ENABLING STRUCTURES

INNOVATIVE SOLUTIONS
FOR
COMPLEX CONSTRUCTION PROBLEMS

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EXCITING WORLD OF STEEL STRUCTURES
PART 1- INTRODUCTION

PART 2 - CASE STUDIES FOR ENABLING STRUCTURES

PART 3 - SPECIAL STRUCTURES

DO NOT FORGET NEWTON!!!!

PART 1

🌟 WHAT IS ENABLING STRUCTURE ?

🌟 HOW TO ARRIVE AT DESIGN LOADS ?

🌟 INFORMATION FROM CLIENT THRO’ SEARCHING QUESTIONS.

🌟 SEGREGATION OF INFORMATION.

🌟 IF INFORMATION NOT AVAILABLE HOW TO APPROXIMATE ?
DETERMINATION OF FACTOR OF SAFETY.

- SERVICEABILITY REQUIREMENT MORE PREDOMINANT.
- F.S. JUST SUFFICIENT TO CATHER FOR STRENGTH.
- D.L AND L.L NEED NOT BE AS PER IS CODES.

STRUCTURAL SCHEME

- SAFETY.
- ECONOMY WRT MATERIAL CONSUMPTION.
- EASE OF EXECUTION OF GIVEN SCHEME.
- ECONOMY WRT TIME FOR ERECTION AND ACTUAL OPERATION.
TYPES OF STRUCTURES
MARINE AND RIVER CONSTRUCTION

SUB STRUCTURE
- UNDER GROUND
- UNDER WATER

SUPER STRUCTURE
- PORTS
- JETTIES
- BRIDGES

CASE STUDY 1
50 MET LONG FLOATING WALKWAY BRIDGE
SALIENT POINTS

1. ACCESS TO WORK SITE.

2. DEPTH OF WATER MORE THAN 5.0 MET.

3. PRINCIPLES OF HYDRAULICS AND STABILITY.
CASE STUDY 2

JACKUP PLATFORM

NO ACCESS AVAILABLE. WHAT IS THE SOLUTION?

MOORING DOLPHINS FOR WESTERN INDIA SHIPYARD, GOA
JACK-UP PLATFORM DESIGNED FOR 3 NUMBERS. 1200 MM DIA. PILE.

PROVIDED WITH OVER HEAD FACILITY TO INSTALL PILING PULLIES IN THE REQUIRED LOCATION
JACK UP PLATFORM FOR SOIL EXPLORATION AT JOGESHWAR DEAJEJ FOR IPCL

PILING FOR JETTIES
• PILING WORK-- ONSHORE OFFSHORE
• PILES -- PRECAST INSITU

• CHALLENGES IN OFF SHORE PILING.
• RANGE OF PILE DIAMETER.
• SPEED OF CONSTRUCTION .
• QUALITY OF CONSTRUCTION.
CASE STUDY 3

MARINE JETTY AT DAHEJ FOR BIRLA COPPER, GUJARAT
THE JETTY . . .

- 1152 M LONG IN APPROACH, 208 M LONG ON BERTHING FACE.
- JETTY CONSTRUCTION FROM LAND- END ON METHOD

PILING

- 6 PILES IN 5 DAYS
- FRONT CANTILEVER 24 M
- SUPPORTED SPAN 24 M
- 30 M REAR CANTILEVER
WATER CURRENTS OF 3 TO 4 M/SEC
15 T CAPACITY UNDER SLUNG CRANE FOR MATERIAL HANDLING
ROLLING BRACING IN PLAN

MARINE JETTY
AT
DAHEJ
FOR
GUJARAT CHEMICAL PORT,
GUJARAT
THE JETTY . . .

- The jetty is more than 1000 m long

PILING . . .

- Piling gantry constructed piles up to about 1000m in length in 10 months with four piles from front cantilever of 24m & two piles from side cantilever of 8m.
- This gantry also had 30m rear cantilever for 20t capacity under slung crane.
PILING . . .

- Tailor made erection gantry was also designed for handling of precast concrete units.

- Rest of the gantry was done up with steel piles having vertical & raker piles in combination.
NOTE - THE BRACKET ON SIDE FOR ROLLING THE GANTRY
PRECAST CONCRETE ERECTION GANTRY

MARINE JETTY
FOR
THERMAL POWERSTATION
AT
TUTICORIN, TAMILNADU
THE JETTY

- The jetty was about 1000 m long with twin pile bents spaced at 20 m C/C.

THE GANTRY

- The gantry had 20 m left cantilever, 10 m supported span and 30 m right cantilever.
- 50 m long floating bridge was also designed for breakwater to jetty site approach.
BRACING THE PILES
PILING GANTRY FOR JETTY AT AGATTI LAKSHADWEEP JETTY HEAD AT AN ANGLE OF 104 DEGREES
ASH DISPOSAL PIPE LINE BRIDGE FOR THERMAL POWERSTATION AT DAHANU, MAHARASHTRA

- JACK-UP PLATFORM DESIGNED FOR 3 NOs. 600 MM DIA. PILE.
- MOVING RIG ON PLATFORM & SUSPENDED PILING PULLEY ADJUSTABLE IN REQUIRED LOCATION
- PILE GROUPS SPACED AT 30M C/C TO SUPPORT STEEL GIRDERS
JACK UP PLATFORM FOR ASH DISPOSAL PIPELINE BRIDGE PILING FOR THERMAL POWER STATION, DAHANU
CASE STUDY 4
SUPER STRUCTURE

BRIDGE ON MAHANANDA RIVER
AT DALKHOLA WEST BENGAL
THE BRIDGE . . .

