In Module 4 of this course, we will look at TOD from the design perspective. What are the design principles that can be incorporated into projects and policies to deliver a better TOD corridor? The goal of this module is to become aware of the importance of design strategies for successful TOD. Along with Module 3, which breaks down other key building blocks used in TOD implementation, this module outlines the design principles that should be taken into account when thinking holistically about a TOD corridor project. This module is particularly relevant for practitioners that do not have an architectural or urban design background, as it provides specific design recommendations for TOD implementation.

Even though the focus of this course is on TOD Corridors, many of design principles presented here are applied at the station or even plot area. The design principles we will describe zoom in and out geographically, going from corridor to plot scale. This does not mean that the principles discussed here are not central to implementation at the Corridor level. After all, TOD Corridors are composed of station areas, and corridor projects can create economies of scale by taking a coherent design approach. For example, changes in urban codes that apply to an entire corridor or city, or utilization of a complete streets approach, can be used across station areas to create cohesive design.
The objective of this module is to introduce participants, particularly people without an urban design or architecture background, to a variety of design concepts that are central for successful TOD project implementation. After completing this module participants will be familiar with design vocabulary commonly used in TOD projects, and will be able to utilize these concepts when designing and implementing TOD corridor projects.

Module Objective and Outline

Objective:
The objective of this module is to introduce participants, particularly people without an urban design or architecture background, to a variety of design concepts that are central for successful TOD project implementation. After completing this module participants will be familiar with design vocabulary commonly used in TOD projects, and will be able to utilize these concepts when designing and implementing TOD corridor projects.

Outline:
1. Density
2. Quality Public Transit
3. Non-motorized Transportation
4. Vehicle Demand Management
5. Mixed-use Development
6. Neighborhood Centers & Active Ground Floors
7. Public Spaces and Natural Resources
8. Community Identity and Heritage
9. Resilience
The specific design components discussed within this module are based on elements outlined in the World Resources Institute publication "TOD Guide for Urban Communities," with some new components added. Though that manual was developed for the Mexican context, the design principles included in the publication are widely applicable.

As mentioned previously, the concepts presented in this module are DESIGN and URBAN FORM strategies. Therefore, when a topic such as density is discussed, for example, the design and urban form strategy of increasing floor-area-ratios along corridors will be examined; such financing tools, like economic incentives used to encourage increased building height, will not be covered in this module.

This module is structured along the following design components:

- Density
- Quality public transit
- Non-motorized mobility
- Vehicle demand management
- Mixed-use development
- Neighborhood centers and active ground floors
- Public spaces and natural resources
• Community identity and heritage
• Resilience

Each of these design components will be discussed in detail, and specific design recommendations for each component will be provided.
Let’s start with our first design component, density.

Many of the TOD design principles presented in this module are reliant on densely-populated neighborhoods with high concentrations of employment opportunities, amenities, and services along a corridor. Dense populations create the ridership numbers needed to sustain public transit financially, while economic agglomeration promoted by TOD together with improved mobility and accessibility create demand that generates trips across a region. Higher concentrations of people establish the customer base needed for businesses and services to grow, and, with proper design, can encourage walking and biking, which can bring vibrancy to streets and public spaces.

To prevent urban sprawl, high-density development can be encouraged within cities through specific design and policy strategies. In city centers and along transit corridors, articulated densities should be established. Building codes, for example, can be changed to increase the maximum floor-area-ratio (FAR) permitted and allow for development on smaller plot sizes. In parallel land consolidation can be facilitated for larger development. Allowing for density bonuses and incentive zoning in corridor plans is another strategy that can be used to encourage high-density construction. Finally, design for buildings can also be adopted to increase density. For example, smaller size properties, including micro-unit apartments or offices can be introduced to increase density; their compact design can raise
the number of units able to be constructed within an apartment or office building. High quality design, improved infrastructure, and high quality amenities also attract and support additional density without producing the sensation of congestion.

Planning TOD at a corridor scale requires a clear understanding of where residential and employment densities exist and where they are projected to grow. Thought should be given to existing infrastructure capacity and the cost of adding capacity with increasing densities. Not all stations within a TOD corridor will have high densities; however, corridors should be planned so that they serve high density residential and job centers within a city-center. Such planning should take into account the level of connectivity of a station, to align human and economic densities, mass transit capacity and network characteristics for greater accessibility.
Curitiba, Brazil is a well-recognized example of a city that has focused densities along its Bus Rapid Transit (BRT) TOD corridors. In Curitiba, buildings located along BRT corridors are permitted to have much higher floor area ratios, or FARs, than buildings located further from the corridors. By allowing for higher FARs along corridors, Curitiba has consciously developed strategically distributed density, or ‘articulated density,’ along transit corridors. The establishment of higher densities along corridors has created the necessary ridership, labor force, and customers needed to sustain local market and transit needs, and has increased accessibility to other employment, services, and residential hubs along BRT networks.

