HIGHWAY ENGINEERING
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Souvik
2021

INTRODUCTION

- The process of conveyance from one point to another is termed as transportation

- Transportation has following effects over the socio-economic aspect of the life.

  (a) It helps in progress and advancement of the community.

  (b) Efficient transportation is essential for the economic prosperity and development of the country.

  (c) It helps in movement in emergency for defence of the country and to maintain better law and order.

Medium of transportation :-

- Transportation can be achieved by any of the following media.

(i) Land (ii) water (iii) Air	} Major	(iv) pipeline. (v) conveyor belt. (vi) Elevator. (vii) cable cars. (viii) Rope way. (ix) Hyper loop.
		} MINOR.

On the basis of the above media of transportation following four major modes of transportation are used.

(a) Roadway / Highway for road transportation.
(b) Railway " rail "
(c) water way " water "
(d) Airways " Air "

Railway :-

- It is the movement of multiple wagons or a train of wagons with steel wheels over two parallel steel rails, that offers comparitively lesser resistance. Hence the cost of transportation by this method is approx. $\frac{1}{6}$th of that by road transportation. but less flexible.

- Railways are considered as arteries of an nies transportation system.

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WATER TRANSPORTATION :-

- It offers min. resistance to traction, hence is cheapest method amongst the all.
- But the time required in this case is comparitively more.
- It is suitable for transportation of bulk goods of relatively low value.

AIR TRANSPORTATION :-

- It is the fastest method available for transportation.
- But the cost involved in this is also very high.
- It is suitable for transportation of high value goods for large distance.
- This method is affected by weather conditions.

ROADWAY / HIGHWAY :-

- It is the most flexible mode of transportation amongst the all.
- But it consumes petroleum product at highest rate and rate of emission of pollution is highest in this case.
- Major road transportation is achieved by highways and expressways.
- Highways are special type of roads designed to allow high speed of vehicle.
- It is generally constructed on embankment as

(a) Better drainage facility
(b) Safety in flood time.
(c) no lateral entry of public or animals.

Eg :- National Highway (NH) and State Highways (SH)

- Expressways are superior type of highways which are designed as a direct source of connectivity b/w two defined points.

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- It is also known as freeway. It organise the traffic in channelised way

Eg:- Kona expressway.

DEVELOPMET OF ROADS :-

Development of roads took place in following sequential order.

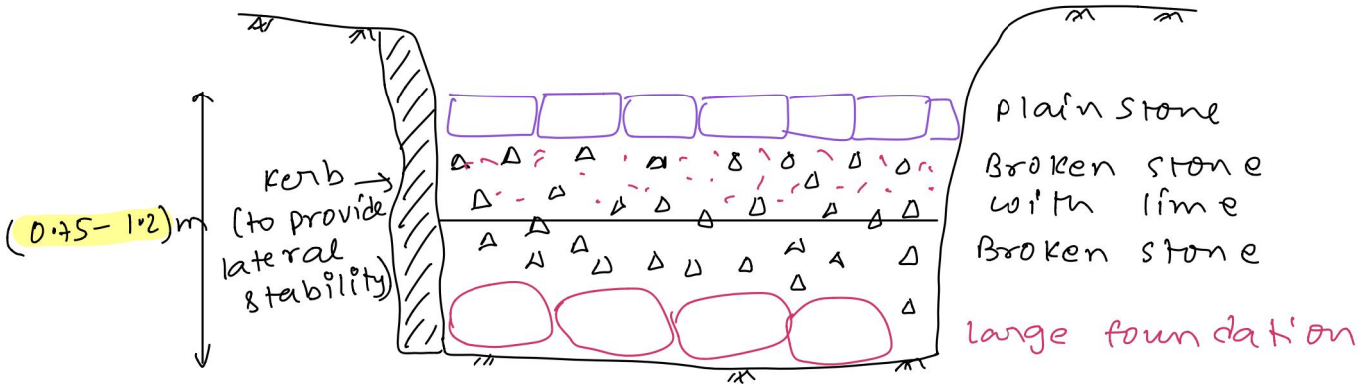
(i) ROMAN ROADS.
(ii) TRESAGUET ".
(iii) METCALE ".
(iv) MACADUM ".

(i) ROMAN ROADS :-

- These were the earliest of the roads developed for their military purposes.

- These roads involves

(a) They were built straight regardless of gradient.
(b) The soft soil was excavated and removed up to an extent hard strata was reached.
(c) The total thickness of construction was in range of (0.75 - 1.2) m.



