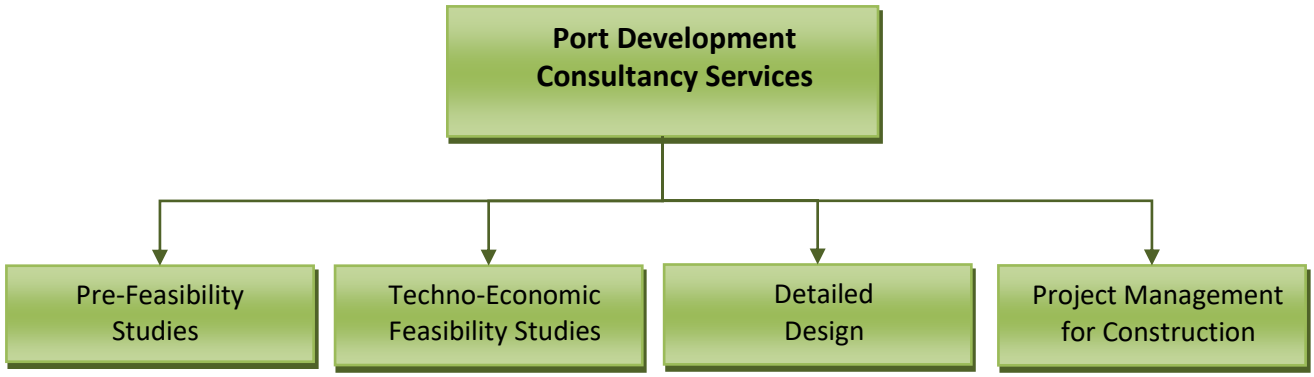
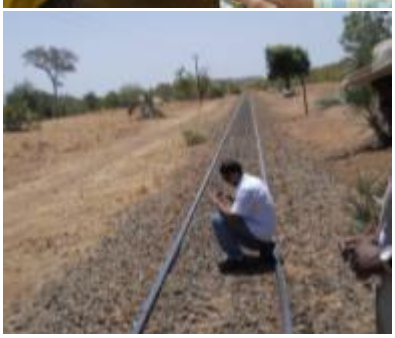
COASTAL ENGINEERING & LOGISTICS STUDIES



Zebec has vast in-house experience in master-planning of ports and logistics for mining projects. Our team of port planners, coastal engineers, structural engineers, material handling system designers and finacial analysts, are able to deliver innovative solutions that exceed our clients' objectives and aspirations.

We have successfully played the part of a logistics consultant in mining logistics projects in various countries such as Indonesia, Australia, Madagascar, Mali, Senegal, Mauritania, Liberia, Guinea, Guinea Bissau, Mozambique etc. The principal commodities we have worked with include coal, iron ore, bauxites, aggregates, rock armour to name a few.



Our Services includes:

- Planning of road and rail alignment and construction methodology
- Planning of barge operations on rivers, including selecting optimum sizes of barges, channel alignment, barge loading and unloading ports, lock navigation, and planning of a shipyard for assembly and maintenance of barges
- Planning and design of seaports based on the annual export volumes and size of vessels to be loaded (Ports upto 119 mmtpa has been planned)
- Conducting meetings with local government and private operators on behalf of the client
- Technical feasibility studies
- Financial viability assessment of the various modes of transport

Cargo logistics

We provide the client with a robust logistics strategy which offers the lowest cost per ton of cargo moved including:

- Understanding local regulations and government incentives
- De-bottlenecking of existing infrastructure
- Locating bulk storage yards to ensure operations with least disruptions
- Cost/benefit of various transport modes
- Simulation of operations

Ports and Harbours

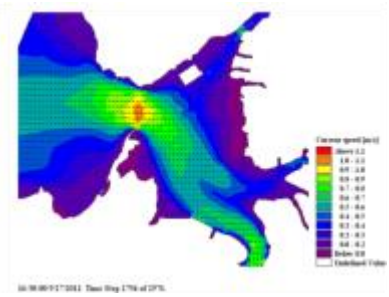
Zebec provides overall planning for port expansions and new port development from general cargo ports to container ports, fishing ports, dry and liquid bulk cargo terminals, cruise terminals, marinas, Ro-Ro and ferry ports.

