

No. PL-30(119)/79

Dated the 11th Oct, 1979

To

- (1) The Chief Engineers of all State PWDs and Union Territories (dealing with roads)
- (2) Director General Border Roads
- (3) Engineer-in-Chief, C.P.W.D.

Subject :- Special steps to prevent soil erosion in hilly areas in the context of overall soil conservation measures in the country

The need to conserve the country's land and soil resources requires no special emphasis. Road construction in hilly areas tend to upset the natural setting and contribute to the loss of these irreplaceable resources and as such calls for careful attention right from the stage of conception of the road to surveys and investigations, project formulations construction and subsequent maintenance. To ensure that best results are achieved and expensive maintenance procedures are avoided, measures taken should not be considered in isolation but built into the road project itself as an integral part with all necessary provisions for the purpose.

2. To combat the problem of land degradation and soil erosion associated with road construction in hilly areas, the Ministry had recommended certain measures for adoption on National Highways and State Roads, vide D.O. letter No. PL-50(13)/74 dated the 10th September 1974 from DG (RD) & Addl. Secretary addressed to all State Chief Engineers copy enclosed for ready reference (Annex. I). It has, however, been observed in certain cases that these instructions have not been fully adhered to and roads continue to be built in an unplanned manner without adopting the basic soil conservation and slope stabilisation measures. In view of the importance of all this in the national context, it is reiterated and emphasised that the State PWDs and other agencies involved in road construction in hilly areas should take all the necessary measures right from the project conception stage to ensure that land degradation and soil erosion are prevented to the maximum extent possible. For facilitating the designers and field staff in this regard, measures to be taken at different stages in the construction of roads in hilly areas are given in Annexure II. The points of guidance given in this Annexure are

not exhaustive and there could be other measures which have been found to be successful under particular situations. In this context, due consultation with officers of the Forest and Soil Conservation Departments will be helpful. To ensure that the soil conservation measures are planned and executed in a systematic manner and no important features are lost sight of, a check list is suggested vide Annexure III. Preferably this list should form a part of the road project itself for facilitating cross-checking of the requirements at different stages.

3. Many of the points of guidance given in Annexure II equally apply to existing roads. The check list in Annexure III can also be used to identify existing deficiencies as regards erosion prevention and to evolve suitable remedial measures so that there is concerted and coordinated action on this important aspect. It is suggested that the concerned Executive Engineer of the PWD and the District Forest Officer jointly discuss to identify existing roads having problems of soil erosion or passing through vulnerable areas. These roads could be jointly surveyed by them for evolving appropriate remedial measures for implementation. This process would also help the PWD Engineers to get conversant with erosion prevention measures so that they can apply these on other roads in general including those that may be planned to be built hereafter.
4. It is requested that necessary action may be taken on the above suggestions under intimation to this Ministry. This circular may please be brought to the notice of all officers of your department engaged on road works in the hilly terrain as also other State Institutions dealing with road construction such as Zilla Parishads, Rural Engineering Organisations, Forest Department, Irrigation and Project Authorities, etc.

ANNEXURE I

LETTER NO. PL-50(13)74-SP DATED THE 10TH SEPTEMBER 1974 FROM DIRECTOR GENERAL (ROAD DEVELOPMENT), MINISTRY OF SHIPPING AND TRANSPORT (ROADS WING), NEW DELHI ADDRESSED TO CHIEF ENGINEERS OF ALL STATE PUBLIC WORKS DEPARTMENTS AND UNION TERRITORIES DEALING WITH ROADS.

Subject : Special steps to prevent soil erosion in hilly areas in the context of overall soil conservation measures in the country

The need to conserve and build the country's land and soil resources, so that these serve the present as well as future generations, has assumed paramount importance in the wake of developing shortage of tillable land and water resources. Unplanned road construction in hilly areas has been identified as one of the causes contributing to loss of these resources.

2. By its very nature, road construction in hills is a destructive process for the strata of the hill side, at least in the initial stages. Road cuttings through areas otherwise not susceptible to land-slides normally disturb the natural inclination of the soil in such a way as to create conditions for large scale landslides in the first few years after construction. Even dense forests are not immune to this problem. With the removal of vegetative cover, destructive action of water gets further pronounced and accelerates the process of soil erosion and formation of deep gullies. End result of this is that enormous quantities of soil and rock move down the rivers, lakes and finally to the sea.
3. It is, therefore, necessary that utmost care is taken during road construction, as regards planning of works and treatment of the catchment area of drainage, so that soil erosion is prevented as far as possible. To combat this problem, the following measures are especially commended, for adoption on National Highways as well as State Roads :-

