RAMA UNIVERSITY

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Transportation Engineering - 1

Department of Civil Engineering

Faculty of Engineering & Technology

TRANSPORTATION ENGINEERING – I (Highway Engineering)
Lecture – 2 & 3 (Unit – 1)

Topics to be covered:

History of Road Development

- PATHWAYS (PAGDANDI / LEEK)
- ANIMAL DRAWN ROADS
- INDUS – VALLEY CIVILIZATION ROADS
- ROMAN ROADS
- FRENCH ROADS OR TRESAGUET ROAD
- TELFORD CONSTRUCTION
- MACADAM ROAD
- DIFFERENCE BETWEEN TELFORD AND MACADAM ROAD
- WATER BOUND MACADAM (WBM) ROADS
- WET MIX MACADAM (WMM) ROADS
- MODERN ROAD CONSTRUCTION

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HISTORY OF ROAD DEVELOPMENT

Pathways (Pagdandi / Leek): These human pathways would have been created for searching purposes prompting campgrounds, food, streams for drinking water and so on.



Animal Drawn Roads : For shipping the men and materials. Since these stacked animals required more level and vertical clearances than the strolling man, track ways rose. The invention of wheel in early Mesopotamian Civilization – Ubaidian culture (approx 3500 – 5000 B.C.) was a revolution in they transport system.



INDUS – VALLEY CIVILIZATION ROADS

Indus – Valley Civilization (2600 – 2800 B.C.) flourished with well planned towns having an elaborate street and drainage system. The streets were laid out in regular order in straight lines (modern grid pattern). The biggest street in Mohenjo Daro was half a mile long and about thirty feet wide. It is likely that the wheeled carts were in existence then.

Harappan Roads

Street paving has been found from the first human settlements around 4000 BC in cities of the Indus Valley Civilization on the Indian subcontinent in modern-day Pakistan, such as Harappa and Mohenjo-Daro. Roads in the towns were straight and long, intersecting one another at right angles.

ROMAN ROADS

➢The most punctual huge scope street development is ascribed to Romans who built a broad arrangement of streets transmitting in numerous directions from Rome.

- The Roman Civilization (eighth Century B.C.) was notable for acceptable street framework it assembled.

➢Around 1,00,000 km. street organize filled military and regulatory needs of the Roman Empire reached out over tremendous districts. Rome was the point of convergence from where 29 significant streets emanated every which way.

- This is the premise of the acclaimed saying: "All streets lead to Rome."

➢The top layers of the pavement comprised of level stones. Lime mortar was utilized to solidify the stones. Scaffolds were worked over the waterways with stone squares.

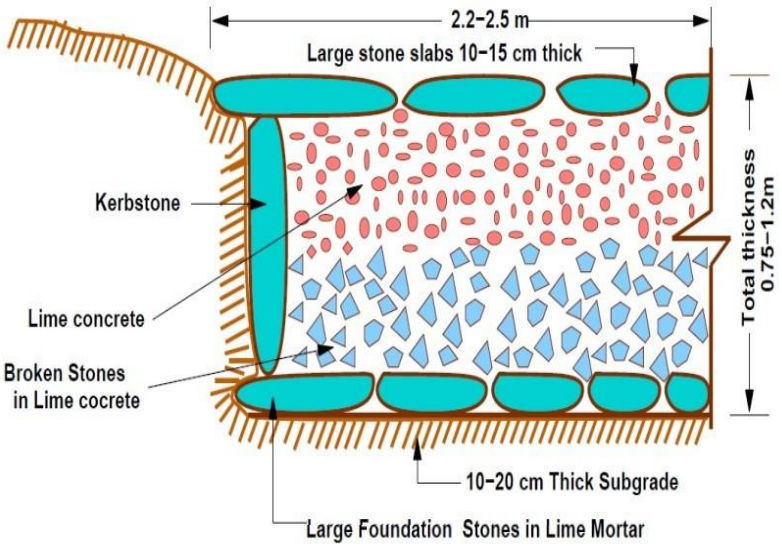
- The art of building long and durable bridges was specialty of Roman civilization.
- Appian way which was build by Romans in 312 B.C. extended over a length of about 580 KM.

