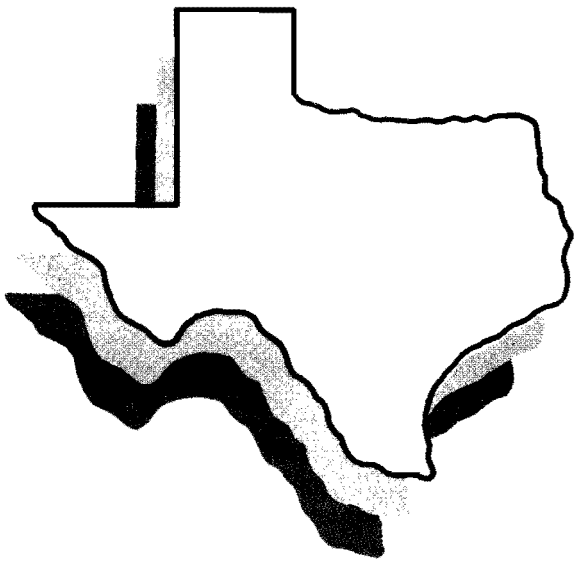
SUMMARY OF RESEARCH PROJECT IMPLEMENTATION

DHT-20



DEPARTMENTAL INFORMATION EXCHANGE

STATE DEPARTMENT OF HIGHWAYS
AND
PUBLIC TRANSPORTATION

RESEARCH SECTION, FILE D10-R, P.O. BOX 5051 AUSTIN, TX 78763-5051, 512-465-7403, STS 241-7403

TECHNICAL MEMORANDUM

To: Jon Underwood,P.E. Date: 01/25/90

From: Jeff Seiler

Subject: Project Implementation

The following list contains projects which involve some sort of implemented results. The project number, the project title, and the Benefit to Cost (B/C) ratio are first noted and are then followed by the implementation statement. Please note that an X in the B/C column indicates that we were unable to calculate the Benefit to Cost ratio due to lack of information.

Project	Title	B/C
3	Road Tests on Hot-Mix Asphaltic Concrete	X

The results of this study led to evaluations and amendments to specifications.

4	Economic Impact of the Interstate System on Selected Areas in Texas	X

The Bureau of Public Roads has used the data developed in this study for some national statistics relative to the impact of the Interstate System.

5	Intersection Illumination	X

This study resulted in a number of findings related to roadside sign legibility, lighting arrangement, intersection illumination, overhead signing, driver tension responses and the use of models to study illumination. However, the most significant finding was that the 30 foot standard light height used by Texas Highway Department was not optimum and that lights mounted at heights greater than that were significantly more effective.

6	Ramps and Interchanges	X

This study developed a method for comparing the cost, operational efficiency, and relative merit of several types of non-directional interchanges.

7	Design Parameters for Columns in Bridge Bents	X

The results of this study were used in the Bridge Division.

8	Study of Highway Medians in Cities	X

The study proved to be of significant value in that it determined what type of median should be used under specific conditions. Furthermore, it showed that careful operating procedures were required during construction in order to permit established businesses to survive during this period.

9	Modifications of Properties of Asphalt	X

The results of this study were used as a basis for specifications.

12	Improved Methods for Cleaning Joints in Concrete Bridge Decks	X

The joint-cleaning technique developed in this study was used by many Districts in Texas.

13	Vegetation Control on Texas Highways	X

The results of this study were used throughout Texas for vegetation control.

15	Cost Effectiveness Priority Program for Roadside Safety Improvements on Non-Controlled Access Roads	X

The material in this report including the rationale used in the development of roadside safety improvement evaluation procedures, field procedures to be applied in conducting the physical roadside hazard inventory, and recommendations of safety improvements on Texas highways was implemented on a statewide basis.

17	Urban Transportation Study Procedures	X

The program produced by this study was used by Districts as well as Divisions.

22	Automated Design of Prestressed Concrete Beams Made Continuous for Live Load	X

The computer program developed in this study was used by the Department.

25	Experimental Use of High Strength Reinforcing Steel	X

Based on the results of this study, and information from other sources, the longitudinal reinforcing steel in the stems of the Texas Highway Department Standard Concrete Slab and Girder Spans was redesigned.

28	Determining the Capabilities of Electronic Equipment	X

This study led to the use of the electro-tape for measuring distances and the auto-trol for cross sectioning.

37	An Evaluation of the Moisture and Density Road Logger Unit	X

The capabilities of the road logger moisture and density logging unit were evaluated in accordance with the objectives and were found to have certain advantages which could be capitalized upon by the Department. The study server to acquaint engineers of the Department with the new measuring equipment and techniques. A few districts use nuclear measuring equipment and others are considering doing so.

