



THE 21<sup>ST</sup> INTERNATIONAL  
OPERATIONS & MAINTENANCE  
CONFERENCE IN THE ARAB COUNTRIES

# THE ROLE OF UNIVERSITIES AND PROFESSIONAL INSTITUTES IN SHAPING MAINTENANCE EDUCATION IN LIGHT OF THE FOURTH INDUSTRIAL ERA

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# Engineering Education



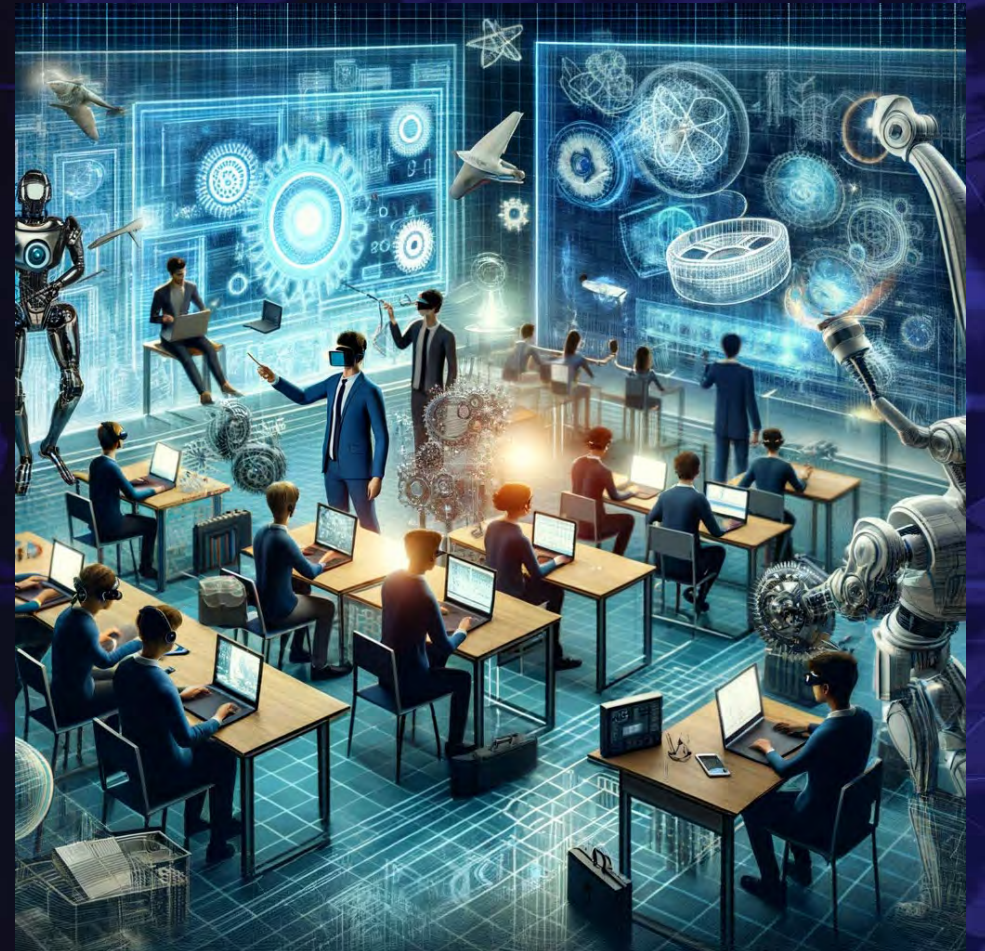
**Civil engineering makes up to about 50% of all engineering graduates**

- Engineering is the backbone of civil and social development as it has a crucial role in housing, construction, and everyday necessities.
- Building Maintenance falls under the umbrella of Civil engineering disciplines.
- There are Reports on increased demand but also a decline in the number of students choosing civil engineering due to:
  - Outdated study plans
  - High work commitment
  - Relatively lower salaries

**56% of the world's population lives in cities which expected to be 70% by 2050**

# Engineering Education History

- **Industry 1.0 (18th-19th Century):** Reliance on textbooks and lectures with limited use of visual aids and models.
- **Industry 2.0 (Late 19th - Early 20th Century):** Technical drawings and scale models in teaching.
- **Industry 3.0 (Mid-20th Century):** Integration of computer technology in education like CAD systems.
- **Industry 4.0 (21st Century):** Building Information Modelling, Artificial Intelligence, Natural Language Processing, automation, and machine learning.





