ENGINEERING TRAINING INSTITUTE AUSTRALIA

RESIDENTIAL SLABS & FOOTINGS

PAUL UNO

BE MBdgSc MIE(Aus) CPEng NER RPEQ APEC Engineer IntPE(Aus)

- Over 40 years' experience in the design & construction industry.
- Former Senior Lecturer – UNSW and University of Sydney.
- Inspected many concrete slabs and footings as well as written numerous reports on why slabs have failed.

Recommended Text:

Reinforced Concrete: The Designers Handbook
(2015 Revised Edition)

Beletich, Hymas, Reid and Uno

Live streamed via zoom

WORKSHOP SUMMARY

This course is aimed at civil and structural engineers in Australia and New Zealand who wish to design residential slabs and footings to either the current Australian Standard AS2870-2011 or NZ B1 Building Code, Structure NZ (inc Amdt 19) which is referenced in NZS 3604 Section 17, Expansive soils, or, by Basic Structural Engineering Principles.

This workshop will cover relevant topics relating to slabs and footings over the 2 day period and will also address FINE (GEO5) software.

DAY 1 *(8.30am AEDT Zoom invite will be emailed)*

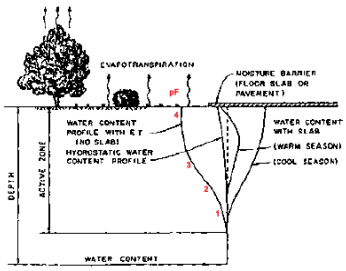
9.00 - 11.00 Session 1
- SOIL PROPERTIES AND SOIL SUCTION

- Clay mineralogy and swelling potential (Kaolinites, Illites, Montmorillonites)
- Clay cracking potential eg 2:1 vs 1:1 clay types
- Expansive clays distribution map for Australia
- Soil Salinity vs Soil Sodicity and its effect on Soil Swelling vs Concrete Degradation
- Soil Suction parameters (ie Matric vs Osmotic suction) vs Total Soil suction (pF scale)
- Effects of Sulphates in soil
- Soil Electrical Conductivity Extract (Ece in dS/m) vs Osmotic Suction values (kPa)
- Cation Exchange Capacity (CEC) & Activity ratio (AR) for various clays
- Thornthwaite Moisture Index (TMI) and its relationship to Soil Suction Change Design Depth (H_s)
- Atterberg Limit Tests vs Shrink vs Swell Tests (as per AS1289)
- Correlation regression: Shrink-Swell Tests vs Atterberg limits (eg LL, PL, PI and LS)
- Shrink-Swell Index (I_{ss}) Soil properties
- Soil Classifications (S, M, H1, H2, E)
- Site Classifications (including P sites)
- Tutorial 1 (Soil Properties)

11.00 - 11.15 Morning Break

11.15 - 1.00 Session 2
- SITE CLASSIFICATION AND SWELLING POTENTIAL (including effect of Trees and Cut/Fill)

- Determination of Site Classifications (including P sites), Soil Suction Change Design Depth (H_s), and Characteristic Surface Movement (y_s)
- Example on calculating the surface movement y_s using soil shrinkage index values, suction values, soil layer thicknesses to then achieve a site classification (eg M, H1, H2, E)
- Determination of Surface Movement and Suction Design Depth due to Trees ie (y_t) and (H_t)
- Design suction change profiles
- Determination of Crack Depths
- Effect of Cut and Fill
- Effect of Trees on y_s and H_s
- Tutorial Exercise 1 (Soil suction only)
- Tutorial Exercise 2 (Soil suction including effect of trees)
- Tutorial Exercise 3 (Soil suction including cut and fill effects)



1.00 - 1.30 Lunch Break

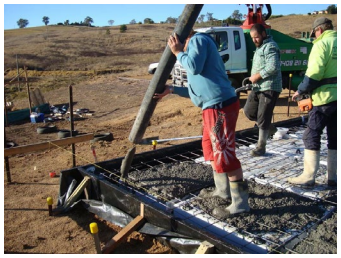
1.30 - 3.00 Session 3
- DOMESTIC CONSTRUCTION CONSIDERATIONS (as per AS2870)

- Clad frame vs articulated masonry veneer vs masonry veneer, vs articulated masonry full vs full masonry (ie double brick), and the footing systems that are appropriate for those construction types
- Requirements of articulation in masonry walls (as per CCAA TN61)
- Footing systems include raft slab, footing slab (ie SOG), waffle slab, stiffened slab and strip footing
- Compaction of fill (rolled, controlled, sand and non-sand) in accordance with AS2870
- Drainage issues eg leaking pipes, poor drainage, pavement slope
- Incorrect usage of waffle pod system and potential litigation
- Properties of the polystyrene pods including proper disposal
- Pros and cons of using a waffle pod slab system
- Requirements of Steel Reinforcement
- Other void systems (eg domes)
- Measures to provide effective site drainage
- Tutorial Exercise

3.00 - 3.15 Afternoon Break

3.15 - 5.00 Session 4
- CONCRETE MIX DESIGN AND ON-SITE CONCRETE PLACEMENT ISSUES (eg Cracking)

- Materials used in concrete mixes for house slabs and footings (including flyash blends and market branding eg builders cement)
- Effect of Sulphates on Concrete used in domestic construction
- Polythene (ie polyethylene) VPM and DPM underlay requirements (as per AS4347.6)
- Water to cement ratios (including effects of slumps 80mm, 100mm and above)
- Typical Concrete Mix designs used in residential concrete.
- Types of cracking common to residential slabs (eg plastic shrinkage cracking, plastic settlement cracking and longer-term drying shrinkage) and use of trimmer bars
- Minimization of cracking on slabs by attention to weather conditions (ie temperature, humidity and wind speed) to be able to quantify the potential for plastic shrinkage cracking
- Use of admixtures, evaporative retarders and curing compounds (to assist in cracking minimization)
- Non-structural crack issues (ie crazing, dusting, durability and corrosion control points, especially in saline soils)
- Proper joint saw cutting techniques (where required)
- Effects of deteriorated wall ties and omission of slip joint material
- Effects of using low ductility mesh in suspended concrete slabs
- Relationship between concrete slab crack size and termite entry



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.

