CIVIL ENGINEERING MARVELS OF RECENT TIMES

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VIADUCTS / BRIDGES

BANDRA – WORLI SEA LINK, MUMBAI

- **It constitutes (i) North end approach structure with precast segmental construction, (ii) the cable stayed bridge at Bandra channel 250 m X 250 m, (iii) another cable stayed bridge at Worli and (iv) the South end approach structure.**
- **This was executed by Hindustan Construction Company.**
- **The total length of the structure-5.6 kms.**
- **Functionally "highly efficient" bridge with elegance of the highest order.**

HYDRAULIC STRUCTURES

NARMADA CANAL SYSTEM, GUJARAT

Type of canal	**:**	**Lined Contour Canal**
Length	**:**	**458 km upto Rajasthan border and 74 km in Rajasthan**
FSD in head reach	**:**	**7.6 m**
Basewidth in head reach	**:**	**73.0 m**
Discharge capacity in head reach	**:**	**1133 cumecs (40,000 cusecs)**

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Gross command area : 34 lakh hectares

Gross length of branch canals : 2,500 km

Gross length of distributaries : 5,500 km

Gross length of minors, subminors : 30,000 km

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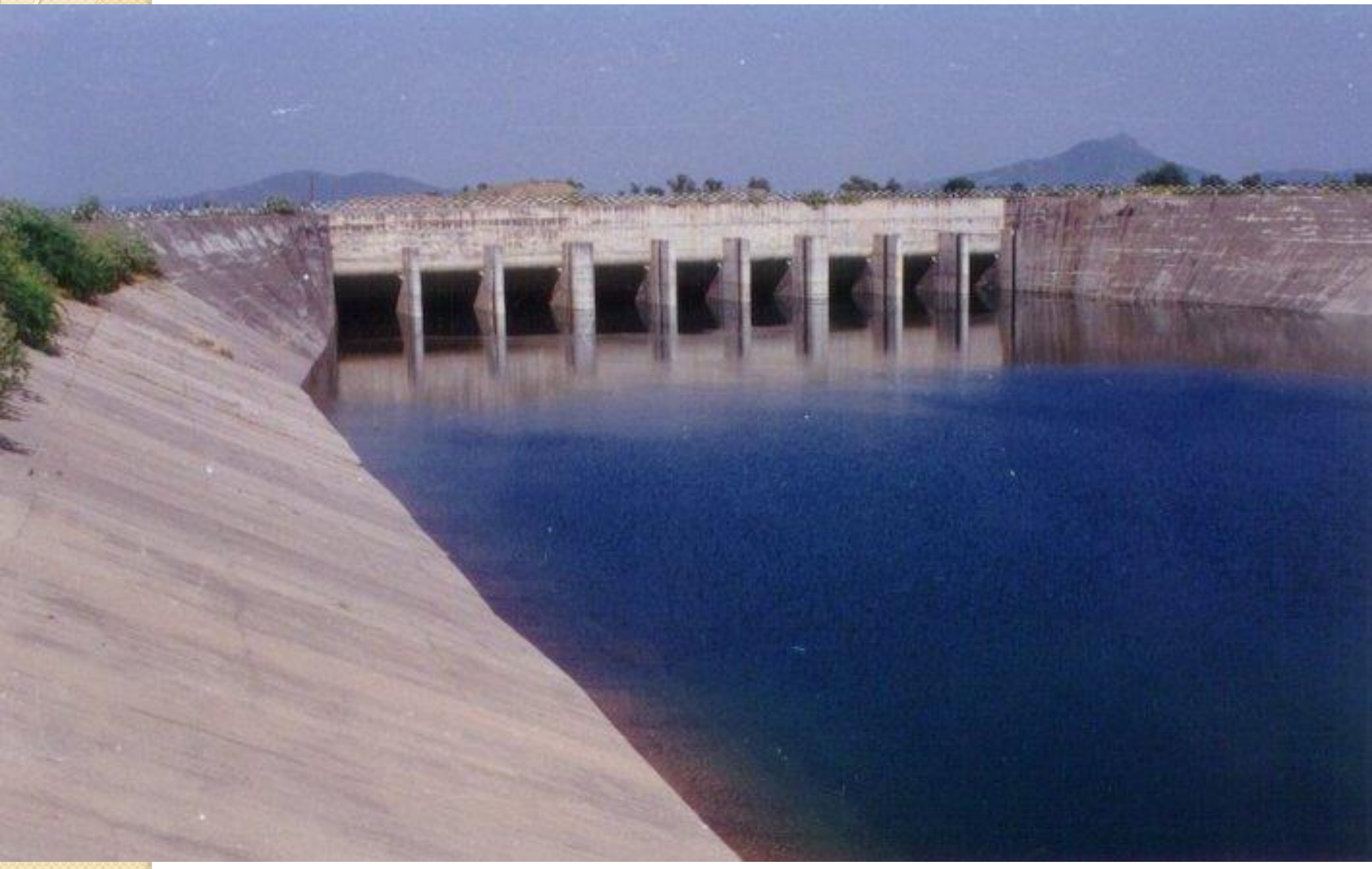
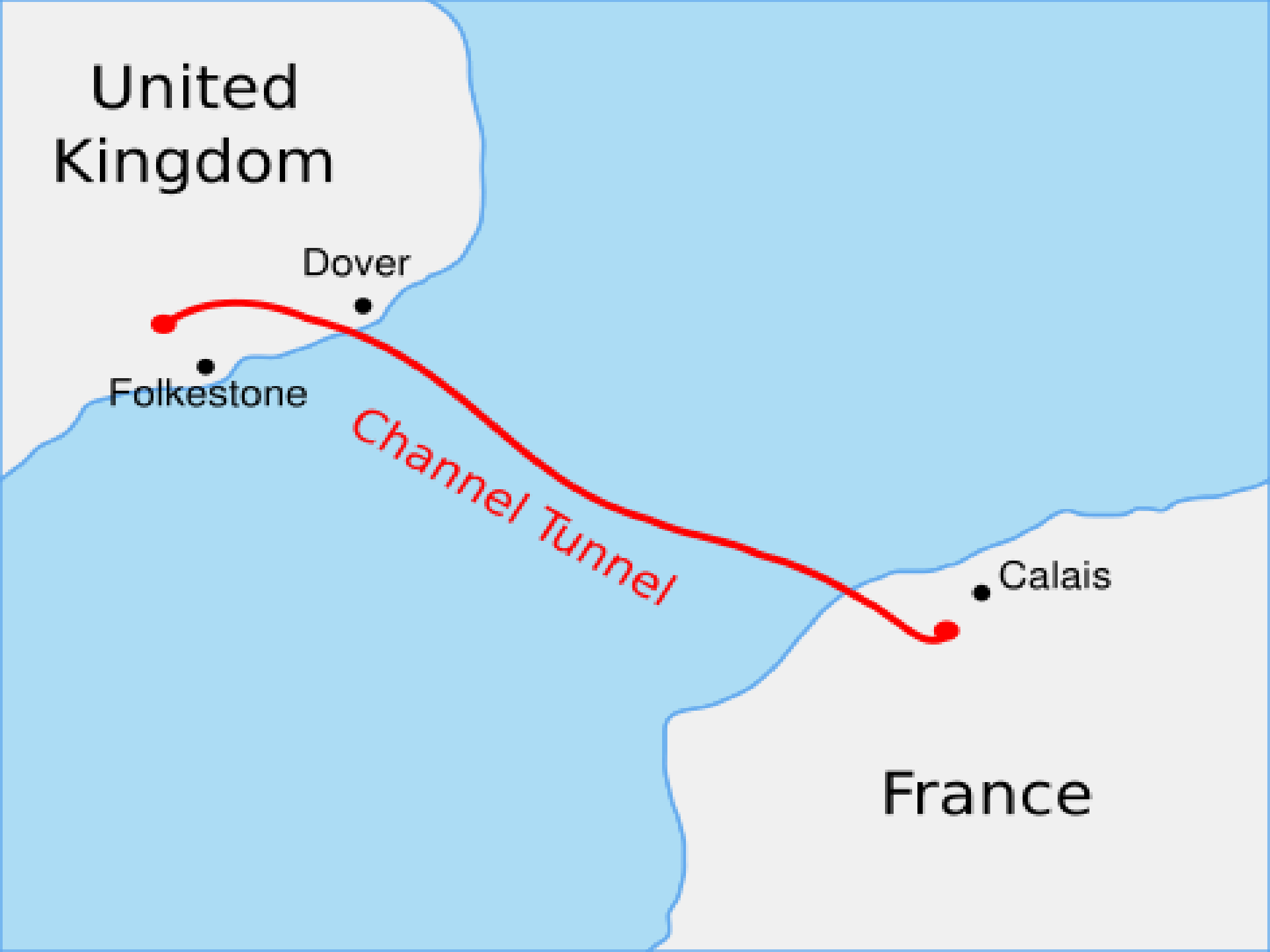


