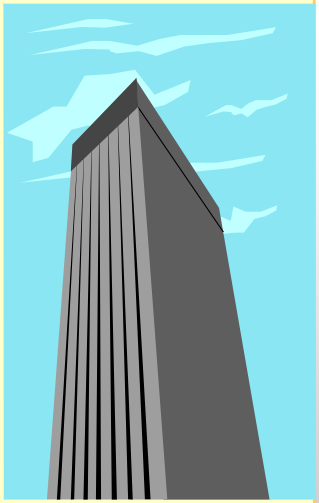
Chaoyang University of Technology



非破壞檢測與應用

Applications of Nondestructive Testing and Evaluation

朝陽科技大學 江支弘

非破壞評估概論

- 量化非破壞評估年會 (Annual Review of Progress in Quantitative Nondestructive Evaluation) 1974
- 老化中的**公共工程**
  http://www.asce.org/reportcard/2005/index.cfm
- 公共工程非破壞研討會
- 非破壞評估的主要功能

  強度測定 Strength determination,

  材料特性評估Properties evaluation,

  損害評量 Damage accessment
- 各種方法
- 整合型科技

非破壞檢測：各種應用

- 國防與航太：如太空梭、潛水艇、飛機之表面與重要結構，華航
- 電廠：如渦輪機葉片，台電
- 石化廠：如輸油管線， 中油
- 生命科學：研究與醫療服務, 台大醫院
- 材料科學：如成份分析, 工研院材料與化工研究所
- 地震學與災害防治, 地震中心, 中研院地球科學研究所

老化中的工公共工程

老化管理 Aging management

(1)各種公共工程必須確保其結構完整（Structural integrity），意指結構之功能、安全機制、到系統以及各組成單元之維護管理。

(2)老化管理之定義：確認並評估公共工程的老化，包括可用年限、功能評量及高危險區的認定等。

非破壞評估與老化管理

- 現況評量（Condition assessment）：由資料搜集與儲存、模型之建立，從而作出預測以供決策參考。

  ACI201, ACI207, ACI364
- 學界與業界之互動, 法令與工程規範之修訂（朱與江,2001）
- 檢測程序的研發: 道路鋪面的劣化、地下維生系統、橋樑內部結構等之評估，提高可用性、降低成本。

非破壞評估的主要功能

- 強度測定，包括金屬與複合材料Strength determination: metal & composites
- 材料特性評估，包括聲學、電學、光學Properties evaluation: acoustic, electrical, and optical
- 損害評量，包括脫層、裂縫、雜質、孔隙Damage accessment: delamination, crack, inclusion, void

發展中➔災害防治，包括基礎與結構物的現況評量 Hazard prevention: condition accessment of foundations and structures

- ACI228

ACI 207.3R-94

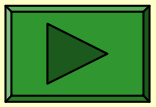
- Practices for evaluation of concrete in existing massive structures for service conditions
- Serviceability of concrete in massive structures such as dams or other hydraulic structures, bridge foundations and piers, building and reactor foundations, and others.

ACI364.1R-94

- Guide for evaluation of concrete structure structures prior to rehabilitation
- To determine the feasibility of changing the use of a structure; the structural adequacy and integrity of a structure or element; the feasibility of modifying the existing structure to conform to current codes
- To evaluate the structural problems resulted from unusual loading or exposure conditions, inadequate design, or poor construction practices.

ACI228.1R-95

- In-place methods to estimate concrete strength
- Statistical characteristics of tests



各種非破壞檢測方法

- 音洩法 Acoustic emission
- 渦電流 Eddy current
- 微波 Microwave
- 熱波 Thermal waves
- 超音波 Ultrasonics, acoustics, elastic waves
- 磁粒法 Magnetic flux leakage
- 液滲法 Penetrant techniques
- 放射線法 Radiographic techniques
- ACI228

ACI228.2R-98

Nondestructive test methods for evaluation of concrete in structures

Visual inspection		Nuclear	
Stress waves I	pulse vel., UL-echo, impact-echo, SASW	Magnetic & electric	covermeter, half-cell, polarization
Stress waves II	sonic-echo, impul. resp., crosshole	Infrared thermography	
Radar		Penetrability	

整合型科技

機率概念: tb 2-1 (p6, Bray and Stanley)

可檢測性設計Design for inspectability: fig 3-1 (p18, B & S)

