GENERAL GUIDELINES FOR BRIDGE CONSTRUCTION FOR THE SAFETY OF NAVIGATION OF VESSELS IN MALAYSIA

Division	**Navigation Safety and Maritime Communication**
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ABBREVIATION	
IHO	International Hydrographic Organization
USCG	United States Coast Guard
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
PIANC	Permanent International Association Of Navigation Congressess (World Association For Waterborne Transport Infrastructure.
ATON	Aid To Navigation
NAVAID	Navigational Aid
HAT	Highest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring.
MLWN	Mean Low Water Neap
MSL	Mean Sea Level

1.0 INTRODUCTION

In general, vessel(s) may encounter a situation whereby their air draught is insufficient to clear obstruction in their way, such as bridges. This situation can result in accidents, loss of life, and damage to property.

The consequences of failing to comply with the air draught and to properly calculate a vessel's vertical clearance under bridges and other obstructions, such as power lines, passage could be disastrous.

In order to ensure vessel(s) can safely pass under the bridge(s), the height of the bridge need to be properly calculated and determined to provide sufficient vertical clearance.

2.0 Purpose

These guidelines are intended to provide reference before a bridge construction project is implemented by taking into account the safe and practical navigation routes in estuaries or rivers as well as the maritime industry in the area.

Following these guidelines, before a bridge construction project is implemented, it will be possible to make informed decision about how to construct a safe and practical navigational route in an estuary or river while also considering the maritime industry in the surrounding area.

3.0 REFERENCE TO HYDROGRAPHIC STANDARDS AND NAVIGATIONAL AND GUIDELINES

Standard and guidelines for bridge relating to safe navigational clearance in Malaysian waters to International Standards and National Standards.

3.1 International References

3.1.1 IHO Publication S-4 (Formally M-4), B 380 Bridge and Overhead Obstructions: Clearances, B-380.
3.1.2 USCG Bridge Program Reasonable Needs of Navigation White Paper
3.1.3 IALA Recommendation O-113, on the Marking of Fixed Bridges and Other Structures over Navigable Waters.
3.1.4 NP 100 The Mariners Hand Book.
3.1.5 PIANC Guidelines
InCom WG 19: Ship Collisions due to the Presence of Bridges (2001)

3.2 National References

3.2.1 Merchant Shipping Ordinance, 1952.
3.2.2 Merchant Shipping Ordinance Sarawak, 1960.
3.2.3 Merchant Shipping Ordinance Sabah, 1960.
3.2.4 The Sarawak River Ordinance, 1993 – Lembaga Sungai Sarawak.
3.2.5 Ports and Habours Enactment, 2002 – Jabatan Pelabuhan dan Dermaga Sabah.
3.2.6 Penang Port (Navigation Within The Area of the Bridge) Rules 1986
3.2.7 NPM 5/2014 - Pemakluman Kepada Pengarah Laut Berhubung Sebarang Aktiviti Melibatkan Kapal Dalam Perairan Malaysia, Jabatan Laut Malaysia.
3.2.8 NPM 2/2019 - Keperluan Pelaksanaan Kajian Dan Penilaian Analisa Risiko Marin Bagi Aktiviti Melibatkan Kapal Di Dalam Perairan Malaysia, Jabatan Laut Malaysia
3.2.9 Tatacara Permohonan Aktiviti Marin, Analisa Risiko Marin dan Kebenaran Operasi, Jabatan Laut Malaysia.
3.2.10 Malaysia Tide Tables by National Hydrographic Centre, Royal Malaysian Navy.
3.2.11 Guidelines for Hydrographic Survey Specifications by National Hydrographic Centre, Royal Malaysian Navy.

4.0 DEFINITIONS AND TERMINOLOGIES

4.1 Air Draught

Air draught is a term used to describe the distance from the top of The vessel's highest point to its waterline.

4.2 Aids to Navigation

An Aids to Navigation (also known as Navigational Aid, ATON or NAVAID) is any sort of marker which aids the mariners in navigation. Common types of such aids include lighthouses, buoys, fog signals, light beacons and day beacons.

4.3 Chart Datum (CD)

Chart Datum is the plane of reference to which all charted depths and drying heights are related. In tidal areas CD is chosen to show the least depth of water found in any place under 'normal' meteorological conditions. CD will vary from place to place in relation to the land survey datum or mean sea level.

4.4 Charted Depth

It is a vertical distance measured from the Chart Datum to the bottom of the sea bed.

4.5 Charted Elevation

The vertical distance of a point or a LEVEL, on or affixed to the surface of the earth, measured from Mean High Water Spring.

