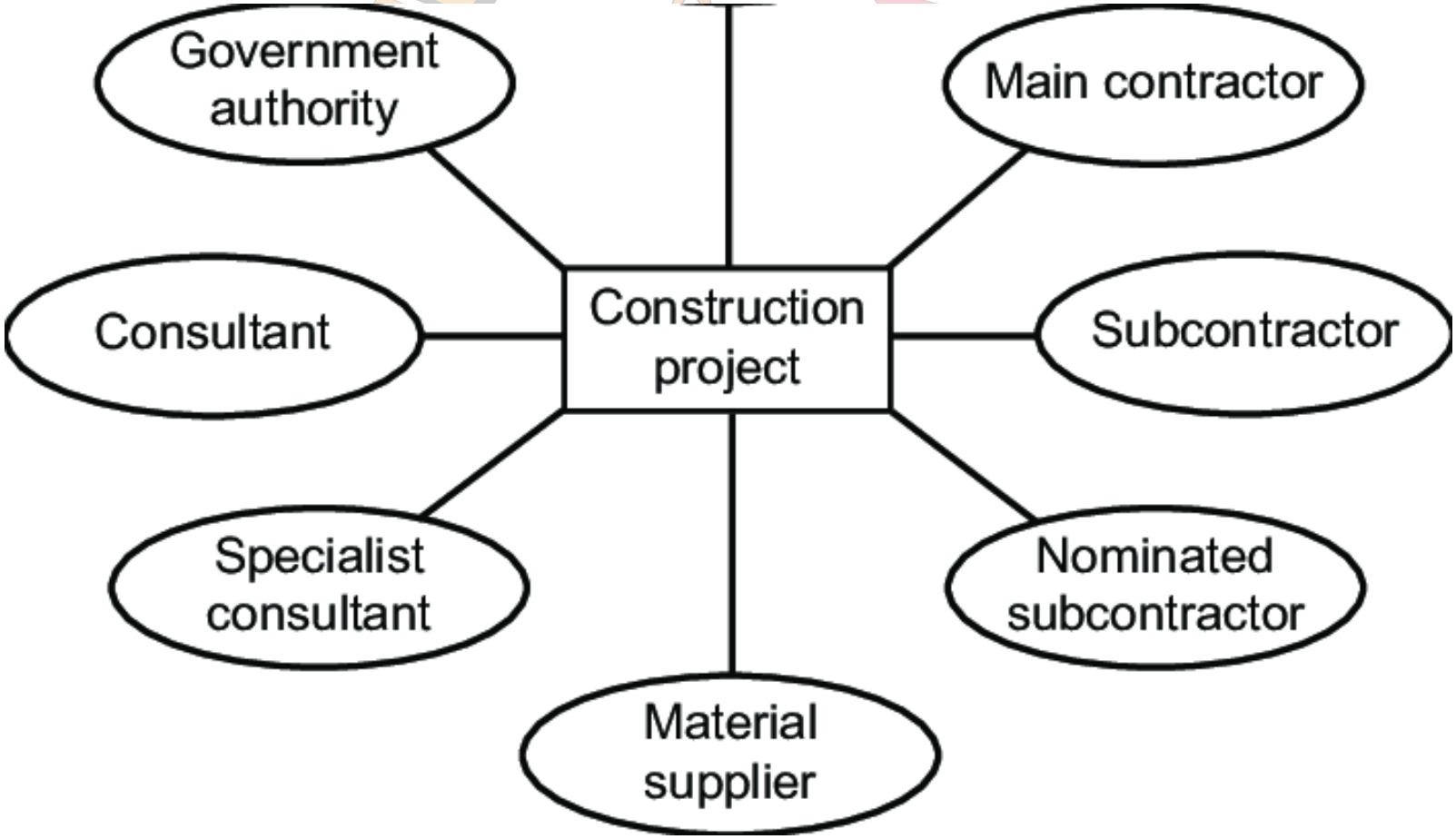
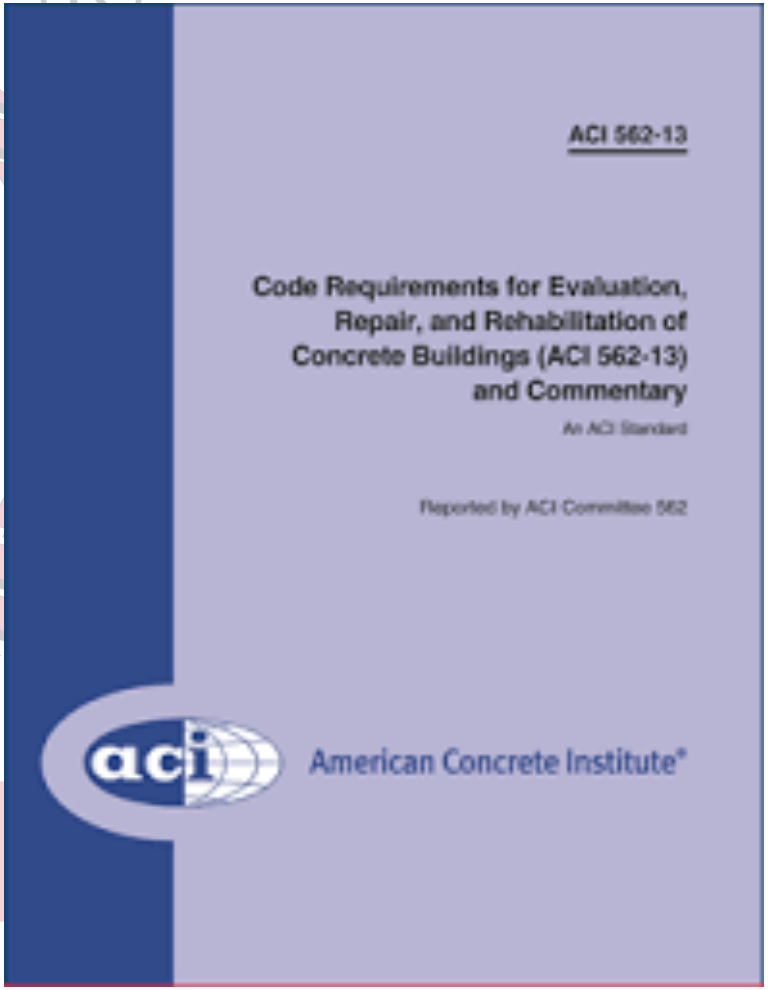
Equipping the engineers to "dictate" the technical requirements (rather than the sellers)

