Faculty of Engineering
Department of Civil Engineering

ENGINEERING DESIGN SOLUTIONS FROM ACTUAL SITE DATA: CASE STUDY OF THE WATER SPORTS TRAINING FACILITY IMPROVEMENT PROJECT

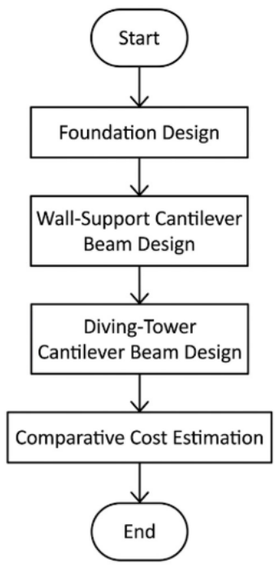
Problem Statement / Rationale / Motivation

A change of use and heavier loads, especially impact at the diving tower, mean the existing structure may not be adequate. The foundations and cantilever beams are redesigned for safety and cost.

Design Objectives

- To design a new foundation capable of safely supporting the modified structural loads.
- To design a cantilever beam structure for supporting the diving platform.
- To conduct a comparative study on the cost and cost-effectiveness of reinforced concrete (RC) and steel structures.

Project Methodology



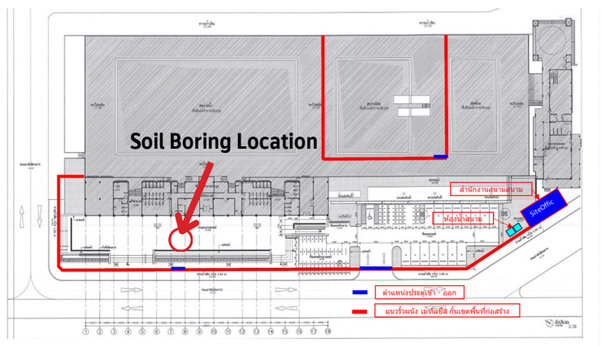
Project Results



Design Constraints

- **The tip load on the cantilever causes high moment and shear at the support, with a risk of deflection and cracking.**
- **A long span also increases deflection and negative moment.**

Borehole Location (BH)



Engineering Standards

- ACI 318-19: Standard for Structural Concrete Design
- (Building Code Requirements for Structural Concrete)
- Standards for Load and Resistance Calculations in Civil Engineering

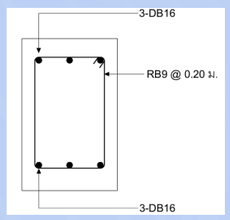
Design Approach / Methodology

1. Site Investigation and Data Collection: Conducting site inspections and soil investigations to evaluate soil properties and site conditions.
2. Structural Analysis: Performing load calculations, including dead loads and live loads.
3. Engineering Design: Designing the foundations, cantilever beams, and reinforcement detailing.
4. Cost Estimation: Preparing the Bill of Quantities (BOQ) for material and cost comparison.

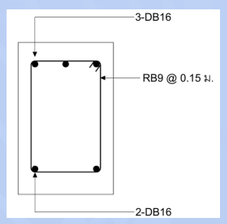
Design Deliverables / Results

- RC Beam Details: Beam size 0.25 × 0.40 meters, reinforced with 3 DB16 top and 2 DB16 bottom bars and RB9 stirrups spaced at 0.15 meters.
- Cost Comparison:
- Reinforced Concrete Beam: 8,860 Baht (9 m beam)
- Steel Beam (H-Beam): 36,000 Baht (9 m beam)

Beam B1

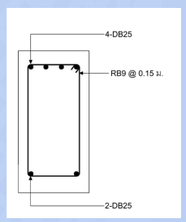


Existing B1: 0.25 × 0.40 m, 6-DB16, RB9 @ 0.20 m

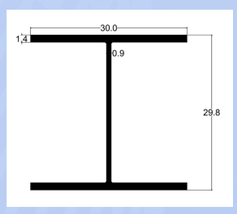


New B1: 0.25 × 0.40 m, 3-DB16 top, 2-DB16 bottom, RB9 @ 0.15 m

A 9-meter cantilever beam for the diving tower



RC cantilever: 0.25 × 0.50 m, 4-DB25 top, 2-DB25 bottom, RB9 @ 0.15 m



Steel option: H-beam 300 × 200 × 9 × 14 mm

Comparative Cost Estimation

BILL OF QUANTITIES

Project: Original beam design (existing B1)

No.	Description	Qty	Unit	Material (THB/unit)	Labour (THB/unit)	Amount (THB)
1	Ready-mix concrete 280 ksc (1,920 kg)	1.00	lot	2,000.00	0.00	2,000.00
2	Deformed bar DB16	7.00	bars	340.00	0.00	2,380.00
3	Round bar RB9	7.00	bars	120.00	0.00	840.00
				Total material cost		**5,220.00**

Cost per 1 m = 660 Baht, about 50 Baht/m more than the new design.

