

Pasang Surut (PASUT)

PASUT (TIDE)

Naik-turunnya paras laut, terutama karena gaya tarik akibat gravitasi (gravitational attraction) antara bulan, matahari dan bumi



Air Pasang (Naik)
(flood tide)

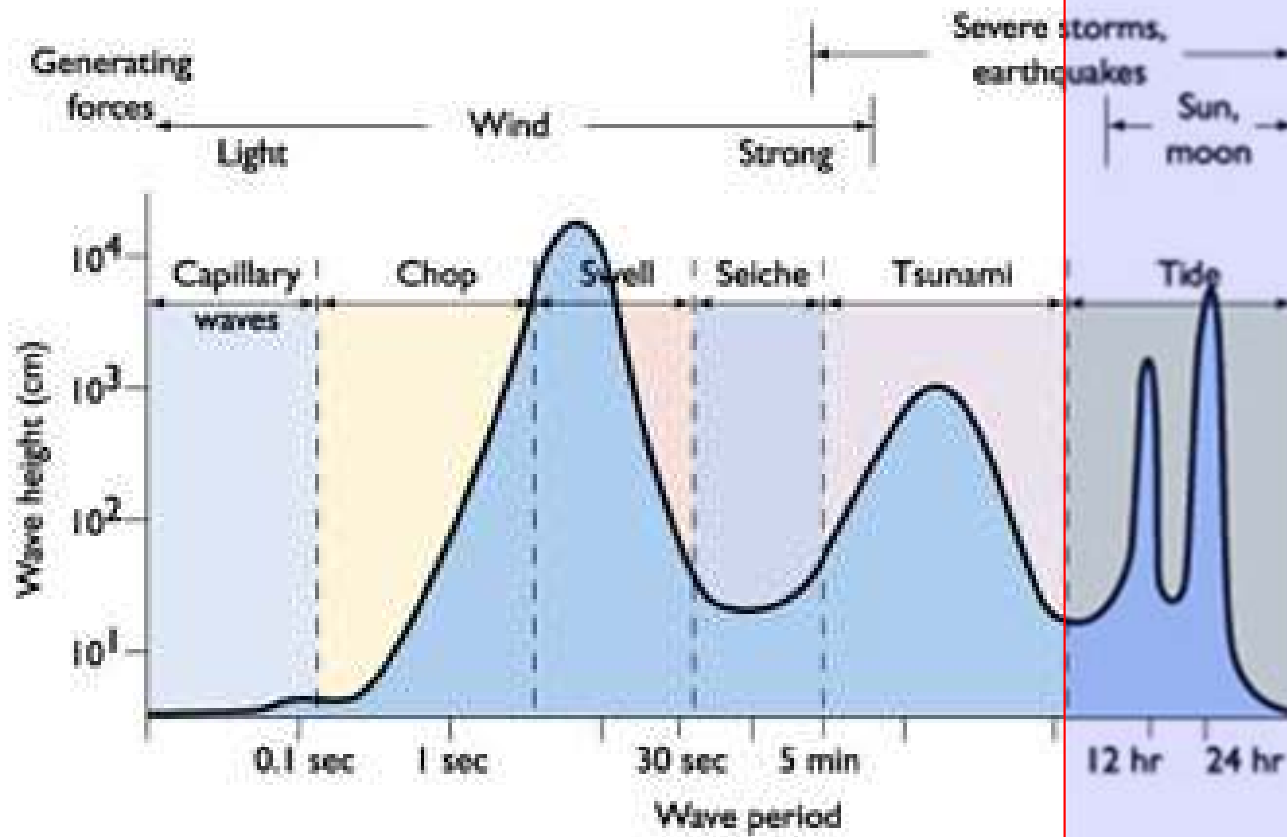


Air Surut (ebb tide)

Karakter Pasang surut (Pasut)

1. Merupakan gelombang panjang baik berupa gelombang berjalan (*progressive*) maupun diam (*standing*)
2. Memiliki periode dominan 12 jam 25 menit
3. Dibangkitkan oleh adanya gaya gravitasi bulan dan matahari terhadap bumi
4. Perambatan gelombang pasut dan amplitudonya dipengaruhi oleh adanya gaya friksi, rotasi bumi (gaya Coriolis)
5. Resonansi gelombang pasut ditentukan oleh bentuk dan kedalaman basin laut dan batas-batas lautan dan daratan (morfologi pantai)

Spektrum Energi Gelombang





Kekuatan Pasut

Tunggang Pasut (Tidal Range):

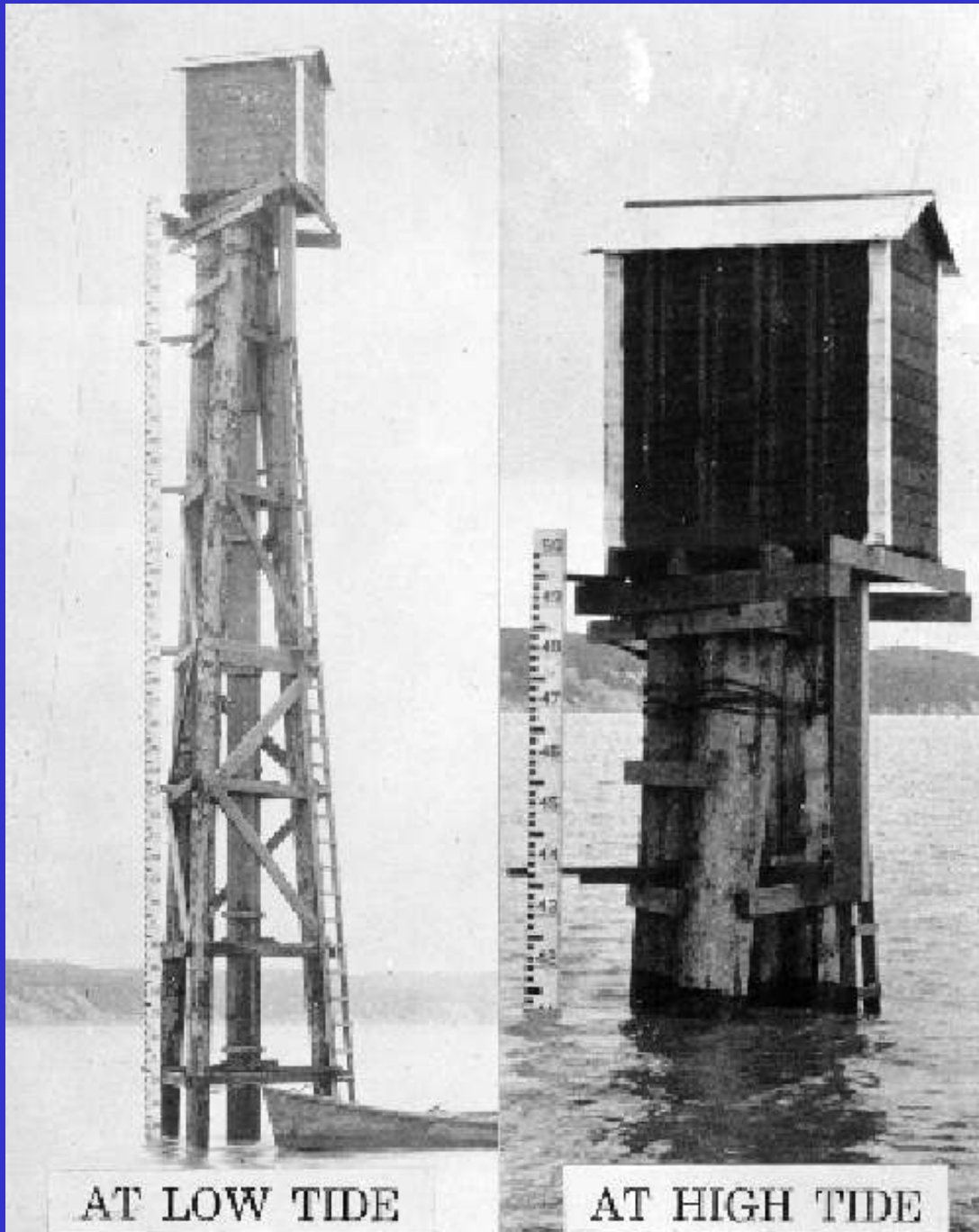
Beda (selisih) tinggi paras (muka) laut saat air pasang tertinggi dan air surut terendah

