

Efficient Pollution Reduction Measures During Road Construction



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Status of Road Construction in India

- The government has set an ambitious target of building almost 45 km of roads per day – up from 9km/day just four years ago – this fiscal year.
- Between 2014-15 and 2018-19, the overall budgetary allocation to the highways sector has increased from Rs 32,000 crore to Rs 71,000 crore.

Under construction

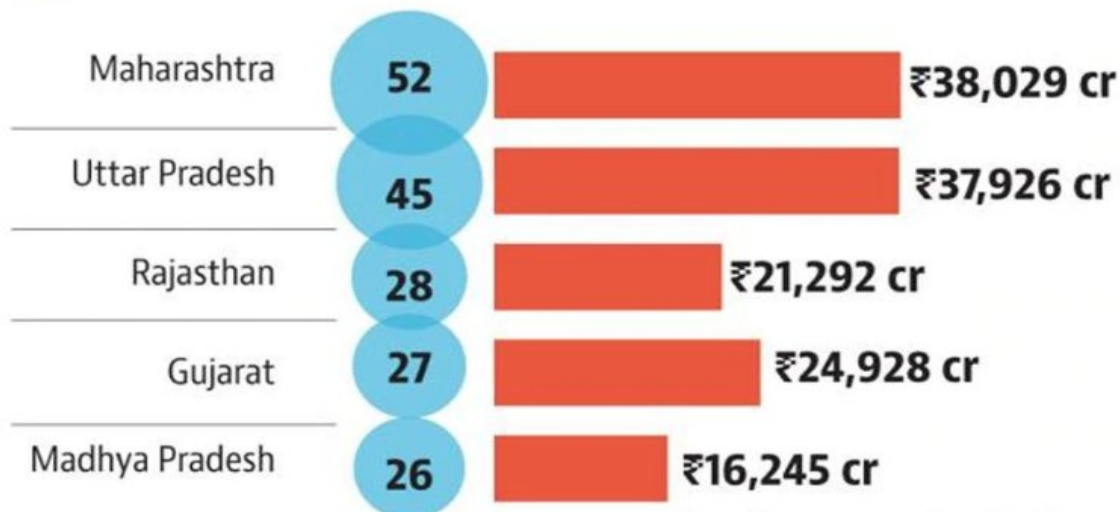
200 projects

Close to completion by mid-2019

₹1.5 lakh crore

Cumulative value of these works

● Number of projects* ■ Value ₹ crore



*Not all are expected to finish in 2019



- Major road projects offer tempting solution to an area's economic problems
- Roads often bring significant economic and social benefits, but they can also have substantial negative impacts on communities and the natural environment.
- However, such developments need not cause major environmental damage if the proper and efficient mitigation measures are adopted in the life of the project



- The three most damaging effects of road construction are noise, air pollution/ dust and vibrations.
- Noise mainly occurs during road construction phases but it can also occur to a lesser degree during maintenance operations.
- Dust is created during the construction of gravel roads and unbound aggregate layers.. Excess dust production can be treated by means such as watering, the use of alternative materials, and by using dust binders near houses.
- Vibration can be caused by uneven road surfaces and can pose significant impacts and problems to houses close to the source.

