Engineers India Limited

Civil and Structural Engineering Solutions Across The Energy Spectrum

Profile

Engineers India Ltd. (EIL) is a leading global engineering consultancy and EPC company. The Company has a diverse portfolio comprising Hydrocarbon, Chemicals & Fertilizers, Mining & Metallurgy, Infrastructure, Water and Waste Management, Solar & Nuclear Power sectors.

EIL has emerged as a 'Total Solutions' engineering consultancy company providing design, engineering, procurement, construction and integrated project management services from 'Concept to Commissioning' with highest quality and safety standards. It also provides specialist services such as heat and mass transfer equipment design, environmental engineering, specialist materials and maintenance and plant operations and safety services.

EIL has successfully completed all projects, all of which are operating smoothly (in most cases at more than rated capacity), and has, hence, created an array of satisfied clients. EIL has secured many repeat businesses from its clients which is a sign of client satisfaction, confidence and trust reposed in EIL.

"Over the past five decades, EIL has executed more than 5000 projects including over 400 major projects worth USD 200 Billion in" total cost.

EIL has earned the reputation of being a veritable treasure of technical knowledge, skills and professional competence. EIL has worked with almost all process licensors and a large number of engineering/ contracting companies worldwide and our engineers are well versed with international engineering codes and standards. With a workforce of over 3000 experienced employees & a variety of specialised services available under one roof, EIL offers an unique advantage to clients like none other.

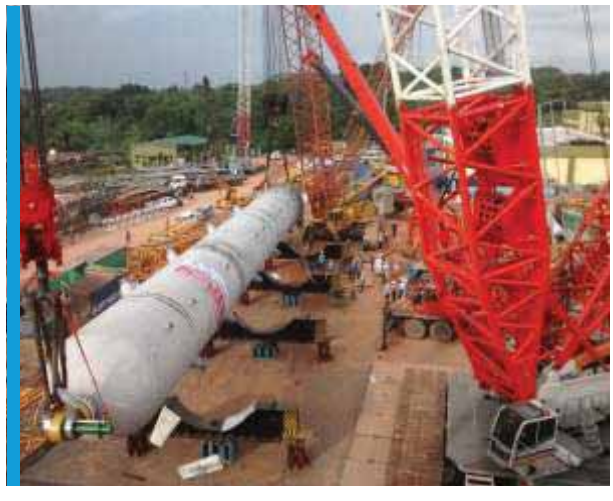
5.6 million available Technical Manhours annually
9,600 available Construction Management and Supervision Man-months annually

GLOBAL PRESENCE

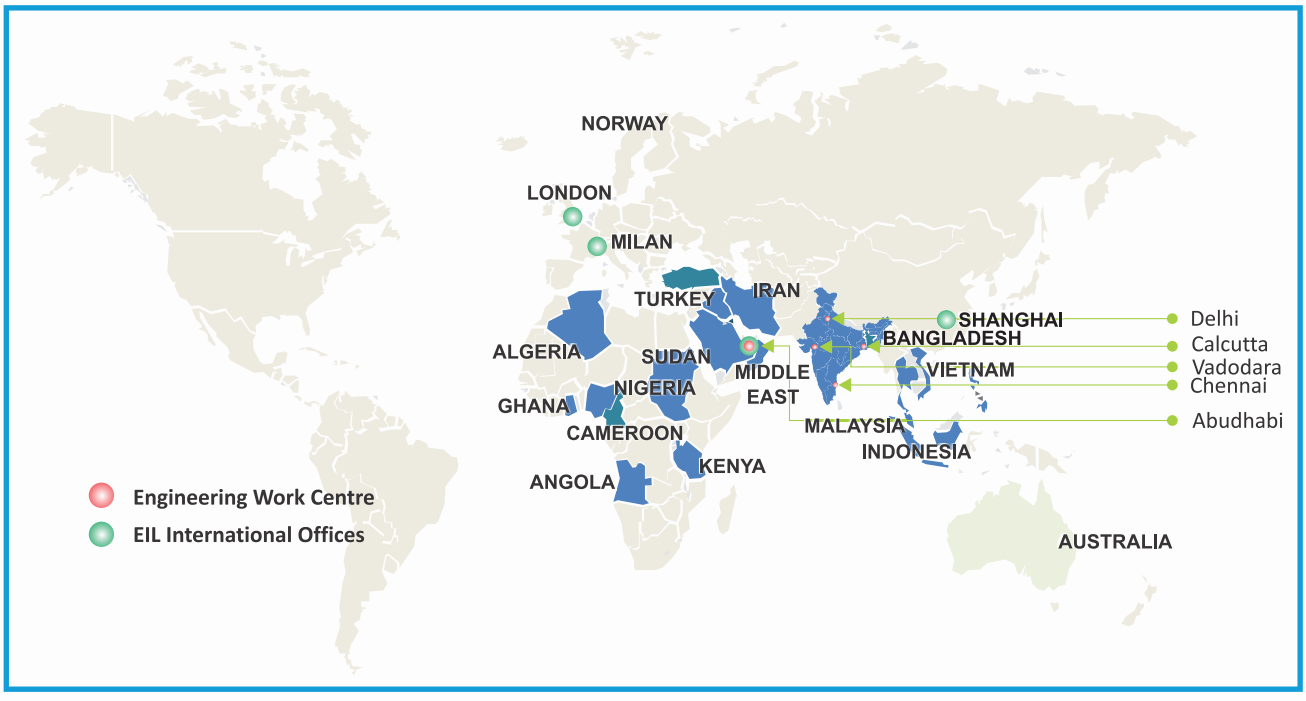
Geographical Regions	Key Countries served
Middle East	UAE | Bahrain | Kuwait | Iran | Oman | Saudi Arabia | Qatar | Iraq
Asia / Asia Pacific	Australia | Malaysia | Indonesia | Bangladesh | Vietnam
Europe	Norway | Turkey
Africa	Algeria | Ghana | Kenya | Nigeria | Angola | Sudan | Cameroon