38	Determination of Accuracies in Earthwork Quantities from Photogrammetrically made Surveys	X

There was a general acceptance of the photogrammetric method for obtaining cross-sections to be used in design and earthwork computations by the engineers in the field. One of the major items in the automation system resulted from the work done in this study. This is the procedure for taking cross-sections by photogrammetric methods to determine earthwork quantities for payment to the contractor.

39	Evaluation of Terminal Anchorage Installation on Rigid Pavements	X

The design details developed in this study are presently being used by the Department for anchorage systems on jointed concrete pavement.

40	Implementation of Automated Digital-Graphics Mapping System	X

In addition to the Signboard Plan Sheets for the Highway Beautification Program, Automated Graphics was implemented in the development of Traffic Condition Diagram Sheets. Additional implementation is scheduled for selective photogrammetric map sheets for use in highway design and planning.

45	Determining and Evaluating the Skid Characteristics of Texas Highways	X

This study led to the development of the skid trailer which is used throughout the state for pavement friction measurements.

46	Performance Study of Continuously Reinforced Concrete Pavement	X

This study developed the techniques and equipment necessary for the statewide rigid pavement deflection study.

49	Development of a Construction Control Profilograph	X

The project developed a suggested test method and specifications for construction roughness control.

51	A Study of the Basic Characteristics of Synthetic Aggregates for Bituminous Pavements	X

This study incorporated the use of pre-coated aggregate and lightweight aggregate into the Departments specifications as well as outlining design criteria for their use.

52	Design Criteria for Overhanging Ends of Bent Caps-Bond and Shear	X

This study provided the necessary data for the establishment of reasonable and safe design procedures and stresses, especially shear and bond stresses, which could be applied in designing the overhanging ends of bent caps.

62	Insulation of Bridge Decks	X

This study showed that insulating the underneath side of the bridge deck with sprayed Urethane foam did not significantly reduce the number of freeze-thaw cycles of the bridge deck, or materially aid in preventing the formation of ice on the top surface of the deck.

68	Sign Support Structures	X

The result of this study was the "break-away" sign support.

69	Creep in Prestressed Lightweight Concrete	X

The method developed in this study predicting camber in prestressed concrete beams, along with its computer program, was used frequently by the Bridge Division to predict a camber in long prestressed concrete beams.

70	Chemical Admixes for Concrete	X

The research led to a revision of Specification Item 437, Concrete Admixtures.

71	Deleterious Materials in Concrete	X

Results from this study led to a change in the Texas Highway Department "Standard Specifications for Road and Bridge Construction.

86	Highway Signing Research	X

The results of this study were used extensively in the formulation and issuance of specifications.

87	Financial Management Research Study	X

Many of the recommendations of this study were adopted by the Department.

88	Factors Affecting Anchor Bolt Development	X

Based on the results of these studies, several changes were made in the design of anchor bolts.

91	Shear Strength of Bent Caps Between Columns	X

The results of this study were incorporated into the D-5 design methods.

93	Evaluation of Control Extension	X

This program was implemented into the Department's photogrammetry operations and was used for control extensions in areas where elevation data necessary for other programming can not be obtained.

94	Structural Model Study of Concrete Slabs and Girder Spans	X

As of November 18, 1971, all calculations for over-load permits involving the type of bridge study are made using the reduced live load distribution factors recommended as a result of the study.

97	Hybrid Plate Girders Subject to Bending and Shear	X

The results were combined with the results of other studies and a design specification was produced and published in the 1969 edition of the AASHO Standard Specifications for Highway Bridges.

106	Statistical Evaluation of Bridge Deck Survey Data	X

A number of construction changes were implemented during the course of this project and these changes were based on project data.

111	Rail-Highway Grade Crossing Safety Evaluation	X

The comprehensive inventory of rail-highway grade crossings and the diagnostic technique developed as a result of the study was used by the Texas Highway Department.

139	Application of Closed Circuit Television for Traffic Surveillance in Texas	X

This research investigated factors to be considered in the application of surveillance systems and results have been used to this regard in Texas.

171	Extension of TIES Roadway Design System	X

This study resulted in enhancements of the TIES Roadway Design System in the areas of preliminary location and design studies, and bridge design and geometrics.

177	Development and Implementation of the Design, Construction and Rehabilitation of Rigid Pavements	X

Improvements have been made in the Department's design procedures as a result of this research. Condition survey data have been used to prioritize projects for rehabilitation.

178	Analysis of Diamond Interchange Operation and Development of a Frontage Road Level of Service Evaluation Program (PASSER III)	X

The program developed under this study has been used throughout the state.

181	Application of In-Motion Weighing in Planning and Design	X

This report was distributed to all of the states by the FHWA.

