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Study of U-turn Followed by Left Turn Scheme as a New Concept of Signalized Intersection : Case Study of Ahmedabad City

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ABSTRACT

Today's transportation experts are tested to meet the portability needs of an expanding populace with restricted assets. At numerous parkway intersections, blockage keeps on compounding. Drivers, walkers, and bicyclists encounter longer postpones and more noteworthy introduction to hazard. Today's movement and wellbeing issues are more unpredictable and confused. Conventional intersections are in some cases observed to be deficient to moderate transportation issues. Thusly, numerous transport engineers are researching and executing inventive medications trying to realize totally new possibilities. This study covers U-turn Followed by Left Turn (UTLT) outline that may offer extra advantages contrasted with ordinary at-evaluation intersection. In this presented case study of Ahmedabad city where UTLT scheme implemented as an alternative to four arm signalized intersection. This paper data introduces learning of alternative intersection including geometric configuration highlights, operational and security issues, access administration issues, expenses, and development sequencing and relevance.

Keywords: Median U-turn, Right Turn, Alternative Intersection, Weaving, Signalized Intersection

I. INTRODUCTION

India is a developing country and its cities are undergoing rapid urbanization and modernization as a result there is rapid growth in the road traffic. Traffic movement in India is very complex due to the heterogeneous traffic stream sharing the same carriageway. Also despite having lane markings, most of the times lane discipline is not followed particularly at intersections. Highway Capacity Manual and other works assume homogeneous and lane based traffic for analysis, which exists in developed countries. There is notable lateral movement at intersections and vehicles tend to use lateral gaps to reach the head of the queue and overtake even during saturated part of green phase. Due to these fundamental differences, the standard western relationships for predicting the values of saturation flows and PCU factors are not appropriate for developing countries like India. The ability to accurately quantify vehicle delays at signalized intersections is a critical component for the planning, design and analysis of signal controls. As a result of random fluctuations in traffic flow and interruptions caused by traffic controls, delays that individual vehicles experience at a signalized approach are often subject to highly stochastic and time-dependant variation. Accurate estimation of the delays of individual vehicles at signalized intersections is also essential for road design. Delay estimation at signalized intersections has been extensively studied in the literature and several methods for estimating vehicle delay at signalized intersections have been widely used. However, it seems that the exploration on the method for estimating the delay is still continuously conducted. A detailed description of the characteristics and problems associated with mixed traffic conditions prevailing in India have been presented in the subsequent section following literature review. Hence in the present research work an attempt was made to measure delay at particular identified signalized intersections of urban area in Ahmedabad city.

A crossing point is a hub, and more often than not it is a piece of movement stream in expressway system. Limit of crossing point influences the aggregate limit of interstate system because of a wide range of turning developments. For activities of clashing, blending and separating brought on by movement stream, the movement attributes of convergence are more intricate than those of street mid square segment. Activity stream in creating nations includes diverse sorts of mechanized and non-mechanized vehicles prompts blended movement conditions and path evolving designs.

II. METHODS AND MATERIAL

1. Review of Literature

Savage concentrated on the change of a five-path roadway with a two-way left-turn path (TWLTL) to a UTLT crossing point hall in Michigan and found a 20 to 50 percent expansion in the hallway limit. A study by Stover registered CLVs for the convergence of two six-path blood vessel streets. The impacts of diverting left turns were processed utilizing these volumes. The procurement of double left-turn paths on all methodologies decreased CLVs by 12 percent contrasted with giving single left-turn paths yet at the same time required multiphase activity signal controls. The rerouting of left turns through directional hybrids and their forbiddance at the primary convergence lessened CLVs by 17 percent. Maki analyzed the UTLT and the customary TWLTL on four-path and six-path roads and found a 20 to 50 percent expansion in limit (throughput) for the UTLT.

Koepke et al. found that the directional hybrid outline gave around 14 to 18 percent more limit than the customary double left-turn path plan. The consequences of basic path volume (CLV) investigations, in the wake of considering covering activity developments, uncovered diminishments of around 7 to 17 percent in CLVs relying upon the quantity of blood vessel paths (six or eight) and the movement blend. Lower CLVs deciphered into higher activity stream limit at the crossing point.