Air Quality

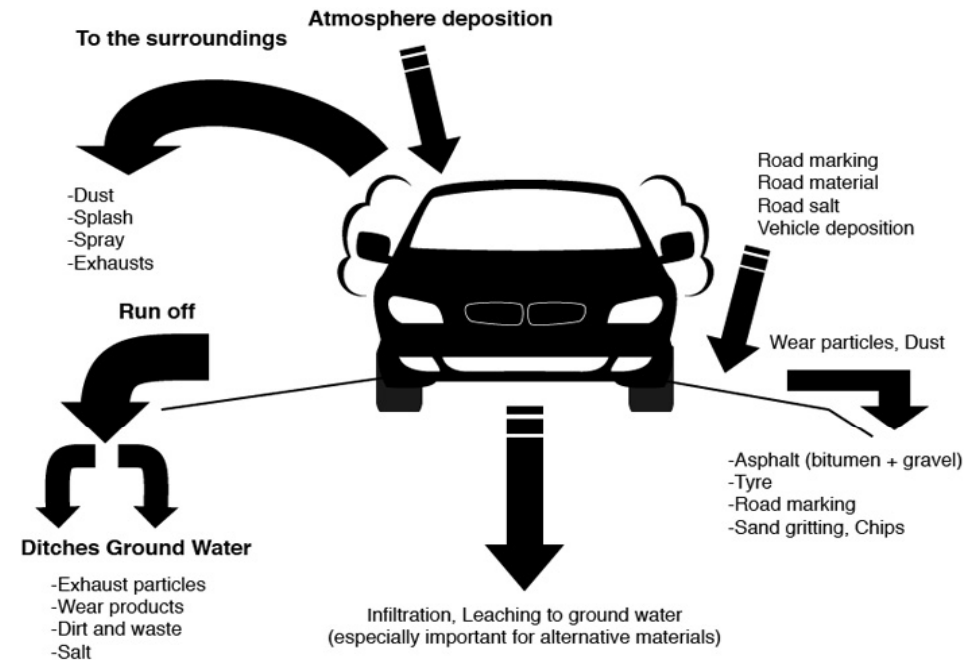
Road construction activities such as

- earthwork,
- rock cutting,
- transportation of construction materials,
- vehicular exhausts etc.

will contribute to increase in

levels of air pollutants, especially

Carbon Monoxide (CO), Oxides of Nitrogen (NOX) and Suspended Particulate Matter (SPM).



For mobile source emissions

- i) Construction requiring street closing should be carried out during non-peak hours.
- ii) Delivery trucks or other equipments should not be permitted during periods when they are being unloaded or are not in active use.
- iii) Concrete should be supplied from an onsite batching plant in order to reduce travel distances of concrete delivery trucks. But trucks carrying cement, gravel, sand will have to travel to site and may cause dust emission. Instead ready mix concrete carried in enclosed container may be better option as compared to on site batch mixing.

For Stationary Source emissions

- i) All stationary equipment should be located as far away as possible from sensitive receptor locations in order to allow dispersion of emitted pollutants.
- ii) Areas prone to fugitive dust emissions due to activities such as demolition, excavation, grading sites and routes of delivery vehicles across patches of exposed earth, should be frequently watered to suppress re-entrained dust.
- iii) Apart from these, the equipment / machines and vehicles should be always kept in good state of repairs to minimize emissions. Low emission construction vehicles / equipments should be used wherever feasible.
- iv) Construction areas should be enclosed, wherever possible.

Controlling Dust Emissions

Dust emissions can be prevented or reduced in four basic ways:

1. Limit the creation or presence of dust-sized particles.
2. Reduce wind speed at ground level.
3. Bind dust particles together.
4. Capture and remove dust from its sources.



Some dust control techniques

- Apply gravel or landscaping rock to areas where planting, mulching, or paving is impractical.
- Construct natural or artificial wind breaks or wind screens. Consider restricting landclearing or earthmoving activities during periods of high winds.
- Apply water to reduce emissions from temporary sources.
- Clear vegetation only from areas you will work right away.
- Surface-apply chemical suppressants to non-trafficked areas to form a less erodible soil surface.

Water

- The most used alternative, due to its low cost of implementation and excellent results.
- Water should be applied at least three times a day or more, depending on the atmospheric conditions.
- Be aware of the quantity of water applied and prevent excess water that can cause erosion problems.
- A water tanker is driven on-site spraying water over the affected areas preventing dust from airborne.



Chlorides/Chemical Suppressants

- Chloride retains moisture for prolonged periods helps in fighting against dust and erosion problems.
- The unique property of chlorides helps to hold down dust and stabilize unpaved road surfaces, creating smooth-riding roads that last.
- Chemical suppressants produces interfacial tension between the particles of dust to produce agglomeration of the macron and micron size particles.



Barriers

- A board fence, wind fence, sediment fence or similar barrier can control air currents and blow soil.
- All of these fences are normally constructed of wood.
- Perennial grass and stands of existing trees may also serve as wind barriers.
- Barriers prevent erosion by obstructing the wind near the ground and preventing the soil from blowing off-site.
- Barriers shall be placed at right angles to prevailing wind currents at intervals of about 15 times the barrier height.
- Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and blown soil.