Umumnya: 1 sampai beberapa meter

Mis: pantura Jawa: ~ 1 m

Muara S. Musi: 3 m

Bagansiapi-api: 6 m



The Macrotidal Bay of Fundy, Canada



Teluk Fundy, Kanada:
Tidal range > 16 m

Bay of Fundy tides

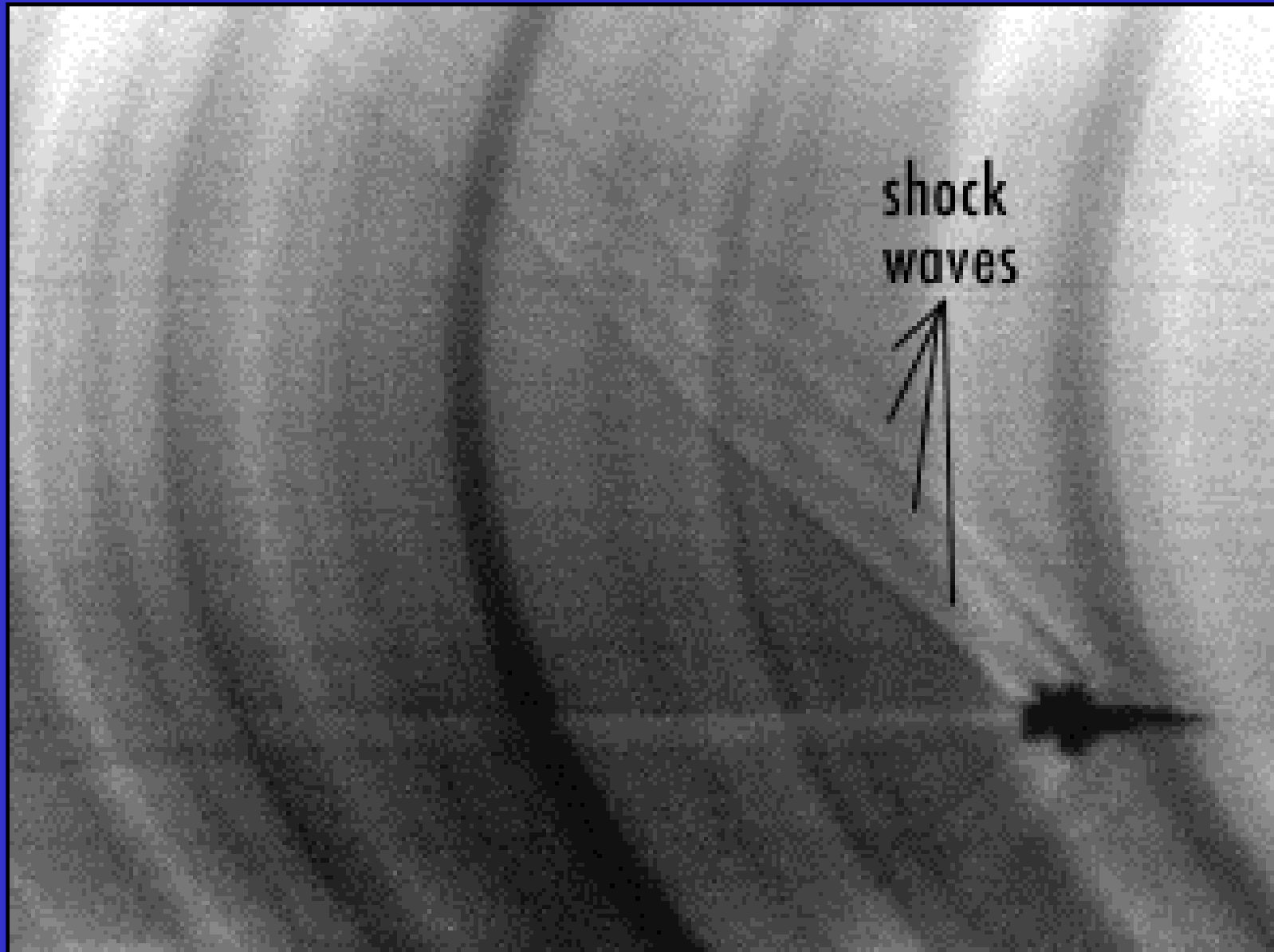


- Extreme tides (10m or more) found where small marine basin adjoins large ocean
 - Bay of Fundy, Nova Scotia
 - Gulf of California
- (in most places, tides are 1 to a few meters in range)

Tidal bore: Severn River, England



Tidal Bores, prinsipnya mirip Shock Waves



Tidal ecosystems



- Naik Turunnya paras laut akibat Pasut menciptakan lingkungan yang mengalami stress (stressful environments) bagi organisme laut daerah intertidal

Tidal ecosystems



- Organisme lainnya memanfaatkan kolam pasut (tide pools), dimana genangan air masih ada walaupun air surut

TEORI PASUT (TIDES)

Pasut: terminologi generik utk mendefinisikan naik turunnya paras laut (sea level) relatif terhadap daratan dan dibangkitkan oleh keseimbangan percepatan gravitasi bulan dan matahari serta percepatan **centrifugal**.

Gaya gravitasi (F_g) antara dua benda dirumuskan sebagai :

$$F_g = \frac{GM_1M_2}{R^2}$$

(7.1)

Di mana M_1 dan M_2 adalah massa dari kedua benda, R adalah jarak antara kedua pusat benda, dan G adalah konstanta universal ($6.6 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$).

Equilibrium Theory

Assumption

Tides are always in equilibrium with the gravitational pull of the moon and Earth is a planet covered in water.

Tidal bulges.

