LESSON 5.1

Tides and How To Allow for Them

In this module we will be looking at the factors which cause the tides and how to calculate their effects. At first this subject might seem a little daunting, but our easy explanation and methods will make things very clear and simple.

Let's make a start by looking at the amazing systems of tides and what causes them.

WHAT CAUSES THE TIDES

The major influences on the water surrounding the earth's surface are the Sun and the Moon. The gravitational pull of these bodies causes the water to have a tidal effect and this effect is maximised or minimised according to the the relative positions of the Earth, Sun and Moon. The overall effect is also governed by the distance that Sun, Moon and Earth are apart. As these bodies are in elliptical orbits you will begin to see that the systems can become quite complicated. Add to this the fact that the earth consists of Continents, and very irregular land masses, and you will see that the Tidal System can be, and is, very intrinsic.

However, from the user's point of view tidal data is less complicated. It is derived from the history of water levels at various places and therefore can be predicted to an extreme degree of accuracy.
As mentioned above the Sun and Moons gravitational effects cause the tides. The Moon being the nearer body has the main influence. We will assume that the earth consists of all sea and no land. Looking at **Fig 5-1** you will see that the effect of sun and moon will cause the water to "hump" up on one side. In fact if you look at **Fig 5-1** on the left hand side the moon is causing the 'humping' of water on the side nearest to it. Because of the laws of equilibrium (we will not get into physics here) the water will also "hump" up on the side opposite to that of the Moon.

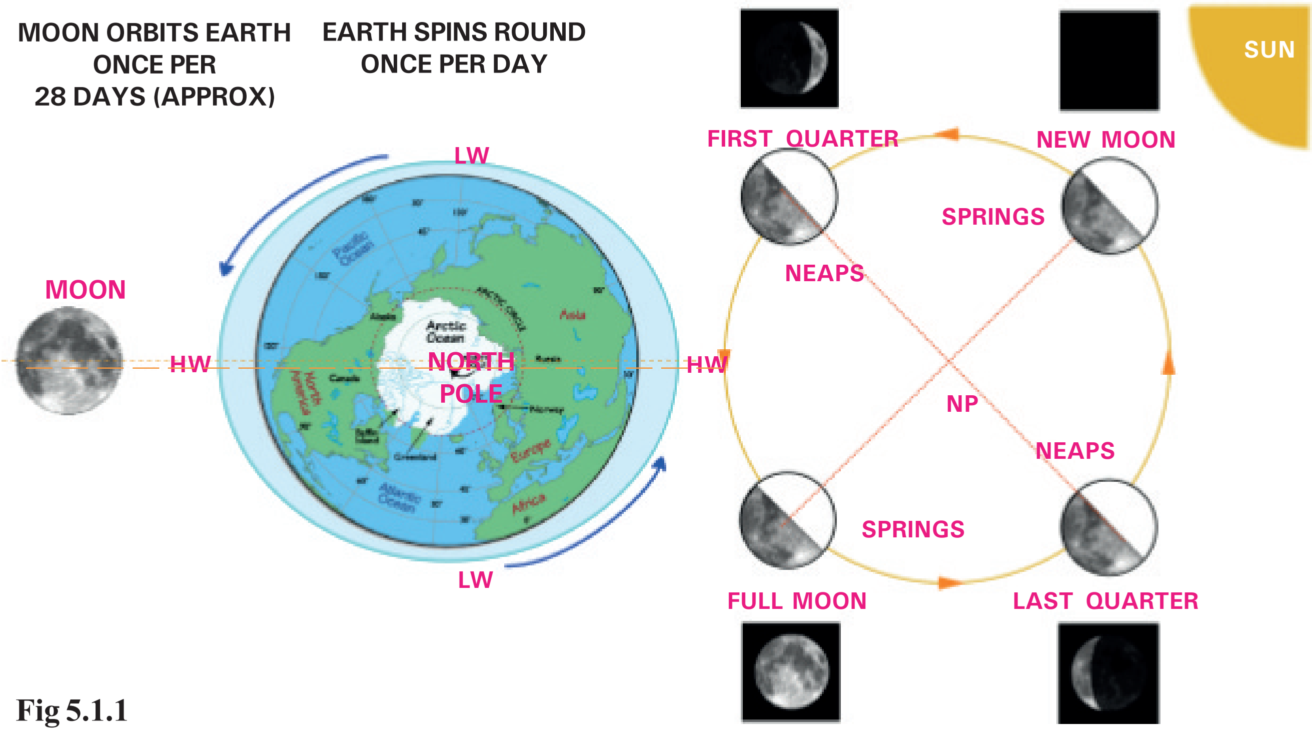


Fig 5.1.1

The Moon takes approximately 28 days to orbit the earth and of course the earth is spinning on it's own axis once in 24 hours. Again looking at **Fig 5-1**, you will see that the Sun and Moon are in line with one another on two occasions each month, New Moon and Full Moon.During this time the tidal influence is at its greatest and will produce very high high tides,and very low low tides.

