10. TRANSIT ACCOMMODATIONS

(Credit: Kimley-Horn and Associates, Inc.)

INTRODUCTION


On-board a Broward County Transit (BCT) bus
(Credit: Broward County Transit)

Public transit serves a vital transportation function for many people; it is their access to jobs, school, shopping, recreation, visiting friends and family, worship, and many other daily functions. Broward County Transit (BCT) and its Community Bus partners use the street network to serve these trip functions. For transit to provide optimal service, streets must accommodate transit vehicles as well as access to stops. Transit connects passengers to destinations and is an integral component of shaping future growth into a smarter, more sustainable form. Street design should also help transit support placemaking, which is discussed in more detail in Chapter 13, "Re-Placing Streets: Putting the Place Back in Streets."

This chapter provides design guidance for both transit stops and transit operating in the streets, including bus stop layout and placement and the use of bus bulbs and transit lanes. The chapter ends with a discussion of ways to accommodate light rail, street cars, and Bus Rapid Transit (BRT).

BROWARD COUNTY COUNTY-WIDE COMMUNITY DESIGN GUIDEBOOK

The *Broward County County-Wide Community Design Guidebook* was prepared by Anthony Abbate Architect, PA and adopted by the Broward County Board of County Commissioners. The Community Design Guidebook (CDG) recommends design principles for transportation that integrate public transit into street design and urban form. The CDG recognizes that the character of an urban community is based upon its modes of transportation. Transit-specific considerations included in the transportation design principles are included below.

- The most effective way to influence the future urban form of a community or along a corridor within a community is to identify the modes of transit to be implemented.
- Without implementation of alternative transit modes the default design mode will continue to be the automobile.
- Design routes for multi-modal transportation with priority to transit vehicles, pedestrians, and bicycles.

- Serve the primary right to mobility through various modes including pedestrian and transit.
- Coordinate primary and secondary transit corridors in relation to planned land uses.
- Integrate art and design into the service infrastructure.
- Develop major transit corridors tied to land use.
- Design transit to encourage ridership and promote redevelopment.
    - High-quality, attractive, safe, comfortable, and convenient facilities promote transit use.
- Design transit facilities for people.
    - Provide a bench or a rail for resting.
    - Provide trash receptacles.
    - Integrate shading louvers to provide shade and increase protection from inclement weather.
    - Provide a means for displaying well-designed public information and advertising.

> *"One can travel from here without a car, but it takes quite a walk to reach where a bus stops and then there is an interminable wait for the bus"*
> - *(Broward Complete Streets Guidelines public survey respondent)*

FDOT District Four Transit Facilities Guidelines

Broward County is located within District Four of the Florida Department of Transportation (FDOT). District Four developed *Transit Facilities Guidelines* to provide a basis for development of transit facilities located within the jurisdiction of District Four and for engineers to interact with local agencies or private entities developing transit facilities. According to the Guidelines, it is the intention of District Four to facilitate the design process for transit facilities through the development of the guidelines. Project teams are encouraged to work with the FDOT District Four staff, Broward County Transit (BCT), the Broward Metropolitan Planning Organization (MPO), and local government transportation planners during the planning and design process for projects that affect transit facilities to ensure early consideration of transit needs and identification and resolution of design conflicts and decisions.

BCT 95 Express Bus
(Credit: Broward County Transit)

ESSENTIAL PRINCIPLES OF DESIGNING STREETS FOR TRANSIT

Public transit should be planned and designed as part of the street system. It should interface seamlessly with other modes, recognizing that successful transit depends on customers getting to the service via walking, bicycling, car, taxi, or paratransit. Transit should be planned following the following principles.