Naturally, not all areas of a TOD corridor will warrant the same level of density. Areas within an urban core will demand higher densities, whereas sections of a corridor that extend to suburban areas will taper off in density. In the coming sections we will discuss strategies for determining where densification along a corridor should be encouraged, keeping in mind possible limitations, including current and future market demand and the readiness of a certain station areas to achieve TOD through the application of the other design components discussed in this module.
Quality public transit, a cornerstone of TOD, is the provision of reliable, safe, affordable, and well-connected public transportation. Public transit can operate using many different forms, including rail, bus, BRT, LRT, or metro. A public transit network will ideally include an integrated mix of several transit technologies, with multi-modal stations clustered in the urban core of city.

When effectively executed, quality public transit creates conditions in which people choose public transit over a personal vehicle – this can lead to fewer vehicle kilometers/miles traveled, reduced vehicle ownership, and reduced air pollution and greenhouse gas emissions, as people opt instead for public transport and non-motorized transit. Fewer cars on the road also allows for better utilization of valuable space in city centers, reducing the demand for expensive surface and below-ground parking lots.

What design strategies can cities adopt to change people’s travel behaviors and to increase use of public transportation? Public transit is inherently linked to urban development and land use. The viability of a transportation system relies on its connection to densely-populated neighborhoods; if properly linked to high-density communities, transit systems allow for more convenient trips between destinations in a city. The design recommendations given in this module are strategies by which public transit can best be integrated into a city in order to maximize potential ridership; strategies discussed will
include proximity to the urban footprint, viability of public transit, access to public transit, and public transit infrastructure.
A quality transit system consists of a hierarchy and variety of public transit systems, providing riders with a choice of options to get around a city. A TOD corridor should be designed with the goal of incorporating and connecting as many types of transit systems to one other to create a more robust transit network, but not all stations across a corridor will demand the same variety and capacity of transit options. The types of transit options will depend on various factors including proximity to the urban core, and to dense residential and economic hubs. Those areas the foster the greatest trip demand should feature a greater variety of transit options as well as higher ridership capacity options. When planning a TOD corridor, it is necessary to understand the existing demand at each station, based on existing and projected economic conditions. This will help to prioritize the stations that should plan for the greatest hierarchy of public transit systems.

Here, a hypothetical map of a hierarchized public transit system featuring metro, BRT and feeder bus systems is presented. The zoomed in section of the larger map represents the central business district. Each of the black dots and the corresponding size of the dot demarks a linkage between different types of transit systems. The largest dots, for example, represent connections between two or more metro lines. In some cases these connections are further supported by other forms of transportation such as BRT or feeder bus. Naturally, stations along a corridor that are located within the urban core will sustain higher ridership and therefore can accommodate a greater range of public transit system
connections, especially those with higher ridership capacities such as metro and BRT. Stations that are further away from the urban core, with lower densities, and weaker economic markets will likely foster less variety of public transit systems and will not be able to sustain those systems which have higher carrying capacities.

In addition to variety, efforts should be made to integrate the various forms of public transit. This can be achieved through measures such as integrated fare systems across the different systems; easy access to transfer between systems, and combined operations to ensure higher quality, complementary and complete public transit system network.

As discussed in the next section, non-motorized forms of transportation infrastructure (such as sidewalks, bicycle lanes, and bikeshare systems) are an integral part of TOD design and should also be addressed when creating a truly complementary and integrated and hierarchized transportation system.
Transit-oriented development is only achievable when land use and transportation planning are integrated. When both efforts are unified, a city can establish a cohesive, compact, and sustainable vision about where to incentivize growth through the provision of quality public transit along with the necessary infrastructure, jobs, housing and, services needed to create demand. For corridor scale TOD, integrated land use and transportation planning not only aids in the selection of routes and station areas, but also provides a framework from which to assess the stations within a corridor and determine what interventions are needed to strengthen its TOD readiness.

In order to maximize ridership potential, a transportation system must be properly integrated into an urban area using the connected-city model. In this model, public transit connects an urban community to the rest of the city in which it is located; a community does not depend exclusively on the use of automobiles or roads for access to other urban areas.

