

GEORGIA INSTITUTE OF TECHNOLOGY

Engineering Experiment Station

PROJECT INITIATION

Date: November 15, 1974

Project Title: Verification Testing of the Transette Personal Rapid Transit System

Project No.: B-432

Project Director: Mr. R. A. Goodman

Sponsor: National Science Foundation

Effective: June 27, 1974

Estimated to run until: December 31, 1975

Type Agreement: Contr. / RDI-74-22600 Amount: \$ \$105,700 (NSF Funds)
17,714 (GIT Contribution)
\$123,414 Total

Reports Required: Monthly Progress Letter, Final Report

Sponsor Contact Person (s):

Technical Matters

Mr. Evan Anderson

Project Officer

Experimental R&D Incentives Prog.

National Science Foundation

Washington, D. C. 20550

Contractual Matters

Wilbur W. Bolton, Jr.

Grants & Contracts Officer

National Science Foundation

Washington, D. C. 20550

Plus one month for preparation and submission of final report.

Assigned to: SENSOR SYSTEMS

Division

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Bonnie Wettlaufer



GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT TERMINATION

12054
2054
2054

Date: June 29, 1977

Project Title: Verification Testing of the Transette Personal Rapid Transit System

Project No: B-432

Project Director: Mr. R. M. Goodman

Sponsor: National Science Foundation

Effective Termination Date: 12/31/76

Clearance of Accounting Charges: All clear

Grant/Contract Closeout Actions Remaining: NONE

- ☐ Final Invoice and Closing Documents
- ☐ Final Fiscal Report
- ☐ Final Report of Inventions
- ☐ Govt. Property Inventory & Related Certificate
- ☐ Classified Material Certificate
- ☐ Other _____

Assigned to: Systems & Techniques Laboratory (School/Laboratory)

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ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

7 January 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 1, covering the
period 27 June to 31 August 1974

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

This is the first Monthly Progress Letter on the referenced agreement. The Agreement has been signed by all parties and is effective 27 June 1974. Close contact has been maintained with Dr. Sutton of Transette, and he is making good progress with organization of his company and detailed engineering plans for the system. Mr. Goodman of Georgia Tech and Dr. Sutton attended a planning meeting in Washington on 21 August.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh



ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

7 January 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 2, covering the
period 1 September to 30 September 1974

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

Dr. Sutton of Transette has completed his arrangements, and a contract was formalized between Georgia Tech and Transette, Inc., on 22 September which, it is believed, will satisfy the needs and requirements of all three interested agencies. Transette is proceeding rapidly with preparations on the site and with design and fabrication planning for the cars. Drawings are nearing completion. It is expected that installation of the guideway can be begun early in October. Dr. Sutton is now hoping to complete concrete work sooner than originally planned, in order to minimize weather difficulties.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

7 January 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 3, covering the
period 1 October to 31 October 1974

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

Since the contract with Transette was signed on 22 September, considerable progress has been made in detailed planning and preparation of all drawings. The installation of the guideway began on 10 October and the concrete placement and finishing was completed on 29 October. Car mold preparation has included alterations to accept an improved glazing and door system.

Drawings Status

Layouts and detailed drawings for all phases of the test site installation have been prepared and include route, profile, mechanical, electrical power, control, concrete, guide rail, and slider bed details. In addition detailed drawings for improvement of the glazing and door installations have been prepared. A structural, splined, one piece neoprene gasket mechanically locks the Lexan glazing to the body and to the roof. It greatly improves the esthetics of the car while reducing assembly time of the body components. Acoustical damping material is located on the ceiling to reduce reverberation when the car is only partially loaded. A much improved door has been designed to permit automatic operation and to increase safety. Georgia Tech has selected a color scheme using the school colors of gold and white with black accent. The top will be white with a gold body and seats. The body and roof molds have been modified to accept the new glazing system. The clutch control mechanism in the rear axle has also been redesigned to simplify and make fail-safe its operation.

Guideway Installation

Progress in installing the guideway has proceeded rapidly with the initiation of grading on 10 October. Rough grading was completed on the 11th. During grading, the main electrical duct bank serving the campus was discovered to be at a depth of 18 inches rather than 5 feet. Adjustments were made to the grades and final grade stakes [blue tops] were set on the 12th and 13th October. The maximum grade is now 7 per cent compared to $5\frac{1}{2}$ per cent previously designed.

Fine grading was accomplished on the 14th and 15th. Rock had been anticipated in the maximum cut area at the top of the ridge at the west end, and in fact considerable difficulty was experienced in establishing the final grade on the east end. There were large boulders and an old street bed in a rubble fill. Fine grading was completed on the 17th.

Forming began on the 15th and was delayed by rain on the 16th. Three 24-inch drainage culverts were placed on the 17th. The first pour of approximately 600 feet was completed on the 18th; the second pour, approximately 700 feet, on the 23rd. The final pour of the terminals was made on the 29th. Backfill and clean up began on the 31st.

In addition to 3000 feet of edge forming, more than 400 feet of fiberglass belt return ducts were fabricated and placed below the slab. Eight machinery pit forms and 50 small idler pulley and carousel support wheel pit forms were fabricated and placed. Close attention was paid to grade and smoothness control and a high quality guideway has been achieved. A number of favorable comments have been made of the guideway quality. Tolerances of $\frac{1}{4}$ inches in 10 feet, strength of 3000 psi, and surface roughness criteria were established by specification before pouring.

Test Plans

Mr. Joe Herlihy, Mr. Allan Robertson, and Mr. Don Sussman of TSC met with R. M. Goodman, Jr. of Georgia Tech and J. F. Sutton of Transette on the 15th and 16th of October. The final draft of the Test Plan was reviewed and was agreed upon with only very minor modifications. The final plan was received on 31 October. The Test Plan as written by TSC personnel is excellent.

Student Relationships

The students living in the Area 3 dormitories have quickly accepted the route of the guideway. Walking time over the previous paths of 8 to 9 minutes has been reduced to just over 6 minutes on the guideway. Use of the cars will permit trip times of less than 1-1/2 minutes, resulting in a total time saving per day of one-half hour or more per student.

7 January 1975

Student interest has been fairly high. No graffiti were experienced on the wet concrete. The student newspaper, "The Technique," has run two stories and one Letter to the Editor concerning the program. An additional story will be published in November.

Four students have been employed to help in the installation. Transette is very pleased with their performance.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh



ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

16 January 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letter No. 4, covering the
period 1 November to 30 November 1974

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Dr. Sutton of Transette regarding work on the referenced project during November. As indicated, both preparation of the site and work on the equipment is proceeding satisfactorily. Fabrication of the control house is expected to be completed during December, as is tooling for the cars.

Georgia Tech engineering personnel have continued to monitor the activities of Transette personnel, and are thoroughly satisfied with progress of the work.

Very truly yours.

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG:jm
enclosure

Progress Report #2

November

Summary:

Following the placement of the concrete slab in October, clean-up of the site has proceeded with back-filling, landscaping, mechanical pit forming and pouring, pit drainage placement, and fabrication of pit covers and support frames.

Guideway Installation:

Clean-up of the site and form removal began in the first week of the month. Back-filling and shaping of the areas adjacent to the slab was accomplished. The Physical Plant Director, Mr. Charles Johnson, agreed to landscape the site. Considerable inclement weather has delayed completion of the landscaping, however.

Eight large mechanical equipment pits were poured. Prefabricated forms were built and included angle iron frames fastened to the forms. After excavation of the pits, the floors were poured. The forms were fastened to the floors and the walls poured.

Angle iron frames were fabricated and are to be fastened to the pit frames to support the steel plate pit covers.

An additional 32 small pit frames and covers were fabricated for the idler and return pulley pits.

Conduit and four inch drains were placed in each pit before pouring the walls. Attempts to use a ditcher to dig 300 feet of drainage ditches were unsuccessful because of rock. This was later accomplished by a back-hoe and by hand.

Cars:

Final sanding and polishing of the new patterns was completed. The decision

was made to use a high gloss finish on all body components so that each pattern has been carefully sanded and polished to a high gloss. The use of a splined gasket on the windows will result in greatly improved appearance and simplifies final assembly of the cars. Elimination of the steel muntins on each end of the car permits a wrap-around window at each end. A large forming block has been fabricated so that forming and trimming of the glazing may be accurately done easily.

Selection of control elements has been accomplished. The proximity switches and logic elements are all off-the-shelf items. A unique control house has been designed. It will be located on a ridge near station 400. The entire track is visible through the window above the control panel. The control house provides space for all motor starters, switches, and logic elements. This permits easy trouble shooting and instrumentation.

Budget:

Material costs have continued to escalate. Price variations of as much as fifty per cent have been obtained from various suppliers. It has been necessary to secure quotations from a number of suppliers on any given item to reduce budget impact. Labor and overhead continue to be under the budget so the overall budget position is favorable.



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

January 15, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letter No. 5, covering the
period 1 December to 31 December 1974


Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Transette covering the work on the referenced project during December. Also enclosed are copies of photographs illustrating the installation. As indicated, the work is continuing to move satisfactorily. The control house has been installed, control hardware is designed and ready for procurement, and body tooling is complete and fabrication has been contracted.

Georgia Tech personnel continue to monitor the operation closely, and remain satisfied with the rate of progress.

Very truly yours,

Robert M. Goodman, Jr. 
Chief, Sensor Systems Division

RMG/mh
enclosure

8 January 1975

Progress Report #3

December

Summary

Following pouring of floors and walls of all mechanical equipment pits, four inch drains were installed and covers and supports fitted and placed. A concrete slab was poured for the control house. The control house was fabricated and placed on site 3 January 1975.

Guideway Installation

The eight mechanical equipment pits were completed. More than 300 feet of four inch drain lines were installed. Pit covers were fabricated of 1/4 inch steel plates and bolted in place. All pit covers are flush with the guideway surface.

Considerable rain has delayed the landscaping except at the eastern and western terminals. In general, the drainage is quite good except for one location where a small interception ditch at the top of a cut is necessary.

The control house was built and installed on the ridge near the off-line station. A spun 1/4 inch thick aluminum dome eleven feet in diameter was used for the roof. The base is a circular cylinder $3\frac{1}{2}$ feet high. The walls then flare outward to meet the roof. The window covers $\frac{3}{8}$ of the periphery and is solar-control plexiglass cold bent to contour. The structure is double laminated plywood over formers and 2 x 4 studs. The exterior is sprayed with white fiberglass. An interior liner was formed on the dome. The roof and side walls are insulated with fiberglass. A concrete slab ten feet in diameter was poured in place. The control house will be air conditioned. All controls will be located on a console adjacent to the window. The entire track is visible from the operator's position. Use of binoculars permits inspection of the entire track area. The main switch, all motor starters, remote switches, and logic panels are located at the operator's console. Space for test instrumentation and visitors will be provided in the rear of the house.

The guide rail fabrication has been delayed until February. Vendor quotations on steel in December were more than double the budget. Contact with Bethlehem Steel has indicated that a partial load (3000 feet) of four inch channel can be made available at a price within the project budget, however. The steel supply situation has opened up considerably in the past two weeks.

Material for the motor and pulley frames to be placed in the machinery pits has been procured and the frames are presently being fabricated.

Control hardware has been finalized and is now ready for procurement. All components are off-the-shelf items so that cost is reduced. It is planned to use all Westinghouse motors, sensors, starters, and other control elements to ensure minimum problems of component compatibility. Westinghouse has been most cooperative in design of the control system.

All belting is now stored in the Belting Incorporated warehouse in Chamblee, Georgia. It will be slit and joined in place just before system operation begins.

Cars

Fabrication of all body tooling is essentially complete. The body fabrication has been contracted to GlasTec Company in Marietta. Disassembleable molds have been fabricated so as to eliminate joints in the body and to reduce assembly time. The first body will be laid up the third week in January.

Fabrication of the body frames and the chasses will also begin in January.

