Report on a Proposal

To Construct

AN AIRPORT MONORAIL SYSTEM

For Operation Between

LOS ANGELES INTERNATIONAL AIRPORT

and

DOWNTOWN LOS ANGELES

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Submitted By

GOODELL MONORAIL SYSTEMS, INC.

To

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

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REPORT No. 52-621

January, 1962

Compiled By

Arthur C. Jenkins & Associates, Consulting Engineers.

GOODELL MONORAIL SYSTEMS, INC.

810 South Spring Street,

Los Angeles

February 19, 1962

Los Angeles Metropolitan Transit Authority
1060 South Broadway
Los Angeles, California.

Gentlemen:

Submitted herewith is a proposal by Goodell Monorail Systems, Inc., to construct a monorail system for operation between the Los Angeles International Airport and points in the downtown Los Angeles area.

Design characteristics and construction cost estimates have been prepared by Murel Goodell, President of Goodell Monorail, Inc., of Houston, Texas, designer of the system.

Estimates and projections of potential traffic and revenue have been made by Arthur C. Jenkins, Consulting Engineer, of San Francisco, who has also estimated the cost of operating the system, and laid out the basic routing of two alternate alignments.

Provision for forming an underwriting group to consider purchase of revenue bonds, sufficient to construct and equip the system, has been favorably considered by the firm of Payne, Webber, Jackson & Curtis, of Los Angeles.

Los Angeles
Metropolitan Transit Authority February 19, 1962

We, therefore, submit for your consideration this proposal that, if the system, as suggested, meets with approval of your Authority, we will proceed with the next logical steps of financing, detailed design, and planning in accordance with specifications and terms of agreement that may be mutually acceptable. We are prepared to proceed immediately with final negotiations.

Yours very truly,

William L. Hoyt, President,
Goodell Monorail Systems, Inc.

GOODELL MONORAIL INC.
1951 Richmond Ave., Houston 6, Texas

December 29, 1961

Mr. William L. Hoyt, President
Goodell Monorail Systems Inc.
810 South Spring Street
Los Angeles 14, California

Subject: Goodell Monorail System -
<u>Los Angeles Airport Service</u>

Dear Sir:

Two routes and station points have been examined between the Los Angeles Airport and the Los Angeles Union Passenger Terminal located to the northeast of the central business district and the Civic Center.

We would propose to design, build and erect a two-way Goodell Monorail suspended type system on one of these routes as follows:

Route A. Airport - Santa Fe - Harbor Freeway - Union Passenger Terminal, and Statler area, approximately 16 miles.

Route B. Airport - Century Blvd. - Harbor Freeway - Union Passenger Terminal and Statler area, approximately 17 miles.

Costs of such a system are hereby quoted on two bases, first, with electric power propulsion and, secondly, with alternate gas turbine propulsion, as follows:

Propulsion	Route A 16 miles	Route B 17 miles
1. Electric Power	$34,609,500	$36,540,000
2. Gas Turbine	$31,273,500	$32,936,000

These costs are exclusive of land and rights-of-way, stations and service area.

We propose to furnish this system, tested and ready for operation within 18 months from signing of contract.

Upon your acceptance, detail plans and specifications of the final system design and routes will be presented to you for approval and will constitute part of the formal contract. In addition, we would present our formal insurance bond covering the entire system contract outlined above.

Transmitted herewith are data giving a technical description of the system and its operation. It includes the completed system of columns and double track rails, facilities at the service center, storage yard and central station, monitor facilities, fully automated operation, TV monitor, necessary station facilities and eleven passenger coaches, complete and ready for operation. An allowance of one million dollars has been included for design and construction of the Monorail stations including a postoffice stop. It is proposed that a local architect design these stations to meet your requirements as to detailed specifications.

Our proposal includes nine 26-passenger coaches with space for standees and baggage, giving a normal one-way passenger capacity per hour of 400 persons seated. One extra coach is included for standby duty and another to be used as an automatic inter-airline terminal transfer coach. This coach will shuttle between the several airline facilities at the airport for use of passengers transferring from one airline to another.

Very truly yours,

PART A

CONSTRUCTION DESIGN AND COST ESTIMATES

Prepared by Murel Goodell

I. SUMMARY OF COST

For a proposed monorail system installation extending between the Los Angeles International Airport and the Los Angeles Union Terminal serving points in the downtown area, the estimated cost by two alternate routes and by two alternate types of propulsion, would be:

Type of Propulsion	Route A	Route B
Electric Power	$34,609,500	$36,540,000
Gas Turbine	$31,273,500	$32,936,000

II. ALTERNATE ROUTES

Both routes that have been considered would originate in the loading area at the Airport and terminate at the Los Angeles Union Passenger Terminal northeast of the business district and civic center.

Route A would follow the private right of way of the Atchison, Topeka and Santa Fe Railway Company freight line, paralleling Aviation Boulevard, Florence Avenue and Slauson Avenue, to the Harbor Freeway and would then proceed within the right of way limits of the Harbor Freeway to the Hollywood Freeway and thence easterly to the Union Passenger Terminal at Alameda and Macy Streets.

Route B would be the same as Route A except that Century Boulevard would be used as an approach to the Harbor Freeway instead of the railroad right of way as contemplated under Route A.

III. PASSENGER STATIONS

Passenger loading facilities of approximate functional and aesthetic design would be provided at the Airport, with an intermediate station in the vicinity of or at the Statler Hotel, and one at the Los Angeles Union Passenger Terminal.

IV. GENERAL ENGINEERING

The Goodell Monorail suspended-type system has been adopted as best suited to meeting municipal requirements for safety, operation, passenger capacity and design. This system lends itself to a lower installed cost per mile than other type as demonstrated by testing experience of many construction materials and applications. In the end analysis, cost of the physical facility governs the complete economic feasibility of the installation. The Goodell system is ideally suited for mass production techniques, and cost can be further lowered with greater production volume. Component parts of this system wherever possible are the product of major manufacturing firms who are recognized by their time proven standards of dependability and quality.

Steel has been adopted for columns and rails because, as of today, it represents the lowest cost per installed mile and lower site construction time, without any sacrifice in safety or suitability to basic structural requirements. Several new types of epoxy coatings are available for customer selection, offering pleasing colors and increased years of life as compared with other existing types of protection. Included in this cost proposal is a 20 year paint maintenance contract for columns and rail.

V. PROPULSION TYPES

Much study has been made of basic types of propulsion devices, and there are two methods that are best suited to the Goodell Monorail System, consisting of the conventional electric powered units or self contained gas turbine power. A brief description of each is as follows:

A. Electric Propulsion

Motors	4 per car, GE-1250, 100 HP or equal with right angle drive to each of four wheels.
Power	Electric, 600 Volts direct current.
Weight	28,300 pounds per coach with propulsion equipment and full passenger load.
Substations	3 required, one at the airport, one at the Union Passenger Terminal and one midway on the route. Each substation would be equipped with 750 KW silicon diode rectifiers, two at the airport, two at the Union Passenger Terminal and three at midway. One rectifier at each substation would be used as a spare with automatic cut-in facilities. With this total capacity there would be sufficient power potential to provide for doubling the number of passenger coaches.
Trolley Wire	2/0 bronze conductor with positive and negative.
Feeder Cable	900,000 CM, positive and negative.