DELTA WORKS, NETHERLANDS

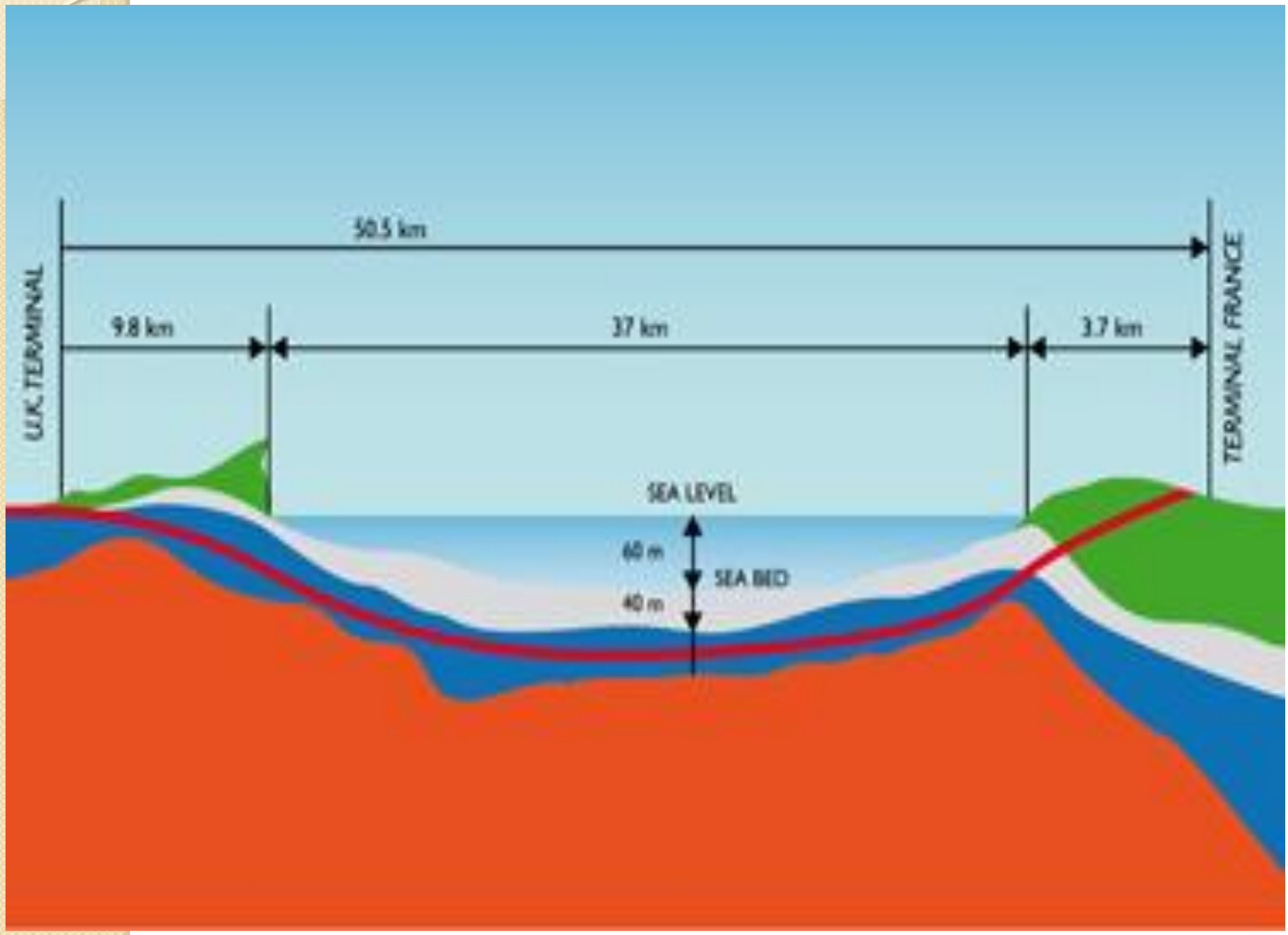
- The flooding in 1953 made it very clear how vulnerable the land and the people living there were. Therefore a huge effort the Delta Works project was made to create a new and better protection to make sure this would not happen again.
- The piers support 300- to 500-ton steel gates and their hydraulic machinery, as well as a roadway above and load-bearing beams below.
- The height of one pillar is 38 meter and its weight 18,000 tons. When the sea becomes dangerous, one hour is enough to lower the flood gates.

