FOSTERING QUANTITY SURVEYORS IN CIVIL ENGINEERING WORKS

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WHAT IS CIVIL ENGINEERING WORKS?
CIVIL ENGINEERING WORKS:

- planning, design, construction, maintenance and management of physical infrastructure networks.
- Fixed structures, public works related to earth, water or energy and their processes.
- power plants, bridges, roads, railways, structures, water supply, irrigation, the natural environment, sewer, flood control, transportation and traffic.
Civil Engineering

- Water Resources
- Construction
- Environmental
- Geotechnical
- Material
- Structural
- Urban Planning
- Transportation
CHALLENGES:

- Knowledge in civil engineering
- Terminologies
- Special requirements
- Alternative designs & alternative materials
- Value engineering exercises
- Latest technology
- Identify major costs:
  - Controllable
  - uncontrollable
- Unit costs and all-in cost
- Elemental cost analysis
HIGHWAYS
A public road ie a major road connecting two or more destinations.

Often named and numbered eg E2 (PLUS)
SINGLE CARRIAGEWAY

one, two or more lanes arranged within a single carriageway with no median (divider) to separate opposing flows of traffic.

2 lanes

3 lanes

4 lanes
DUAL CARRIAGEWAY

For traffic travelling in opposite directions separated by a central reservation. Roads with two or more carriageways which are designed to higher standards with controlled access.

- 1 lane in each direction.
- 2 lanes in each direction.
- 3 lanes in each direction.
- 4 lanes in each direction.
ROAD INTERCHANGES

- A road junction that uses grade separation, and one or more ramps, to permit traffic to pass through the junction without crossing any other traffic stream.

- Interchanges are used when at least one of the roads is a limited-access divided highway (e.g., expressway or freeway).
TYPES OF INTERCHANGES

Cloverleaf Interchange
TYPES OF INTERCHANGES

Diamond Interchange
TYPES OF INTERCHANGES

Stack Interchange
TYPES OF INTERCHANGES

Trumpet Interchange
CHALLENGES IN HIGHWAY PROJECTS

- Working on a “life” highway
- Extra costs on:
  - Preliminary works
  - Temporary works
  - Relocation of existing services
  - Temporary road diversion
  - Overtime works / odd hours
  - Risks to road users - extra safety measures
BRIDGE
BRIDGE

- An overpass that allows one transportation route, such as a highway or railroad line, to cross over another without traffic interference between the two routes.
- To cross over river, straits, lake, deep valley, ravine, land.
TYPES OF BRIDGE

1. Beam Bridge
   - Girder Bridge
   - Truss Bridge
   - Rigid Frame Bridge
2. Arch Bridge
3. Cantilevered Bridge
4. Suspension Bridge
5. Cable-Stayed Bridge
COMPONENTS OF A BRIDGE

- Pier & Foundation
- Abutment
- Tower
- Cable
- Anchor
- Hanger
- Deck
- Bearing
- Parapet wall
Main Components and Load Distribution of a Bridge

Concrete arch

Cantilever

Suspension

Cable-stayed
Beam Bridge

Girder Bridge

Truss Bridge

Rigid Frame Bridge
Girder Bridge  
Steel Truss Bridge  
Rigid Frame Bridge
Arch Bridge
Arch Bridge

Seri Setia, Putrajaya.

Pulau Bunting, Kedah
Cantilevered Bridge

Double-cantilevered Box Girder Bridge

SG. SANTUBONG BRIDGE KUCHING, SARAWAK
Suspension Bridge

Putrajaya Monorail Suspension Bridge
Cable-Stayed Bridge

- Fan cable stays
- Cable stay anchorage
- Stays
- Harp cable stays
Cable-Stayed Bridge (cont’d)

Seri Wawasan Bridge, Putrajaya.

Sultan Abdul Halim Mu’adzam Shah Bridge (Second Penang Bridge)

www.penang-traveltips.com
AIRPORTS
AIRPORT CLASSIFICATIONS

- Based on “highest requirement” of an aircraft that can use the airport.