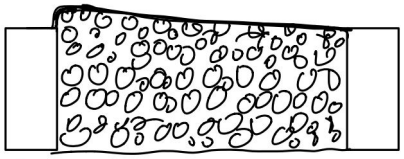
Drawbacks :-

(i) No cross-slope is provided.
(ii) No drainage system.
(iii) large foundation stones were provided at bottom which are of no use, as pressure due to surface load decreases with depth. Hence they only increases the cost.

(ii) TRESAHUET ROADS :- (France)

- The main feature of these roads was reduction in overall thickness of the road upto 30cm.
- In this case due consideration was given to the moisture condition and drainage of the road.
- The subgrade was prepared and a large layer of foundation stone are laid on edges, which act as curb stone.
- The space b/w the kerb is then filled with smaller stones, sized of which reduced as we approach to top.
- Here cross-slope of 1 in 45 over the surface is also provided.

NOTE:- Metcalf road were developed in parallel to previous one, but no recorded literature is available for it. (developed in England)



Tresguet Road.

19th Dec

(iii) TELFORD ROADS :-

- In this also heavy/large foundation stones were provided above the soil subgrade and cross slope at top surface was given to ensure removal of the water.
- A level subgrade was prepared of width 9m
- large foundation stones of thickness (17-22)cm was laid over the subgrade, with larger stone at the centre and smaller at the edges to provide 1:45 slope
- The central portion of about 5.5m width was filled with two layers of angular broken stones.
- A 4cm thick gravel surfacing was laid at top and cross-drains were provided at spacing 90cm.
- Instead of kerbs a layer broken stones were used to impart lateral stability.

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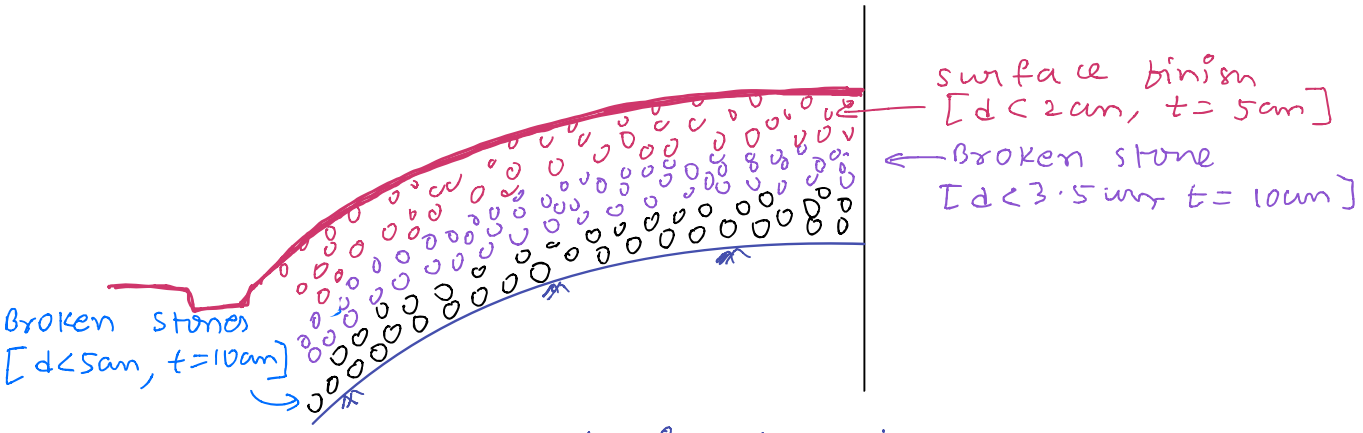
Note :- From roman roads to telford roads two design consideration were common

(i) Subgrade soil was constructed on a level surface

(ii) large foundation stones were used to make bottom most layer.

(iii) The major change in designing of roads was introduced by macadum.

(iv) MACADUM ROADS :-



compacted soil sub grade
[cross-slope 1 in 36]

- Macadum roads differs from previous design in following aspects.

(a) Soil subgrade was also laid at a cross-slope of 1 in 36 to avoid the seepage of water in it.

(b) He was the first one to suggest that large foundation stones are not required to be placed at the bottom layer.

(c) Similarly the next layer of pavement also was constructed above this layer with broken stones of smaller size.

(d) Though the total thickness of construction was less, but load distribution was comparitively better.

(e) The size of broken stones at top was decided on the basis of stability under animal drawn vehicle.

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NOTE:- (i) Different types of specification were develop for the construction of bituminous pavement layers for use in base and surface courses.