Track Record

- 72 Major Refinery projects, including 10 grass root refineries,
- 9 Petrochemical complexes,
- 41 Oil and Gas Processing projects,
- 213 Offshore platforms including 40 process platforms,
- 46 Pipeline projects,
- 13 Ports, Storage & Terminals,
- 9 Fertilizer projects,
- 32 Mining and Metallurgy projects,
- 33 Infrastructure projects (airports, highways, bridges, water management, & energy-efficient intelligent" buildings),
- 23 Turnkey/EPC projects.
- Infrastructure Projects
- Power / Captive Power Projects



Experience Credentials & Global Presence



Overseas Clients

MIDDLE EAST	ADNOC, ADMA OPCO, GASCO, TAKREER, ADCO, ZADCO, BOROUGE, BUNDUQ, NPCC, ADGAS, BANAGAS, BAPCO, ALBA, KNPC, EQUATE, PIC, NPC, ORPIC, SAUDI ARAMCO, SABIC
ASIA	PETRONAS, WIKA, PAU, TPAO, BCIC
AFRICA	SONATRACH, BOST, KPRL, DANGOTE, INDORAMA, SONANGOL, SUDAPET, WNPOC, HYDROMINE GLOBAL MINERALS GMBH Ltd.

INDIA

INTERNATIONAL

CIVIL-STRUCTURAL ENGINEERING

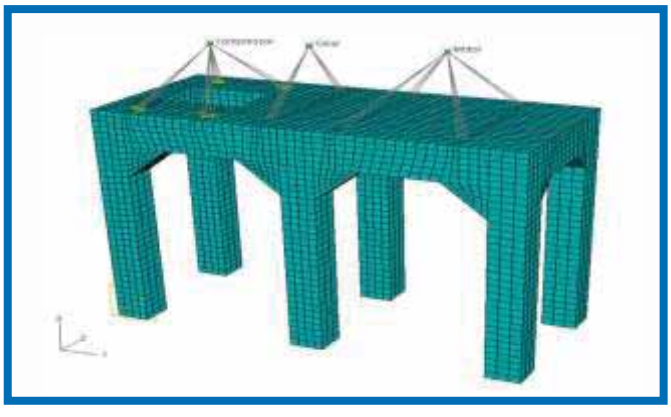


Fig. 1a: 3D Wiremesh Display of FEM Model of a Table-Top Compressor Support- to analyse the behaviour

EIL performs Civil and Structural Engineering Design and Analysis functions on all RCC and Steel structures envisaged in a project. EIL renders concept to commissioning services for all the RCC and steel structures in the plant.

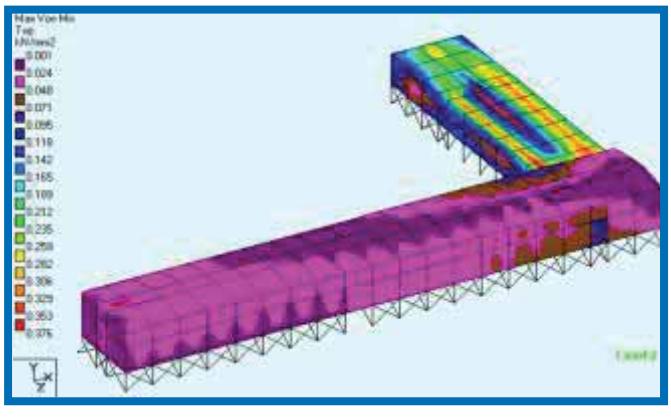


Fig. 1b: Blizzard Analysis model of the Indian Antarctic Station "Maitri"

Geotechnical Engineering

Exclusive Geotechnical services rendered in-house are:

- Geotechnical Investigations for all projects and development of Foundation Design Philosophy/Criteria
- Development of Piling capacity and design
- Ground Improvement works viz. Prefabricated Vertical Drains, Stone Columns, use of Geo Synthetic materials, Soil Stabilization etc.
- Liquefaction Solutions
- Scour Depth analysis
- Specialized geotechnical solutions such as Soil nailing, Slope stability analysis, Gabion wall, Reinforced Earth wall etc.

