ENGINEERING TRAINING INSTITUTE AUSTRALIA — CRACKING IN CONCRETE STRUCTURES DESIGN WORKSHOP

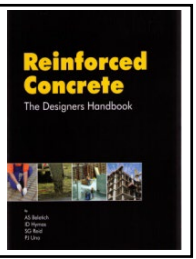
PAUL UNO *BE MBdgSc MIE(Aust) CPEng NER RPEQ APEC Engineer IntPE(Aus)*

- Over 40 years of experience in the design and construction industry.
- Devised the internationally recognised bleed water evaporation E formula $E = 5[(Tc+18)^{2.5} - r\,(Ta+18)^{2.5}](V+4)x10^{-6}$ which is used to determine the likelihood of Plastic Shrinkage Cracking.
- Written hundreds of reports for clients on the causes of structural and non-structural cracking in concrete structures.

Recommended Text:

Reinforced Concrete: The Designers Handbook (2015 Revised Edition)

Beletich, Hymas, Reid and Uno



WORKSHOP SUMMARY 8 hours of CPD

The workshop is designed for engineers who wish to understand the reason why concrete cracks and then how to design structures to eliminate the problem before it happens.

The course will look at all the various forms of cracks that occur both in the plastic state then in the hardened state. It will then look at the structural aspects of cracking in concrete with an emphasis on the cracking formulas used both in Australia and overseas.

Finally, the workshop will address practical cracking details and how to avoid both structural and non-structural cracking in the first place.

All sessions provide worked examples, tutorial exercises and solutions.

PROGRAMME *(8.30am - Zoom invite will be emailed)*

9.00 – 11.00 Session 1 - EARLY AGE CRACKING

- Cracks that occur in concrete while is it still soft (ie. its plastic state)
- Cracks that occur in the non-structural or plastic state are normally:
  - (A) Plastic Shrinkage Cracks, or
  - (B) Plastic Settlement Cracks.
- For Part A, the 4 key parameters are (i) Air Temperature (ii) Wind Velocity (iii) Relative Humidity (iv) Concrete Temperature.
  - Formulas and software available (in Australia and Overseas) to determine the likelihood of plastic shrinkage cracking.
  - Use of fibres.
- For Part B, the 3 key parameters are (i) Layout of the steel reinforcement (ii) Cover to the top reinforcing steel (iii) Concrete mix design.
- Tutorial to calculate the likely onset of plastic shrinkage cracking or plastic settlement cracking.

11.00 – 11.15 Morning Break

11.15 – 1.00 Session 2 - THERMAL CRACKING

- Guidelines provided by CIRIA C660-2007, C766-2018 and ACI-207R.
- Thermal cracking in concrete usually occurs during either: Phase 1 (Plastic to Semi-plastic state) due to heat of hydration or Phase 2 (Structural State) due to Solar effects.
- The 8 key parameters that increase the probability of thermal cracking in Phase 1 are (i) Cement content (ii) SCM's used (iii) Air Temperature (iv) Concrete temperature (v) Time of Placement (vi) Member thickness (vii) Formwork used (viii) Degree of Restraint.
- The 4 key parameters that influence thermal cracking in Phase 2 are (i) Air Temperature (ii) Thermal Gradient (iii) Direct Solar Radiation (iv) Member thickness.
- Case studies of how the thermal cracking in various concrete structures can occur so easily both in Summer and Winter.
- Tutorial to determine the likelihood of thermal cracking in Phase 1 (following the guidelines set out in CIRIA C660-2007 and C766-2018).

1.00 - 1.30 Lunch Break

1.30 - 3.00 Session 3 - STRUCTURAL CRACKING 1

- Formulas and structural requirements in AS3600-2018.
- The 4 key parameters that affect the likelihood of cracks occurring in hardened structural concrete are (i) Steel Ratio (ii) Bars vs Mesh (iii) Drying Shrinkage Regime (iv) Restraint.
- Formula behind Tables 8.6.2.2 (A) & (B) in AS3600-2018 which relates bar spacing & bar diameter to steel stress (& therefore crack width).
- Crack equations from various researchers eg Gergely-Lutz (USA), Beeby & Hughes (UK) as well as overseas Codes eg BS8110, BS5400, CEB-FIP, ACI-224R, and Eurocode requirements to compare their results to existing equations and charts.
- Derivation and use of the formula behind the beam and slab equations in AS3600-2018 Section 8.6 and 9.4.3.

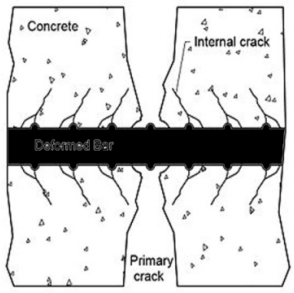
3.00 - 3.15 Afternoon Break

3.15 - 5.00 Session 4 - STRUCTURAL CRACKING 2

- Examines 'Direct Tension' cracking and the various stress concentration formulas that can be utilized to determine where cracking will occur in concrete and the severity of that cracking.
- Practical details 'on-site' which can induce cracking in concrete (eg. dowel type, joint layout, pit locations, slab size, plastic vs non plastic underlays).
- Tutorial to determine the best layout of joints to minimize potential slab cracking.
- Long term causes of concrete cracking eg (a) Steel Reinforcement Corrosion (b) AAR (Alkali Aggregate Reaction).

Certificate of Attendance will be emailed

CALCULATORS REQUIRED



Livestreamed via zoom

- One day course – **$730 pp**

FURTHER INFORMATION

- (02) 9899 7447
- +61 413 998 031
- registrations@etia.net.au

- *To register, visit our website* www.etia.net.au ***OR*** *scan the QR Code.*

Cancellations made more than 5 working days prior to a course will incur a 20% processing fee of the full registration amount.
Cancellations made 5 working days or less will incur forfeiture of the full registration fee.