Stone

- Stone can be an effective dust deterrent for construction roads and entrances or as a mulch in areas where vegetation cannot be established.
- In areas of high wind, small stones are not as effective as 8-inch stones.



- Covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering shall be applied to aggregate fines.
- Open stockpiles shall be avoided or covered. Where possible, prevent placing dusty material storage piles
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
- Use of vehicle wheel and body washing facilities at the exit points of the site.
- Dusty activities should be re-scheduled where possible if high-wind conditions are encountered.
- Instigation of an environmental monitoring and auditing program to monitor the construction process in order to enforce controls and modify method of work if dusty conditions arise.

Noise

- During construction phase, sources of noise pollution will be operation of machinery like compressors, bulldozers, transportation vehicles.
- Noise is defined as a sound that is undesirable to the listener. The level of the disturbance caused by sound will depend on its extent and intensity, and on the sensitivity of the persons affected.
- Noise disturbances may cause irritation as well as agitation and stress to livestock.



The effective control of road construction noise can be achieved by considering the following techniques:

- Mitigation at the source;
- Mitigation along the path; and
- Mitigation at the receiver.



Existing retaining wall acting as noise barrier during construction

Mitigation at the Source

- Source control is, in general, the most effective form of noise mitigation and involves controlling a noise source before it is able to emit potentially offensive noise levels.
- Construction noise (exclusive of blasting) is typically generated by two source types:
 - Stationary equipment; and
 - Mobile equipment.
- Noise levels from both types of noise sources are dependent on equipment characteristics and their operation.

less noisy equipment:

- One of the most effective methods of diminishing the noise impacts caused by individual equipment is to use less noisy machinery.
- By specifying and/or using less noisy equipment, the impacts produced can be reduced or, in some cases, eliminated.
- Source control requirements may have the added benefits of promoting technological advances in the development of quieter equipment.



using a less noisy piece of equipment (right) may be possible, as opposed to using more conventional and sometimes noisier equipment (left) to perform the same operation

Mufflers:

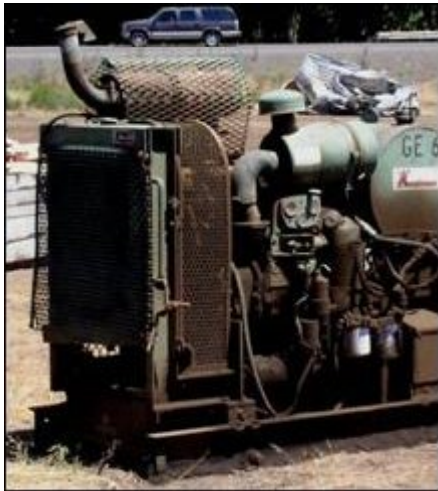
Most construction noise originates from internal combustion engines.

A large part of the noise emitted is due to the air intake and exhaust cycle.

Specifying the use of adequate muffler systems can control much of this engine noise.



Shields: Employing shields that are physically attached to the particular piece of equipment is effective, particularly for stationary equipment and where considerable noise reduction is required.



Unshielded, non-baffled equipment



Shielded compressor

- **Dampeners:** Equipment modifications, such as dampening of metal surfaces, is effective in reducing noise due to vibration. Another possibility is the redesign of a particular piece of equipment to achieve quieter noise levels.
- **Aprons:** Sound aprons generally take the form of sound absorptive mats hung from the equipment or on frames attached to the equipment.

The aprons can be constructed of rubber, lead-filled fabric, or PVC layers with possibly sound absorptive material covering the side facing the machine.

- **Enclosures:** Enclosures for stationary work may be constructed of wood or any other suitable material and typically surround the specific operation area and equipment. The walls could be lined with sound absorptive material to prevent an increase of sound levels within the structure.

Selection of Equipment:

Newer equipment is generally quieter than old equipment for many reasons, including technological advancements and the lack of worn, loose, or damaged components.