DESIGN WORKSHOP

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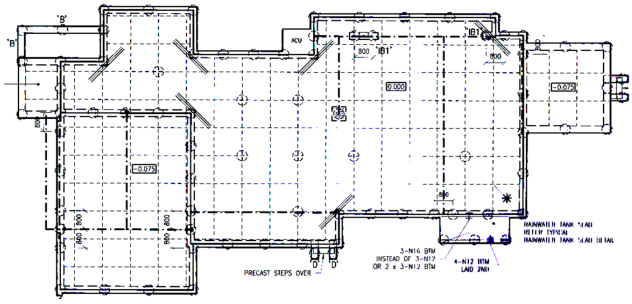
DAY 2

9.00 - 11.00 Session 5
- SOIL CAPACITY, APPLIED LOADS, ULTIMATE vs ALLOWABLE BEARING CAPACITY

- Soil Cohesion (C_u) and (C') vs Soil Angle of Internal Friction (ϕ)
- Drained vs Undrained Soils
- Soil Test Correlations DCP vs SPT vs y_s
- Typical dead loads on domestic slabs and footings (eg roof tiles, studs, frames)
- General Applied Loads (and Pressures) as per AS/NZS 1170.1
- Soil Bearing Capacity - Allowable vs Ultimate
- Basic Terzaghi (and Vesic) formulas to determine ultimate bearing capacities for rectangular, strip and circular footings.
- Tutorial Exercise (referenced in NCC (Aust) and NZS 3604 Section 17, Expansive Soils, Building Code B1).

11.00 - 11.15 Morning Break



11.15 - 1.00 Session 6
- SLAB DESIGN: Standard (Deemed to Comply) Method #3.0-AS2870 vs Chart 4.1

- Use of Chart 4.1 in Section 4.0 of AS2870 (and its derivation) in order to determine the footing beam depth
- Effective Slab Widths applicable to slabs in domestic construction
- Uncracked vs Cracked Second Moment of Area calculations (ie MOI)
- Beam depth, spacing and minimum reinforcement, trimmer bars
- Suspended slab design in domestic construction
- Tutorial Exercise

1.00 - 1.30 Lunch Break

CALCULATORS REQUIRED

Differential mound movement (mm), $y_m = 0.7\, y_s$

Edge distance from centre-heave (m), $e = \frac{H_s}{8} + \frac{y_m}{0.036}$

Edge distance from edge-heave (m), $e = 0.2\,L \quad \leq 0.6 + \frac{y_m}{0.025}$

Download *FINE GEO5* demo version via the link

www.etia.net.au/geo5-demo-version

Settlement Spread Footing

1.30 - 3.00 Session 7
- ENGINEERED DESIGN (#4.0 AS2870) plus Steel Screw & Bored Concrete Piers Design

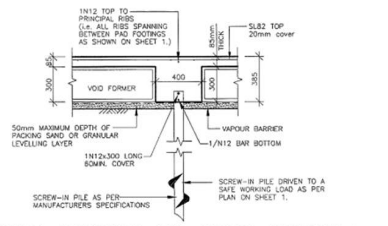
- Centre Heave (sometimes referred to as Hogging or as Edge Drop)
- Edge Heave (sometimes referred to as Sagging or as Edge Lift)
- Structural Design of Concrete Piers/Piles
- Structural Design of Steel Screw Piers for domestic beam and slab construction (using Individual Bearing method vs Cylindrical Shear method) and accounting for potential punching shear failure according to IPENZ Note 28 document and overseas documents
- Winkler method vs Walsh Method vs Mitchell Method
- Use of FINE (GEO5) Beams and Slabs on Elastic Foundations software
- Tutorial Exercise

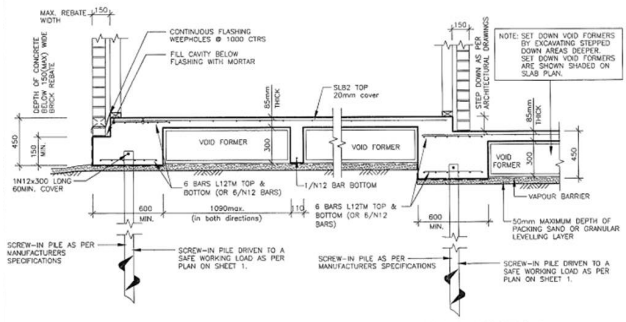
3.00 - 3.15 Afternoon Break

3.15 - 5.00 Session 8
- HOUSE SLAB DESIGN EXAMPLES

- Estimation of Wall loads, Roof loads and Floor loads (as per AS1170.1 and AS2870)
- Structural design of various concrete slabs using house plans from start to finish using both Stiffened Raft (conventional method) and Waffle Pod (Rib Raft) methods for various soil types eg M, H, E (incl. effect of trees) in various combinations, for example:
  - Single Storey home – Rectangular house plan – SOG Design
  - Single Storey home – Non-Rectangular house plan – Slab on Ground (SOG) Design
  - Double Storey home -Rectangular house slab plan + Suspended concrete slab

Certificate of Attendance will be emailed





Live streamed via zoom

- Two day course – **$1,590**

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.*

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