LINKING PROJECTS

UK CHANNEL TUNNEL


United Kingdom
Dover
Folkestone
Channel Tunnel
Calais
France

- **50.5 km undersea rail tunnel linking UK and France.**
- **At lowest point it is 75 m deep (45 m below the sea bed).**
- **Carries high speed passenger trains.**
- **Commissioned in 1994.**
- **Consists of two 7.6 m dia rail tunnels 30 m apart with a 4.8 m service tunnel in between and cross passages.**
- **Precast segmental linings provided.**


50.5 km
9.8 km
37 km
3.7 km
U.K. TERMINAL
TERMINAL FRANCE
SEA LEVEL
60 m
40 m
SEA BED

INTERNATIONAL AIRPORTS

HONGKONG INTERNATIONAL AIRPORT


Lantau Island 大嶼山
Hong Kong Special Administrative Region
of the People's Republic of China
Legend
Rail
Road
Townships
New Town/Airport/Utilities
Airport Express Line/
Tung Chung Line
Towards Tsing Yi
Ma Wan
Sunny Bay
Yam O
The Brothers
AsiaWorld-Expo
and SkyCity
North Lantau
Highway
Hong Kong
Disneyland
Siu Ho
Penny's Bay
Tai Pak Wan
Hong Kong
International Airport
Hong Kong-Zhuhai-
Macau Bridge
(Two Proposed Routings)
Tai Ho
Discovery Bay
Tung Chung
Peng Chau
Lantau North
Country Park
Mui Wo
LANTAU ISLAND
Ngong
Ping
Tung Chung
Road
South
Lantau
Road
Hei Ling Chau
Tai O
Lantau South
Country Park
Shek Pik
Reservoir
Chi Ma Wan
Pui O
Cheung Sha
Cheung Chau
Fan Lau
Shek Kwu Chau
Soko Islands

- **This Airport has been termed by many as "the most ambitious Civil Engineering project of recent days".**

- **It has the largest passenger terminal in the world, heaviest jets are being parked.**

About 35 kms of super highways and tunnels are built to connect the Airport to the main city.

- **The project was completed with construction duration of 9 years.**

- **The Airport is located essentially on reclaimed land.**

- **The existing hillocks in the small / scattered islands were removed and the excavated rubble along with enormous quantum of additional fill was dumped to integrate the individual small islands into a large single island.**

- **The terminal had to be nailed firmly to the foundation to save it from ocean tides which inturn were nailed to the bed rock by concrete piles.**

TOWER STRUCTURES

BURJ DUBAI
(BURJ KHALIFA)

- Tallest man made structure in the world to-day.
- Founded on 192 piles 50 m deep.
- Consumption: 330,000 cu.m of concrete and 39,000 tonnes of steel.
- Concrete was pumped upto 156^{th} floor – above that was light steel structure.
- Total height - 828 m.

EMPIRE STATE BUILDING

- The Empire State Building located in Manhattan.
- The Building Materials on the exterior is Indiana limestone and granite, trimmed with aluminium and chrome nickel steel from the 6th floor to the top, the interior the lobby was made by Ceiling high marble, imported from France, Italy, Belgium and Germany.
- It has height 448 meters to top of antenna, 391 meters to 102nd floor observatory, 320 meters to 86th floor observatory. And cover an area of 83,860 square feet.

SPORTS STADIUM

BEIJING NATIONAL STADIUM

- The Stadium is a marvelous structure backed up by superb structural design and excellent materials.

The structure, however random it might look, follows the rules of geometry.

- The construction commenced in 2003, and completed in 2008.

- The 3D steel roof spans 330 metre long, 220 metre wide space, also encompassing a grass field of 800 sq.m.