The types of engines and power transfer methods also plays a significant roll in achieving lowered equipment noise.

The use of electric powered equipment is typically quieter than diesel, and hydraulic powered equipment is quieter than pneumatic power.



Older equipment may be as efficient as new, but may not meet noise emission requirements



Newer paving equipment

Mitigation along the Path

- In some situations, such as in urban areas or on isolated sections of a project, it may be beneficial and necessary to construct barriers adjacent to the work area or at the right-of-way. These can take the form of natural shielding, temporary shielding, and/or permanent shielding.

Existing Features: Utilizing existing shielding such as berms, existing noise barriers, or structures for relatively static equipment such as pumps, generators, compressors, air ventilation, batch plants, and storage areas may be appropriate.



Existing noise barrier left in place until replacement noise barrier is constructed

Temporary Abatement

- Advantage may also be taken of the screening effect of any nearby object such as parapet walls, buildings, trailers, or temporary site offices.
- Early Construction of Permanent Noise Barriers
- Shielding of certain construction activities may be accomplished by specifying that the construction of permanent noise barriers be implemented as early as possible during the project's construction phase.



Mitigation at the Receiver

- Mitigation at a receiver can vary in its complexity, ranging anywhere from relocating residents for a day to insulation of a building.
- Even after mitigation measures have been applied, the outcome may still be unpredictable with no guarantees that the implemented methods achieve expected results.
- Therefore, mitigation at the receiver should only be considered as a last alternative. However, there are cases where creative techniques have been successfully implemented.

Building Envelope Improvements

Building envelope mitigation to reduce construction noise can include techniques such as sealing existing building elements, providing new sealed windows and doors, adding building insulation, etc. Such techniques, while effective, may also require modification of the building's heating, ventilation, and air conditioning system.

Noise Masking

Noise masking is a technique that is still in the developmental stage employment of noise cancellation technologies, changing "background" noise levels, etc. such as constructing water falls or other cascading water designs