- Design-Build Contracts → **Design-Repair contracts**



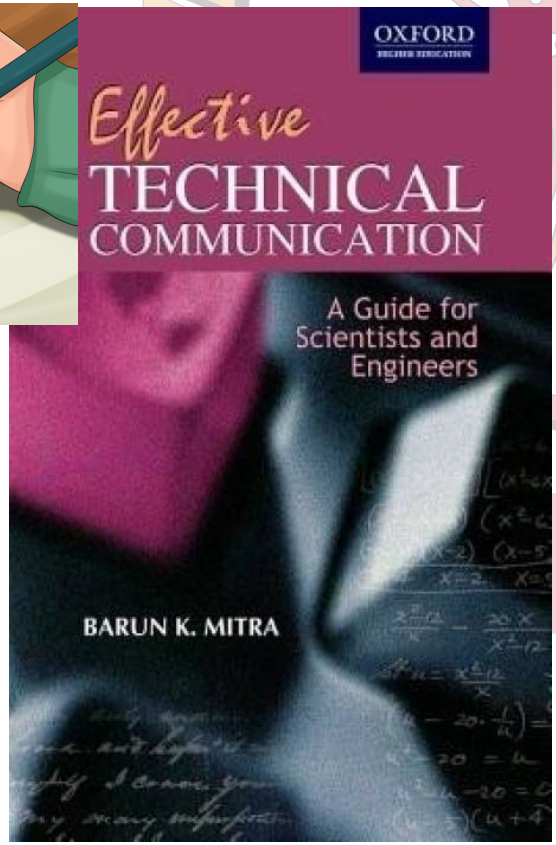
ACI 562 code on repair/rehabilitation

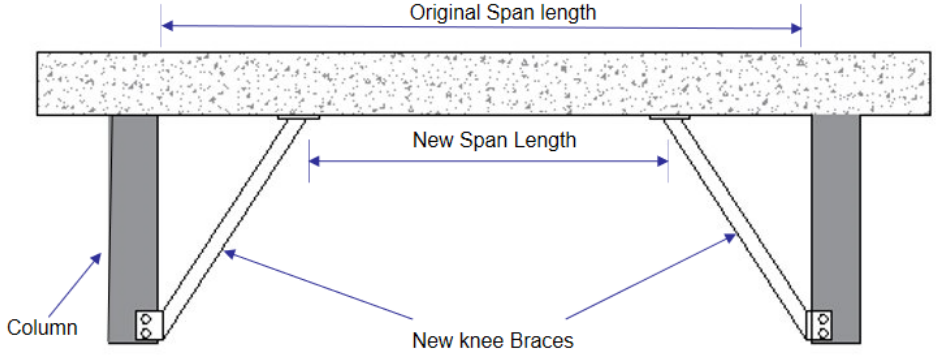
- To establish good practices for evaluation, design, materials selection, and construction & inspection
- To raise the level of performance of repair and protection systems
- To establish clear responsibilities and authorities for all participants/stakeholders
- To provide the local building officials a way to issue permits



