3. STATION DESIGN

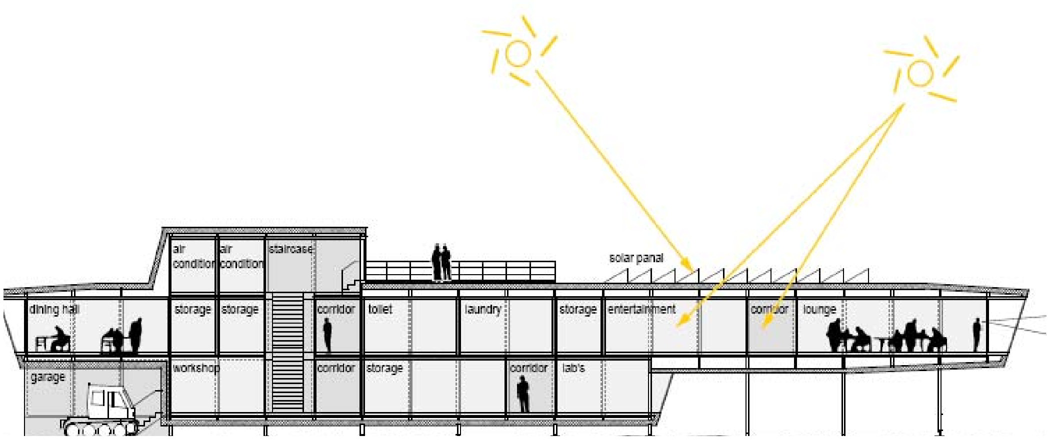
3.1 Station Description

The Station design has been drawn based upon logistic needs, operational demands, trouble free supply and maintenance of life supporting systems. Design and placement of the module is conceptualized to keep minimum movement of men and material in and around station, to reduce the footprint on the area.

An expert committee comprising specialists from School of Planning and Architecture, New Delhi, Central Building Research Institute, Roorkee, Structural Engineering Research Centre, Chennai, Mormugao Port Trust, Goa and a Civil Engineer with experience of building construction in Antarctica, selected the design offered by M/s IMS Ingenieurgesellschhaft mbH. This German company, selected out of the four short listed firm, was involved in general planning for the new German Antarctic research station Newmayer III at Ekstron iceshelf, west of Atka Bay. The recommended conceptual design (Figure 8) is environmental friendly and commensurate with the environmental Protocol vis a vis objectives and requirements of the base.

Figure 8 : Artist's Impression of Building

Perspective View



Sectional Elevation

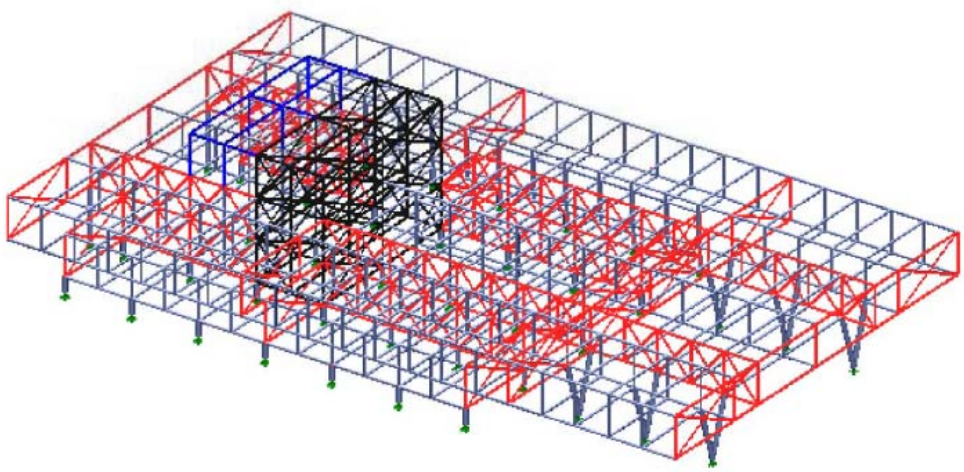
3.2 Structural Design

3.2.1 Base Foundation and Stability

The structure conceptualizes placing containers on a platform and uses their load carrying capacity and stability for load transfer. The containers will be fitted by standard fixing elements (stacking cones and bridge fittings), friction-locked together and will build a 3D-sheet type bearing system. The foundation platform shall be designed as an elevated girder grid construction which will be supported on columns (Figure 9).