184	Simulation of Traffic by a Step-Through Technique	X

This research led to the development of the TEXAS Model for intersection traffic simulation. This model and its enhancements are being used throughout Texas and other states.

205	Priority Use of Transportation Facilities	10/1

The results of this study have been used by the SDHPT and other agencies in Texas in assessing the effectiveness and need for priority treatment projects.

208	Design Criteria of Post-Tensioned Anchorage Zone Bursting Stresses	X

Study results have been used to predict problems and avoid problem on SDHPT projects.

210	Evaluation of Urban Freeway Modifications	5/1

Various urban freeway modifications such as ramp revisions, ramp additions, interchange modifications, and use of narrow lanes has been implemented.

214	Engineering Economy and Energy Considerations in Design, Construction and Materials	X

A series of 29 reports were prepared to address each of the major areas affecting highway efficiency in design, construction, and maintenance. Statewide presentations were made to key personnel in each district in the form of design schools.

220	Evaluating Urban Freeway Guide Signing	2.7/1

The guide lines for level of service analysis of guide signs has been implemented.

222	Evaluation of Overhead Sign Background Materials and Mercury Vapor sign Lighting Fixtures	X

Specifications were developed for overhead guide sign background materials and mercury vapor sign light fixtures and distributed for Statewide use.

223	Crash Test Evaluation of Precast Concrete Barrier and Remedial Measures for Crash Cushions	300/1

The design has been incorporated into the design manual and circulated to all the districts.

225	Economics of Highway Design Alternatives	X

Case studies and traffic/land use predictive techniques have aided in preparation of environmental documents.

226	Development of Economical Precast Concrete Bridges	X

Standard details have been prepared by the Bridge Division. Box beam details were simplified and incorporated in current standard details.

228	Traffic Management During Urban Freeway Maintenance Operations	2/1

Slides with written script have been prepared for the subjects (1) capacity (2) moving maintenance and (3) supplemental arrowboards. Distribution of the report has been made to the districts.

230	Bridge Rail to Contain Heavy Trucks and Buses	X

Bridge rail type T6 tested and developed on this project has been issued by the Bridge Division as an available standard bridge railing.

239	Pavement Rehabilitation Fund Allocation	X

PES for flexible pavements has been implemented and did incorporate work done in this project.

240	Fly Ash Experimental Projects	3.9/1

A specification for fly ash has been approved by SDHPT. Sources are approved after thorough testing. Approved lists are published. Use is decided at the District level for each specific job.

244	Analysis of Drilled Shaft Foundations for Overhead Sign Structures	1.28 to 2.11/1

Standards drawings have been prepared and distributed.

246	Polymer Concrete for Concrete Pavement Rehabilitation	6.4/1

Implementation of the use of polymer concrete has begun in several Districts. Several contracts have been awarded for repair of concrete pavements in which large quantities of user-formulated and commercially-available polymer concrete were used.

247	Evaluation of Fatigue Life of Structural Steel Bridge Details	16/1

The Retrofit design has been performed on many bridge structures as a result of this research.

249	Implementation of Rigid Pavement Overlay and Design System	50/1

Computer programs RPOD-2, RPRDS-1, and PRPO1 have been provided to the Department to aid in implementing the findings. Also, guidelines have been prepared for pavement-design engineers which will help them in identifying the needs of in-service pavements and perform a rational analysis of overlay thickness design.

250	Vehicle Emissions at Intersections	8/1

The Environmental Protection Agency has approved the TEXIN model in their Air Quality Modeling Guidelines. Presently this model is used nationwide.

251	Deployment of a Digital Profilometer	506 to 898/1

A new profilometer was purchased and calibrated. Software was developed for this new device and then all was delivered to SDHPT for use.

252	Design and Characterization of Recycled Pavement Mixtures	1.49/1

Stockpiles of roto-milled HMAC have been combined with virgin material in mix designs. Several projects throughout the state have utilized these results.

253	Moisture Effects on Asphalt Mixtures	> 3/1

Texas allows either the Texas Boiling Test or the Wet-Dry Indirect Tensile Test be used for determining moisture susceptibility. However, standard specifications now call for the Wet-Dry IDT unless otherwise noted on the plans.

254	Design of Nonprismatic or Hollow Bridge Piers or Columns	X

The Department's contact representative has begun informing other bridge designers of the benefits of programs developed. One program has been used for preliminary designs of bridge and other pier projects.

255	The Influence of Steel Casing on the Load Carrying Capacity of Drilled Shafts	X

Specifications have been revised to require detailed analysis of shafts when skin friction is used in design and casing is left in place during construction.