Using this model, transit corridors must be located in proximity of a city’s current or planned urban footprint. City officials must assess where enough transit demand exists to sustain public transportation, or where there is potential for future development (based on integrated land use and transportation plans), and route primary and secondary transit systems to these areas in order to accommodate and create demand. These decisions
should be made within the context of establishing a compact and efficient system that connects high density areas of the urban core to one another and to other lower density TOD nodes throughout the urban footprint.
To ensure quality transportation, the type of transit provided or the frequency of transit services should be adjusted based on the population density of the area being served. More frequent and higher quality transit lines should serve areas with high density. Ridership projections can be used to determine the appropriate type and frequency of public transport service.

To realize desired public transit ridership numbers, a transit corridor must be made accessible to the maximum number of people possible. In order to ensure optimum accessibility, a transit system’s stops should ideally be located at a distance allowing easy access by walking or biking from any residence in a community. The suitable distance for walking depends on the topography, climate, quality of sidewalk with 500 meters, 800 meters or 1000 meters most often used. A distance approximately equivalent to a 15-minute walk or a 5-minute bike ride ensures that transit stops can easily be reached by walking or biking from a resident’s home.
A final step that should be taken to ensure high-quality public transit is the construction and maintenance of appropriate infrastructure for transit systems throughout a corridor. Transit infrastructure should be planned to accommodate and prioritize transit needs over personal vehicles; with the proper infrastructure, public transit systems can be the most efficient option for travel within cities.

When designing transit infrastructure within cities, road layout in particular must be taken into consideration to allow for efficient operation of bus systems and BRT options. Ideally, dedicated bus lanes with a minimum width of 3.5 meters should be created throughout the entirety of a corridor. Designated bus bays for public transit boarding and alighting should be provided along the entire length of a bus route. Bus stops should include shelters, information about bus routes, and widened sidewalks for improved pedestrian flow.

Infrastructure to transfer from metro to buses should be carefully designed and tested to ensure good quality accessibility from one mode to the next.
In addition to at grade and below grade public transit infrastructure, many cities are building elevated transit systems and taking advantages of these connections by including second story public spaces. When designing flyovers, viaducts, and other forms of elevated transit infrastructure, special attention should be made to allow for the creation of these elevated pedestrian bridges. Since many of these new transit lines are in the centers of busy road corridors, this allows for easier access to stations. Optimally, they should be planned in conjunction with adjacent developments, so commuters can travel directly into 2nd stories of malls or other commercial centers.
3. Non-motorized Transportation (NMT)

**Design strategies for NMT:**
- Continuous road layout
- Internal connectivity
- Pedestrian and cycling networks
- Sidewalks and bike paths

Non-motorized transportation (NMT), a fundamental concept of TOD, is a term that encompasses the modes of walking and bicycling. Most trips begin and end with walking or cycling, modes that conveniently bring people to mass transit. In order to encourage NMT, safe, connected, and inviting infrastructure must be provided.

Walking and cycling provide low or no-cost alternatives for getting around. Well-designed NMT infrastructure has the potential to coax drivers to make local trips by foot or bike, reducing greenhouse gas emissions and improving quality of life for households who cannot afford a vehicle. Encouraging NMT creates more foot traffic, which has the potential to positively impact local businesses, activate public spaces, and improve security by establishing more “eyes on the street.” Additionally, there are health benefits associated with walking and cycling due to increased physical activity. Reduced vehicle trips can also reduce traffic accidents.

Specific design strategies, including the creation of pedestrian and cycling networks and improvements to the continuity of road layouts, internal connectivity, sidewalks and bike paths, and improved lighting and street furniture can be used to encourage NMT.
To encourage NMT across a TOD corridor, the overall layout of roads within the corridor should be carefully analyzed and adjusted to increase connectivity. Road layout can be improved in a variety of ways, but all improvements should seek to create appropriate and efficient access to housing, jobs, public transit, and services for people and vehicles.

Roads that provide access to urban areas should include adequate pedestrian and cycling infrastructure. Pedestrian and cycling paths—roads dedicated specifically to NMT—should be constructed throughout a city, providing safe and efficient access for pedestrians and cyclists. TOD corridors serve as great opportunity to demonstrate on a smaller scale how to increase continuity of road layouts and showcase continuity’s inherent benefits.