Dorothy et al. assessed movement operational measures to concentrate on the distinctions in the execution of UTLT crossing points contrasted with the customary TWLTLs. A movement system reproduction model was utilized to recreate these circumstances for 1-hour time frames. The reproduced system had flags each 0.5 mi with the directional hybrids each 0.25 mi. A 60:40 split between the entering volumes on significant street and cross road was accepted. At the point when turning rates were low, the hybrids were displayed as stop-controlled. With higher volumes, signal control was accepted in the model. The sign cycle was 80 s with a 60:40 circulation of green time for the significant street stage and cross road stage, separately. The middle width differed from 40 to 100 ft. The key discoveries were as per the following:

- When the left-turning activity rate was 10 percent, UTLT convergences with signalized directional hybrids had bring down left-turn absolute travel times than traditional crossing points. The distinctions were 20, 40, and 150 s/veh at 30,50, and 70 percent mainline immersion, individually. Also, UTLT convergences with signalized directional hybrids had bring down left-turn complete travel times than ordinary crossing points when the left-turning movement rate was 25 percent. The distinctions were 20, 30, and 70 s/veh at 30,70, and 90 percent mainline immersion, separately.
- The UTLT crossing points gave reliably bring down system head out times contrasted with the five-path TWLTL outline.
- For low left-turning rates, the directional middle hybrids with stop control had roughly the same left-turn absolute time and system complete time as the directional medians with signalized hybrids.

Reid and Hummer looked at movement operations along a run of the mill blood vessel expressway with UTLT crossing points to the blood vessel with routine plans with TWLTL. The examination passage was a 2.5-mi segment of the northwestern interstate hallway in Detroit, MI. The area comprised of five noteworthy signalized crossing points with fluctuated separating from 1,600 to 3,500 ft and AADT running from 52,000 to 60,000 veh/day. CORSIM was utilized to reproduce movement execution, and Synchro was utilized to create streamlined sign timings. Four time periods were considered in the investigation, incorporating crest periods in the morning, early afternoon, midafternoon (2–3 p.m.), and night. Normal measures of adequacy were produced for a sum of 48 CORSIM runs. The

investigation demonstrated that the UTLT crossing point could fundamentally enhance framework travel times and speeds in the hallway amid the busiest hours of the day and to not trade off framework travel times amid off top periods. The passageway with UTLT crossing points demonstrated a 17 percent diminish in absolute travel time inside the study territory system contrasted with a hallway with a TWLTL. Normal rates expanded by 25 percent and the normal number of stops expanded for the UTLT crossing point contrasted with the TWLTL.
Reid and Hummer later utilized CORSIM to look at the movement execution of seven whimsical blood vessel crossing point plans, including the quadrant, UTLT, RCUT, Jug handle, split convergence, and DLT convergence. They utilized turning development volumes from existing disengaged crossing points in Virginia and North Carolina. Off top, crest, and volumes comparing to 15 percent higher than the crest volumes were analyzed. For every crossing point sort, 36 to 42 CORSIM recreation keeps running of 30-moment terms were broke down. For UTLT convergences, the CORSIM models utilized unsignalized U-turn hybrids for two-path authority streets and signalized U-turn hybrids for four-path gatherer streets. Entering volumes for the recreated crossing points extended from 4500 to 7500 veh/h. The UTLT crossing point created essentially lower than normal aggregate travel times in contrast with the ordinary convergence. The adjustment in general travel times for all developments through the crossing point when contrasted with a routine convergence was - 21 to +6 percent amid crest conditions. The general change in the quantity of stops when contrasted with a traditional crossing point was - 2 to +30 percent amid crest conditions.

Bared and Kaiser utilized CORSIM® to examine the activity operational advantages of signalized UTLT on a regular four-path street converging a four-path road. The cross road left-turn development was permitted at the primary convergence, bringing about a three-stage signal. An increasing speed path was accommodated the vehicles taking a right hand turn onto the side street from the real street. These two elements utilized as a part of the study were not quite the same as the run of the mill UTLT convergence usage in Michigan. Entering volumes at the convergences utilized as a part of the re-enactments went from 2000 to 7000 veh/h.