Budget

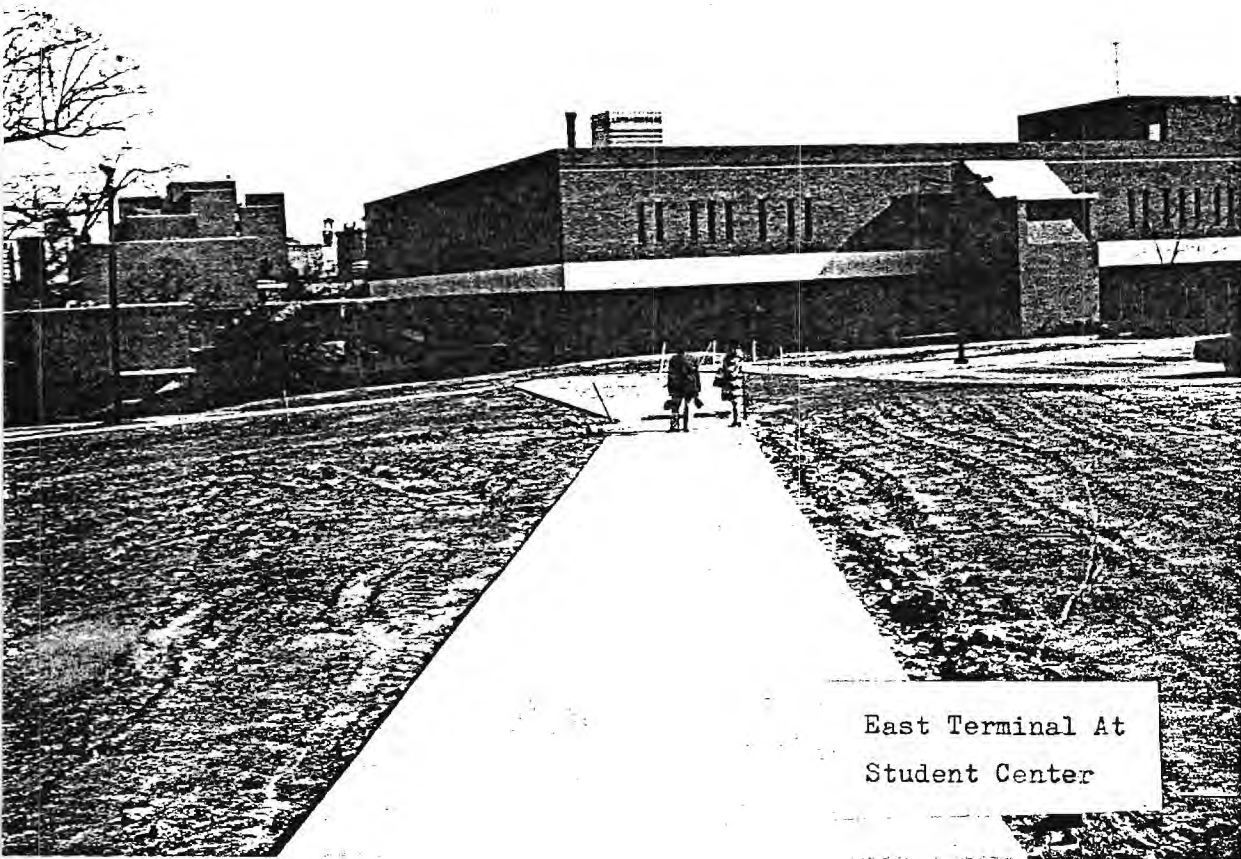
The program budget position is favorable. Tight control of all overhead costs and labor has so far compensated for the higher material costs encountered.



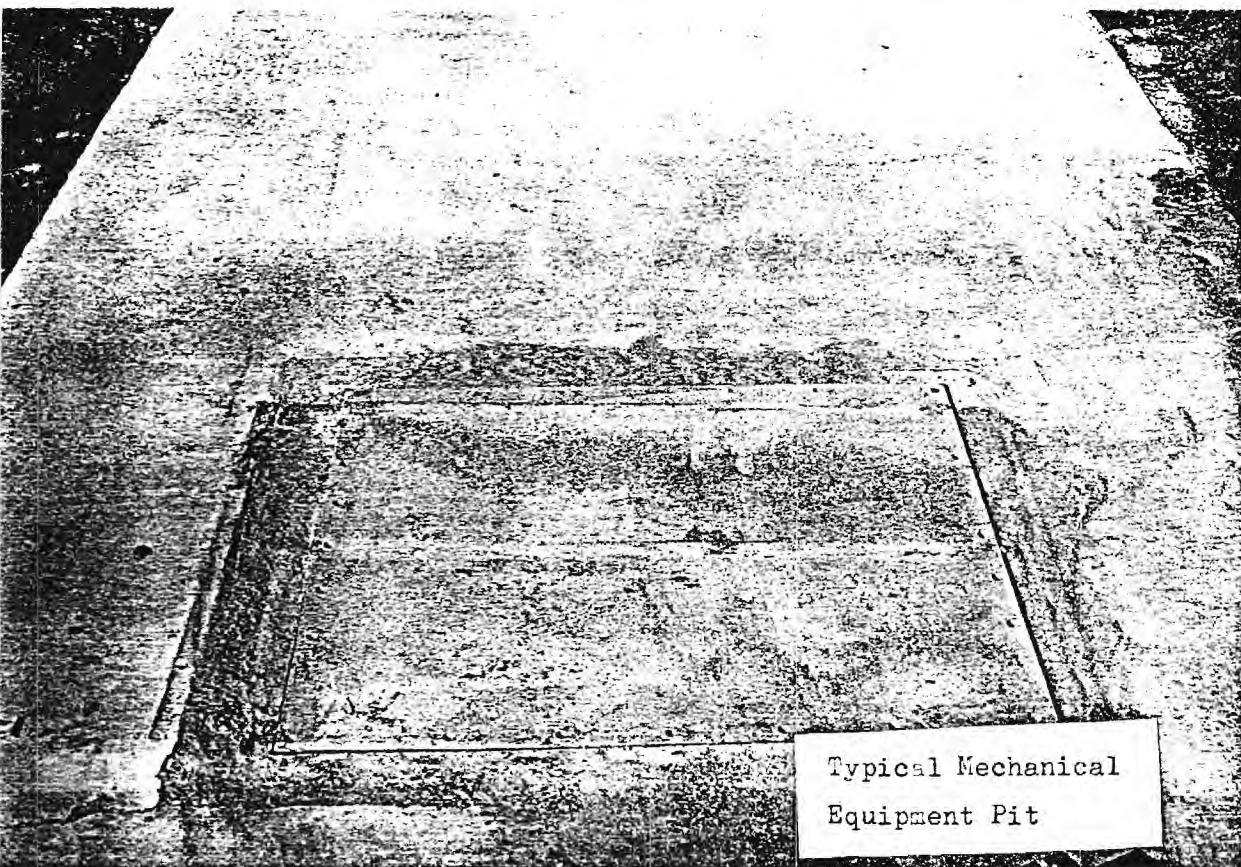
East View Of Track
From Operator's Position
Inside Control House



West Terminal
7 % Grade



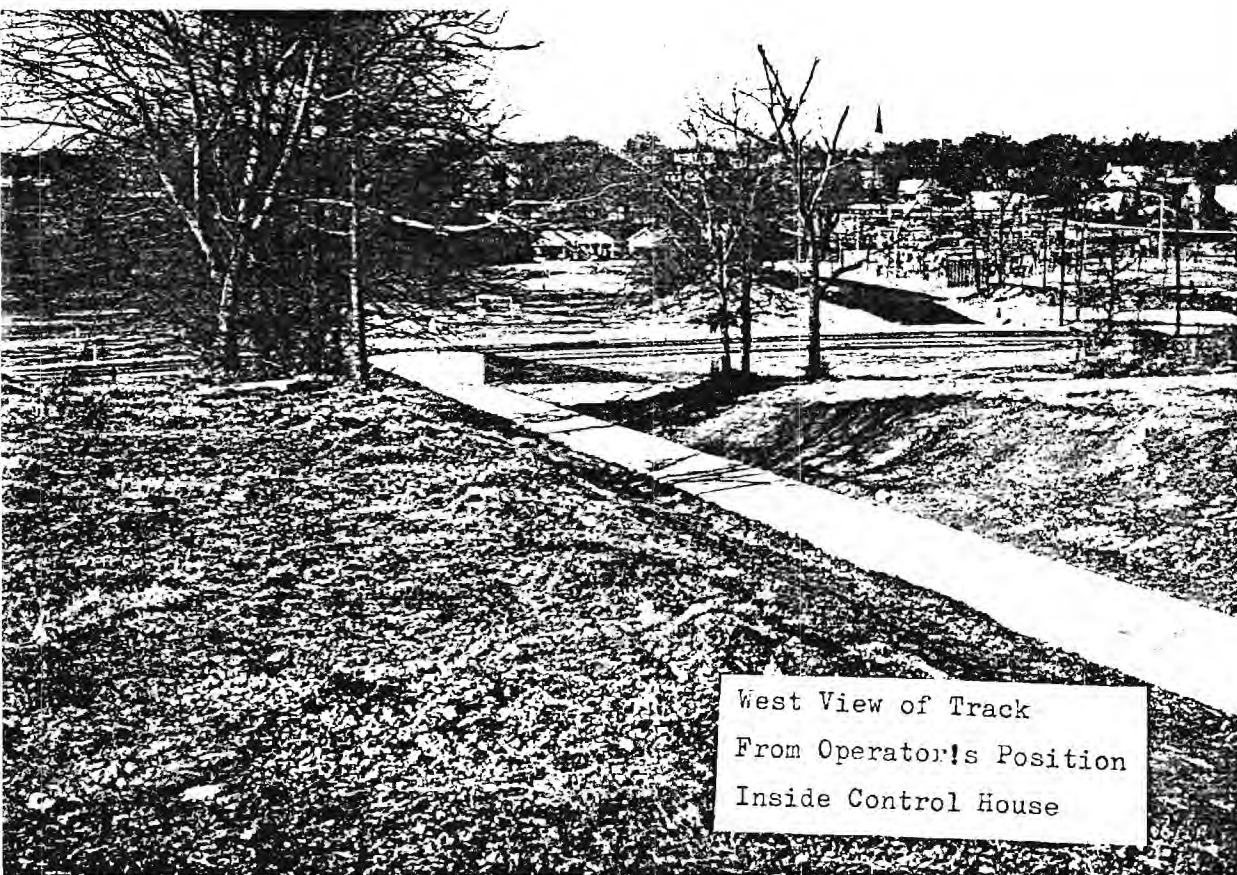
East Terminal At
Student Center



Typical Mechanical
Equipment Pit



Curve Near East
Terminal



West View of Track
From Operator's Position
Inside Control House



Control House &
West End of Off-line
Station

10-922



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

February 26, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letter No. 6, covering the
period 1 January to 31 January 1975

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Transette covering the work on the referenced project during January. Also enclosed are two photographs showing work on the cars. As indicated, the work is continuing to move satisfactorily. Good progress has been made in installation of the guideway, preparation of the control system, and fabrication and assembly of the cars.

Georgia Tech engineering personnel continue to monitor the operation closely, and are thoroughly satisfied with the rate of progress.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh

Enclosure

20 February 1975

Progress Report #4
January

Summary

Fabrication and assembly of the mechanical equipment installation has proceeded. Guiderail material has been received and fabricated for assembly. Eight bodies have been fabricated and two assembled.

Guideway Installation

Regrading of the shoulders of the track and grading of interception ditches at the top of two cuts has improved the drainage so that no washing of the shoulders is now occurring. Frequent rain continues to delay land-scaping of the area. Drawings of the cross section of the slab and the profile were furnished to Finch and Heery, Architects, for planning a steam line crossing beneath the track. The line will be tunnelled to avoid cutting of the track slab. Installation of the steam line is expected to be placed under contract in May or June. No conflict with the test program is anticipated.

Fabrication and assembly of the mechanical equipment has proceeded rapidly. Twenty-three idler pulley assemblies have been fabricated and welded and are ready for installation. These are two inch diameter flat pulleys on stainless steel shafts. Adjustable brackets were fabricated and will be bolted to channels already installed in the idler pits.

The main drive pulleys have a four inch diameter and are six inches wide. Four inch seamless pipe was cut into length and turned on a lathe to crown the pulleys. Teflon and molybdenum-sulfide roll end bearings were then inserted in the pulleys. All thirty-four have been completed.

Pulley brackets of $3/8 \times 3$ inch steel plate were fabricated and jig welded. Forty-six have been fabricated. Twelve drive pulleys are on order.

All seven of the mechanical equipment frames have been completed except for the motor mounting plates. These will be added after receipt of the motors. Assembly jigs have been fabricated to permit accurate installation of the pulley brackets and motors.

Two ten-foot diameter steel rings have been cut from $1/2$ inch plate for the carousels. The outside was beveled at 45° and the inside trued to a nine foot diameter. Carousel support assemblies have been completed for both vertical and horizontal alignment. A tooling set-up has been

installed on the shop floor to facilitate final grinding of the rings prior to installation.

Three hundred and thirty guiderail attachment members have been cut, drilled, and punched. These will be welded to dual forty foot rail sections. Provisions for thermal expansion from 0°F. to 120°F. have been made. A total of 3320 feet of 4 inch channel (5.4 lb/ft) has been received. Following shop assembly, the rail sections will be bolted to the concrete slab. Two carts have been constructed to hoist and place the sections.

Westinghouse engineers in Detroit have reviewed and approved the solid state logic system. The system uses off-the-shelf plug-in cards which have an excellent record of reliability for the past several years in industrial applications. The logic system receives inputs from the proximity switches along the track and operates the block control, car station indexing, dispatching, and door monitoring sub-systems.

Cars

All eight bodies have been layed-up in fiberglass. The main body has a gold gell-coat and the top an off-white gell-coat.

The interior was layed-up on a three-piece mold. The exterior was sprayed into a one-piece mold. The two sections were then placed in an assembly jig and spliced together. The seam is hidden by the window gasket so no seams show. Polyurethane foam was poured into the wall cavities to stiffen all panels. A floor board of 3/4 inch plywood floor was then bonded underneath the inside shell. Finally the underside of the plywood was sprayed with fiberglass to completely seal the body. The resulting body is extremely sturdy.

The two pieces of the top are secondarily bonded together. All eight sub-assemblies of the body and top should be complete by the end of February.