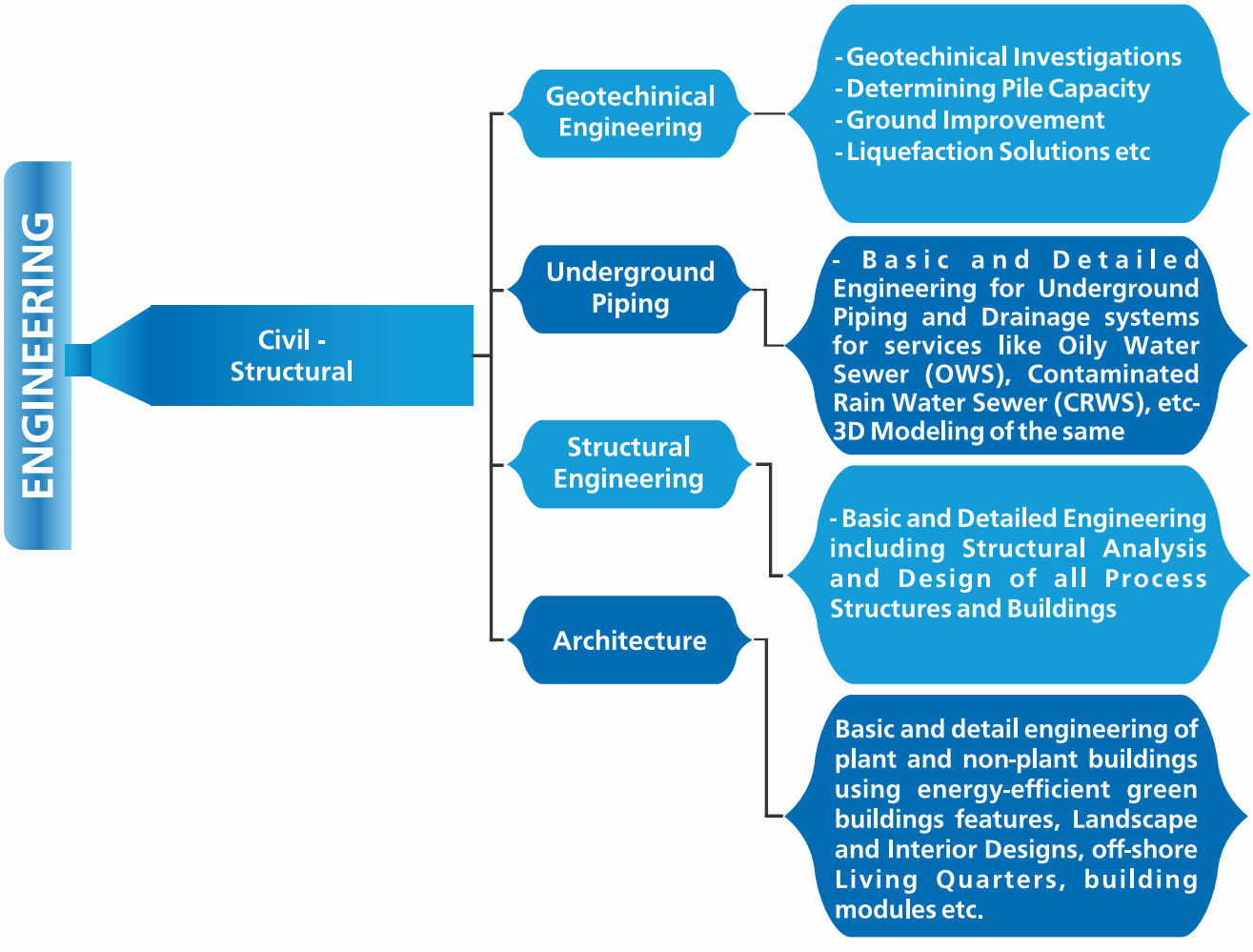


Fig. 2: Organization of Civil-Structural Functions

- Geo Hazard studies for pipeline projects.
- River bank protection works
- Numerical solutions for various Geotechnical problems

Fig. 3: Piperack

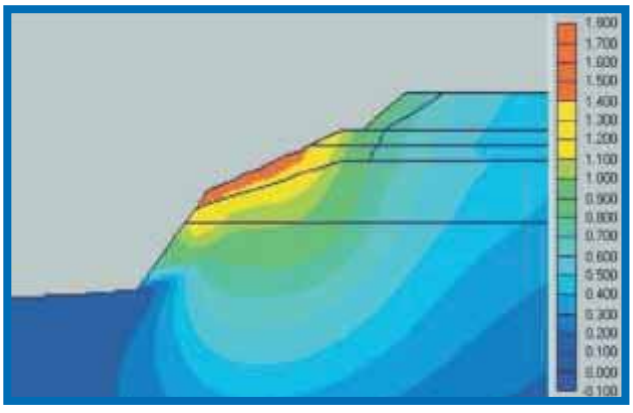


Fig. 4: Slope stability analysis – To assess the safe design of any slope, human-made or natural

