

M. Tech. in CIVIL & TRANSPORTATION ENGINEERING / CIVIL TRANSPORTATION ENGINEERING / TRANSPORTATION ENGINEERING

Syllabus of Paper – 1

TRAFFIC ANALYSIS

Components of Traffic System : Introduction, Human-vehicle-environment system, Characteristics of road users; Characteristics of vehicles; Characteristics of highways, friction. Traffic Data Analysis : Traffic study components, types of data; Volume studies; Speed studies; Travel time and delay studies; Intersection studies, pedestrian studies; Parking studies, accident studies. Traffic Characteristics : Microscopic and macroscopic flow characteristics; Time headways, temporal, spatial and flow patterns; Interrupted and un-interrupted traffic; Microscopic and macroscopic speed characteristics; Vehicular speed trajectories; Speed characteristics-mathematical distributions; Speed and travel time variations; travel time and delay studies; Microscopic and macroscopic density characteristics; distance headway characteristics; Car-following theories; Density measurement techniques; density contour maps. Highway Capacity Analysis : Highway Capacity and Level of Service; freeway and multi-lane analysis; freeway weaving sections. Traffic Accidents Analysis : Accident characteristics – road – driver – vehicle; Accident recording and analysis; Highway safety improvement program; Safety audit. Traffic control devices : Introduction about the signs, markings, signal and warrants; Signal phasing and development of phase plans; fixed and vehicle activated signals; Webster method; ARRB method; Drew method; IRC method, Signal coordination; Area traffic control. Environmental Considerations : Air pollution; kinds of pollutants, air pollution standards; Measures of air quality, modeling and control; Measurement of sound levels, acceptable limits; Prediction of noise levels, traffic noise control

URBAN TRANSPORTATION PLANNING

Urban transportation problem: Urban Issues, Travel Characteristics, Evolution of Planning process, Supply and Demand – Systems approach. Travel demand: Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques. Data collection and inventories: Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship. Four stage demand forecasting: UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates. Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models. Mode Choice Analysis: Mode Choice Behaviour, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches. Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Diversion Curves. Traffic corridors: Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis. Urban freight travel demand: Freight Characteristics, Factors influencing Freight Travel, Freight

Demand Estimation, Freight flow on the network. Plan preparation and evaluation: Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities. Pivot Point Analysis, Environmental and Energy Analysis.

PAVEMENT ANALYSIS AND DESIGN

Introduction: Types and components of pavements, highway and airport pavements, materials used in pavements. Factors Affecting Pavement Design: Variables considered in pavement design. Classification of axle types, standard and legal axle loads, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts. Traffic analysis: ADT, AADT, truck factor, growth factor, lane distribution factor, directional distribution factor and vehicle damage factor. Stresses in Flexible Pavements: Layered system concepts. Stress solution for one, two and three layered systems. Fundamental design concepts. Stress analysis in flexible pavements. Stresses in Rigid Pavements: Westergaard's theory and assumptions. Stresses due to curling, stresses and deflections due to loading, frictional stresses. Stresses in dowel bars and tie bars. Stress analysis in rigid pavements. Design of Flexible Pavements: IRC method of flexible pavement design. Asphalt Institute's methods with HMA and other base combinations. AASHTO method of flexible pavement design. Design of Rigid Pavements: IRC methods of rigid pavement design. AASHTO method of rigid pavement design. Design of rigid pavement shoulders. Drainage in Pavements: Design of Pavement Drainage, Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geotextiles, pipes. Estimation of inflow, determination of drainage capacity.