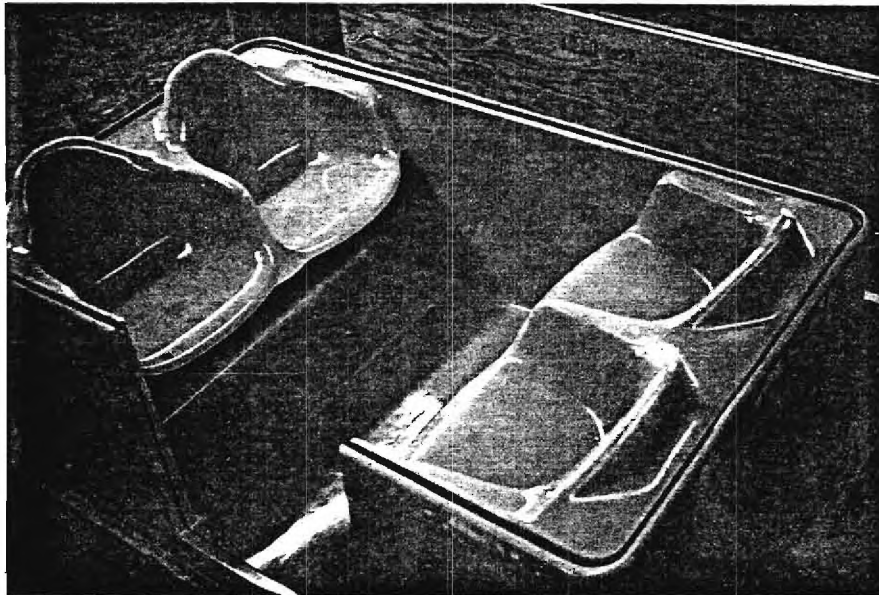
Final assembly of the glazing form block was complete. An electric strip heater was constructed and fastened to the form block. A sheet of glazing will be placed on the form block, the corners heated and bent. The heater is controlled to permit annealing of the bend after forming. Routing to final shape by a template will be done before the window is removed from the form block.

Door and window frames have been fabricated. The final assembly has been delayed pending receipt of tubing for the frame header. Door components have also been fabricated. The main chassis frame has been

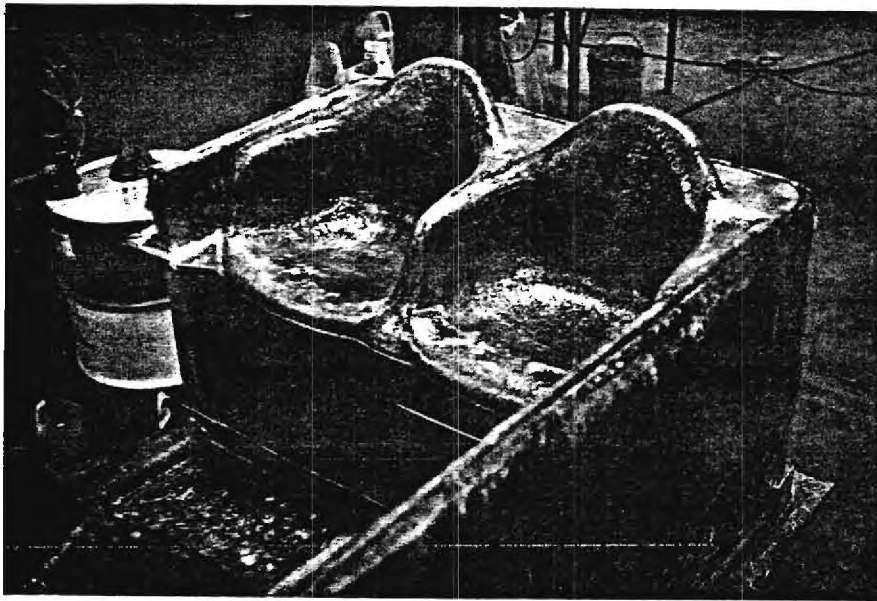
fabricated and jig welded assembled. The frame bolts to Tee-nuts were inserted in the body during lay-up. Components of the emergency brake sub-system have been received. They include discs, calipers, and the master cylinder.

Budget

Tight control of all expenses continued to be necessary. Higher than budgeted costs for the test site preparation and installation have been experienced on all material. The steel for the guideway was quoted as high as \$30 per hundred weight in December. It was finally procured early in February at \$17.55 per hundred. Principal material cost remaining on the contract is for the slider bed, wiring, and the fence. The first three Progress Payments for a total of \$39,300 have been received. Contract payments remaining total \$42,788.



Interior of completed car.



Portion of car interior during fabrication.



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

April 22, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letters No. 7 & 8 covering the
periods 1 February to 28 February 1975 and
1 March to 31 March 1975

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Transette covering the work on the referenced project during February and March. Since their report has integrated description of the work for the two months into one document, we are also allowing this letter to cover the two reporting periods. As indicated, the work is continuing to progress satisfactorily. Work has continued on the guiderails, control house, cars, and control and propulsion equipment. Track installation will begin the latter part of April, and initial operation is expected in May. Despite rising costs, the budget remains under control.

Georgia Tech engineering personnel continue to monitor the operation closely, and are thoroughly satisfied with the rate of progress.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh

Enclosure

Progress Report #5

February and March

Summary

Shop assembly of the guiderail sections has been completed. Control house console and furniture was completed. Car assembly is nearing completion. Control and propulsion equipment have been procured. Track installation will begin the week of 21 April. Initial operation is expected in May.

Guideway Installation

The guiderails were cut to exact forty foot lengths and then placed in a welding jig. Seven pre-punched cross-ties were welded to the two guiderails. Following assembly, they were steam cleaned and moved to the test site. Epoxy primer and top coat were then applied. In addition to the straight sections of dual guiderail, the off-line, acceleration, deceleration, and curve sections have all been delivered to the site. The curve section was partially assembled and will be bent to a twenty-five foot radius at the time of placement. Two dollies with hoists have been fabricated. With these, two men can easily place each forty foot track section in its precise final location. Spacing between sections will be gaged, depending on the rail temperature at the time of attachment to the concrete. Each section is to be anchored at its midpoint so that contraction results in a controlled gap between sections. The maximum gap of 0.28 inches will occur at a rail temperature of zero degrees. Careful alignment of the cross-ties which are at five foot intervals will minimize lateral movement of the cars.

All mechanical equipment frames were primed and painted. A tooling jig was built to facilitate leveling and precise alignment of the various belt pulleys. Following alignment the frames are drilled and the brackets bolted on. Only small adjustments should be necessary after installation in the pits to insure good belt tracking. The helical gearmotors will be shop assembled on the frames before placement on site. Two 2-hp carousel drive gear motors, three 3-hp and five 5-hp helical gearmotors and two 10-hp motors have been procured along with the necessary timing belts and sprockets. Delivery is expected before the end of April.

The two ten-foot carousels were out of tolerance and were returned to the fabricator in February. Recutting and re-welding combined with an additional rim have resulted in acceptable parts. The carousels were fastened to the shop floor and ground with a motor mounted on a radius arm. The carousels were then primed and painted and are ready for placement.

A control console was built to house all motor switches and the operator's panel. Four cabinets were built for the various starters and other equipment. The console is covered with gold colored laminate; the furniture is covered with rosewood butcher block laminate. These are ready for shop assembly of the equipment.

The dome of the control house was primed and painted with white automotive acrylic enamel.

Final selection and procurement of all control equipment was made. Allen-Bradley proximity sensors, controls, starters, solid state logic, and breakers have been shipped and are expected the week of 21 April. Significant improvements from the previously planned Westinghouse system are improved fail-safety and reliability. Memory set, re-set solid state relays replace the J-K flipflops previously selected. If a sensor becomes inoperative for any reason, the motor will shut down. The Allen-Bradley sensors operate at 110 volts so that any electrical noise will be less likely to interfere with the control system operation.

Cars

All eight bodies were received from GlasTec Company. An excellent quality was attained in both the car body and top assemblies. The door and window frames have been assembled and are ready for final car assembly. All exposed metal door frames, window frames, and door parts are painted to match the gold body. The doors have been jig welded and finish ground and sanded. Slots were milled in the upper part of the door to receive the gasket. Fiberglass channels were layed-up in place on the inner side of the lower portion to which pre-formed fiberglass panels were bonded. Poured-in-place polyurethane foam between the panels eliminate oil-canning. The resulting door is quite sturdy and attractive. Roller bearing cam followers are bolted to the top of the door and ball-bearing linear bearings to the bottom. These ride on a 3/4 inch shaft attached to the body frame. All components are ready for final assembly.

The initial glazing gasket was received for tool try. It is a one-piece unit with the muntins and corners injection molded so that the gasket is an integral unit. Fitup is to tolerance with the exception of the vertical members at the left window. A corrected gasket is expected to be delivered the week of 21 April.

The transmission was redesigned to incorporate certain improvements. These include a wet clutch, helical gears, and a passive fail-safe clutch control. Needle bearings and the helical gears have been procured. Fabrication of the transmission is underway. The improved clutch control is pre-loaded to design acceleration at maximum gross weight. In the event of over-load a lower value acceleration will be experienced. If the gross weight is less than the maximum, the control will reduce the acceleration that would otherwise result. A horizontal pendulum provides a force proportional to acceleration and limits the acceleration or deceleration to 0.125 g.

Publicity

Channel 11 TV ProNews of Atlanta ran a brief film on the TRANSETTE - Georgia Tech program. Pictures of the track, control house, and some of the fabrication activities were included.

Steve Fisher of the local McGraw-Hill office wrote a story which was published the first week of April in Engineering News-Record. Several inquiries have been received since publication of this story.

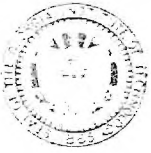
Mr. Amisano of Tombs, Amisano, and Wells is interested in the possibility of TRANSETTE for the downtown re-vitalization project in Norfolk.

A representative of the California Department of Transportation has asked for data on the TRANSETTE SYSTEM for inclusion in Transguide, one of their quarterly publications.

Mr. J. G. Dresser, Jr. of the Jacksonville Port Authority called to express interest in an installation at the Jacksonville Airport. He said that the Georgia Tech installation is almost identical with their problem of connection of a parking lot 2000 feet from the terminal. He stated that of all the systems they have looked at, this one looks most attractive. He asked for additional information and plans a trip to inspect the site and further discuss their needs.

Budget

Costs for the test site preparation have continued to be significantly higher than budgeted. Materials and labor have both reflected the general inflation of the past six months. Car costs are approximately on budget. Motors and controls have been less than budgeted. Tight control of all expense continues to be necessary.



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 9, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentives Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letters No. 9 & 10 covering the
periods 1 April to 30 April 1975 and 1 May to
31 May 1975

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Transette covering the work on the referenced project during April and May. Since their report has integrated description of the work for the two months into one document, we are also allowing this letter to cover the two reporting periods. As indicated, the work is continuing to progress satisfactorily. Work has continued on the guiderails, control house, cars, and control and propulsion equipment. Track installation will begin in the next two weeks, and initial operation is expected in July.

Georgia Tech engineering personnel continue to monitor the operation closely, and are thoroughly satisfied with the rate of progress.

Very truly yours.

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh

Enclosure

Progress Report #6

April and May

Summary

Assembly of the cars and mechanical equipment has continued. All control equipment has been received. Installation of control house console and furnishings has been completed. Fencing and guiderail installation are proceeding.

Guideway Installation

Inclement weather and higher priority jobs have delayed the landscaping of the track shoulders until the 29th of May. A flume was built by the Physical Plant personnel of Georgia Tech to reduce the amount of rain run-off that had previously run under the track at station 1175. The improvement in drainage is quite significant. Grassing of the shoulders is now underway and should be completed by 7 June.

Fastening of the guiderail sections has been delayed until the grassing was completed. Precision alignment of the guiderail sections might have been disturbed by the tractors involved in the grassing and landscaping operations. All materials for installation of the guiderails is on hand and the installation will be made the week of 9 June. A fencing contract has been signed and enclosure of the track will also begin on 9 June. The fence is one meter high with a top rail and posts at ten feet intervals. Installation should be complete by 16 June.

Material for the slider bed has been located. After considerable study, a design decision was made to change from stainless steel to ultra high molecular weight polyethelene. This material with a molecular weight in excess of 2 million shows extremely high resistance to abrasion while retaining quite low frictional properties. An 0.030 inch sheet will be mechanically fastened between side guides. The side guide will assist belt tracking and reduce the likelihood of attempts by the students to stand on the moving belt.

Alignment and installation of all idler pulleys was completed on the mechanical equipment frames. Installation of the console and equipment cabinets in the control house has been completed. Service wiring and the air conditioner have been installed. Vinyl wall cloth was used on the lower walls. Four instances of rocks impacting on the control house have been noted. No damage has resulted however. A water repellant material, manufactured by Lockheed-Georgia, has been obtained and will be applied to the control house and car windows. This is the same material now specified by the FAA for all airport control house windows. Visibility, even in hard rain, is quite good with no wipers necessary.

All of the control sensors, solid state logic, starters and breakers have been received. The solid state logic elements are presently being wired and will be completed in mid-June. Fiberglass boxes to house up to six proximity sensors are being fabricated. These will be placed along the track.

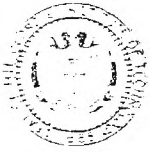
Cars

All gaskets for the windows have been received. The glazing material has been delayed however. Enough for two cars has now been received. The abrasion resistant acrylic is manufactured only by DuPont. It offers resistance even to steel wool so that in service scratches are reduced. Although it does not have as high impact resistance as poly-carbonate, it is much more impervious to weathering and is less likely to haze. It is also a less expensive material. Tool try of the windows will occur the first week in June. All components for the doors and windows are ready for installation. Door operators have been procured and are ready for installation.

Chassis components are all on hand and are being assembled. The clutch manufacturer has forwarded clutches on consignment.