- Techno-economic feasibility studies (TEFS) & Detailed project reports (DPR)
- Master planning and optimization of port layouts
- Selection of equipment for handling and storage of cargo
- Optimization of berth and equipment use
- Design of civil structure including berths, jetties, warehouses & stackyards
- Design & alignment of breakwaters
- Dredging, dredge disposal and reclamation studies
- Harbour wave studies
- Prediction of sedimentation in harbours and approach channels
- Optimization of dredged channel depths, width and layout
- Coastal impact of dredging and new coastal structures
- Design of cooling water intake and outfalls for power plants
- Design of specialized vessels for cost-effective transhipment operations
- Ship motion analysis & manoeuvring simulations
- Vessel mooring studies and multi-body interaction studies
- Planning and co-ordination of site surveys – Geo technical, bathymetric, topography, tidal, current, wave sediment
- Preparation of standard operating procedures based on level of automation and manning
- HR strategies and organization structure planning
- Project management of development works
- Port safety and security planning
- Business potential and market demand studies
- Preparation of a business plan and marketing strategy
- Financial analysis based on optional tariff structures and traffic volumes
- Risk analysis and management
- Advisory services in bidding for tenders
- Due diligence for investment in marine assets

Coastal Engineering & Numerical Modeling

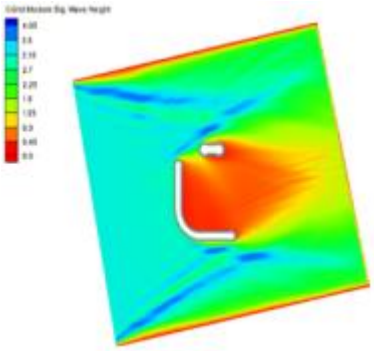
The services offered by Zebec in hydraulic numerical modeling can be broadly classified into the following sub sections:

- Hydrodynamics studies
- Sediment transport studies
- Wave transformation studies
- Wave disturbance studies
- Dredging and dispersion studies
- Oil spill studies



Hydrodynamic modeling

These studies are used to estimate currents, surface elevations due to tides, river flows and storm surges. This information is used as one of the inputs in the design of port structures. The currents and surface elevations obtained from these studies are essential inputs for assessment of sedimentation, dispersion during dredging & dumping.



Sediment transport

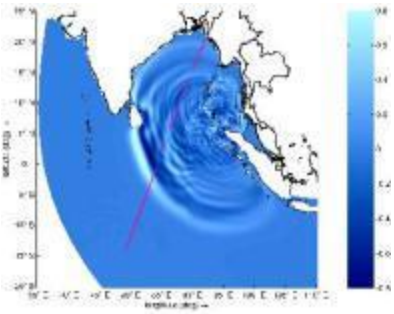
This is useful to estimate the backfilling of dredged channels, morphological changes in sea, river & estuarine environments.

Wave transformation

This involves the transformation of waves from offshore to the near-shore areas. This near shore wave data is a necessary input for design of coastal structures and estimation of downtime for transhipment operations.

Wave disturbance studies

This is useful in estimating the disturbance due to short waves in the port basin. It helps in understanding the total operational days of the port.



Dredging and disposal studies

Dredging studies are used to estimate the extent of spreading of the bed material which is brought into suspension during dredging operations.

Tsunami Simulation

Can be used to assess the water displacement at the fault site, and wave propagation from origin

Oil spill studies

These studies are carried out to simulate the oil slick mobility, amount of oil left on the water surface, evaporation and evolution of the oil properties in ambient environmental conditions. Mitigation measures and response in an emergency can be planned.

Simulation of Logistics

Simulation tools are capable of providing realistic and accurate inputs to decision variable and subsequent performance parameters in the system e.g. coal movement from pit to port, material flows in shipyards, etc. The purpose of simulation is to identify the bottlenecks in the logistics flow, gauge critical determinants, study their effects on the system and make them tailor-made to the best feasible extent. Simulation provides insights into behavior of the system as a whole when responding to stimuli. The software used is ExtendSim.

Capacity planning

Logistics system models are developed to simulate a new proposed system or to modify the existing one. Capacity of system components is a critical factor e.g. crane capacity, crusher throughput, barge size and carrying capacity etc.

Scheduling

A system-specific scheduling is aimed at synchronizing the system components in order to achieve the set objectives e.g. throughput per year, reasonable waiting time for vessels, availability of barges/rakes etc.

Financial modeling

The results of the simulation model are inputs for the financial model for the given system. Each change in each of the decision variables will translate into the cost; thus enabling to find the most feasible set of system variables.

Simulation

Logistics consultants with years of experience will drive the simulation models. The starting point of simulation is process flow diagram that enlists all the system parameters to model. After the client approves the process flow, a simulation model is developed. This model is optimized to get the most feasible system combination.