Traffic Impact Considerations for Multifamily Developments with Significant Commercial Components

Assessing the Interplay between Residential and Commercial Traffic Generation

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Abstract

This article looks at how multifamily developments with significant commercial componentsaffect traffic. It focuses on how traffic from residential and commercial mixes together. When multifamily houses and businesses share space, it helps towns grow well, but it also brings problems with traffic during busy times. Traffic Impact Assessments (TIAs) are very important for checking how many cars are on the road, how much parking is needed, and what infrastructure is needed. Special tools like VISSIM and Synchro help find ways to reduce traffic problems. These include plans like making areas easy to get to by buses, safe for people walking, and having well-designed ingress and egress. The study shows that planning early, working with others, and using data is very important for cities to grow smoothly and efficiently. The article ends with useful advice for city planners, builders, and lawmakers to improve traffic in areas where mixed-use developmentsshare space, fit well into cities, cause fewer problems, and give more benefits to people living there.

Keywords: Traffic Impact Assessments (TIAs), Mixed-use developments, Multifamily developments, Commercial traffic generation, Residential traffic patterns, Traffic congestion mitigation, Transit-Oriented Design (TOD), Pedestrian-friendly layouts, Parking demand and accessibility, Vehicle trips per dwelling unit, Traffic modeling tools (Synchro, VISSIM), Infrastructure capacity analysis, Real-time traffic data, Traffic signal optimization, Sustainable urban planning.

Introduction

Multifamily developments with large commercial areas are becoming very popular in cities and suburbs. This trend shows a growing interest in mixed-use environments. These places have residential units alongside stores, restaurants, and offices, giving residents easy access to services and lively communities. Mixing these spaces fits well with current city planning that values walking, easy access, and smart land use [1].

Residential and commercial uses in the same area bring special challenges, especially with traffic. Mixed-use places show different traffic patterns that overlap. Factors like peak hours, parking needs, and vehicle flow affect these patterns. Residential traffic is often busy in the early mornings and evenings. Commercial traffic is usually heavy at midday and on weekends. This mix might create congestion and put pressure on infrastructure if not dealt with carefully. Overview of multifamily developments with commercial components [2].

As these developments gain popularity, understanding the traffic impact becomes very important for their planning and design. Effective traffic impact assessments (TIAs) help the surrounding transportation network handle the different needs of both residents and commercial users. This section gives an overview

of multifamily developments with commercial features, showing their importance in modern urban design and starting an in-depth look at their traffic impact considerations.

The Importance of TIAs in Urban Planning

As cities grow and change, the development of multifamily projects is becoming more common. These mixed-use spaces bring many benefits like better land use, more business activity, and easier access for people. However, they also create unique problems, especially with controlling traffic and reducing traffic jams. Knowing and solving these problems is very important to keep city systems working well for a long time.

TIAs are key tools in urban planning. They offer a clear way to study how new projects affect transport systems. These assessments study things like how much traffic a development brings, the busiest travel times, and how much infrastructure can handle. TIAs aid planners and developers in foreseeing and reducing negative effects on nearby roads. This is important for mixed-use projects. The mix of residential and commercial traffic leads to complex and changing transport needs [3].

The role of TIAs goes beyond managing traffic jams. Good traffic evaluations help safety, cut down environmental harm, and improve life quality for locals and visitors. They help people make smart choices by offering data-based insights about infrastructure needs, allowing city planners to create areas that work well and last long. For multifamily projects that include big commercial parts, TIAs are very important. They help these projects fit smoothly into the current city setup, reducing problems and increasing benefits for everyone [4].

Urban planners and developers think about traffic early during planning. They create smart transportation systems that help homes and businesses. Cities keep getting bigger, so traffic impact assessments (TIAs) become really important. These assessments help build strong, easy-to-reach, and nice places to live.

Understanding Traffic Generation in Mixed-Use Developments

Mixed-use developments, combining commercial and residential are becoming more common in city planning. They use the land well and support lively, walkable neighborhoods. However, these projects have unique traffic challenges because residential and commercial areas create different traffic patterns. Knowing these differences is very important for good planning and successfully adding these projects to current transportation systems.