With electric propulsion there would be the conventional electric power distribution system for the full length of the track, together with electric substation facilities, all of which would require continuous maintenance and inspection. Wherever such an electric system is used there is always present an accident hazard. The propulsion equipment, although adaptable to automatic control, would involve many moving parts that would require continuous maintenance and inspection.

B. <u>Gas Turbine Propulsion</u>

Motor	One gas turbine per coach, using Solar T-350 or equal, with 370 shaft HP and right angle drive to the two rear wheels.
Power	Self contained independent power system on each passenger coach without need for electric distribution system.
Weight	22,800 pounds per coach with propulsion equipment, full passenger load and full tank of fuel. Weight of turbine consisting of two moving parts with sleeve bearings, 375# plus 160 pounds for full load of fuel.
Duration	Full tank of fuel will provide for six hours of continuous operation.
Maintenance	Approximately 5,000 hours of operation without maintenance.

Gas turbine propulsion is ideally suited to the type of operation contemplated on relatively long haul non-stop schedules. Due to the very few moving parts and long periods between maintenance cycles there would be less out-of-service time for coaches on the system. This type of gas turbine is now being used by the Union Pacific Railroad in the Los Angeles area and has proven to be sturdy, dependable, economical and efficient.

C. Reduced Power for Electric Propulsion

Consideration was given to a system of electric propulsion using only two motors per coach instead of four and the results proved to be unsatisfactory.

Two 100 HP electric motors instead of four would reduce the dead weight by 3,700 pounds per coach and system cost would be cut by about one million dollars, or 3%. This includes the corresponding reduction in sub-station capacity. It would also produce a slight reduction in cost per coach hour of operation.

On the other hand, it would reduce the acceleration capability from 4.0 to 2.7 MPH/sec which would in turn result in an increase in round trip running time of between 14 and 18%.

VI. PASSENGER COACHES

Passenger coaches as contemplated for use on this system would have the following characteristics:

Seating - 88 passenger capacity all seated, forward facing, contour style with provision for nominal standees and for baggage.

Suspension - Coach suspended to travel beneath the supporting rail with propulsion equipment above the rail.

Speed - Designed for normal operating speed of 50 miles per hour on level and tangent track.

Acceleration - Designed for 4 MPH/sec at maximum load and normal track conditions.

Deceleration - Designed for normal rate of 3.0 MPH/sec and emergency rate of 5.9 MPH/sec.

Controlling Grade - 8% maximum.

Weight - Empty coach with gas turbine propulsion and full fuel container, 15,600 pounds, plus live load per seated passenger with baggage and ten standees with baggage, at 200 pounds per passenger with baggage, for a total of 7,600 pounds, or a combined weight per loaded coach of 22,400 pounds.

Car Coupling - Above rail through chassis with 40,000 pounds cushioned impact buffing strength transmitted through hanger arm assembly.

Refueling - For gas turbine, minimum refueling interval under normal operating conditions, six hours.

Interior - Floor surface of Antico Renaissance grade, or equal, vinyl and vinyl covered walls to window height.

Accessories - Air conditioning and heating plant, efficient interior lighting, full automation with service utility manual control and TV monitored from central station.

Wheels and Tires - Each coach is supported by four wheels equipped with Michelin pneumatic tires and damped air springs. There is a closed hydraulic Servo power system to control sway action by positive positioning. (See Drawing No.). This type of Michelin 10.00 x 15 steel cord tire has been selected because of its ready availability and adaptability to the contemplated load characteristics. In addition, it has the lowest overall diameter thereby presenting a more sleek and streamlined track assembly. Use of steel cord eliminates the characteristic thumping noise of Nylon tires that normally results from temporary out-of-round forming when standing idle. Pneumatic brakes are employed for normal braking and ski type mechanically operated emergency brakes are located on the front and rear track tire bogies for application to top of running rail. These emergency brakes can be used by serviceman as a lifting device for tire service. A steel wheel is used on each bogie to carry the load in case of a flat tire.

Power Supply for Gas Turbine - Enclosed section and plan shows the direct drive gas turbines coupled directly to the drive wheels. In the gas turbine drive, it is proposed to use the Solar model T-350 with 370 shaft HP output driving the two rear wheels. In addition, it is provided with 24 V. DC output as well as 110 V. AC 60 cycle car power supply. The Solar turbine is of a dual shaft, gas torque converter design wherein the drive shaft output at full stall has an estimated 1800 ft. lb. torque. The fuel that would be used is designed to meet technical requirements for Los Angeles operation. Adequate muffler maintains a highly acceptable passenger noise level contiguous to the verticle exhaust comprising no apparent visible fume or smoke conditions.

Air Conditioning - The estimated air conditioning per coach is 8 tons. This capacity will maintain coach air at 75° F D.B. with 50% relative humidity when outside air is 95° F D.B. and 78° F W.B. The system will use Trane Manufacturing or equal with Freon 22. All equipment wherever possible will be located in the truck chassis above the rail.

Heating - The heating system for the coach is capable of 100,000 BTU per hour which will maintain 75° F car temperature when outside air temperature is 0° F, using a Janitrol combustion heater or equal with approximately 3 years replacement life.

Body and Hanger Design - The traction chassis unit and hanger arm are of 6061-T6 grade aluminum plate hollow box welded beam design. An aluminum skin housing will enclose the truck assembly and hanger arm, designated for maximum accessibility of parts for servicing. The coach suspension is also designed with provision for quick disconnect from power truck and hanger to expedite servicing and simplify substitution when necessary.

Aluminum is used for the basic coach structure with 7/32 inch solex type safety plate flat glass and 1/4" curved plexiglass. Aluminum faced plywood with vinyl covering will be used for the floor which together with a box keel under the floor will provide the main coach structural member. External skin is of thick aluminum with spot welded "Z" section stiffners. Space between the internal finish and the external skin of the coach will be insulated with Halfoam or equal, a molded-in-place epoxy resin foam material, of light weight, chemically inert and self-extinguishing.

The main access door is five feet in width of opening with wall disappearing doors, located on the center of the coach. Operation will be comparable to full automatic modern elevator doors. In addition there will be two emergency doors provided.

Interior lighting will be provided by electro-luminescent ceiling panels with above average indirect fluorescent cove lighting and directional spots over the seats. (See Drawing No.).

High fidelity background music will be included for passenger enjoyment.

As there are many types of passenger seating chairs available, it is proposed that seat specifications be drawn up by the transit agency.

There will be a built-in, quickly detachable, porter-operated, mobile baggage pod for air mail and packages.