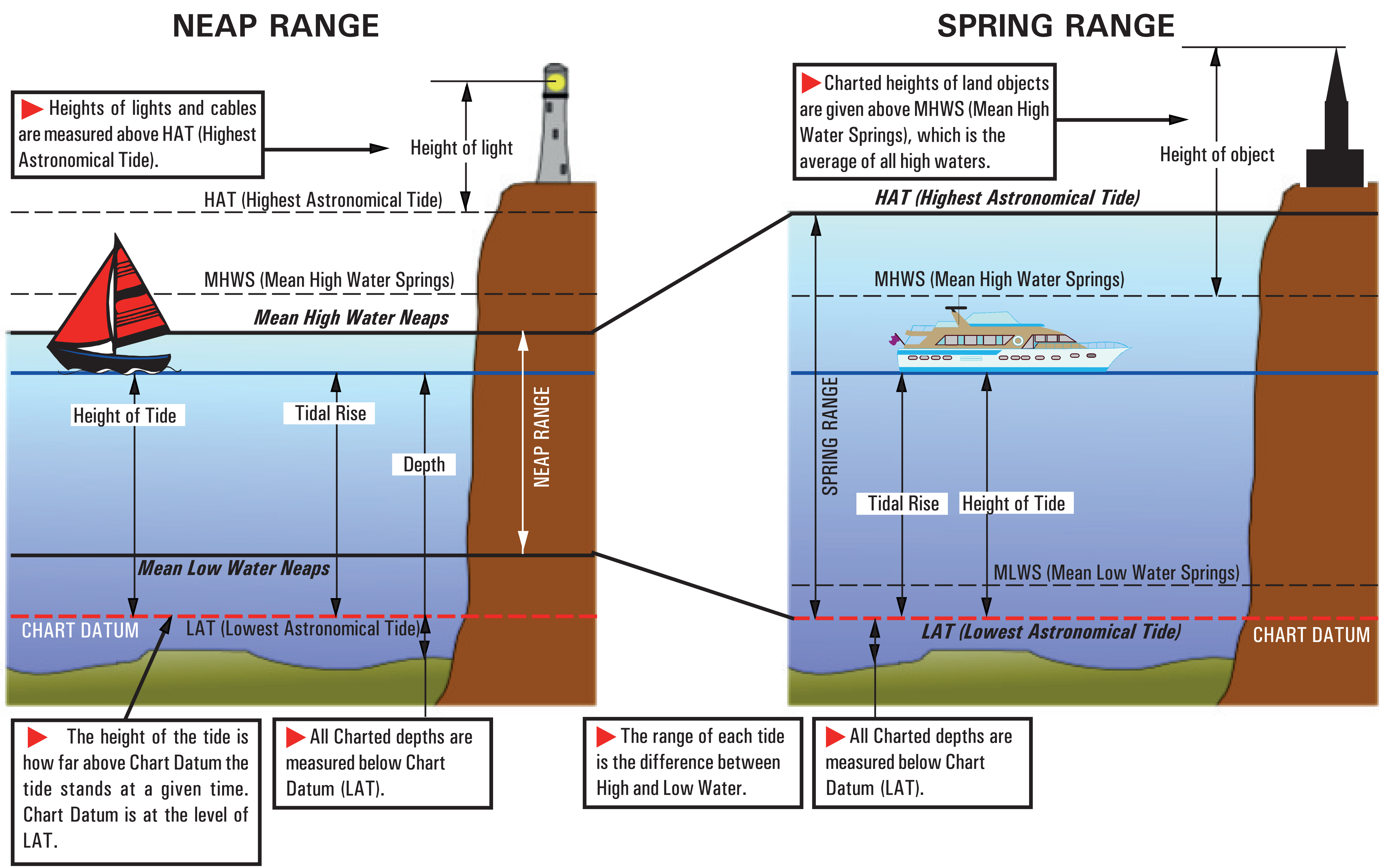
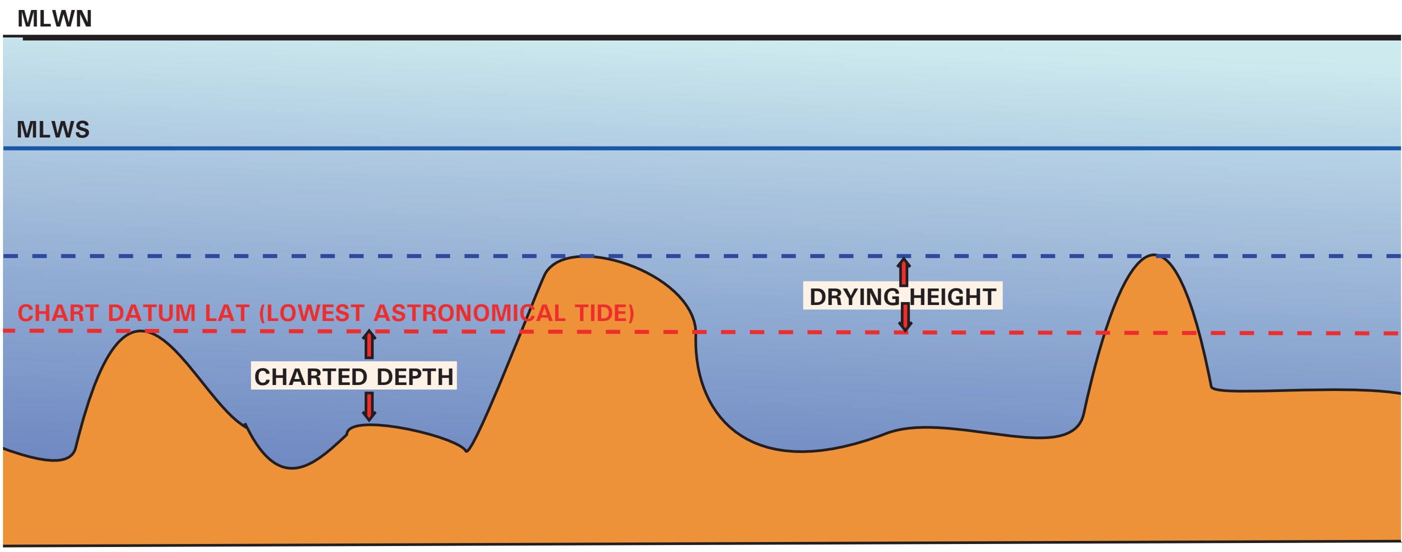