Relocation of Residents

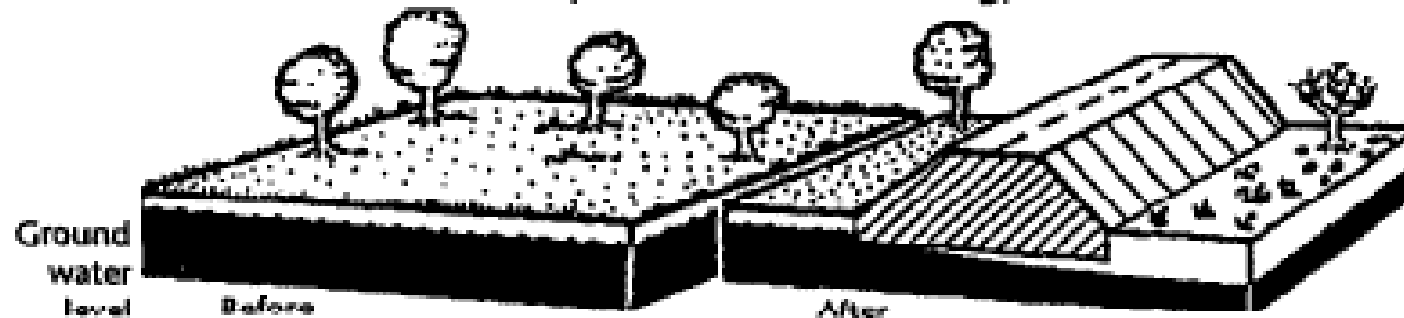
Vibrations

- Vibrations disturb people close to roads but they may also cause damage to buildings and sensitive equipment. vibrations can cause damage to geological and archaeological objects.
- Unnecessary high vibration sources, such as compaction with heavy vibration rollers or bedrock blasting, should be avoided or minimized in built-up areas. Heavy vibrations can cause damage to buildings and installations.
- Methods and equipment that minimize vibrations should therefore be employed. This this is often difficult in practice however, since roadworks demand specialized mechanical equipment such as diggers, heavy trucks, etc. Closer hole spacings and lighter charges should be used where possible in blasting operations to reduce induced vibration in the surroundings.
- Modern equipments normally has better noise and vibration attenuation than older machines.
- Road condition can also affect vibration. For example heavy trucks passing over a road section will create large vibrations. Keeping the road in a good and even condition will minimize the amount of vibration.
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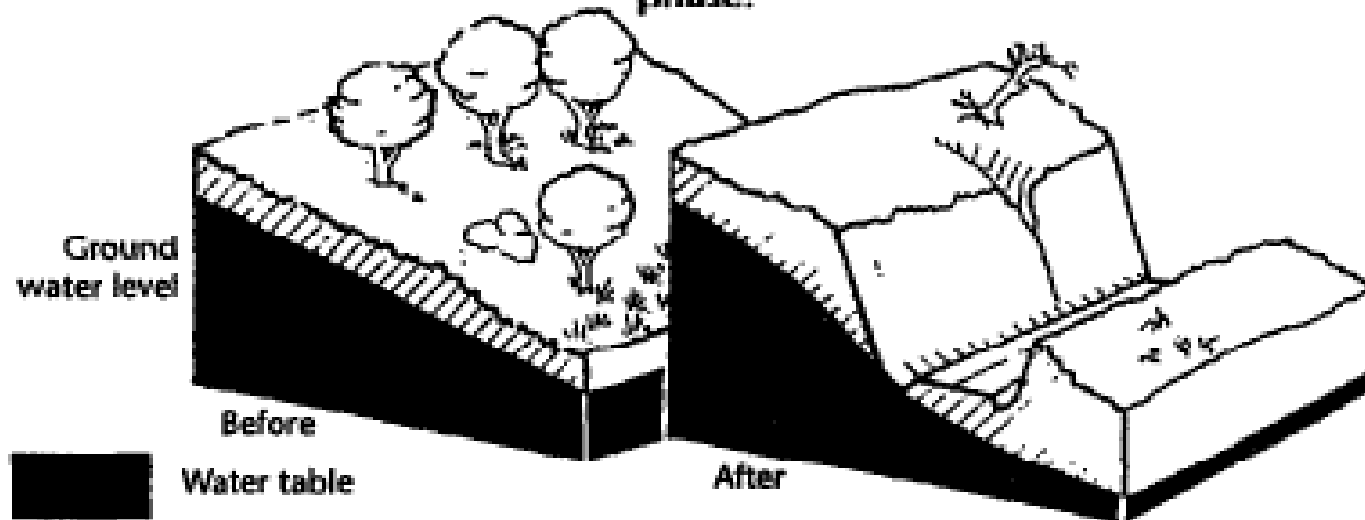
Impact o Water Resources

MODIFICATIONS IN WATER TABLE AS A RESULT OF ROAD CONSTRUCTION

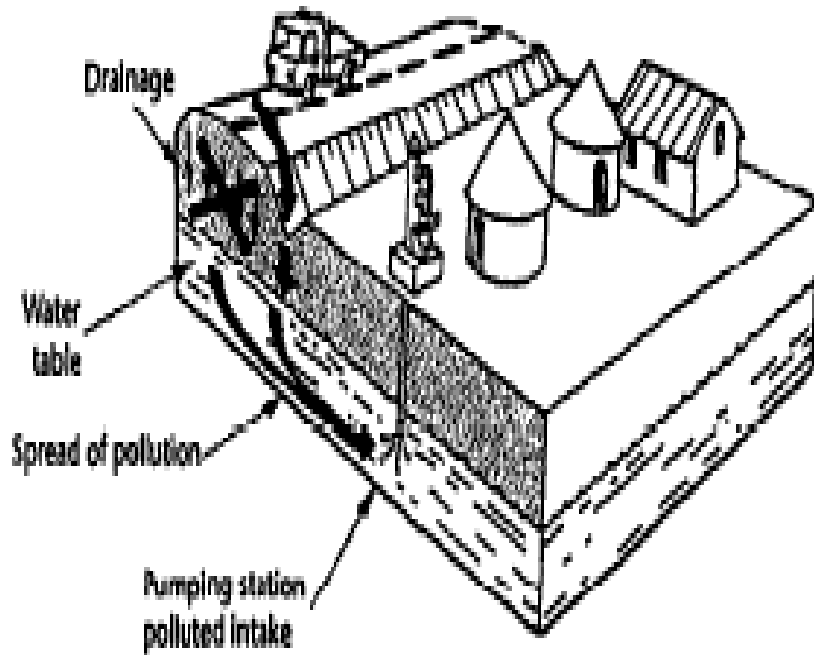
1. A fill road that causes a drop in the water table downstream
(in black on the drawing)