The columns will be designed as vertical adjustable spindles. For the absorption of vibrations and the compensation of deformations it is envisaged to place the columns on elastomere bearings. The foundation of the building is designed to suit firm rock base. Considering the high wind loads on the building and the low dead weight of the structure, additional anchors will be arranged under the footings to avoid lifting off, of the columns from the ground.

Figure 9: Base, and Structure of the Building



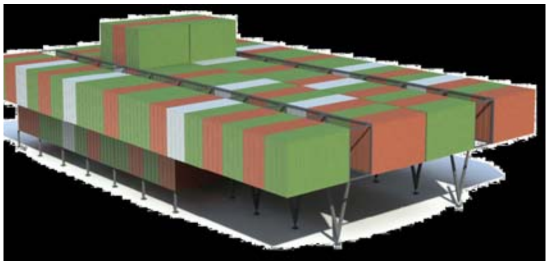
All steel members will be protected against corrosion by robust galvanizing. Since the columns will be exposed to snowdrift and thus to stronger abrasion, an additional coating will be applied on these higher strained members.

The structural elements of the platform will be prefabricated and assembled on site by friction grip screws. Welding on site is not planned. The elements of the platform structure will be fabricated from rolled steel sections of ordinary structural steel. Only for the elements exposed to higher loads and extreme weather conditions like the columns, steel with high viscosity at low temperature (ML- or NL-type) will be used.

3.2.2 Outer Shell

An additional exterior jacket (outer hull) will be erected around the containers. It will protect the internal space from wind, precipitation and irradiation. This exterior jacket forms the visible corpus of the station. The facade system is constructed of sandwich elements comprising a PUR-core between steel sheet covers. The panels will be of a special construction that combines the standards for cold stores and for façade systems (Figure 10). From the cold stores a special locking system for the splices will be used, so that they cannot loosen because of wind-inducted vibrations.

Figure 10 : Inner Base of Container and Outer Shell



Inner Base of Containers

Outer Shell

By providing a PUR-core, the elements will have a high shear resistance to withstand the wind forces, good temperature performance to withstand lower temperature upto -45^{0}C and to eliminate vibrations, which are higher than that of elements with a mineral-wool core. Due to corrosion protection provided by Al-Zn, the covering steel sheets will give a longer lifetime and a higher irradiation resistance than other materials, e. g. plastics and coatings. All the joints will be sealed against wind and snow by special gaskets and lockings.

3.2.3 Aerodynamic Stability

Since the site of the station represents a region of katabatic winds, following design criteria have been given due consideration:

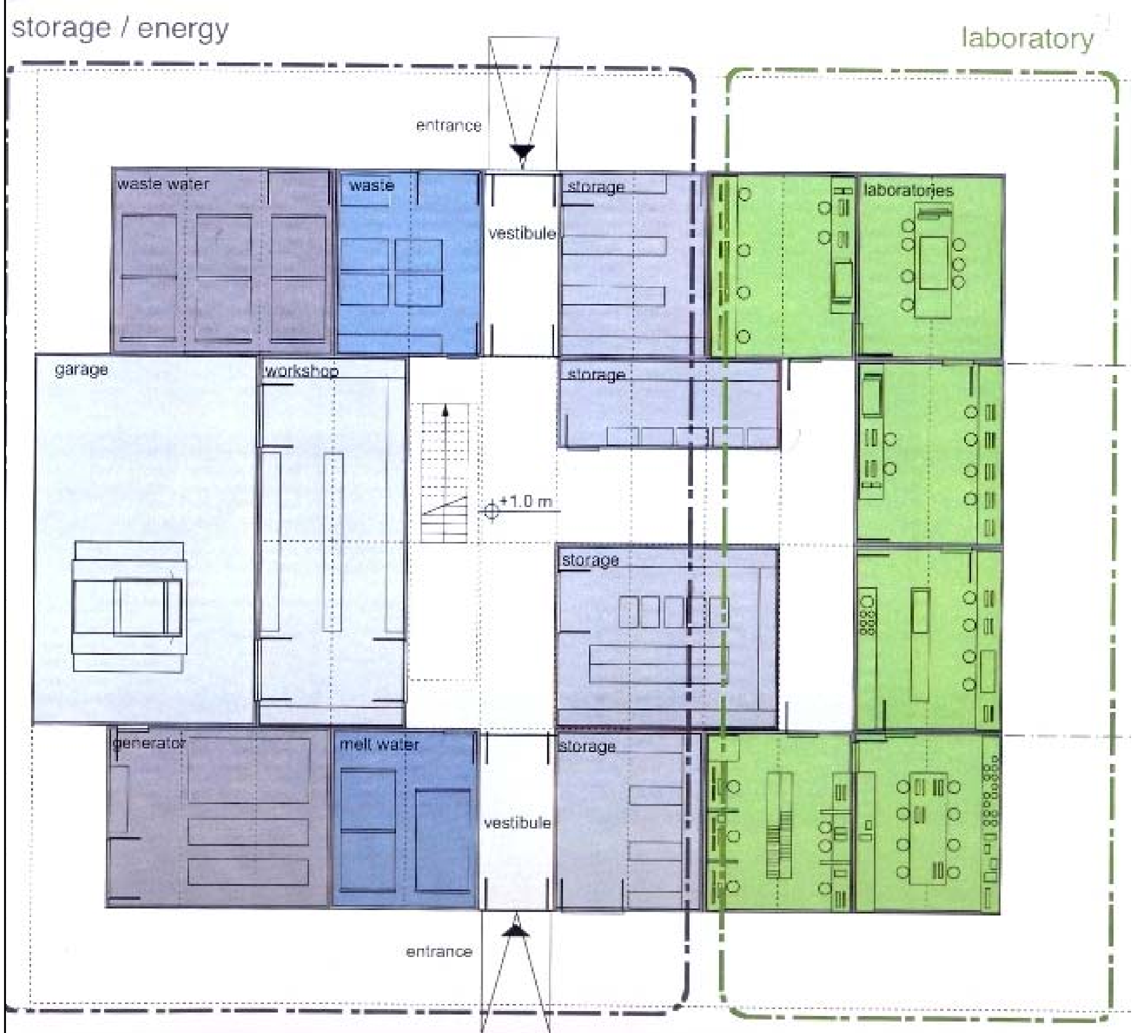
- Providing free passage for wind to pass above and under the structure
- Positioning the station in such a way so that winds pass the structure perpendicularly

The wind tunnel tests would be performed on the model of the station at Structural Engineering Research Centre (SERC), a reputed national laboratory under the Council and Scientific and Industrial Research (CSIR), by providing vital statistics on wind flow and wind pressure measurements.