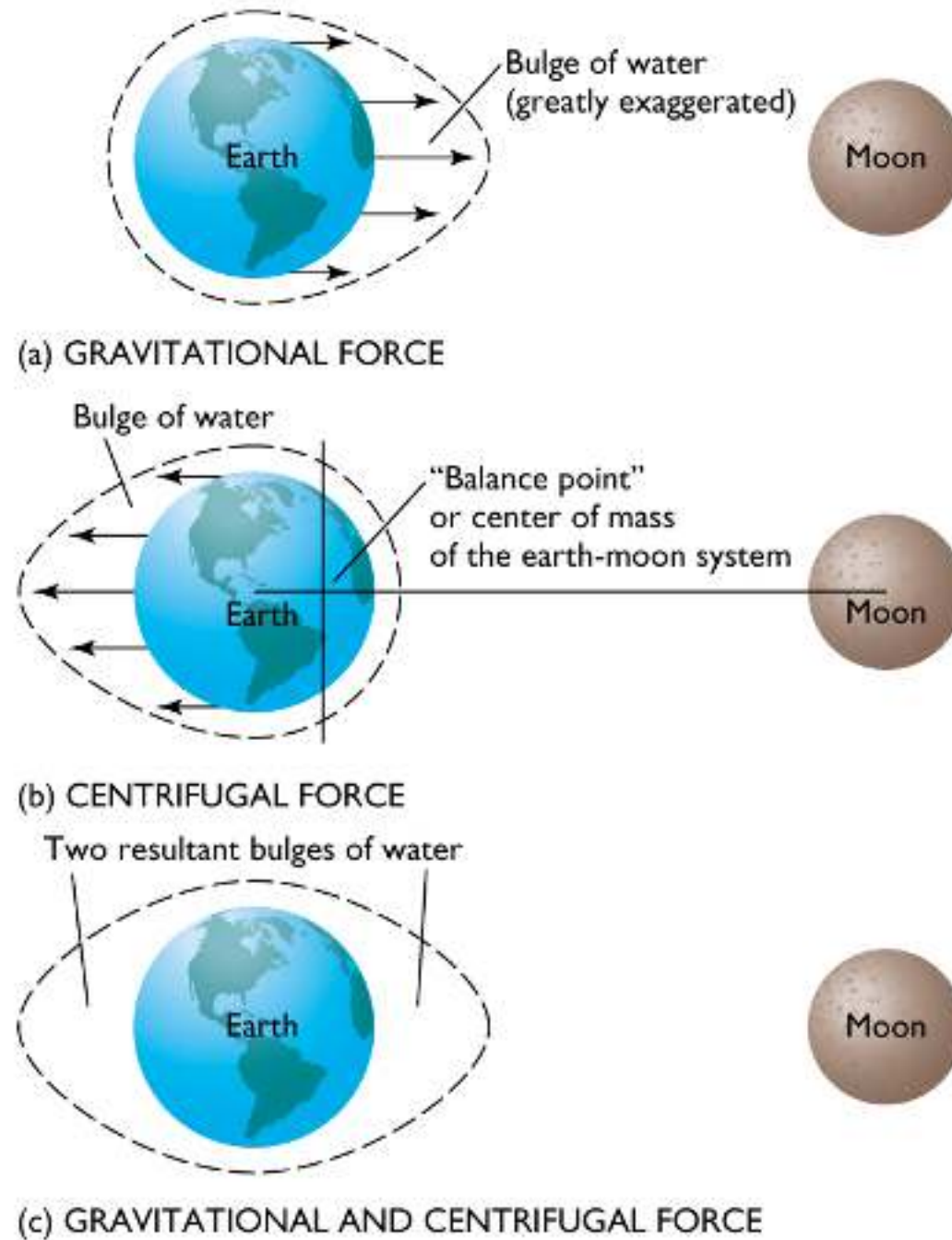


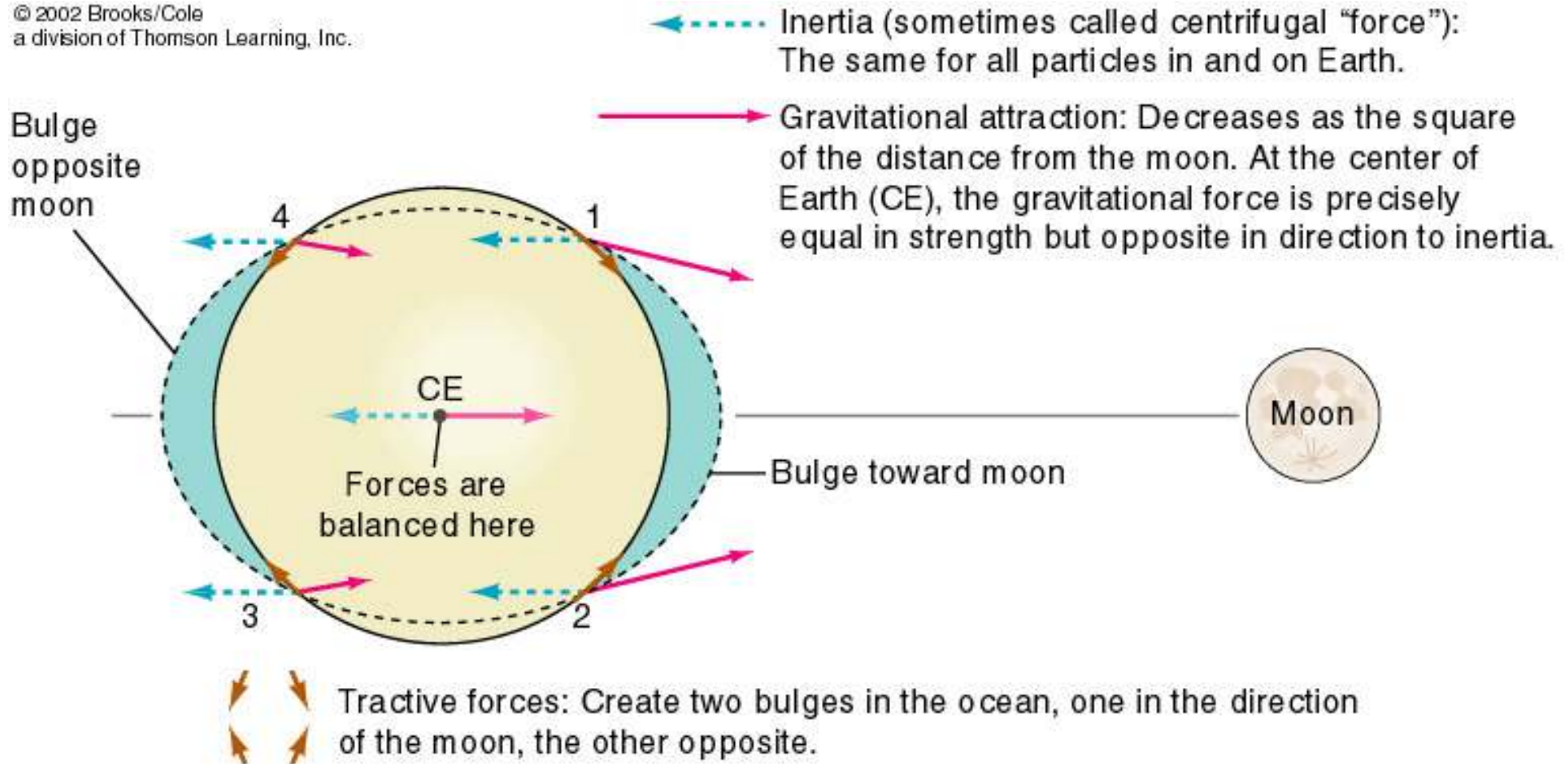
Figure 8.5

Gravity and centrifugal force

(also called "tractive forces")

Equilibrium theory of tides

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The two forces that can move the ocean are balanced only at the center of Earth (point CE). Elsewhere the net imbalance is a small force that causes ocean water to converge into two equal "bulges," as shown.

Resultante Gaya Pembangkit Pasang (Tide Generating Force)

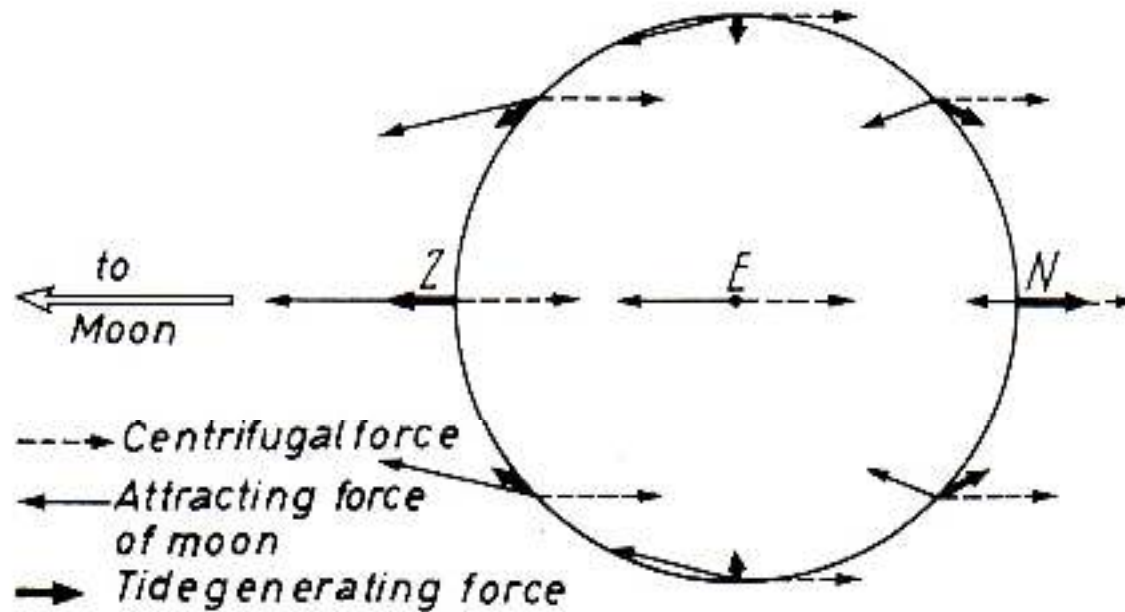


Fig. 180. Tide-generating force as a resultant of attracting force and centrifugal force along a meridional section through the earth. Z , N , moon in zenith or nadir, respectively; E , center of the earth.

Komponen Horinzontal Gaya Gembangkit Pasang: membangkitkan Arus Pasut \Rightarrow Paras Laut Naik (Pasang) kemudian Surut \Rightarrow PASUT

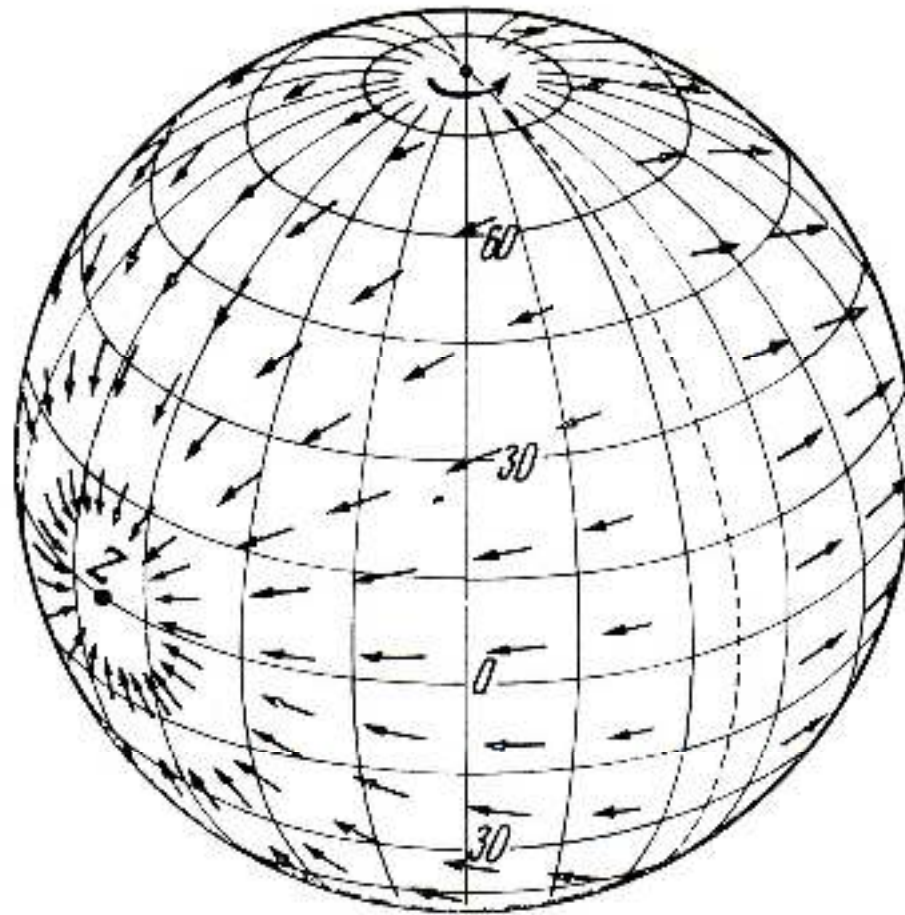
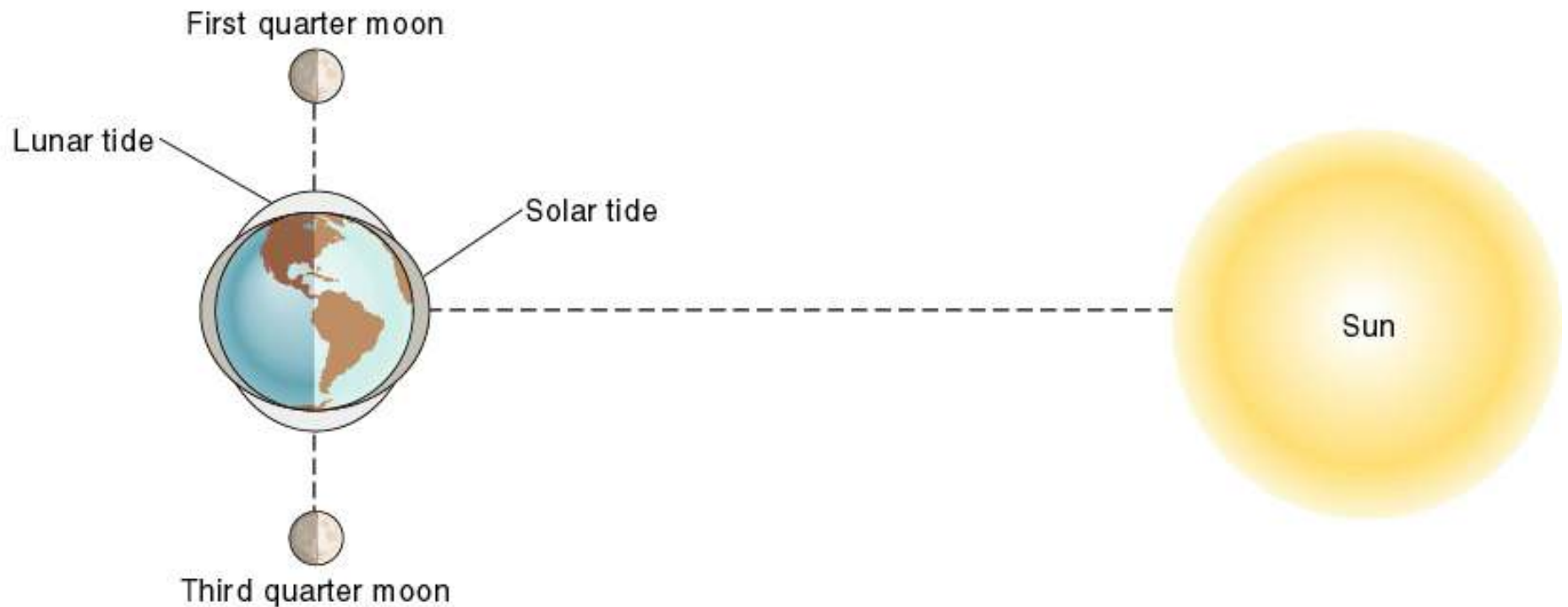


