

An Unconventional Design for

BUS U-TURNS

AT



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SIGNALIZED INTERSECTIONS



USF



COLLINS AVE
A1A

NO U-TURN
EXCEPT
BUSES

Introduction

- U-turn related projects by USF
- NCHRP project by MRI
- No evidence to prove that the U-turns draw safety or operational problems
- Few studies about Bus U-turns

Background

- Funded by Miami-Dade Transit
- Safety concerns about the Bus-U-turns at the intersection SR A1A @ 193rd Street



Concerns from the City of Sunny Isles Beach

- An unusual and unexpected maneuver
- Congestion at the intersection.
- Traffic safety concerns.
- Pedestrian safety
- Air pollution to the area of Ocean One
- Sight distance problem of right turn vehicles

Objectives

- Operational and safety effects of Bus U-turns at the signalized intersection.
- A general rule for bus U-turns design at intersections

Existing Condition



Data Collection

- Traffic data
- Crash data
- Signal timing
- Geometry



Data Processing

- Turning movement counts for 8-hours
- Traffic conflicts
- Pedestrian/bicyclist activities
- Signal phase sequence
- Information of bus route
- Headway of buses (about 4 minutes)
- Radii of U-turn
- Crash patterns between 2001-2003

Operational Analysis

- SYNCHRO 6.0
- Overall intersection LOS “A” during morning peak hour and noon time, and LOS “B” during afternoon and PM peak hour
- Bus U-turn approach operated at LOS “D”
- Bus U-turn does not cause major operational problems

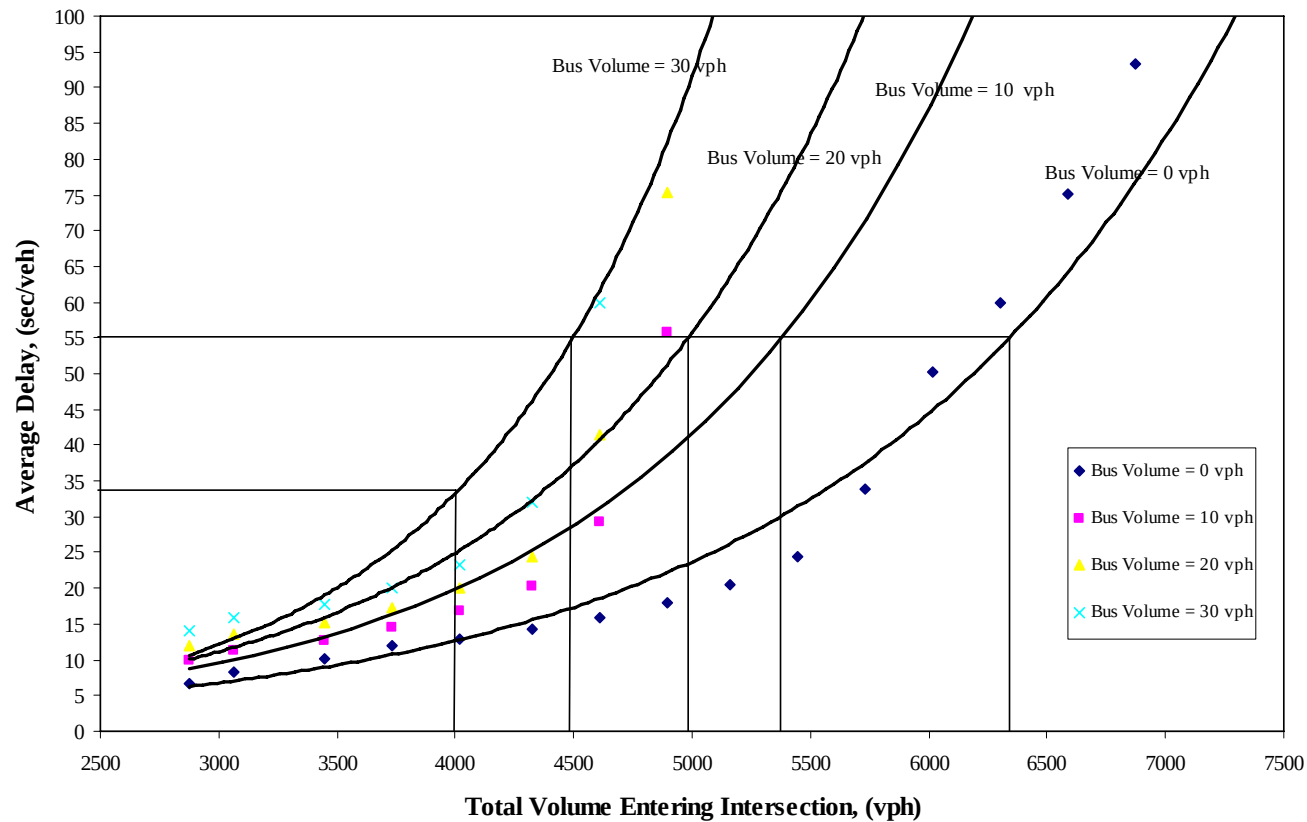
Level of Service at the Study Intersection