4.6 Charted Vertical Clearance

It is a vertical bridge clearance on charts that are referenced to the Highest Astronomical Tide (HAT) in tidal areas.

4.7 Drying Height

Height above chart datum/sounding datum, of any areas which are dry at low water.

4.8 Height of Tide

The vertical distance measured from the Chart Datum to the level of the water at any time.

4.9 Observed Depth

The vertical distance measured from sea bottom to the sea surface at any time.

4.10 Under Bridge Clearance

It is a vertical clearance excess of the air draught which allows a vessel to pass safely under a bridge or obstacle.

4.11 Highest Astronomical Tide (HAT)

Highest Astronomical Tide. The highest level which can be predicted to occur under average meteorological conditions and under any combinations of astronomical conditions; it will not be reached every year and are not the extreme level which can be reached. Storm surges may cause considerably higher level to occur.

4.12 Lowest Astronomical Tide (LAT)

Lowest astronomical tide (LAT) is defined as the lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions. Many national charting agencies, including the United Kingdom Hydrographic Office and the Australian Hydrographic Service, use the LAT to define chart datums.

4.13 Height

Means the maximum height of a vessels structure and shall include any Protrusion above the waterline.

4.14 Horizontal Clearance

Horizontal clearance is the distance measured between columns of the bridge in navigable waters that allows a vessel to pass through safely under a bridge.

4.15 MHWN

Mean High Water Neap (MHWN). The height of MHWN is the average neap high water level taken over a long period of time.

4.16 MHWS

Mean High Water Spring (MHWS). The height of MHWS is the average spring high water level taken over a long period of time.

4.17 MLWN

Mean Low Water Neap (MLWN). The height of MLWN is the average neap low water level obtained the same periods of MHWN.

4.18 MLWS

Mean Low Water Spring (MLWS). The height of MLWS is the average spring low water level obtained during the same periods of MHWS.

4.19 MSL

Mean Sea Level is the average value of levels observed each hour over a period of at least a year (preferably over about 19 years) or the average sea level in the absence of tide.

4.20 Navigable Waters

All waters from the high seas connected to rives, canals, basin and tributaries, which are, navigable by sea going vessels.

4.21 Soffit Level

The underside of a building or a structure, such as an arch, beam, stair, etc.

4.22 Springing Level

The point from which an arch or vault springs or rises from its support.

4.23 Vertical Clearance

The Vertical Clearance is the distance measured from the water surface to the lowest member of the bridge structure (i.e. soffit, or springing level).