(ii) Some of the specs used in India are as follows:

(a) WBM (water Bound macadum)
(b) PM (Penetration macadum)
(c) BM (Bituminous macadum)
(d) DBM (Dense Bound macadum)
(e) WMM (wet mix Macadum)

DEVELOPMENT OF ROADS IN INDIA

Mohenjo-Dara → Ashoka → Mughal → Britishers.

(I) Govern ment of India paused the resolution in 1927 for appointment of a committe to examine the situation and development of Roads in India under the leadership of MR Jaykar.

- Major recommendations of this comm. are as follows

(i) The Road development in the country should be the subject of NATIONAL INTEREST

(ii) An extra tax should be leaved on PETROL from the users for development of roads & would be termed as central Road fund.

(iii) A semi-official technical body should be we formed to give technical know how for development of roads.

(iv) A research organisation should be instituted to carry out research and develop neco techniques of Road development.

(II) AS per the recommendation of Jaykar committee CRF (central Road fund) was established in 1929

(III) At the approval of govt a semi-official technical body was form in 1934 termed as IRC (Indian road congress)

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(IV) In 1939, Motor vehicle act was brought in place to frame the laws and ordinances relating to traffic. [It governs driver vehicle and owner operation]

(V) A conference of chief Engineer of all states was called by IRC for collective development of roads in India in 1943 [1st 20 year plan] (1943-1963) [It was completed in 1961 only] termed as nagpur road conference,

In this target of 16 km / 100 km² area of country for development of roads was to be achieved.

(VI) In 1950 central Road research institute (CRRI) was established for carrying out research of Road technology.

(VII) In 1956 national highway act was passed for following purposes.

- To declare certain selected highway as NH
- To enter into any land for carrying out survey.
- To acquire land & take possession for development of highway.

(IX) Due to the early completion of first 20 yr plan in 1961, second 20 yr plan was initiated in 1961 (1961-1981) in Bombay for development of 32 Km / 100 km² of area.

(X) In 1973, HRB (Highway research board) of IRC was setup to give direction and guidance for research activities in India

(XI) In 1978, National transport policy committe (NTPC) was appointed to prepare a comprehensive national transport policy for the country for next 10 yrs (decade).

(XII) In 1981, third 20 yr Road development plan was introduced. (1981-2001), Lucknow, 82 Km / 100 km²

(XIII) In 1988, NHAI act was passed.

(XIV) In 2000 PMGSY was launched by Indian govt to increase

(XV) Fourth 20 yr Road development plan should have been introduced in 2001, but on the insistance of govt IRC