When possible, distances between destinations should also be reduced. When the distance between locations is reduced, people are more likely to use NMT. Roads that restrict access, such as cul-de-sacs in gated communities, should be avoided. These types of roads work against creating connected and inviting corridors. As discussed shortly, block sizes should be minimized to avoid the creation of inhospitable superblocks. These types of long blocks can deter walking, as they increase the perceived distance between locations.
In neighborhoods along a corridor, it is important that internal connectivity is promoted to the fullest extent possible. To encourage internal connectivity, creation of dead end streets should be avoided during the initial planning stage as they reduce connectivity and make travel by foot, bike, and car inefficient and unpleasant. At least passageways for bicycles and pedestrian should be preserved. Additionally, block sizes throughout a neighborhood should be taken into specific consideration during the planning stage. Block size should ideally be no longer than 250 meters (or better 110 meters, according to UNHabitat) to improve trip efficiency- short block distances can help create shorter trips. If blocks are longer, pedestrian connections and paths can be designed into the plot layout to achieve improved connectivity.

The right side of the image seen on this slide shows the inefficiency in movement that ‘super blocks’ create, as compared to the smaller blocks shown on the left side of the image. Even though the distance between points A and B is the same as the distance between points B and C, the walking distance between A and B is 500m, while the walking distance between B and C is 1500m.

When evaluating placement of stations along a TOD corridor, careful consideration of internal connectivity should be taken to determine whether an area is conducive to efficient movement for motorists, pedestrians and cyclists. Strategies to improve internal
connectivity serve to strengthen continuity of road layouts at the wider city scale, and can create possibilities for expanding pedestrian and cycling networks along the corridor and the across the broader city.
When designing pedestrian and bicycling projects at the corridor scale, a concerted effort to create connected and contiguous networks for cycling and walking must be made. These networks must be viable routes for both recreational and commuting purposes. As with all NMT routes, pedestrian and cycling networks must be direct and efficient. Bicycling networks should be designed to connect neighborhood centers, key origins, and destination points within a neighborhood and across a corridor. Pedestrian paths can be planned to increase access to areas where roads cannot be built due to rough terrain or insufficient space between buildings.
Just as special attention is given to designing road infrastructure for cars, NMT infrastructure must be carefully designed to benefit pedestrians and cyclists. Let’s look at some good practices for pedestrian and cycling infrastructure design.

To best accommodate pedestrian flow, it is recommended that sidewalks be designed using a three-section strategy, as illustrated in the image depicted on this slide. These three zones are as follows:

- **Service zone**: The service zone should contain a sidewalk’s urban furniture (benches and trash receptacles), vegetation (trees and plants), and storm water management infrastructure. Underground infrastructure, like electricity and cable infrastructure, should also be placed in this zone.
- **Pedestrian flow zone**: The pedestrian flow zone is the zone strictly dedicated to pedestrians, and should be free of all obstructions. Special attention should be given to the material chosen for construction of the sidewalk, as maintenance of this area is critical; users of all ability levels, including those with disabilities, must be able to maneuver across the material. The width of this area must be able to accommodate pedestrian flow in both directions.
- **Front-of-building zone** – This area marks the transition from public to private property. The front-of-building zone can be utilized to serve many purposes: this is the area in
which restaurants can create outdoor seating and stores can post signage. For private residences, front porches and plantings provide transitions to private property.

A fourth zone for bicycles can be added when space permits: bicycle lanes can be included as an additional section of the sidewalk or as part of the street. Bicycle flow can be improved when bicycle paths are constructed at road level; separate designated spaces can help keep bicyclists and pedestrians from invading each other’s space.
Another important design component of TOD is vehicle demand management, or VDM. VDM is the application of strategies and policies to reduce or redistribute travel demand for private vehicles. Utilization of some of these concepts is also termed Transportation Demand Management, or TDM. Discouraging the use of private automobiles in the planning and design of a community gives priority to users of more sustainable means of transportation. The management of vehicles, combined with increased usage of quality public transit service, can contribute to the reduction of air pollution and greenhouse gas emissions, traffic accidents, and the time and cost of daily commutes. In this course, we will focus on the design aspects of vehicle demand management; however, it is important to note that there are other policy tools used for VDM, such as congestion pricing and registration fees, that will not be covered here.

Private vehicles are a necessary component of any city. However, their usage should be managed carefully so as not to encourage development that is inefficient, unsustainable, and inequitable. This section discusses design components of vehicle demand management that can help to optimize daily commutes, establish appropriate road order, incorporate controls in parking practices, and improve road safety.
Location plays a critical role in reducing dependence on personal vehicles. Efforts should be made to create compact regions with short commutes, that connect people to areas with high concentrations of jobs clustered around quality mass transit hubs. Daily commutes can be optimized and public transportation ridership can be encouraged when employment opportunities are located near transit stops. One study of travel data from Denver, Colorado found that 38% of workers with jobs located within a 15 minute walk of a transit station opted for public transit over personal vehicles. The study also concluded that 62% of those living and working within a 15 minute walk of a transit station used public transit for their daily work commute. Through various incentives, businesses, companies, and other commercial entities can be encouraged to locate near transit systems in order to ensure that their employees will not have to rely on automobiles to reach work.