Intersection SR A1A @ 193rd St.		Northbound				Southbound		Eastbound		Westbound		Total
		LT	TH	RT	U-turn	TH	RT	LT	RT	LT	RT	
PM Peak	Delay (sec./veh)	23.8	5.4	5.4	53	13.7	13.7	51.4	9.1	43.9	43.9	11.6
	LOS	C	A	A	D	B	B	D	A	D	D	B
AM Peak	Delay (sec./veh)	6.3	4.6	4.6	52.9	8.9	8.9	50.1	7.6	37.6	37.6	8.6
	LOS	A	A	A	D	A	A	D	A	D	D	A
Noon Peak	Delay (sec./veh)	7.0	4.0	4.4	52.9	8.8	8.8	51.1	9	48.1	48.1	8.7
	LOS	A	A	A	D	A	A	D	A	D	D	A
Non Peak	Delay (sec./veh)	18.3	5.0	5	52.9	10.9	10.9	51.6	9	41.5	41.5	10
	LOS	B	A	A	D	B	B	D	A	D	D	B

Bus U-Turn Design

- SYNCHRO 6 Simulation Model
- Model Calibration
- Threshold: LOS “E” or average intersection delay of 55 seconds per vehicle
- Simulations were run for different values of intersection volumes and bus-turn lane volumes

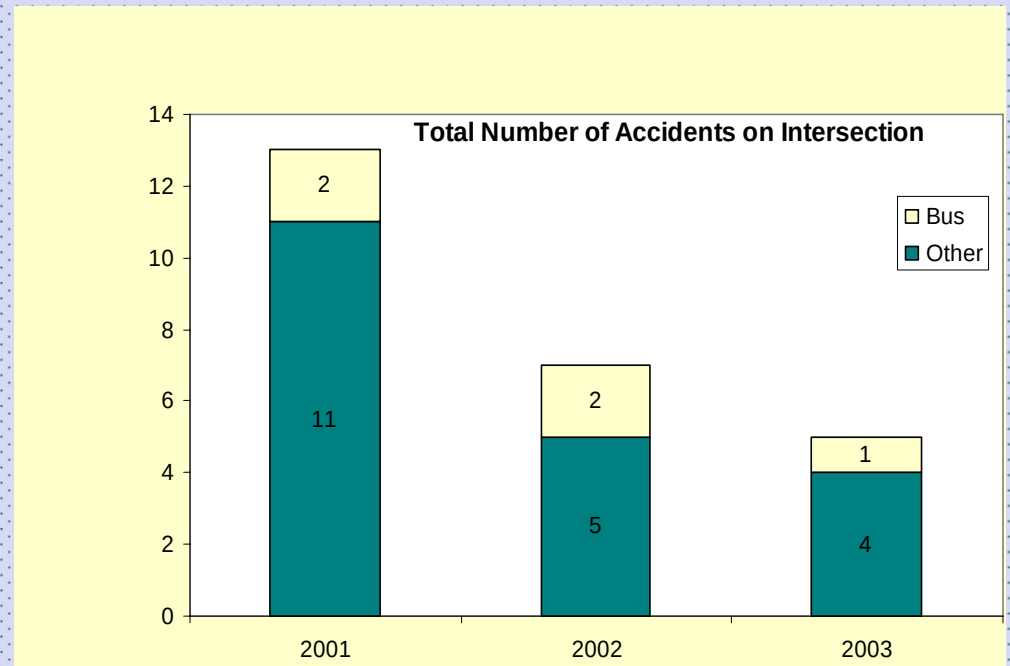
Impact of Bus Volumes on the Intersection Delays



