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Transit Guideways for the Toronto Region

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The Government of Ontario embarked on a major rapid transit project late in 1982, with the following key considerations:

- Provide a transit service along the Lakeshore through downtown Toronto between populated regions at either end.

- Linkup local transit networks to the main inter urban line.

- Develop City Centers by connecting them through a rapid transit line.

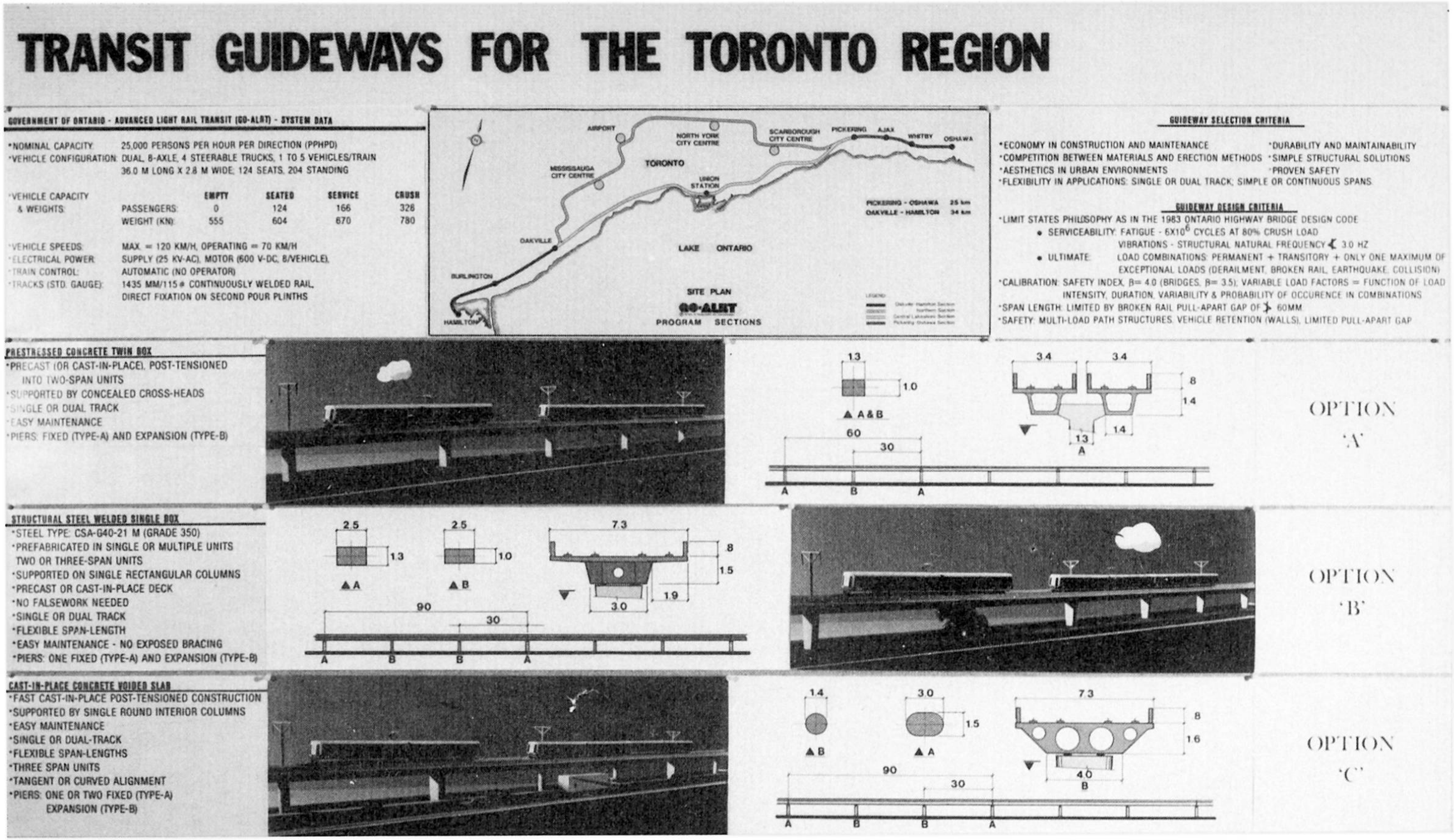
- Promote a home-based transportation technology.

The proposed system will offer rapid transit service in an exclusive right-of-way to about four million inhabitants in the regions between Hamilton and Oshawa. The total length of the project is about 200 km.

The service capacity of the system will be about 25,000 passengers per hour per direction, provided by trains of up to five vehicles, travelling at average speeds of 70 kph at 2 minute headways, between stations that are spaced at about 3 km. The top speed of the trains will be 120 kph.

The system will be state-of-the-art in advancement, comprising vehicles that are light-weight, driverless, electrically powered and automated. They will be operated from a central command and communications complex, with on-board computers. The vehicles will be propelled by rotary electric motors powered from an over-head supply system. They will utilize steerable trucks to minimize wheel and rail wear and squeeling on curves. In order to accommodate a large number of commuters, the vehicles are envisaged to be long, in the order of forty meters. They are to be with single articulation to enable them to negotiate tighter curves.

New design criteria were written to ensure economical and safe designs. The criteria were based on Limit States philosophy and were modelled after the Ontario Highway Bridge Design Code. The consequences of failure in a transit guideway dictated a safety level higher than that generally assigned for highway bridges. Thus, risk analysis resulted in load factors that reflected failure probabilities in guideways that are in the order of one tenth of those expected from bridges. Load combinations were based on probabilities of such loads occurring simultaneously together at expected intensity levels. Hence, permanent, transient and exceptional loads were combined in a logical manner, leading to optimum designs, economically and structurally.