- On some streets, transit vehicles should have higher priority than private vehicles.
- The busiest transit lines should have designated bus lanes.
- Where ridership justifies, some streets, called transit hubs, may permit only buses or trains in the travelled way. These often also allow bicycles.
- Technology should be applied to increase average speeds of transit vehicles where appropriate through options such as transit signal priority (TSP) and bus queue jumpers.
- Transit stops should be easily accessible, with safe and convenient crossing opportunities.
- Transit stops should be active and appealing public spaces that attract people on a regular basis, at various times of day, and on all days of the week.
- Transit stops function as community destinations. The largest stops and stations should be designed to facilitate programming for a range of community activities and events.
- Transit stops should include infrastructure for passengers waiting to board such as real time traveler information systems, natural or artificial canopies (shelters), wayfinding signs, route maps, system maps, benches, and trash receptacles.
- Transit stops should provide space for a variety of amenities in commercial areas, to serve residents, shoppers, and commuters alike.
- Transit stops should be attractive and visible from a distance.
- Transit stop placement and traveled way design influences accessibility to transit and network operations, and influences travel behavior/mode choice.
- Zoning codes, local land use ordinances, and context sensitive design and solutions guidelines around transit stations should encourage walking and a mix of land uses (see Chapter 14, "Designing Land Use along Complete Streets").
- Streets that connect neighborhoods to transit facilities should be especially attractive, comfortable, inviting, and safe for pedestrians and bicyclists.

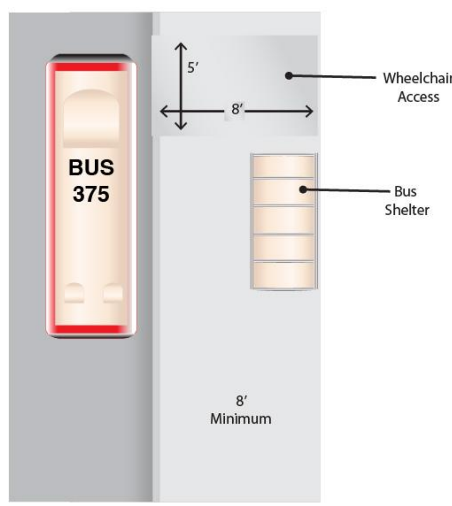
Old Town Transit Center in San Diego
(Credit: Kimley-Horn and Associates, Inc.)

OPTIMIZE ACCESS TO TRANSIT

The width and function of the pedestrian network influences safety and help achieve accessibility to the bus stop. The range of access to adjacent properties, from visual access to physical access on streets served by transit, are important design considerations. Bicycle-friendly streets do the same for those who access transit by bicycle.

Bus approaching well-situated bus stop near enhanced crosswalk (Credit: National Complete Streets Coalition)

Every transit trip also requires a safe and convenient street crossing at the transit stop. The demarcation of pedestrian, bicycle, transit, and vehicular use areas should be carefully considered to provide optimal access and exposure to the uses. A disproportionally high number of pedestrian crossing crashes occur at transit stops. Every transit stop should be evaluated for its transit connection and crossing opportunities. If the crossing is deemed unsafe, mitigation can occur in two ways: a crossing should be provided at the existing stop, or the stop can be moved to a location with a safer crossing. For street crossing measures, see Chapter 8, “Pedestrian Crossings.” Simply stated, there should not be transit stops without means to safely and conveniently cross the street.



ADA compliant bus stop (Credit: Michele Weisbart)

But simply moving a stop is not always a service to transit users who may have to walk further to access their stop. Convenient access by passengers must remain at the forefront of all transit stop planning: eliminating stops because they are perceived as unsafe will not be satisfactory to riders who cannot walk very far. But eliminating or consolidating stops can be beneficial to transit operations and users by reducing the number of times a bus, streetcar, or light rail train has to stop. The trade-offs are added walking time for users but reduced transit operator delay, resulting in a shorter journey overall. For example, this might mean a two to three minute longer walk for some passengers but an eight to 10 minute shorter bus ride for all.

BUS STOPS

The following sections provide guidance for designing bus stops.

Boarding a BCT bus
(Credit: Broward County Transit)

LAYOUT

A well placed and configured transit stop offers the following characteristics:

- Clearly defines the stop as a special place
- Provides a visual cue on where to wait for a transit vehicle
- Does not block the path of travel on the adjacent sidewalk
- Allows for ease of access between the sidewalk, the transit stop, and the transit vehicle

Layout guidelines include the following:

Bus stop shelter
(Credit: Sky Yim)

- Consolidate streetscape elements to create a clear waiting space and minimize obstructions between the sidewalk, waiting area, and boarding area
- Consider the use of special paving treatments or curb extensions (where there is on-street parking) to distinguish transit stops from the adjacent sidewalks
- Integrate transit stops with adjacent activity centers whenever possible to create active and safe places
- Avoid locating bus stops adjacent to driveways, curb cuts, and land uses that generate a large number of automobile trips (gas stations, drive-thru restaurants, etc.)

