Transportation Infrastructure Projects: Conception to Execution (TIPCE) - 2019

A presentation on

SYSTEMATIC OVERVIEW OF SAFETY EFFECTS OF ACCESS MANAGEMENT

Sarika Pantawane  
Research Scholar  
Civil Engineering Department  
Indian Institute of Technology Roorkee  
Uttarakhand, India

Dr. Indrajit Ghosh  
Associate Professor  
Civil Engineering Department  
Indian Institute of Technology Roorkee  
Uttarakhand, India
Why To Manage Access?

- Streets and Highways
- Owners Right
- Change Land Use
- Access Management
- Road Users Right

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Access Management (AM)

- Access management, defined by the *Access Management Manual* (2003) as the systematic control of the location, spacing, design and operation of

  Driveways
  Traffic signals
  Median openings
  Interchanges
  Street connections to a roadway

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Benefits of Access Management

1. Safety of arterial roadways

2. To preserve highway capacity

3. Prevent the costly road improvement
Benefits of Access Management

4. Improve access to property

Avoid

Arterial

Promote

Internal roads provide access to multiple lots with minimum curb cuts on the adjacent arterial.

5. To improve operational efficiency

6. To enhance community environment and economy

[Bar chart showing retail sales from 1990 to 1996 for access corridors and communities]
The Transportation-Land Use Cycle

- Arterial Improvements
  - Increased Accessibility
    - Increased Land Value
      - Increased Traffic Generation
        - Increased Traffic Conflict
          - Deterioration in Quality of Traffic Flow
            - Land Use Change
              - Arterial Improvements

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The Transportation-Land Use Cycle

Iowa Case Study: Uncontrolled Development (IOWA AM Manual)

Implementing A.M technique:

Avoid

Promote

Good Spacing

Inadequate Spacing

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Problem Statement

- Driveways are the features of critical concern, that provide connection between highway and abutting land-use.
- The presence of driveways add additional conflict points, thereby complicating the highway activity and reduce safety.
- About 37% of total accidents took place on junctions itself during the year 2016 in India (MoRTH 2016).
Access Management along Roadway Segment

- Studies investigate the effects of driveways on safety (Gluck et al. 1999; Brown et al. 1999; Papayannoulis et al. 2015), usually showing an increase in crashes as the number of access point increases.

- Other researches indicated that by doubling the access frequency from 10 to 20 access points per mile increased the crash rate by about 40% (Papayannoulis et al. 2015).

Figure: Crashes and access density (Gluck et al. 1999)
Access Management along Roadway Segment

• As identified by (Gluck et al. 1999) a roadway with 60 access points per mile has a crash rate index three times greater than for a roadway with 10 access points per mile.

Table: Relative crash rates for total access connection spacing (Gluck et al. 1999)

<table>
<thead>
<tr>
<th>Total Access Points Per Mile</th>
<th>Accident Rate Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>1.4</td>
</tr>
<tr>
<td>30</td>
<td>1.8</td>
</tr>
<tr>
<td>40</td>
<td>2.1</td>
</tr>
<tr>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>60</td>
<td>3.0</td>
</tr>
<tr>
<td>70</td>
<td>3.5</td>
</tr>
</tbody>
</table>

• It was estimated by (Elvik et al. 2017) that each additional access point increase crash rate by 4%.
In Utah, the access management techniques has been implemented. Increase in rear-end crashes with the corresponding reduction in right-angle crashes there by reducing the crash severity.

Figure - Change in Collision Type after Implementing Access Management Technique (Schultz et al. 2007)
Access Management along Roadway Segment

- The methods that required attention to is the roadway functional hierarchy (U.S. Department of Transportation Federal Highway Administration, 2017).
- Roadways are ranked by their functionality based on the priority given access to abutting lands (Williams et al. 2014).

Figure: Mobility v/s Accessibility (Williams et al. 2014)
The access management techniques include:

1. **Traffic signal spacing**

   Very signal per 1.6 km corresponded to 0.48 crashes per MVKT. (Schultz et al. 2010).

   Crashes increased by 36.6 percent for each additional signalized intersection per mile while each additional lower volume un-signalized access point per mile was associated with a 0.5 percent increase (Thompson et al. 2017).

   Reducing signals spacing from 4/mile to 2/mile will reduce the total crash rate by up to 50%. (NHCPR 420)

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**Variety of access management** techniques are used by state and local government to control the access along major arterial and other roadways (William et al. 2011).
2. **Controlling the location and spacing of driveways**

Reducing the number of driveways by 50% would result in a 22 to 29% decline in the accident potential (Levinson et al. 2000).