259	Detector Configuration and Location at Signalized Intersections	4.1/1

A letter to all the District Engineers was distributed which included guidelines for multiple loop detector layout.

262	Safety in Construction and Maintenance Zones	X

Standard sheets have been prepared for inclusion in construction plans. Also, some of the findings have been presented in special design schools, maintenance conferences, etc.

265	Operational Effects of Driving on Paved Shoulders	X

The results of this research were used as a basis of recommended changes in State Motor Vehicle Laws relative to definitions and use of paved shoulders.

268	Transportation Cost and Resources	X

Forecasts were used quarterly by the Highway Cost Index Committee.

270	Evaluation of Materials for Shoulder Mounted Signs and Sign Maintenance Management	X

Specifications on flat surface reflective sheeting as well as other specs. have been adopted.

276	Evaluation of Guide Sign Construction Materials	X

Findings are incorporated into standard specifications.

280	Safe End Treatment for Roadside Culverts	X

Findings have been implemented by Administrative Circulars 8-79, 13-79, 77-79, and 60-80, which transmit design policy, guidelines, and standards to the field.

282	Development of Traffic Information for Estimation of Mobile Source Emissions for Air Quality Monitoring	10/1

Developed and tested an emissions model that more realistically establishes mobile source emissions based on traffic data. Model now being used by D-8.

283 Vehicle Emissions from Roadways 10/1

Developed a model for estimating roadway emissions on the downwind side of a roadway or intersection. Model in use by Highway Design Division.

284 Flexible Pavement Data Base and Design 85.9/1

User costs were added to the flexible pavement design system. New load zoning procedures where added to the Department's load zone policy and procedures.

285 Asphalt Concrete Mix Design and Specification 20/1

Specifications for asphaltic concrete were revised, and several regional seminars were held explaining the changes to Department and contractor personnel.

287 Desirable Asphalt Properties X

The results of this project were used in developing requirements and present test methods for determining moisture susceptibility of hot mix asphaltic concrete.

288 Freeway Ramp and Frontage Road Operation 19/1

Warrants were developed for conversion of two-way traffic on frontage roads to one-way traffic. Additionally, the findings of this study were used in developing legislative requests.

290 Developing a Freeway Data Collection System 20/1

Procedures were developed for locating and installing loops on freeways and frontage roads in order to achieve maximum efficiency in collection of freeway traffic data. Procedures have been in use for several years.

292 Handling Traffic in Work Zones X

New traffic control signs and measures were incorporated in Departmental standards for traffic control plans, barricades, and construction.

293	Warrants for Interconnection of Isolated Traffic Signals	157/1

This study developed warrants for interconnection of traffic signals to allow for more orderly progression of traffic along a roadway or street. Warrants are in use by the state and many cities and counties.

294	Determination of Earth Pressures on Reinforced Box Culverts	1.01/1

This study developed procedures and equations that are used in the design of box culverts.

295	Bridge Deck design for Railing Impacts	X

Results of this study were used in improving the safety and crash worthiness of bridges. The standard bridge design details were modified to include the results of this study.

301	Hydraulic Performance of Culverts with Safety Grates	X

Standard details for safety grates on the end of culverts were prepared. Benefits include improved understanding of culvert hydraulics, better hydraulic computation factors and increased confidence in the types of safety grates used. Additionally, this study determined that culvert headwalls could be removed when safety grates were used.

303	Behavior of Prestressed panel Cast-In-Place Concrete Bridge Decks	X

This study determined that fiber board strips used in construction of bridge decks could cause problems. An advisory concerning this was distributed to all districts as SDHPT bridge tips.

307	Implementation of a Pavement Management System for Texas	X

Findings of this study are the basis for the continued development of a pavement management system for Texas.

308	The Influence of construction Methods on the Design of drilled Shafts	X

Specification for Drilled shafts were rewritten to require desired slump of concrete.

309	Automated Turning Movement Count System for Signalized Intersections	8.5/1

Algorithms were developed and tested to determine turning vehicle volumes. System currently in use by D-18.

311	Evaluation of Fast-Setting Repair Materials for Concrete Pavements and Bridges	X

Several materials were evaluated for fast setting repair of concrete pavement and bridges . Implementation manual was developed and published showing conditions under which each material be used.

314	Modification of a Hydromatic, Finite-Element Model to a User-Oriented Program for a Two-Dimensional Analysis of Backwater at Bridges	X

Modifications to simplify the program for analysis of backwater at bridges were made and successfully used to evaluate conditions where the Department was involved.

315	Production of High-Strength Concrete	X

Guidelines for design of high strength concrete mixes were incorporated into specifications. On two projects where used for prestressed concrete beams, there was approximately 17% saved on beam length.