- Since Beijing is highly vulnerable to earthquake, the steel roof is separated from the seating bowl to render the structure earthquake resistant.

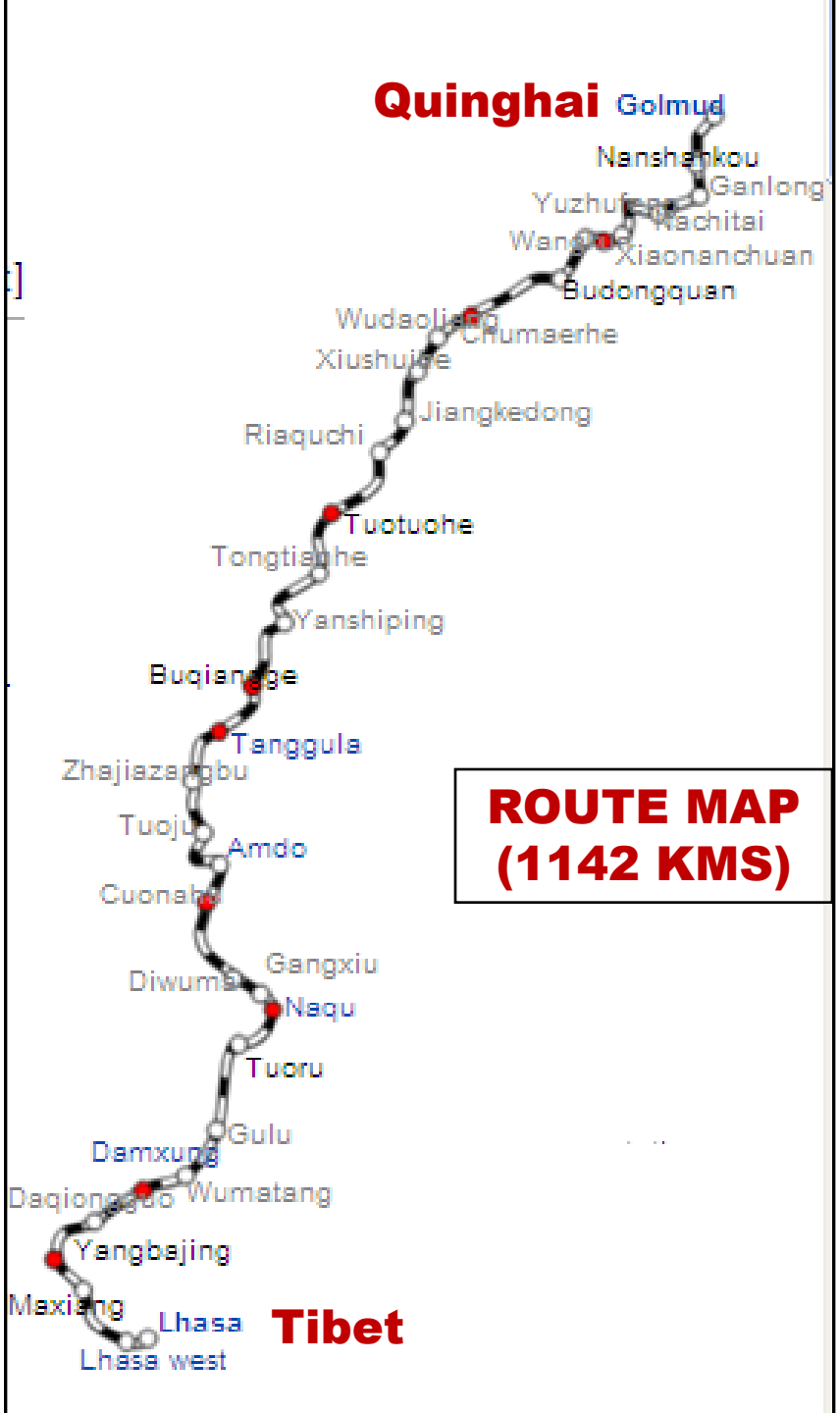
- The structure is one of the world's largest steel structure.

- One of the special features is the provision of underground geothermal pump system through which ground source energy is collected. This, in turn, keeps the stadium cool in summer and warm in winter.

- The stadium is a tribute to modern engineering skills.