Residential areas usually have clear traffic patterns that match daily habits and work times. Busy times for these zones often happen in the morning and evening when people head to or return from work or school. In the middle of the day, traffic in these areas often decreases a lot. On weekends, the patterns might change, with traffic often linked to fun activities, errands, or social gatherings. Also, traffic in residential zones typically features slower speeds and more frequent stops, especially in areas with many pedestrians and cyclists [3].

In contrast, commercial buildings create different and changing traffic patterns based on the business type, work hours, and how customers act. Retail places, for example, probably see the most traffic in the afternoons, evenings, and weekends when people go shopping or enjoy leisure activities. Offices, however, often match the busy hours of homes, with a lot of traffic in the mornings and evenings when people go to or from work. Commercial areas also bring more delivery traffic, including trucks and heavy vehicles, which adds difficulty to managing traffic [5].

The mix of residential and commercial in the same area brings special challenges for those who plan transport. These places share roads, but traffic from homes and businesses often clashes and causes jams.

Morning home traffic sometimes meets delivery trucks heading to shops, blocking main roads. Also, heavy retail traffic in the evening can match the time when people come home, needing smart traffic control [4].

To tackle these problems, traffic engineers need to consider how residential and business traffic interact when designing roads, access points, and parking areas. Mixed-use places often gain from methods like shared parking, improving traffic lights, and promoting other ways to get around, such as walking, biking, or using public transport. Understanding the different and similar traffic patterns of home and business areas helps planners create transport systems that reduce traffic jams and increase the efficiency and sustainability of these developments. This detailed understanding is very important for the long-term success of mixed-use projects. The smooth integration of residential and commercial traffic patterns creates a well-functioning and livable community.

Assessing Shared Traffic Infrastructure and its limitations

Mixed-use developments, combining living spaces and shops or offices, present unique challenges for traffic management. The mix of residential and businesses in the same area often puts pressure on traffic systems. Roads, intersections, and parking areas see changing demand all day. Busy times happen when home and business traffic overlap. For example, the morning rush from people going to work usually occurs with store deliveries or early shoppers, causing more traffic jams [3]. Similarly, evening shopping or dining activities can conflict with residents returning home, further straining shared infrastructure.

Limitations in shared traffic infrastructure led to bottlenecks, longer travel times, and less accessibility. These issues are very common in areas where the infrastructure wasn't planned for the changing and overlapping traffic patterns found in mixed-use spaces. Insufficient parking spots or badly designed entry and exit points usually make these problems worse. Poor planning probably harms the functionality and attraction of mixed-use developments [4].

Key Traffic Metrics for Multifamily Developments

Effective planning for multifamily buildings needs a thorough understanding of traffic numbers to fit smoothly into current transport systems. Important points are the number of car trips per home and business area, parking demands ease of access, and ways to lower trips in mixed-use areas.

The Institute of Transportation Engineers (ITE) provides standard rates for predicting vehicle trips based on the number of homes and the size of commercial buildings. However, research shows that actual vehicle trips often differ greatly due to factors like location, closeness to public transport, and city density. Studies have found that apartment buildings in cities with good public transport usually cause fewer vehicle trips than ITE predictions suggest, highlighting the importance of assessments that consider the specific area [6].

Parking demand in multifamily buildings depends on how many units there are, how close the buildings are to public transit, and other ways to get around. Old parking rules often cause too many parking spaces, which raises building costs and makes people rely on cars more. Studies show that places near transit stations or in areas where people can walk easily often use less parking. This supports the idea of having flexible parking rules that match real needs [7].

Implementing ways to reduce trips is very important for lessening traffic impacts in areas with different uses. Promoting public transport, improving paths for walking and cycling and supporting transportation demand management (TDM) programs help decrease the need for private cars. Also, mixing homes and shops lets residents visit nearby places, which probably cuts down external traffic [8]. Studying these traffic numbers and using the right plans allows planners and developers to create multifamily areas that fit with current transportation systems, support sustainable travel, and improve urban life quality.

Mitigation Strategies for Traffic Congestion

Traffic congestion is a constant problem in areas with both homes and businesses. Here, people living and working cause traffic to overlap. Using good strategies is important to allow vehicles to move better, make it easier for people to get around, and improve how well these areas work.

Transit-oriented design (TOD) is a strong method for reducing traffic jams in areas where people live, work, and have fun. It places homes, shops, and parks close to bus or train stations. This setup allows people to depend less on cars and use public transport more. Some research shows TOD probably cuts car travel by 20-40% in cities, which helps traffic flow better and lowers pollution levels. Walkways and bike paths around transit stations also promote more eco-friendly travel methods, easing traffic issues even more [9].