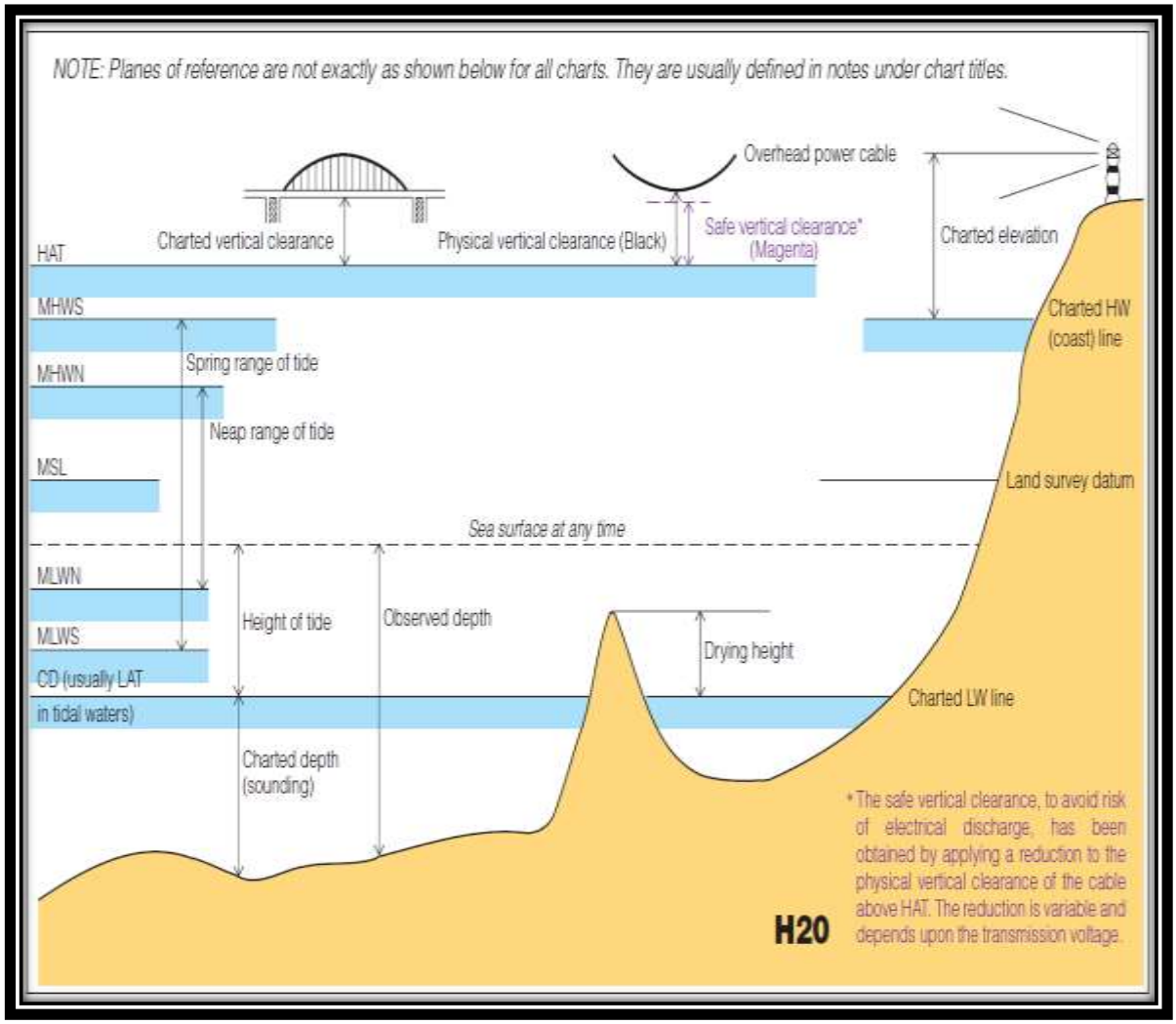

Figure 1 above shows graphically the terms used in this guideline

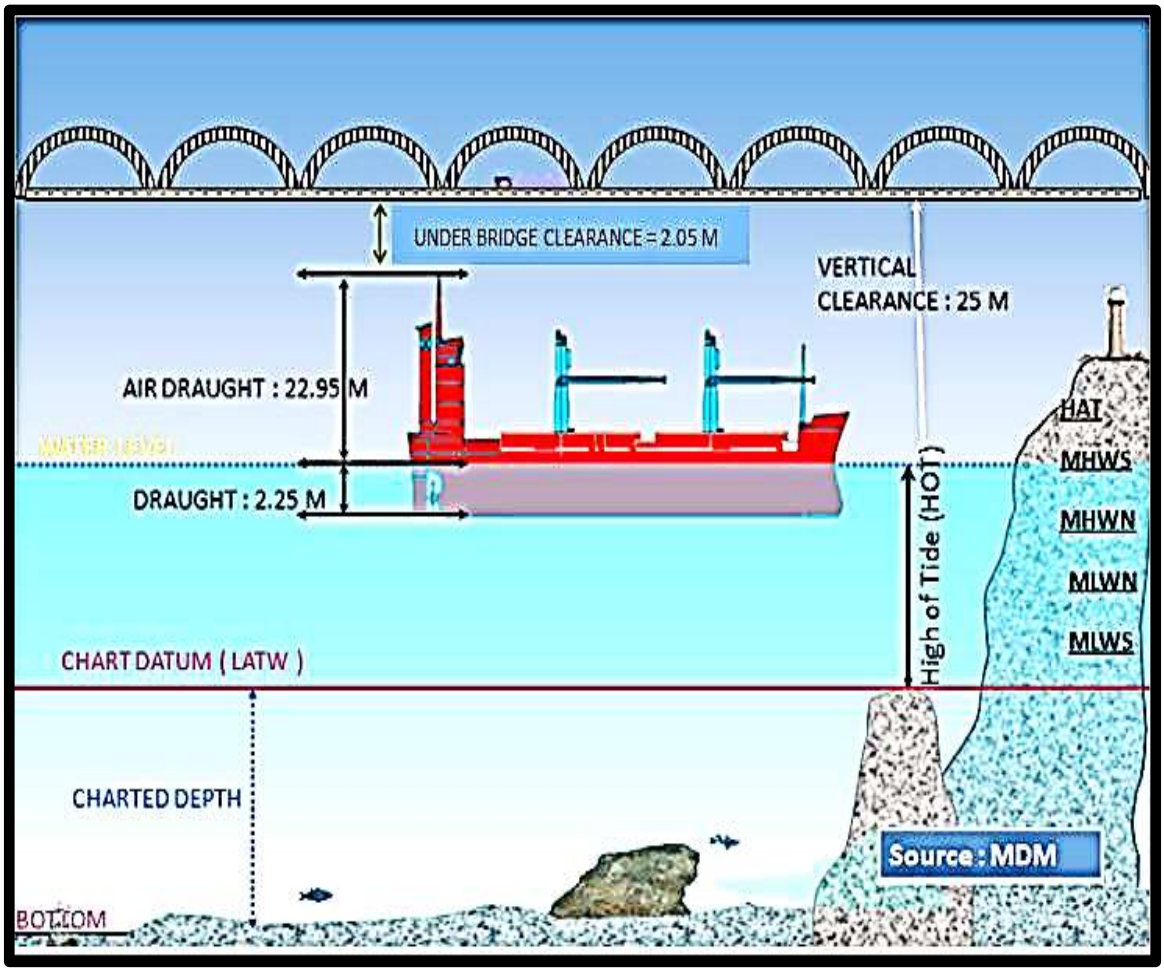

Figure 2 illustrates the state when a vessel passing under a bridge

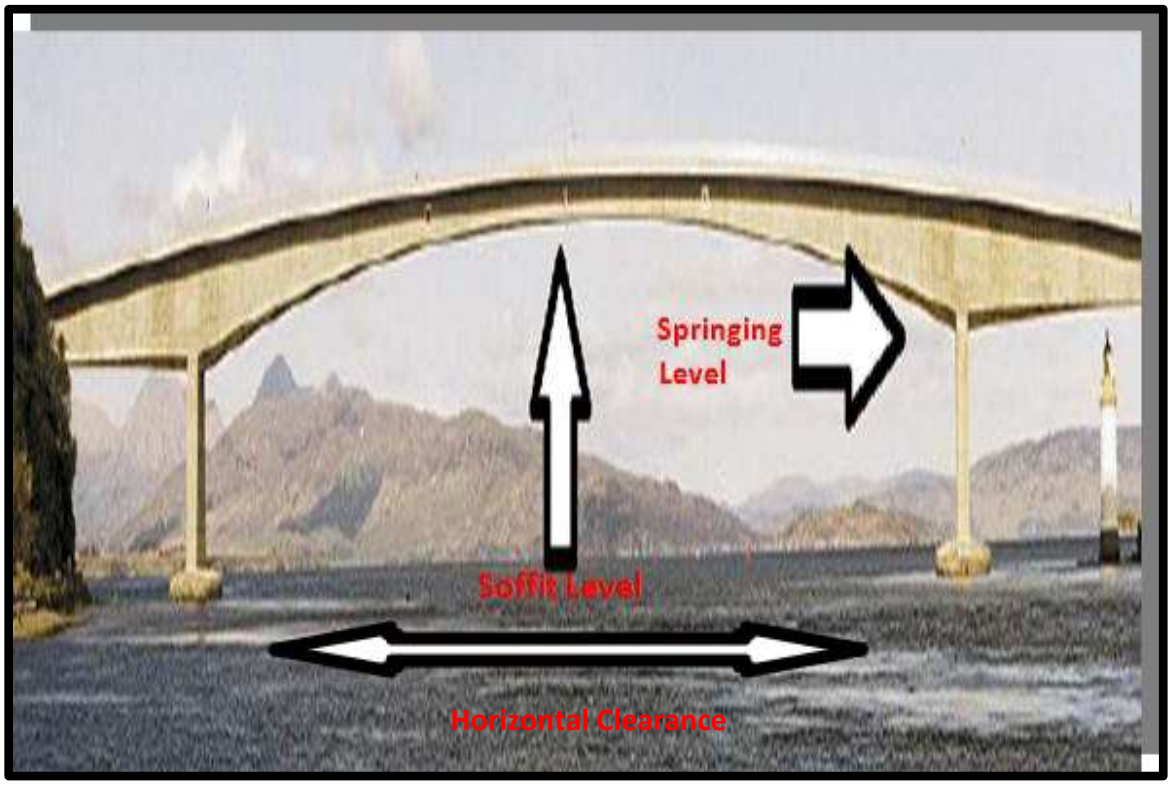

Figure 3 illustrates the soffit level, springing level and Horizontal Clearance

5.0 NAVIGATIONAL EVALUATIONS

Navigational evaluations should be conducted to compose the most accurate picture of current and prospective navigation on navigable waters. A Navigational Evaluation should be conducted by the project owner early in project planning and updated periodically during project development because the navigable waters usage are dynamic and may change over time. Such evaluations should identify and/or consider, not limited to the following factors:

5.1 Existing commercial users (marine industrial, passenger cruise and excursion, etc.);

5.2 Existing recreational users;

5.3 Vessel trip frequency;

5.4 Various navigable water stages;

5.5 Projected changes in navigable waters usage based upon anticipated waterway improvement projects;

5.6 Impacts to vessel owners that would be precluded from transiting the navigable waters if a proposed bridge project is authorized;

5.7 Impacts from bridge approaches based on associated navigational clearances;

5.8 All bridges upstream and downstream of the proposed bridge site to determine existing minimum horizontal and vertical clearances (including overhead transmission line clearances);

5.9 Guide clearances for the navigable waters, if established;

5.10 Navigable waters layout and geometry;

5.11 Navigable waters depth and elevation fluctuations *(range of tides, average high water elevation, changes in bathymetric contours, etc)*;

5.12 Channel and navigable waters alignment;

5.13 Natural flow of the navigable waters including currents, water velocity, water direction and velocity fluctuations (seasonal, daily, hourly etc), that might affect navigation.

5.14 Current speed and direction;

5.15 The marking of fixed bridges and other structures over navigable waters. (IALA, O-113 for the marking of fixed bridges over navigable waters)

6.0 CONSIDERATIONS IN DETERMINING BRIDGE DESIGN

The limitation on height and breadth of a bridge may be determined by the dimension of a vessel(s) passing through the bridge(s). It may also determine by a need for a vessel(s) to be able to turn in narrow water close or near to the bridge(s). In either case, the necessity to limit the bridge dimension should be thoroughly examined, and if it appears to limit the vessel's height and breadth to less than the bridge dimension which is desirable other considerations shall also be made.

This guideline also refers to the Navigational Evaluation as an important tool to determine the bridge dimension. The importance on the bridge measurement, in particular, its height above water and the span between columns is to allow a vessel to pass through safely under a bridge and the conditions are as follows:

6.1 VERTICAL CLEARANCE

The Vertical Clearance is the distance measured from the water surface to the lowest member of the bridge structure (i.e. soffit, or springing level). A water level that exceeds two percent or less the time, during the life of the project is a reasonable design criteria for determining the near maximum surface for a heavily used channel. The distance between the top of the vessel including any protrusion and the lowest member of the bridge is dependent upon the vessel's motion characteristics.

6.2 HORIZONTAL CLEARANCE

Horizontal clearance is the distance measured between the columns of the bridge in navigable waters that allows a vessel to pass through safely under a bridge. Minimum distance for this clearance vary depending on the structure and the following should be complied :

6.2.1 Traffic density and whether one-way or two-way traffic and/or overtaking will be permitted;

6.2.2 Alignment and velocity of the current;

6.2.3 Risk of collisions;

6.2.4 Consequences of collision because of hazardous cargo, damage to bridge and vessel and interruption of navigable waters and bridge traffic; and cost of bridge pier protection against ramming (in recent years, computer modelling has been used to determine horizontal clearances based on probabilistic methods for measuring deviation from the ships' intended paths).

7.0 REFERENCE OF BRIDGE VERTICAL CLEARANCE RECORDED IN MALAYSIA

Proposal of new construction bridge may refer to the vertical clearance of the existing bridge in that particular area, if applicable.

The bridge vertical clearance for the safety of navigation of vessels navigating under the bridge in various places in Malaysia are shown in table 1.

REGION	RECORD REFERENCE BRIDGE AND VERTICAL CLEARANCE
NORTHEN Perlis,Kedah, Pulau Pinang, Perak	a) Penang Bridge (28 metres) b) Sultan Abdul Halim Muadzam Shah Bridge (30 metres)
CENTRAL (Selangor, Negeri Sembilan, Melaka)	a) Selat Bridge, Pelabuhan Klang (15.5 metres)
SOUTHER N (Johore)	a) Second Link Bridge (25 metres) b) Sungai Johor Bridge (25 metres)
EASTERN Kelantan, Terengganu, Pahang)	a) Tanjung Lumpur Bridge, Kuantan, Pahang (12 metres)
Table 1 : References Of Bridge Vertical Clearance In Malaysia	
**In determining the affective minimum bridge vertical clearance for a new bridge, the navigational evaluation listed in para 5 of this guidelines should be considered*.	

8.0 CONTACT LIST

If there are any queries, please contact the nearest regional office for further information:

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