Lubrication will be done by an automatic master system with a network of copper tubing reaching all points. Truck assemblies are equipped with a completely automatic CO_2 fire protection system, and hand operated CO_2 bottles are located inside the coach on either side of the doors.

In the basic design of this coach emphasis has been laid upon the desirability of reducing the noise level to a bare minimum not only for comfort of passengers but also to eliminate any inconvenience or annoyance that might otherwise be caused by outside noise from operation.

VII. FOUNDATIONS

Each foundation for track supporting columns will be modified in design detail as may be needed to meet the specific requirements of the particular point of location. In general, wherever possible, foundations will consist of a drilled shaft with bell bottom, filled with reinforced concrete with necessary sub-level knee supports as required. In certain locations, because of special rail conditions or difficult construction areas due to sloping banks of freeway cuts or fills, piling will be substituted for knee supports. (See typical sketch enclosed.)

To reduce the possibility of damage during foundation installation, an isotopic electronic probe unit will be used to give the depth and radius of any interferring objects or utilities beneath the ground surface, and if necessary, the foundation location will be shifted to suit the condition and suitable design modifications will be accordingly made.

VIII. RAILS & COLUMNS

Rails and columns are of steel construction, mounted on reinforced concrete foundations.

All reasonably conceivable normal and emergency type loads are anticipated in the design incorporating strain gauge testing, operational experience and existing requirements of local and state regulatory agencies.

Mass production pipeline techniques are employed in construction using special jigs designed to give uniform and extremely close tolerance in finished dimensions.

Rails and columns are of A-36 grade welded steel box type, designed for the ultimate use of larger cars of 46 passenger capacity and 30,000 pounds operated in tandem. The design encompasses such loads as an unbalanced dynamic load of a single-track loaded coach with cross wind of 20 lbs. per sq. ft. with an impact factor of 1.25 with reference to the live load of the loaded coach. It includes the maximum torsional moment caused by the static, dynamic and wind load of the coach on a curve track, or the difference in area of the train above and below the neutral axis of the rail. A centrifugal force of 0.177 times the 30,000 pound load of a coach unit is used which is equivalent to negotiating a 150 foot radius curve at 20 MPH, or 100 MPH around a curve 1,750 feet in radius. A system safety factor of 1.7 is used.

Rails will be delivered to the site equipped with all coats of epoxy paint excepting the final finish coat which is to be applied after rails and columns have been installed. It is important to note in this connection that the electrostatic method of paint application will be used throughout which completely eliminates the propogation of spray to surrounding area, landscape and nearby objects. Epoxy paint can only be applied to the desired surface because of the design of the system. (See Drawing No.).

Generally the ground clearance beneath the bottom of the coach will be a minimum of 16 feet, with a minimum of 23 feet over railroad rights of way. Column heights will be variable and designed so as to pass over freeway interchanges wherever necessary. (See Drawing No.). All spans are normally 100' centers wherever possible. The normal span length between columns will be 100 feet with shorter spacing on curves and under special conditions of above average loading.

The Estimated Bill of Materials is as follows:

<u>ROUTE "A"</u> - Santa Fe R/W and Harbor Freeway

<u>Towers and Rails</u>

"T" Towers & Foundation, No. required	785
"J" Towers & Foundation, No. required	67
Linear Rail Footage 161,320 + 5%	169,386

<u>Right of Way Space Required</u>

Aerial - 30' wide and 20' high
Surface - 5' x 5' on average at 100 ft. centers
Subgrade - 8' long and 20' wide (long axis at right angle to direction of travel)

<u>Right of Way Distances Required</u>

At Airport	9500 linear feet
Union Passenger Terminal	2600 linear feet
Santa Fe R. R.	36,645 linear feet
Freeway	33,985 linear feet

<u>ALTERNATE ROUTE "C"</u> - Century Blvd. and Harbor Freeway

<u>Towers and Rails</u>

"T" Towers & Foundation, No. required	861
"J" Towers & Foundation, No. required	67
Linear Rail Footage 178,540 + 5%	187,467

<u>Right of Way Required</u>

At Airport	9,500 linear feet
Union Passenger Terminal	2,600 linear feet
Century Blvd.	29,228 linear feet
Freeway	54,980 linear feet

<u>Weight Factors (Average)</u>

"T" Towers, each	12,000#
"J" Towers, each	10,000#
Rail per linear foot	200#

IX. ERECTION OF STRUCTURES

Traveling cranes operating on the Monorail track itself will transport the prefabricated assemblies to the foundations which have been previously completed. A specially designed track-operated jig will be used to affix and proportionately bend and bank the rail to each approaching tower or curve as required to give a track road bed of uniform curvature as required. Field welding will complete and integrate the all welded steel system. The general objective is to maintain as much straight line, non-curving track as possible.

By use of multiple construction units the erection time can be shortened by several months at a slight increase in cost.

X. TESTING OF STRUCTURE

Immediately after the final plans and specifications have been approved and signed, it is proposed to first build and erect two foundations with two "T" columns at 100 foot centers and 130 feet of 2-way rail, on the right-of-way and to perform a full scale static and dynamic testing procedure with loading to the point of destruction.

Upon completion of the system installation every foot of rail and all columns will be statically and dynamically tested in place by a coach with sandbag or water load, to meet necessary insurance, local and state regulations.

XI. STATIONS

Station cost allowance will be included in the contract. It is anticipated that a local architect will be engaged for station design so as to meet requirements of the transit agency. Specific location of stations are to be designated by the transit agency.

This proposal includes an automatic shuttle coach operation at the Airport to provide transportation between the various airline facilities. The shuttle system would function essentially the same as an automatic elevator, except that travel will be horizontal instead of vertical. This operation would provide an on-call service, controlled automatically so as to merge the shuttle car between main-line schedules.

XII. SWITCHING

Five switching units are contemplated, two at the airport and two at the service center for both directions of traffic, plus one switch connecting to a single-track storage facility of sufficient length to accommodate the maximum number of coaches that might be out of service at one time. These coaches would be under control of the central station operator.

These track switches are fully automatic and will operate on a five second time period. Experience has demonstrated that for this installation the required track switching is simple, rugged, dependable and highly satisfactory.

XIII. SERVICE, STORAGE, MAINTENANCE AREA

It is anticipated that 1-1/2 acres supplied by others, will be adequate to serve these terminal facilities. To keep down excessive switching trackage, it is anticipated that a ground level approach of the coaches into the terminal area will be used. At this slot-discharge point a special dolly, tractor driven, and operated by the service mechanic will be used to detach the entire coach from the rail. The entire coach and truck assembly will then be treated as an ordinary surface vehicle or hangared aircraft to park, service, or maintain as required.

The service area will be concrete slabbed with a colored metal clad building with 20,000 square feet of area and ceilings 21 feet high. Housed in this building will be tools, shop, office space, spare parts, cleaning equipment and refueling facilities if turbines are employed. For operation by the serviceman there will be provision for manual control from inside the coach.

