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SAFETY IN THE GEOMETRIC DESIGN OF HIGHWAY

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ABSTRACT

This project deals with safety with in the geometric design of highways. The study is employed to a way to incorporate safety into the look of highways. New analytical tools developed within the past years are accessible for designers, planners, traffic engineers and construction engineers to quantify safety in project development: to a tier (level) of detail that had not been potential within the past. With these tools, the expected safety performance of a transportation project will be evaluated and also the safety implications of progressive changes in design elements will be quantified. Included within the report is steering on a way to implement these tools and best practices for design professionals in order that they will apply the foremost applicable technical information on quantitative safety performance – crashes and their outcomes – to develop comes for a spread of contexts. Best practices incorporate the fundamental technical information on safety effects, still as analysis processes tailored to project size, scope, and context. With such input, professionals will compare safety data with alternative measureable data on the environment, costs, traffic operations, etc., to make an informed decision. The Information Report being developed in this project describes the methodologies accessible to produce a consolidated estimate of the safety differential between various design treatments. The goal is an example for a practician the quantitative safety differences of the various designs. This enables them to form sound engineering judgments once seeking flexibility among existing AASHTO design guidance or when seeking design exceptions on projects which will not meet standard AASHTO or state or local criteria.

Keywords: Geometric Design, Safety, American Association of State Highway And Transportation Officials (AASHTO).

I. INTRODUCTION

1.1 Geometric design of highways

The geometric design of roads is the branch of highway designing worried with the situating of the physical components of the roadway as per guidelines and imperatives. The essential goals in geometric design are to upgrade proficiency and wellbeing while minimizing cost and natural harm. Geometric outline likewise influences a rising fifth target to encourage more extensive group objectives, including giving access to occupation, schools, organizations and living arrangements, suit a scope of travel modes, for example, strolling, bicycling, travel, and vehicles, and minimizing fuel use, outflows and natural damage. Geometric roadway outline can be broken into three principle parts: arrangement, profile, and cross-area. Joined, they give a three-dimensional design to a roadway. The arrangement is the course of the street, characterized as a progression of flat digressions and bends. The profile is the vertical part of the street, including peak and droop bends, and the straight level lines associating them. The cross segment demonstrates the position and number of vehicle and bike paths and walkways, alongside their cross incline or saving money. Cross areas likewise indicate waste components, asphalt structure and different things outside the classification of geometric outline.

1.2 Pavement

A main road pavement could be a structure consisting of various layers by using different materials on top of the natural soil sub-grade, whose primary perform is to transfer the applied vehicle masses to the sub-grade. The pavement structure ought to be ready to give a surface of acceptable riding quality, adequate skid resistance, favorable light weight reflective characteristics and low pollution. The final word aim is to make sure that the transmitted stresses because of wheel load area unit sufficiently reduced, in order that they're going to not exceed bearing capability of the sub-grade. Two sorts of pavements area unit typically recognized as serving this purpose, specifically versatile pavements and rigid pavements.

1.3 Types of pavements

The pavements are often classified supported the structural performance into two, they are:

1. Versatile pavements or (flexible pavements) and
2. Rigid pavements.

In versatile pavements, wheel masses area unit transferred by grain-to-grain contact of the combination through the structure. The versatile pavement, having less flexural strength, acts sort of a versatile sheet (e.g. hydrocarbon road). In rigid pavements, wheel masses area unit transferred to sub-grade soil by flexural strength of the pavement and also the pavement acts sort of a rigid plate (e.g. cement concrete roads). Additionally to those, composite pavements are on the market. A skinny layer of versatile pavement over rigid pavement is a perfect pavement with most fascinating characteristics. However, such pavements area unit seldom mutilized in new construction attributable to high value and complicated analysis needed.

1.4 Versatile pavement or flexible pavements

Flexible pavements can transmit wheel load stresses to the deeper layers by grain-to-grain transfer through the points of contact within the pavement structure. The wheel load functioning on the pavement is going to be distributed to a wider space, and also the stress decreases with the depth. This stress distribution characteristic, versatile pavement usually has several layers.