317	Field Compaction of Asphalt Mixtures	10/1 in 10 years

Adopted the Rice Method to determine maximum theoretical density and adopted new standard specification for air void criteria.

320 Film on Multi-Agency Cooperation in Transitway Projects — X

Developed film which depicts multi-agency cooperation in transitway development.

321 Evaluation of Traffic Control Plans at Reconstruction Sites — 1.3/1

Developed a catalog of traffic control strategies and devices with guidelines for preparing work zone traffic control plans. Barricade and Construction Sheets were revised.

322 A Study of Raised Reflective Pavement Markers — 1.89/1

Installation guide provided for raised pavement markers.

325 Estimating Remaining Service Life of Flexible Pavements — X

Developed a procedure to estimate the remaining life of flexible pavements. Findings were incorporated into Highway Cost Allocation Studies and findings also put into the RENU2 program which is used to develop the 20-year Operational Planning Document.

326 Behavior of Reinforced Concrete Box Culverts Under Backfill and Traffic Loads — 9.6/1

Findings used in the design of reinforced concrete box culverts.

327 A Delay-Based Method of Highway Project Evaluation — X

Speed/Volume relationships were developed and incorporated into a model for calculating delay savings-to-construction cost ratios. Findings used to develop the 10-year project development plan.

328 Pavement Edges, Roadway Discontinuities, and Vehicle Stability — X

Findings on pavement edges used by Attorney General Department in tort claims.

330	Protection of Personnel in Maintenance and Construction Zones	X

Specifications for safety vests were revised and recommendations for uniforms to be worn by courtesy patrols were made.

338	Statewide Evaluation of Truck Operations and Regulations on Urban Freeways	100/1

Recommendations were made for speed zone enforcement and driver education programs.

339	Improving Urban Mobility Through Applications of High-Occupancy Vehicle Priority Treatments	6/1

This study showed that the Katy Freeway Transitway had increased peak-hour person movement by 93%, increased peak-hour vehicle occupancy by 21%, and the peak-hour passenger-miles/hour has increased by 139%. More informed decision-making is possible on such issues as operating procedures and transitway design.

343	Improved Design of Light Poles, Guardrails and Appurtenances	10.3/1

New tension fuse plate details have been used to revise sign standards and have worked well for large sign supports such as steel sizes W12 x 26 to W6 x 9. Steel size S3 x 5.7 to S4 x 7.7 should not use tension fuse plates.

344	Guidelines for Diamond Interchange Control	30.6/1

The Districts have been utilizing the warrant guidelines in the analysis of diamond interchange traffic volumes and the Department has purchased a "diamond interchange controller" which provides both three phase and four phase operation.

346	Concrete Safety Shaped Barrier for Roadside Application	Depends on # of impacts

A rubber cylinder crash cushion end treatment was developed and has been effective for high frequency impact locations in experimental locations.

351	The Effect of Bentonite Slurry on Drilled Shafts	X

Additional specifications are now included in plans. Also, contractors are not allowed to let holes stand overnight before placing concrete.

359	Rapid Repair of Wet Asphalt	X

Fly ash, Sylvax, Traffix and Instant Road Repair were effective products for patching wet asphaltic concrete pavements, provided they are placed on stable materials.

361	User Friendly TEXAS Model for Intersection Traffic	X

This project converted the model for use on a microcomputer and added a data entry facility.

363	Evaluation of Chace Air Indicator for Use in Concrete Construction	X

Changes to test method Tex 416A Part D "Chace Air Indicator" is now being completed to use recommendations from this study concerning calibration of the CAI and its use.

364	Production of Concrete Containing Fly Ash	X

Fly ash of proven quality and uniformity can successfully be substituted for a portion of the cement. Specifications allowing the optional use of fly ash in concrete have been fully implemented. A supplement to Construction Bulletin C-11 has been written and is being used on a project to project basis. Special provisions to Item #60 "Concrete Pavement" and Item 421 "Structural Concrete" have been proposed. Also, approved fly ash sources are available.

366	Segregation in Asphalt Mixtures Produced in Drum Mix Plants	X

The study found specific segregation problems and offered possible solutions based on the segregation patterns themselves. However, segregation remains a difficult problem, even with a trouble shooting guide.

367	Guidelines for the Use of High-Strength Concrete in Texas Highways	X

Specifications are now adequate for high-strength concrete. Guidelines for high-strength mix design have been implemented in Supplement No. 2 to Construction Bulletin C-11. This supplement, with minor changes, will be incorporated into the new C-11. High-strength concrete has been used in prestressed concrete beams on two bridges with satisfactory results.