Fig. 181. Distribution of the horizontal component of the tide-generating force over the globe. (Position of the tide-generating celestial body at the equator in the zenith of Z ; arrow at the pole indicates sense of earth's rotation.)

Tides: The moon and the sun together

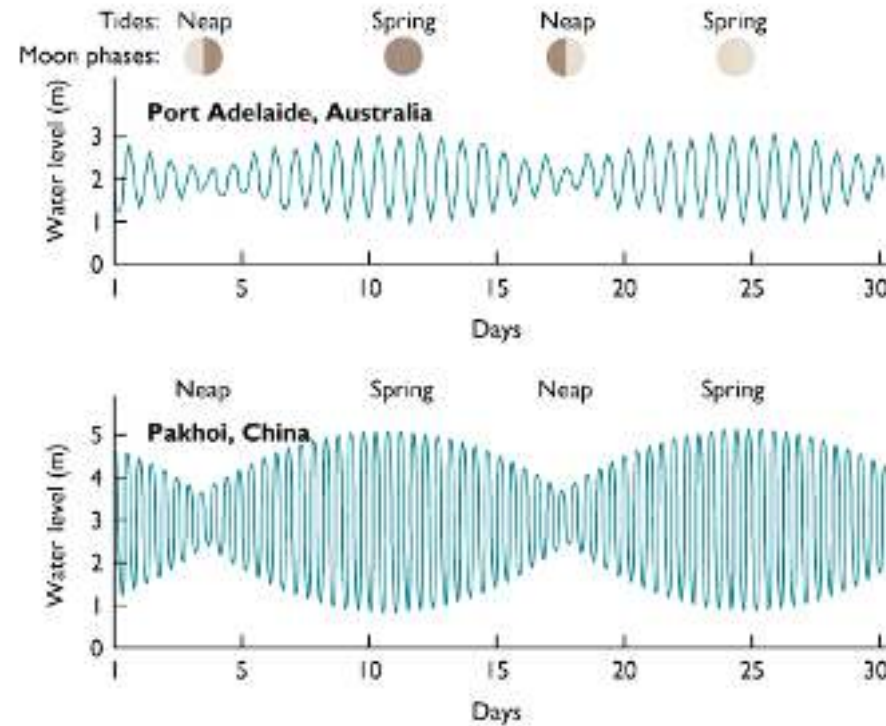


b Neap tides

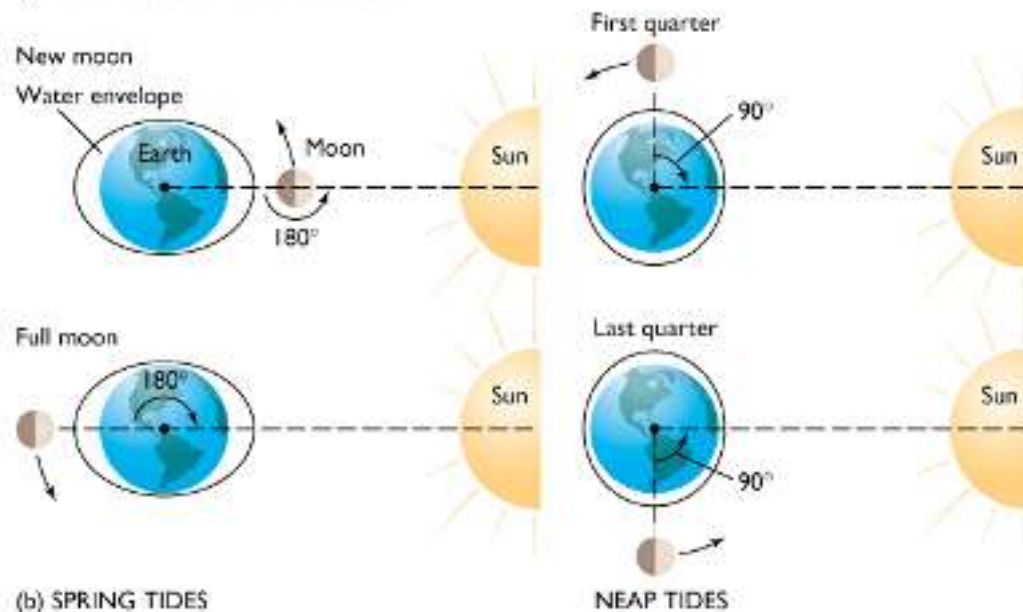
Spring and neap tides.

Bila Pengaruh
Bulan dan Matahari
Saling menguatkan:
Kekuatan Pasut
Maksimum:
Pasang Purnama
(Spring tide)

Bila Pengaruh
Bulan dan Matahari
Saling mediadakan:
Kekuatan Pasut
Minimum:
Pasang Perbani
(Neap tide)

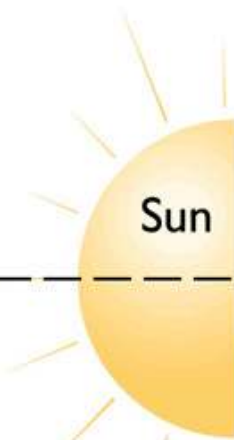
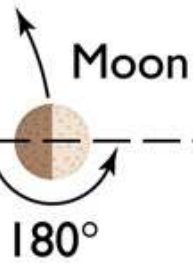
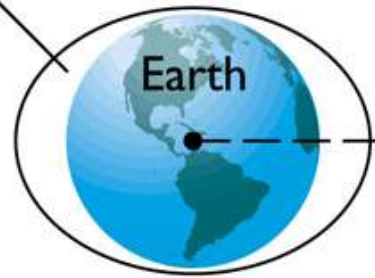