1.5 Rigid pavements

Rigid pavements have enough flexural strength to transmit the wheel load stresses to a wider space below. A typical cross section of the rigid pavement is shown.

Compared to versatile pavement, rigid pavements square measure placed either on the ready sub-grade or on one layer of granular or stable material. Since there's just one layer of fabric between the concrete and also the sub-grade, this layer will be referred to as base or sub-base course.

II. LITERATURE REVIEW

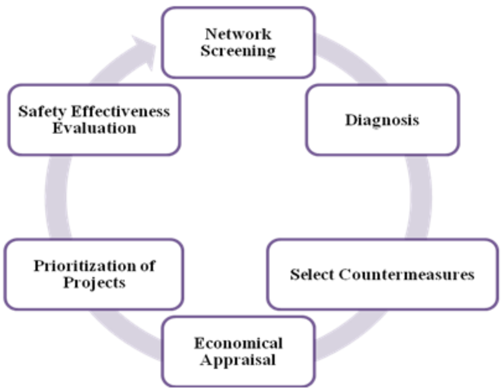
The development of geometric outline measures and criteria goes back to the late 1930's. The American Association of State Highway and Transportation Officials (AASHTO) has been the wellspring of a large portion of the outline qualities and criteria utilized as a part of geometric express way plan. Albeit most States and organizations have built up their own particular models, the configuration approach and outline values appeared in the AASHTO strategies are acknowledged by accord and shape the premise for individual State plan rehearses. Likewise, the FHWA has received the AASHTO strategies for outline and development and significant remaking of Federal-guide parkways (Neuman, 1993). The most current AASHTO plan approach reference was distributed in 1994, A Policy on Geometric Design of Highways and roads.

The geometric parts of an expressway incorporate elements that effect or identify with its operational quality and safety. These components, which are noticeable to the driver and influence driving execution, incorporate components of the roadways, inclines, and roadside. Roadways have highlights identified with: roadway shape (level and vertical arrangement); convergences and trades; cross areas (e.g., number of paths and path width, nearness of shoulders and checks); channelization and medians; and different random components (e.g., carports, spans). Inclines have highlights identified with: sort (e.g., turnpike, blood vessel, passage and exit); design (e.g., jewel, circle, trumpet, and so on.); length; ebb and flow; and different various components (e.g., speed-switch to another lane). Physical elements of the roadside include: boundaries (e.g., guide rails); obstructions (e.g., clamor hindrances, trees, signs); and different various elements (dike inclines, trench, and so forth.).

III. METHODOLOGY

3.1 Roadway safety management process

It presents recommended ventures to screen and decrease crash recurrence and seriousness on existing roadway systems. It incorporates strategies helpful for recognizing change locales, conclusion, counter measure choice, monetary examination, venture prioritization, and viability assessment. As appeared in below Figure



Road safety management process

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- Network Screening
- Diagnosis
- Select Countermeasures
- Economic Appraisal
- Prioritization of Projects
- Safety Effectiveness Evaluation

Highlights of this a role in the manual are advances in network screening techniques and security assessment techniques. In Network Screening, a few new system screening execution measures are acquainted with movement the security investigation concentrate far from customary accident rates. The significant confinement connected with accident rate investigation is the erroneous supposition that a direct relationship exists between traffic volume and the recurrence of accidents.

3.2 Highway Safety Predictive Methods

The Highway safety manual (HSM) gives a decent case of the prescient strategies that can be utilized for evaluating crash recurrence expected by accident seriousness, and impact sorts on a roadway system, office, or individual site. The assessment can be made for mixes of outline components for different circumstances: existing conditions, plan options, or new roadways. The prescient strategy permits existing and proposed outline ideas and contrasting options to be evaluated quantitatively in conjunction with limit, cost, right-of-way, group needs, and natural contemplations.