368	Nondestructive Measurements of Thickness and Elastic Stiffness of Pavement Layers	15/1

The results of this study are being used in project 1123, "Non-Destructive Test Procedures for Analyzing Structural Conditions of Pavements"

369	Evaluation of Texture Requirements for Portland Cement Concrete Pavements	X

The Texas SDHPT Specifications Committee adopted recommended modifications to the Texas texture specifications.

375	Reduced Delay Optimization and Other Enhancements for PASSER II-80 (PASSER II-84)	257/1 nationwide 128/1 Texas

Research claims a 10% improvement in delay. This technique has been incorporated in the 1985 Highway Capacity Manual. The model has been implemented on the SDHPT mainframe and a microcomputer version of the model has been prepared.

377	Traffic Control for Stop-and-Go and and Short Term Maintenance/Construction Operations and Techniques for Installing Lane Closures	4.1/1

A letter was sent March, 1989 to all the Districts approving techniques for lane closures on an experimental basis.

381	Optimum Design of Bridge Girders Made Using High-Strength Concrete and Deflection of Long-Span Pre-stressed Concrete Beams	X

The Department has recommended incorporation of the results into proposed code revisions. The research reports are being used as design references in the Bridge Division.

382	Resistance of Anchor Bolts to Fatigue and Impact Loading	X

Newer barriers are being designed with modified anchor systems which take into consideration some of the recommendations resulting for this research.

396	Improved Values of Travel Time and Accident Costs for Highway Project Evaluation	X

The findings have been placed onto the HEEM tapes and can be used in prioritization of projects. The findings were sent to each District along with methodology. Several Districts have used the findings for project prioritization.

397	Larger Trucks on Texas Highways	X

Many of the results of this study have been incorporated into the Geometric Design Manual and are being used by the Districts.

400	Serviceability Ratings of Texas Highways for Pavement Management and Related Studies	82/1

"Ride Quality" specifications for rigid pavement have been developed and are being used on select projects. "Ride Quality" specifications for flexible pavements are being developed and will be implemented when completed.

404	New Guardrail End Treatment	X

This study has produced the benefit of an additional end treatment for guardrail which tests indicate will result in better field performance for impacting vehicles compared to the standard turned down end. This end treatment will also be far less costly to install and maintain than some of the proprietary end treatments currently being installed in selected locations. If field experience correlates well with test results, this end treatment could be used nationwide.

408	Improved Delineation of Concrete Barriers and Gore Areas	X

The results of this report are to be incorporated into standards.

415	Design Method for Drilled Shaft Retaining Walls	X

The results of this project allow the Department to revise its design procedures for placing drilled shafts in relatively soft soils.

417	Energy Absorbing Traffic Rail	X

This project successfully developed a bridge rail to absorb the energy of a vehicle and reducing chances of injury to all people involved while at the same time reducing maintenance cost to the Department for repair of the damaged bridge rail.

421	Development of a Freeway Data Base Model	8/1

Model freeway data base was developed. This data model collects freeway traffic data, analyzes this information and stores on Department main frame. Several districts are using this to assist in traffic management of the freeways in their districts.

422	Evaluation of Pavement Concrete Using Texas Coarse Aggregates	X

The results of this study involving the percentage of steel in continuously reinforced concrete pavements (CRCP) has been implemented into the Departmental design standard CRCP(B)-89C.

423	Guideline for Identifying Improvements in Diamond Interchanges	400/1

Guidelines were developed for identifying needed improvements at diamond interchanges were developed. These guidelines allow for ways to determine needed improvements and their priority for scheduling. Highway capacity courses were provided for various departmental and city personnel.

424	Evaluation of the Texas Truck Weighing Program	X

This project evaluated the Departments truck weighing program that was in force for weighing trucks for planning purposes, made recommendations for change. These recommendations were implemented with regard to the needed number of sites.

425	Preparation of Texas Manual for Planning and Design of High Occupancy Vehicle Priority Facilities - Transitways	X

Manual was prepared for planning and design of high occupancy vehicle (HOV) priority facilities - transitways, and it was incorporated into the Highway Design Division's Design Manual.

427	Effectiveness of Texas Membrane Curing Compound Quality and Application Requirements	1/1

Study evaluated Texas specifications, storage, handling, application, and curing methods. The determination was that existing Texas methods were adequate.

435	Repair of Slides in Earth Slopes	X

One week short course designed and developed on repair and prevention of earth slides. Course presented to Department personnel.

438 Evaluation of the 4-Cycle Magnesium Sulfate Soundness Test to Control Quality of Aggregates for Use in Hot Mix and Surface Treatments — 91/1

This project determined that the 4-cycle soundness test was the best single test to determine aggregate durability. Therefore, this test became a Department standard, and is being used for determination of aggregate durability for hot mix and surface treatments by most of the Department's districts.