(a) VARIATIONS IN TIDAL RANGE



New moon

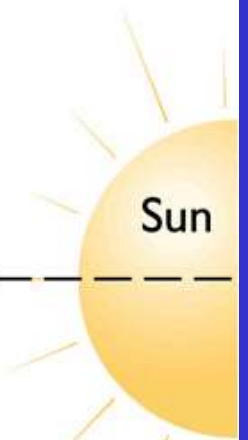
Water envelope



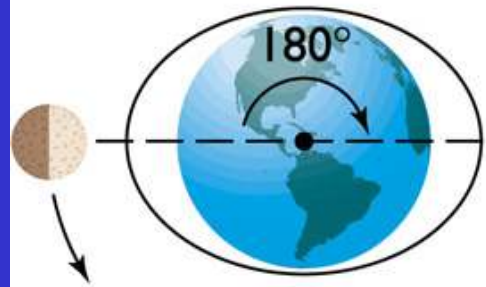
First quarter



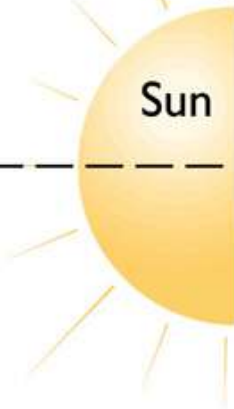
90°



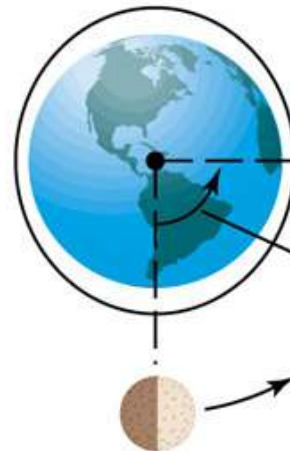
Full moon



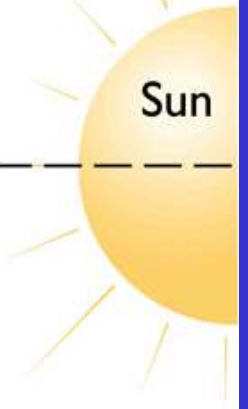
180°



Last quarter

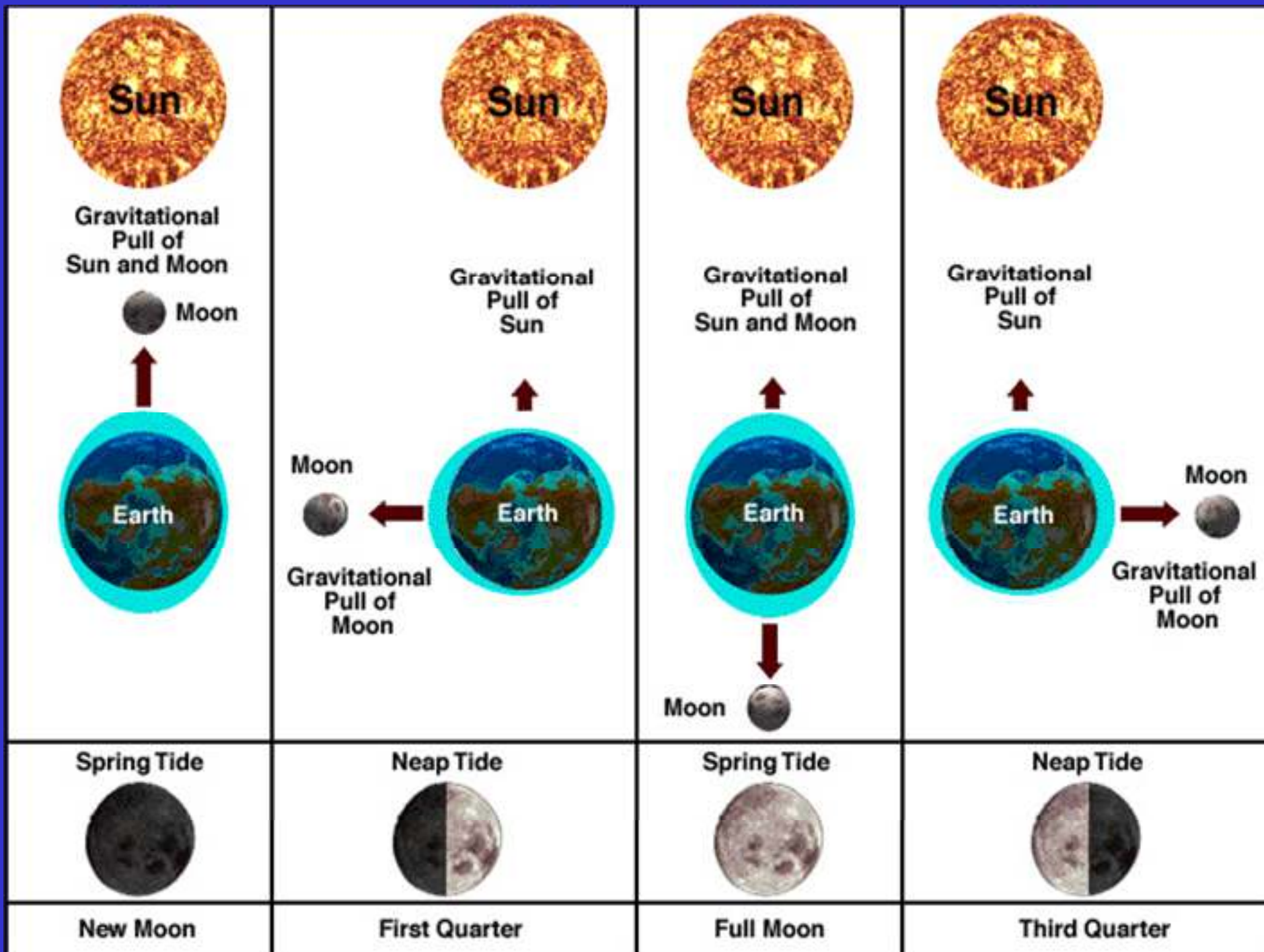


90°



(b) SPRING TIDES

NEAP TIDES



Tidal predictions.