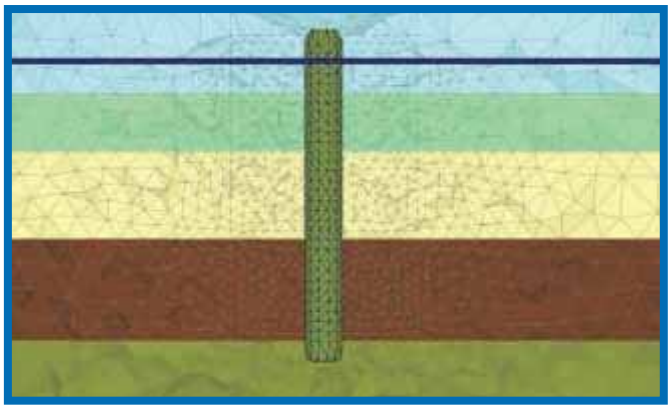


Fig. 5: Analysis of stone column – For Ground Improvement

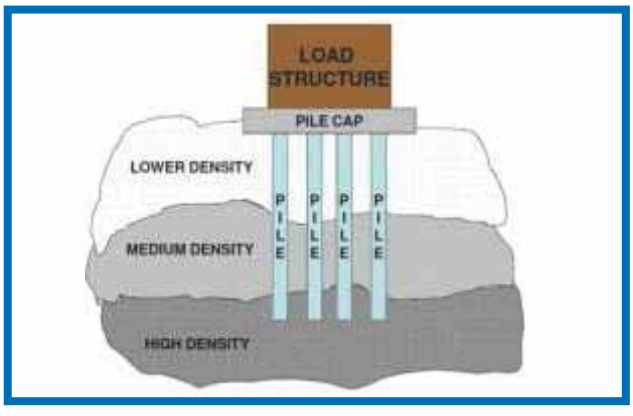


Fig. 6: Pile Capacity Analysis & Design – To assess the strength of the pile

Fig. 7: 3D Analysis of Building considering Diaphragm Action of slabs – A diaphragm transmits lateral load to the vertical resisting elements

Under Ground Piping Services

Expertise in Underground Piping services rendered in-house are as follow:

- Layouts for different Underground services like Fire Water, Cooling Water, Drinking Water, OWS, CRWS, Storm Water Drainage and Sanitary System
- Detailed Offsite Area Drawings and Unit Area Drawings consisting of Roads and all underground services required inside and outside unit like
- Fire Water
- Cooling Water
- Blow down
- Drinking water
- Oily Water Sewer (OWS)
- Contaminated Rain Water Sewer (CRWS)
- Storm Water Drainage
- Sanitary System
- Electrical/Instrumentation trenches along with all levels and co-ordinates

These also include the interface of Underground Gravity and Pressurized Piping in the Structural Foundation Layouts.