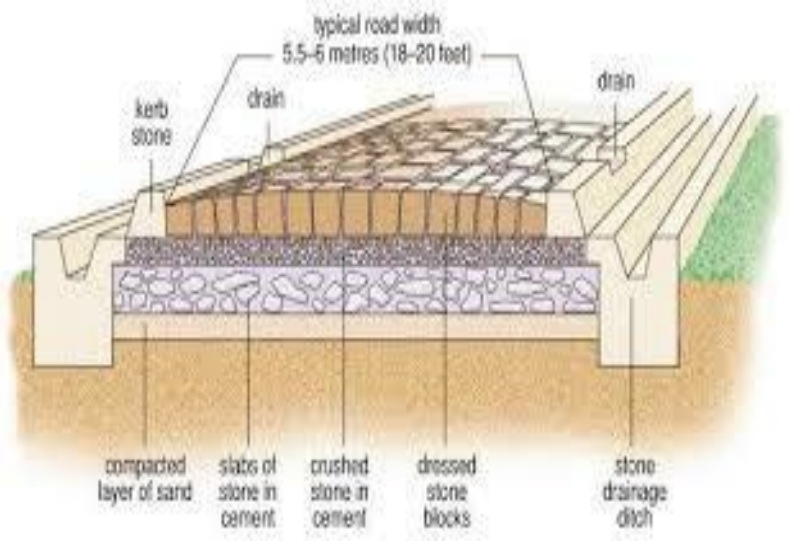
Salient Features:

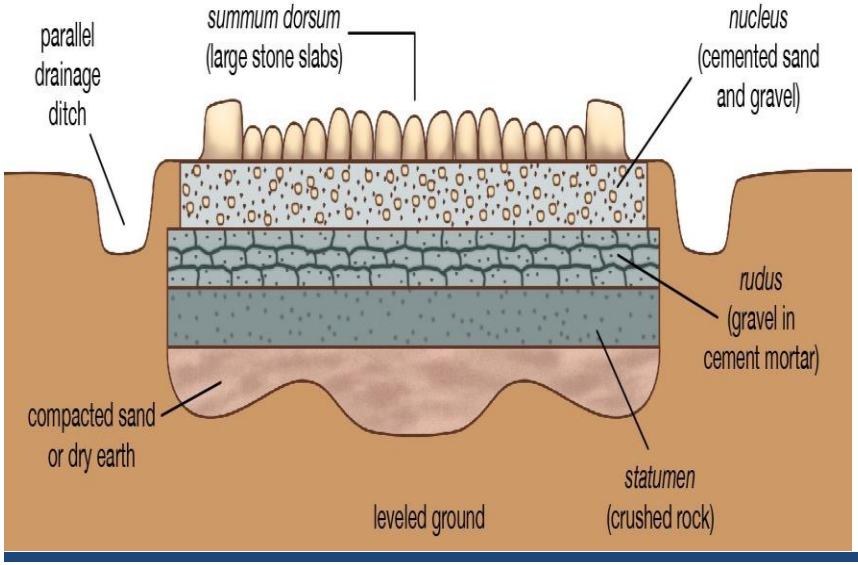
- An earthed road with a graveled surface.
- They were build straight without any gradient.
- The soft soil from top was removed till the hard stratum was reached.
- The total thickness of road section worked out as high as 750 mm to 1200 mm.