2. Applicability of UTLT Scheme

Likewise with all the plans portrayed in this study, the LTUT crossing point configuration is pertinent under certain conditions however not proper for all conditions. An essential motivation to pick the UTLT convergence rather than an ordinary outline is the capacity to prepare higher volumes on the real street, particularly through volumes. As specified before, the UTLT crossing point is commonly a hall treatment. Applicant passages for this outline are rapid, middle isolated thruways with some two-way hybrids that have moderate significant street and minor street right-turn requests. Less clashing travel streams, two-stage signals, short cycles, and the chance for good movement in both headings are all conceivable.

Decreasing sign stages at the crossing point gives expanded throughput in the scope of 30 to 45 percent for the UTLT crossing points in contrast with the routine convergences. Moreover, UTLT crossing points have been resolved to have crash rates that are 20 to 50 percent lower than routine convergences. Head-on and point crashes that have high probabilities of damage are essentially decreased for the UTLT crossing points contrasted with routine convergences.

Some of the situations where an UTLT intersection may be suitable include the following:

- If there are heavy through volumes and moderate right-turn volumes on all approaches.
- If the right-turn approaches volume/total approach volume is less than 0.2 on all intersection approaches.
- If the righ-turning volume is less than 400veh/lane, and opposing through volume is greater than 700veh/lane on two opposing intersection approaches.
- If the v/c is greater than 0.8 on two opposing intersection approaches.
- If the intersection is heavily congested with many signal phase failures for through traffic.

3. Study Area

Pakwan intersection located in fast developing city located in Ahmedabad, India was chosen for the present study. It is four legged isolated type, provided with pre timed signal control operating in four phases with permitted left turns. These study intersection was in such

a way that they have fair geometry (level gradient on all the approaches) and there is least interference to traffic by pedestrians, bus stops and parked vehicles etc. Average driving behaviour was assumed and the condition of vehicles was assumed to be moderate. The traffic is highly heterogeneous in nature with poor observance of lane discipline. The composition of traffic consists of a large proportion of motorized two wheelers, a small percentage of auto rickshaws, cars and very smaller proportion of heavy vehicles.

Site Selection Criteria: Intersection consists major and minor road intersecting on arterial road of Ahmadabad city. At this intersection highly hourly traffic flow causes traffic congestion and traffic congestion causes delay.

Following criteria were applied during site selection:

1) The selected approach provides a protected right-turn phase and an exclusive right-turn lane for right turn movement. The impact of right-turn lanes and permitted right-turn phase was not considered in this study.
2) The selected sites have large right-turn traffic demand. The average queue length for right-turning vehicles at selected sites should be greater than five vehicles per cycle.
3) Lane widths are at least 3.5 m.
4) There are few pedestrian or cyclists.
5) There is no roadside parking adjacent to a travel lane within 100 m of the stop bar.
6) The approach grade is level.
7) The intersection is not located in a central business district.

Figure 1. Arial view of study area

III. RESULTS AND DISCUSSION

1. Geometric Deign Considerations

The UTLT convergence performs well on arterials that have adequate middle width to suit the U-turn move. This segment talks about the geometry of the primary convergence, U-turn hybrids, medians, and the dividing between the principle crossing points and hybrids. In view of Michigan deparment with these crossing points, MDOT common configuration qualities are talked about all through this segment. Michigan passages with UTLT crossing points have middle widths going from 60 to 100 ft. This configuration is utilized as a hallway treatment as a part of Michigan, despite the fact that it has been utilized effectively for confined convergences. Figure 2 demonstrates a configuration for a common four-legged UTLT crossing point.

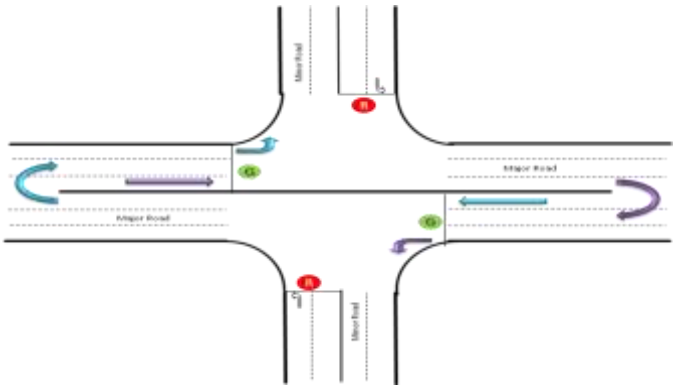

Figure 2. Illustration example of an UTLT intersection

At a UTLT crossing point, the configuration of the principle convergence is like the outline of a customary convergence. The primary crossing point is intended for bigger volumes of right-turn developments than a customary convergence serving the same aggregate volumes since the left-turning vehicles turn out to be correct turning vehicles. On account of this, the crossing point must be outlined with right-turn sounds of adequate width and length to oblige the volume of turning vehicles. Contingent upon the right-turn volume, double right-turn paths or a selective right-turn path and a neighbouring shared-use through and right-turn path might be required.