2. A cut road that lowers the water table. Ground cover disappears in second phase.



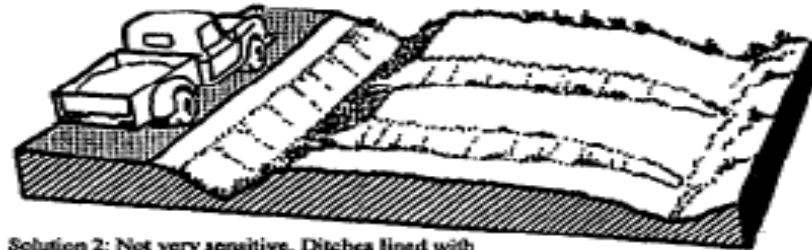
GROUNDWATER CONTAMINATION FROM ROADS



PROGRESSION IN RUNOFF TREATMENT



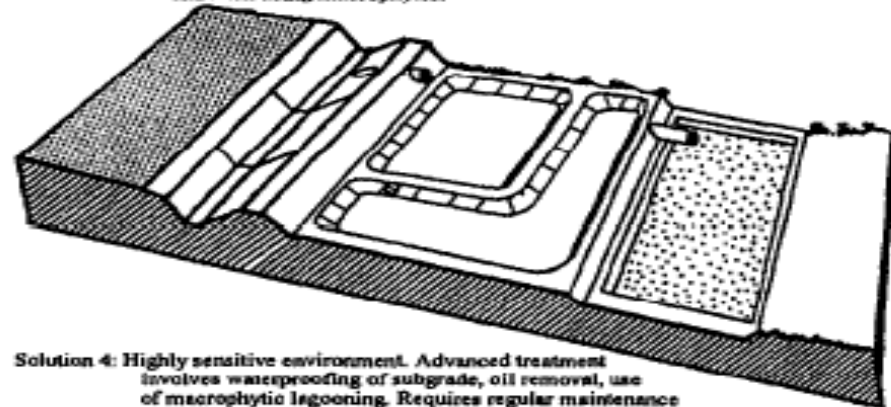
Solution 1: Not very sensitive environment. Direct evacuation of water from pavement.



Solution 2: Not very sensitive. Ditches lined with grass to promote infiltration.



Solution 3: Sensitive environment. More complete filtration using macrophytes.



Solution 4: Highly sensitive environment. Advanced treatment involves waterproofing of subgrade, oil removal, use of macrophytic lagooning. Requires regular maintenance

Water Pollution

Issues

Water
Pollution

Source

Contamination
from construction
activities

Waste water
logging

Mitigation Measures

- Installation of plant & machinery close to water bodies be avoided
- Limestone and coal ash be stacked together, fenced by bricks or earth wall, and kept away from water.
- Measures be taken to prevent waste water produced from entering into rivers & irrigation systems.
- Provision of soak pits
- Diversion to a ditch
- Provision of proper drainage

Issues

Land
Pollution

Land slide/soil
erosion

Conservation
of Eco-resources

Felling of
Trees

Source

Leakage of oil,
lubricants etc.

Soil Erosion

Construction
Activities

Land Clearing

Mitigation Measures

- Machinery is placed on an impermeable base
- Soakage pits along with oil and grease trap will be provided around the storage area
- Soil stabilization measures viz. bio-engineering, planting grasses/trees
- Earth borrowing, piling, and building temporary camps are prohibited in forest lands to preserve forests.
- Compensatory afforestation is carried out

Conclusion

Efficient mitigation measures are necessary to achieve environmentally sound and sustainable development of road projects



Thank You.....