The HSM strategies fundamentally have a standard structure to give quantitative assessments of anticipated crash recurrence. The estimation procedure utilizes relapse models created from accident information for comparable locales beginning with a base condition that is then balanced, utilizing crash modification factor (CMFs), as per safety impacts of contrasting geometric outline highlights, activity control highlights, what's more, activity volumes. Different modification are made to make up for the measurable difference of accident information, (for example, relapse to the mean predisposition), particular site conditions, and nearby and provincial conditions.

HUMAN SAFETY MANUAL	**UNDIVIDED ROADWAY SEGMENTS**	**DIVIDED ROADWAY SEGMENTS**	**INTERSECTIONS**			
			Stop control on minor legs		Signalized	
			3-leg	4-leg	3-leg	4-leg
Rural two lane, two way roads	Yes	No	Yes	Yes	No	Yes
Rural multi- lane highways	Yes	Yes	Yes	Yes	No	Yes
Urban & sub urban arterials	Yes	Yes	Yes	Yes	Yes	Yes

3.3 Highway Safety Crash Modification Factors

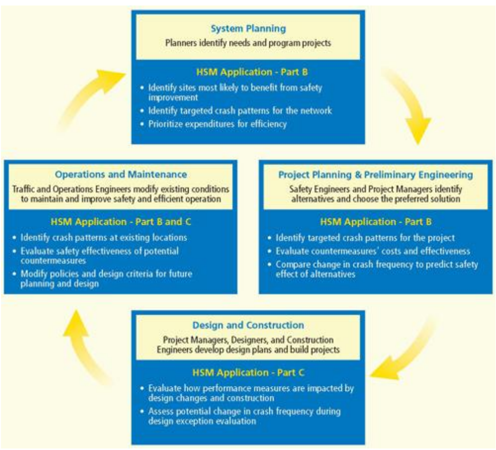
Parts D and C of the HSM give data on the impacts of different wellbeing medicines (countermeasures) or roadway highlights as far as their capacity to diminish crashes. Extra data identifying with CMFs is contained at the FHWA CMF Clearing house.

Provides a way of treatments organized by site type:

- Roadway segments
- Intersections
- Interchanges
- Special facilities
- Road networks

The CMFs will be readily applicable to any design or evaluation process where optional treatments are being considered. The CMFs will also be a valuable addition to the documentation of design exceptions. Below table provides an example of a CMF.

Treatment	**Setting (road type)**	**Traffic volume**	**Accident type (severity)**	**Crash modification factor (CMF)**	**Standard error**
Provide a median	Urban (arterial multi lane)	Unspecified	All types (injury)	0.78	0.02
			All types (non injury)	1.09	0.02
	Rural (multi lane)		All types (injury)	0.88	0.03
			All types (non injury)	0.82	0.03



Applications of HSM in the project development process

IV. GEOMETRIC DESIGN

Geometric design for transportation facilities includes the look of geometric cross sections, horizontal alignment, vertical alignment, intersections and varied details. These basic parts area unit common to any or all linear facilities like road ways, flying field runways, railways and taxiways.

Though the small print of style standards varies with the mode and therefore the category of facility, most of the problems concerned in geometric design are similar for all modes. Altogether cases, the goals of geometric design to maximize the safety, comfort and economy of facilities, where as minimizing their environmental impacts.

It is mainly focuses on the basics of geometric design and presents standards and examples from totally different modes. The order of presentation of fabric during this is to contemplate.

1. Geometric cross section
2. Vertical alignment
3. Horizontal alignment
4. Super elevation
5. Coordination of horizontal and vertical alignment
6. Intersections and interchanges

For functions of exposition, the order of the topics is not vital. In an exceedingly typical style project, on the opposite hand, there’s a certain order of tasks, within which the institution of a tentative horizontal center line typically precedes institution of vertical alignment.

This is often as a result of the elevation of the present ground on the center line is a very important thought in establishing the vertical alignment. The method of planning the vertical alignment begins with plotting a profile of the present topic, and a tentative horizontal center line should already be established in order to do this.

