The aim of the training is providing the trainees for actual practical place and facilities in Structural Concrete practice training. Through the hand on experience, trainees can obtain more detail knowledge about the lecture subjects and the construction industry.
CONCRETE

- Weak in resisting tension.
- Strong in resisting compression.
STRUCTURAL CONCRETE PRACTICE

STEEL REINFORCEMENT

- Strong in resisting both compression and tension.
“REINFORCED CONCRETE” (R.C.)

- Combination of both concrete and steel reinforcement to achieve better performance of the structure in resisting loading.
MATERIALS OF CONCRETE

CEMENT

- Strength of concrete is mainly affected by Cement.

Types

- Ordinary Portland Cement (O.P.C.).
- Rapid Hardening P. C.
- Sulphate Resistance P. C.
- White Cement & Special.

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MATERIALS OF CONCRETE

AGGREGATES

- Crushed stone which size
  - $\geq 5\text{mm}$: Coarse
  - $< 5\text{mm}$: Fine

- Larger size aggregates in concrete will reduce its workability.
MATERIALS OF CONCRETE

WATER

- To hydrate the Cement.
- To make the Concrete workable.
- Drink Quality.
WHY CONCRETE?

- Economic
- Easy to produce
- Easy to operate
- Suitable for different size and shape
- Durability (over 50 years if good quality.)
- Strong (normal strength up to 45N/mm² or mPa..)
- Good insulation (e.g. sound, thermal, etc.)
- Quick hardening (for vertical member, formwork can be stripped at 16 ~ 24 hours after pouring.)
- To provide operation time enough (for normal mix of concrete, there are 1.5-1.75 hours for operation after mixing.)
- Low permeability
CALLING CONCRETE

- For concrete strength / maximum size of aggregate: e.g. 10/20 ;
  20/20 ;
  30/20 ; etc..

- For ratio of the materials: (Cement : Sand : Aggregate): e.g. 1 : 3 : 6 ;
  1 : 2 : 4 ;
  1 : 1 : 2 ; etc..
CALLING CONCRETE

Trial mix:

- Alternately designed for separate construction site.
- To save money on materials, e.g. more aggregate but less cement content.
- For special requirements, e.g. extreme high workability; hardening period; temperature arising rate; grade of surface finish; resistance of poor environment…
- Has to get the engineer’s approval by making samples and complicated tests.
WATER TO CEMENT RATIO: (W/C RATIO)

- The ratio by weight (kg.) between Water and Cement of the fresh mix concrete.
- The range W/C normal from 0.3 to 0.7.
- Too much water cannot be totally absorbed by cement of the concrete, it will produce voids in it, and decrease the strength.
- We can adjust quantity of water into concrete by this range to make the concrete workable.
- To mix high quality concrete, the moisture content of the aggregate is also be considered.
ADMIXTURE TO CONCRETE

- These are not water substitution agent.
- But can increase workability of concrete.
- Also can shorten or extent the concrete hardening time.
- Types of admixture:
  - Water-reducing
  - Superplasticizing
  - Set accelerating
  - Set retarding
  - Air entraining
  - Water repellent
INSPECTION BEFORE CONCRETE CASTING

- Make sure release agent has been applied to the form surface before steel fixing.
- To check formwork and steel reinforcement according to drawings and requirements.
- Cleaning the form.
- To check struts and braces of the formwork.
- Seal-up all holes and gaps of the formwork to prevent cement grout leakage.
- Estimating volume of concrete to be casting and contact the supplier.
INSPECTION BEFORE CONCRETE CASTING

- Consider the wastage.
- Concreting method, sequence and frequency.
- Site access.
- Tools and plants to be used.
- Location of plant arrangement.
- Manpower.
- Traffic condition.
- Weather forecasting.
- Got approval and then order concrete according to the requirements.
MAKING CONCRETE

ESTIMATING

- To measure the actual volume ($M^3$) of concrete from the drawings or on site measurement.