# Interest Shift in Building Maintenance

- Shift in interest through the years in Building and Maintenance Field
- Education must align with the global trends



# Engineering Education Challenges in Industry 4.0

- **Educational Curricula:** Courses offering and development of curricula
- **Sustainability:** Educate within sustainable frameworks
- **Fourth Industrial Revolution:** Work with advanced technologies like AI, IoT and NLP.



# Maintenance Education Curricula

- New education programs must be developed and promoted by the universities and professional institutes.
- Many Universities only offer building maintenance courses as electives or as special topics in senior years
- Maintenance course offerings in engineering institutes are still uncommon



# Basics of Building Maintenance and Codes

- Development of Educational Curricula must be based on the basics of maintenance and engineering obtained from Codes and Standards:
  - **ACI 546.3R:** Guide for the Selection of Materials of the Repair of Concrete
  - **ACI E706:** Repair Application Procedures (RAP) 1-14
  - **ACI 546R:** Concrete Repair Guide
  - **ACI 364.1R:** Guide for Evaluation of Concrete Structures Before Rehabilitation
  - **ACI 364.3R:** Guide for Cementitious Repair Material Data Sheet
  - **ACI 437R:** Strength Evaluation of Existing Concrete Buildings
  - **ACI 437.1R:** Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria
  - **ACI 562:** Assessment, Repair, and Rehabilitation of Existing Concrete Structures - Code and Commentary
  - **BS EN 1504:** Products and systems for the protection and repair of concrete structures – definitions, requirements, quality control and evaluation of conformity
  - International Property Maintenance Code



American Concrete Institute  
*Always advancing*

## ACI CONCRETE REPAIR PRODUCTS

ACI provides 50+ products on the topic of Concrete Repair.

[SHOP NOW »](#)

**In the ACI alone there are over 50 published code related to maintenance and concrete repair**



# Basics of Building Maintenance and Codes



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الكود المصري  
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ECP - 2020

اللجنة الدائمة لإعداد  
الكود المصري  
لتشغيل وصيانة المباني العامة والمباني التراثية

قرار وزاري رقم ٢٦٠ لسنة ٢٠١٨

الطبعة الأولى - الإصدار الأول

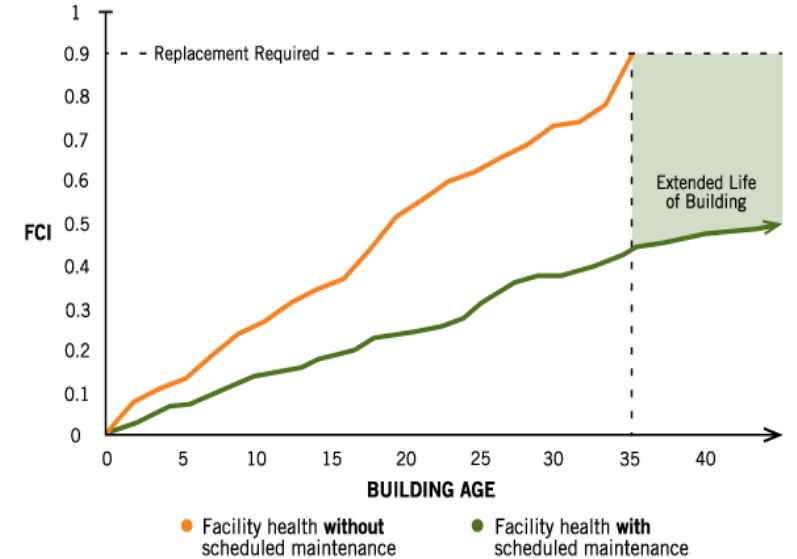
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الكود المصري لصيانة المباني العامة  
والتراثية