4.1 Geometric cross section

The essential thought in the configuration of geometric cross segments for thruways, runways, what's more, runways is seepage. Points of interest shift contingent upon the kind of office and organization. Expressway cross segments comprise of voyaged way, shoulders (or stopping paths), and seepage channels. Shoulders are proposed fundamentally as a wellbeing highlight.

They give for convenience of halted vehicles, crisis use, and sidelong backing of the asphalt. Shoulders might be either cleared or unpaved.

Standard path widths are typically 3.6 m (12 ft.), despite the fact that smaller paths are basic on more established roadways, may in any case be given in situations where the standard path width is not conservative.

- Shoulders or stopping paths for vigorously voyaged streets are regularly 2.4 to 3.6 m (8 to 12 ft.) in width;
- Smaller shoulders are now and again utilized on daintily voyaged streets

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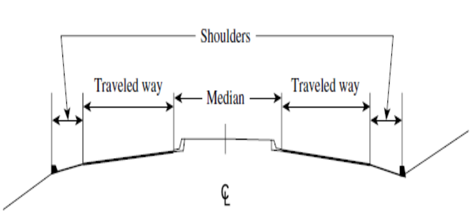
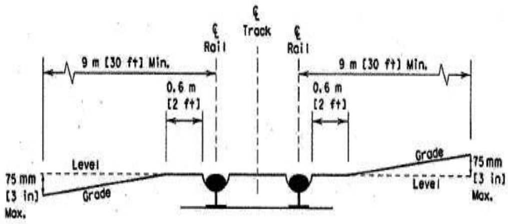


Divided highway cross section



Railroad track geometric cross section

Recommended standards for maximum grades, percent

Type of terrain	Freeways	Rural highways	Urban highways
Level	3-4	3-5	5-8
Rolling	4-5	5-6	6-9
Mountainous	5-6	5-8	8-11

4.2 Vertical curve

Vertical tangents with different grades are joined by vertical curves such as the one shown in above figure. Vertical curves are mostly parabola centered about the point of intersection (P.I.) of the vertical tangents they join. Vertical curves are thus of the form

$$Y = y_0 + g_1x + rx^2/2$$

Where y = elevation of a point on the curve

y_0 = elevation of the beginning of the vertical curve (BVC)

g_1 = grade just prior to the curve

x = horizontal distance from the BVC to the point on the curve

r = rate of change of grade

4.3 Intersections and interchanges

Geometric outline of transportation offices must accommodate the determination of traffic clashes. All in all, these might be delegated

- Merging
- Diverging
- Weaving
- Crossing

Consolidating clashes happen when vehicles enter an activity stream; wandering clashes happen when vehicles leave the movement stream; weaving clashes happen when vehicles run into each other by first combining and afterward veering; also, crossing clashes happen when they run into each other straightforwardly

V. CONCLUSION

Roadway design has generally centered on whether a design component meets least standards rather than by substantive safety. Safety-conscious design standards and choices examination utilizing substantive safety procedures can be assessed in the process procedure utilizing two main general methodologies: highway safety prescient techniques, and crash modification factors. Applying substantive safety in building and outline depends intensely on utilizing these strategies. The practices talked about the consolidate the specialized information that has been created in the course of the last five to ten years in the exploration directed to deliver the Highway safety Manual. Agencies have available to them different analytical instruments for use in applying these strategies. New apparatuses keep on being created as the condition of practice in substantive safety advances. Geometric design of transportation facilities incorporates determination of cross areas, vertical alignments, horizontal alignments, and different design details. Standard cross areas for tangent horizontal alignment are indicated by most design associations. Vertical alignment comprises of vertical tangents and parabolic vertical bends. Most extreme grades for vertical tangents are dictated by the impacts of vehicle power/weight proportions on velocities on different evaluations. Both the length and steepness of the evaluation are critical.

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