- $(\text{Vol.} \times 2400\text{kg per } M^3) \times (1 + \text{wastage})$

  Sum of proportion of materials

  $=\text{Unit weight of materials}$
MAKING CONCRETE

- *Batching materials. (By weight)*

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MAKING CONCRETE

- **Mixing** concrete. (By Hand, or Power tools)

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Q.C. ON SITE FOR CONCRETE DELIVERY

WORKABILITY TESTING:

- SLUMP TEST
  - To check workability of concrete.

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Q.C. ON SITE FOR CONCRETE DELIVERY

WORKABILITY TESTING:

- SLUMP TEST
  - To check water content in the proportion of the mix.
  - Higher concrete slump, higher the price.

![Types of slump](image_url)

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Q.C. ON SITE FOR CONCRETE DELIVERY

WORKABILITY TESTING:

- COMPACTING FACTOR TEST
  - More accurate method of testing the workability.
  - But more complicated and time need.

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Q.C. ON SITE FOR CONCRETE DELIVERY

STRENGTH TESTING:
- CONCRETE CUBE TEST
  - To take some samples from the fresh concrete and to make standard cubes for COMPRESSION TEST. (size: 100mm, 150mm)
  - Nos. of sample taken should be according to the client’s requirements, or depending on the buyer’s (contractor) need.

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Q.C. ON SITE FOR CONCRETE DELIVERY

**STRENGTH TESTING:**
- **CONCRETE CUBE TEST**
  - The compressive strength defined the quality of the concrete and for reference of striping formwork.
  - Test cubes should be stored in curing tank. And testing on 1st, 3rd, 7th and 28th day or as require.
Q.C. ON SITE FOR CONCRETE DELIVERY

TEMPERATURE TEST:

- Concrete temperature should be kept \( \leq 32 \, ^\circ\text{C} \) before casting, or as require.

- To control concrete temperature:
  - Ice water for mixing concrete.
  - Set Retarder to be added to the concrete mix.
CONCRETING

CASTING:

- Placing concrete to final position.
- Distribution of suitable quantity and evenly to the place.
- Casting layer by layer, the thickness should be below 600mm with well compacting in each.
CONCRETING

CASTING:

- When pouring concrete, the falling height should be minimized to prevent segregation and impact force to the formwork or the steel reinforcement.

- To control casting time and procedure, to prevent “COLD JOINT” and reducing its Workability.

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CONCRETING

CASTING:

- Hoist & wheel barrel, Crane & bucket, or Concrete pump can be employed.

(higher slump concrete to be used for PUMP. “Pump mix”)
COMPACTING:

- To minimize air content in the concrete, so reduced air voids.
- To make the concrete dense, so better its performance.
- Tamping method and Poker vibrator for internal compacting.
- External vibrator and vibration table for external compacting.
CONCRETING

- **COMPACTING:**

- OVER COMPACTING will lead segregation.

- But, INADEQUATE COMPACTING will lead Honeycombing.
FINISHES:

- Formed finish. (F1 - F5)
- Unformed finish. (U1 - U5)
- Treated finish. (T1 - T6)
- or Instructed by the Engineer.
CONCRETING

CURING:

- To prevent evaporation of moisture from concrete, so better for concrete strength development.
- To prevent surface cracks of concrete.
- To reduce temperature of the hardening concrete.
- Carrying out immediately when concrete become harden.
CONCRETING

CURING:

- Methods:
  
  Covered with impervious layer
  
  e.g. plastic sheet,
  
  applying curing compound.
  
  Spraying water to concrete surfaces.
  
  Remaining formwork.
  
  Filling to foundation.