RAILWAY LINE

QINGHAI – TIBET RAILWAY
(Golmud – Lhasa Railway line)


Quinghai
Golmud
Nanshankou
Ganlong
Yuzhufeng
Nachitai
Xiaonanchuan
Budongquan
Wudaolianq
Chumaerhe
Xiushuihe
Jiangkedong
Riaquchi
Tuotuohe
Tongtianhe
Yanshiping
Buqiangge
Tanggula
Zhajiazangbu
Tuoju
Amdo
Cuonahe
Gangxiu
Diwumai
Naqu
Tuoru
Gulu
Damxung
Wumatang
Yangbajing
Maxiang
Lhasa
Lhasa west
Tibet
ROUTE MAP
(1142 KMS)

- **The railway line runs between Golmud and Lhasa for a distance of 1142 kms. The construction commenced in 2001 and completed in 2006.**
- **The average altitude over 80 percent of the route is over 4000 m (above sea level) and the average temperature during the year is about - 7 ºC.**

About 550 km of the line is laid on permaforst.

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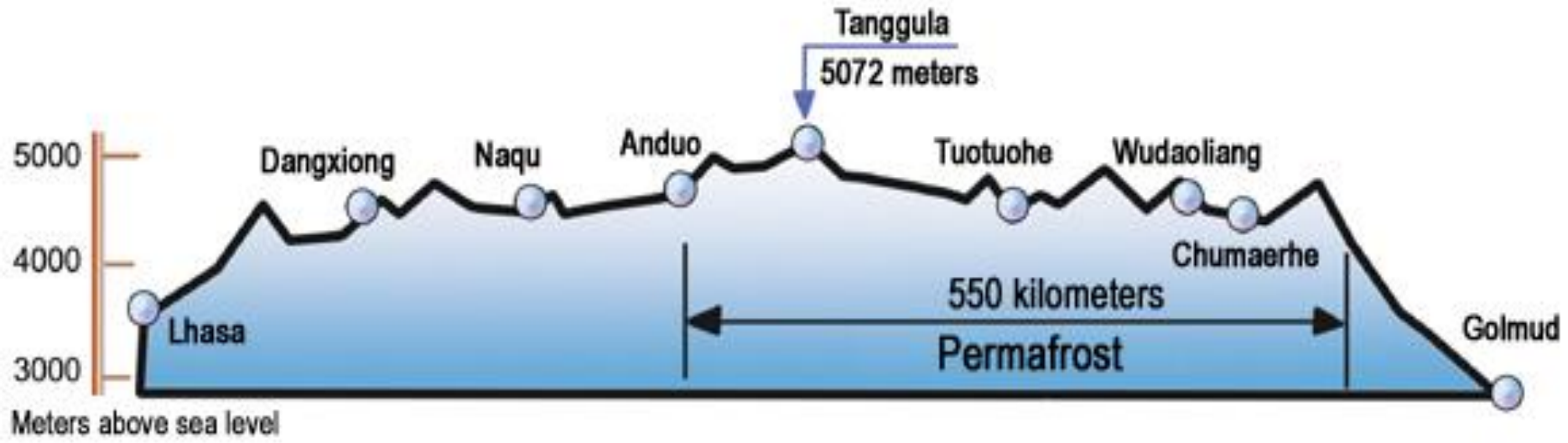
Vertical Sectional Diagram (Golmud - Lhasa section of Qinghai-Tibet Railway)



- Low temperatures, low oxygen levels, fragile ecology, seismic hazaards etc., have been the challenges both during construction and during maintenance.

- In the permafrost region, elevated tracks are built with foundations sunk deep into the ground. Where tracks are built on ground in permafrost region, the rail beds are passively cooled by various means to keep it frozen during summer.

ARCHITECTURAL MARVELS

LOTOUS TEMPLE

- **This Lotus Temple structure is a prominent attraction in Delhi, constructed in 1986.**
- **The temple reaches a height of more than 40 mtrs with 27 giant white petals of marble in a lotus shape, springing from high pools.**
- **The complex consists of the main house of worship, the central hall and the ancillary service blocks. The central hall is capable of holding upto 2500 people.**

- **The surfaces of shells are cladded with marble panels fixed to the concrete surface with specially designed stainless steel brackets and anchors.**

- **The reinforcement used was entirely galvanized steel to avoid long term negative effects of corrosion of rebars.**