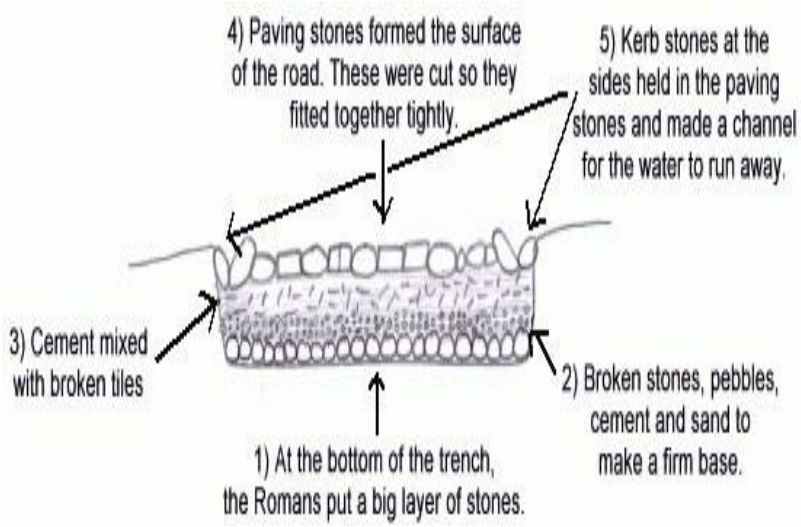


Layout and Cross Section of Roman Roads







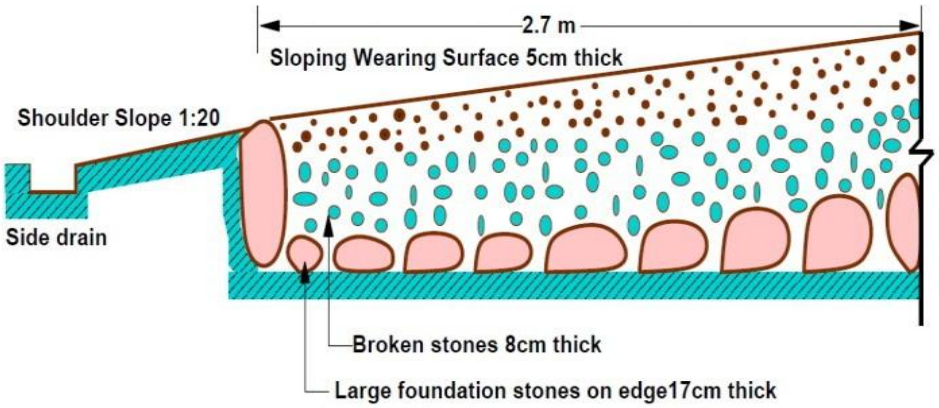


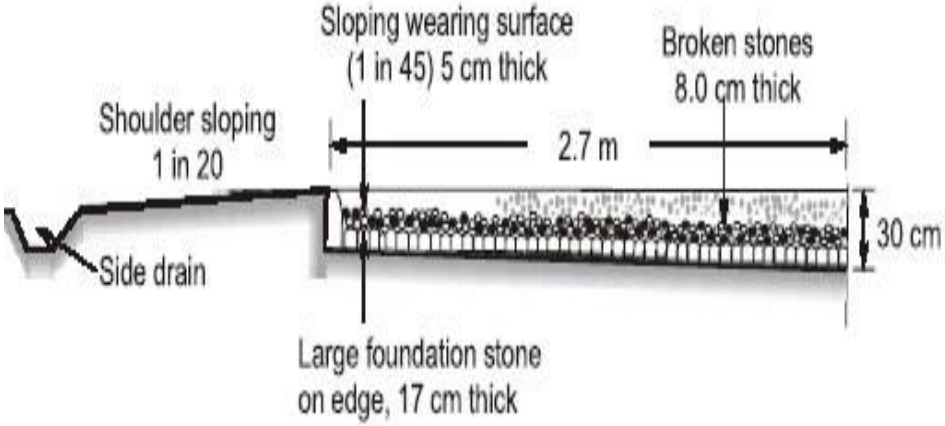
FRENCH ROADS OR TRESAGUET ROAD

- The next major development in the road construction occurred during the regime of Napoleon.
- The significant contributions were given by Tresaguet in 1764 and a typical cross section of this road.
- Pierre Tresaguet developed an improved method of construction in France during 1764 AD.
- He developed a cheaper method of construction than the locally unsuccessful revival of Roman practice .
- The pavement used 200 mm pieces of stone of a more compact form and shaped such that they had at least one at side which was placed on a compact formation.
- Smaller pieces of broken stones were then compacted into the spaces between larger stones to provide a level surface.
- Finally the running layer was made with a layer of 25 mm sized broken stone.

Salient Features :

- The thickness of road was order of 30 centimeters.
- Consideration was given to subgrade moisture condition and drainage of surface water.
- The top wearing course was made up of smaller slope having a cross slope of 1 in 45 to the surface to provide surface drainage.
- Shoulder sloping was also provided of the order of 1 in 20 to drain the surface water to the side drain.