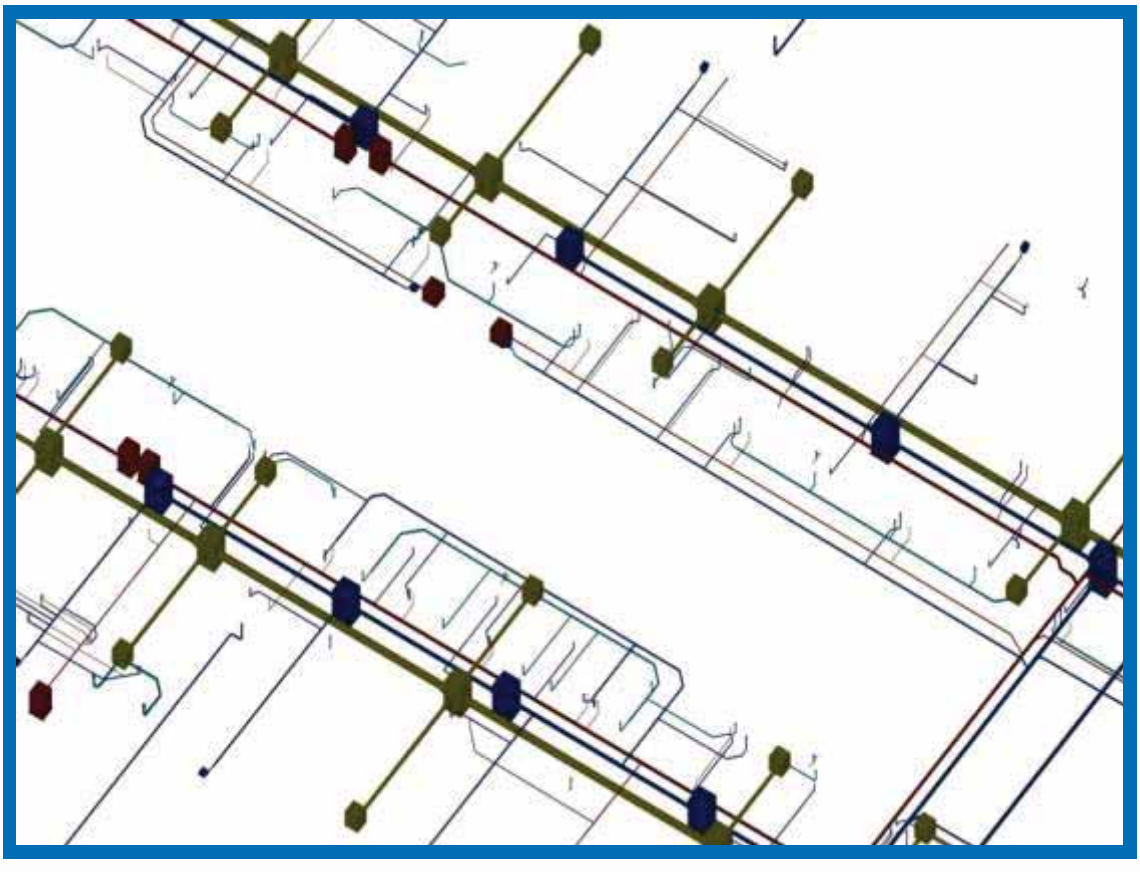


Fig. 8: Part View of model of Underground Piping Services

Structural Engineering

Expertise in Structural Engineering comprises carrying out Basic and Detailed Engineering (includes Structural Analysis, Design and Drawings) for the following:

- Process Structures/Buildings
- Blast Resilient Buildings
- Machine Foundations (for Compressors, Pumps, Static Equipment, etc.)
- RCC & Steel Chimneys/Stacks
- Piperacks
- Technological Structures (For supporting equipments)
- Double-Walled Cryogenic storage Tanks
- Dynamic Analysis for Seismic Forces
- Shell Roofs
- Green Buildings
- Plant Buildings

  (Sub-Stations and Control Rooms)
- Specialist review of Contractor's Designs and Drawings as the Prime Consultant (PMC) for many domestic and overseas projects
- Third-Party review of Contractor's Design & Drawings as an independent consultant for projects such as:
  - ⇨ Airports - Delhi and Mumbai International Airports
  - ⇨ Sports Facilities - Commonwealth Games Project

- Proof-checking of Consultants' Designs and Drawings for:
  - ⇨ Integrated Vaccines Complex (IVC)
  - ⇨ Jawaharlal Institute of PG Medical Education Research (JIPMER), Puducherry
- Design, basic engineering and detail engineering of Infrastructure Development works including site grading, roads, RCC Pavement, Storm Water Drainage, compound wall, fencing, etc.
- Design, basic engineering and detail engineering of Oily Waste Sewer (OWS) and Contaminated Rain Water Sewer (CRWS) system both in Process Units and Offsites including developing P&IDs, Datasheets, Layouts and General Arrangement Drawings

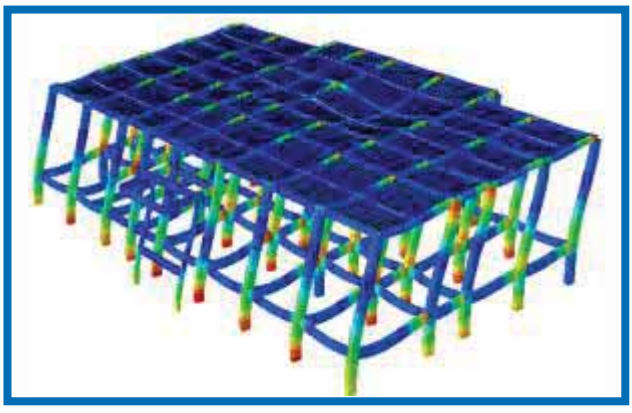


Fig. 9c: Pushover Analysis of a Control Room Building– For assessing the Seismic Vulnerability of structures

- Design, basic engineering and detail engineering of Sanitary Sewer System and Drinking Water System including creating P&IDs, Datasheets, Layouts and General Arrangement Drawings
- Design & Engineering of Tank Farms
- 3D Modelling of Underground Piping and RCC electrical trenches in Process Units and Offsites including developing Underground Piping GADs extracted from 3D Model
- Adequacy/structural health checking and subsequent repair, retrofitting, rehabilitation of existing distressed structures and foundations
- Re-qualification of existing structures as per revised statutory/codal requirements and strengthening/retrofitting, if required
- Revamping, expansion, extension, capacity enhancement, strengthening of existing structures in brown-field projects