XIV. AUTOMATION

All coach operation will normally operate in a predetermined cycle as to acceleration, normal running time, deceleration, station stop and loading. The central station operator can change the program tape so as to change the headway time and regulate seat capacity per hour and also electronically place into system operation additional coaches from storage yard rail parking track.

The General Electric control equipment or equal is divided into several sub-systems:

a. Wayside equipment, based on three (3) control "blocks" per mile of one-way route, which provides transmission of wayside signals for speed control of cars, and interchange of signals between check points in each "block" and the main dispatching or programming center.

b. The "on-car" speed-distance regulator which translates supervisory way-side signals into appropriate manipulation of the conventional car propulsion equipment.

c. Station programming equipment, which controls the stopping of cars at stations and terminals, door opening and closing, and dispatching of the car to the next station or terminal. Terminal equipment also includes provision for omitting, shortening or lengthening station stop time in order to make any needed adjustment in headways.

d. Main dispatching equipment, from which the entire operation can be supervised, observed and controlled. (The principal source of regular programmed or emergency way-side signals). This includes a two-way communication network, over which voice communication between cars and dispatcher can be affected.

e. Train protection equipment, which serves the protective functions of conventional railroad way-side signal equipment.

XV. T. V. MONITOR

The independent TV central station operator monitoring function breaks down into two types of systems:

a. System of fixed cameras located at suitable intervals along the rail transmitting to central station operator for observing all coach action in that respective zone. (See Drawing No.).

b. A system employing two cameras per car, one scanning the right-of-way ahead and the other showing the passenger in each car. Each camera would have a matching monitor in the main dispatching center. Signal transmission would be by microwave monitor. This involves signal wiring along the right-of-way which picks up the camera signals and transmits them to the viewing receiver units in the central dispatcher's office. This system would probably require a Federal Communications Commission permit.

Service factors of the two systems would be the same. The purchaser has a choice of either one of the above two systems as a part of this proposal.

XVI. OPERATION

A typical example of EXPRESS operation on the 16 mile Santa Fe Route from the airport to the Statler area then to the Union Passenger Terminal would involve an elapsed time from closing the door at the last stop at the airport to door opening at the Statler Station of 9-3/4 minutes, or for an alternate coach from the airport to Union Passenger Terminal the time would be 11 minutes. It is anticipated that a normal round trip would require from 37 to 41 minutes. Allowance has been made for four stops at the airport at three minutes each and regular three minute system station stops.

To meet the baggage time problem at station stops, detachable wheeled baggage pod sections have been designed in such a manner that a three minute station stop should be more than adequate for the porter to place baggage in the particular airline compartment. Adequate "empty" pods are included at each station for transfer to the coach.

Coaches would be automatically controlled in each respective speed zone, including station stops and approaches, and when desirable, reduced speed on certain curved track. Coaches are designed for a 60 foot radius if necessary at the Union Passenger Terminal.

With nine coaches in operation, a uniform headway of four minutes could be maintained. On the average there would be approximately 1.6 trips per hour for 44.8 passenger seats per hour one way. This gives a total seating capacity of 403 passengers per hour in one direction. The balancing speed or maximum speed would be 90 miles per hour.

It is estimated that each coach would travel 50 miles in one hour of operation at 16 hours a day or 800 miles per day for 360 days in the year, less 10% out-time, or approximately 250,000 miles a year or 5,000 hours per year per operation.

It is proposed that one man per shift would be required at the mid-point central monitor station. He would control the automatic programming equipment, dispatching, voice control to various stations and TV monitoring. He would be able to control the number of cars on the line, put into operation additional cars from the spur track at service stations, observe and control various stations for any congestion causing delays. It is proposed that there will be at least one chief porter at each station per shift under control of the central station.

XVII. COST OF OPERATION

All the following costs are computed and charged to the cost of coach operation per hour based on an average of 16 hours/day operation, and 50 miles per hour of travel.

		Cost Per Coach Hour
1.	Load tires - guide tires..............................	$ .60
2.	Maintenance and repair to heating and air-conditioning, floors, seats, windows, baggage pods and misc., lighting and fixtures, daily coach cleaning, necessary cleaning materials........	.90
3.	Station monitor operators, 2 @ 4.00/hr.	.90
4.	Automation, TV & electric equipment................. (This estimate on highside for lack of firmly established data for this type of operation)	2.00
5.	Power cost @ 9.4 mils rate @ 272 average kw. hr., maintenance and repair coach equipment @ 3-1/2¢/car mile, and substation and track maintenance @ 3-1/2¢/car mile..	6.06
6.	For gas turbine operation, turbine maintenance and repair 5000 hours (sleeve bearing type) at $2000 average per overhaul. Turbine fuel 32 gallons per hour @ 8¢/gal. Mechanical equipment, universals and bearings..	4.00
7.	Total Cost Per Coach Hour	
	Electric Propulsion..................................	10.46
	Gas Propulsion.......................................	8.40

The above cost estimates do not include administrative overhead, porters or baggage attendants, any station costs or overhead, advertising or maintenance of displays, ticket collections, retirement of debt capital, operating insurance and taxes.

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ARTHUR C. JENKINS
REGISTERED C.E. E.E. M.E.
MEMBER A.S.C.E. A.I.E.E. I.T.E. S.A.E. S.A.M.E.

TRANSPORTATION - TRAFFIC
TRANSIT - UTILITIES - VALUATION

February 19, 1962

Mr. William L. Hoyt, President
Goodell Monorail Systems Inc.
810 South Spring Street
Los Angeles 14, California

Dear Mr. Hoyt:

In September of 1961, a report was submitted to you containing my findings as to estimated traffic that might reasonably be expected to use a monorail system if installed to operate between the Los Angeles International Airport and the downtown business district and the civic center area of Los Angeles. Estimated traffic was converted into annual revenue and projected from the year 1960 to 1975.

Subsequently, the original estimates have been reviewed in light of more specific routings and further information as to technical features of the structural facilities and design of passenger cars that are proposed to be used in the service.

At this more recent date there appears to be no reason to substantially change the original estimates, due to the degree of conservatism that was incorporated in the computations and projections.

The attached supplementary report is submitted to convey my final estimates as to traffic, revenue and financial characteristics of the proposed monorail system.

Respectfully submitted,

Arthur C. Jenkins

ACJ:ae
Encl.

PART B

ESTIMATED PASSENGER TRAFFIC AND REVENUE

Computed and Compiled by

Arthur C. Jenkins - Consulting Engineer

I. OBJECTIVE AND SCOPE

It is the objective of this general analysis to determine the feasibility of financing, constructing and operating a high speed, light-weight elevated monorail passenger system between the Los Angeles International Airport and the downtown business section of Los Angeles.

II. CONCLUSIONS

1. For a practical, high speed, light weight, attractive and convenient rail passenger line operating between the Los Angeles International Airport and a downtown terminal in Los Angeles, the sources of passenger traffic would be:

   a. Diversion of passengers who would otherwise use the airport bus line on the downtown route.

   b. Diversion of passengers who would otherwise use automobiles to and from the airport.

   c. Induced new traffic that would not otherwise use either of those modes of travel.