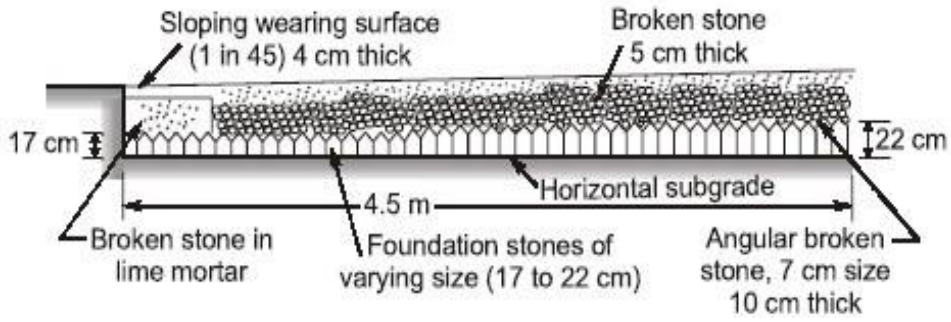


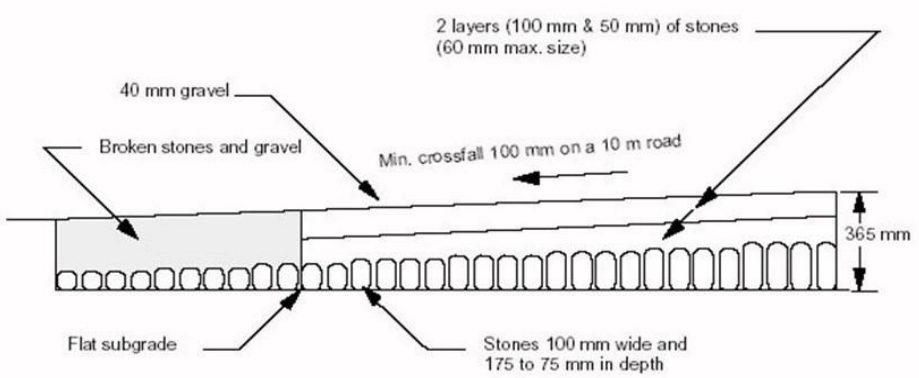
TELFORD ROADS OR TELFORD CONSTRUCTION

- The next development was done by Scottish engineer Thomas Telford (1757-1834).
- His work started in early 19th century in England.
- His main principles as an engineer, throughout the Highlands, were to take the gentlest gradients, with substantial bridges and box culverts in place of cobbled fords.
- This was to ease the passage of Carriages and other wheeled traffic.
- The surface was also to be dressed with 'a good depth' - records suggest 30-40cm (12-15 inches) - of gravel to prevent damage to the hooves of the livestock.
- He was responsible for the Caledonian Canal; harbor works at Aberdeen, Dundee, and elsewhere; and the building of more than 900 miles (1,450 km) of roads, including many bridges.

SALIENT FEATURES:

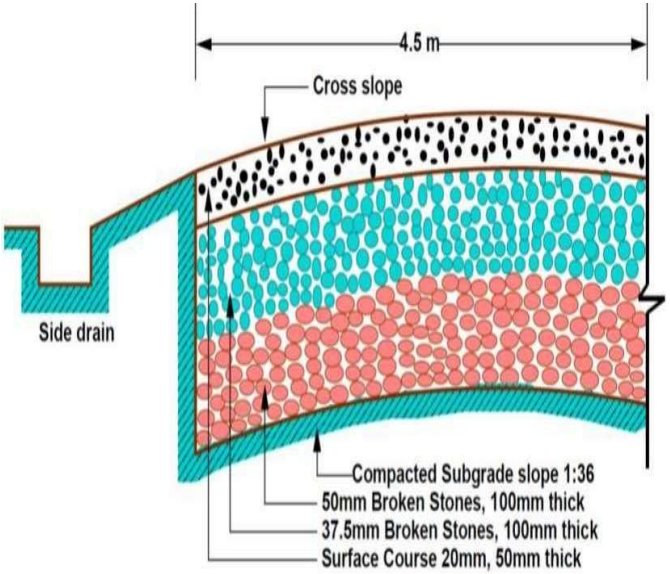
- He proposed a level subgrade of width 9 meters.
- Thickness of foundation stone varied from 17 cm. at edges to 22 cm. at the centre.
- A binding layer of wearing course 4 cm. thick was provided with cross slope of 1 in 45.
- The centre of about 5.5 meters width was covered with two layers of angular broken stones to compacted thickness of 10cm and 5 cm.

