



Design principles for dry bulk marine terminals

Terms of Reference

1- Definition of the problem

No current guidelines exist for the planning and design of specialist marine terminals for the import and export of bulk solids such as coal, iron ore, grain, aggregates etc.

Existing guidelines are dated and technology, vessels and bulk handling equipment have all progressed rapidly in recent years. In addition specialist bulk handling terminals often present severe environmental challenges giving rise to potential noise dust and other environmental hazards.

PIANC has produced overall guidelines on Port Planning (WG 158) and a series of guidelines on specialist terminals including oil terminals (WG 153) and small and medium container terminals (WG 135), and has others in production including RoRo and RoPax Terminals (WG167) and LNG terminals (WG172).

Guidelines for Dry Bulk Terminals will aim to form part of this set of design guidelines for ports and marine terminals

2- Objective of the working group

Dry bulk cargoes are characterised as cargoes which are loaded or discharged in a loose, unpackaged form usually in a continuous process and normally shipped in full shiploads using specialist bulk carriers. In 2010 approximately 3.2 billion tonnes of bulk solid cargo was transported by sea, comprising over one third of all international seaborne trade.

The five major bulk solid cargoes handled worldwide are:

Tonnage (Mtpa in 2010)

Iron ore	984
Coal	904
Grain	343
Bauxite	64
Phosphate	23

Many other products such as processed mineral ores e.g. copper concentrate, sulphur, cement, fertilisers, sands and aggregates, wood chips etc. are also shipped and handled in bulk form using a variety of specialised equipment.

The new Working Group for bulk solids handling terminals will need to address the site selection, planning and design of the specialist terminals required for the reception and delivery of these products.

3- PIANC reports and other works to be reviewed

1978 UNCTAD – Port development: a handbook for planning in developing countries

1985 Frankel (World Bank) – Bulk Shipping and Terminal Logistics

1995 PIANC Report of PTCII WG No. 24 Criteria for Movements of Moored Ships in Harbours – A practical Guide
2001 IAPH – Guidelines for planning and design

2002 PIANC Marcom Report WG 33 Guidelines for the Design of Fender Systems
2005 Agerschou and al – Planning and design for of ports and marine terminals

2014 Thoresen – Port designer's handbook

2014 PIANC Report No. 158 – Masterplans for the development of existing ports.

4-Matters to be investigated

There are a number of significant differences between a conventional commercial cargo terminal and a specialised bulk cargo terminal including:

- **Location** – specialist bulk export terminals are normally located as close as possible to the production source or mining area providing the material for export, while import terminals are located close to the centre of processing or utilisation of the cargo. Typically there is no requirement for bulk terminals to be located close to main centres of commercial or industrial activities, although bulk terminals can form part of a conventional commercial port complex.
- **Vessel Handling and Mooring** – many bulk terminals handle some of the largest vessels in the world in a range of conditions including open sea terminals. This introduces unique issues with respect to the size and number of tugs required, mooring of vessels, motions of vessels at the berth which can be larger than almost any other types of vessels.
- **Water depths** – bulk carriers are generally large deep draught vessels requiring marine access channels and water depths greater than those required for most commercial vessels. Often laden bulk carriers will be tidally restricted, i.e. they can only approach/leave the berth over a high tide window.
- **Cargo Hazard Management** – Apart from environmental and health hazards, there are issues such as self combustible cargoes, cargo liquefaction, pest control for grain cargoes, etc, which are particular to dry bulk terminals. Some guidelines in this area would be useful to point out the risks and provide appropriate references to good practice.
- **Handling equipment** – most bulk carriers require rapid high capacity mechanised loading or unloading equipment in the terminal. This may include bulk stackers/reclaimers in the storage yards, belt conveyor systems to/from the berths and specialist shiploaders and unloaders on the quayside.
- **Storage facilities** – significant open storage areas or specialist covered storage or silos are required at the terminal. Requirements will vary for product type, location and climate. Consideration should be given to the large loads arising from stockpiling material and settlement of the yard storage areas
- **Stockyard handling of ores** – There are multiple methods for stacking and reclaiming of dry bulk products from very simple operations to fully enclosed fully automated systems. The needs vary with the product properties and some methods are unsafe or at least ineffective for some products. Guidance on methods appropriate for different products should be included.
- **Single user** - Many terminals are dedicated single-user facilities generally handling only a single commodity although there may be several different grades, e.g. in the case of iron ore - fines, lump ore and pellets.
- **Trans-shipment** – Because of the draft of large bulk and ore carriers direct loading and unloading at ports are not always viable. There is an increasing trend and significant technical developments in the area of trans-shipment for bulk cargoes for both export and import operations. Trans-shipment can be a complex and, if not done well, an

expensive operation, but it is also in many cases the only practical solution. The needs of transshipment operations and trans-shipment port infrastructure require special attention to all aspects of the operation including guidance on suitable equipment, transfer barges, sea states, safety considerations and risks.

- **Environmental considerations** – Environmental impact of dry bulk handling (dust, noise, risk of contamination,...) is often a relevant factor in planning and design of dry bulk terminals.

The WG will need to address all of these issues and make recommendations, using examples from existing terminals where possible.

5- Method of approach

The WG should aim to encompass actual terminal operators and mechanical handling specialists as well as marine design consultants. Meetings of the WG should aim to be held where visits can be made to existing terminals to gain first-hand experience of the issues involved in the planning, design and operation of such terminals.

6-Suggested final product of the working group

The final product should be in the same format as recent WG reports (e.g. WG 135 and WG 158)) and available for electronic download. The number of pages is not limited by printing costs, but the main report should be concise (e.g. <100 pages) with supporting material and examples in appendices. Use should be made of good quality exhibits (diagrams and illustrations) and photos of existing projects

It should give practical guidance and views on site selection, planning and design as well as containing examples of terminals already in existence or being planned. Whenever applicable the Working with Nature principle should be considered.

7- Desirable background or experience of the working group members

The members of the Working Group should include:

- a) technical departments of specialist terminals(from both developed countries and countries in transition)
- b) Specialist marine terminal consultants
- c) Mechanical handling specialists/consultants
- d) Equipment suppliers
- e) Sister Associations members: IAPH, IMPA and IHMA
- f) Other organizations as UNCTAD or ICHCA (International Cargo Handling Coordination Association)

8- Relevance for countries in transition

Many of the bulk terminals are located in countries in transition. Clear guidance on site selection, planning, design and environmental issues is needed to ensure appropriate development of such terminals.

9- Climate Change

As with all PIANC WGs, impacts of climate change should be considered.