Publicity

Channel 11 TV continues to follow the progress of the installation and plans another story at the appropriate time. Inquiries from various architectural firms continue. The student newspaper at Georgia Tech ran an additional story on the 30th of May. A new brochure will be prepared as soon as the cars and track installation are ready.



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 1, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R & D Incentive Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letter No. 11 covering
the period of 1 June to 30 June 1975

Reference: Agreement RDI 74-22600, entitled "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

Delays have continued to be experienced in getting the Georgia Tech Physical Plant to plant grass along the track site. Planting of the grass is a necessary prerequisite to installation of the fence, which in turn must be done before the track can be installed.

This delay was brought to the attention of the Physical Plant supervisor, and to his supervisor. Grass planting has now been subcontracted, and is expected to be completed during the first week of July. The fence will also be installed the first week of July, and, hopefully, the track also.

Assembly of the cars has continued.

Wiring of the computer will be completed within the first two weeks of July.

Georgia Tech engineering personnel continue to monitor the operation closely.

Very truly yours.

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh

B-450a



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 11, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 12 covering
the period of 1 July to 30 July 1975.

Reference: Agreement RDI 74-22600, entitled, "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We are enclosing a copy of the Progress Report received from Transette covering the work on the referenced project for July. As indicated, the work is continuing to progress satisfactorily. The grassing was completed and a chain link fence put up. The guiderail sections were fastened in place. The wiring of the solid state logic was completed and bench tested. Assembly of the chassis components is progressing. At least one car should be completely assembled by August 15.

Georgia Tech engineering personnel continue to monitor the operation closely, and are satisfied with the rate of progress.

Very truly yours,

Robert M. Goodman, Jr.
Chief, Sensor Systems Division

RMG/mh

Enclosure

PROGRESS REPORT #7

1 August 1975

Guideway

The Georgia Tech Physical Plant completed planting of grass on the track shoulders and adjacent slopes early in July. Erosion of the banks and silting of the track now appears to be under control. Diversion of rain run-off up the hill from the track by a flume has helped considerably.

The entire track has been enclosed by a one-meter high chain link fence. It was placed three feet from the concrete with three foot openings at all load and unload positions. Posts were set in concrete. A top rail was provided.

The guiderail sections were fastened in place with high strength anchor bolts. The four inch channel cross-ties are fastened at five foot intervals by two anchors. Each forty foot track section is anchored at its midpoint to control expansion. Each of the other cross-ties has slotted holes that permit longitudinal movement but maintain alignment. Expansion joint clips have been fabricated for each joint to maintain alignment of the railends from 00° F. to 120° F. Horizontal and vertical curves were bent in place. The guiderails for the carousel were rolled and are ready for placement. The carousel support pits were completed and are ready for installation of the carousel. The carousel drive assemblies were completed. These consist of a two horsepower motor and a worm-gear reducer. A wheel and tire is mounted on the reducer. This assembly is mounted on a hinged mount. Lead ballast ensures traction of the tire on the carousel.

The control house was furnished with custom furniture and console. All interior wiring was completed. A special cabinet was constructed to house the solid state logic equipment. All furnishings are rosewood butcher block laminate. The lower walls are covered with vinyl wall cloth and the upper with white fiberglass. An air conditioner was installed in a cabinet. As soon as the Physical Plant group provides power, the control house will be complete.

Control System

Assembly and wiring of the solid state logic equipment has been completed. The fixed block control system has been bench tested. Results are very satisfying. The proximity sensors are located at seven and one-half second intervals along the track. Memory flip-flops are set as a car enters a block. If it is not re-set by the cars leaving the block, entry of another car into the preceding block causes that section to be shut down.

Fiberglass cabinets were fabricated to house up to six proximity sensor control elements. Conduit for both the power wiring and the control wiring has been received and will be installed shortly. All mechanical pits were cleaned and pointed as necessary. Drains were completed.

Rolling Stock

Window fabrication of the abrasion resistant Lucite material was unsuccessful. Forming of the coated material is quite difficult. Solar control acrylic has been obtained.

Fabrication and assembly of the chassis components has proceeded quite well. The rear axle assemblies have been machined and assembled. They include helical gearing, needle radial and thrust bearings, an oil-cooled plate clutch and clutch control. A mechanical accelerometer controls the force on the clutch to limit car acceleration with light loads. A power take-off has been provided to drive a forced ventilation fan for the passenger compartment. Use of a fan permits ventilation without opening windows or vent surfaces. If desired, heating may also be provided by the installation of a generator, battery, and strip heater.

The door operator has been fabricated and assembled. An arm on the lower side of the car is deflected by a fixed cam as the car enters a station. A chain and sprocket drive rotates the shaft of a hydraulic door closer until it reaches a detent. The door closer shaft drives a cable drum that opens the door. Following a fifteen second dwell at the unloading position, the control system activates a plate cam on the road bed that pushes the arm in the direction of closing. As the door closure comes out of its detent, the closing and latching speeds are controlled by the hydraulic cylinder in the door closer. Both are adjustable. A door closing force of six pounds has been provided. The door rides on linear bearings so that friction has been reduced to a minimum.

Air suspension has been provided between the car body and the running gear. Four air bag elements are installed on the car. Pressure may be varied if necessary. Four bar linkages maintain level attitude of the running gear and maintain alignment.

The front axle assemblies are complete. These include the front wheels to which discs were welded and custom spindle brackets to which calipers are fastened. A master cylinder is spring operated by a track cam. Manual re-set is provided following tripping.

Guide wheel sub-assemblies have been fabricated and assembled. Actuation by a solenoid operated track cam occurs if the passenger presses a push button inside the car before the off-line station is reached. The push button operates a metal flag that activates a sensor located seventy feet from the switch point. The linkage is re-set each time the door closes.

All components of the chassis are being primed and painted with epoxy paint prior to final assembly.

B-432



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

September 1, 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, D. C. 20550

Subject: Monthly Progress Letter No. 13 covering
the period of 1 September to 30 September 1975

Reference: Agreement RDI 74-22600, entitled, "Verification
Testing of the Transette Personal Rapid Transit
System"

Gentlemen:

We hope to be informed soon of the Grant Review Board decision on the request for additional funds as stated in Dwight Allen's letter of August 29.

Delays in the completion of the Transette System have been experienced as a result of problems in final assembly of the cars. The problems are thought to be minor, but they are requiring a great deal of time for alterations and other changes.

One car has been completely assembled, and then dismantled for painting. Arrangements have been made to display a car inside the Georgia Tech Student Center. It is hoped that the first car will be reassembled and on display by October 10.

Progress is being monitored and we are still satisfied with the progress.

Very truly yours

Robert M. Goodman, Jr.
Director, Systems & Techniques
Laboratory

RMG/mh

6-752

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

29 October 1975

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letter No. 14 covering the period of
1 October to 31 October 1975

Reference: Agreement RDI 74-22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

Following receipt of the N.S.F. Grant Review Board's decision approving the request for additional funds for Transette, payment was made to Transette for the remaining money budgeted under the present subcontract.

In accordance with your request, a letter supplying supplemental information concerning the reasons for the change of route in the Transette test track was submitted on 21 October 1975.

The first Transette car has been finished and was displayed on campus at the Engineering Experiment Station, at a regional E.R.D.A. meeting, and on the test track. The appearance and workmanship of the car received favorable comments from many sources. A picture of the car and an article about it appeared in the Atlanta Constitution on 23 October 1975.

On 22 October Mr. George Anagnostopoulos of T.S.C. visited to discuss the program. He appeared to be favorably impressed with the work that had been accomplished, and displayed considerable interest in the verification test program. During discussions between Mr. Anagnostopoulos and Dr. Frank Sutton of Transette, consideration was given to the timing of the T.S.C. tests. We at Georgia Tech were surprised to learn that the probable start date for the verification test program would be in early January of 1976. This tentative plan presents significant problems in that the test program is now planned for a period beginning after the termination date of the existing contract. We are reviewing the considerations raised by the timing of this test schedule and will be in touch with you soon to discuss its impact on the program.

Ms. Leiker, a staff member of the Transette program at Georgia Tech, has arranged with the Georgia Tech Psychology Department to evaluate student

Mr. Evan Anderson

29 October 1975

Page 2

reaction to the Transette system. This work will be done for academic credit as a special project. The results of the evaluation will be summarized in a report which will be made available to N.S.F. and T.S.C. following the conclusion of the test program. This activity will not be supported by N.S.F. contract funds.

Sincerely,

R. M. Goodman, Jr.
Project Director, B-432

RMG/mac

cc: Dr. Frank Sutton
Transette, Inc.

Mr. Al Camp
Georgia Tech

B-432

ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

7 January 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letters No. 15 and 16 covering the periods
1 November through 30 November and 1 December through
31 December 1975

Reference: Agreement RDI 74-22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:


As reported in Progress Letter No. 14, tentative plans were made by Dr. Frank Sutton of Transette and Mr. George Anagnostopoulos of TSC for the DOT verification testing in early January 1976. Because of continuing slippage of the completion of the Transette test installation on the Georgia Tech campus, very close attention has been given to required changes in plan for the completion of the verification test.

On 12 November a meeting was held in the Georgia Tech Office of Contract Administration, attended by Mr. Ed Renfro, Director of the Office of Contract Administration, Mr. Al Camp, Mr. Jay Wilson, Ms. Linda Leiker, Mr. R. M. Goodman, Jr., and Dr. Frank Sutton. A complete review of the progress made by Transette under the Georgia Tech subcontract was given by Dr. Sutton, who expressed the belief that Transette could be ready to begin the test program on 5 January 1976. On 22 November 1975, Dr. Sutton sent to Mr. Renfro a written review of the delays experienced by Transette. In this letter, Dr. Sutton also discussed the anticipated schedule for completion of the Transette installation and concluded with a recommendation that Georgia Tech request an extension of its agreement with NSF to 1 April 1976. In accordance with this recommendation, on 16 December 1975, Georgia Tech submitted to the National Science Foundation our Proposal ST-OD-76-001, which requested that NSF Agreement RDI 74-22600 be extended for three additional months to 31 March 1976, and that the funding be supplemented in the amount of \$4,684.

It now appears that Transette will be unable to complete the test installation early in January, but it is hoped that the installation can be completed by the end of January. This revised estimate by Dr. Sutton has, we understand, been discussed with Mr. George Anagnostopoulos. The validation tests are presently planned for the month of February, although no specific date has been set.

Georgia Tech has not as yet received a response to our request for an extension of the program. We are, however, proceeding on the assumption that the extension will be granted. Close contact will be maintained with Dr. Sutton during the month of January and it is recommended that, if at all possible, Mr. Evan Anderson visit Georgia Tech during the month of January for an on-site review of the program.

Sincerely,

R. M. Goodman, Jr. 
Director
Systems & Techniques Laboratory

RMG/mac

B-452

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

9 March 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letters Nos. 17 & 18 covering the periods
1 January through 31 January, and 1 February through
29 February 1976

Reference: Agreement RDI 74-22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

During January and February, several design changes were implemented which have caused some delay but which should result in an overall improvement in the Transette system. Conduit has been run into the control house; the carousels are in place; and the track sections to the carousels and the off-line station have been installed. The electric motors and associated sheave assemblies have been installed in the pits.

In order to ensure continuity and completion of the work, Georgia Tech submitted its proposal ST-OD-76-001 to NSF on December 16, 1975, requesting that the referenced agreement be extended for three months to 31 March 1976, and that additional funding be authorized in the amount of \$4,684. As of this writing, it is our understanding that your organization is processing the proposal, but it has not been received by the Georgia Tech Research Institute, our contracting agency.

Pending a reply, Transette has continued to work on completion of the site. The request for three additional months was based on estimates made by Dr. Frank Sutton of Transette, who had informed us just prior to submission of our proposal that he believed the site would be ready for DOT testing during January. Actual progress by Transette, however, has been slower than anticipated, and the completion of the site is still to be accomplished.

We are informed by Dr. Sutton that he discussed the status of the program with you in a phone conversation on 23 February. Dr. Sutton also informs us that he has discussed scheduling of the test with Mr. George Anagnostopoulos

Mr. Evan Anderson

9 March 1976

Page 2

of TSC, Cambridge, Massachusetts, and that Mr. Anagnostopoulos has requested a date of 26 April for the test, stating that there would be conflicts before that date. Dr. Sutton has assured us that the site will be completed in time for testing on that date.

Since our proposal of December 16 requesting a three-month extension is being processed, it would appear unsuitable for us to withdraw it and resubmit with a longer extension stipulated. Rather, we suggest that when our outstanding proposal is acted upon, Georgia Tech submit another proposal, requesting a further extension that will permit completion of the site and performance of the DOT tests.

We would like to again urge that, if possible, you visit Georgia Tech for an on-site review of the program as soon as possible.

Sincerely,

R. M. Goodman, Jr.
Project Director, B-432

RMG/mac

enclosure

25 February 1976

MEMORANDUM

TO: R. M. Goodman, Jr.
Engineering Experiment Station

FROM: J. F. Sutton
Transette, Inc.

SUBJECT: Status of the Transette Program

Evan Anderson called on 23 February to discuss status of the Transette program. He is discussing with the NSF public relations people their plans for media coverage of test operations. They have been discussing the possibility of sending in a film crew to get background film before the tests start up and to make a short film of the test operation. This would be of assistance to the network crewmen who would also, presumably, take additional footage. He will communicate their plans as they materialize. Evan is quite satisfied with the progress of the program to date.