Fig 5.1.2 Tidal Heights and Ranges

Fig 5.1.2A Charted Depths and Drying Heights



For example:

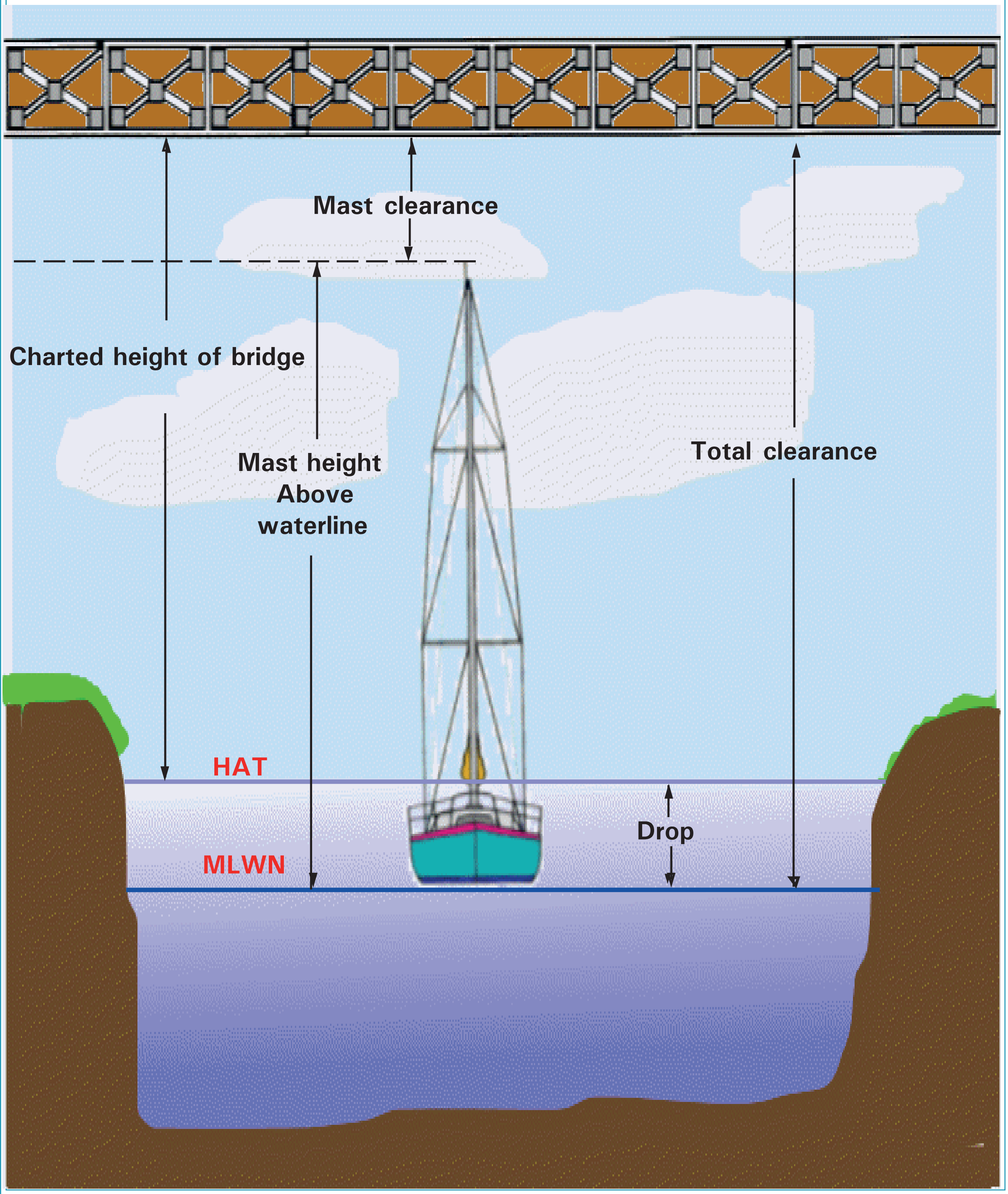
Rock or Sandbank awash at Chart Datum

Rock or Sandbank Showing drying height above Chart Datum

Rock or isolated point Showing drying height above Chart Datum

Fig 5.1.2A

HEIGHTS UNDER A BRIDGE



Air Draught (or clearance) under Bridges and Cables

As you can see from the diagram all clearances under Bridges and Cables are measured above HAT (Highest Astronomical tide. The correct term for this is the Air Draught

On a recent trip to Norway on a cruise liner the ship had an air draught of 72 metres and the height of a cable spanning the Fjord was 74 metres. From the deck it looked as though we would hit the cable but the Captain and Norwegian Pilot had done their homework and the ship cleared the cable with 2m to spare!

Also twice per month the Sun and Moon are at right angles to one another, known as the first quarter and the last quarter. This causes what we define as Neap tides where we have lower high waters and higher low waters.

This sounds complicated so have a look at **Fig 5.1.2** which shows you the effect of Spring and Neap tides. You will see here examples of what we call the Spring and Neap range of tides.

As a matter of interest, a Spring tide will not necessarily occur exactly at new or full Moon but about 2 days after it. This is because the water does not respond to the gravitational pull of the Sun and Moon instantly, but in fact lags for approximately two days.

Semi-Diurnal Tides
Around the UK we experience usually two high tides and two low tides each day. These are called Semi-Diurnal Tides with successive High and Low waters being spaced just over six hours apart.

Now let's have a more detailed look at **Fig 5.1.2**. You will see first the Spring and Neap Ranges of the tide.