BILL OF QUANTITIES

Project: New beam design (new B1)

No.	Description	Qty	Unit	Material (THB/unit)	Labour (THB/unit)	Amount (THB)
1	Ready-mix concrete 280 ksc (1,920 kg)	1.00	lot	2,000.00	0.00	2,000.00
2	Deformed bar DB16	6.00	bars	340.00	0.00	2,040.00
3	Round bar RB9	7.00	bars	120.00	0.00	840.00
				Total material cost		**4,880.00**

Cost per 1 m = 610 Baht, about 50 Baht/m cheaper than the original beam.

BILL OF QUANTITIES

Project: Diving tower beam as a steel beam (9 m)

No.	Description	Qty	Unit	Material (THB/unit)	Labour (THB/unit)	Amount (THB)
1	H-beam 300 × 200 × 9 × 14 mm	9.00	m	4,000.00	0.00	36,000.00
				Total material cost		**36,000.00**

Cost per 1 m = 4,000 Baht, about 3,000 Baht/m more than the RC beam.

BILL OF QUANTITIES

Project: Diving tower beam as an RC beam (9 m)

No.	Description	Qty	Unit	Material (THB/unit)	Labour (THB/unit)	Amount (THB)
1	Ready-mix concrete 350 ksc (2,160 kg)	1.00	lot	2,500.00	0.00	2,500.00
2	Deformed bar DB25	6.00	bars	900.00	0.00	5,400.00
3	Round bar RB9	8.00	bars	120.00	0.00	960.00
				Total material cost		**8,860.00**

Cost per 1 m = 985 Baht, about 3,000 Baht/m cheaper than the steel beam.

Conclusions and Recommendations

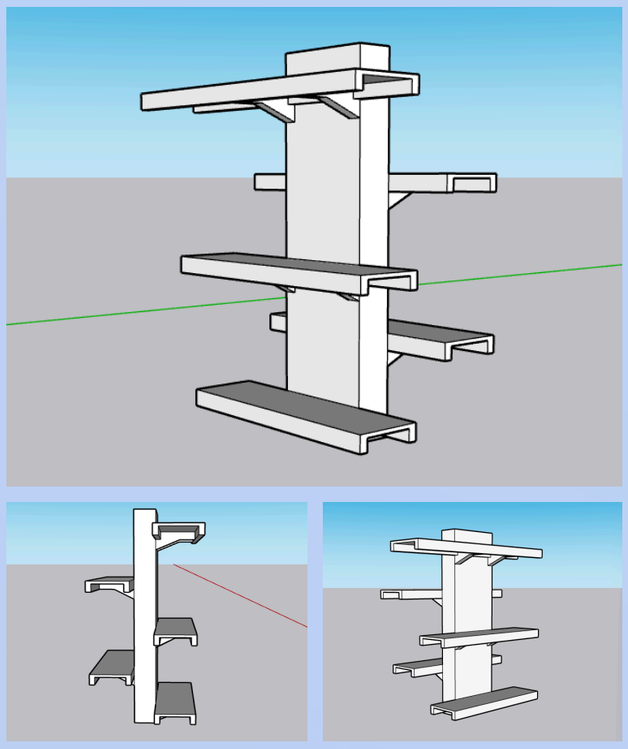
From the study and design analysis, the reinforced concrete cantilever beam was found to be the safest and most cost-effective option for the diving platform, costing approximately 8,860 Baht for the 9 m beam compared to 36,000 Baht for the 9 m beam for the steel beam.

The newly designed Beam B1 is reinforced with DB16 bars and RB9 stirrups at 15-centimeter spacing, providing adequate structural safety. All designs comply with the ACI 318-19 code.

Key Courses Used in the Project

- RC Design : beam B1 re-design
- Foundation Engineering : pile capacity
- Structural Analysis : beam and column loads
- Soil Mechanics : SPT, soft clay
- Construction Estimation : RC vs steel cost
- Steel Design : steel beam option

Diving Tower



Acknowledgements

This project was successfully completed with the valuable guidance of Assoc. Prof. Acting Sub Lt. Supachai Sinthaworn, D.Eng., the project advisor, who provided consultation and recommendations throughout the study. The authors would also like to express their sincere appreciation to Kam Architect Co., Ltd. for providing site information and support, which significantly contributed to the structural analysis and design in accordance with actual site conditions.

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