Subsequent to the conversation with Mr. Anderson, a date of 26 April was established for a test by TSC personnel. George Anagnostopoulos has schedule conflicts that preclude their personnel from being on the test site prior to the 26th of April. A firm commitment was made by Transette that the test installation will be completed in advance of this date so that the contractual checkout will ensure better test operations. Anagnostopoulos is writing a formal memorandum establishing this date for his management, NSF, and Georgia Tech so that the test will commence on that date. He is quite complimentary of the status of the test preparation.

On the 24th of February I noticed a contractor from SAC-70 with his superintendent, J. D. Brown, at the stem line closing of the track. I asked them what their plans were relative to tunneling or cutting the track. I was told that the original bid had included only \$330 for cutting an 8-foot ditch, 50 feet long across the track, and for restoration of the slab and the fence. I was further told that they were asking \$5,000 to tunnel under the track. It was obvious that the contractor was not interested in the restoration of the track to its original condition to the degree that would be required.

JFS/mac

cc: Linda Leiker, EES



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

5 May 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letters Nos. 19 and 20 covering the periods
1 March through 31 March and 1 April through 30 April 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of the
Transette Personal Rapid Transit System"

Dear Mr. Anderson:

Final preparations of the Transette test site continued during March and April. Again, unpredicted complications were encountered which will result in a possible four-week delay of the starting test date. Dr. Sutton informs us that he has continued to keep Mr. George Anagnostopoulos of TSC, Cambridge, Massachusetts, informed of the installation progress and possible test scheduling. As reported in our Progress Letters numbers 17 and 18 dated 9 March, the anticipated date for starting tests was 26 April. We now anticipate that the date will be sometime in the latter part of May.

Due to continued financial difficulties encountered by Dr. Sutton, Mr. Ed Renfro of our Contracts Administration Office agreed to release the last of the withheld funds. Dr. Sutton submitted an invoice to Georgia Tech on 22 March and subsequently received a check in the amount of \$7,009 for the balance of the project money.

We were informed on 23 March that our request to NSF of 16 December 1975 for an extension to cover anticipated costs for assistance and monitoring of the Transette installation and testing (our Proposal ST-OD-76-001) had been approved. The new termination date is 30 June 1976.

On 23 April, Mr. R. M. Goodman, Jr., Miss Linda Leiker and Dr. Frank Sutton attended a meeting at the Georgia Tech Engineering Experiment Station during which Mr. K. B. Johns of the Transportation Research Board discussed the types of transportation programs the Board might be interested in instigating


Mr. Evan W. Anderson


5 May 1976

Page 2

and funding. This was the first time Mr. Johns had heard about the Transette System and he was very interested in more details about the system.

We regret that your visit was not possible earlier, but hope you will be able to come when the system is in operation.

Sincerely. 

R. M. Goodman, Jr. 
Project Director, B-432

mac

ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

16 July 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letters Nos. 21 and 22 covering the periods
1 May through 31 May and 1 June through 30 June 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

A solution was reached during this reporting period to the conflict of interests that had developed between the existing Transette slab and the requirement to lay a pipe under the slab for the Student Athletics Complex (SAC) presently under construction.

A cost estimate of roughly \$20,000 was reported to us by the SAC contractors for hand tunneling under the slab to lay the pipe in the planned oblique direction. It was also reported to us by the contractors that crossing the slab at right angles would be less expensive for tunneling, but would create an additional expense and time delay for sending pipe back to the factory to be reworked. A meeting was held on 10 May between personnel of Georgia Tech, Transette, and the Student Athletic Complex contractors to discuss the matter. A decision was reached at that meeting that the only feasible solution would be to remove concrete sections from either side of the track and hand tunnel under the remaining track section.

It was agreed verbally that the slab would be replaced so as to be as good as or better than its original condition. This was later put in writing, along with details of the procedure for cutting and repairing the slab, as Dr. Sutton was concerned about doweling, wire mesh, settling, and buckling. It was also agreed that the job would be completed by 20 May, to an extent that progress of the Transette project would not be hindered. Mr. Ed Renfro, Director of the Georgia Tech Contracts Administration Office, has taken a strong personal interest in the progress of the Transette project, and was very helpful in expedition of the solution to this problem.

Mr. Evan W. Anderson
16 July 1976
Page 2

Concrete sections approximately six feet long were cut and removed from either side of the track on 12 May. Removal of soil was completed on 13 May. On 14 May, concrete was poured up to the lower level of the slab. Slab sections were poured on 19 May and the forms removed. A few areas were hand filled. One corner broke, was repaired, and is now broken again. Back-filling began on 24 May. The repaired section is neither as smooth nor as level as it was originally, but it is believed to be adequate.

While the slab was being cut, conduit was stretched, brackets tightened, and sensor wire pulled. As these and other time-consuming tasks needed to be completed, we do not feel that the tunneling caused a significant delay in progress. Installation of the wood for the slider bed was started 7 June.

Dr. Sutton was invited to send an invoice to Georgia Tech to cover costs incurred due to cutting the slab. He sent an invoice for \$1,770.50, which will not be an additional expense to the grant.

On 26 May, Mr. Anderson telephoned Mr. Goodman to discuss the cutting of the slab. On June 24 and 25, Mr. Anderson visited the Transette installation site and fabrication plant. On 25 June Mr. Anderson met with Mr. Goodman, Mr. Renfro, and Miss Leiker to discuss delays and an extension of the termination date. Mr. Anderson informed us that paper work for an extension was in progress.

As bolting was to begin on 6 July, signs were put up at each gate along the track on 2 July to notify students that the track would be temporarily closed to pedestrian traffic beginning 6 July; due to rain there was a one day delay. Rope barricades and new signs were put across each gate on 7 July. Unforeseen problems occurred in getting belting over the pulleys in the pits, but all belts are now on and spliced with the exception on the turnstiles.

On 11 May, Stephanie Gluck of Vision Associates telephoned Georgia Tech to get information about Transette in regard to making a film for NSF. Dr. Sutton was at Georgia Tech at the time, and talked to her at length about the system.

Sincerely,

R. M. Goodman, Jr.
Project Director, B-432

RMG/ae

B-432



ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

11 August 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letter No. 23 covering the period
1 July through 31 July 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

During this report period, final installation preparations were being completed and checked. Wiring was completed and a strip of concrete six inches wide was added to the outer edge of the slab along the curve section. A design change in the carousels necessitated the construction of new carousels. These were completed and welded into position. When tested, the carousels turned properly, but the chassis wheel in contact with the carousel surface appeared to "lean." Hopefully, this will be corrected by gluing belting material to the carousel surface. Also, one chassis wheel did not make good contact with the concrete slab. A plywood platform has been cut and will be covered with fiberglass and mounted so that the wheel will have a traction surface. Sensor heads were mounted and are being wired. They will need to be aligned when the chassis is tracking properly.

Several problems were encountered when the timing belts and driving belts were tested. The timing belts slipped under load; hopefully, this will be corrected by improving the tension and alignment. The driving belt pulley bushings in the three long belt sections, which are nylon, were found to be overloaded due to belt tension and driving load. It was determined that the nylon bushings could not handle the load, therefore, the pulley bushings in all three sections are being replaced with oilite bushings. This will result in a lengthy delay, as each belt must be cut, all pulleys removed, each bushing replaced, pulleys replaced, and the belts spliced. After splicing, belt tension may still require alignment.

During a telephone conversation between Mr. Evan Anderson of NSF and Mr. R. M. Goodman, Jr., of Georgia Tech, it was reported to Mr. Goodman that the DOT, TSC tests were to begin on 9 August, since Mr. George Anagnostopoulos of TSC would not be able to schedule the tests until after

Mr. Evan W. Anderson
11 August 1976
Page 2

October if they did not begin on 9 August. At present, it does not appear possible that the tests can begin on that date. The earliest possible date would be 16 August, and even that date is by no means certain.

During a telephone conversation on 21 July, Mr. Anderson asked that no public announcements about Transette be given until after satisfactory completion of the tests. Mr. Goodman asked Mr. Anderson to send us a guideline for handling public announcements. In a letter dated 26 July, Mr. Anderson suggested the following guidelines, should we be approached for information during the initial days of testing:

- a) This is a test of an innovative PRT system.
- b) Part of the test (\$127,000) is being supported under a grant to Georgia Tech by the National Science Foundation.
- c) NSF is planning a public release upon completion of the tests.
- d) The Transportation Systems Agency (DOT) is conducting the test which should last from two to three weeks.
- e) All technical aspects can be freely discussed.
- f) For any further information regarding programmatic aspects, refer them to me. [Mr. Anderson]

We were also informed that Durrin, Inc., a Washington firm, would make a five-minute film of Transette to be used for various internal and external showings. In addition, a one-minute film would be made by Jim O'Donnell for television. Dr. Sutton has informed us that Tony Sargent of CBS television is anxious to make a film clip.

Mr. Anderson's letter of 26 July informed us that the NSF Grants Office is processing a no-cost extension with an expiration date of 31 December 1976.

Sincerely,

R. M. Goodman, Jr. /
Director
Systems & Techniques Laboratory

mac



B-432

ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

3 September 1976

Mr. Evans W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 24 covering the period
1 August through 31 August 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

During this report period, problems continued to be encountered with the drive pulley bushings. As discussed in Progress Letter 23, the nylon bushings were replaced with oilite bushings which were believed capable of taking the loads. However, when tested, the bushings still became hot enough to melt the plastic cap inserts. Dr. Sutton decided that to solve the problem it would be necessary to replace the bushings with roller bearings. He reported to us that he had done some calculations and determined that the roller bearings would take the driving loads. To retain the bearings, a steel washer which fits tightly into the pulley sleeve was welded to each end of the pulley shafts. The steel washers eliminated the need for the plastic caps, and also allowed better heat flow than did the plastic caps. All the driving pulleys on the continuous operation belt sections are now equipped with roller bearings. As time allows, all the remaining bushings will also be replaced with roller bearings.

Power was being consumed by unnecessary friction from two sources. Due to different elasticities, the belts curled when running, causing friction against the wood lips over the stainless steel slider bed. To cure this, the overlap has been cut away. A lubricant, molybdenum polydisulfide, which can be sprayed on the slider bed, was obtained and tested. The lubricant may need to be applied as often as once a week until a good film is established on the slider bed; hopefully, after that, lubrication will be needed less often. With these modifications, the uphill belt and the long belt are operating properly. The curve belt has been tested, but has a tracking problem. A chassis running on the belts has not yet been tested.

Mr. Evan W. Anderson
3 September 1976
Page 2

Dr. Sutton informed us that he had deleted one sensor along the track because the track was shorter than originally planned. However, the sensor had been planned for in the logic diagram which is hard wired. This was discussed with Mr. Chuck Summers of Georgia Tech, who designed the logic. Mr. Summers believes that only three wire changes will be necessary to adapt the logic to the absence of the one sensor.

Mr. Evan Anderson of National Science Foundation informed us that he and both film crews, as discussed in Monthly Progress Letter No. 23, would arrive at Georgia Tech on 30 August to inspect the Transette Test Site, and would film on 31 August and 1 September. He had been informed that Tony Sargent of CBS News here in Atlanta would like to make a film also, and asked that we invite Mr. Sargent to film on 2 September. Mr. Sargent was asked not to release any publicity until it had been cleared by Mr. Anderson. Due to the encountered delays, the filming date was delayed, and is now set for 13 September. Mr. George Anagnostopoulos of TSC informed us that he is scheduled to come to Georgia Tech on 16 September to begin testing. Dr. Abernathy of TSC also telephoned to let us know that he was interested in the human factors engineering.

Sincerely,

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R. M. Goodman, Jr.
Project Director, B-432

RMG/ae

B-402



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

6 October 1976

Mr. Evans W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 25 covering the period
1 September through 30 September 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

During this period, several design changes were made which, while not necessary for testing or operation of the Transette System, will result in better overall design and operation according to Dr. Frank Sutton of Transette. The door opening mechanism was simplified and changes were made to the guide wheels and chassis which should result in better tracking and smoother ride quality. In addition, to ensure better tracking, the off-line track is being moved to a position approximately two inches beyond the outer edge of the concrete slab. This is being accomplished by bolting spacers between the concrete and the off-line track.

It is hoped that the persistent problems encountered with the drive pulley bushings, as discussed in Progress Letters 23 and 24, have finally been resolved. All the bushings in the drive pulleys, including those in both carousell sections, have been replaced with roller bearings. As discussed in Progress Letter 23, the timing belts in the acceleration belt sections, which also caused difficulties, were replaced with chains. The belt sections were tested with the timing belts installed and worked properly. The fiberglassed plywood platforms mounted for better outer wheel tracking, as discussed in Progress Letter 23 proved to be too high when tested. They have been removed and altered accordingly. The two short curve belts have not been installed.

At the suggestion of Mr. R. M. Goodman, Jr., of Georgia Tech, several people who had shown interest in the testing of the Transette System were informed that Mr. Evan Anderson of the National Science Foundation and two film crews, as discussed in Progress Letter 23, would be on campus to film preliminary tests of the system.

Mr. Anderson arrived on 13 September. He informed us that the National TV News film crew would arrive the next day, but that the crew from Durrin Inc., could not meet the schedule and would come to Georgia Tech at some later date.