Highest Astronomical Tide (HAT)
This is the the point above which all vertical clearances on a chart are shown. For example if the clearance height of a bridge is 4 metres then it is 4m above HAT

All other heights on a chart are above MHWS. Underlined figures are drying heights above Chart Datum (see below).

Mean High Water Springs (MHWS) & Mean High Water Neaps (MHWN)
These are the average or predicted heights of the Spring or Neap tides at High Water (HW) over a period of 18.6 years.

Mean Low Water Springs (MLWS) & Mean Low Water Neaps (MLWN)
These again are the average heights of Spring Low Water and Neap Low Water over the 18.6 year period.

Chart Datum and Lowest Astronomical Tide (LAT)
All Depths on a chart and Drying Heights are measured from the level of Chart Datum. This used to be from MLWS but it was decided about 15 years ago to make this even safer. Therefore a new datum called **Lowest Astronomical Tide (LAT)** was introduced. This is the lowest level to which the tide is ever predicted to fall (for Astronomical reasons). It does not take into account any meteorological conditions which can effect the tide.

Chart Datum (LAT) therefore, can be defined as the level from which all heights of tide are calculated and the level from which all depths on a chart are measured. Also any areas that dry out (Sandbanks, Rocks etc.) are measured from this datum.

Range of the tide
This is the difference between the heights of High and Low Water. It can be either the Spring Range which is the difference between MHWS & MLWS or the Neap Range which is the difference between MHWN & MLWN.

Now please take time to review the simulations on the next page:

Now view the simulations shown below on your resource CD:

Tides	SEARCH
Chart Datum	SEARCH
Using Rule of Twelfths	SEARCH
Calculating Height of Tide	SEARCH