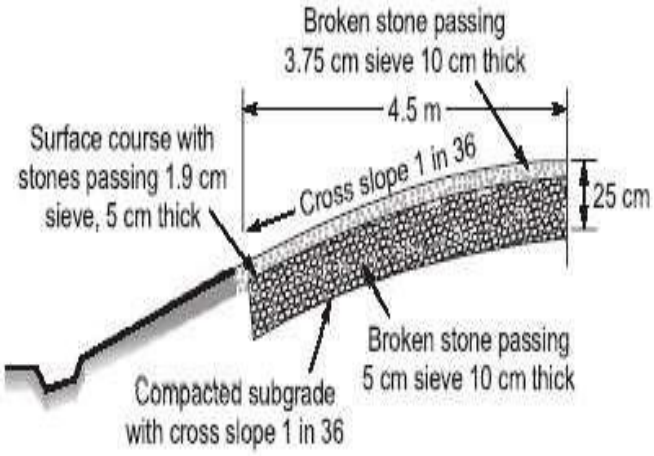




BRITISH ROADS OR MACADAM ROAD

- The British engineer John Macadam introduced what can be considered as the first scientific road construction method.
- Stone size was an important element of Macadam road.
- By empirical observation of many roads, he came to realize that 250 mm layers of well compacted broken angular stone would provide the same strength and stiffness and a better running surface than an expensive pavement founded on large stone blocks.
- Thus he introduced an economical method of road construction.
- Metcalf accepted that a decent street ought to have great foundations, be all around depleted and have a smooth arched (Rounded) surface to permit water to deplete rapidly into trench along the edge of the street.
- The importance to subgrade drainage and compaction was given so the subgrade was compacted and prepared with cross slope of 1 in 36. The size of broken stone for the top layers was decided on the basis of stability under animal drawn vehicles.
- The pavement surface was also given the cross slope of 1 in 36.
- Total thickness was kept uniform from edge to centre to a minimum of 25 cm.





DIFFERENCE BETWEEN TELFORD AND MACADAM ROAD CONSTRUCTION

PARAMETER	TELFORD CONSTRUCTION	MACADAM CONSTRUCTION
Subgrade Slope	Horizontal	1 in 36
Foundation stone	From 170 mm to 220 mm.	From 50 mm to 100 mm.
Base course	Two layers of broken stones	One layer of broken stone
Surface course	40 mm thick with slope 1 in 45	50 mm thick with slope 1 in 36
Thickness of cross section	410 mm at center and 350 at edge	Uniform 250 mm only.

WATER BOUND MACADAM (WBM) ROADS

➢Macadam's technique for development picked up acknowledgment as a logical strategy for development and henceforth was received by different notions with slight alterations.

➢ One of the most famous strategies which is now common in numerous nations is the water bound macadam (WBM) roads.

➢In this strategy the messed up stones of the base course and surface course, if any , are limited by the stone residue in nearness of dampness and consequently the name.

➢WBM streets are being used in India both as a completed base course surface for minor streets and as a decent base course for prevalent roads conveying heavy traffic.

➢Residue is shaped on the streets surface during dry climate because of smashing and scraping activity of steel tyred creature drawn vehicles, which is effortlessly raised by quick moving vehicles.

➢So as to limit the residue irritation a few residue palliatives including overwhelming oils and bituminous materials were attempted with differing degrees of accomplishment.

WET MIX MACADAM (WMM) ROADS

- The WMM process is a newly developed concept. Earlier it was done through the WBM (water bound macadam) process.
- While constructing a road, there needs to lay down the base course material right before hot mix asphalt is laid, and that process done through the Wet Mix Macadam.
- Wet Mix Macadam consist of laying spreading and compacting of clean, crushed, well-graded granular materials on a prepared and approved Granular sub-Base.
- The materials used for the sub-base, base or existing pavement are prepared in a plant as per the specifications provided.
- It shall be laid on one or more layers as per line and level, grade and cross section
- Once it is prepared, it is brought to the site for overlaying and rolling under the guidelines of engineers.
- The thickness of single compacted Wet Mixed Macadam (WMM) Base shall not be less than 75 mm.
- The Maximum thickness of single compacted layer base can be up to 250 mm

Advantages of WMM over WBM

- ✓ The roads constructed through WMM process are durable.
- ✓ The WMM roads get dry sooner as compared to that of WBM.
- ✓ The WMM process allows constructing road faster than other processes.
- ✓ The WMM process saves plenty of water.
- ✓ The WMM machines are easily operated and give a bunch of benefits.

"Thank you"

Have Any Query ?

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