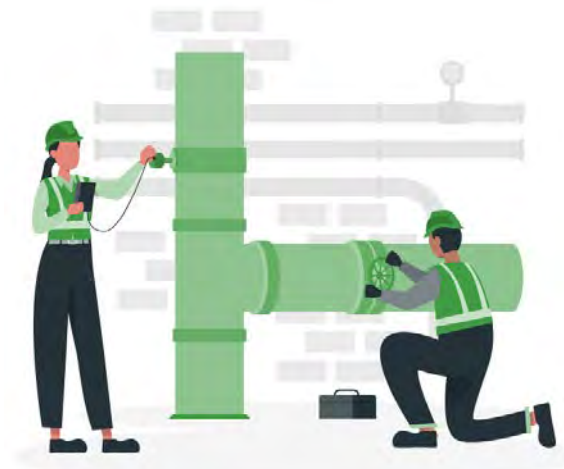


# Sustainability and the Environment

- There is a global trending interest in sustainability and green practices
- Regular Maintenance can extend structure's life span further which contributes to overall sustainability goals
- Use of recyclable materials
- Use of Nondestructive testing techniques
- Energy efficient operation



- Green Maintenance
- Sustainable Maintenance



**Courses must highlight the role of maintenance in sustainability and the environment preservation**



# Sustainability and the Environment

- **SDG 11 - Sustainable Cities and Communities:** This goal is about making cities and human settlements inclusive, safe, resilient, and sustainable.
- **SDG 12 - Responsible Consumption and Production:** This goal aims to ensure sustainable consumption and production patterns.





# Adopting Industry 4.0 Technologies

- Maintenance can highly benefit from adopting these technologies
  - **Data Analytics through Machine Learning** > Advanced data analysis and prediction (Utilizing vibration, temperature, and moisture levels data to evaluate concrete damage)
  - **Image Recognition and Analysis** > Advanced image analysis (Concrete crack detection and classification)
  - **Internet of Things (IoT) devices** > Real-time data collection enabling more proactive and maintenance strategies
  - **Robotics** > Use of drones to collect samples or take images for inspection





# Software

- Educational program must introduce software's especially the ones related to machine learning and artificial intelligence
- Software's now have user interface now with Maintenance and Machine learning applications without coding

Predictive Maintenance Toolbox



Condition Monitoring



Predictive Maintenance

MACHINE LEARNING AND DEEP LEARNING

Classification Learner   Experiment Manager   Regression Learner

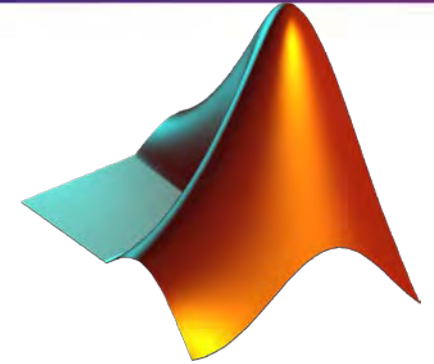
NEURAL NETWORKS

Narrow Neural ...   Medium Neural ...   Wide Neural Network

Bilayered Neural ...   **Trilayered Neural ...**   All Neural Networks



Python



MATLAB



TensorFlow

TensorFlow

## ChatGPT in Education

- It is based on the Natural Language Processing (NLP) which is a field of artificial intelligence
- Development of algorithms and systems that can understand, interpret, and generate human language.
- ChatGPT can be a great tool for learning





# ChatGPT in Education

- In the 1970s there was a debate whether to allow calculators
- The debate is coming again for ChatGPT and Artificial intelligence

MIT Technology Review [Featured](#) [Topics](#) [Newsletters](#) [Events](#)

ARTIFICIAL INTELLIGENCE

## ChatGPT is going to change education, not destroy it

The narrative around cheating students doesn't tell the whole story. Meet the teachers who think generative AI could actually make learning better.