Fig. 10: Cooling Tower

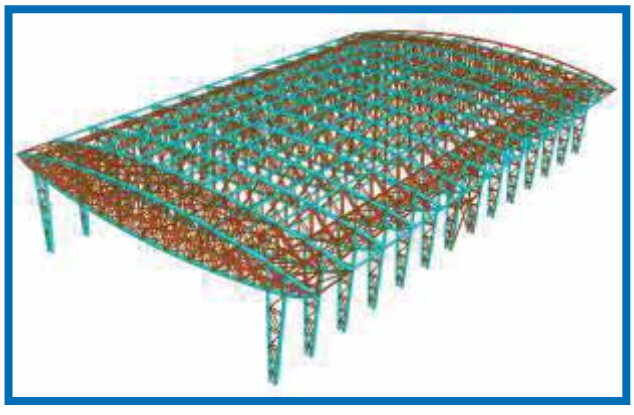


Fig. 11: 3D Perspective view of Stadium for Commonwealth Games 2010

- Trouble-shooting of various problems occurring during construction and operation
- Field-engineering support to construction team during site execution works

Advanced Structural Analysis

In-house expertise and experience in advanced analysis has been evolved for analysis of unconventional structures including:

- Development of Site-specific Seismic Spectra based on Probabilistic Seismic Hazard Analysis (PSHA)
- Seismic Margin Assessment and retrofitting of existing structures
- Development of seismic fragility curves of structures using Non-linear procedures (Pushover Analysis)
- Blast resilience assessment of existing structures
- Seismic analysis of buried pipelines
- Thermal stress analysis of critical structures (Outer containment of double wall storage tanks)
- Dynamic analysis of machine foundations
- Application of soil-structure interaction (e.g. Pile-soil, pipe-soil etc.) in various problems

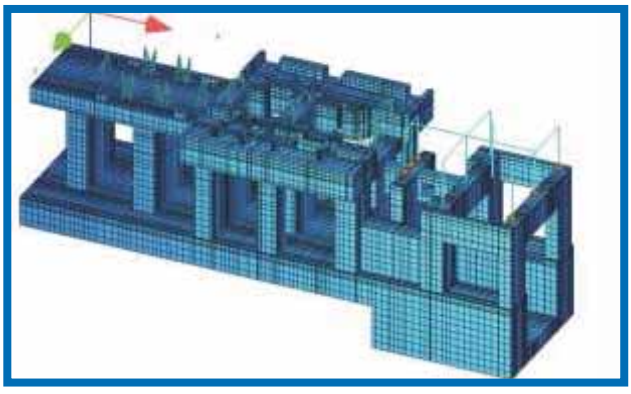


Fig. 12: Dynamic Analysis of Tabletop foundation – Assessing the behavior by subjecting to dynamic loading

Deliverables

The outputs of Civil-Structural Engineering Department include:

- Foundation Design Philosophy
- Specification for Geotechnical Investigation
- Specification for Piling works
- Geotechnical Data for Packages
- Pile Detail Drawings
- Ground Improvement Drawings
- Underground Piping Layouts
- Quantity Estimates & Bills of Materials (BOMs)
- Design Basis Reports
- Detailed Design Calculation Reports

Fig. 13: Pipe rack Structure

- 3D Modelling
- General Arrangement Drawings extracted from model
- Detailed Reinforcement Drawings
- Structural Steel General Arrangement Drawings extracted from model
- Structural Steel Connection Details (Welded and Bolted)
- Review of Fabrication Drawings
- Material Requisitions
- Site-specific Seismic Spectra
- Inputs for Feasibility Reports

Civil-Structural– Software & Resources

Commercially acquired, state-of-the-art softwares, which include 3D Modelling softwares, form the resource core of the department. The softwares being used presently are as follow:

- Plaxis 2D - for analysis of soil deformations and stability
- Geo 5 - for analysis of soil deformations and stability
- Allpile – for determining Pile capacity
- Pipenet – for Pipe Network Analysis
- Inroads – for Site Grading volume analysis and Optimisation of Site Grading quantities using contour drawings
- STAAD.Pro – for Structural Analysis and Design
- SAP 2000 – for Interactive Structural Analysis and Design
- ETABS – for Structural Modeling and Analysis and Design of Building Systems
- PDS – for 3D Modeling and Extraction of Drawings
- PDMS – for 3D Modeling and Extraction of Drawings
- TEKLA Structures – for Building Information Modeling and Steel Detailing
- RCDC – for RCC Detailing
- NISA – for Finite Element Analysis
- ANSYS – for Finite Element Analysis
- ABAQUS – for Finite Element Analysis
- AutoCAD – for 2D and 3D Computer-aided Design and Drafting
- Navisworks – for importing, combining and reviewing 3D model created in 3D Modeling softwares