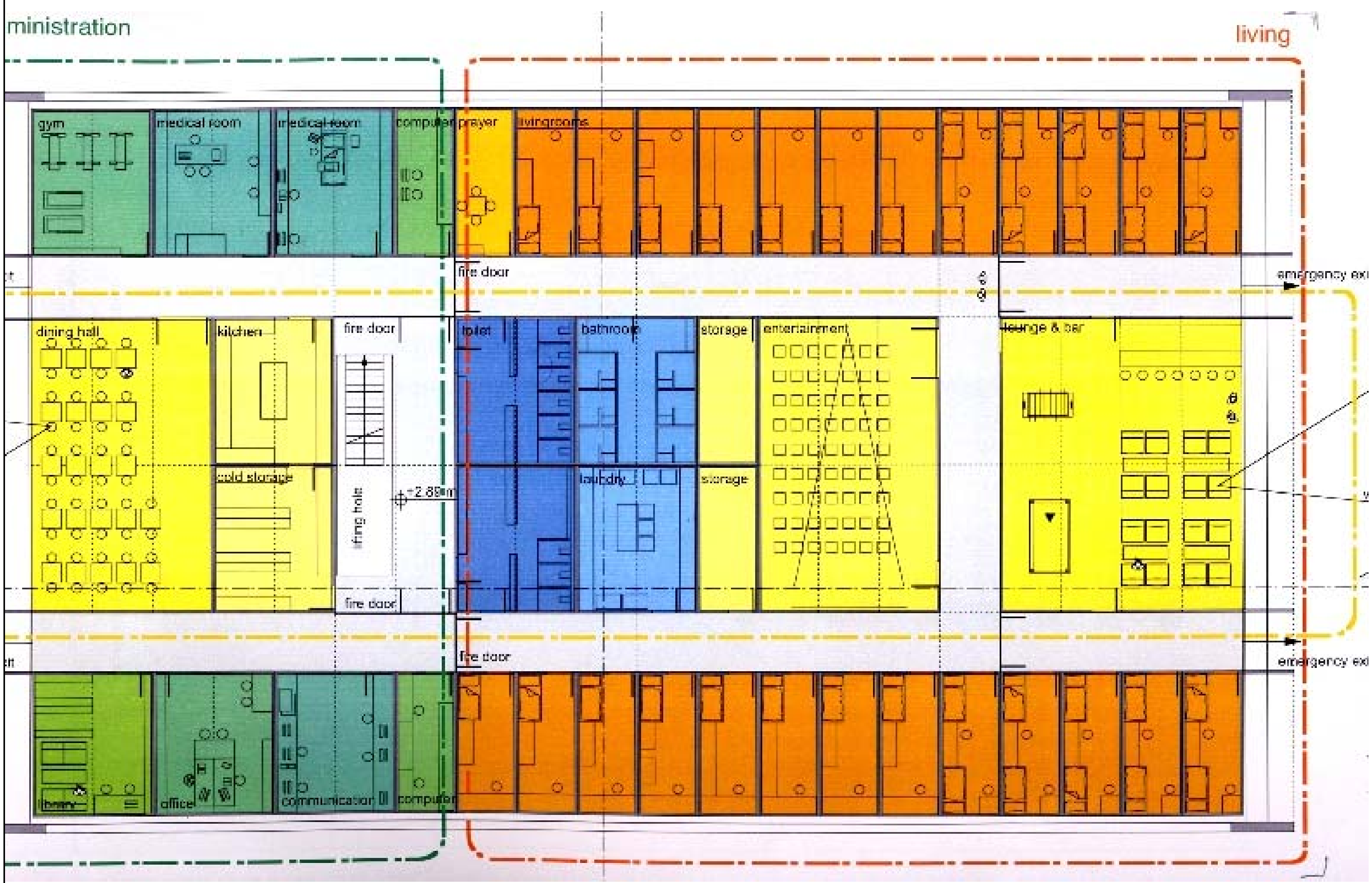
3.3 Room System

The rooms of the research station are designed to be built up in modular construction using standard containers (20’ long, 8’ wide and 9.5’ high). The advantage of this system is the ease of transport by truck or ship in India as also in Antarctica. The inner walls of the rooms shall be lined with plasterboards and will create a comfortable indoor environment. The inner layer would consist of mineral-wool for fire protection, thermal insulation and sound absorption The floors of the rooms will be built up with a mineral-wool filling and floor panels. Between the outer shell and the walls of the containers, a cavity will be arranged to prevent condensation effects. The windows in the outer shell are also included in the inner walls and will have provision for inner darkening by using roller shutter. For safety of the inmates, the outer windows will be fitted in locked version (Figure 11).

Figure 11 : Facility Distribution in Ground and Upper Floor



Plan of Ground Floor



Plan of Upper Floor

3.3.1 Fire Protection

Besides the technical fire protection like smoke detectors and alarm systems, the building design also considers the protection against fire. Each room will be a solitary fire compartment and rated at F30 (Fire resistance for 30 minutes). Rooms with higher fire loads or fire danger are rated F90. For the fire protection, groups of rooms will be separated by fire walls into fire areas. Emergency stairs shall be provided into safe areas for emergency evacuation and the escape routes will be marked. Safety lights and a smoke removal system will be provided. All materials of the stations will be fire proof or at least flame resistant.

3.3.2 Energy supply

The station shall be supplied with power (electrical energy) and heat (thermal energy) by CHP units (combined heat and power) only. CHP units will be designed to perform for the complete range from minimum to maximum energy demand. Low noise diesel engines, low voltage switch gear, heat distribution panel, hot water generation, one day dies automatic fire extinguishing system will be installed in one plant room. Contact established with national and international players for supplementing the energy requirements by alternate sources like wind and solar energy.