Other important things

- Communication skills
  - Technical report writing
  - Engineering drawing to explain civil work





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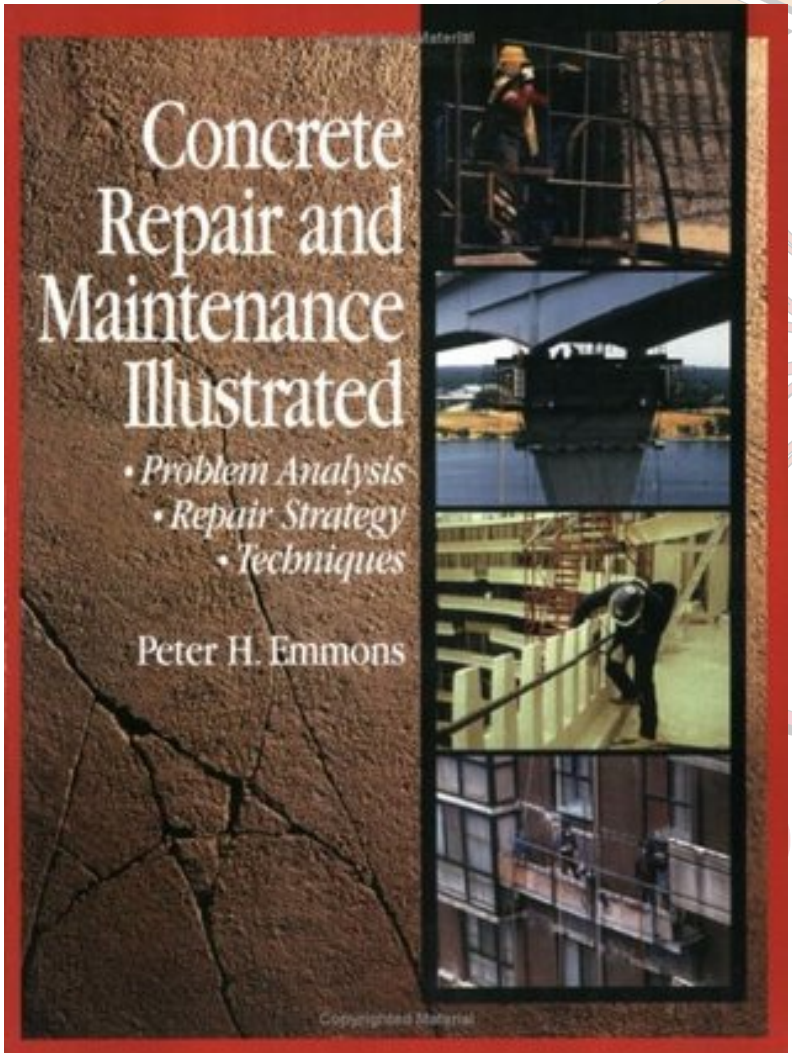
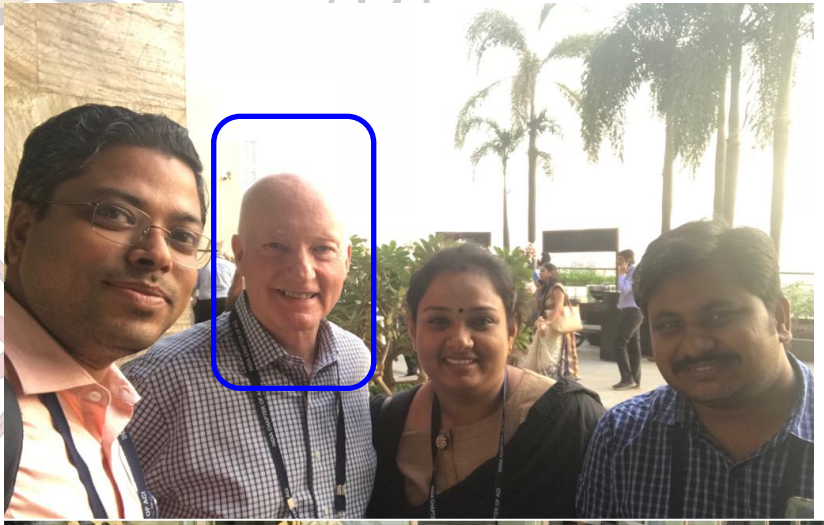
Textbook, suggested by Prof. M.S. Mathews





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Persons who influenced my career significantly

With Prof. David Trejo,
my MS/PhD advisor

With Prof. Ravindra Gettu and
Prof. Manu Santhanam,
my mentors/collaborators at
IIT Madras

All my other teachers…

Persons who influenced my career significantly

BTCM Students…