- (i) Roads should not be located through geologically unstable strata if this can be avoided;
- (ii) Road alignments should avoid large scale cuttings and fillings, and follow the lie of the land as far as possible. Use of tunnels to avoid deep cuts should be considered where feasible as also economical;
- (iii) Where necessary, provision of breast walls of suitable design should be considered to help achieve stability of the hill cuttings;
- (iv) To the extent feasible, roads should be aligned away from streams and torrents except where these are to be crossed. Since the greatest damage always occurs along water courses, special attention is necessary to create protection belts of forests on both sides;
- (v) Drainage of water from the roadside must be given top attention and necessary system of drains constructed to lead the runoff to natural water courses. In particular, suitable interceptor and catchwater drains must be provided above the cut slopes for speedy and safe disposal of rain water;
- (vi) Excavated material should not be thrown haphazardly but dumped at suitable places where it cannot get easily washed away by rain. It is otherwise expected as a normal requirement of hill road design that the cross-section is either wholly in cutting, so that with the adoption of retaining walls of a suitable type, the cutting spoils can be utilised to the extent possible, guided of course by consideration of economy and best road stability;
- (vii) Depending upon the availability of land and other resources, afforestation of roadside land should be carried out to a sufficient distance on either side of the road. The selection of plant species will depend on climate, altitude and soil conditions, but preference should be given to deep rooted trees and plants. For preparing the detailed scheme of afforestation, persons having knowledge of soil conservation or forestry should desirably be associated.
- (viii) Vegetative cover should be established on all cut/fill slopes through any one of techniques described in L.R.C. Standard

"Treatment of Embankment slopes for Erosion Control" (under print). The activity of establishing vegetation on barren slopes should be treated as part of the regular maintenance operations on all hill roads.

4. It is requested that necessary action may be taken on the above suggestions under intimation to this Ministry. This circular may please be brought to notice of all officers in your department engaged on road works in the hilly terrain as also to other State institutions dealing with road construction such as Zilla Parishads, Rural Engineering Works Organisations, Forest Departments, Irrigation and Power Project Authorities, etc.

Annexure II

POINTS OF GUIDANCE ON PREVENTION OF SOIL EROSION NEEDING ATTENTION IN THE CONSTRUCTION ROADS IN HILLY AREAS

1. General

1.1. Aspects relating to route selection and highway location, surveys and investigations, preparation and presentation of road projects, etc. are discussed in detail in IRC Special Publication No. 19 "Manual for Survey, Investigation and Preparation of Road Projects". For road construction in hilly areas, while the guidelines given in this Manual apply equally and have to be duly considered, the following points related to prevention of soil erosion should be specially kept in view during different operations.

1.2. Effective erosion prevention and soil conservation measures require careful attention at different stages of a road project, starting right from the stage of project conception. To help the concerned Engineers in determining whether all aspects, considerations and items of work with regard to erosion prevention have been duly taken into account and to facilitate review at different stages, a check list has been prepared, Annexure III. The check list which should be read in conjunction with the points of guidance listed hereunder should form part of the road project itself for facilitating cross checking of the requirements at different stages.

2. Points of Guidance

- (i) The road construction project estimates should provide for not only the requisite scale of investigations but also the necessary measures against soil erosion so that these can be built into the project with adequate financial provision.
- (ii) Before finalising the alignment, erosion potential of each alternative should be carefully examined, and the one involving least disturbance to the natural ground should be preferred.
- (iii) Roads should not be located through geologically unstable strata if this can be avoided. Study of the geological maps of the area and consultations with the local Geological Department will be helpful in this regard.
- (iv) Road alignments should avoid large scale cuttings and fillings and follow the lie of the land as far as possible. Use of tunnels to avoid deep cuts should be considered where feasible and economical.
- (v) To the extent feasible, roads should be aligned away from streams and torrents except where these are to be crossed. Since the greatest damage always occurs along water courses, special attention is necessary to create protection belts of forests on both sides.
- (vi) It will be advisable, at least for important roads, to have consultation with the officers of the Forest Department at the stages of route/alignment selection, surveys and investigations etc. so as to ensure that the selected alignment has minimum potential for soil erosion and that the project designs and estimates provide for the necessary soil erosion control measures. The idea is that with such joint consultation pursuits practiced for some selected roads, the PWD Engineers would get conversant and should be able to take care of such requirements by themselves for other road projects in general.
- (vii) Where the road is in cutting, half cut and half fill type of cross section which involves least disturbance to the natural ground should be adopted subject to considerations of economy and road stability being satisfied.
- (viii) The cut slopes should be made stable for the type of strata in the initial construction stage itself by resorting to stable cut slopes with benches etc. including the use of slope stabilising structures like breast walls, pitching etc.
- (ix) For treatment of unstable areas, say 50 M above and 30 M below the road level depending on the site conditions, necessary funds should be provided in the project estimates. This may even be in the form of certain percentage of total cost but based on some possible assessment of treatment works possibly needed.
- (x) Area for clearing and grubbing should be kept the minimum subject to the technical requirements of the road. The clearing area should be properly demarcated to save desirable trees and shrubs and to prevent overclearing.
- (xi) Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operation and permanent erosion control features can follow immediately thereafter if the project conditions permit, otherwise temporary erosion control measures should be provided between successive construction stages. This requirement has already been stressed in the Ministry's "Specifications for Road and Bridge Works" (vide clause No. 306.3). Under no circumstances however should very large surface area of erodible earth material be exposed at any one time by clearing and grubbing.
- (xii) Location and alignment of culverts should be so chosen as to avoid severe erosion at outlets and siltation at inlets.
- (xiii) The cross-drainage structures should discharge safely on the valley side, and in this connection, all necessary precautions/safeguards should be taken to ensure that the discharging waters do not cause erosion even when they flow for long periods. For this purpose, all necessary channel training and erosion control works like pitching/paving of the

