



**PAUL UNO** BE MBdgSc MIE(Aust) CPEng NER RPEQ

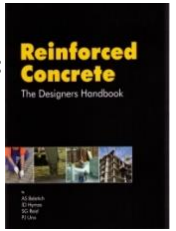
- Over 40 years of experience in specification, design & construction phases of tanks.
- Assessed other engineers' tank designs and reasons for cracks in concrete tanks.
- Devised the internationally recognised bleed water evaporation E formula  

$$E = 5[(Tc + 18)^{2.5} - r(Ta + 18)^{2.5}](V+4) \times 10^{-6}$$
 which is used to determine the likelihood of Plastic Shrinkage Cracking.
- UNSW Sessional Lecturer at the School of Construction Management.

Recommended Text:

**Reinforced Concrete:  
The Designers  
Handbook**  
(2015 Revised Edition)

Beletich, Hymas, Reid and Uno



## WORKSHOP SUMMARY

This full day workshop is primarily aimed at design engineers and anyone with a technical background needing to perform simple structural designs or design checks on any form of liquid retaining structure (eg reservoirs, water retaining structures and pools).

The interest in saving water has focussed attention on tank design, ensuring that tanks are designed and constructed correctly to address the needs of the community for years to come.

This workshop is particularly appropriate for swimming pool construction. This type of structure needs to be able to withstand the extremes of prolonged drying conditions, high evaporation rates and the need to empty and fill tanks without the problems of crack initiation, efflorescence and other durability issues during this period.

## PROGRAMME (8.30 - 9.00 Registration)

### 9.00 - 10.30 Session 1

#### - CONCRETE PROPERTIES & DURABILITY ISSUES

- Cement and concrete materials required to produce water tight & durable concrete structures. (ie low shrinkage cements, silica fume, flyash and slag blends, carbonation, chloride ingress and sorptivity effects in various concrete grades).
- Causes for concrete cracking, particular plastic shrinkage cracking, plastic settlement cracking and semi-plastic thermal cracking.
- Mix designs required for correct pumping or spraying of concrete (in accordance with Z12, EFNARC and ACI 506R).

### 10.30 - 11.00 Morning Tea

### 11.00 - 12.30 Session 2

#### - AUSTRALIAN & OVERSEAS DESIGN STANDARDS

- Australian and overseas Standards (including various State Water Authorities) e.g. AS3735 (Liquid Retaining Structures Code), AS2783 (Swimming Pool Code), CIRIA 91 and CIRIA C660 (Early Age Thermal Crack Control in Concrete), WSA (Water Services Association), BS8007 (previously incorporated in BS5337), Eurocode EN1992-3 (2006) and PCA-USA as well as the requirements for crack control according to AS3600-2018.
- Crack width criteria showing the reasons for certain maximum crack width sizes and the testing done to establish these values.
- Effects of surrounding materials and environment including the quantification of these effects via indices such as the Ryzner Index and Langelier Saturation Index (as referenced in AS3735).
- Typical mix designs and minimum w:c ratios for water retaining structures (including modern admixtures eg polycarboxylate ethers)

### 12.30 - 1.30 Lunch (Provided at Venue)



### 1.30 - 3.00 Session 3

#### - STRUCTURAL DESIGN

- Methods of simple design to check or carry out:
  - Simple structural design for a circular and rectangular tank wall
  - Floor design using  $H^2/Dt$  (shape factor) vs M charts and 'beam on elastic foundation' theory.
- Hoop stress and hoop reinforcement, vertical stress and vertical reinforcement, maximum crack width and crack control.
- Methods of quantifying crack width using crack width formulas.
- Cracking caused by excess heat differential in thick walls and floors (in accordance with the CIRIA C660-2007 and C766-2018).
- Tutorial exercises allow attendees to carry out quick hand checks on wall thickness and reinforcement required to satisfy tank actions (liquid loads), base conditions (rigid vs free) and soil conditions.

### 3.00 - 3.30 Afternoon Tea

### 3.30 - 5.00 Session 4

#### - CONSTRUCTION ISSUES

- Key areas that should be addressed on site to ensure that cracking does not occur due to construction oversights.
- Issues such as correct choice of formwork (timber vs steel), blowhole minimization, formwork removal timing permeable form-liners, correct choice of vibrator, evaporation control, concrete testing regime, water-stops (both hydrophilic and hydrophobic) and joints (including dowelled and key joints).
- Tank repair options if cracking does occur including material choices (epoxy, polyurethane, vinyl ester).

### 5.00 - 5.15 Certificate of Attendance & Feedback sheets



## CALCULATORS REQUIRED

#### COURSE COST

- 1 day course – \$680 pp

#### DATES, VENUES & REGISTRATION

- Registration form (back of catalogue)
- Visit our website [www.etia.net.au](http://www.etia.net.au)

#### FURTHER INFORMATION

- Office (02) 9899 7447
- Mobile 0413 998 031
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