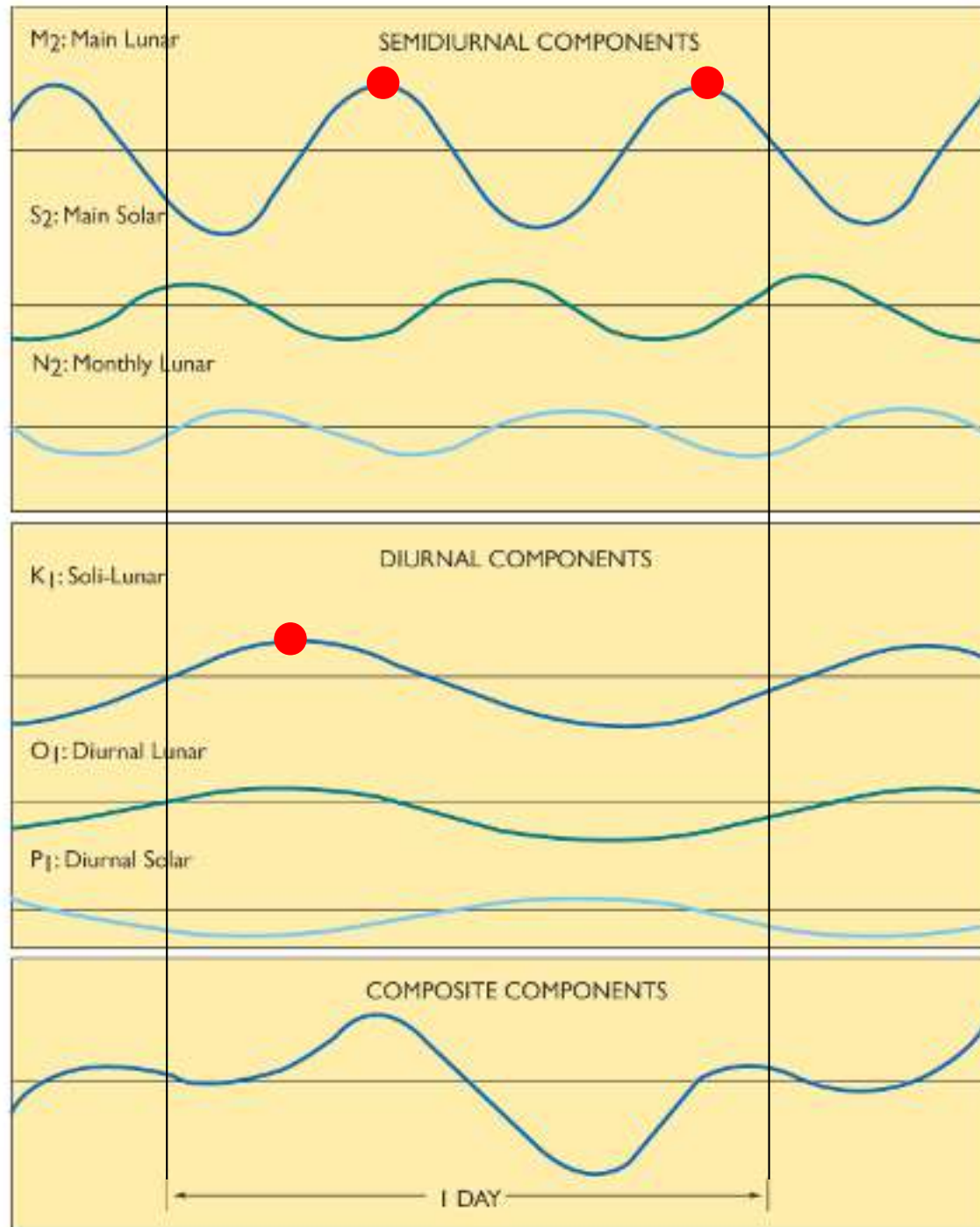
semidiurnal

+

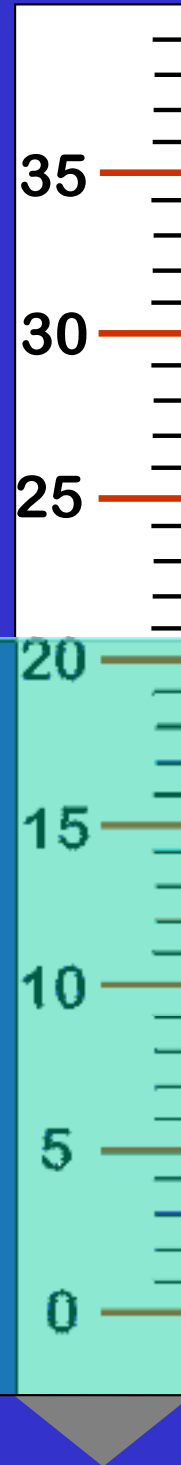
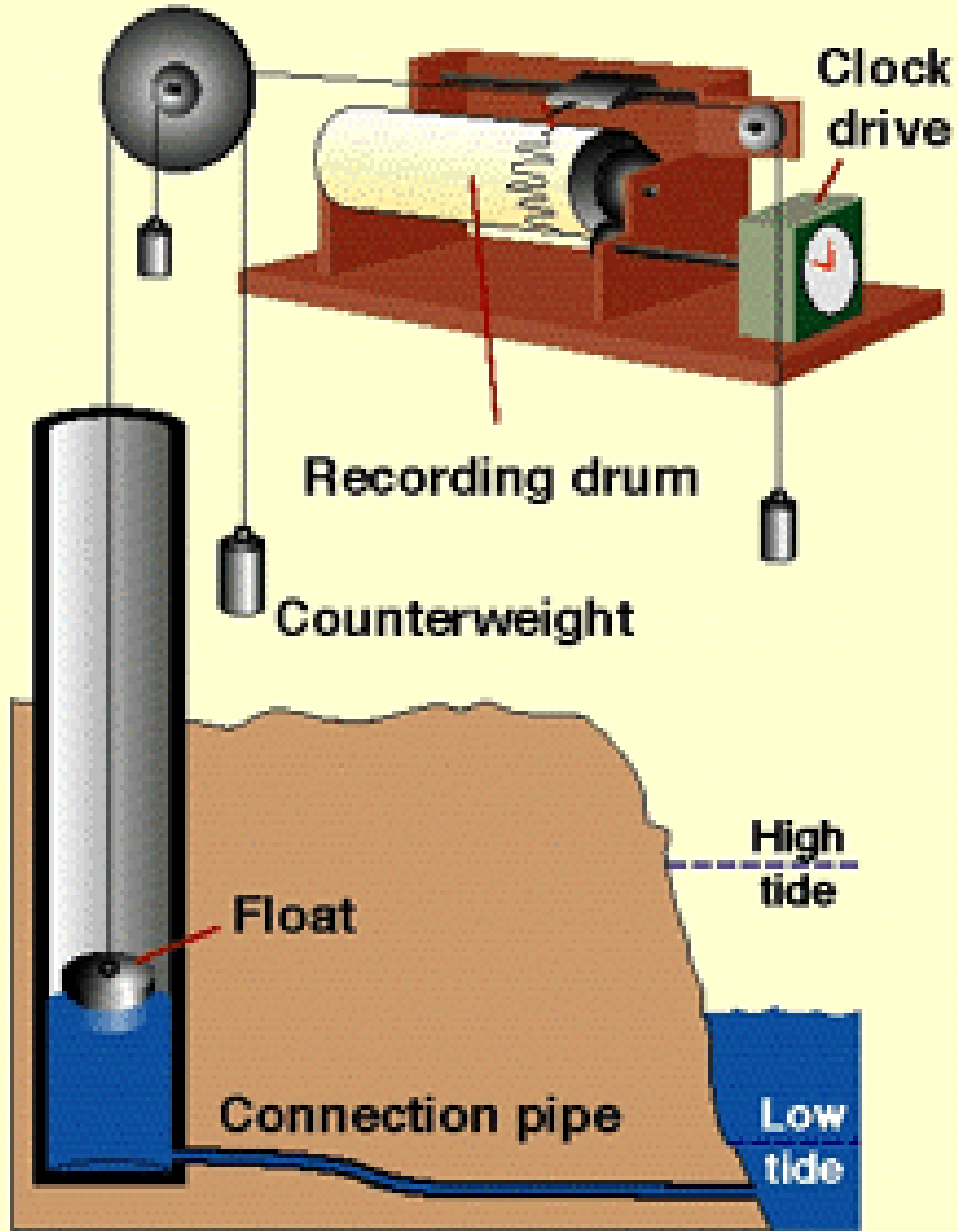
diurnal

=

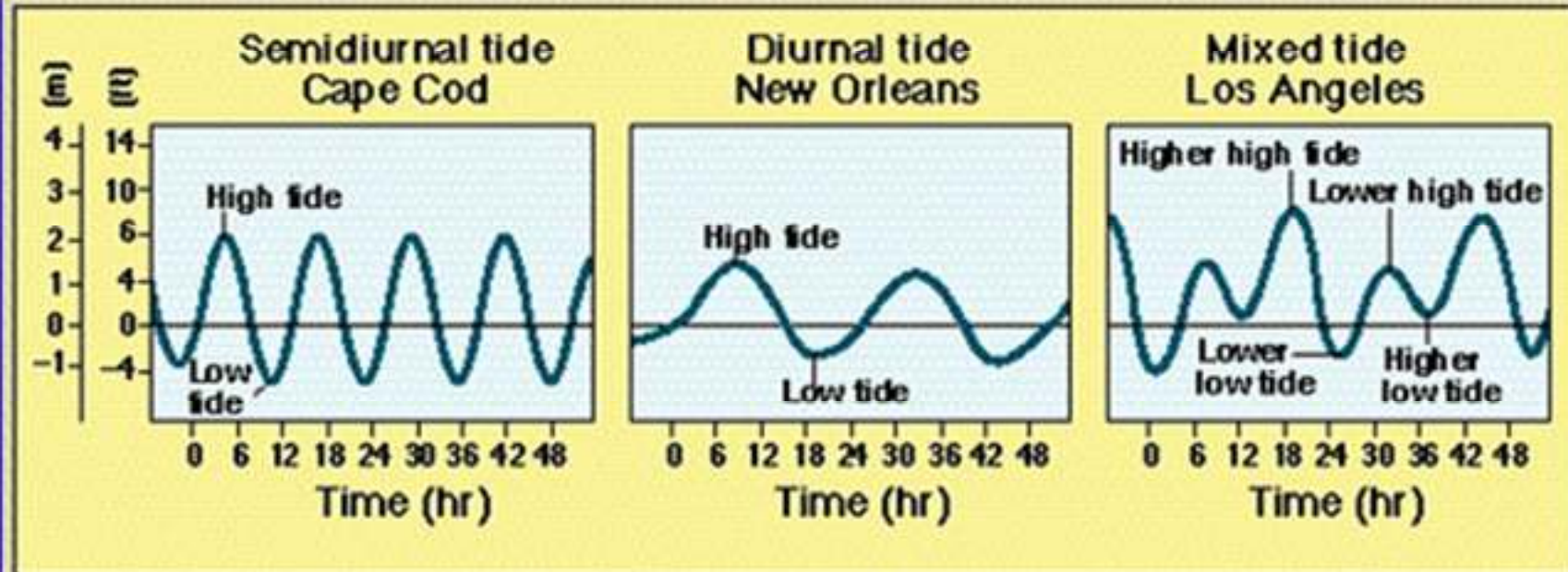
composite



A Mechanical Tide Gauge



Records for Three Common Types of Tides



Semidiurnal tides are two equal high tides and two equal low tides a lunar day

Diurnal tides are one high tide and one low tide a lunar day

Mixed tides have two different high tides and two different low tides a lunar day.

A lunar day: the period of the Earth's rotation with respect to the Moon, 24 hours and 50 minutes

Cara pengklasifikasian pasang surut yang paling sederhana adalah dengan menggunakan periode dominan dari pasang surut yang diamati. Hal ini didasarkan pada perbandingan (F) jumlah amplitudo dua komponen diurnal utama (K_1 dan O_1) terhadap jumlah amplitudo dua komponen semi-diurnal utama (M_2 dan S_2)