Other efforts can be made to reduce the number of personal vehicle trips made for the purposes of commuting by coordinating shared vehicle initiatives, such as carpools, vanpools, or busing initiatives. These programs can involve businesses, educational or health facilities, and individuals to encourage a maximum number of people to participate.

TOD corridors and stations should be located in areas with current or projected high employment densities to capitalize on increased transit ridership. This strategy can be combined with parking management initiatives discussed later in this section to further
incentivize transit ridership.

To encourage NMT and decrease vehicle usage, people must feel safe using sidewalks and streets as pedestrians and cyclists. Road safety, as achieved through road design, is another critical strategy for vehicle demand management that can be applied throughout a TOD corridor, and in particular around mass transit stations where pedestrian volumes will tend to concentrate.

Improving intersections and crosswalks is an important first step that must be taken to increase road safety. Clearly defined road crossings and pedestrian-oriented intersections create conditions that allow for the sharing of the road by motorized vehicles and pedestrians. Road crossing infrastructure must be designed so that all types of pedestrians, including children, the elderly, and persons with disabilities, are able to cross the street. Road crossings should be at sidewalk or road level, with ramps that have a maximum slope of 8%, to increase accessibility. The crossing itself should be as short as possible so that pedestrians can cross the street quickly. To improve road safety conditions for all, traffic signals should provide clear messages from an appropriate location. Street intersections should create 90 degree angles, and have appropriate horizontal markings. Finally, efforts should be made to reduce the number of roads that share an intersection to ensure that the potential for vehicular accident is reduced.

Road design is another important strategy for vehicle demand management. Good road
design can lead to multiple positive outcomes, including improved road safety. Congestion levels and vehicle usage within an urban neighborhood can be managed through the assignment of maximum speeds, maximum number of lanes, and maximum lane widths based on road typology.

Road types include primary, secondary, and local roads; each type of road serves a specific function based on its location. Primary roads, throughways that connect traffic to local roads, should be designed to be wider access ways; primary roads should have 4 to 6 lanes that are approximately 3 meters wide, and should allow for a maximum vehicular speed of 60 km/h – with some experts promoting speeds not to exceed 50 km/h. In contrast, secondary and local roads, which provide residential access, should be characterized by fewer lanes, smaller lane widths, and lower maximum speeds. Local roads in particular should establish maximum speeds of 40 km/h in order to prioritize non-motorized mobility and decrease the likelihood of traffic accidents, with some experts suggesting speeds not to exceed 30 km/h. Road typology can also be used to determine other design aspects of a road, such the inclusion of bike lanes, medians, and parking spaces, and the width of sidewalks and exclusive public transport lanes. Different road features take up specific amounts of space on a road, and therefore require roads of certain widths; for example, a BRT-exclusive bus lane would not fit on a local road, because local roads are typically too narrow.
Parking management is another important tool used in vehicle demand management.

Parking can impact urban areas undesirably; parking lots are an inefficient use of land, and can serve to perpetuate the use of private vehicles. Efforts to minimize parking should be made, and, where needed, parking fare structures should be established for short-term and long-term parking.

For private parking facilities within a community near a mass transit station, building codes and design guidelines for new development can include specifications that discourage the construction of parking spaces and parking lots. Policies to achieve this outcome can include those that change minimum parking requirements for housing units or commercial developments; new policies might allow developers to build fewer parking spaces per unit. In addition, building codes can be created that allow for the sale of parking spaces separately from the purchase of residences. Codes can also be established that allow developers to replace parking space with bicycle parking facilities, removing parking space requirements entirely. When parking facilities are provided on public roads, parking spaces must be well-defined and have appropriate signage.

To avoid the underutilization of parking spaces, effort should be made to repurpose parking lots during times of the day when demand for parking is lower. For example, a collective
parking facility in a residential zone can be used as a play area or community space when parking demand is low. Finally, a stronger emphasis should be placed on bicycle parking in order to make bicycling a viable means of transportation. Bicycle parking facilities should be provided in strategic locations throughout a community, and should be properly integrated with other forms of public transit.
Another central piece necessary to achieve successful and sustainable TOD are mixed-use and efficient buildings.