Designing pedestrian-friendly layouts is very important for reducing traffic jams and encouraging people to be active. Wide sidewalks, safe places to cross the street, and green areas invite people to walk as their main way of moving around in areas with mixed uses. Also, including bike lanes and options like bike-sharing and scooter-sharing move traffic away from private cars [10]. This change not only reduces road crowding but also improves life by creating lively, human-focused areas. Developments that focus on easy walking access to services and transit stations often have less traffic, as residents and visitors probably rely less on cars.

Effective ingress and egress are important for reducing traffic jams at entrances in areas with different uses. Separate roads for residents and businesses help spread out traffic and cut down on jams during busy times. Smart traffic tools, like changing traffic lights and systems that watch traffic in real-time, improve flow at crossings and gates [11]. They adjust light timings based on traffic, allowing cars to move smoothly and lessen wait times. Adding spots for dropping off people and special areas for deliveries helps traffic by avoiding clashes between residents and businesses.

Using designs that focus on transit, friendly walking paths, and smart entry and exit plans, builders and city planners probably reduce traffic in mixed-use areas. These steps not only ease traffic but also help create sustainable and enjoyable urban places.

Modeling and Simulation Tools for Traffic Impact Analysis

Modeling and simulation tools have become very important in studying how traffic changes, especially for seeing how new buildings affect current roads and transportation systems. These tools help city planners and engineers look at how cars move, how roads can handle traffic, and the chances of traffic jams. They give useful information based on data for coming up with good strategies to manage traffic.

Traffic modeling tools like Synchro, VISSIM, and AIMSUN are widely used to study city traffic effects. Synchro is mainly used to look at traffic light timing and improve how intersections work. It gives a big picture of traffic flow, helping planners decide on changes to roads. VISSIM, however, provides a detailed view by simulating how each vehicle moves in a network. This offers a deeper understanding of how drivers behave, how vehicles interact, and how new traffic plans affect flow. AIMSUN combines both big and small-scale modeling, making it ideal for detailed traffic studies of varied project sizes [12].

Table 1: Level of Services (LOS) Criteria

Table I
Level of Service (LOS) Criteria

LOS	Unsignalized Intersections seconds per vehicle	Signalized Intersections seconds per vehicle
A	0-10	0-10
B	10-15	10-20
C	15-25	20-35
D	25-35	35-55
E	35-50	55-80
F	over 50	over 80

Modeling tools are very important for understanding traffic patterns and deciding on infrastructure needs. For example, simulations with VISSIM probably reveal bottlenecks in the network, predict congestion during busy times, and assess how new road designs perform. In the same way, Synchro helps test and set up traffic light timings for smoother vehicle flow through intersections. These analyses are very important for planning infrastructure that handles both residential and commercial traffic in mixed-use areas. By learning about traffic through simulations, planners find focused solutions to reduce congestion and make access easier [13].

Real-time data in traffic modeling tools changes traffic impact studies by improving the accuracy of forecasts. Modern tools now use information from IoT sensors, GPS devices, and smart traffic systems to provide dynamic and current insights into road conditions. For instance, real-time data probably helps adjust traffic light timings or direct vehicles to quieter roads. This immediate data use allows active traffic management, cutting delays and raising the overall efficiency of transportation systems. Additionally, predictive modeling techniques, paired with real-time data, let planners predict the effects of future projects and design infrastructure appropriately [11].

By using advanced modeling and simulation tools, urban planners and engineers probably make wise decisions that reduce traffic jams, really improve road safety, and use infrastructure money wisely. These tools not only give important insights during planning but also help with ongoing traffic management, keeping urban transportation networks efficient and sustainable.

Case Studies of Traffic Impact in Mixed-Use Multifamily Developments

The Bridgeport Mixed-use development project serves as a prime example of how TIAs are essential for ensuring the sustainable integration of multifamily and commercial spaces into urban infrastructure. Located in a rapidly growing suburban area, the project comprises 1,100+ residential units and 150,000+ square feet of commercial spaces, including retail outlets, storage units, restaurants, gas stations, offices, boutiques,and brewery. This new building complex sits right on Bridge Road/Route 17 in North Suffolk. Over 40,000 cars drive through here daily. It is very easy to reach both the Monitor-Merrimac Memorial Bridge Tunnel and the James River Bridge.