TRANSIT GUIDEWAYS FOR THE TORONTO REGION
GOVERNMENT OF ONTARIO - ADVANCED LIGHT RAIL TRANSIT (GO-ALRT) - SYSTEM DATA
*NOMINAL CAPACITY: 25,000 PERSONS PER HOUR PER DIRECTION (PPHPD)
*VEHICLE CONFIGURATION: DUAL, 8-AXLE, 4 STEERABLE TRUCKS, 1 TO 5 VEHICLES/TRAIN
36.0 M LONG X 2.8 M WIDE; 124 SEATS, 204 STANDING
*VEHICLE CAPACITY & WEIGHTS:
EMPTY SEATED SERVICE CRUSH
PASSENGERS: 0 124 166 328
WEIGHT (KN): 555 604 670 780
*VEHICLE SPEEDS: MAX. = 120 KM/H, OPERATING = 70 KM/H
*ELECTRICAL POWER: SUPPLY (25 KV-AC), MOTOR (600 V-DC, 8/VEHICLE),
*TRAIN CONTROL: AUTOMATIC (NO OPERATOR)
*TRACKS (STD. GAUGE): 1435 MM/115# CONTINUOUSLY WELDED RAIL,
DIRECT FIXATION ON SECOND POUR PLINTHS
AIRPORT
NORTH YORK CITY CENTRE
SCARBOROUGH CITY CENTRE
PICKERING
AJAX
WHITBY
OSHAWA
MISSISSAUGA CITY CENTRE
TORONTO
UNION STATION
PICKERING - OSHAWA 25 km
OAKVILLE - HAMILTON 34 km
OAKVILLE
LAKE ONTARIO
BURLINGTON
HAMILTON
SITE PLAN
GO-ALRT
PROGRAM SECTIONS
GUIDEWAY SELECTION CRITERIA
*ECONOMY IN CONSTRUCTION AND MAINTENANCE
*COMPETITION BETWEEN MATERIALS AND ERECTION METHODS
*AESTHETICS IN URBAN ENVIRONMENTS
*FLEXIBILITY IN APPLICATIONS: SINGLE OR DUAL TRACK; SIMPLE OR CONTINUOUS SPANS
*DURABILITY AND MAINTAINABILITY
*SIMPLE STRUCTURAL SOLUTIONS
*PROVEN SAFETY
GUIDEWAY DESIGN CRITERIA
*LIMIT STATES PHILOSOPHY AS IN THE 1983 ONTARIO HIGHWAY BRIDGE DESIGN CODE
• SERVICEABILITY: FATIGUE - 6X10^6 CYCLES AT 80% CRUSH LOAD
VIBRATIONS - STRUCTURAL NATURAL FREQUENCY ≮ 3.0 HZ
• ULTIMATE: LOAD COMBINATIONS: PERMANENT + TRANSITORY + ONLY ONE MAXIMUM OF EXCEPTIONAL LOADS (DERAILMENT, BROKEN RAIL, EARTHQUAKE, COLLISION)
*CALIBRATION: SAFETY INDEX, β= 4.0 (BRIDGES, β= 3.5); VARIABLE LOAD FACTORS = FUNCTION OF LOAD INTENSITY, DURATION, VARIABILITY & PROBABILITY OF OCCURENCE IN COMBINATIONS
*SPAN LENGTH: LIMITED BY BROKEN RAIL PULL-APART GAP OF ≯ 60MM
*SAFETY: MULTI-LOAD PATH STRUCTURES, VEHICLE RETENTION (WALLS), LIMITED PULL-APART GAP
PRESTRESSED CONCRETE TWIN BOX
*PRECAST (OR CAST-IN-PLACE), POST-TENSIONED INTO TWO-SPAN UNITS
*SUPPORTED BY CONCEALED CROSS-HEADS
*SINGLE OR DUAL TRACK
*EASY MAINTENANCE
*PIERS: FIXED (TYPE-A) AND EXPANSION (TYPE-B)
1.3
1.0
▲ A & B
3.4
3.4
.8
1.4
1.4
1.3
A
60
30
A B A
OPTION 'A'
STRUCTURAL STEEL WELDED SINGLE BOX
*STEEL TYPE: CSA-G40-21 M (GRADE 350)
*PREFABRICATED IN SINGLE OR MULTIPLE UNITS TWO OR THREE-SPAN UNITS
*SUPPORTED ON SINGLE RECTANGULAR COLUMNS
*PRECAST OR CAST-IN-PLACE DECK
*NO FALSEWORK NEEDED
*SINGLE OR DUAL TRACK
*FLEXIBLE SPAN-LENGTH
*EASY MAINTENANCE - NO EXPOSED BRACING
*PIERS: ONE FIXED (TYPE-A) AND EXPANSION (TYPE-B)
2.5
1.3
▲ A
2.5
1.0
▲ B
7.3
.8
1.5
1.9
3.0
90
30
A B B A
OPTION 'B'
CAST-IN-PLACE CONCRETE VOIDED SLAB
*FAST CAST-IN-PLACE POST-TENSIONED CONSTRUCTION
*SUPPORTED BY SINGLE ROUND INTERIOR COLUMNS
*EASY MAINTENANCE
*SINGLE OR DUAL-TRACK
*FLEXIBLE SPAN-LENGTHS
*THREE SPAN UNITS
*TANGENT OR CURVED ALIGNMENT
*PIERS: ONE OR TWO FIXED (TYPE-A) EXPANSION (TYPE-B)
1.4
▲ B
3.0
1.5
▲ A
7.3
.8
1.6
4.0
B
90
30
A B B A
OPTION 'C'