

ancing transportation systems in second-tier cities through the use of davanced th analysis and ITS solutions to safety and mobility problems

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BACKGROUND

This study was conducted due to concerns related to pedestrian/vehicle conflicts in the area of the intersection of University Dr. and Administration Ave. The intersection is currently controlled by stop signs on the minor approaches (Administration Ave., the NDSU Station Post Office, and the Alumni Center), while the major movement (University Dr.) has free-flowing southbound traffic (Figure 1). Pedestrian traffic primarily consists of employees and students from North Dakota State University (NDSU). The Alumni Center and NDSU Station also are pedestrian attractions.

The intersection has a unique geometric design due to the close proximity of the Alumni Center's and the Post Office's driveways. Motorists from both driveways may either turn left on University or proceed westbound through the intersection onto Administration Ave.

There are two designated pedestrian crosswalks at the intersection (Figures 1 and 2). These crosswalks are intended to guide the pedestrians to the north side of the Administration Ave. before crossing University Dr. and vice versa.



Figure 1. University Dr. and Administration Ave. Intersection Drawing.

Figure 2. University Dr. and Administration Ave. Crosswalks.



OBJECTIVE

The objective of this study is to evaluate pedestrian safety at the intersection of University Dr. and Administration Ave. The analysis covers a section of University Dr. extending from 13th Ave. N. to Administration Ave. The following main activities were addressed in this study:

- T Existing conditions/problem areas
- T Data collection
- T Short-term improvements
- T Long-term improvements

EXISTING CONDITIONS/PROBLEM AREAS

The layout of the University Dr. and Administration Ave. intersection, specifically the approach on the east side, causes some confusion to pedestrians. The two driveways tempt pedestrians to make unsafe crossing maneuvers. Most of the unsafe maneuvers consist of pedestrians crossing University Dr. diagonally from the AD parking lot (Figure 3). The diagonal crossings create more pedestrian/vehicle conflicts and require a longer pedestrian walk time, therefore, increasing the chances of pedestrian/vehicle incidents.

As traffic volumes increase on University Dr., pedestrians may have to wait longer for a suitable gap to cross the street. Therefore, an analysis was performed to determined whether the pedestrian traffic is significant enough to install a pedestrian traffic signal.



Figure 3. Unsafe Crossing Maneuvers at University Dr. and Administration Ave.

TRAFFIC DATA ANALYSIS

Several site visits were conducted at the study area to obtain the appropriate data. Digital photos were taken to capture the study area's geometric characteristics and pedestrian maneuvers. The University Dr. and Administration Ave. intersection was videotaped on Wednesday, September 15, 1999, during the AM and PM peak-periods. Both pedestrian and vehicular counts along with pedestrian gaps were recorded between 7:45-9:45 AM and 4:00-6:00 PM.

Traffic Signal Warrants

The field data collected were primarily used to perform a traffic signal warrant analysis based on the Manual of Uniform Traffic Control Devices (MUTCD). The MUTCD consists of 11 warrants that are used to determine whether a traffic signal is justified. Warrant #3 deals with pedestrian volumes, and consists of the following factors:¹

- 1. \$100 pedestrians per hour crossing the major street during a four-hour period. (2 morning & 2 afternoon)
- 2. \$190 pedestrians per hour crossing the major street during any one-hour period.
- 3. #60 pedestrian gaps per hour for conditions 1 and 2.

The pedestrian gap can be defined as the time needed for a pedestrian to traverse the crosswalk along with a specified amount of startup or lost time. The lost time accounts for pedestrian hesitation and time to initiate the crossing movement. Therefore, the gap time is typically a conservative value.

Results of Warrant Analysis

The traffic signal warrant analysis determined that every hour of the 4-hour analysis period had #100 pedestrians per hour crossing the major street and \$60 pedestrian gaps per hour. The time needed to record a pedestrian gap was 12 seconds (Equation 1). The pedestrian hourly volumes crossing University Dr. ranged from 61 to 89, while the pedestrian gaps ranged from 74 to 123 (Table 1). Therefore, a pedestrian traffic signal is not justified. It should be noted that this conclusion is based entirely on counts performed in a single day. There may be some fluctuations in pedestrian volumes during other days of the week. Also, this analysis does not take into account pedestrian flows during special functions on the NDSU campus or at the Alumni Center.

¹US Department of Transportation, *Manual on Uniform Traffic Control Devices: For Streets and Highways*, Washington DC, 1988.

Equation 1. Pedestrian Gap Time.

and Gap Volumes.