Bryant B. Goodloe conducted the TIA and recommended several public road improvements that shall be designed and constructed according to the City of Suffolk’s requirements. The TIA for this project focused on analyzing peak-hour traffic volumes, parking needs, and the performance of ingress and egress points using tools such as Synchro 9 signal timing analysis for traffic signals and Synchro 9 HCM for unsignalized conditions. The Level of Service (LOS) criteria for this assessment will be consistent with the Highway Capacity Manual (HCM 2000). The year 2000 table was used, since the 2010 version will not analyze a combination left through lane. Table 1 shows the values for the signalized and unsignalized intersections.

The Turning Movement Counts (TMCs) taken were at the intersection of Windward Lane and Bridge Road from 7:00 to 9:00 a.m., 11:00 a.m. to 1:00 p.m., and from 4:00 p.m. to 6:00 p.m. at this unsignalized intersection.

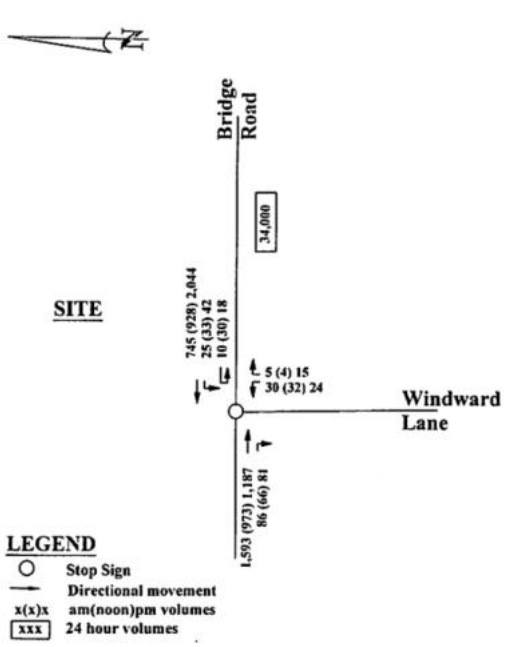

Figure 1: The year 2018 - Existing Lanes with traffic volumes without build condition

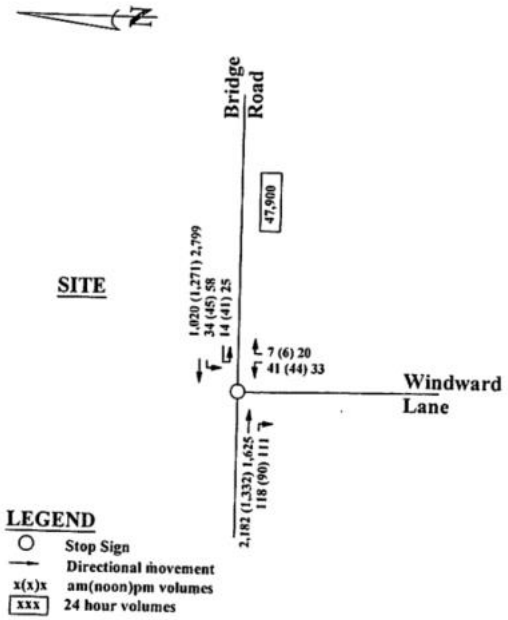

Figure 2: Year 2027 - No build traffic volume

We can see from the above two figures that without any improvements on the public road will increase the traffic volume significantly. The peak hour factor (phf) was calculated for each approach. A phf of 0.92 was used for all new conditions. The percentage of heavy vehicles used was counted and calculated at 5% in the a.m. on Bridge Road, 6% at noon, and 2% for the p.m. A value of 2% was used for Windward Lane and thenturned into this street for all conditions.

The traffic generated by this project was determined by using the Institute of Transportation Engineers Trip Generation Manual, 9th Edition. The residential traffic is estimated to be 70% towards the east, 28% towards the west, and 2% towards the south. The commercial traffic is estimated to be 43%

towards the east, 55% towards the west, and 2% towards the south. The calculation for pass-by traffic is shown in Table 2 below.