(1) 故障率，可靠度與非破壞評估Failure rate, reliability , and NDE

(2) 缺陷特徵與非破壞評估Flaw characteristics and NDE

(3)破壞力學與非破壞評估 Fracture mechanics and NDE

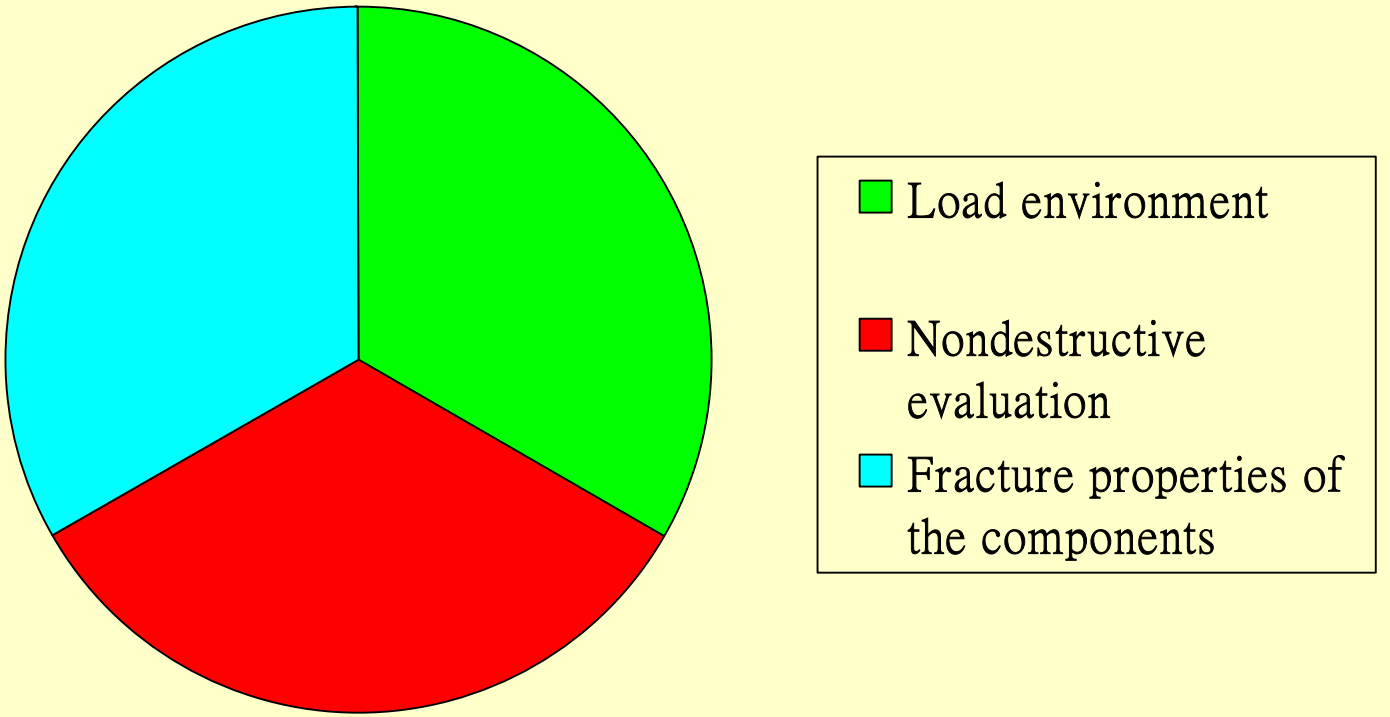
在製造程序與維護管理中應用非破壞評估的損益分析

Cost and benefit analysis for NDE in manufacturing and maintenance

低風險、高保障⇨高投資於非破壞評估

Lower Risk, Higher Assurance , more Expensive NDE

Total Failure Prevention



Probability in Nondestructive Evaluation

1. What is the probability of existence of a defect?
2. Given the existence of a defect, what is the probability that its size is in a specified range?
3. Given the existence of a defect in a specified range, what is the probability of detection for a particular NDE system?
4. What is the probability of a defect of a certain size propagating to failure prior to the next inspection?

本課程進度提醒

- 5/11 10:10am 小考 地點 T1-507
- 5/11 11:10am 紅外線熱像法 材料實驗室
- **5/18** 紅外線熱像法、超音波法 材料實驗室