By Will Douglas Heaven April 6, 2023

## Artificial intelligence such as ChatGPT to be allowed in Australian schools from 2024

'Kids are using it right across the country. We're playing catch-up,' federal education minister says as states back national framework

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## Even at Harvard, academic efforts to combat ChatGPT are mixed

For now, premier US university sees few good options beyond in-class assignments – at least among faculty taking the threat seriously

September 7, 2023

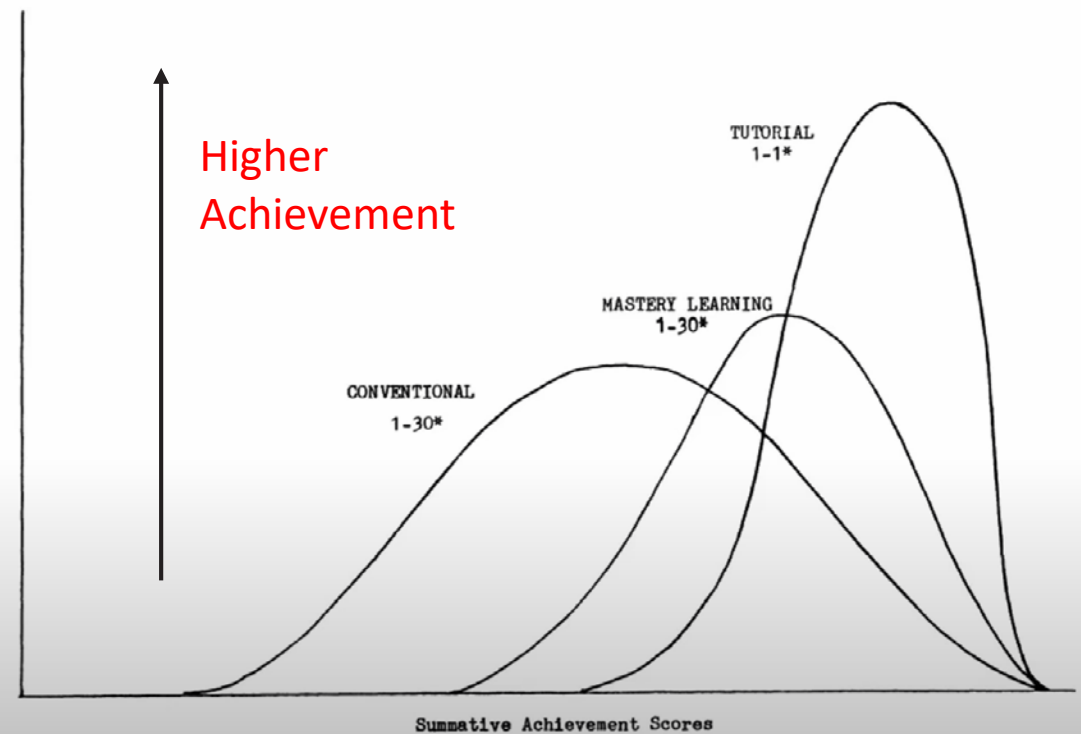
[Paul Basken](#)

Twitter: [@pbasken](#)

# ChatGPT in Education

- **Conventional Instruction:** Traditional form of learning seen in many schools. It typically involves a teacher delivering the same curriculum to all students
- **Tutorial Instruction:** Personalized form of learning, often involving one-on-one teaching or small groups.
- ChatGPT offers a unique Tutorial Instruction type learning

FIGURE 1. Achievement distribution for students under conventional, mastery learning, and tutorial instruction.



\*Teacher-student ratio

June/July 1984

## Examples on ChatGPT

- This an example of AI power in describing images for education



Picture 1: Corrosion



Picture 2: Cracking



Picture 3: Efflorescence





# Examples on ChatGPT

## Conclusion

- Professional Institutes and Universities should develop educational courses that:
  - Built upon solid basics and codes of maintenance
  - Be within the framework of Sustainability and SDG's
  - Emphasize on advanced software's especially the ones related to Machine Learning and AI
  - Embrace ChatGPT and similar technologies





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