Transit stops are required by the Americans with Disabilities Act (ADA) to be accessible. Specifically, ADA requires a clear loading area (minimum 5 feet by 8 feet) perpendicular to the curb with a maximum 2 percent cross-slope to allow a transit vehicle to extend its lift to allow people with disabilities to board. The loading area should be located where the transit vehicle has its lift and be accessible directly from a transit shelter. The stop must also provide 30 by 40 inches of clear space within a shelter to accommodate wheelchairs. The greater use of low-floor transit vehicles may make this requirement moot; but it will still be necessary to provide enough room so wheelchair users can access the front doors.

TRANSIT-SPECIFIC STREETSCAPE ELEMENTS

The essential streetscape elements for transit infrastructure include signs, shelters, and benches.

Benches should be provided at transit stops as right of way permits.

Transit shelter with bench and bicycle parking adjacent to park-and-ride lot, Pembroke Pines
(Credit: Kimley-Horn and Associates, Inc.)

Shelters keep waiting passengers out of the rain and sun and provide increased comfort and security. Shelters vary in size and design; standard shelters roof widths are 3 to 7 feet wide by 6 to 16 feet long. They include covered seating and sign panels that can be used for transit information. Shelters should

- Be provided at busy transit stops at transfer points
- Have electrical connections to power lighting and/or real-time transit information, or accommodate solar power
- Be set back from the front of the bus stop to allow for the bus to merge into travel lanes when the stop is located at the far side of an intersection or at a mid-block location. This setback is not required when the stop is located at the near side of the intersection or at a bus bulb.

Transit shelter with solar power
(Credit: Maribel Feliciano)

Shelters should be located in a sidewalk's transit infrastructure area (furniture zone) so they don't conflict with the pedestrian zone. Shelters may be placed in the sidewalk's frontage zone provided that they do not block building entrances or the pedestrian zone.

Transit stops should also provide other amenities to make waiting for the next bus comfortable:

- Trash/recycling receptacles should be provided and maintained at most stops.
- Depending on headways and the number of passengers boarding and alighting, electronic “next bus” readouts can be used to inform passengers when to expect the next bus.
- Very busy bus stops and transit stations should include space for vendors to sell newspapers, magazines, flowers, and other goods to keep the stops lively.
- Rapid bus lines can include facilities that allow passengers to pay their fare before boarding the bus (sometimes called pre-boarding fare collection or off-vehicle fare collection). Along with wide doors on buses, this allows buses to reduce their travel time by reducing dwell time at stops.

Pre-boarding fare collection, TransMilenio, Bogotá, Colombia
(Credit: Stewart Robertson)

BUS STOP PLACEMENT

A bus stop’s optimal placement depends on the operational characteristics of both the roadway and the transit system. The placement of bus stops at the far side of signalized intersections is generally considered to be preferable to near side or mid-block locations. However, each location has its advantages and disadvantages, as shown in Table 10.1.

Table 10.1 Bus Stop Placement Considerations

Location	Advantage	Disadvantage
Near Side	• Minimizes interference when traffic is heavy on the far side of an intersection • Provides an area for a bus to pull away from the curb and merge with traffic • Minimizes the number of stops for buses • Allows passengers to board and alight while the bus is stopped at a red light • Allows passengers to board and alight without crossing the street if their destination is on the same side of the street. This is most important where one side of the street has an important destination, such as a school, shopping center, or employment center that generates more passenger demand than the far side.	• Increases conflicts with right-turning vehicles • Stopped buses may obscure curb-side traffic control devices and crossing pedestrians • Obscures sight distances for vehicles crossing the intersection that are stopped to the right of the buses • Decreases roadway capacity during peak periods due to buses queuing in through lanes near bus stops • Decreases sight distance of on-coming traffic for pedestrians crossing intersections • Can delay buses that arrive during the green signal phase and finish boarding during the red phase • Less safe for passengers crossing in front of the bus
Far Side	• Minimizes conflicts between right-turning vehicles and buses • Optimal location for traffic signal synchronized corridors • Provides additional right-turn capacity by allowing traffic to use the right lane • Improves sight distance for buses approaching intersections • Requires shorter deceleration distances for buses • Signalized intersections create traffic gaps for buses to reenter traffic lanes • Improves pedestrian safety as passengers cross in back of the bus	• Queuing buses may block the intersection during peak periods • Sight distance may be obstructed for vehicles approaching intersections • May increase the number of rear-end accidents if drivers do not expect a bus to stop after crossing an intersection • Stopping both at a signalized intersection and a far-side stop may interfere with bus operations
Mid-Block	• Minimizes sight distance problems for pedestrians and vehicles • Boarding areas experience less congestion and conflicts with pedestrian travel paths • Can be located adjacent to or directly across from a major transit midblock use generator	• Decreases on-street parking supply (unless mitigated with a curb extension) • Requires a mid-block pedestrian crossing • Increases walking distance to intersections • Stopping buses and mid-block pedestrian crossings may disrupt mid-block traffic flow