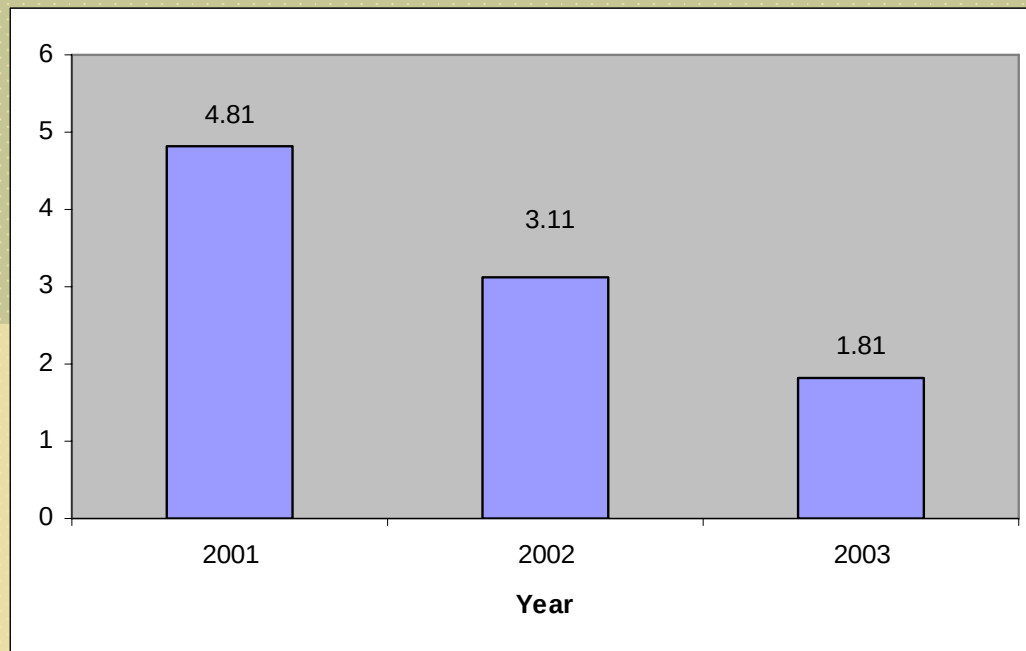
Safety Analysis

CRASH ANALYSIS

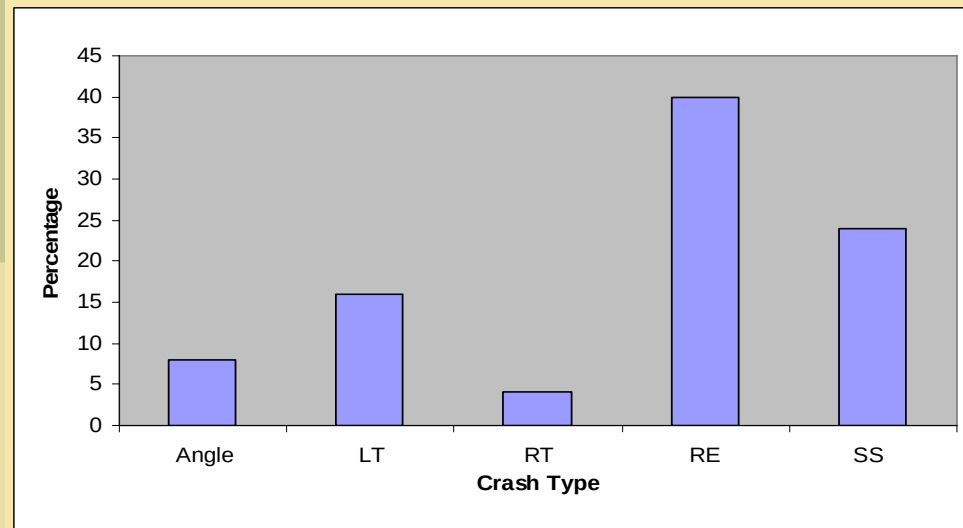
- 1-2 accidents involving buses per year
- Careless driving or signal violation



Crash Rates



Crash Type





Safety Analysis

CONFLICT ANALYSIS

- Traffic conflicts are interactions between two or more drivers where one or both drivers take an evasive maneuver to avoid collision
- Conflicts were identified based on 8 hour video of the intersection

Conflict Type

- Slow-Vehicle, Same-Direction Conflict (C1);
- Lane Change Conflict (C2);
- Bus U-turn Conflict (C3);
- Angle Conflicts (C4); and
- Pedestrian and Vehicle Conflicts (C5).

Traffic Conflicts Observed in the Field

Conflict Type	Number of Conflicts Observed	Conflict Rates (conflicts/hour)	Conflict Rates (Conflicts per Thousand Vehicles)
1	16	2.0	0.9
2	17	2.1	0.9
3	2	0.3	0.1
4	10	1.3	0.6
5	3	0.4	0.2
Total	48	6.0	2.7