3.3.3 Heat Ventilation and Air Conditioning

Heating of the station shall be provided by thermal radiators (the utilization of waste heat allows to reduce the number of CHP units to two). In comparison with oil based radiator, this will help saving of diesel fuel and therefore the emissions to air. This will also reduce the impact on environment. In order to minimize heat loss, the heat piping will be installed inside the container casing.

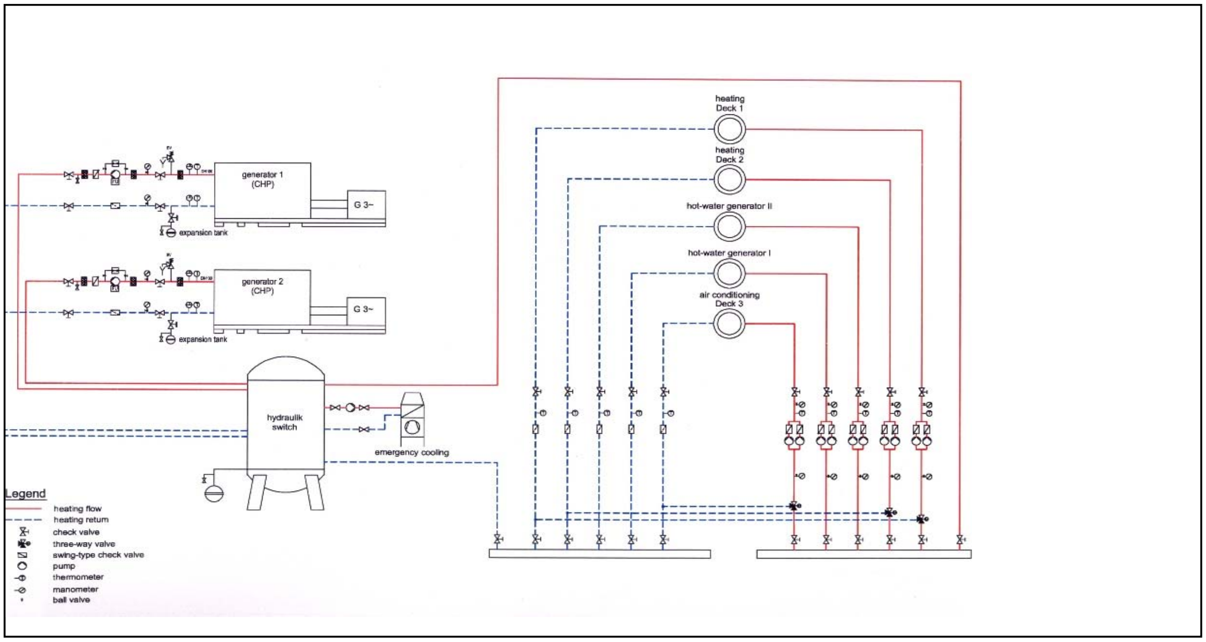
Conditioned air to the station will be supplied according to minimum rate of fresh air supply and heating of the station will be with thermal radiators. The operational expenses will be therefore minimized. Airflow regulators will allow optimum adaptation of air flow to the areas of demand. The two-stage heat recovery system will enable at stage two, the reutilization of humidity from the discharged air; hence operational expenses of the air conditioning system are very efficiently minimized. The “intelligent” integration of heat recovery system will allow reutilizing the heat of the discharged air optimally (Figure 12). Assembly of the ventilation & air conditioning plant room shall be on top of station (Deck 3). Sound attenuation will be applied not to produce noise to disturb the occupants and surroundings. Provision will be made to control ventilation from room and zones whenever required.

3.3.4 Water Supply and Wastewater Management

Water quality shall be improved by two stage filtration when it shall be sourced from lake. Fresh water demand will be reduced by reutilization of treated shower effluent. Corrosion proof material shall be used for complete water supply system.

Treatment of the shower effluent in the specific reactor will be used as water for toilets subsequently; hence water demand will be minimized by reutilization. Potable water demand will be supplemented by treated seawater. The design of the waste water system with biological clarification plant will be selected to maintain the desired effluent standards. Sanitary installations will be selected according to demand and use. Installation of wastewater piping inside the thermal insulation casing will be frost proof.