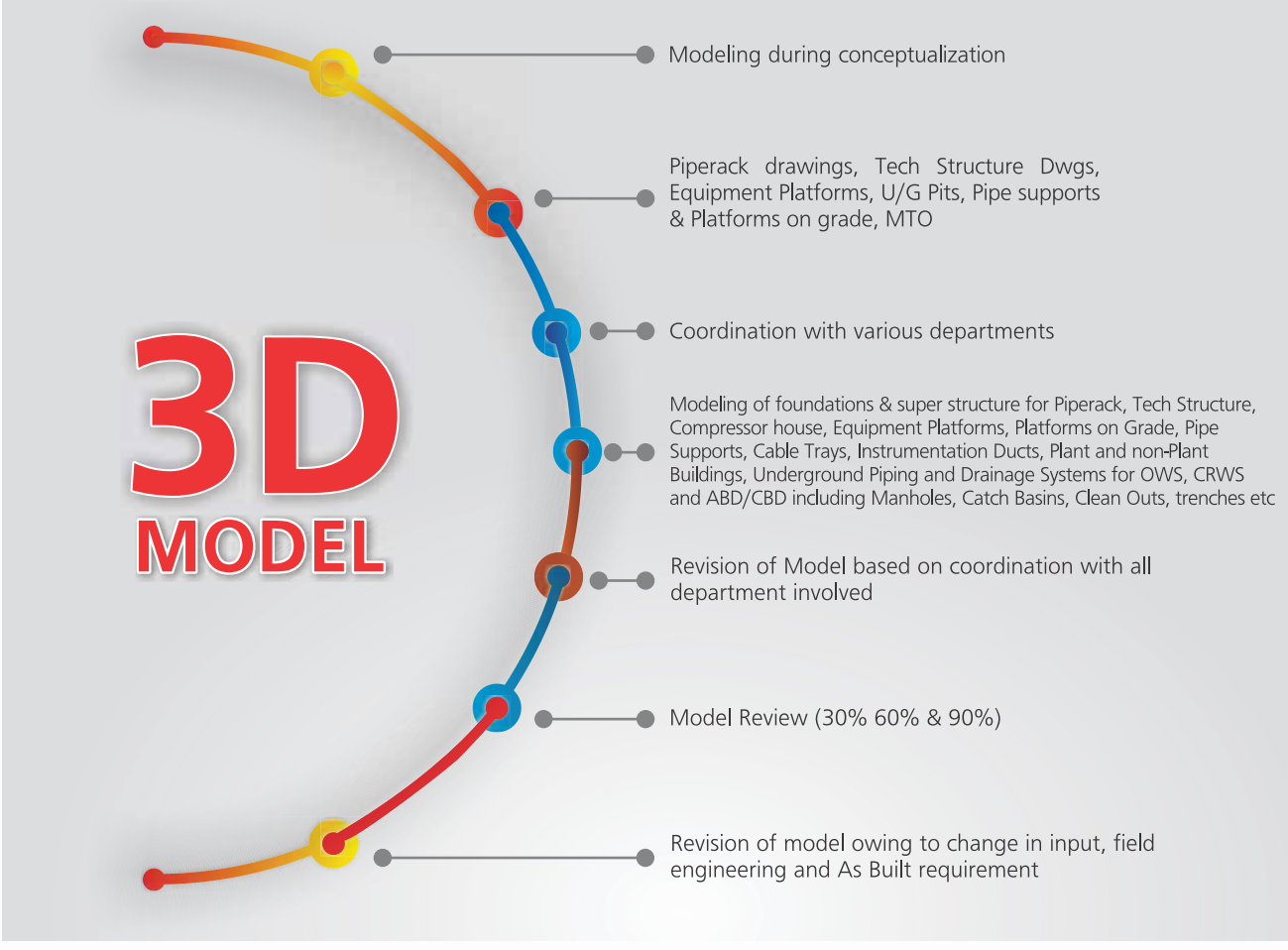


Fig. 14: Diagram depicting 3D Model Based Workflow in the organization

Other resources and facilities:

- Electronic Document Management System (eDMS), through which the entire engineering workflow of the company has been integrated
- AADHAAR: In-house experience of the past projects, which have been captured and digitally documented for easy and quick retrieval
- STANDARDS AND SPECIFICATIONS: Continuous development and updating of Specifications, Standards, Guides and Procedures to meet the organisation's Quality, Knowledge, Risk, HSE and Feedback Management Systems

Fig. 15: Flare Stack Support Structure

Major & Critical Structures Designed

Unique Civil-Structural Engineering designs carried out hitherto are:

- Reactor-Regenerator Structure supporting equipment weighing up to 8000 MT
- Review of Steel superstructure and design of RCC foundation of 145 m height demountable flare and associated auxiliary equipments
- The largest building designed 40 m wide x 55 m long x 60 m high having RCC twin towers connected with steel roof truss on the top and shear walls and the structure resting on pile foundation
- Analysis and Design for dynamic effect of cyclonic winds (64 m/s)
- Design of Foundations for assembly and tilting structures
- Construction stage analysis and design check for considering two independent towers
- Interconnected (T-shaped configuration) RCC framed halls of 20 m span each with RCC sloping beam-slab roof in 50 m wide x 100 m long x 30 m high building
- Effect of Masonry in-fill Panels considered in the Analysis
- RCC ducting for HVAC