2. It is estimated that potential annual traffic from these three sources for the year 1965, would be:

a. Diversion from airline bus traffic	706,000
b. Diversion from auto traffic	2,373,000
c. Induced traffic	308,000
Total Passengers	3,387,000

3. At the rate schedule presently in effect on the airport bus system, of $1.25 for adult passengers, it is estimated that passenger revenue

on the monorail line for the year 1965 would be $3,991,000, and revenue from other sources would be $347,000, or a total of $4,338,000.

4. It is estimated that during the ten-year period 1965-1975, the average annual revenue would be $7,224,000.

5. The above estimates are premised upon a rail system of ultramodern design, with high speed, light weight, elevated monorail type, operated on short headways, with terminal facilities of modern, convenient and attractive design, fully coordinated with the architectural and physical character of the new airport, with emphasis upon convenience of handling luggage.

6. Economic feasibility of such a system will depend upon the cost of facilities, including the right of way, rail supporting structure, passenger cars and station facilities; the annual cost of operation; and the cost of financing.

7. With increasing airline passenger traffic, increasing automobile congestion and interference of vehicular traffic with airline bus service at grade, there appears to be a most favorable climate for an elevated railway system which, due to the concentrated points of source, constant character of patronage and premium fare structure, has high prospect of success as compared with a conventional local passenger transit system that would be required to serve a scattered population with short-interval stops, high peak to base ratio and low fare with transfer privilege.

8. There are three prospective routings that appear to have merit, as follows:

   a. Northeasterly from the airport along existing railroad right of way of Slauson Avenue, thence easterly along Slauson Avenue to the Harbor Freeway, thence along the freeway into the downtown area, with bus connection to serve the Wilshire Boulevard Area.

b. Easterly from the airport along Century Boulevard to the Harbor Freeway, thence north on the freeway into the downtown area.

c. Easterly along Slauson Avenue or Century Boulevard to existing railroad rights of way and thence northerly into the downtown area from the southeast.

III. BASIC CONSIDERATIONS

In approaching the question of financial feasibility, it is necessary to estimate the potential passenger traffic and the prospective annual revenue over a sufficient period of years to establish a reasonable and realistic program of financing.

Certain of the basic considerations, pertaining to establishment of a monorail system of the type contemplated, are as follows:

1. Airline passenger traffic has been growing at such a rapid rate during recent years, and the size and speed of planes have increased to such an extent, that the Los Angeles International Airport has found it necessary to expand runways, modernize passenger handling facilities, and make other major improvements in order to keep pace with the trend.

2. Improvement in airplane design, increased service, extensive world coverage, and expanded terminal facilities have resulted from public acceptance of this mode of travel as an essential part of the present-day pattern of the desire of airline companies and airport management to provide collateral service to airline passengers commensurate with the superior quality of air transportation.

3. Except for the attractive downtown ticket offices, the modernistic and futuristic appeal of the airline passenger industry is in effect isolated behind the entrance gates of the airports. Outside those gates, the airline passenger descends from the fantasy of his lofty luxury into the realities of the perpetual battle of street traffic congestion. He is at the mercy of the automobile.

4. Vehicular traffic congestion at the concentration points and on the streets and freeways in the vicinity of metropolitan area airports

has grown to such proportions as to clog the entrances, approaches and parking lots.

5. Growth of airline travel that evolves from the inherent appeal of this mode of transportation, is no doubt already retarded by the difficulty of airport access, and the anticipated future upward trend of air passenger volume may be stifled by intolerable vehicular congestion.

6. Despite past reluctance of the airline industry and airport management to consider ground transportation as an integral part of airline travel, the time has arrived when the interrelationship of the two must be recognized, and it is imperative that steps be taken to break the bottleneck through acceptance of some modern mode of transportation that will conveniently, comfortably and speedily bring passengers to the airports when beginning an airline trip, and take them away when the trip has been completed, completely free of the interference of street level traffic.

7. To accomplish this objective, it is obvious that the passenger conveyance must be operated either below or above the street surfaces, and in view of the magnitude of prospective volume, it is equally obvious that underground facilities cannot be justified due to the high cost of construction.

8. Therefore, it becomes evident that the only practical means of accomplishing the objective is to adopt an elevated transportation system with high speed cars of automatic or semi-automatic design, of small enough size to be flexibly adaptable to automatic operation and control, so as to provide a relatively short interval of time between cars.

9. Design of rail cars, supporting structures and station facilities should be in keeping with most recent and modern concepts of safety, lightweight construction, high-strength metals, uniform rates of acceleration and deceleration, noiseless and smooth operation, electronic controls and closed circuit television monitoring, and appealing decor consistent in all respects with design, appointments, comfort and convenience of the service provided by the airlines themselves.

10. Station facilities, although necessarily of conservative design, should be generous in proportions, attractive in architecture, conveniently accessible and closely located to ample automobile parking area.

11. Baggage handling facilities should be given high priority in design of cars and station equipment so as to reduce to a minimum the cost, damage and inconvenience of luggage transport.

12. The routing should be such as to take advantage of available airways over streets, freeways or existing rail rights of way, so that the cost of track structures can be kept at a minimum and displacement of dwellings and buildings can be avoided.

13. The vast expanse of available space above the paved surfaces of the street system offers almost unlimited possibilities as a means of relieving vehicular traffic congestion in metropolitan areas, where the capacity of converging arteries far exceeds the ability of the downtown traffic system to absorb the volume into the antiquated system of streets that was layed out in the era when automotive vehicles presented no serious problem.

IV. BASIC ASSUMPTIONS

It is obvious from casual observation of the transportation problem at the International Airport, that whatever system of mass transportation is considered, it will have to be separated from the grade of normal vehicular traffic. This must be the basic premise upon which the study is made.

Experience to date has indicated conclusively that no form of mass transportation can satisfactorily meet the problem if it is to use existing structures, highways and freeways in combination with other vehicular traffic, or even on private right of way, if the line must cross existing streets at grade.

This leaves two alternate methods of construction, either underground or overhead. The volume of airport traffic at present and that which may be developed in the future is far less than sufficient to justify an underground system. It becomes apparent, therefore, that if a rail passenger system is to be built, it must utilize the space above existing streets in the form of an elevated structure for its entire length between the airport and its point or points of destination in the downtown area.

V. ROUTING

The system contemplated is inherently a point-to-point operation with little, if any, intermediate local short haul traffic. The primary objective, therefore, becomes one of transporting passengers from a convenient point of loading at the airport to a convenient point of discharge at final destination over a route that will permit the fastest travel within reasonable limits of safety, and at minimum cost of rights of way and facilities. By reason of this point-to-point characteristic, the selection of routing becomes somewhat flexible, which is highly important in considering the initial investment in rights of way.

Initial cost of the system is one of the controlling aspects and its financial success may depend greatly upon keeping the original cost at a minimum. It becomes important, therefore, that in selecting a route, maximum advantage be taken of existing rights of way and facilities where available, thereby eliminating the necessity for acquiring use of land that is presently occupied by residential and business development.