- In layman terms, the “biggest” aircraft that can land at the airport.
<table>
<thead>
<tr>
<th>Code number (1)</th>
<th>Aeroplane reference field length (2)</th>
<th>Code letter (3)</th>
<th>Wing span (4)</th>
<th>Outer main gear wheel span* (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Less than 800 m</td>
<td>A</td>
<td>Up to but not including 15 m</td>
<td>Up to but not including 4.5 m</td>
</tr>
<tr>
<td>2</td>
<td>800 m up to but not including 1200 m</td>
<td>B</td>
<td>15 m up to but not including 24 m</td>
<td>4.5 m up to but not including 6 m</td>
</tr>
<tr>
<td>3</td>
<td>1200 m up to but not including 1800 m</td>
<td>C</td>
<td>24 m up to but not including 36 m</td>
<td>6 m up to but not including 9 m</td>
</tr>
<tr>
<td>4</td>
<td>1800 m and over</td>
<td>D</td>
<td>36 m up to but not including 52 m</td>
<td>9 m up to but not including 14 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>52 m up to but not including 65 m</td>
<td>9 m up to but not including 14 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>65 m up to but not including 80 m</td>
<td>14 m up to but not including 16 m</td>
</tr>
</tbody>
</table>

a. Distance between the outside edges of the main gear wheels.
AIRPORT COMPONENTS
Main components :-

- **LANDSIDE**
  - Main Terminal Building (MTB)
    - to serve passengers and facilities
  - Airport Traffic Control Tower (ATC)
    - Air controllers responsible for the separation and efficient movement of aircraft and vehicles.
- **Meteorological Department**
  - meteorological service for aircraft flying in and out
Main components (cont’d):-

- **AIRSIDE** - where aircrafts operate
  - Runway
    - Aircraft take off and land.
  - Apron
    - Passengers embark and debark and where aircraft are parked
  - Taxiway
    - Movement between runway & terminal
  - Hangar (MRO)
    - To hold aircraft in a protective storage
AIRPORT TERMINOLOGIES

- DCA - Department of Civil Aviation
- Airside - Airfield
- Landside - Surface transportation
- MTB - Main Terminal Building
- ATC - Air Traffic Control
- MRO - Maintenance, Repair & Overhaul (hangar)
- ILS - Instrument Landing System
- FIDS - Flight Information Display System
- BHS - Baggage Handling System
Water Treatment Process Flow
**Water Treatment Process**

- **Filtration**: Process of removing suspended solids from water by passing the water through a permeable fabric or porous bed of materials.

- **Chlorination**: Adding disinfectants to destroy microorganisms that can cause disease in human. Adding of lime to reduce acidity of water.
Water Treatment Process

River → Raw Water Pumps → Aerator → Filters

Disinfection and pH Correction ← Flouridation ← Mixing Chamber ← Clarifier

Clear Water Tank → Treated Water Pumps → Balancing Reservoir → Water Quality Monitoring
Water Treatment Process (Cont’d)

River
Raw water flows to the raw water pump sump.

Raw water pumps
Water is pumped to treatment plant via a raw water pipe.

Aerator
Create turbulence to achieve dissolved oxygen content of 80% saturation. Pre-lime & primary coagulant, poly aluminium chloride (PACI) are added.

Flash mixing chamber
Where a flocculent aid (polyelectrolyte) is added to enhance floc formation for easier removal in the clarification process.

Clarifiers
Clarifiers - floc concentration, collection & discharge. Settled water overflows into collection channels for onward flow to the filters.

Mixing chamber
Rapid gravity sand filters - remove fine particles that have not settled in the clarification process. Clarified water is filtered through a sand filter media to trap unsettled particles.

Filters
Rapid gravity sand filters - remove fine particles that have not settled in the clarification process. Clarified water is filtered through a sand filter media to trap unsettled particles.
Fluoridation

Filtered water collected at filtered water channel & sodium silicofluoride is added, then flows to clear water tank.

Disinfection & pH correction

Add chlorine for disinfection & tests carried out to ensure treated water free from pathogenic organisms. Hydrated lime is added for pH correction.

Clear water tank

Provide sufficient contact time for disinfection & conditioning chemicals to work on the water.

Water quality monitoring

Treated water quality is tested in lab to ensure water clean & safe for consumption. An independent external testing lab is also engaged.

Balancing reservoir

Store treated water is gravitated towards service reservoirs to cater the consumers. Recorded by custody transfer flowmeter.

Treated water pumps

To pump clean & treated water from balancing reservoir or clear water tank to the water supply distribution agency.
Components of Water Treatment Cycle

- **Dams** - A barrier that impounds water or underground streams. Collect raw water from rivers.

- **Raw water pipes** - Transfer raw water from dams to reservoir.

- **Water treatment plants** - Treat raw water to become potable water.

- **Treated water pipes** - Transfer treated water to reservoir.