- P.S.C. BOX GIRDER BRIDGE
- 12 SPANS OF 52.80 M, SUPPORTED ON WELLS-PIERS.
- 1200 T BOX GIRDER TRAVELLING STAGING
- TEMPORARY 3 PILE GROUPS ON EACH SIDE TO BREAK THE SPAN TO 13.2M FOR SUSPENSION OF SHUTTERING ABOVE DECK SLAB
- TIME CYCLE OF 100 DAYS REDUCED TO 60 DAYS
NOTE THE SUSPENDERS FOR CAPACITY 60 T
BRIDGE ON SOMESHWAR CREEK AT RATNAGIRI MAHARASHTRA
- The bridge is 58 m long having one span of 40 m between abutment & central well pier.

- Rest of the length cantilevered.

- Centering box girder to support P.S.C. box girder – weighing about 500 t.

- Centering box of 39 m length was launched from abutment over temporary pair of columns at 13 m C/C spacing.

- Center box was lowered to required level.
PART 3
SPECIAL STRUCTURES

LIMESTONE STOCK PILE SHED FOR CLINKER PLANT AT JAFARABAD FOR NARMADA CEMENT COMPANY LTD.
COVERING THE LIME STOCK WAS NECESSARY WHILE THE PLANT WAS IN OPERATION

THE SHED WAS TO BE ERECTED IN PARTS OF 53 M WIDTH X 20 M LENGTH, 30 M AWAY AND ROLLING IN POSITION.

TOTAL LENGTH – 200 M

TWO PORTALS 10M APART & TRIANGULAR PURLINS IN ROOF ALONG WITH SIDE CLADING CANTILEVERING 5M, CONNECTED IN TANDEMN & ROLLED ON RAILS WITH TROLLEYS ATTACHED TO THEIR SHOE.
SPECIAL DETAIL FOR HINGE

BRIDGE ON RAILWAY LINE NEAR ITARASI MADHYA PRADESH.
THE BRIDGE HAS 45 DEGREES SKEW SPAN OF 40M
6 PSC GIRDERS WEIGHING 140T EACH CONSTRUCTED ON ELEVATED STAGING
WINCHED & SIDE SHIFTED TO REQUIRED POSITION
IN-SITU DECK SLAB WITH SUSPENDED SHUTTERING

WEB SHUTTER OF 6M HANDLED WITH OVERHEAD MONORAIL
HINGED AT BOTTOM EDGE OF STAGING FACILITATED THE ROTATION FROM VERTICAL TO HORIZONTAL POSITION. IT ACTED AS A WORKING PLATFORM ALSO.
TWO FOLD USE OF SHUTTERING ON HINGE ACTS AS WORKING PLATFORM FOR REINFORCEMENT ASSEMBLY.

MOORING DOLPHIN FOR OIL JETTY AT MANGALORE
MAXIMUM HORIZONTAL PULL 230T.

FREE WATER DEPTH 18M

ALLOWABLE DEFLECTION 6MM

ALTERNATIVE I - VERTICAL PILES WOULD HAVE RESULTED IN LARGE DEFLECTIONS; 1200 MM DIA. PILES IN LARGE No. – COSTLY

ALTERNATIVE II – RAKER PILES CONNECTED ALONG OUTER EDGE OF 8X8M PILE CAP – UNACCEPTABLE DEFLECTIONS & SEVERE BM & AXIAL FORCE

ALTERNATIVE III – 4 INDIVIDUAL PILE GROUPS OF 3-800 DIA AT 1:4 RAKE. PILE CENTER LINE MEETING IN PILE CAP & TRIPOD FORMATION AT EACH CORNER. THIS RESULTED IN REDUCED DEFLECTION & BM.
ALTERNATIVE I

ALTERNATIVE II

ALTERNATIVE III
MORE EFFICIENT
CENTERING FOR 125T FENDER BLOCK FOR CONTAINER BERTH AT ADANI PORT
HORIZONTAL BEAM SPANING 13M – COSTLY

INVERTED TRIANGLE IN STEEL USED TO TRANSFER THE FORCE. UTILISING FULL CAPACITY IN TENSION.

CRADDLE FOR 125 T FENDER BLOCK
CRANE FOR ERECTION OF LARGE SPAN SHED OVER WATER

- ERECTION CRANE DESIGNED TO ERECT THE LARGE SPAN SHED IN A RECORD TIME
- SHED – 41M WIDE, 130M LONG & 30M HIGH
CRANE DESIGNED TO ERECT SHED OVER WATER

CRANE OUT/OUT 48 M x 34 M HIGH x 24 M BASE WIDTH
FLOATING PONTOON FOR BAND-DRAIN WORK FOR SOIL CONSOLIDATION AT DEEP WATER PORT AT KAKINADA

PONTOON

- WHY BAND-DRAINS ARE REQUIRED?
- TAILOR-MADE UNIQUE PONTOON WAS DESIGNED
- ACHIEVED A WORLD RECORD OF 2200 BAND-DRAINS IN A DAY FOR VERY SOFT CLAY CONSOLIDATION FOR BREAK WATER
REMOVABLE STEEL COFFERDAM FOR INTAKE CHANNEL 7M WIDE X 12M HIGH
SPEEDY CONSTRUCTION OF 12M HIGH RCC WALL WITH BUTTRESSES
17 M HIGH RCC WALL ON HILL SLOPE FOR BUNGALOW