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UNIT- I

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HIGHWAY

AND

RAILWAY ENGINEERING

Requirements of Ideal Alignment
&
Factors Controlling Highway Alignment

FACTORS CONTROLLING HIGHWAY ALIGNMENT:

Once the necessity of the highway is assessed, the next process is deciding the alignment. The highway alignment can be either horizontal or vertical and they are described in detail in the following sections.

Alignment

- The position or the layout of the central line of the highway on the ground is called the alignment.
- Horizontal alignment includes straight and curved paths. Vertical alignment includes level and gradients.
- Alignment decision is important because a bad alignment will enhance the construction, maintenance and vehicle operating cost.
- Once an alignment is fixed and constructed, it is not easy to change it due to increase in cost of adjoining land and construction of costly structures by the roadside.

Requirements

The requirements of an ideal alignment are

- The alignment between two terminal stations should be short and as far as possible be straight, but due to some practical considerations deviations may be needed.
- The alignment should be easy to construct and maintain. It should be easy for the operation of vehicles. So to the maximum extend easy gradients and curves should be provided.

- It should be safe both from the construction and operating point of view especially at slopes, embankments, and cutting. It should have safe geometric features.
- The alignment should be economical and it can be considered so only when the initial cost, maintenance cost, and operating cost is minimum.

Factors controlling alignment

- We have seen the requirements of an alignment. But it is not always possible to satisfy all these requirements. Hence we have to make a judicial choice considering all the factors.
- The various factors that control the alignment are as follows:
- **Obligatory points**: These are the control points governing the highway alignment. These points are classified into two categories. Points through which it should pass and points through which it should not pass. Some of the examples are:
- **Bridge site**: The Bridge can be located only where the river has straight and permanent path and also where the abutment and pier can be strongly founded. The road approach to the bridge should not be curved and skew crossing should be avoided as possible. Thus to locate a bridge the highway alignment may be changed.
- **Mountain**: While the alignment passes through a mountain, the various alternatives are to either construct a tunnel or to go round the hills. The suitability of the alternative depends on factors like topography, site conditions and construction and operation cost.
- **Intermediate town**: The alignment may be slightly deviated to connect an intermediate village or intermediate town nearby by .

These were some of the obligatory points through which the alignment should pass. Coming to the second category that is the points through which the alignment should not pass are:

- Religious places: These have been protected by the law from being acquired for any purpose. Therefore, these points should be avoided while aligning.
- Very costly structures: Acquiring such structures means heavy compensation which would result in an increase in initial cost. So the alignment may be deviated not to pass through that point.
- Lakes/ponds etc: The presence of a lake or pond on the alignment path would also necessitate deviation of the alignment.

Traffic:

- The alignment should suit the traffic requirements. Based on the origin-destination data of the area, the desire lines should be drawn.
- The new alignment should be drawn keeping in view the desire lines, traffic flow pattern etc.

Geometric design:

- Geometric design factors such as gradient, radius of curve, sight distance etc. also governs the alignment of the highway.
- To keep the radius of curve minimum, it may be required to change the alignment of the highway.
- The alignments should be finalized such that the obstructions to visibility do not restrict the minimum requirements of sight distance.

- The design standards vary with the class of road and the terrain and accordingly the highway should be aligned.

Economy:

- The alignment finalized should be economical.
- All the three costs i.e. construction, maintenance, and operating cost should be minimum.
- The construction cost can be decreased much if it is possible to maintain a balance between cutting and filling.
- Also try to avoid very high embankments and very deep cuttings as the construction cost will be very higher in these cases.

Other considerations:

Various other factors that govern the alignment are drainage considerations, political factors and monotony.

- Drainage
- Political - If a foreign territory comes across a straight alignment, we will have to deviate the alignment around the foreign land.
- Monotony - For a flat terrain it is possible to provide a straight alignment, but it will be monotonous for driving. Hence a slight bend may be provided after a few kilometers of straight road to keep the driver alert by breaking the monotony.
- Hydrological (rainfall/water table):

Special consideration for hilly areas

Alignment through hilly areas is slightly different from aligning through a flat terrain. For the purpose of efficient and safe operation of vehicles through a hilly

terrain special care should be taken while aligning the highway. Some of the special considerations for highway alignment through a hilly terrain is discussed below.

- Stability of the slopes: for hilly areas, the road should be aligned through the side of the hill that is stable. The common problem with hilly areas is that of landslides. Excessive cutting and filling for road constructions give way to steepening of slopes which in turn will affect the stability.
- Hill side drainage: Adequate drainage facility should be provided across the road. Attempts should be made to align the roads in such a way where the number of cross drainage structures required are minimum. This will reduce the construction cost.
- Special geometric standards: The geometric standards followed in hilly areas are different from those in flat terrain. The alignment chosen should enable the ruling gradient to be attained in minimum of the length, minimizing steep gradient, hairpin bends and needless rise and fall.
- Ineffective rise and fall: Efforts should be made to keep the ineffective rise and excessive fall minimum.