An increase in access spacing from 90 m to 180 m reduced the accident rate by 50% (Flintsch et al. 2008).

3. **Median Treatment**

The crash rate for the roadway segments with a non traversable median were less than the rates for those without (Gattis et al. 2005).

As the width of the median increased, the crash rate decreased.

The mean crash rate for undivided highways was 5.29 crashes per million vehicle miles travel (MVMT) which was much more than the roadways with raised or divided medians with 3.34 crashes per MVMT (Gluck et al. 1999)
Access Management Techniques

4. **Use of Service Roads:** The segments with service lanes are associated with fewer rear-end and head-on crashes, median opening presence is found to increase both of these crash types (Mitra et. al. 2017).

5. **Careful Management of Driveway Location**
Application of Access Management

- Siqi et al. (2016) study to resolve the problems of congestion in commercial area by implementing A.M techniques.

For the access I, it would be an effective method to move back the gate of access.

Remove the exit (access III) to the main road. The distance between the access and the intersection should be more than 100m.

Ban of Illegal Parking

Set the One-Way Traffic

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Williams et al. (2014) mentioned that well-managed access points can

- **Reduce crashes** by 50 percent,
- **Increase capacity** by 23 percent to 40 percent, and
- **Reduce travel time and delay** by 40 percent to 60 percent.

That is why access management is no longer an option but is a requirement to the transportation network (William et al. 2014).
Literature Review

- Cheng et al. (2014) developed a process to determine which roads of the National Highway of G205 can most benefit by the implementation of access management techniques.

1. **Obtain Data**
   - AADT, signals per mile, adjacent land use, and potential for future development.

2. **Classify by access-related road Crash Analysis**
   - Access-related crash severity and access-related crash rates

3. **Classify by access density**

4. **Classify by access road type**

5. **Other Classification**

6. **Recommended Access Management Techniques**

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Literature Review

- Brown et. al. (2018), presents a quantitative method for evaluation the access management project.

\[
AMR = A_1(OR) + A_2(SR) + A_3(AR_1) + A_4(AR_2)
\]

Where
- AMR = access management rating,
- \(A_1, A_2, A_3, A_4\) = adjustment factors,
- OR = operations rating,
- SR = safety rating, and
- \(AR_1, AR_2\) = accessibility and land use ratings.

Figure: AMR (brown et. al 2018)
Avelar et al. (2013) studied the safety of driveways along both rural and urban arterial state highways.

Figure: (a) Urban model (b) Rural model
AM in Urban, Suburban and Rural area

- Researchers in Indiana developed for urban and sub-urban arterial segments.
- The crash ratio for urban roadways is over four times higher than for suburban roadways.

Figure: Crash ratio v/s Access density

Figure: Severity ratio v/s Access density

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Access Management near Intersection

- **Intersections** represent transportation features of critical concern, as they are designed to facilitate the *safe and efficient movements* of numerous vehicles.
- Accesses within the functional area of intersection complicate the intersection activity as they *add additional conflict points.*

Figure: Four-legged intersection (a) without driveways (b) with driveways

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Megat et al. (2017) showed that when access points are within closer proximity to an intersection, crash rate tends to increase significantly. He suggested a minimum distance of 300 ft at which access can be located near intersection.

Each additional commercial driveway within 250 ft would result in 6 to 7 percent increase in the number of crashes depending upon the type of intersection. (Oh et al. 2004).

William et al. (2005) suggested a minimum spacing between intersection and the driveways of 305 ft for a roadway with the posted speed limit of 40 mph.
Access Management near Intersection

- Xu et al. (2014) reported that **corner clearance has negative correlation with crash frequency**. It was found that crashes will be reduced by **three with every 100 ft** of additional corner clearance.

- Closer intersection spacing can increase friction among vehicles resulting higher crash rates. Result show **the increase in crashes as the number of intersections increase** on urban two-lane roadways in Michigan (Levinson et al. 1997).

- Zhao et al. (2016) developed a model, indicated that **access point reduces the capacity of the lane** group when it is close to the signalized intersection.
Conclusion

• The relative increase in accidents can be expected as the total driveway density in both directions increased.
• A well-managed access points can reduce crashes by 50 percent, increase capacity by 23 percent to 40 percent, and it can reduce travel time and delay by 40 percent to 60 percent.
• Land use was identified to play a significant role in the safety of arterial roadways segments.
• When access points are within close proximity to an intersection, crash rates tend to increase significantly.
• The greater the frequency of driveways and intersections, the greater the number of accidents. In addition, wide access spacing give drivers more time for perception, reaction and navigation.


THANK YOU