It is possible to make use of existing railroad rights of way that are so laid out that the route will not be excessively circuitous, the cost of construction can be kept at a minimum. In doing this, and depending upon the route, it may be necessary to construct more mileage of line than would be required over a direct point to point alignment.

The circuity of routing, however, does not offer too great a problem in view of the high average speed that can be attained by an elevated monorail system with few, if any, intermediate stops between terminals. It is not the purpose of this study to develop joint use agreements between the airport transit operation and owners of existing facilities that might be adaptable to the proposed operation. The elements of cost for such use do, however, have a bearing upon the final feasibility determination.

In the area between the airport and downtown Los Angeles, there are many industries that are served by branch lines of the major railroads. Location of the railroad tracks is such that it might be possible to use a combination of railroad rights of way that would provide almost continuous routing from the airport to the downtown business section and create no interference with normal railroad operation.

There is another possibility of using the railroad right of way for part of the distance and the freeway right of way for the remaining distance. The latter, although affording a more direct routing, would involve special design characteristics at the overpasses along the freeway where the clearance for standard highway construction has been maintained. It is desirable, therefore, that the potential advantages and disadvantages of both forms of routing be thoroughly explored.

VI. TERMINAL FACILITIES

Provision of adequate passenger terminal facilities at the airport and downtown presents a major part of the problem. Details of design are beyond the scope of this analysis, but some consideration must be given to the nature of the facilities when estimating the probable use.

At the airport, there will be ample ground area for construction of a suitable terminal which should fit in with the type of architecture used in the newly expanded facilities. In the downtown are, however, the problem is more difficult due to limited access routes and scarcity of suitable space for terminal structures.

Obviously, it would be desirable, if reasonably possible, to establish stations in the same locations as those presently in use at the Statler Hotel and Biltmore Hotel. This may not be practical at least for the Biltmore. General terraine and location of structures appear adaptable to providing a Statler Hotel station. To provide maximum service, stations should be located in the vicinity of the Civic Center. It is, therefore, contemplated that the basic station location plan will make provision for a station at the Statler Hotel, one at the Union Passenger Terminal, and possibly one intermediate thereto.

Public transportation is presently provided by bus between downtown and the airport from two pick-up points, one at the Biltmore Hotel, and the other at the Statler Hotel. A transfer shuttle is operated between the Statler Hotel and the Wilshire Boulevard area. Another airport bus route operates between the airport and Hollywood.

VII. POTENTIAL SOURCES OF TRAFFIC

When considering financial feasibility of the contemplated monorail system all potential sources of traffic must be explored. In addition to the airline passengers traveling to and from the airport there are many workers regularly employed at the airport, a substantial number of sight-seers who travel by automobile, and a large number of persons who accompany airline passengers.

A good rapid transit rail line will attract some of the persons from each of these categories. It must be kept in mind, however, that due to the pattern of population distribution and decentralization characteristics of the Los Angeles metropolitan area it will not be possible to provide monorail service to all persons now traveling by auto.

It must be recognized that only a selected portion of the total airport travel population is to be served by the monorail system. There must be a starting place, however, and the logical approach is to lay out one trunk line at the outset that will, within a reasonable mileage of track and roadway, provide service to a potential volume of traffic sufficient to meet the financial requirements of the facilities and the service to be provided.

Although there has been a considerable expansion of hotel capacity to the west along Wilshire Boulevard there still is a high concentration of hotels in and immediately adjacent to the central business district. Also included in this area are the financial center of Southern California, extensive wholesale and retail activities, together with the City, County, State and Federal Office

Buildings in the Civic Center. All of these are closely associated with airline passenger travel as well as air mail and air express.

Therefore, in developing an initial approach to elevated high speed rail transportation to and from the airport, it is logical to select the downtown business area due to its high population density as the largest potential source of prospective airline passenger traffic. The remainder of the vast region of the Los Angeles metropolitan area must, at least for the present, be considered as producing inadequate concentration of potential traffic to justify any such elevated rail service.

VIII. INADEQUACY OF PRESENT SERVICE

In the early days of airline travel ground transportation to and from the airports was to a large extent conducted by a deluxe type of transportation vehicle. Limousines were used in many cases. The airplane was looked upon as a deluxe type of long-haul transportation, and it was considered necessary to maintain a high standard of ground transportation with luxury-type vehicles commensurate with the quality of the airplanes themselves.

The limousine was actually a limousine in those days. During more recent years, however, as the volume of passenger traffic has increased and the cost of providing ground transportation has continued upward, use of small capacity deluxe vehicles has largely disappeared.

In all large metropolitan areas today, the typical ground transportation service is provided by passenger buses. The bus is essentially no different from any other mass transit bus except for the rear end baggage compartment. Actually, it is less appealing in some respects than the modern interurban bus used in metropolitan areas. There is nothing about the vehicle or the service that offers any special passenger appeal.

At present, airport buses are operated in both directions at intervals of one-half hour, leaving on the hour and on the half-hour from the Biltmore and Statler Hotels.

A typical airline trip from Los Angeles to San Francisco involves almost as much time getting to the airport and checking in as is required in the air between the two airports, and then another interval of approximately the same time on the ground getting from the San Francisco airport to a downtown destination. The travel time is considerably extended for those who must proceed for a greater distance.

Air travel is sometimes made more unpalatable when ground transportation employees are on strike and no terminal connecting service is available.

In summary, it might be said that the weakest link in airline transportation has been the ground transportation service to and from the airports. Airplanes have progressed in a relatively few years from the two-engine DC-3 to the modern jets with their luxurious appointments, high speed and ultra-comfort for the passengers. On the other hand, ground transportation has gone in the reverse direction from the fairly luxurious limousine of 20 years ago to the 33-passenger bus, which finds it increasingly difficult to maintain a reasonable schedule due to street traffic congestion.

Any substantial effort to provide a modern means of ground transportation more nearly in keeping with the standards of airline transportation should be looked upon with great favor by not only the airline companies and the public, but also the airport administration and city traffic officials.

IX. EXPLANATION OF COMPUTATIONS AND STATISTICS

1. General

In the section appended hereto are shown the results of statistical analysis relating to the past, present and probable future trend of airline traffic moving through the Los Angeles International Airport.

Although the primary purpose of this report is to determine the financial feasibility of a rail line operation between the airport and the downtown area of Los Angeles, such findings must be based upon a realistic analysis of past trends and reasonable prediction of future growth.

It is, therefore, necessary that careful analysis be made of actual traffic volume not only on the airlines, but also that which passes into and out of the airport confines by all modes of transportation.

The volume of passenger traffic that will be attracted to a rail system will consist of two segments. First there will be those persons who can be diverted from present means of conveyance, and, secondly, there is the potential patronage of the future that can be captured as the growth trend continues upward. This analysis has explored each of those potential sources of traffic in an orderly sequence and with an ample degree of conservatism.