- Curing time: Normal curing time is 4 to 7 days.
CONCRETING

CONSTRUCTION JOINT:

- The joint between stages of concrete which casting in different time.
- To provide rough, sound, clean and moist surface to receive the fresh concrete pouring. (better key)
- By applying retarder on the fresh concrete surface, and wash out the cement;
  - installation of metal lathing to surface before concreting;
  or
  - hacking concrete surface.
CONCRETING RECORD

Concreting record should be including:-

- The project’s name
- The buyer’s name
- Supplier’s name
- Mixing time
- Date
- Delivery time
- Concrete grade
- Starting time
- Slump
- Completion time
- Admixture
- Location use
- Concrete temperature
- Q. C. signature
- Cube test record
- Foreman signature

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MATERIALS OF REINFORCEMENT

- Putting reinforcement into concrete to achieve better performance of the structure in resisting loading (tension, torsion, shear).

- It can be Steel, Fiber glass, Fiber carbon, etc.
STEEL REINFORCEMENT

- **TYPES**
  - Mild steel rod (R or M)
    Yield stress 250 N/mm²
  - High-yield bar (Y or T)
    Yield stress 460 N/mm²

- **SIZE:**
  - Ø (mm) :- 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, etc..
    (but Ø 6 and 50mm not recommended)
  - Length (M) :- 12, 15, 18, or in roll, etc..
STEEL REINFORCEMENT

PLACING

- Vertical and Horizontal bar: - to Tension zone.

- Links or Stirrups: - to take Shear and Torsion.
STEEL REINFORCEMENT

BEFORE USE ON SITE

- Certificates from the supplier.
- Sample test
  - e.g. Tensile test, Bending test, Re-bend test.
- Free from rusty and dirt (the bonding strength).
STEEL REINFORCEMENT

DESCRIPTION ON DRAWING

e.g. 7 Y25 03 200T

CONNECTION OF BAR

- Coupler
- Overlap
  - Lap length is the specified multiples of the steel bar diameter. (e.g. 42D)
  - It is depending on the design requirements.
- Welding (for specified type of steel only, NOT RECOMMENDED).
STEEL REINFORCEMENT

COVER

- Distance from outer side of steel bar to concrete surface.
- Thickness is depending on different requirements.
  - To provide FIRE RESISTANCE.
  - Prevention rusting of steel.
  - To provide BONDING strength.
**OPERATION OF STEEL REINFORCEMENT WORK**

**BENDING SCHEDULE (BS 4466)**

- Standard estimating method of the bar length.
- Standard shape code.

<table>
<thead>
<tr>
<th>Member</th>
<th>Bar Mark</th>
<th>Type &amp; Size</th>
<th>NO. of Members</th>
<th>No. in each</th>
<th>Total No.</th>
<th>Length of each bar (mm)</th>
<th>Shape Code</th>
<th>Bar Shape (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**XXXXXXX CONSTRUCTION COMPANY**

**BAR BENDING SCHEDULE**

*All bending dimensions are in accordance with BS 4466.*

**PROJECT REFERENCE:**

Prepared by Mr. K. M. Kwok

(PolyU. IC)
OPERATION OF STEEL REINFORCEMENT WORK

**Cutting:**
- Length according to drawings and bending schedule.

**Bending:**
- To bend the cut bars according to drawings and shape code. To rope them separately.

**Placing:**
- Distribution of steel bars layer by layer, and placing to correct distance (centre to centre = c/c ).
**OPERATION OF STEEL REINFORCEMENT WORK**

**Fixing:**
- Tying the steel bars with soft wire at each intersection.
- Wire ends should be bent toward inside to prevent contact to concrete surface.

**Cover blocks or Chairs:**
- Normally, fixed at 600mm c/c to provide cover.
OPERATION OF STEEL REINFORCEMENT WORK

INSPECTION BEFORE CONCRETING:

- To send request of inspection form to the engineer representative (ER) for steel reinforcement and general work checking.
- To prepare latest work drawings, measuring tape, marker, and safety access for the ER.
- Inspection with the ER.
- To modify defects immediately.
- Re-inspection if need.
- To get approval of concreting.