Syllabus of Paper - 2

TRAFFIC SYSTEM DESIGN

Geometric design of highways: Design controls and criteria; Design Elements; Cross section Elements; Geometric standards for Mobility and Accessibility; Landscaping; Optical Design; Express ways Requirements – Weaving areas, Deceleration and Acceleration Lanes, Ramp configurations. Geometric design of at grade intersections: Types and their Suitability, Factors Affecting Design – Design Principles – Data Requirements, Parameters of Intersection Design, Principles of Channelisation, Functional Classification of Channelising Islands, Island Designs, Delineation and Approach-end Treatment, Design of Orthogonal, Skewed, Rotary Intersections, Mini Roundabouts and New Types of Intersections, Location of Bus Stops and Parking Controls, Use of Templates and Flexi Curves. Geometric design of grade separated intersections: Types of grade separations; warrants; Spacing; Ramps; Control of Access; Design of Merging and Diverging lanes; Design of weaving sections, Over and Under structures; Vertical clearances; Multiple interchanges. Design of bicycle and pedestrian facilities: Bikeways Facilities – Bikeway Design Specifications – Bikeway Level of Service – Junction Treatments – Bicycle Parking Facilities – Cycle Network Planning – Pedestrian Facilities – Pedestrian q-k-v Relationships – Walkway Widths – LOS for Walkways – Subways and Over Bridges – Pedestrian Precincts – Passenger Conveyors. Parking layout and design: Parking Demand Analysis; Design of On – Street and Off – Street Facilities; Parking lots; Garage Design; Operational Design elements; Entry and Exits; Traffic Circulation Layout; Design elements for Large Parking generators. Street lighting: Traffic Criteria and Warranting Conditions; Light Sources, Luminaire Design and Placement; Design of Lighting Systems.

LAND USE AND REGIONAL TRANSPORTATION PLANNING

Urban regional dynamics: Population, Urbanisation and Migration, Urban forms and structures, Sector theory, Urban nodes, Multi Nuclei, Concept of Region, Hierarchy of activities Issues Related to Regional Planning, Methods of Delineation Regions, Hierarchy of Regions, Findings of Commission on Urbanisation, Introduction to Micro Economic Theories of Landuse, Concepts by Van Thunan, Christaller and Losch. Land use transportation models: Classification of LUT Models, Economic Base Mechanism, Allocation Mechanism and Spatial Allocation and Employment Relationships, Garin Lowry Models, Contribution by Putman and Wilson, Issues Related to Land use Transport - Interaction. Regional travel demand estimation: Factors Affecting Goods and Passenger Flows, Use of Mathematical Models to Estimate Freight and Passenger Demand, Abstract Mode Models, Mode Specific Models, Direct Demand Models, IVF Models, IO Model, Case Studies, Truck Terminal location – planning. Regional network planning: Problems in Developing Countries, Network Characteristics - Circuitry, Connectivity, Mobility, Accessibility and Level of Service Concepts - Network Structures and Indices – Network Planning – Evaluation - Graph Theory – Cut sets – Flows & Traversing – Optimum Network - Inter-modal Co-ordination. Special features of low volume Roads – Rural Road Network Planning Policy formulation and evaluation: Application of Land use Forms and structures at Urban and Regional levels, Use of Multi-Objective and Goal Programming Techniques, Small Area Management, Residential Neighbourhood and Structure Planning.

PAVEMENT CONSTRUCTION AND EVALUATION

Pavement Construction: Construction equipment. Construction and preparation of subgrade soil. Construction of sub-base layer. Construction of granular base layer. Construction of bituminous base/surface/wearing course. Construction of cement concrete slab. MORT&H specifications for construction of road works. Pavement Inventories and Evaluation: Factors affecting pavement deterioration. Functional condition evaluation techniques: roughness measurements. Identification of uniform sections. Serviceability concepts: visual and ride rating techniques. Structural condition evaluation techniques: NDT procedures, rebound deflection, deflection bowl measurement and analysis. IRC overlay design method. Structural evaluation using falling weight deflectometer, back calculation of layer moduli, ground penetrating radar for pavement evaluation. Evaluation for pavement safety: skid resistance. Hydroplaning reduction with porous overlays and popcorn friction overlays. Pavement Maintenance: Routine maintenance, periodic maintenance, special repairs. Responsive maintenance programme, rehabilitation and reconstruction.