Conclusions

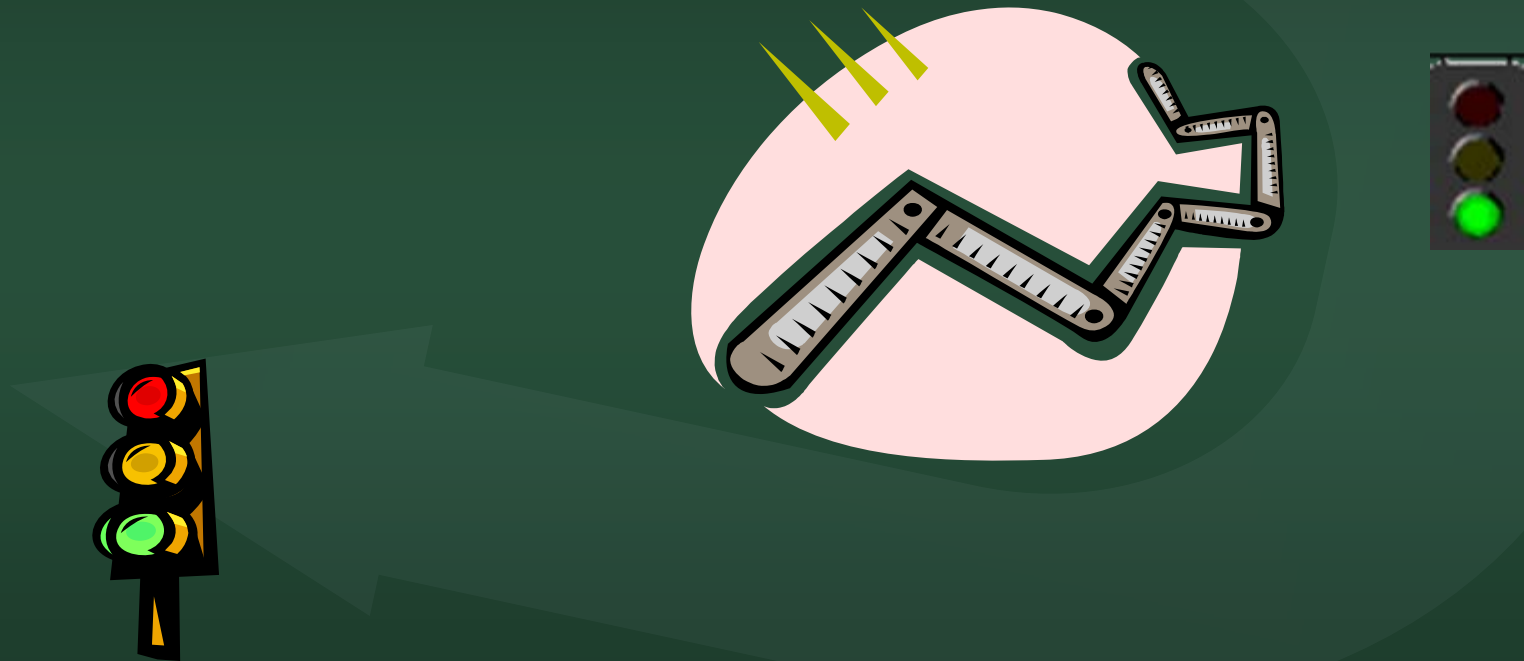


- Bus U-turn does not cause major operational and safety problems



Other Considerations

- Signal and Sign Control
- Bus Lane and Turning Radius



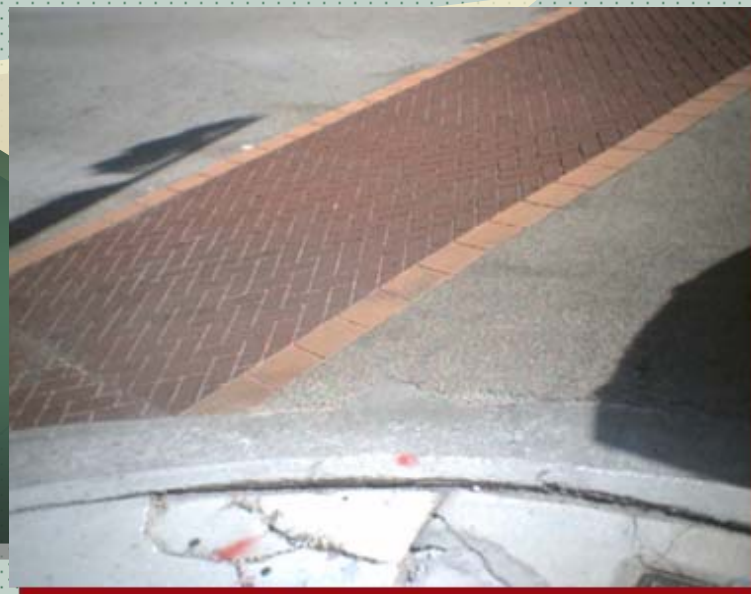




BUS LANE
ONLY
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