439 Strategies for Bridge Replacement — X

The results of this project are assisting the Bridge Division in developing budgets for bridge replacement. This assists in assuring that sufficient money is available to replace the most defective bridges.

440 Evaluation and Training Related to Drum Mix Plants — X

A manual on the operation of drum mix plants that are used for preparation of hot mix was prepared. Training schools covering theory, equipment operation and calibration procedures are being conducted around the state.

442 Design of Rest Area Comfort Stations — X

New site layouts, building designs and materials have been incorporated into new sites and rehabilitation of existing sites. These new plans are designed to ease maintenance requirements, reduce vandalism, reduce complaints, increase safety to travelers, and generally benefit tourism.

443 Texas Diamond - A Microscopic Simulation Model for Diamond Interchanges — X

A computer model to analyze traffic at interchanges, the TEXAS Model, previously developed by research was expanded in this study to include the popular diamond interchange.

445 Mower Thrown Object Accidents — X

This study and subsequent research led to development of a deflector kit for roadway mowers to decrease the amount of mower thrown objects. Thereby, reducing the probability of accidents caused by mower thrown objects.

446 Shear Strength for Embankment and Retaining Wall Foundation Design X

Prior to this research the Department used the standard texas triaxial test to determine the shear strength of soils when designing embankments and foundations. This research determined that this standard test over estimated the shear strength of very soft soils. This project further determined that the transmatic test was more accurate for these soils, and developed revised Departmental test methods which follow the standard ASTM Test D2850.

447 Longer and Wider Trucks on the Texas Highway System X

Federal rules have allowed longer and wider trucks to operate on the nations highway system. Results of this study have been incorporated in the Department's design policy and design manuals. Additionally, the truck off-tracking computer program has been revised. This program assists in designing of turning radii to assist trucks in making turns.

453 Low Maintenance Crash Cushion X

The purpose of this study was to develop a crash cushion that would ease the very large maintenance requirement that the Department spends in the repair of crash cushions after an accident, while not decreasing the probability that an occupant of a vehicle would survive a crash. This study developed a rubber crash cushion made of rubber cylinders, that will benefit future work in this area.

454 Development of Peak Period Traffic Assignment Capability X

The results of this study are used by the Department to improve the procedure that is used to make traffic assignments for future roadway designs and upgrades.

457 Thin Bonded Overlay Implemented 59/1

Results of this project were incorporated in specifications for specific projects. Information generated for this study will add to existing knowledge about rehabilitation options and strategies.

459	Development of Subbase Friction Information for Use in Design of Concrete Pavements	145.7/1

Frictional restraint data developed in this study was used to update concrete pavement designs.

461	Guardrail/Bridge Rail Transitions	X

Many severe accidents have occurred in the transition between the guardrail and bridge rail. This project developed standard details and specifications. Study resulted in a transition section which should lessen the severity of accidents in the region just upstream of concrete bridge railing.

464	Estimating Residual Fatigue Life of Bridges	2/1

An automated bridge testing system was developed to make accurate predictions of fatigue life for various bridge components.

466	2-Dimensional Analysis of Backwater at Bridges	26/1

Existing programs and subroutines were revised in this study to more accurately define conditions in free-surface flow of water in streams. This program was also modified to run on a microcomputer. User manuals were updated and plotting programs were rewritten. Results of this program will be useful in design to reduce occurrences of flooding.

467	Enhancements to PASSER II-84	
and		
458	Operations and Design Applications Using PASSER III-85	257/1

Microcomputer model developed to improve signal timing and optimization for coordinated interchanges. Training workshops were held and results are in use across the United States.

473	Investigation of the Effects of Raising the Legal Load Limits to 80,000 Pounds on Farm to Market Roads	25/1

This study developed a microcomputer program (LOADRATE) to assist in determining the effects of raising the load limit on a roadway.

476	Investigate and Improve Current Methods of Predicting Load Equivalents for Design	44/1

This study developed a new method for predicting vehicle loads for flexible pavement designs which considers the four environmental zones in Texas.

481	Durability and Performance of Concrete Containing Fly Ash Including Its Use in Hot Weather Concreting	X

As a result of this study standard construction procedures were modified to place limitations on the use of Type B fly ash.

483	Development of a Method to Produce Stable Foundations for Highway-Railroad Grade Crossing	X

This project developed a procedure and rating system to set priorities for rehabilitation under the annual railroad crossing replanking program. Additionally, an experimental grade crossing was developed, installed and evaluated.

484	An Evaluation of the Impact of Permitting Car-Pools to use the Katy Transitway	X

Results of this study are being used by the Department and Metro in formulating decisions on design and operation of Houston transitways.