Figure 12 : Proposed HVAC System



3.3.5 Lighting

Lighting fixtures will be equipped with energy saving technology. Incandescent lamps with "warm" light temperature will be installed in comfort zones. At other places compact fluorescent light or fluorescent light with electronic ballast shall be fixed (Figure 13). All lamps shall be installed as per requirement of light and temperature in the rooms. Living and common rooms will be fitted with "warm white" light (3,000 K); offices, laboratories and technical rooms with "neutral white" light (4,000 K). Areas with a brightness of 2,000 Lx or more can be equipped with "bio lamps" (6,500 K); these provide light which is largely same as natural sunlight. A light calculation will be executed for each area in order to provide optimum adequacy in illumination. For the selection of lighting fixtures, glareless and easy handling lamps will be considered. The lighting installation will provide possibility to adapt the illumination depending upon seasons.

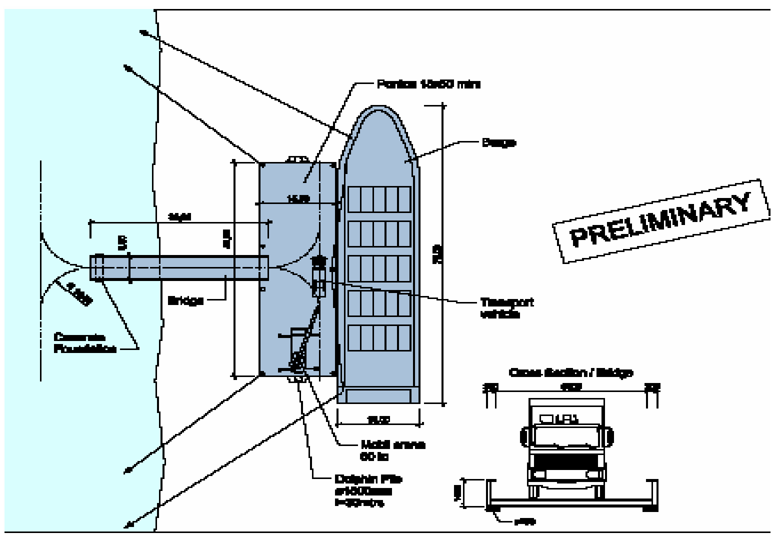
Figure 13 : Artist's Impression of Lighting Arrangement in Rooms

Laboratory *Living Room*

3.4 Shipping and Transportation

The MI-8 helicopters or better alternatives that have carrying capacity of 4000 kg or more will be used to shift the containers from ship to the site. The container modules may or may not be fully equipped, depending upon the load carrying capacity of the helicopter. Equipping of modules will be effected in India, so that required changes if any can be made before loading these on the ship. Supply of material to station from a boat landing may also be considered. A vehicle access road shall be constructed from landing site to station. The pontoon of the boat landing shall be fixed at two dolphin–piles (Figure 14). The access between land and pontoon will be made by a movable bridge to compensate the tidal range. For unloading from the barges, mobile cranes may be used.

Figure 14 : Artist's Impression of Landing Site



3.5 Emission abatement in Station Design

Station design is prepared meeting the provisions of Environmental Protocol. Prefabrication of the material will reduce the activity during transportation and at the construction site and ultimately the noise and air emissions shall be reduced. Optimization of the cable and piping length will reduce raw material utilization, maintenance requirement and more manpower. Use of eco-friendly material with high insulation will have control over heat loss from the building so it will save extra energy requirement. Introduction of CHP will help to reduce the fossil fuel requirement for station heating.

Water conservation in terms of optimization and reutilization will reduce the water requirement and thus energy demand required to collect, transport and treat the water and wastewater. This shall be achieved by using optimized spray shower, waterless urinals and recycling of gray water after treatment for flushing into toilet

Energy system is designed to implement electrical energy produced from solar and wind power thus having less dependency upon fossil fuel based generators. At all the places according to light calculation, CFL will replace incandescent lamps thus minimizing electrical requirement and giving better illumination.

3.6 Decommissioning

The decommissioning of the building can be executed similar to the erection by unlocking the fixing elements and lifting off the containers. For the decommissioning and removal of the boat landing only the dolphin piles shall be needed to be removed. Provisions are made in design not to produce waste material at site. All the building modules can completely be removed and transported back to India after decommissioning.

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