channel and outfall points, drop walls, flexible apron etc. should be considered and provided for as a part of initial design and construction.

- (xiv) Drainage of water from the roadside must be given **top attention** and necessary system of drains constructed to lead the runoff to natural water courses. In particular, suitable **interceptor** and catch water drains must be provided above the cut slopes for speedy and safe disposal of rain water. The **drains** should have gentle gradients and side slopes to carry flows safely without erosion.
- (xv) Excavated material should not be thrown haphazardly but **dumped** duly dressed up in a suitable form at suitable places where it cannot get easily washed away by rain and such **spoil deposits** may be duly turfed or provided some vegetative cover towards the same purpose.
- (xvi) Depending on the availability of land and other resources, **afforestation** of roadside land should be carried out to a sufficient distance on either side of the road. The **selection of plant species** will depend on climate, altitude and soil conditions, but preference should be given to **deep rooted trees** and plants. For preparing the detailed scheme of afforestation, persons having knowledge of soil conservation or forestry should desirably be associated;
- (xvii) Vegetative cover should be established on all cut/fill slopes through any one of the techniques described in IRC : 56-1974 "Recommended Practice for Treatment of Embankment slopes for Erosion Control". The activity of establishing vegetation on barren slopes should be treated as part of the regular maintenance operations on all hill roads.
- (xviii) Strip forests suitable for the site conditions for a **minimum distance** of 30 m on either side of the road should be provided. These shall be raised and maintained by forest authorities. No felling except of dead or dying, of trees should be permitted in this area.
- (xix) Along with other road components, due attention **should be paid** to the maintenance of drainage and soil conservation works. Drains, catchpits etc. should be cleared of all **debris** and repaired where necessary before the on-set of the rainy season. Eroded areas should be promptly made up **and provided** with vegetative cover.
- (xx) For any seriously problematic areas where natural **measures** are not likely to be successful, specialist organisations like the CRRI, GSI etc. may be consulted for evolving suitable remedial measures.

Annexure III

CHECK LIST OF POINTS ABOUT EROSION CONTROL IN THE CONSTRUCTION OF ROADS IN HILLY AREAS

1. Does the road construction project estimate provide for the **necessary measures** against soil erosion?
2. Have soil maps and aerial photographs studied and **investigations made** to locate areas or sections with high erosion potential?
3. Has erosion potential been considered for each alignment?
4. Have **geological maps** been studied or local Geological Department consulted to avoid unstable strata?
5. Does the selected alignment follow the lie of the land and **avoid large scale cutting**?
6. Has use of tunnels to avoid deep cuts been investigated?
7. Is the road alignment susceptible to damage/erosion by **streams and torrents**?
8. Is consultation/coordination with other departments like Forest Department necessary? If so, have they been consulted?
9. How will adjacent and nearby streams, ponds and lakes be **affected** by project construction?
10. Will special erosion control measures be required to **protect adjacent properties**?
11. Does the road cross section involve a lot of disturbance to **the the natural ground**?
12. Are the design cuts **lopes** stable for the type of strata?
13. Are slope stabilising structure like breast walls, pitching etc. **required**?
14. Does the cut hill face require any special treatment to **prevent slips**?
15. Has the area for clearing and grubbing been clearly demarcated?
16. Has a work schedule been worked out for the different **construction operations**?
17. What erosion control works are required before clearing and **other work** is started?
18. Are any temporary erosion control measures required **between successive** construction stages?
19. Have sediment traps, benches, catch water drains, side drains, **sodding**, ditch paving, slope protection works and other erosion control items been identified on the plans and provided in **the contract**?
20. Have the location and alignment of culverts been fixed with **due consideration** to erosion at outlets and siltation at inlets?
21. Have the necessary erosion control measures been taken at **the outfalls** of culverts?
22. Has the proper disposal of surplus excavated material been **thought of** and provided for?
23. What action has been taken to establish vegetative cover on **cut/fill slopes** and plantings on the disturbed roadside land?
24. Are the existing drainage facilities maintained in good order?
25. Have any inadequacies in **planning, design and construction** been identified and reported to higher authorities?
26. Do any of the design measures require **modification** in the light of field conditions?
27. Do any of the problems require consultation with specialist **organisations** like the CRRI, GSI etc?