 $\frac{36 ft(crosswalk distance)}{4.0 fps(pedestrian walk time)} + 3.0 sec(lost time) = 12.0 sec$

euestran wark time)

Table 1. Pedestrian

Morning Gap Information			Afternoon Gap Information		
Time	Gaps	Pedestrians	Time	Gaps	Pedestrians
7:45-8:00	16	41	4:00-4:15	17	14
8:00-8:15	27	25	4:15-4:30	15	15
8:15-8:30	25	11	4:30-4:45	20	14
8:30-8:45	21	12	4:45-5:00	22	17
Hour Total	89	89	Hour Total	74	60
8:45-9:00	28	28	5:00-5:15	17	47
9:00-9:15	33	11	5:15-5:30	21	19
9:15-9:30	34	9	5:30-5:45	17	10
9:30-9:45	28	13	5:45-6:00	19	12
Hour Total	123	61	Hour Total	74	88

SHORT-TERM IMPROVEMENTS

Although the field counts determined that sufficient amounts of pedestrian gaps were encountered, the average pedestrian walk time was observed to be approximately seven seconds for the north crosswalk. This value may indicate that pedestrians are rushed as they cross the street or that pedestrians at this location do not use the "lost time" and walk faster than average. Therefore, several short-term improvements may be implemented to increase pedestrian safety.

Red Clearance Interval Modification

One method to increase the number of pedestrian gaps is to increase the red clearance interval of the traffic signal at University Dr. and 13th Ave. N. (one block north of University Dr. and Administration Ave.). This increase would allow more time for pedestrians to cross University Dr. before the traffic platoon (a group of vehicles) from13th Ave. N. would arrive at Administration Ave. Currently, the red clearance of the 13th Ave. N. signal is 1.2 seconds. The City of Fargo normally allows a maximum red clearance of 3.5 seconds, however, they may consider a red clearance of up to 4.0 seconds.

Crossing Signs

School or pedestrian crossing signs could also be installed along University Dr. near the crosswalk. These signs are intended to advise motorists that a crosswalk exists on the facility that they should look for crossing pedestrians and students. The signs also encourage pedestrians to use the crossing since it becomes more prominent. Examples of a pedestrian crossing sign and a school crossing sign are shown below.



Pedestrian Crossing Sign



School Crossing Sign

Speed Reductions

Speed reductions may also be imposed along University Dr. between 13th Ave. N. and Administration Ave. as vehicles approach the crosswalk. Typically, speed limits at a school crossing are 20 mph when school is in session. The speed reduction will allow longer pedestrian gaps since the travel time of the vehicles departing from 13th Ave. N. will be greater. An example of a school speed limit sign is shown below.



School Speed Limit Sign

Guide Signs

Another short-term enhancement of the intersection is related to pedestrian guide signs. These signs are intended to guide the pedestrians to crosswalks and to discourage jaywalking. Field observations recorded a significant number of pedestrians not using the provided crosswalks. In fact, more pedestrians crossed University Dr. without using the crosswalk during the morning

observation period (Appendix A). The improper crossings consisted of pedestrians crossing on the south side of Administration Ave. and crossing diagonally from the AD Parking Lot or NDSU Station. Both of these maneuvers are safety hazards since they have more pedestrian/vehicle conflicts and require more time to complete. Pedestrian signs inform pedestrians that they should not cross at hazardous locations and guide them to proper crosswalks. Examples of pedestrian signs are shown below.



LONG-TERM IMPROVEMENTS

Future growth in both vehicular and pedestrian traffic will require additional improvement strategies. Several long-term enhancements may be incorporated to improve pedestrian safety. Most of these changes involve access management strategies and/or the implementation of a pedestrian traffic signal.

Access Management

Sidewalk and curb realignment on the south side of Administration Ave. could be an effective method to guide pedestrians to the crosswalks (Figure 4). Currently, the south sidewalk attracts pedestrians to proceed across the street to the east (or the west as shown in Figure 4) instead of crossing north via the crosswalk. These geometric changes along with pedestrian signs or landscaping could guide pedestrians to the current crosswalks.

Figure 4. Enhancements of Sidewalk (South Side of Administration Ave.).



The driveways to the Alumni Center and NDSU Station could also be reconfigured (Figure 5). Combining the two driveways would serve two purposes: 1) reducing the confusion and conflicts of motorists leaving the two facilities and 2) providing an easier path for pedestrians to the north side crosswalk.

Rerouting the traffic leaving the Alumni Center and NDSU Station could be another long-term improvement option. Fewer pedestrian/vehicle interactions would occur if vehicles entered the two facilities from University Dr. and exited using 12th St. N., which is on the east side of the parking lots.

Figure 5. Geometric Changes to Existing Driveways.



Pedestrian Traffic Signal

Although a pedestrian traffic signal is currently not warranted, future traffic studies may prove otherwise. Increases in vehicular traffic, Alumni Center functions, and off-campus parking will adversely affect the pedestrian safety at this intersection.

SUMMARY

Safety concerns related to geometric designs and unsafe pedestrian crossing maneuvers are evident at the University Dr. and Administration Ave. intersection. At this time, an intersection analysis determined that a pedestrian traffic signal is not warranted according to the MUTCD. This study discussed several short-term and long-term improvements that could be made to increase pedestrian safety at the intersection:

Short-Term Improvements

- T Traffic signal red extension (University Dr. and 13th Ave. N.)
- T Pedestrian crosswalk signs
- T Pedestrian guidance signs
- T Speed reductions school zone

Long-Term Improvements

- T Access management Sidewalk reconfiguration
 - Driveway reconfiguration
- T Pedestrian traffic signal

Appendix A Pedestrian Volumes