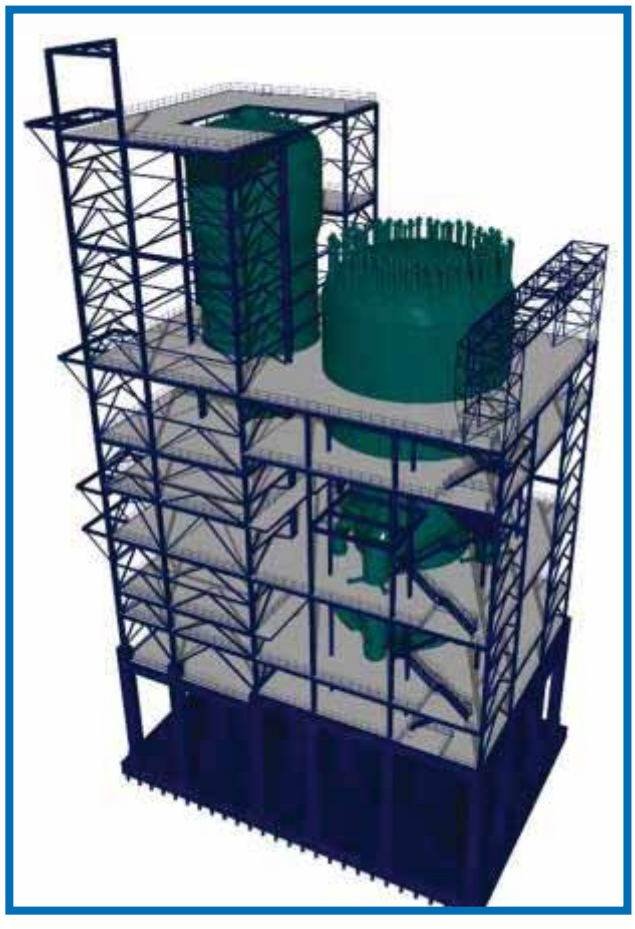


Fig. 16: Reactor-Regenerator (RR) Structure

- Design of foundations for horizontal sliding doors
- Blast resistant building designed for a maximum capacity of 5 psi
- Detailing of interfaces for drive mechanisms of folding-cum-vertically-repositionable platforms (FCVRPs 3 pairs), horizontal sliding doors (HSDs 47 m high in 4 pairs), elevators (2 nos.), maintenance cradle, etc.
- Design of MLP track (14 m wide twin-rail x 560 m long), axle turning systems (3 nos.) & anchor blocks (2 nos.) for 2,000 MT capacity
- 3 stage (preliminary, intermediate and final) technical review (face to face) of design calculations and construction drawings by system design review team (SDRT) constituted by the Owner comprising eminent professors from IITs and IISc
- Largest Building = 1,140 m long (Pot Room)
- Widest Building = 125 m wide (Cast House)
- Tallest Building = 36 m high (ABF)
- Design of Gantry Girder for 400 MT EOT Crane

Fig. 17: Demountable Flare

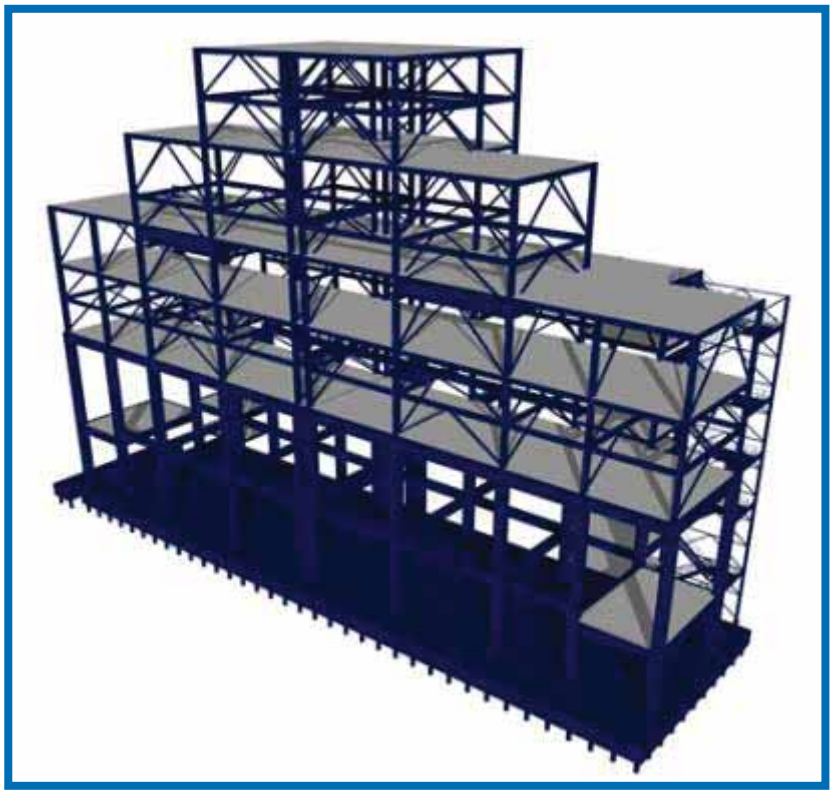


Fig. 18: Tertiary Separator Structure

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Delivering Excellence through People

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