- **Elevated water tank** - Restore water
## COSTS ANALYSIS OF WATER TREATMENT WORKS

### MILD STEEL CONCRETE LINING PIPE

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Estimated Rate (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 mm dia. MSCL</td>
<td>490.00/m</td>
</tr>
<tr>
<td>700 mm dia. MSCL</td>
<td>620.00/m</td>
</tr>
<tr>
<td>800 mm dia. MSCL</td>
<td>690.00/m</td>
</tr>
<tr>
<td>1000 mm dia. MSCL</td>
<td>910.00/m</td>
</tr>
<tr>
<td>1200 mm dia. MSCL</td>
<td>1,180.00/m</td>
</tr>
</tbody>
</table>

### ELEVATED RESERVOIR
- Rate (RM)/litre = RM 1.00/litre

### RESERVOIR
- Rate (RM)/litre = RM 0.50/litre
# COSTS ANALYSIS OF WATER TREATMENT WORKS

## HOT TAPPING WORKS

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Estimated Rate (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 mm dia. MSCL</td>
<td>6,000.00 /no</td>
</tr>
<tr>
<td>300-450 mm dia. MSCL</td>
<td>21,000.00 /no</td>
</tr>
<tr>
<td>400-500 mm dia. MSCL</td>
<td>25,000.00 /no</td>
</tr>
<tr>
<td>700-900 mm dia. MSCL</td>
<td>50,000.00 /no</td>
</tr>
<tr>
<td>800 mm dia. MSCL</td>
<td>80,000.00 /no</td>
</tr>
<tr>
<td>900 mm dia. MSCL</td>
<td>100,000.00 /no</td>
</tr>
</tbody>
</table>

## LINE-STOPPING WORK

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Estimated Rate/LS (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 dia. mm</td>
<td>500,000.00</td>
</tr>
<tr>
<td>900 dia. mm</td>
<td>600,000.00</td>
</tr>
<tr>
<td>1200 dia. mm</td>
<td>1,000,000.00</td>
</tr>
</tbody>
</table>
WASTE WATER MANAGEMENT

WASTE WATER
GENERATION
AT HOME

Sewage Treatment Plant

Septic Tank

Erazaer
Wastewater Treatment Flow Chart

- Influent
- Bar Screen
- Grit Removal
- Extended Aeration Basins
- Secondary Clarifier
- Filter
- UV Disinfection
- Reclamation Ponds
- Solids Dewatering
- Solids Disposal
Wastewater Treatment Technologies

- Conventional Activated Sludge System (CASS)
- Advance Oxidation Process
- Aerated Lagoon
- Anaerobic Digester
- Sequential Batch Reactor (SBR)
- Anaerobic, Anoxic and Oxic Zone (A2O)
- Multi Step Feed Aeration
# Comparison of various types of STP in Malaysia

<table>
<thead>
<tr>
<th>Sewage Treatment Plant</th>
<th>Treatment Process</th>
<th>PE</th>
<th>Process Plant Footprint</th>
<th>sqm/PE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Pantai 2 STP</strong></td>
<td>Aerated Lagoon</td>
<td>566K</td>
<td>136,600 m²</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Jelutong STP, Penang</strong></td>
<td>Sequential Batch Reactor (SBR)</td>
<td>1.2mil</td>
<td>32,000 m²</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>New Pantai 2 STP</strong></td>
<td>A2O</td>
<td>1.43 mil</td>
<td>25,000 m²</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Langat CSTP - Concept Design Stage</strong></td>
<td>Multi Step Feed Deep Aeration</td>
<td>995K</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A20 - Anaerobic, Anoxic and Oxic Zone

- A compact treatment facility using Advanced A2O process + sludge treatment + dewatering facilities.
- To replace the existing aerated lagoons, which will incorporate anaerobic digestion with solid dewatering.

PANTAI 2 SEWAGE TREATMENT PLANT
A20 - Anaerobic, Anoxic and Oxic Zone & Multi Step Feed Deep Aeration

Key Challenges:
- Limited STP site space
- High level of ammonia

TMG's advanced technologies:
- Deep Aeration Method
- Step-feed multi-stage denitrification process

Diagram:
- Influent
- Deep Aeration Method
- Anoxic Tank
- Aerobic Tank
- Anoxic Tank
- Aerobic Tank/Oxic Tank
- Under ground
Deep Aeration Method

Features of Deep Aeration Method

1. **Sizable STP in Small Footprint**: The required land is half of the one for the standard aeration method, so this can be a solution for land constraint.