Single-use areas, such as residential or commercial-only districts, promote the use of personal vehicles, as people are forced to travel long distances to run errands. Furthermore, single use areas create dead zones devoid of vibrancy, as residents lack outdoor activities in their neighborhoods after dark, and commercial areas become desolate when businesses close. Well-designed mixed-use spaces, however, can provide a diverse range of urban services for city residents that establish 24-hour districts; this can decrease the number of trips residents take by car outside of their neighborhood. The diversity of uses within sustainable urban communities makes them appealing and vibrant destinations, encourages the use of public spaces, promotes the use of non-motorized transit, and generates economic value.

Specific design strategies, including the strategic location of regional facilities and neighborhood facilities, can be used to create more efficient TOD neighborhoods.
When planning for TOD at the corridor-level, it is important to take into consideration the location of facilities at both the neighborhood and city or regional level. While residents must have access to specific types of facilities within their neighborhood, other facilities can be accessed by residents at a wider, regional or city scale.

At the neighborhood scale, facilities such as retail, playgrounds, schools, and public market spaces should be easily accessible by residents from any point within that neighborhood. While retail and playgrounds should, ideally, be no further than 600 meters away from any point within a neighborhood, schools and markets should be less than a 1 km trip. When facilities are accessible at the neighborhood scale, residents avoid vehicular usage; residents can complete errands in their neighborhood, and have less of a need to leave their neighborhood by vehicle for destinations farther away. When the location of neighborhood facilities is complemented by good pedestrian and cycling infrastructure, many day-to-day errands can be done on foot or by bike.

At the regional or city level, it is also optimal to locate certain public facilities within a reasonable spatial distance from any point in that region. Ideally, schools, grocery stores, universities, health care, and cultural facilities should be easily accessible to residents within a region by a mix of public transportation, pedestrian, and cycling networks. If these facilities are easily accessed by residents, then a region has achieved its goal of mixed-use....
development.

One constraint to achieving optimal access is demand. Areas that do not have sufficient densities may not be able to sustain facilities. Market analysis should be included in all decisions about placement of facilities at both the neighborhood and regional levels, keeping in mind future growth projections.

The images found on this slide show recommended distances that can serve to guide optimal placement of facilities in neighborhoods and regions in Mexico. For example, it is recommended that a hospital be located no farther than 5 km away from all points within a region; such placement of health centers can ensure that all residents have easy access to medical care. **The standard distances of urban facilities vary from country to country and city to city, reflecting local context.**

It is important that TOD corridors are designed to increase accessibility to current and planned neighborhood and regional facilities.
Let’s turn now to another design component of TOD: neighborhood centers and active ground floors. Creating central public spaces and buildings that engage pedestrians is a necessary component of TOD; including such features in the design of a TOD neighborhood can prevent the creation of an isolating built environment. In addition, creation of vibrant neighborhood centers can drive demand along an entire TOD corridor, bringing prosperity to residents throughout the area.

What design strategies can be used to encourage vibrant neighborhood centers throughout a TOD corridor? This section will discuss different strategies that can be taken to create active neighborhood centers and ground floors, including strategies concerning neighborhood center design, local economic development, development of active ground floors, and public-private transition.
Neighborhood centers are vital for the overall success of a TOD corridor; as such, the design of these centers must be carefully considered. All TOD corridors should connect neighborhood centers, recognized central locations where residents can access local business and fulfill demand for goods and services. In addition to commercial opportunities, neighborhood centers should have public space for recreation, and should be connected by public transit, biking, and walking infrastructure to other neighborhood centers.

In order to create active community centers, specific design strategies can be used. Neighborhood centers should be characterized by higher density development than the rest of the community in which it is located. In addition, a neighborhood center can have specific a urban image or urban landmark that creates unique place identity, a strategy referred to as ‘placemaking’ or ‘branding.’

To create vibrant communities filled with thriving business, TOD corridors must have active local economies. Local economic development can be encouraged through design of the neighborhood centers located within a corridor. Neighborhood centers should contain a variety of businesses, both retail and commercial. In addition, it is recommended to locate at least four different types of businesses with distinct space usage within a 600 meter pedestrian trip in a neighborhood center.
In order to develop a community’s local economy, construction codes can also be changed to allow for the creation of “productive residences.” Productive residences are created when residences, including single-family homes, are designed, renovated, and converted in order to integrate commercial or retail space. Allowance of productive residences can increase the number of businesses within a neighborhood center, and can create employment opportunities for a community’s residents.

During planning stages, it is important to conduct local economic analysis to determine best-fit strategies for neighborhood center development. A corridor or city’s primary, secondary and tertiary economic sectors should all be analyzed in course of this process.
Other design strategies used to make TOD corridors more vibrant and attractive are the creation of active ground-floors and the implementation of public-private transition regulations.