2. Summary of Revenue Estimate

On page B-13 under Section VIII are shown the final estimates of annual revenue that can be expected from the proposed passenger rail system at four different rates of adult fare.

The process of developing these revenue figures was to estimate the number of persons presently using automobiles that could be attracted to the rail line, and then to estimate the number of passengers that would be diverted from the present airport bus service to the rail line.

This total was then increased by 10% as an allowance for traffic expected to be induced by the novelty and attraction of the new type monorail transportation. The next step was to segregate the total passengers between reduced rate, half-fare and adult passengers.

Applicable rates of fare were then applied to the passengers in each of these classes to determine the amount of revenue for each, as shown on pages 10 - 12.

To that annual revenue was then added a further increment of induced revenue at rates varying as between the several fare classifications.

3. Example of Computation - For Year 1960

Estimated annual rail line passengers was computed as follows:

	Average Daily Autos			
			To Rail Line	
Class of Auto	Total	To Zone 9	%	Number
Employee Autos	9,000	486	10%	49
Airline Passenger Autos	19,600	6,500	30	2,000
Taxicabs	2,200	900	50	450
Total Daily Autos				2,499

Equivalent Passengers	Daily Autos	Occupancy Factor	Daily Passengers	Annual Passengers
From Employee Autos	49 x	1.3	64	23,360
From Airline Passenger Autos	2,000 x	1.6	3,200	1,168,000
From Taxies	450 x	1.5	675	246,375
Total Passengers			3,939	1,437,735
Annual Passengers Diverted from Autos				1,438,000
Annual Passengers Diverted from Airline Buses				420,000
Total Passengers from Autos and Buses				1,858,000
Induced New Traffic - 10%				186,000
Total Annual Passengers 1960				2,044,000

After computing the total annual passengers, they were then broken down into the three passenger fare classifications; 1. airline employees' reduced rate; 2. children's half-fare; and 3. adult full fare, as follows:

1. Reduced Rate Employee Passengers			
From Employee Autos	10%		2,300
From Airport Buses	4%		16,800
Total Employee Reduced Rate Passengers			19,100
2. Half-Fare Passengers			
From Airline Passenger Autos	1%		11,700
From Airport Buses	1%		4,200
Total Half-Fare Passengers			15,900
3. Full Fare Passengers			
Total Passengers (From above)			1,858,000
Less Reduced Rate		19,100	
Less Half-Fare		15,900	35,000
Total Full Fare Passengers			1,823,000

Passenger volume as computed above was then applied to the specific rates of fare for each classification, to determine the estimated annual revenue, as follows for the $1.25 basic adult rate:

Emplo. Rate	19,100 @ $0.35	$ 6,685
Half-Rate	15,900 @ $0.57	9,063
Full Rate	1,823,000 @ $1.14	2,078,220
Total Annual Passenger Revenue		,093,968
Additional Induced Traffic	15%	314,095
Revenue from Other Sources	10%	209,397
Total Annual Revenue		$2,617,560

4. Airline Passenger Trend

Under section I of Part B, page B-1, the actual volume of traffic moving through the airport has been shown by years as set forth in official documents prepared by the Airport administration.

Airline passengers have increased over the past eight years by an average of 15.8% per year. There appears to be no reason to expect a decline in the rate of growth unless there is some unforeseen catastrophe of major scale involving national economic or military emergency, or unless the volume exceeds the airport capacity.

5. Air Mail, Express and Freight

Air Mail has shown a consistent upward trend except for 1957-58, during each of the past eight years, averaging 7.2% after allowance for the loss in 1957-58.

Air Express and Freight volume has increased regularly over the same period of time, averaging 13.4% per year.

It would appear reasonable to expect that these trends will likewise continue upward, barring unforeseen major emergencies

6. <u>Local Airport Statistics</u>

Section III, page B-2, shows that one year ago there were 205 industries located within a one-mile radius of the airport, with [illegible] lease-holders at the airport with total employment of 32,000 persons. At the time of that survey, there were 17 airlines using the airport, with two additional lines expected in the near future. This magnitude of activity will provide some measure of potential airport rail line patronage.

7. <u>Forecast of Airline Passengers</u>

Under section IV on page B-2, there are shown the results of a long range prediction of airline passenger traffic extending from 1956 through 1970. These estimates were prepared by the Aviation Service Company and submitted to the Los Angeles Department of Airports in February 1956.

Three bases of estimating were submitted as shown in the three columns of the table. The first was termed a "conservative" estimate, the second a "supportable" estimate, and the third a "not improbable" estimate. It is interesting to note that column (4) of the table shows that actual traffic over the period of five years from 1956 through 1960 showed annual increases in excess of the "not improbable" estimate, with exception of the year 1958.

If this actual pattern continues, certainly the conservative estimate will be reached, and it is quite likely that the supportable estimate will be reached. Under favorable conditions, the past trend may continue with a rate of [illegible]th that will equal, if not exceed, the [illegible]d estimate as shown on the table. It is certainly reasonable to expect that the volume of airport rail passengers will continue upward if the volume of airline passenger traffi[illegible]llows the predicted trend.

Actually, there is a probability that the trend of growth on the rail line might exceed the trend of growth on the airlines. This could well be brought about as a result of the rapidly increasing vehicular traffic congestion in the vicinity of the airport and on city streets which, as it worsens, will tend to discourage that mode of travel for airline passengers. They w[illegible] virtually be forced to seek some other means of travel [illegible]s well-designed elevated rapid transit line will solve their problem.

8. Automotive Traffic

To any person using the airlines and to those visiting the airport, it is obvious that a great volume of passenger traffic is carried by automobiles into and out of the airport confines. At the present time, a relatively small percentage of the total airline traffic gets to and from the airport by mass transit facilities. By far the greater portion relies upon the private automobile.

In addition to the airline passengers themselves, these automobiles carry persons employed at the airport, relatives and friends of the airline passengers and many visitors. Although no systematic count has been available to show the annual growth of automotive traffic through the airport gates, its effect has been seriously felt by the heavy congestion on the main arteries leadir   and from the airport. This vehicular   gestion has been a matter of considerable concern not only to the airport administration but also to the city traffic department and to the State Division of Highways.

'ehicular Traffic Count

In an effort to lay the groundwork for some means of relief, a traffic count of airport vehicles was conducted in 1960 and the results were compiled in a document prepared by the California Division of Highways, dated October 1960. This report contains results of an origin and destination traffic survey, the findings of which indicated the points to which drivers of aut   iles passing out of the airport, were destined. The su y was conducted and the report compiled in the usual manner to segregate the traffic first between predesignated zone areas and, secondly, as to the nature of the traffic and the type of vehicle.

Under section V on page B-2, and following sections, are shown the results of that survey. There were four classifications of vehicles as shown in section VII, consisting of private automobiles, taxicabs, U-drive autos and "for hire" vehicles, including buses, airport coaches and limousines. The total group was further segregated as to the nature of the trip being made, resulting in three major classifications as shown under section V. These classifications were: (1) airport employees; (2) airline passengers and traffic related thereto; and (3) miscellaneous traffic.