Source: Federal Transit Administration (FTA), *BRT Stops, Spacing, Location, and Design*, www.fta.dot.gov/research_4361.html

In general, bus stops should be located at the far side of a signalized intersection in order to enhance the effectiveness of traffic signal synchronization or bus signal priority projects. Near-side bus stops are appropriate for stop sign-controlled intersections. But in all cases priority should be given to the location that best serves the passengers.

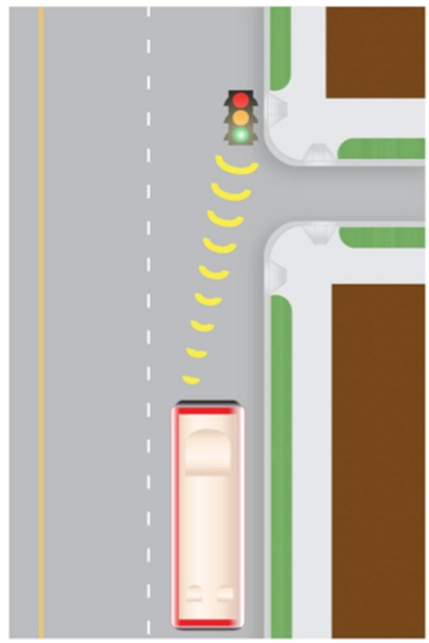
SIGNAL TREATMENT

Signal prioritization is a component of technology-based "intelligent transportation systems" (ITS). These systems are often used by road authorities in conjunction with transit agencies to help improve a roadway system's overall operations in the following ways:

- Reduce traffic signal delays for transit vehicles
- Improve an intersection's person throughput
- Reduce the need for transit vehicles to stop for traffic at intersections
- Help reduce transit vehicles' travel time
- Help improve transit system reliability and reduce waiting time for people at transit stops

Signal prioritization projects include signal timing or phasing projects and transit signal priority projects.

Signal timing projects optimize the traffic signals along a corridor to make better use of available green time capacity by favoring a peak directional traffic flow. These passive systems give priority to roadways with significant transit use within a district-wide traffic signal timing scheme. Transit signal prioritization can also be achieved by timing a corridor's traffic signals based on a bus's average operating speed instead of an automobile's average speed.



Signal-priority technology can help to reduce delay for buses (Credit: Michele Weisbart)

Transit signal-priority projects alter a traffic signal's phasing as a transit vehicle approaches an intersection. This active system requires the installation of specialized equipment at an intersection's traffic signal controller and on the transit vehicle. It can either give an early green signal or hold a green signal that is already being displayed in order to allow buses that are operating behind schedule to get back on schedule. Signal-priority projects also help improve a transit system's schedule adherence, operating time, and reliability.

Although they may use similar equipment, signal-priority and pre-emption are two different processes. Signal-priority modifies the normal signal operation process to better accommodate transit vehicles, while signal pre-emption interrupts the normal signal to favor transit or emergency vehicles.

The placement of a bus stop at the far side of a signalized intersection increases the effectiveness of transit signal-priority projects. Signal treatments should be used along streets with significant bus service.

URBAN DESIGN

Bus stops and amenities vary in complexity and design from standardized off-the-shelf signs and furniture to specially designed elements. The design of the bus stop elements, location of the bus stop in relation to adjacent land uses or activities, and the quality of the roadway's pedestrian environment contribute to a bus stop's placemaking. Transit operators like a branded look to their stops so they are easily identified, but often there is room for customized designs to fit in with the neighborhood, with at least some of the features and amenities.