To achieve active ground floors, neighborhood centers should encourage construction of buildings with commercial ground floors and residential and office space on top floors. This is particularly important for those buildings that surround public spaces, facilities, and pedestrian streets. Commercial businesses that enhance community living, such as cafés or salons, should be encouraged to occupy ground floors.

Closely connected to the idea of active ground-floors is the design of transition areas between public and private spaces. Public-private transitions can help set the tone for a neighborhood center; this transition must serve to create a welcoming experience for pedestrians, as buildings that appear closed off and uninviting diminish the pedestrian experience.

To achieve the correct public-private transition, it is necessary to set standards to guide the design of facades in neighborhood centers. Guidelines for this transition can vary; however, recommended design parameters for neighborhood center facades are as follows:

- 60% of the primary façades of all commercial ground floors that border the
sidewalk or a public space must be transparent, and occupied by windows, displays or doors

• 40% of the primary façades or perimeter walls of all residences must be transparent, and occupied by windows, doors or lattice work

In addition to façade requirements, design requirements for perimeter walls in neighborhood centers can be established. These requirements might include any of the following:

• Setbacks no greater than 5 meters for private buildings and 10 meters for public buildings
• Heights of individual walls cannot exceed 3 meters
Public spaces and natural resources are an important component of successful TOD, as well-planned public spaces have countless social, environmental, and economic benefits for a community’s residents. Public spaces, including green space, provide places of meeting and cultural exchange for all segments of the population, regardless of social or economic status.

Public and green spaces also provide opportunities for city officials to incorporate risk and natural resource management into city planning. Green spaces can mitigate risk by serving as protection from natural disasters; green space can also establish habitat networks to support native flora and fauna. Additionally, well-designed green space and natural habitats can reduce costs through the free provision of ecosystem services. For example, green spaces can serve to improve a city’s overall air and water quality and can decrease urban heat island effects.

Provision of public and green spaces can seem in direct conflict with TOD’s density goals; however, the two design components must be thought of as complimentary. Creating high density TOD corridors that lack areas for community interaction or relief from urban living can be stifling to spirit and health. Balancing the two design components to achieve high density and green and public space is not only possible, but necessary.
TOD projects at both the corridor and station area level must plan, early on, for the placement of public spaces and the conservation of natural habitats- this should preferably result in networks of contiguous green corridors. Public space must be planned and maintained to ensure spaces remain clean, safe, and vibrant.

Public space and natural resources can be incorporated into TOD using several design strategies. These include the development of strategic green areas and public space networks.
In order for cities to be sustainable, they must also be green; sustainable cities are those that have networks of green space strategically located throughout the city. Access to green space has countless health and social benefits for city residents. Conservation of natural habitats and green areas can also reduce risks associated with natural disasters, such as flooding, erosion, landslides, and mudslides. Preservation of sensitive or critical ecosystems and creation of buffers along water ways protect against habitat loss and species extinction, while at the same time improving aesthetics, access to green space, and natural resource production.

TOD projects and TOD design should encourage accessible green space. When planning for a TOD project, it is important to perform an environmental impact study for the project’s area; this can reduce any negative impacts the project might have on the local environment. When designing a TOD project, effort must be made to preserve natural green space. These spaces can be used for environmental services or for recreational purposes. A TOD project’s designed green spaces should be open to the general public, and access to these areas should be prioritized for non-motorized means of transit.
Public spaces should not be viewed as islands in a sea of buildings—instead, they should be designed to be part of larger networks which together provide access to a range of different public services throughout a TOD corridor. To achieve strong networks of public space accessible by all members of a community, TOD corridors should be designed to have green space within specific distances of all points within a neighborhood. As the image on this slide indicates, a neighborhood garden should be accessible to all residents within a 400 meter walking or bicycle trip, a neighborhood park accessible by 800 meter walking or bicycle trip, and a public sports venue accessible by 1,200 meter walking or bicycle trip.

Additionally, public spaces must be designed to integrate with existing urban space and meet the needs of local residents. To properly integrate a public space network, the public spaces within the network should connect with each other and with a neighborhood’s primary leisure spaces. This network can be connected through a system of sidewalks, pedestrian paths, or cycling paths. A public space network should also incorporate community public spaces, especially in areas that lack existing open space, and should be coordinated with existing commercial and public facilities. Within wider public space networks, individual public spaces should be vibrant areas characterized by their accessibility and safety.

Public spaces can also be linked together to allow non-motorized transport (NMT) direct
access to transit stations, creating shortcuts that are not available to cars and improving walkability and access to transit.
Local residents are often far removed from the planning process, having little opportunity to voice visions and concerns for their community. However, community engagement is increasingly recognized as a valuable component of project planning and implementation. Citizens are an important part of the design process because they establish local identity, which can foster increased stewardship of and involvement in community activities.