UTLT once in a while utilizes channelized right turns at UTLT crossing points. Channelized right turns at a UTLT convergence may require significantly all the more right-of-way, present a multistage walker crossing, and make a more troublesome driving move for a driver turning right from the minor road and weaving over to utilize the U-turn hybrid. At some UTLT convergences (e.g., at fractional UTLT crossing points), right turns

from the side street are permitted and in addition left-turn coves gave on the minor street approaches.

MDOT has created outline rules for directional middle crossovers. In Michigan, it is standard for drivers of traveller vehicles to line next to each other in a 30-ft wide crossover and regards it as though it had two paths. In any case, huge trucks and other substantial vehicles ordinarily utilize the whole width of the crossover. MDOT utilizes striped two-path crossovers (with two paths of capacity paving the way to the crossover) in some spots. These crossovers are normally 36 ft wide.

2. Safety Analysis

Table 1, which is from the FHWA report entitled Signalized Intersections: Informational Guide, demonstrates the quantity of contention focuses at a four-legged signalized convergence (32 all out) when contrasted with the UTLT crossing point (16 all out). The UTLT convergence dispenses with all intersection strife directs related toward left turns and lessens the quantity of consolidation/wander struggle focuses too. Figure 3 demonstrates the area of contention focuses for a UTLT crossing point. Regular accident sorts happening at UTLT intersections are backsides, point, and sideswipe crashes. In the NCHRP Report 524, "Wellbeing of U-Turns at Unsignalized Median Openings," gathered activity struggle information was accounted for. For most sorts of middle openings, clashes including significant street vehicles braking for vehicles turning from the middle opening onto the real street were the most widely recognized kind of contention. The usage of UTLT crossing points brought about general diminishments in backside, edge, and sideswipe crashes by 17, 96, and 61 percent, individually.

Table 1. Comparison of conflict points for MUT and conventional four-legged intersection

	Four-Legged	
	Signalized	
Conflict Type	**Intersection**	**MUT Intersection**
Merging/diverging	16	12
Crossing (left turn)	12	0
Crossing (angle)	4	4
Total	32	16

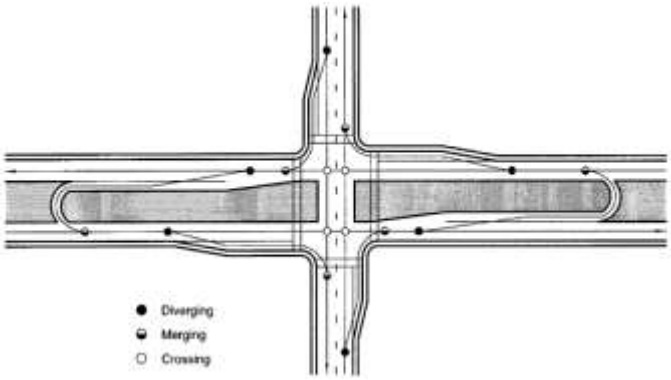

Figure 3. Illustration of conflict point diagram for UTLT intersection

IV. CONCLUSION

The diminishment of sign stages at the crossing point gives expanded ability to the UTLT convergence in contrast with the ordinary convergences. The throughput increments were normally in the scope of 30 to 45 percent. The all out system travel time investment funds as a rule exceeded the extra travel time required for right-turning vehicles from the real street and cross road for passages with the UTLT convergence contrasted with routine convergences. The security execution of the UTLT convergence was superior to anything customary crossing points since it had less vehicle-vehicle struggle focuses. Average aggregate accident decreases ran from 20 to 50 percent Head-on and point crashes that had high probabilities of damage were fundamentally diminished for the UTLT convergence contrasted with ordinary crossing points.

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