Bus stops should be integrated with their surroundings
(Credit: Kimley-Horn and Associates, Inc.)

BICYCLE CONNECTIONS

Connecting bicycle facilities to transit stations helps extend the trip length for cyclists and reduces automobile travel. Secure bicycle parking must be provided at or within close proximity to a bus stop, preferably sheltered. At a minimum, the accommodations can be bike racks or lockers. Bike stations and automated bicycle parking can be located at areas with high levels of transit and bicycle use.

Integrating bicycle parking with transit enhances multimodal connectivity
(Credit: Kimley-Horn and Associates, Inc.)

BUS LANES

Bus lanes provide exclusive or semi-exclusive use for transit vehicles to improve the transit system's travel time and operating efficiency by separating transit from congested travel lanes. They can be located in an exclusive right-of-way or share a roadway right-of-way. They can be physically separated from other travel lanes or differentiated by lane markings and signs.

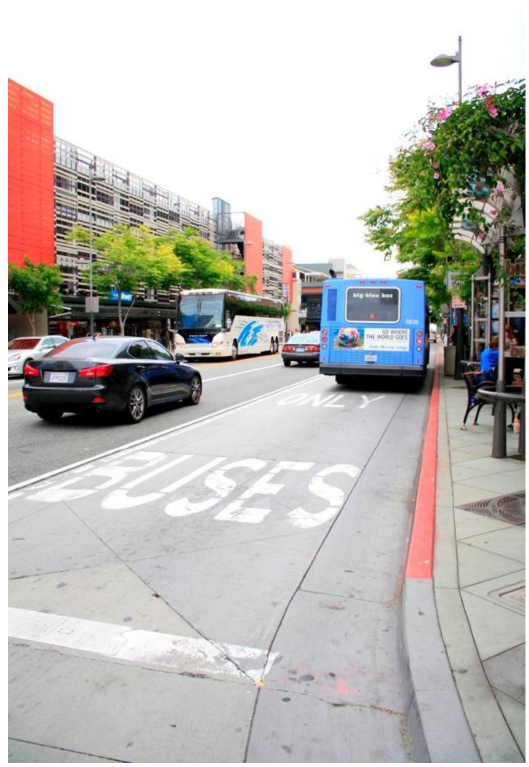
Bus lanes can be located within a roadway median or along a curb-side lane, and are identified by lane markings and signs. They should generally be at least 11 feet wide, but where bicycles share the lane with buses,

Dedicated bus lane
(Credit: Kimley-Horn and Associates, Inc.)

13 to 15 feet wide is preferred. When creating bus lanes, local jurisdictions should consider the following:

- Exclusive transit use may be limited to peak travel periods or shared with high-occupancy vehicles.
- On-street parking may be allowed depending on roadway design, especially with bus lanes located in the center of the street.
- A mixed-flow lane or on-street parking may be displaced; this is preferable to adding a lane to an already wide roadway, which increases the crossing distance for pedestrians and creates other problems discussed in other chapters.
- Within a mixed-flow lane, the roadway can be delineated by striping and signs.
- High-occupancy vehicles and/or bicycles may be permitted to use bus lanes.

Pedestrian access to stations becomes an issue when bus lanes are located in roadway medians.



Bus-only lane: Santa Monica, CA
(Credit: Sky Yim)

Median bus lanes
(Credit: Broward MPO)

BUS BULBS

Bus bulb: Alhambra, CA (Credit: Sky Yim)

Enhance transit facilities to encourage use. Bus bulbs are curb extensions that extend the length of the transit stop on streets with on-street parking. They improve transit performance by eliminating the need for buses to merge into mixed traffic after every stop. They also facilitate passenger boarding by allowing the bus to align directly with the curb; waiting passengers can enter the bus immediately after it has stopped. They improve pedestrian conditions by providing additional space for people to wait for transit and by allowing the placement of bus shelters where they do not conflict with a sidewalk's pedestrian zone. Bus bulbs also reduce the crossing distance of a street for pedestrians if they are located at a crossing. In most situations, buses picking up passengers at bus bulbs block the curbside travel lane; but this is mitigated by the reduced dwell time, as it takes less time for the bus driver to position the bus correctly, and less time for passengers to board.