Mr. Evan W. Anderson
6 October 1976
Page 2

During testing on the evening of 13 September, the belt in the long section jammed and was burnt through. Due to this and other unexpected problems, the film crew was only able to photograph scenes of a car going up the hill section, an interview with Mr. Anderson sitting in a car, and Dr. Sutton and Mr. Anderson getting into a car. The belt and other problems were repaired and adjusted and Mr. Frank Williamson of Georgia Tech filmed a car traveling on the uphill section and continuing along the long continuous section on 15 September.

Others who were at the site during the filming included, Ms. Bette Justice of EES Publicity, Mr. Joe Beach of the Georgia Tech Publications Office, Mr. Charles Seabrook of the Atlanta Journal, and a representative of the Georgia Tech student publication, The Technique.

Mr. Anderson informed us on 28 September that the Department of Transportation tests would begin on 18 October and that Mr. George Anagnostopoulos of Transportations Systems Center does not know as yet when he will be able to come to Tech to conduct his tests.

Solutions for obtaining insurance for Transette are continuing to be investigated by Dr. Sutton and Mr. Ed Renfro of Georgia Tech.

Sincerely,

R. M. Goodman, Jr.
Project Director, B-432

RMG/kh



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

11 November 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letter No. 26 covering the period
1 October through 31 October 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing
of the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

Most of the time and effort expended on the Transette system during this report period were utilized in preparations for preliminary testing and filming of the system.

On 5 October, Miss Linda Leiker and Mr. Frank Williamson of Georgia Tech made a general film of the system in operation for Dr. Frank Sutton of Transette to present to Urban Mass Transit Authority representatives who would be attending a meeting in Washington on 6 October. Those attending the meeting were Mr. Evan Anderson of NSF, Mr. George Pastor, Assistant Administrator for the UMTA R&D Program, Dr. C. Broxmeyer, Director of Advanced Projects for UMTA, and Mr. DiSimone of the Advanced Projects Program. According to Dr. Sutton, everyone who previewed slides and the film of the Transette system was impressed that the system is at all functional, in light of the limited capital invested, compared with other personal rapid transit systems.

On 8 October, the film was shown to Mr. Ed Renfro, Director of the Georgia Tech Office of Contract Administration, and Dr. Sutton and Miss Leiker reported to Mr. Renfro the results of the meeting with UMTA representatives. Dr. Sutton reported that UMTA wants to determine if Georgia Tech has any interest in extending the system across Ferst Drive, and possibly purchasing the equipment and subsequently operating the system. Mr. Renfro appeared favorable to extending the system and stated that he would set up a meeting of Georgia Tech representatives to discuss their reactions.

The Durrin, Inc., film team arrived from Washington on 12 October to produce a professional film of the system. They were aided by a team from Atlanta's Channel 30 television network. They filmed general operation of the system as well as general campus shots, students riding the system, and an interview

Mr. E. W. Anderson

11 November 1976

Page 2

with Mr. Goodman, Transette System Project Director. In addition, they filmed technical aspects of the chassis and driving mechanisms, such as the drive wheel being driven from a dead stop by the driving belts, and the off-line guide wheel switching mechanism in operation. A portion of this film was edited by Mr. Anderson and sent to Georgia Tech, where it was added to the film made on 5 October. The resulting composite film has been shown to several organizations and a variety of people in Atlanta who are interested in the Transette system. Due to the number of requests for a showing of the film, two duplicates have been made.

Dr. Charles Abernethy and Mr. John Owen of TSC arrived on 18 October to begin the validation test program. Dr. Sutton and Miss Leiker introduced them to the system with a slide and film presentation, after which they proceeded to the test site for a more detailed explanation of the system. Dr. Sutton then took them to the current fabrication headquarters where they began making static measurements of system components.

Mr. George Anagnostopoulos of TSC arrived on 19 October to aid in the testing program, but several problems arose which prevented the completing of the testing program at that time. They decided to return to Cambridge and to reschedule the testing program after Thanksgiving.

The major problem encountered has been that the lagging material on two drive pulleys was not strong enough to withstand the friction produced by the driving belt and was worn away. After some discussion between Dr. Sutton and a Habasit Belting representative, it was agreed that, in principle, the best lagging material would be the same material as that used for the driving belt. Use of this material would allow the friction on both parts to be equalized. The concept was tested in the shop, with positive results, so the two worn lagging sections were replaced with belting material.

On one run attempt, a car was pushed onto an acceleration belt. The belt slipped sideways on the top pulley and began to drag against the pit cover, thus producing more friction than encountered during normal operation. As a result, the lagging was worn away. When the car was removed and the belt allowed to run without abnormal forces, the belt realigned immediately. It was determined that abnormal forces produced by pushing the car caused the belt to become misaligned.

Two problems which have not yet been resolved are in the carrousel and curve sections. The carrousel radius is too tight and causes the guide wheel to run against the guide track. It was hoped that simply using a different guide wheel would solve the problem, but when tested the rubbing was not entirely eliminated. The existing guide track could be altered, but it appears that the best solution would be to remove the inner guide track and install an outer guide track with guide wheel switching mechanisms. Also, the bends on both sides of the track at either end of the curve section are too sharp, causing the car to jolt at each location.

Mr. E. W. Anderson
11 November 1976
Page 3

New track sections, bent in a continuous curve rather than a straight line with sharp bends at each end, have been cut and are ready to be installed when time permits. The belts have not yet been installed and there is some question as to whether the belts will be wide enough to accommodate the new curve radius. For testing purposes, a car has enough momentum when going toward the Student Center to coast from the long belt section over the curve section and onto the deceleration belt; however, when moving in the opposite direction and encountering the two sharp curves and slight incline, sufficient momentum is lost preventing the car from coasting onto the long belt.

In addition to the necessary design changes mentioned above and in the last progress letter, other changes have been made which greatly benefit the overall design of the system, such as larger drive pulleys and larger pits. In spite of these problems, everyone appears encouraged and impressed with the system at this point.

A meeting was held in Mr. Ed Renfro's office at Georgia Tech on 27 October to discuss the feasibility and desirability of the extension and subsequent operation of the system. Those attending the meeting were Mr. F. C. Auman, Director of Campus Safety; Mr. R. Fuller, Assistant to the President; Mr. C. B. Robbins, Vice President for Planning; Mr. R. M. Goodman, Jr., Director of Systems & Techniques Laboratory; Mr. J. W. Guthridge, Vice President for Development; Miss Phyllis Rybinski, Contracts Administrator; Miss Linda Leiker, Assistant Project Director of Transette; and Mr. C. R. Johnson, Director of Physical Plant. During the meeting Mr. Renfro indicated that he was aware of some changes which needed to be worked out in order for the system to function for some length of time. He also expressed his continued enthusiastic support. The group unanimously favored a possible extension and operation of the system, providing DOT will finance the entire project including the purchase price of the system, with the exception of some minimal cost sharing by Georgia Tech. The composite film arrived and was presented just prior to the adjournment of the meeting; everyone was impressed with the film.

Sincerely,

R. M. Goodman, Jr.
Project Director, B-432

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8-432



ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

16 December 1976

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, DC 20550

Subject: Monthly Progress Letter No. 27 covering the period
1 November through 30 November 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing of
the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

Final modifications and adjustments in preparation for the Transportation Systems Center validation testing program of the Transette System were undertaken during this report period. Several changes were made to the chassis, clutch, and transmission. To help obtain maximum acceleration of a vehicle on the uphill section of the track, the heavy grade oil in the clutch was replaced with a lighter grade of oil, and the proper clutch adjustment was determined by timing runs of the car on that section with a different setting for each run.

On one of the test runs, the drive pulley lagging was worn away. This occurred after a rain storm, which was also the case when lagging had been worn away on other test runs. It was determined by Dr. Frank Sutton, in consultation with the staff of the Habasit Belting Company (who supplied the belt), that rain water retained between the slider bed and the drive belt increases the coefficient of friction between the two surfaces. It was also discovered that the lower surface of the belt was not as specified in the Habasit Belting Catalog. Subsequently, coefficient-of-friction tests were conducted on belts made of different materials. Each belt was tested under conditions of a dry slider bed, a wet slider bed, and with molybdenum disulfide impregnated into the slider bed. As discussed in Progress Letter 24, this is the lubricant which has been used on the slider bed since August 1976. Test results indicated that a belt constructed with a fabric lower surface had a lower coefficient of friction than the original belt when there was water on the slider bed. In addition, the tested belt weighs approximately 1/3 as much as the original belt. Therefore, the decision was made to replace the belts in the two longest sections with the lighter weight belt. It has a much smoother upper surface so that less rain water will be retained there. Dr. Sutton believes that there will be no significant loss in friction between the smoother belt surface and the drive wheel. This will be tested as soon as the belts are installed.

The termination date of Georgia Tech's contract with the National Science Foundation is 29 December 1976. It does not seem probable that the problems at the curve section and carousels as discussed in Progress Letter 26, can be completely resolved before then. The logic has not yet been tested and the TSC testing program is expected to take about two weeks. Mr. R. M. Goodman, Jr., Director of Systems and Techniques Laboratory, would like to terminate the project as soon as possible due to the over-expenditure already incurred.

At Mr. Goodman's request, Miss Linda Leiker and Dr. Sutton reviewed the test plan and determined that the majority of the tests could be completed as the system exists, and that some of the other tests could be simulated. This was discussed with Mr. Evan Anderson of NSF. Mr. Anderson indicated that he is satisfied with the operation of the basic concept of the system, and that solutions to the problem areas are known. However, he feels that the system should be in automatic mode for operation during the testing program. In addition, he stated that he felt that Georgia Tech should do everything possible to see that the test program is a success and that TSC must be made to realize that the system is a prototype under research and development.

During a conference call between Mr. Anderson, Dr. Sutton, and Miss Leiker on 23 November, it was agreed that a tentative date of 6 December for the test program to begin would be relayed to Mr. George Anagnostopoulos of TSC, and that the date would be confirmed after the two new belt sections and the logic were tested. Once the confirmation was made, Mr. Anderson suggested that Miss Leiker send a letter to that effect to the head of TSC.

A resolution has been reached regarding the problem of where funds should come from to cover the invoice of \$1,770.50 presented to Georgia Tech on 24 May 1976 by Transette, Inc., to cover costs incurred due to the cutting of the track. Transette, Inc., received a check for the amount stated above on 23 November.

As a result of the enthusiasm expressed in a meeting on 27 October (as discussed in Progress Letter 26) of Georgia Tech officials in seeking support for a possible extension of the Transette System, Mr. Ed Renfro arranged for the composite film to be shown as the President's staff meeting on 2 November. Those present at the meeting were: Dr. J. M. Pettit, President of Georgia Tech; Dr. R. J. Fuller, Assistant to the President; Dr. T. E. Stelson, Vice President for Research; Mr. J. E. Dull, Dean of Students; Dr. W. O. Carlson, Dean of Southern Technical Institute; Dr. V. C. Crawford, Vice President for Academic Affairs; Dr. C. D. Robbins, Vice President for Planning; Mr. E. I. Barnes, Vice President for Business and Finance; Mr. S. C. Auman, Director of Campus Safety; Mr. J. W. Guthridge, Vice President for Development, and Mr. D. W. Weaver, Athletic Director. The Tech officials were impressed with the progress of the system. Subsequent

to the meeting, Dr. Pettit and Dr. Stelson expressed interest in looking into the possibilities of extending the system to outlying parking areas and even to an off-campus location at North Avenue and West Peachtree, where Georgia Tech uses space in an office building near a major point for Marta traffic.

Dr. Robbins drew up plans for three possible routes to the dormitories and the overpasses required for each. These plans were studied by Miss Leiker and Dr. Sutton, who proposed the possibility of a one-way loop. The loop would begin at the existing termination point, extend to the Placement Center parking lot, continue through the dormitory area, pass between the dormitories and the SAC 70 complex, and return to the starting point.

An unsolicited, three-phase proposal, which will be submitted to UMTA, is being drafted by Miss Leiker and Dr. Sutton.

Sincerely,

R. M. Goodman, Jr.
Director
Systems & Techniques Laboratory

mac

B-452

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

18 January 1977

Mr. Evan W. Anderson
Project Officer
Experimental R&D Incentive Program
National Science Foundation
Washington, D.C. 20550

Subject: Monthly Progress Letter No. 28 covering the
period 1 December through 31 December 1976

Reference: Agreement RDI 22600, entitled, "Verification Testing
of the Transette Personal Rapid Transit System"

Dear Mr. Anderson:

During this report period, final installation preparations and modifications necessary for the Department of Transportation testing program of the Transette System were completed. These modifications included replacing the original guide rail at the curve section with guide rail having a larger radius of curvature. As discussed in Progress Letter No. 26, the radius of curvature of the guide rail was tight enough to cause excess friction between the rail and the guide wheels. This friction resulted in the loss of momentum of the car and a rough ride. For reasons discussed in Progress Letter No. 27, the uphill and long belt sections were replaced with thinner belts. Under test the long belt worked properly. The uphill belt section, however, folded lengthwise and would not work properly. It was determined by Dr. Sutton of Transette, Inc., that the folding might be due to a combination of the angle of the pulleys and the thickness of the belt. Dr. Sutton decided to remove the polyurethane from the bottom of the original uphill belt and use it again.

The system has continued to be tested and checked as weather has permitted. Mr. Chuck Summers and Miss Linda Leiker of Georgia Tech worked on the final settings of sensor heads and the logic.

At the request of Mr. Ed Renfro, Director of Georgia Tech EES, Contracts Administration Office, a demonstration of the system was held for the Georgia Tech Research Institute Board of Directors on 14 December. Dr. Joseph M. Pettit, President of Georgia Tech, and Dr. Thomas E. Stelson, Vice President Research, were among those present.