$$F = (K_1 + O_1) / (M_2 + S_2)$$

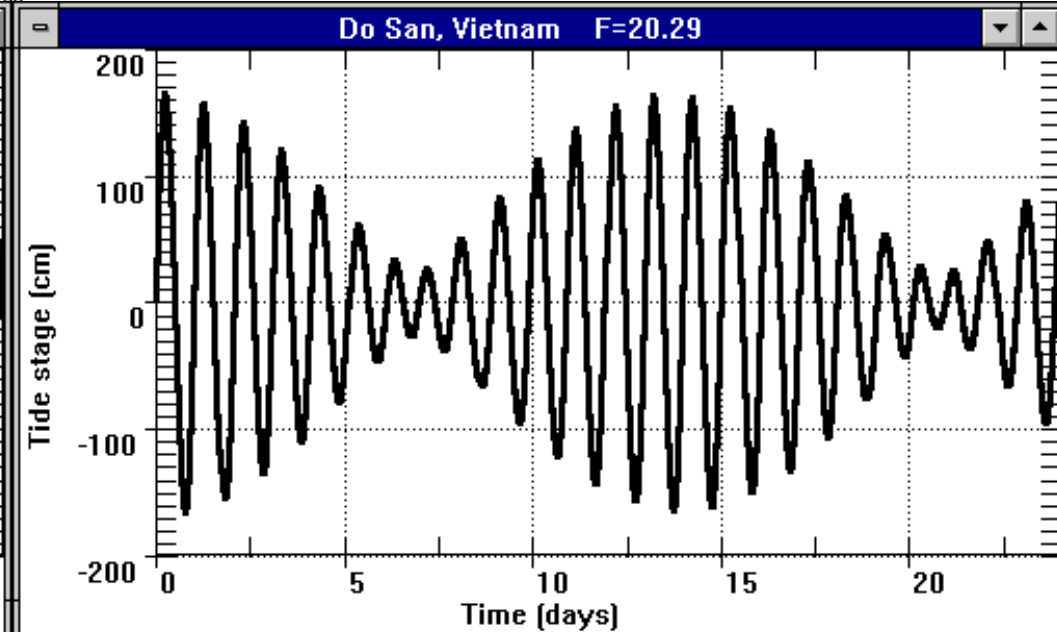
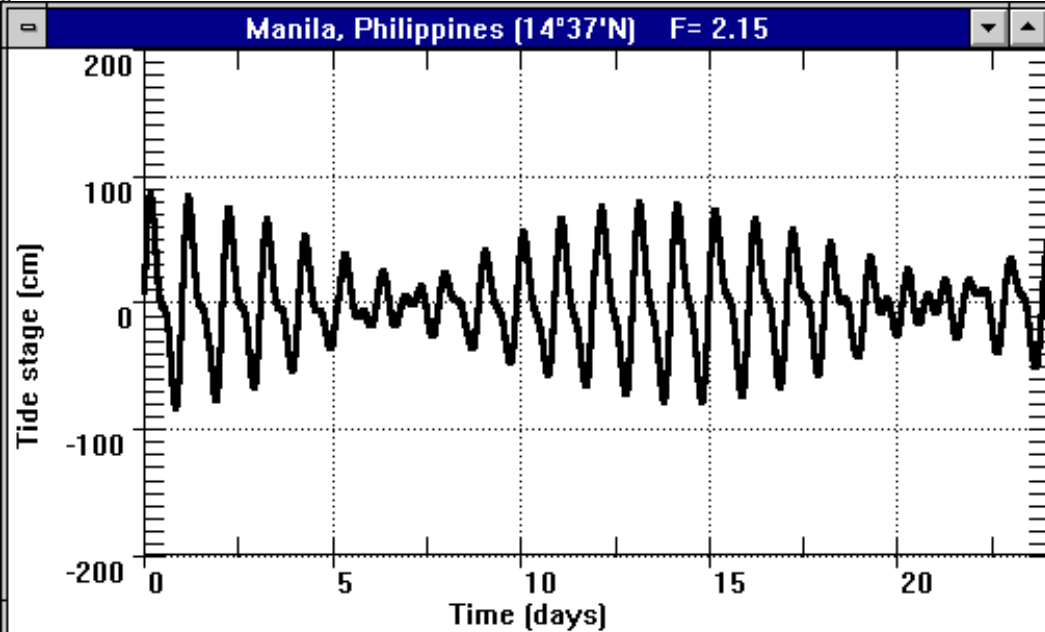
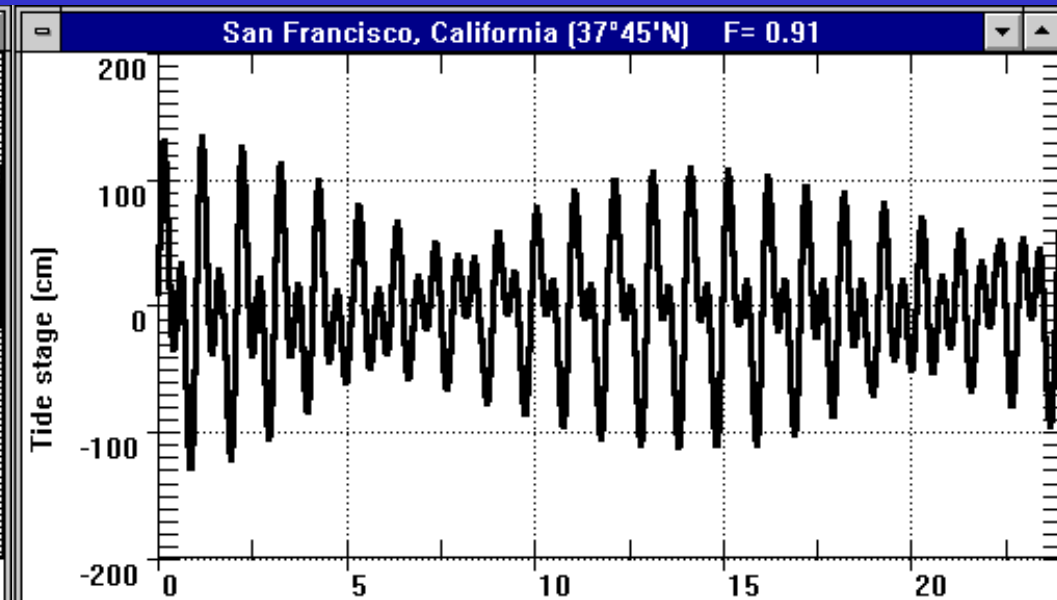
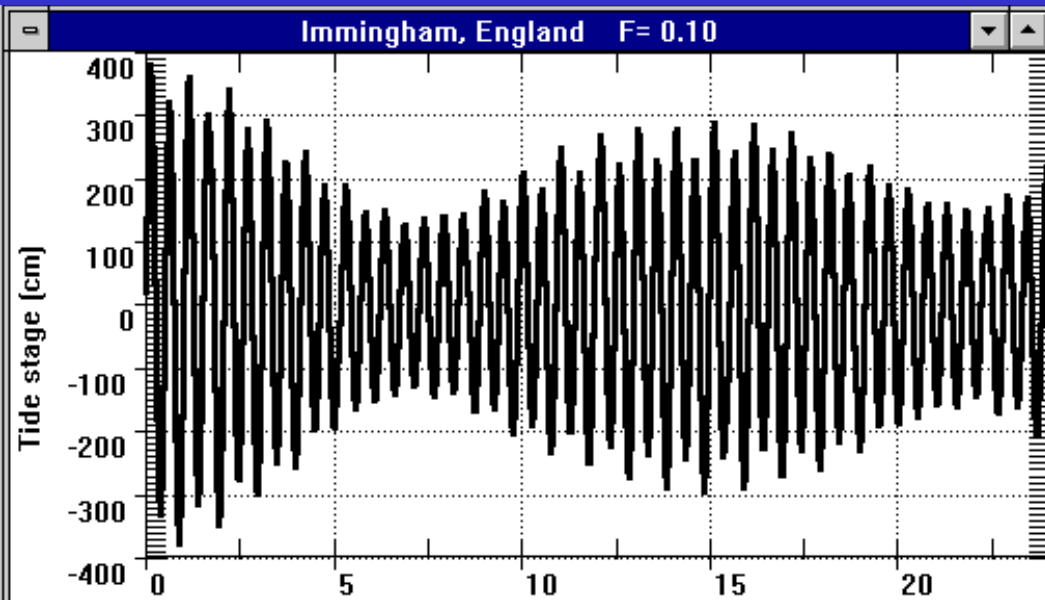
value of F	Category
0 - 0.25	semidiurnal
0.25 - 1.5	mixed, mainly semidiurnal
1.5 - 3	mixed, mainly diurnal
> 3	Diurnal