Table 2: The calculation for pass by traffic

Table IV
Passby Calculations

Description	Weekday Volumes	Use Percent	a.m. peak hour ITE Rate	a.m. peak hour percentage	p.m. peak hour ITE Rate	p.m. peak hour percentage
Shopping Center	2,970	49.6%	30%	14.9%	35%	17.3%
Out-parcels						
Gas-Convenience	2,604	43.5%	62%	26.9%	56%	24.3%
Bank w/drive thru	418	7.0%	47%	3.3%	47%	3.3%
Totals	5,992	100%		45%		45%

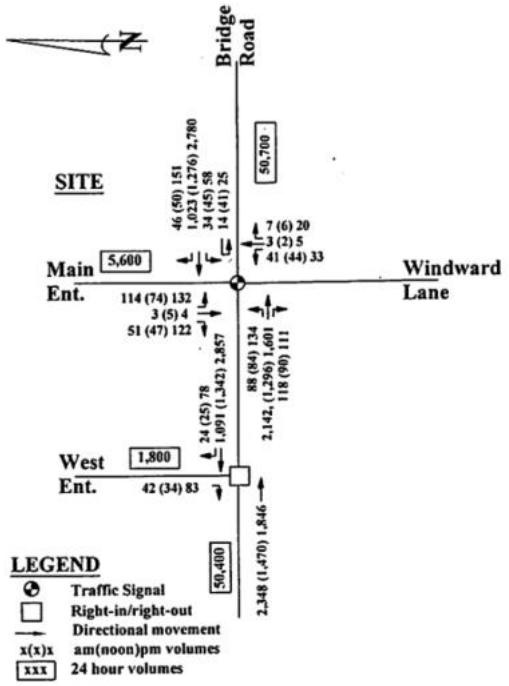

Figure 3: Site Traffic volumes (New Traffic and Passby)

Based on the findings of the Traffic Impact Assessment (TIA), the Traffic Engineer recommended several improvements to enhance traffic flow and safety. The main entrance should include three exiting lanes (one left-turn lane, one left-thru lane, and one right-turn lane) and two entering lanes. On Bridge Road, an eastbound 250-foot left-turn lane with a 200-foot taper and a westbound 200-foot right-turn lane with a 200-foot taper should be constructed. Additionally, a traffic signal should be designed and installed at this intersection.

To accommodate pedestrians, crosswalks, ADA-compliant ramps, pedestrian signal heads, and push buttons should be constructed on the west, north, and south sides of the intersection. The new traffic signal system must be coordinated with the existing Bridge Road traffic infrastructure. Furthermore, ADA-compliant sidewalks, 5 feet in width, should be installed on the Bridgeport side of Bridge Road. For improved access, the developer should provide a right-in/right-out entrance, accompanied by a westbound Bridge Road 200-foot right-turn lane with a 200-foot taper. These measures aim to address the projected traffic demands while ensuring accessibility and safety for all users.

This case study highlights the important role of traffic impact assessments in mixed-use areas. Using advanced modeling tools, integrating Transit Oriented Design (TOD) principles, and adopting smart traffic management methods, the Bridgeport Mixed-Use Development balanced residential and commercial traffic

needs while reducing congestion. The findings show the importance of early planning, working with stakeholders, and new ideas in achieving sustainable city growth.

Conclusion and Recommendations

The integration of multifamily development with commercial components offers chances and difficulties in city planning. These mixed-use areas encourage smart land use, stronger economies, and lively communities. However, they also bring about complicated and mixed traffic patterns that need thorough study and control. Traffic Impact Assessments (TIAs) play a very important part in dealing with these issues by giving detailed information on traffic creation, infrastructure capacity, and possible traffic jams [2].

Effective strategies, like designs focused on transit, pedestrian-friendly layouts, and modern traffic tools such as VISSIM and Synchro, really help with reducing traffic jams and making places easier to reach. For example, VISSIM simulations show where there are traffic bottlenecks and ways to improve how roads work, while Synchro gives important information on traffic lights to make intersections flow better [13]. By using these methods, projects like the Bridgeport mixed-use development show the value of starting to plan early, working with others involved, and finding new ways to manage traffic to meet the needs of both homes and businesses.

In the future, city planners and builders need to use adaptable strategies that support buildings used for multiple purposes, invest in tools to check traffic instantly, and focus on transportation that uses different methods. Leaders have to update land-use rules and offer rewards for eco-friendly traffic solutions. These collective efforts will probably help buildings for mixed-use grow while improving the comfort and efficiency of city areas.

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