One major advantage of bus bulbs over pulling over to the curb is that they require less parking removal: typically two on-street parking spots for a bus bulb instead of four for pulling over.

The following conditions should be given priority for the placement of transit bus bulbs:

- Where transit performance is significantly slowed by the transit vehicle's merging into a mixed-flow travel lane
- Roadways served by express or Bus Rapid Transit (BRT) lines
- Stops that serve as major transfer points
- Areas with heavy transit and pedestrian activity and where narrow sidewalks do not allow for the placement of a bus shelter without conflicting with the pedestrian zone

Bus bulb: Huntington Park, CA (Credit: Sky Yim)

Bus bulbs should not be considered for stops with any of the following:

- A queue-jumping lane provided for buses
- On-street parking prohibited during peak travel periods
- Near-side stops located at intersections with heavy right-turn movements, except along streets with a "transit-first" policy

CHARACTERISTICS

At a minimum, bus bulbs should be long enough to accommodate all doors of a transit vehicle to allow for the boarding and alighting of all passengers, or be long enough to accommodate two or more buses (with a 5-foot clearance between buses and a 10-foot clearance behind a bus) where there is frequent service such as with BRT or other express lines. Bus bulbs located on the far side of a signalized intersection should be long enough to accommodate the complete length of a bus so that the rear of the bus does not intrude into the intersection.

Table 10.2 Standard Transit Vehicle and Transit Bus Bulb Dimensions

Vehicle	Length (feet)	Number of Buses at Stop	Platform Length (feet)	
			Near Side	Far Side
Standard bus	40	1	35	45
		2	55	65
Articulated bus	60	1	80	90
		2	120	130

Federal Transit Administration, August 2004. *Characteristics of Bus Rapid Transit for Decision Making* Project NO: FTA-VA-26-7222-2004.1

BCT bus at a Tri-Rail Station
(Credit: Kimley-Horn and Associates, Inc.)

ACCOMODATING LIGHT RAIL, STREET CARS, and BRT

A growing number of streets have light rail lines, street cars, or Bus Rapid Transit (BRT). These need to be carefully designed into the street.

Light-rail in urban street: San Diego Blue Line
(Credit: Kimley-Horn and Associates, Inc.)

The various options for accommodating light rail, street cars, and BRT within streets are as follows:

- Center-running
- Two-way split-side, with one direction of transit flow in each direction
- Two-way single-side, with both directions of transit flow on one side of the street right-of-way
- One-way single-side, with transit running one direction (either with or against the flow of vehicular traffic) and usually operating in a one-way couplet on parallel streets.

For each configuration, transit can operate in a reserved guideway or in mixed street traffic. When installing light rail or street cars within streets, the safety of pedestrians and bicyclists needs to be fully provided for. If poorly designed, these transit lines introduce hazards and serve to divide neighborhoods where crossings are highly limited and/or difficult or inconvenient (see Chapter 8, "Pedestrian Crossings" for more guidance). In general, in areas of high pedestrian activity, the speed of the transit service should be compatible with the speed of pedestrians.

Busway in median with center platform stations:
TransMilenio BRT, Bogotá, Colombia
(Credit: Stewart Robertson)

Tampa Streetcar arriving at station shelter
(Credit: Kimley-Horn and Associates, Inc.)

The potential for each configuration is influenced by the street type. Some transit configurations will not work effectively in combination with certain street types. Table 10.3 outlines the compatibility of each configuration with the four street types.

Table 10.3 Street Types and Transit Configurations

	Center Running		Two-Way Split Side		Two-Way Single Side		One-Way Single Side	
Street Type	Reserved Guideway	In Street	Reserved Guideway	In Street	Reserved Guideway	In Street	Reserved Guideway	In Street
Boulevard	Y	N	N	Y	Y	N	Y*	Y
Multi-way Boulevard	Y	N*	Y	Y	N	N	Y*	Y
Avenue	Y	Y	Y*	Y	Y*	N	Y	Y
Street	N	Y	Y	Y	N*	N	Y	Y

Notes
Y = Recommended street type/transit configuration combination
N = Not recommended/possible street type/transit configuration combination
*Denotes configurations that may be possible under certain circumstances, but are not usually optimal
Source: Integration of Transit into Urban Thoroughfare Design, DRAFT White Paper prepared by the Center for Transit-Oriented Development, updated: November 9, 2007.

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