When $0.25 < F < 1.25$ the tide is mixed - mainly semidiurnal

When $1.25 < F < 3.00$ the tide is mixed - mainly diurnal

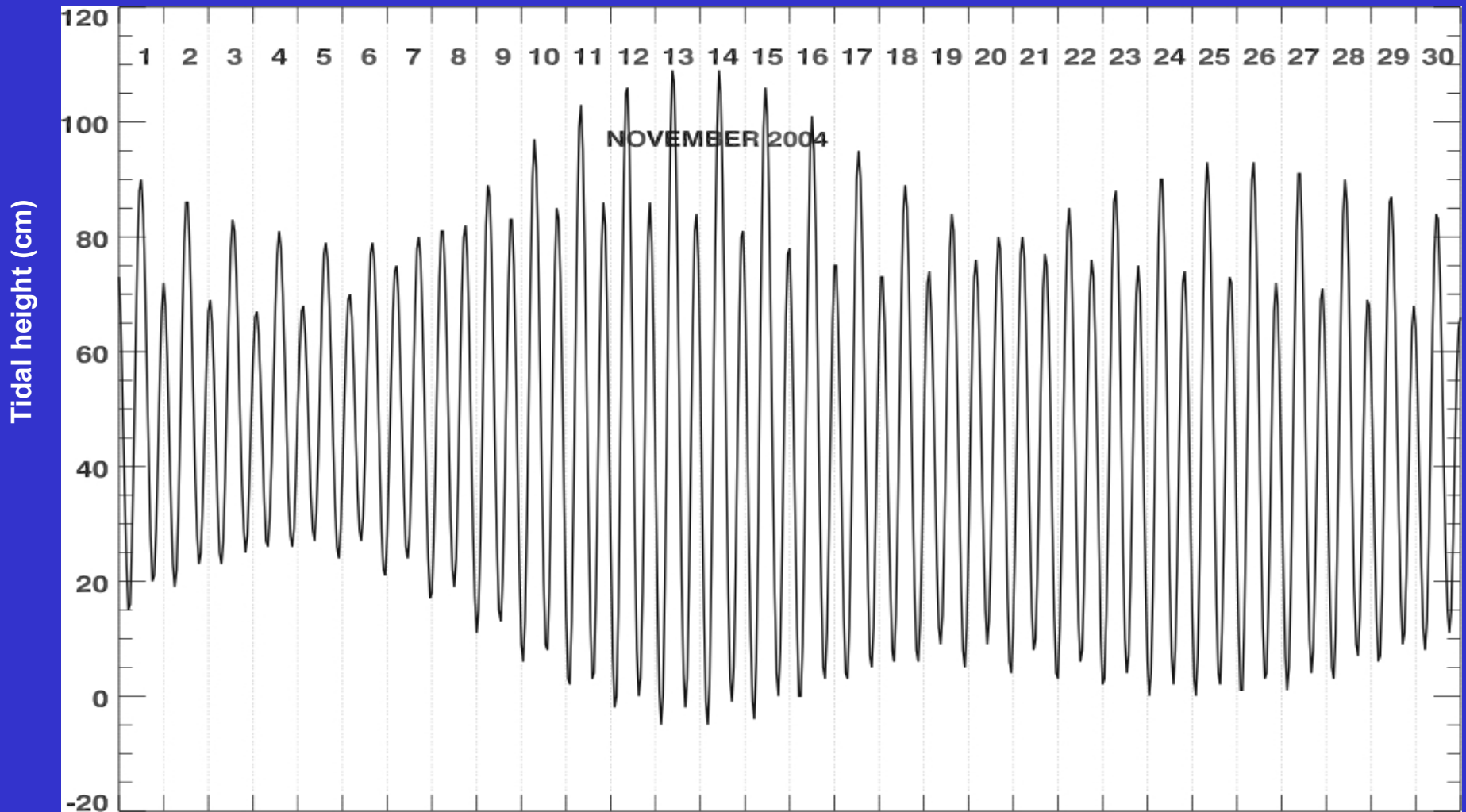
$F > 3$ the tide is diurnal

$F < 0.25$ the tide is semidiurnal

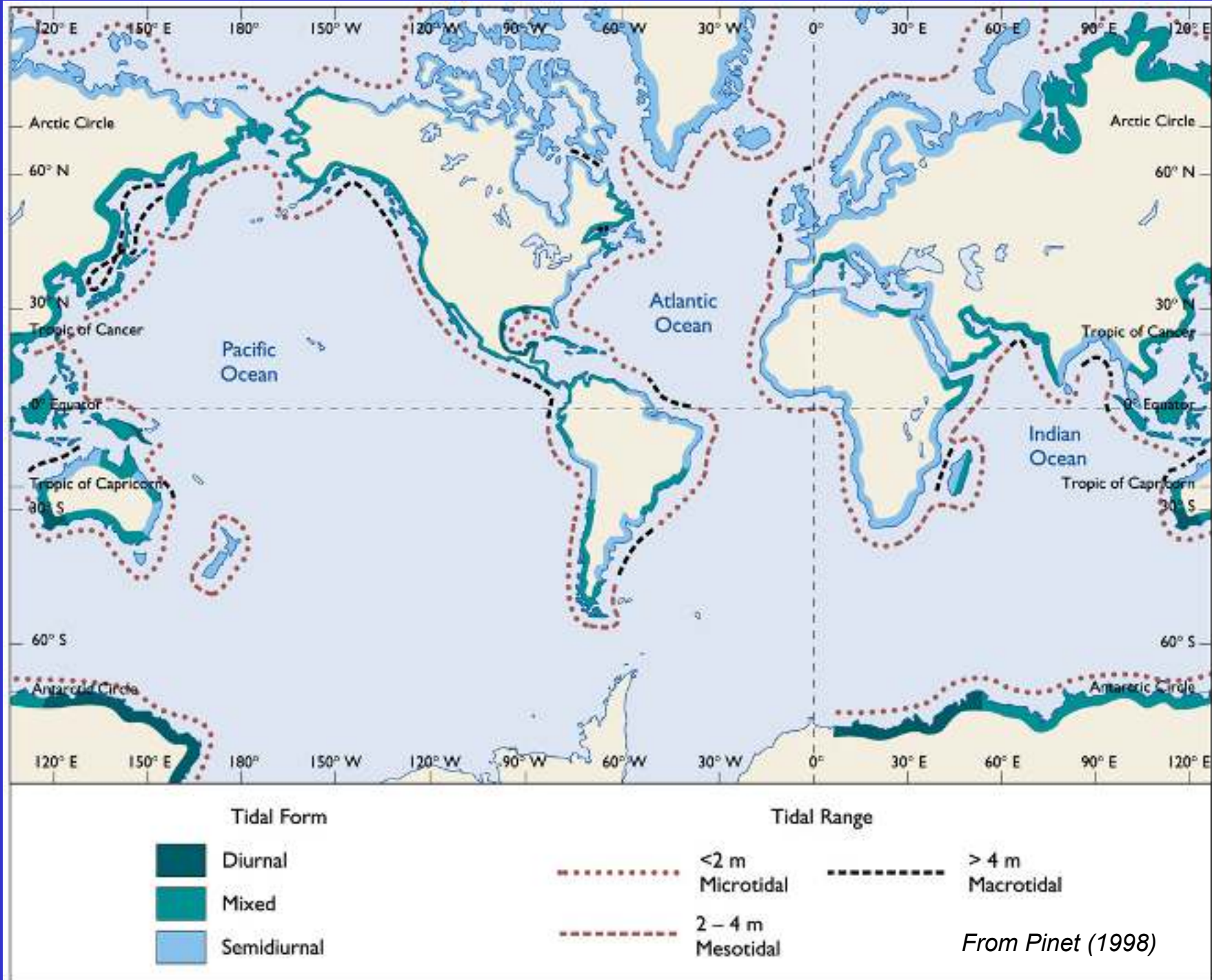


In Hampton Roads: $M_2 = 0.72$ m; $N_2 = 0.16$ m; $O_1: 0.08$ m; $S_2: 0.13$ m; $K_1 = 0.10$ m

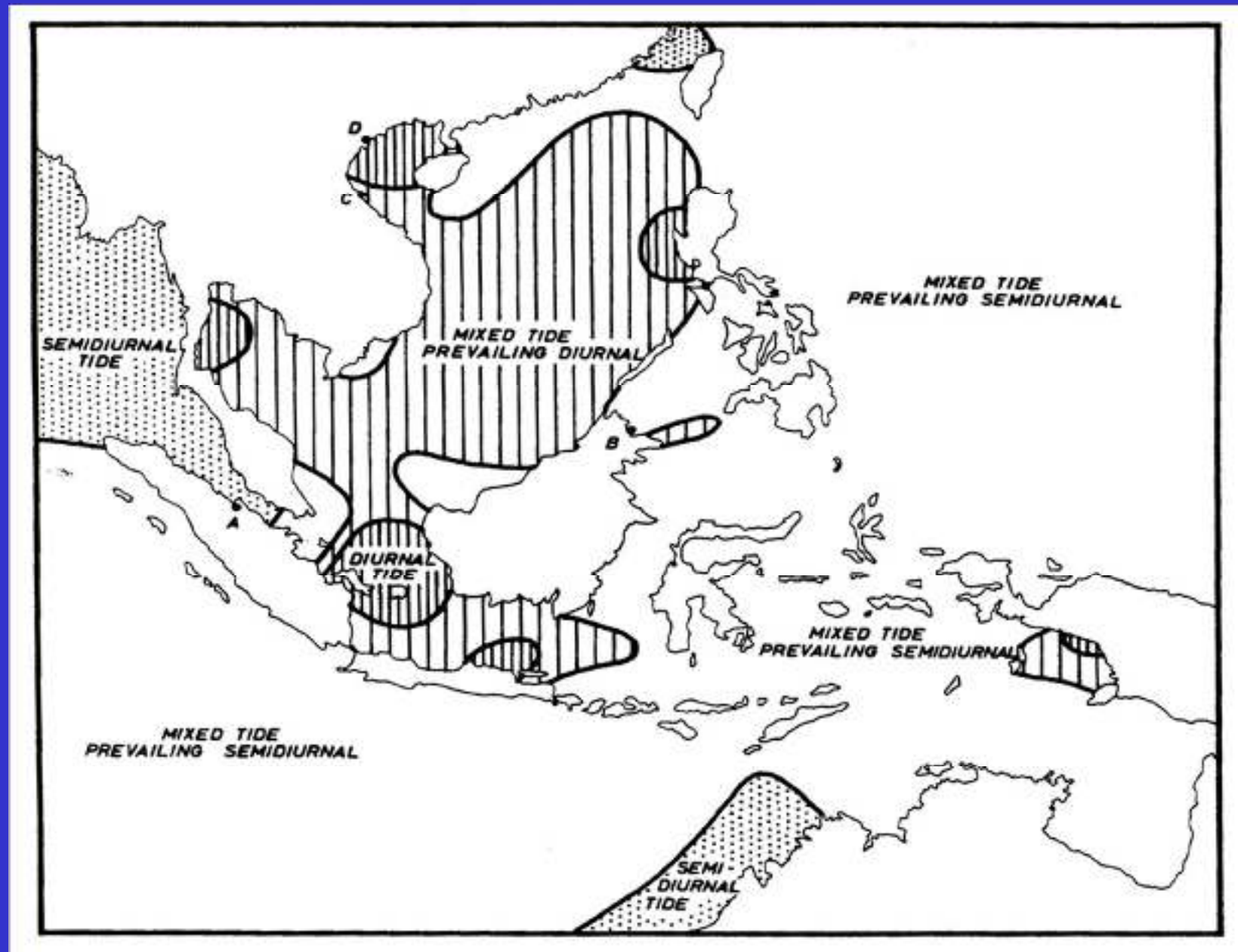
$$F = [K_1 + O_1] / [S_2 + M_2] = 0.21$$



Geographical Distribution of Tidal Pattern



Geographical Distribution of Tidal Pattern at the South East Asian Waters



Daya listrik dapat dihasilkan dgn menahan pasang surut yang masuk dan keluar dibalik sebuah bendungan, menggunakan kepala air yang dihasilkan untuk menggerakkan turbin agar menghasilkan listrik. Kisaran pasang surut mengendalikan energi potensial yang tersedia pada tempat manapun, dan harus melewati 5 m agar listrik yang dihasilkan bernilai ekonomis. Lokasi yang sesuai terbatas pada kisaran yang sesuai dan bendungan dapat dibangun secara praktis



(a)

Gambar 7.15 (a) Lokasi stasiun tenaga pasang surut La Rance. Stasiun ini telah memproduksi sekitar 550×10^8 kWh sejak tahun 1966. (b) Pemandangan lokasi La Rance. (The Open University, 1994).



(b)

Tidal Energy