The general directions in which vehicles were proceeding as they left the airport were determined on the basis of five segments which were, with relation t[illegible] airport; North, Northeast, East, Sout[illegible] and South. A further segregation of traffic was made to determine the volume of vehicles on an hourly basis. The results are shown under section [illegible] on page [illegible] n that table the total vehicles counted are broken do[illegible] hours of the day and by the type of vehicle.

This same segregation was made with respect to the vehicles under the different classes of use. The results of this segregation are shown under section IV on page B-4. This table breaks the vehicles down between those of airport employees and those of non-employees, which would [illegible]clude the air[illegible]e passengers and related traffic.

10. Traffic Zone Layout

As indicated above, there were a number of predesignated zones laid out on the map of the Los Angeles metropolitan area for the purpose of determining the points of origin and destination of traffic using the airport. One of those zones was number 9, which included the downtown business district of Los Angeles and the Wilshire area extending approximately as far west as La Brea Avenue.

Under section X on page B-5, is shown an analysis of the 24 hour traffic traveling between the airport and points in zone 9, segregated by employees' autos, airline passengers and related autos, and taxicabs.

This analysis also shows the percent of the total destined to zone 9, and the percent in each classification that it is estimated could be diverted to the rail system.

11. Deve[illegible] [illegible]nt of Annual Auto Traffic Projections

Under section XI is shown the number of passengers that it is estimated the rail line would obtain, based upon the average occupancy of th[illegible] [illegible]e classifications of vehicles as determined by the tra[illegible] [illegible]count. These[illegible] [illegible]s on page B-5 show an estimate of 1,291 daily automobiles and taxis that would be diverted to the rail line, and an equivalent passenger volume of 3,062.

On page B-6 under section XII there is shown the estimated daily autos in both directions, in projection from 1960 through 1975, as developed from t[illegible] [illegible]ivision of Highways traffic count. Based upon the esti[illegible] therein that for each 100 airline passengers there would be 70 automobiles using the airport, there would be a total of 25,000 autos for 1960, 42,000 for 1965, 74,000 for 1970, and 109,200 for 1975, assuming the ratio between airline passengers and automobiles to continue unchanged. This projection has been used herein for estimating future rail line passengers and checked against a computation based on the long range estimate of airline passengers.

Using these figures and breaking them down between the several classes of users, the projected rail line traffic that would be diverted from autos is shown under section XIII, pages B-6 and B-7. The first group refers to employees' autos. Of the total shown in column (3) of section XII, the employees' autos have been segregated and shown in column (1) under section XIII. In column (2), the number of total employees' autos destined to zone 9 has been shown based upon the results of the 1960 vehicular count, which showed that 5.4% of the total went to zone 9. In column (3) of section XIII there are shown the number of employee automobiles destined to zone 9 that probably would be attracted by the rail service. For this purpose, it was estimated that 10% would make use of the rail line.

Under subsection B of section XIII on page B-7, is shown the same process of development for airline and related autos. The total autos of this classification are shown in column (1), and in column (2) has been included that portion which would be destined to points in zone 9 based upon the traffic count of 1960, which indicated that 33% of the total went to this zone. It is estimated that of this zone 9 traffic, 30% would be attracted to the rail service and the results are shown in column (3).

At the bottom of that page under subsection C, taxicab traffic has been similarly analyzed. The traffic count showed that 40% of taxicab traffic was destined to zone 9, and for purpose of this report it is estimated that due to the nature of this traffic, 90% would make use of the rail service.

12. Estimate of Passengers Diverted from Autos

Under subsection D on page B-8, the estimated automobile traffic in each of these classifications has been converted into passenger traffic by applying the average occupancy figures determined by the 1960 traffic count. In column (4) of this table on page B-8, there are shown the estimated that would be diverted from the two major sources of traffic. In addition to the traffic expected to be captured from these two major sources, it is estimated that there will be a certain measure of traffic that would be generated by reason of the novelty and interest of the new monorail service. To provide for this, a factor of 1.1 was applied to the passengers in column (3).

15. Annual Revenue Computation

Having established the total number of anticipated passengers annually, as shown in column (4), it then became necessary to segregate these totals into the several classifications of traffic that would take different rates of fare. This was done under section XV commencing on page B-9.

Under subsection A, the estimate of employees at a reduced rate was developed. For this purpose it was estimated that 10% of the passengers from employee autos would be involved, and that 4% of the present airport bus traffic would be included, giving a combined result as shown under column (3).

Under subsection B, the half-fare passengers were estimated, based upon the actual percentage of half-fares presently carried by the airline buses. Deducting these two classifications from total passengers produced the volume of full fare passengers under subsection C, page B-10, in column (3).

Having determined the volume of passengers in each of these classifications, the next step was to convert these passengers into estimated annual revenue. This was done under section XVI commencing on page B-10, using a full fare adult rate of $1.00.

In the following subsections B, C, and D, the same process was applied, using full adult fares of $1.25, $1.35 and $1.50. Under subsection E are shown the estimated percents of induced traffic that might be expected under these four basic rate classifications.

16. Revenue from Other Sources

In a rail operation such as that anticipated, there no doubt would be a substantial volume of air mail, air express, and air freight traffic which would produce revenue in addition to the passenger revenue. It is difficult at this point to make a reasonably accurate estimate of the revenue that might be derived from these sources. Therefore, an arbitrary figure of 10% of passenger revenue at the $1.25 rate level has been adopted, which is considered to be well on the conservative side. This estimate is shown under section XVII, page B-12.

17. Final Summary of Estimated Annual Revenue

Under section XVIII, page B-13, is shown the final summary of estimated annual revenue from all of these previously discussed sources, including newly generated traffic, induced revenue, and revenue from other sources. This table shows the estimates under the four different basic adult fares considered. At the foot of this table is shown a sample of the calculations involved in producing the revenue shown in these columns, using the 1965 revenue under the $1.35 basic fare for the purpose.

For purpose of this estimate, no allowance was applied for passenger diminution at higher basic fares.

18. System Characteristics

Section XIX shows preliminary characteristics of the rail system, including route mileage, stations, running time and prospective equipment requirements under various car capacities. All of these features must be worked out with greater refinement for final estimating of cost and investment.

19. Summary

After following the step by step development outlined above, the final annual revenue figures as shown under section XVIII, page B-13, were developed. It is felt that the revenues shown thereon can reasonably be expected to materialize if the fundamental premise as touched upon elsewhere herein is followed, of setting up the rail system so that its destination terminal facilities will be at such locations and of such design as to provide convenience of access, comfort and attraction, at least equivalent to those presently afforded by the airport bus system.

It is important to keep in mind that the degree to which this rail line can capture passenger traffic will depend upon the balance between the desirable features it affords as compared with the desirable and undesirable features of the existing airport bus operation and the private automobile.

Arthur C. Jenkins