On 28 December, Mr. George Anagnostopoulos of TSC relayed to Mr. Evan Anderson of NSF that he would like to be assured of the completion of several installation requirements before he would come to Georgia Tech to

test the system. These requirements included: the installation of emergency brakes on a car, the installation of shock absorbers, the modification of the curve section and the assurance of being able to test the effect of a full load on the long belt section. Mr. Anderson subsequently relayed these requirements to Miss Leiker and Dr. Sutton, and suggested that they set up a conference call to Mr. Anagnostopoulos.

During the conference call, Mr. Anagnostopoulos informed Dr. Sutton and Miss Leiker that he did not agree with the test plan jointly approved by NSF, TSC, and GIT in 1974, and that his primary interest presently is in human factors and not the engineering design of the system. He stated that he had planned to come one day earlier than the scheduled test date to discuss this matter, and which tests he would and would not conduct. In addition, he stated that he felt that all modifications ever intended to be incorporated into the system should be done so before he began his testing program.

Dr. Sutton reminded Mr. Anagnostopoulos that the Transette System installation on the Georgia Tech campus is a prototype for testing purposes, and that emergency brakes are inherently unnecessary, due to the design of the system. Mr. Anagnostopoulos was informed that the shock absorbers had been installed, and that the curve modification was complete with the exception of bolting down the guide rail. In addition he was informed that the maximum load on the long belt would be four cars and results could be tested on the track, in the lab, or calculated.

Mr. Anagnostopoulos then stated that he would come to Georgia Tech to test the system as it is and according to the original test plan only after he received written instructions to do so from Mr. Anderson.

The results of this phone call were relayed to Mr. Anderson, who suggested that Miss Leiker send a telegram to him stating that the system had been inspected and was ready to be tested as per the test protocol agreed upon in 1974. Upon receiving the telegram, Mr. Anderson wrote Mr. Anagnostopoulos, stating that he had been informed that the system was ready to be tested and that testing in accordance with the test plan should begin as soon as possible.

Subsequent to attending an UMTA conference in December, Mr. Anderson informed Georgia Tech and Transette, Inc., that Mr. George Pastor of UMTA had expressed interest in sponsoring further testing of the Transette System. Work is continuing on an unsolicited proposal to UMTA for funding of a three-phase program as discussed in Progress Letter No. 27.

Sincerely,

R. M. Goodman, Jr.
Director
Systems & Techniques Laboratory

RMG:ae

B-432

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

SUMMARY OF COMPLETED PROJECT

Form Approved
OMB No. 99R0013

Please read instructions on reverse carefully before completing this form.

1. INSTITUTION AND ADDRESS Georgia Institute of Technology Engineering Experiment Station Atlanta, Georgia 30332		2. NSF PROGRAM Experimental R&D Incentive Program	3. GRANT PERIOD 27 June 1974 - 31 December 1976 from to
4. GRANT NUMBER RDI-74-22600	5. BUDGET DUR. (MOS) 24	6. PRINCIPAL INVESTIGATOR(S) Robert M. Goodman, Jr.	7. GRANTEE ACCOUNT NUMBER B-432

8. SUMMARY (Attach list of publications to form)

The Transette System, the prototype of a unique personal rapid transit system, was installed on the Georgia Tech campus for the purpose of assessing technical feasibility, general operating characteristics, practicality for on-campus use, and rider evaluation. Verification tests to ensure the safety and operability were to be conducted in accordance with the approved test plan by the Transportation Systems Center of the U.S. Department of Transportation under an interagency agreement with NSF. These tests were not conducted and rider evaluation was not obtained.

The Transette System was designed by an Atlanta-based firm, Transette Incorporated, which performed the installation under subcontract to Georgia Tech. The system operates on a patented novel drive principle and appears to have significant advantages with regard to safety, operating efficiency, dependability, and economy compared to other techniques of personal rapid transit.

The test site consists of 3,000 lane feet of track, an off-line test station, and a control house which overlooks the entire track layout. Two-way traffic around the 1,500 foot loop is made possible by use of a double guide rail down the center of the track and carousels at both ends. The passive cars ride on four pneumatic tires, one of which is friction-driven by a narrow driving belt. The driven wheel is coupled through a 2:1 gear ratio to a tracking wheel riding on the concrete slab. Thus, the car is driven at speeds up to twice that of the drive belt. Smooth acceleration and deceleration are accomplished with a multi-plate clutch.

Several installation deficiencies, for which solutions have been devised but not implemented due to lack of funds, resulted in the system not reaching a degree of reliability such that it was capable of operation over a significant length of time. Therefore, the reliability and capability of routine on-campus use were not determined. However, the basic design concept of the Transette System was demonstrated as feasible.

9. SIGNATURE OF PRINCIPAL INVESTIGATOR/ PROJECT DIRECTOR	TYPED OR PRINTED NAME Robert M. Goodman, Jr.	DATE March 30, 77
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FINAL REPORT

VERIFICATION TESTING OF THE
TRANSETTE PERSONAL RAPID TRANSIT SYSTEM

EES/GIT Project B-432

By

Robert M. Goodman, Jr.
Linda A. Leiker

Prepared for

NATIONAL SCIENCE FOUNDATION
Experimental R&D Incentive Program
Washington, D.C. 20550

Under

Grant No. RDI-74-22600

ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
Atlanta, Georgia 30332

March 1977

I. INTRODUCTION

On 27 June 1974, the Engineering Experiment Station (EES) at the Georgia Institute of Technology received Grant No. RDI-74-22600 from the National Science Foundation (NSF) to manage a program involving installation and verification testing of a prototype personal rapid transit (PRT) system. The system was designed by Transette, Inc., an Atlanta-based firm, which supplied the equipment and performed the installation under subcontract from Georgia Tech. Through an inter-agency agreement with NSF, the Transportation Systems Center (TSC) of the U.S. Department of Transportation (DOT), was originally expected to conduct a test program to evaluate design characteristics and safety aspects of the present Transette System.

The Transette System for personal transit service is intended to fulfill the need for a system that can furnish effective, low-cost transportation of people over moderate distances in high pedestrian traffic areas. It operates on a novel drive principle and appears to have significant advantages of safety, operating efficiency, and economy compared to other techniques of personal rapid transit previously proposed.

The experimental system, which has 3000 lane feet of track, is located along a route of high pedestrian traffic between the Georgia Tech Student Center and a point across the street from an area of student dormitories. Installation is complete with the exception of a few problems for which solutions have been designed but have not been implemented due to lack of funds. Although these problems hinder the continuous operation of the system, the basic technology has been demonstrated and there appear to be no major technical barriers to developing a fully operational prototype system.

II. BACKGROUND

When the Transette System was described and a scale model of the basic design concept demonstrated to Georgia Tech representatives, it was recognized that the system has great potential for use on campus as well as in other public areas to alleviate traffic congestion and parking shortages. The Georgia Tech technical staff members believed that the system had been developed to a point where credibility of performance would have a critical effect on its future economic development and marketing potential. It was also felt that verification testing by an impartial, scientifically recognized agency could establish that credibility and thereby influence favorably the potential implementation of the system. Georgia Tech was aware that the National Science Foundation program of Experimental Research and Development Incentives was designed to provide experimental evidence concerning various incentives which the Federal Government might use to increase the application and use of science and technology in the public sector by (1) identifying the institutional barriers to innovation, and (2) testing appropriate Federal action which might reduce such barriers. The objectives in suggesting installation of a prototype of the Transette System on campus were to establish the technical feasibility of the basic concept and to demonstrate its practicality in routine service. Toward these goals, Georgia Tech requested and subsequently received funding from the NSF Experimental R&D Incentives Program.

III. TECHNICAL DESCRIPTION OF THE SYSTEM

The description and illustrations in this report are intended to provide a general understanding of the system design; no attempt has been made to present full engineering details of the system.

The Transette System is a new concept for personal rapid transit which emphasizes low cost, passenger safety, high performance capability and dependability, very low energy consumption, and low air pollution and noise. The utilization of a unique drive system allows passive four-passenger cars to be driven along a two-way concrete track, eight feet wide, at speeds up to twice that of a narrow driving belt built into the track system. The cars have four wheels (one driving and three roadway) with pneumatic tires. The driving wheel is located at the rear of the car, and positioned out of alignment with the roadway wheels so that it engages the 5-inch-wide driving belt. The driving wheel is coupled through a 2:1 gear train to the rear roadway wheel, transmitting the belt velocity through the drive wheel to the roadway wheel and propelling the vehicle with a velocity twice that of the driving belt. (See Figure 1.)

A variable-speed transmission allows the vehicle to maintain continuous engagement with a driving belt. A multi-plate clutch allows acceleration and deceleration of 2 mph/sec along the belt from fully stopped to maximum speed condition.

Two-way traffic is made possible by the installation of a double guide rail down the center of the 1500 foot track. Two sets of guide wheels engage the guide rail. At each end of the track, the guide rails diverge and become tangent to a motor-driven carousel. The vehicle drive wheel passes from a deceleration belt (terminating at the carousel) onto the carousel and continues onto an acceleration belt at the opposite side of the carousel.

Belt drive motors are located in pits below the guide rail. Acceleration and deceleration belts operate only when needed. They serve one-way traffic and form individual loops by returning in a trough underneath the concrete slab. The remaining drive belts are designed for continuous operation. To reduce costs, each belt serves two-way traffic. This is accomplished by aligning the belt so that it travels in one direction along

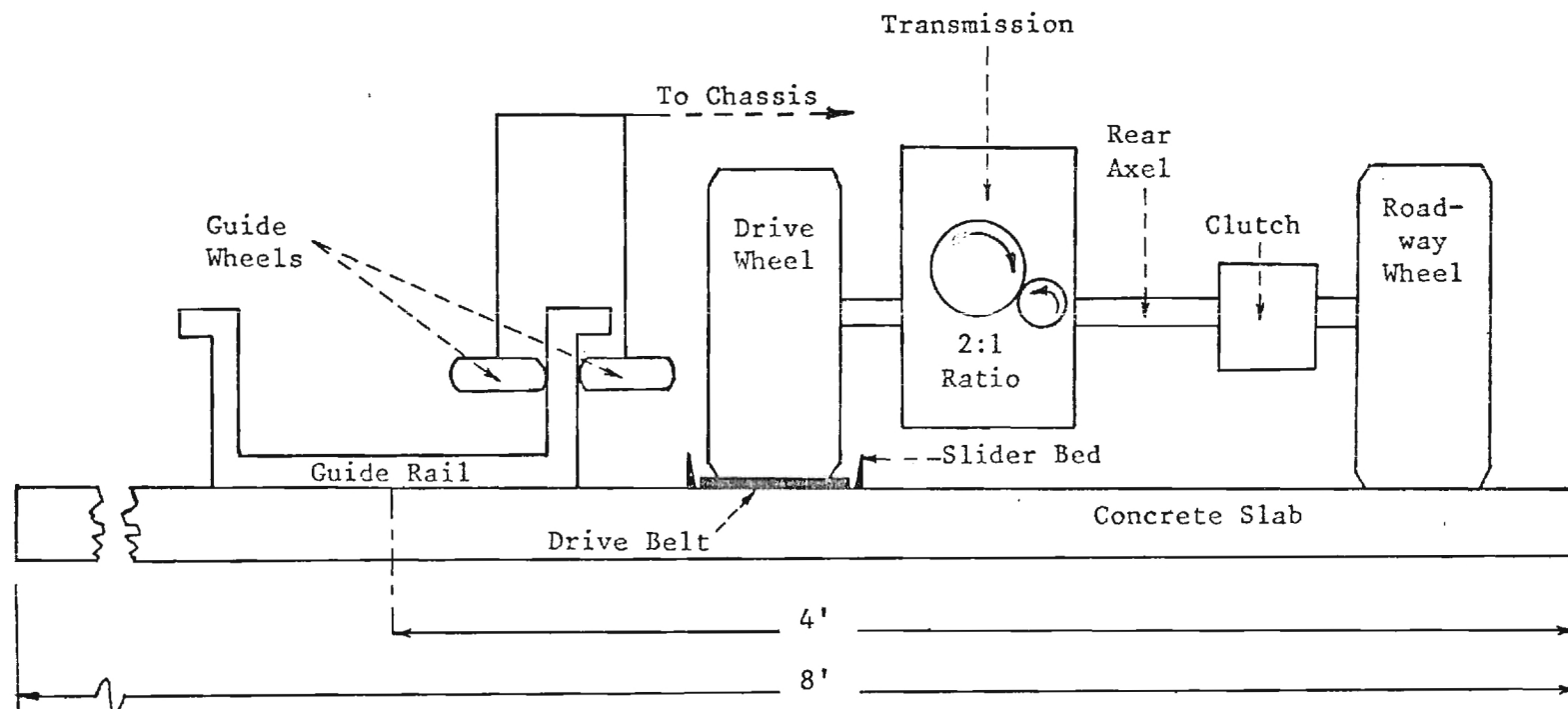


Figure 1. Cross-sectional diagram of Transette guideway and drive train.

the track. From the drive pulley, it continues until it drops into a pit and is guided by idler pulleys to make a 180° turn in the pit. It then continues up the opposite side of the track and into the drive pulley pit where it makes another 180° turn. (See Figure 2.) The distance from one belt to the next is approximately 3 inches.