506	Development of Design Charts for Minor Service Structure Foundations	X

A series of design charts are presented which allow a total graphical procedure to be followed in selecting the proper size of drilled shaft foundation for standard Texas highway signs.

521	The Texas Quick-Load Method for Foundation Load Testing	X

A method to determine the load bearing capacity of piles and drilled shaft foundations. This test can be performed in 1-2 hours as compared with approximately 100 hours required for the standard AASHTO test method with only a minor effect on test accuracy. Considerable cost savings is realized in the utilization of this method.

522	Cathodic Protection of Bridge Decks	X

Cathodic protection procedures are being recommended wherever the corrosive effects of road salts are a potential problem.

523	Discarded tires in Highway Construction (Rubberized Asphalt Seals)	X
&		
529	Evaluation of Rubber Asphalt Mixture as Stress Relieving Inner Layer	X

Rubberized asphalt seals and ground rubber asphalt mixtures have been tried in different areas of the state with varying degrees of success.

524	Recycling Asphalt Concrete	X
527	Pavement	
530		

Recycled asphalt concrete pavement has been widely used to utilize milled pavements to reduce material costs of construction projects.

525	Training Course on Highway Safety Improvement Programming	X

The National Highway Institute now conducts nationwide training courses for effective implementation of roadside safety features.

534	Solar Asphalt Heating System	X

This system has been used in San Antonio and Lubbock to maintain the asphalt temperatures by replacing the heat losses experienced by insulated tanks. It has been recommended by maintenance foreman due to the fact that the asphalt is always ready to use, thus saving valuable man-hours. This system should pay for itself in 5-10 years depending on the amount of asphalt being kept warm.

561 & 1124	Thin Bonded Concrete Overlays Influence of the Temperature of the Substrate on the Construction of Thin-Bonded PCC Overlays	Ranges from -72 if projects are unsuccessful to 59 if successful

Several bonded concrete projects have been done in District 12 with good success. Project 1124 has helped to increase this performance record even further.

1110	Subarea Analysis Using Microcomputers	X

Subarea analysis has been planned for Department-wide usage.

1115	Implementation of the Texas Version of the Highway Performance Monitoring System	X

Recommended that PES sample be modified to include HPMS sample sections and that PES data be used in the pavement portion of the HPMS data set.

1117	Guidelines for Proper Use of Superplasticizers and the Effect of Retempering Practices on Performance and Durability of Concrete	X

Recommended that the practice of allowing retempering of concrete in the field be discontinued.

1121	Investigation of Rutting in Asphalt Concrete Pavements	X

Recommendations for design procedures to reduce rutting in ACP.

1122	Generic Small Support System and Validation of Acceptable Support Performance	X

Recommended use of "Generic Anchor System" for specific sign post installation to simplify work of maintenance and sign crews and should result in significant savings.

1123	Development of Non-Destructive Test Procedures for Analyzing Structural Conditions of Pavements	X

Recommended use of the modulus backcalculation program in the Department flexible pavement analysis and design processes.

1146	A "Before"-and-"After" Evaluation of the High-Occupancy Vehicle Transitway Committed Projects	X

Results being used in assessing feasibility of HOV projects.

1119	Improved Concrete Quality Control Procedures Including Third Point Loading	X

Third point loading conversion kits have been ordered to switch from center point loading. Cost is about $200 per machine. The concrete specification rewrite task group is addressing third point loading in their rewrite of Item 421 "Portland Cement Concrete".

1122	Generic Small Sign Support System and Validation of Acceptable Support Performance	X

As soon as the report is finalized, D-18STO will start on the standard sheets revisions that detail small sign supports.

1133	Animated Graphics for Intersection Traffic Analysis	15/1 over ten years

An Animated display allows engineers to better analyze the movement of traffic through an intersection.

1154	Data Collection Technology and Support	X

Recommendations are being prepared for consideration in modifying the Department's traffic monitoring activities from both the system design and hardware viewpoints.

1183	User-Oriented Analysis Packages for Bridges	X

Code for BMCOL51 has been delivered for immediate implementation.

1193	Commuting Patterns in Large Texas Urban Areas	X

The study findings contained in the final report and study appendix provides information for SDHPT and local area planners on commuting patterns in all Texas metropolitan areas and each area individually.

1220	Development of Low Cost Piezo-electric Film	X
&		
2035	Installation of Automated Vehicle Classification Sites	X

The Department has installed and is currently installing more of these systems throughout Texas for traffic data collection.

1223	Evaluation and Implementation of ARAN Unit	X

The model correlating the ARAN pavement roughness statistics to the Profilometer SI output is presently being implemented on ARAN pavement roughness data being collected by SDHPT personnel.