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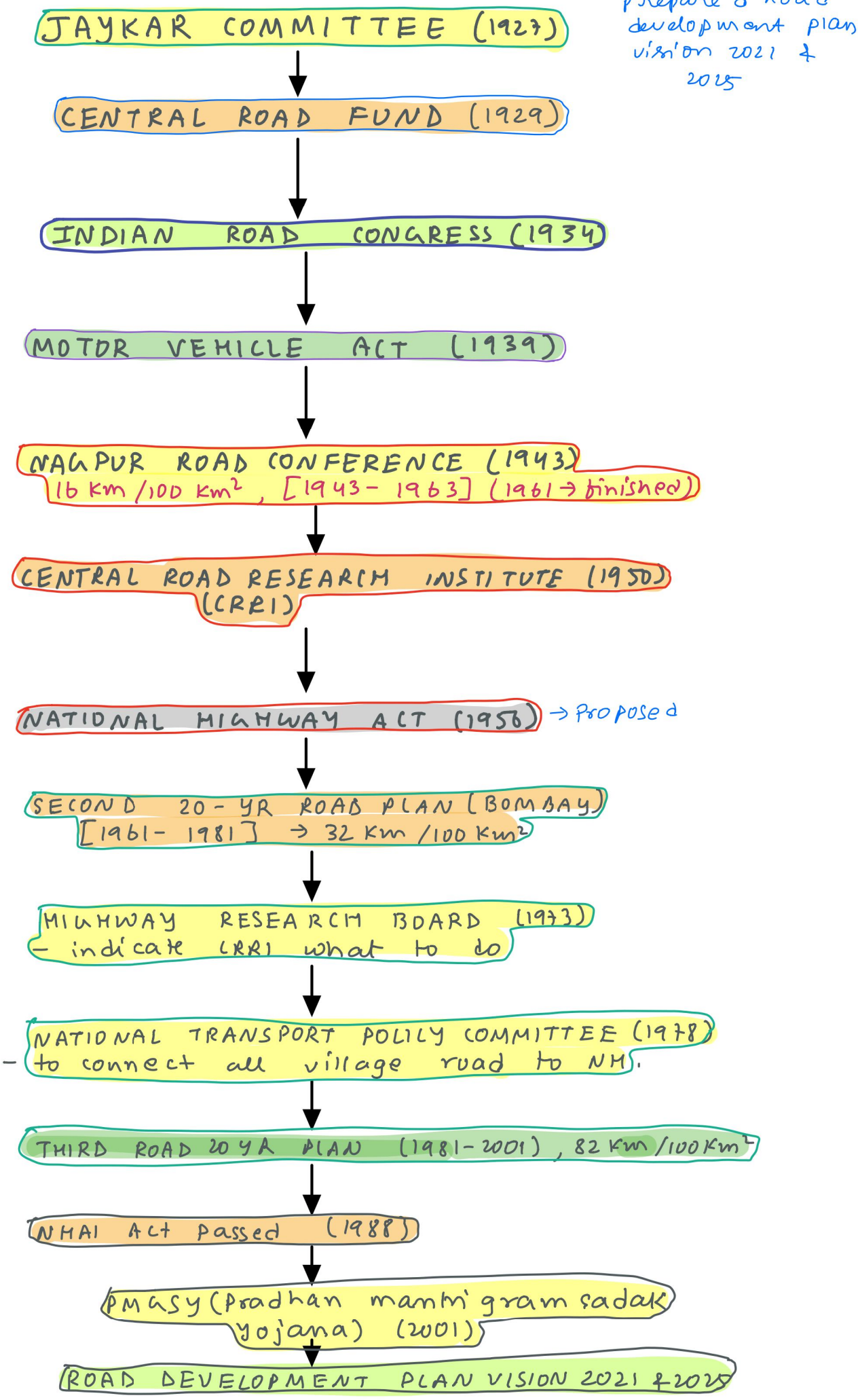
prepare d Road development plan vision 2021 & 2025
JAYKAR COMMITTEE (1927)
CENTRAL ROAD FUND (1929)
INDIAN ROAD CONGRESS (1934)
MOTOR VEHICLE ACT (1939)
NAGPUR ROAD CONFERENCE (1943)
16 Km /100 Km², [1943 - 1963] (1961 → finished)
CENTRAL ROAD RESEARCH INSTITUTE (1950) (CRRI)
NATIONAL HIGHWAY ACT (1956) → Proposed
SECOND 20 - YR ROAD PLAN (BOMBAY) [1961 - 1981] → 32 Km /100 Km²
HIGHWAY RESEARCH BOARD (1973) - indicate CRRI what to do
NATIONAL TRANSPORT POLICY COMMITTEE (1978) - to connect all village road to NH.
THIRD ROAD 20 YR PLAN (1981 - 2001), 82 Km /100 Km²
NHAI Act passed (1988)
PMGSY (Pradhan mantri gram sadak yojana) (2001)
ROAD DEVELOPMENT PLAN VISION 2021 & 2025

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COMPARISION B/W VARIOUS 20 YR ROAD DEVELOPMENT PLAN.

	1st 20 yr plan	2nd 20 yr plan	3rd 20 yr plan
NAME	NAGPUR	BOMBAY	LUCKNOW
DURATION	1943 – 1963 (completed in 1961)	1961 – 1981	1987 – 2001
ROAD DENSITY	16 Km/100Km^2	32 Km/100Km^2	82 Km/100 Km^2
ROAD PATTERN	star & grid	—	—
EXPRESS HIGHWAY	—	1600 Km	20000 Km added
CLASSIFICATION OF ROADS	NH, SH, MDR ODR, VR	SAME	(I) PRIMARY ROADS EH, NH (II) SECONDARY SH, MDR (III) TERTIARY/RURAL VR, ODR

NH = National Highway
SH = state Highway
EH = Express Highway
ODR = other District Road
VR = village Road.

NOTE:- length of the road as per 3rd 20 yr road plan (Km)

(i) Total length of road = $\max \begin{cases} 4.74 \times \text{No. of towns and villages} \\ \text{Road density} \times \text{Area} \end{cases}$

(ii) length of NH = $\frac{\text{Area (Km}^2\text{)}}{50}$

(iii) length of SH = $\max \begin{cases} \frac{\text{Area (Km}^2\text{)}}{25} \\ 62.5 \times \text{no. of towns} - \text{length of NH} \end{cases}$

(iv) length of MDR = $\max \begin{cases} \frac{\text{Area (Km}^2\text{)}}{12.5} \\ 90 \times \text{no. of towns} \end{cases}$

(v) length of ODR and VR = Total – (ii) – (iii) – (iv).