2. **High Treatment Efficiency**: Baffle Plate makes/rectifies circular flow in the aeration tank.
The Status of Flow in Model Deep Aeration Tank

- Spiral Flow
- Baffle Plate
- Diffuser Plate
TERMINOLOGIES

- CENTRALIZED SEWAGE TREATMENT PLANT (CSTP)
  - Anti-Floatation Pile
  - Ground Anchor
  - Soil Nailing
  - Primary & Secondary Clarifier
  - Biological Nutrient Removal Reactor
  - Anaerobic Digester
  - Thickened Sludge Storage
  - Effluent Chamber

- SEWERS
  - a) Force Main
  - b) Gravity Sewers
    - Open cut
    - Pipe Jacking
    - Micro tunneling
    - Pipe Bursting
  - C) Receiving Chamber
  - d) Manholes and Chambers

- NETWORK PUMPING STATION
  - Population Equivalent (PE)
  - Temporary Treatment Plant (TTP)
COST ANALYSIS OF WASTEWATER TREATMENT WORKS
**PIPE LAYING WORKS**

**FORCE MAIN**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>RATE (RM)/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mm DI Pipe</td>
<td>860.00</td>
</tr>
<tr>
<td>200mm DI Pipe</td>
<td>1,300.00</td>
</tr>
<tr>
<td>300mm DI Pipe</td>
<td>1,500.00</td>
</tr>
<tr>
<td>600mm DI Pipe</td>
<td>1,900.00</td>
</tr>
<tr>
<td>700mm DI Pipe</td>
<td>2,200.00</td>
</tr>
<tr>
<td>1400mm DI Pipe</td>
<td>4,2000.00</td>
</tr>
</tbody>
</table>

* method : open cut & pipe jacking for crossing
GRAVITY SEWERS

- **Pipe jacking**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ESTIMATED RATE (RM)/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>225mm VCJP</td>
<td>1,600.00</td>
</tr>
<tr>
<td>300mm VCJP</td>
<td>1,900.00</td>
</tr>
<tr>
<td>450mm RCJP</td>
<td>2,400.00</td>
</tr>
<tr>
<td>600mm RCJP</td>
<td>3,000.00</td>
</tr>
<tr>
<td>750mm RCJP</td>
<td>3,500.00</td>
</tr>
<tr>
<td>900mm RCJP</td>
<td>4,000.00</td>
</tr>
<tr>
<td>1050mm RCJP</td>
<td>4,600.00</td>
</tr>
<tr>
<td>1200mm RCJP</td>
<td>5,500.00</td>
</tr>
<tr>
<td>1500mm RCJP</td>
<td>6,500.00</td>
</tr>
<tr>
<td>1800mm RCJP</td>
<td>7,700.00</td>
</tr>
</tbody>
</table>

- **Jacking & Receiving pit**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ESTIMATED RATE (RM)/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacking pits</td>
<td>50,000 - 185,000.00/no</td>
</tr>
<tr>
<td>Receiving pits</td>
<td>40,000 - 165,000.00/no</td>
</tr>
</tbody>
</table>

* Rate depends on depth of pit.
# B) NETWORK PUMPING STATION

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ESTIMATED RATE(RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS 1 (55,000PE)</td>
<td>140.00 / PE</td>
</tr>
<tr>
<td>NPS 4 (85,000PE)</td>
<td>100.00 / PE</td>
</tr>
<tr>
<td>NPS 5 (13,000PE)</td>
<td>400.00 / PE</td>
</tr>
<tr>
<td>NPS 9 (900,000PE)</td>
<td>40.00 / PE</td>
</tr>
<tr>
<td>NPS 10 (12,000PE)</td>
<td>420.00 / PE</td>
</tr>
<tr>
<td>NPS 12 (9,000PE)</td>
<td>330.00 / PE</td>
</tr>
</tbody>
</table>
CHALLENGES IN WASTEWATER MANAGEMENT

Rapid development in urban areas has increased
- importance of sustainable wastewater management
- complexity of its implementation

Complex due to:
- increased population but limited land availability
- work within developed community
- work within developed infrastructure
- Working in life STP (Sewage Treatment Plant)
- Upgrading a life STP
CHALLENGES IN WASTEWATER MANAGEMENT

Sustainable wastewater management has to address:

- Wastewater collection infrastructure issues
- Wastewater treatment issues
- Bio-solids reuse and disposal issues
- Effluent reuse issues
- Effluent dispersal issues
- Impact to environment
- Impact to social well-being of community
CASE STUDY
UPGRADING BATU BERENDAM INTERNATIONAL AIRPORT

- **Client**: Uni Integrated Sdn Bhd
- **Total contract value**: RM180 Mil.
- **Completion date**: March 2010
PROPOSED BERTAM DAF PHASE 2 WATER TREATMENT PLANT, DURIAN TUNGGAL, MELAKA

**PACKAGE 1** - CONSTRUCTION AND COMPLETION OF INTAKE TOWER AND RAW WATER PUMPING STATION AT DURIAN TUNGGAL DAM AND 1200MM DIAMETER RAW WATER PIPELINE FROM DURIAN TUNGGAL DAM TO BERTAM DAF PHASE 2 WATER TREATMENT PLANT.