Belts slide on a stainless steel slider bed with runs alongside the guide rail and is flush mounted to the concrete slab. The belt configuration is designed to accommodate various velocity requirements along the track and to maintain maximum vehicle speed for as much of the track as possible. The maximum belt speed is 7.5 miles per hour and the maximum vehicle speed is 15 miles per hour on the longest track section, which is 750 feet long.

The belts and carousels operate automatically according to signals from the control logic. Metal sensors located along the track detect passing cars. The logic is designed to maintain a minimum 15-second headway between cars, manage merging from the off-line test station, and stop and start cars automatically at the passenger stations.

For testing purposes, the present track configuration includes a 7.5% grade section, a 32° bend, and the off-line test station. A control house overlooks the entire layout.

For a car to stop at the off-line station, a button in the car must be pushed. This lowers a metal flag below the car which signals a metal detector, causing an impulse to be sent to the control logic. The impulse causes the setting of a switching mechanism located along the track. As the car passes over the set switch, the switch causes the main-line guide wheels to disengage and the off-line guide wheels to engage the off-line guide rail located along the outer edge of the concrete slab at the station. The main belt overlaps the ends of the deceleration and acceleration belts to and from the station so that the drive wheels are always in contact with some belt.

The car door is opened and closed by a cable attached to a wheel mounted perpendicular to the chassis. As the vehicle passes over a metal strip mounted to the concrete slab, the wheel is rotated by friction produced between it and the belting material mounted on the metal strip.

Numbers indicate belt speed in miles per hour.
(Car speed is twice the belt speed.)

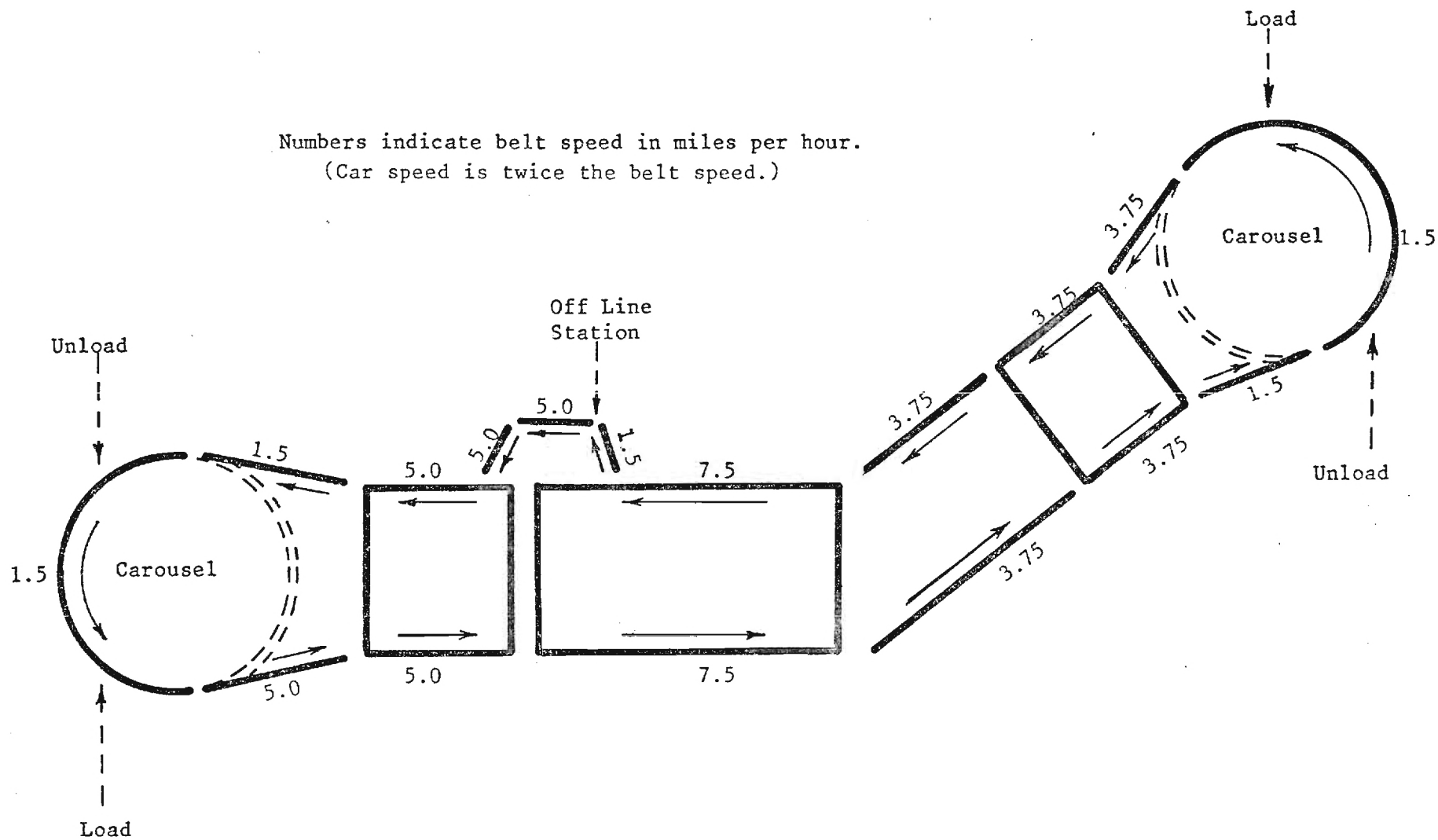


Figure 2. Drive belt schematic.

IV. HISTORY OF THE PROGRAM

The first few months of installation went ahead of schedule and within budget estimates. A change in the track route from the western terminal, together with inflation, started the beginning of delays and over-extension of the budget. Subsequently the termination date of the contract was extended from 31 December 1975 to 31 December 1976. Below is an outline of program activities.

June - September 1974

- Transette, Inc. organized.
- Detailed engineering plans started.
- Contract formalized between Georgia Tech and Transette, Inc.
- Site prepared for pouring of concrete.
- Design and fabrication planned for cars.

October - December 1974

- Final verification test plan agreed upon by TSC, NSF, Georgia Tech and Transette, Inc.
- Pouring of concrete slab completed.
- Mechanical equipment pits poured.
- Pit drains, supports and covers fitted and placed.
- Motor supports fabricated.

January - March 1975

- Solid state logic system approved by Westinghouse.
- Door and window frames fabricated.
- Main chassis frame fabricated and assembled.
- Drive pulleys fabricated.
- Guide rails cut and crossties welded.
- Two dollies and hoists fabricated for ease of two-man placement of guide rail sections.
- Fabrication of cars begun: two assembled.
- Control house fabricated and installed.
- Site graded for proper drainage.

April - June 1975

- Idler pulleys installed and aligned.
- Control console and equipment cabinets installed in control house.
- Service wiring installed.

July - September 1975

- Fencing around the track completed.
- Guide rail sections bolted to concrete.
- Guide rail expansion joints fabricated.
- Carousel drive assemblies completed.
- Interior wiring of control house completed.
- Solid state logic equipment assembled and wired.
- Proximity sensor boxes fabricated.
- Rear axle assembled.
- Door operator fabricated and assembled.
- Air shocks mounted between running gear and and car body.
- Guide wheel sub-assemblies fabricated and assembled.

October - December 1975

- First car completed and displayed at Georgia Tech.
- Transette, Inc. requested a time extension.

January - March 1976

- Georgia Tech requested time extension and additional funds from NSF.
- Conduit run to control house.
- Carousels mounted.
- Track sections to carousels and off-line station mounted.
- Motors installed in pits.

April - June 1976

- Program extension approved by NSF.
- Sensor wire pulled.
- Conduit brackets mounted to concrete.

July - September 1976

- Wiring completed.
- New carousels constructed.
- Nylon drive pulley bushings replaced with oilite bearings.
- Oilite bearings replaced with roller bearings on continuous drive belt drive pulleys.
- Molybdenum polydisulfide applied to slider bed.
- Door opening mechanism simplified.

October - December 1976

- DOT, TSC team came to test system. (See Note 1.)
- Belts of two longest sections replaced with new, thinner belts of different composition.
- Two longest belt sections replaced with original belt.
- NSF informed that the system was ready to be tested.

As fabrication and installation progressed, design changes were made. Some changes were not necessary for the operation or testing program, but according to Dr. Sutton of Transette, Inc., would result in better overall design and operation of the system. Engineering Experiment Station staff feel that considerable time was wasted in making changes to all eight cars or to all track sections, rather than testing a change in one car or track section before completing the remainder of the changes.

Other problems which resulted in very costly time delays and expense derived from misrepresentation of product capabilities. For example, three types of bushings were tested in the belt drive pulleys before bushings capable of taking the loads required were found. According to the manufacturer, all three types should have taken the load requirements.

Note 1. On 19 October during the tests, the lagging on the drive pulley of one belt section was worn away due to unusual forces produced when a car was pushed onto the belt from the curve section. When the TSC test team was informed that it would take approximately one day to replace the lagging, they decided to terminate the tests until some unspecified date. The lagging was replaced on schedule. The tests could, therefore, have been resumed with minimal delay had the TSC test team been willing to accept a short interruption.

The most costly problems, with respect to time and money, were those involving the drive belt. The construction of the belt was represented by the manufacturer as having a lower surface which would slide freely on the stainless steel slider bed, if there was water on the slider bed. The belt also was not supposed to deform or stretch as the result of the tensions required. In fact, however, the belt material did stretch, causing lagging on the drive pulleys to be worn away frequently. The lagging was also worn away if there was water on the slider bed when the belt was turned on; apparently air pockets formed, which acted as suction cups. Under tension, the belt sides curled up to such an extent that the edges rubbed against a wood lip installed over the slider bed to prevent the belt from coming out of the slider bed. The belt manufacturer then suggested using a different belt; this belt was installed, and after running for a short period of time, folded in half lengthwise. The lower surface of the original belt was then sanded off, and it was tested again, with somewhat better results.

Due to foreseeable problems with pulley alignment, the belts for the curve section of the track were not installed. It was hoped that a car would have enough momentum to coast through that section and continue onto the next belt section. However, the radius of curvature at the beginning and end of the guide rail section was small enough to cause considerable friction between the guide wheels and guide rail. This resulted in enough loss of momentum to prevent the car from coasting onto the next belt. The section of guide rail was replaced with one having a larger radius of curvature at both ends. When the system was tested with the new guide rail, a car needed only a little prompting to reach the next belt section.

Another problem area which was not resolved due to lack of funds was the carousels. Again the radius of curvature was so small that enough friction was produced that a car could not travel around the carousel without being pushed. In this case, the friction was between the guide rail of the carousel and the side of the drive wheel which was pulled against the guide rail because of the alignment of the guide wheels. According to Dr. Sutton, this problem can be eliminated by offsetting the guide wheels.

The logic system was successfully bench-tested and later in large degree successfully tested at the test site. Several wiring problems were

discovered, which prevented a thorough test before work was halted due lack of funds.

Two time extensions were granted to allow Transette, Inc. additional time to complete the installation.

During the period between 19 October 1976 and 28 December 1976, several phone calls were made to TSC to try to establish a new test date. Although the installation had not been totally completed, the majority of the tests could have been made in accordance to the official test plan, "Transette Personal Rapid Transit System Test Plan," which had been agreed to on 31 October 1974, by NSF, TSC, Georgia Tech, and Transette, Inc. However, on 28 December 1976, TSC informed Georgia Tech and Transette, Inc., that they did not agree with the approved test plan and would not conduct the tests until they received written instructions from NSF to carry out the tests in accordance with the approved test plan.

Since Georgia Tech was unable to obtain a commitment from TSC during the time period of 19 October 1976 and 28 December 1976, NSF was formally notified on 28 December that the Transette System was ready to be tested in accordance with the 31 October 1974 test plan. Georgia Tech also reminded NSF that the tests needed to be completed as soon as possible since no money remained to conduct the tests.

Georgia Tech was informed that, on 29 December 1976, NSF requested that TSC initiate the testing program as soon as possible in accordance with the "Transette Personal Rapid Transit System Test Plan." However, from 29 December 1976 until 1 March 1977, there was no response from TSC. Therefore, official proceedings were begun on March 1, 1977 to close out the contract between Georgia Tech and Transette Inc., and the contract between Georgia Tech and NSF.

In summary, the majority of the installation was completed and tested on a limited basis with the exceptions of the carousels, curve section, and automatic mode, for reasons described above. The door-opening and off-line mechanisms, although not completely installed, appeared to operate as expected under limited testing. All parts of eight cars were fabricated but only two were assembled and tested. The drive belts did in fact drive a car at speeds twice that of the belts, thus demonstrating the technical feasibility of the basic design concept. Due to the lack of completion of

the installation only limited testing was possible, therefore, it was not possible to determine the practicality in routine service the reliability and dependability of parts. Finally, due to the failure of the TSC team to complete their test program it was not possible for Georgia Tech personnel to obtain rider acceptance and evaluation of the system.

V. CONCLUSIONS

Although the entire installation was not completed and the TSC testing program was not conducted, the basic design concept of the Transette System was demonstrated as feasible, thus achieving one of the two goals of the program. Because of the installation deficiencies, the system never reached a degree of reliability such that it was capable of operation over a significant length of time. Thus, the goal of demonstrating satisfactory routine service and measuring operating cost and efficiency was not reached. Because the testing program was not completed, students were not allowed to ride the system and student evaluation was not obtained. The Georgia Tech technical staff members involved in the program feel, however, that the system is worthy of further testing and development.