**PACKAGE 2** - CONSTRUCTION AND COMPLETION OF 120MLD BERTAM DAF PHASE 2 WATER TREATMENT PLANT.

**PACKAGE 3** - CONSTRUCTION AND COMPLETION OF 2 x 5ML NEW BERTAM BALANCING RESERVOIR, 10ML NEW SUNGAI UDANG RESERVOIR, 20ML NEW AIR SALAK RESERVOIR AND INTERCONNECTION AT EXISTING CHENG RESERVOIR AND PIPELAYING OF 1000MM, 800MM, 600MM AND 500MM MSCL PIPE

**PACKAGE 4** - CONSTRUCTION AND COMPLETION OF 23ML NEW BUKIT JELUTONG RESERVOIR, INTERCONNECTION AT EXISTING BUKIT BERANGAN AND EXISTING BUKIT BERUANG RESERVOIR AND PIPELAYING OF 700MM AND 400MM MSCL PIPE
PACKAGE 2 - CONSTRUCTION AND COMPLETION OF 120MLD BERTAM DAF PHASE 2 WATER TREATMENT PLANT.

Client: Pengurusan Aset Air Berhad (PAAB)

Total contract value: RM 65,000,000.00
Date of Commencement: May 2011
Date of Completion: April 2014
PACKAGE 3 - CONSTRUCTION AND COMPLETION OF 2 x 5ML NEW BERTAM BALANCING RESERVOIR, 10ML NEW SUNGAI UDANG RESERVOIR, 20ML NEW AIR SALAK RESERVOIR AND INTERCONNECTION AT EXISTING CHENG RESERVOIR AND PIPELAYING OF 1000MM, 800MM, 600MM AND 500MM MSCL PIPE

Client : Pengurusan Aset Air Berhad (PAAB)

Date of Commencement : November 2011
Date of Completion : September 2013
Project Amount : RM 59,000,000.00
PACKAGE 4 - CONSTRUCTION AND COMPLETION OF 23ML NEW BUKIT JELUTONG RESERVOIR, INTERCONNECTION AT EXISTING BUKIT BERANGAN AND EXISTING BUKIT BERUANG RESERVOIR AND PIPELAYING OF 700MM AND 400MM MSCL PIPE

Client : Pengurusan Aset Air Berhad (PAAB)

Date of Commencement : October 2011
Date of Completion : October 2013
Project Amount : RM 29,981,722.00
Pakej D47 – Pembinaan Rangkaian Paip Pembetungan di Kawasan Petaling Jaya(Utara)

- Client: Jabatan Perkhidmatan Pembetungan, KeTTHA
- Upon completion capable to carry 200,000 PE of wastewater
- Contract value: RM 277 Mil.
- Start date: March 2013
- Expected completion date: March 2017
JELUTONG SEWAGE TREATMENT PLANT (JSTP)

PMC: Kumpulan Ikhtisas Projek (M) Sdn Bhd
Client: Jabatan Perkhidmatan Pembetungan, KeTTHA
Capacity: to treat 1.2 Mil. PE of wastewater
Contract value: RM478 Mil.
Completed 2004
PANTAI 2 SEWAGE TREATMENT PLANT
**Client**: Jabatan Perkhidmatan Pembetungan, KeTTHA

Upon completion capable to treat 1,423,000 PE of wastewater

**Total contract value**: RM 983 Mil.

**Start date**: July 2011

**Expected completion date**: July 2017
A – PPR Sri Pantai
B – Taman Permainan Kanak-kanak
C – Pusat Komuniti
D – Kampung Dato Tohoh
E – Gelanggang Futsal Tertutup
F – Gelanggang Bola Keranjang

G – PPR Cempoka
H – Padang Bola Sepak
I – Gelanggang Tenis
J – Bangunan Pendidikan
K – Tangki Pencemaran Enapemar

* Kolam pengudaraan sedia ada akan dinaik taraf kepada loji rawatan kumbahan bersistem mekanikal bagi meningkatkan keupayaan rawatan sedia ada.
* Sebuah loji rawatan kumbahan yang mengaplikasikan sistem ‘Advanced A2O’ yang dapat memproses air kumbahan dan enapemar akan dibina.
CHALLENGES:

- Knowledge in civil engineering
- Terminologies
- Special requirements
- Alternative designs & alternative materials
- Value engineering exercises
- Latest technology
- Identify major costs:
  - Controllable
  - Uncontrollable
- Unit costs and all-in cost
- Elemental cost analysis
THANK YOU