This section will focus on design aspects that can create and preserve community identity, an important component to any TOD project, and maintain heritage elements. TOD design can be used to create and develop place identity and shared community streets.
Preservation of local identity is key in defining unique places and creating a sense of belonging among residents, which are central for TOD projects. Effort should be made to recognize local assets when planning a TOD project. TOD design can serve to compliment, enhance, and reflect local cultural, heritage/historical, and environmental features.

TOD design can be integrated with the local environment, including such features as rivers, cliffs, agricultural lands, forests, and regional fauna and floral. Natural areas should be protected from development for the capturing of CO2, aquifer replenishment, and maintenance of biodiversity. When possible, green spaces should be preserved as recreational areas for residents.

Historical areas can also be enhanced through TOD design. Important local landmarks, including heritage buildings, churches, and monuments, must be preserved to keep a community’s history alive. TOD design can serve to increase access to historical locations; for example, pedestrian zones can be created around important monuments and buildings, improving connectivity between important historical sites.

In relation to the historical identity of a community, the architectural features of a TOD project should take local context into consideration. Existing buildings can be used as prototypes, and properties of local architecture, including construction materials and
façade colors, can influence TOD design.

Finally, TOD projects should also take a community’s cultural traditions into consideration when designing development for a neighborhood. If a community has traditional festivals, parades, or weekly markets, these customs must be accommodated through design.
Another way in which community identity can be established is through the creation of shared community streets. Streets should not only be thought of as spaces for cars—instead, they can also be used as shared public spaces. Many cities around the world have programs in which streets are periodically closed to cars and are opened only to pedestrians and bicyclists. When streets are thought of as public spaces, opportunities for community enhancement are created. Community streets can be used for a variety of purposes, including such events as food fairs, festivals, games, and parades.
Zoning codes provide a means from which to facilitate some of the design concepts discussed in this module. Through the establishment of mixed-use districts, encouragement of streetscapes that are created for all user experiences (not just vehicles), sidewalks that are built for multiple purposes including green space, pedestrian experience, and aesthetic transitioning to adjacent businesses and residences, zoning codes can be powerful tools.
For a TOD project to be successful, its design must also be resilient, in particular since it will tend to increase densities around mass transit stations; TOD design must take into account and plan for uncertainty and hazards. Understanding and planning for risks, while seemingly more costly and time-consuming in the short-term, can help protect communities from disasters and lessen economic and social costs during times of crisis.

When implementing TOD at a corridor scale, local risks must be identified and every effort should be made to avoid development in areas of high risk, such as areas prone to flooding or mudslides. Identifying and mapping of such risks is a critical first step in determining a plan for incorporating resilience into TOD corridor design. Once risks are identified and TOD corridors are determined, ideally outside of high risk areas, it is still necessary to design robust corridors that anticipate failure and can withstand hazards. One example is through strategic preservation or establishment of wetlands to absorb flooding from storm events. Finally, redundancy, or spare capacity purposely created within a system so that it can accommodate disruption or pressure, must also be incorporated into TOD corridor design. For example, a city can create redundancy by integrating its TOD transit corridors with other forms of transportation to provide multiple evacuation routes and multiple lines of access to important facilities like hospitals.
Module Quiz

1. Which of the following statements is NOT true?
   a. TOD aims to bring housing and jobs closer together.
   b. TOD prioritizes public transit and NMT over private vehicle usage.
   c. TOD aims to separate residential and commercial zoning.
   d. Public and green space are important components of TOD design.

2. Which of the following statements is NOT true?
   a. Sidewalks can be divided into three zones, or segments.
   b. Trees and vegetation should not be included in any zone of the sidewalk.
   c. Pedestrian zones should be free of all obstacles, well maintained, and wide enough to accommodate pedestrian flow and users of all abilities.
   d. Service zones of sidewalks can include street furniture and service infrastructure.

3. When conducting a local economic analysis, which of the following economic sector(s) should be analyzed?
   a. Primary
   b. Secondary
   c. Tertiary
   d. All of the above

4. In what ways do cities benefit from creation of public space and the conservation of natural resources?
   a. Risk mitigation (e.g., protection from flooding, landslides, and hurricanes)
   b. Ecosystem services (e.g., rainwater filtration and purification, aqueduct and water table recharge, production of oxygen and CO2 sequestration)
   c. Health benefits
   d. All of the above

Answers

1. c
2. b
3. d
4. d
Module Quiz

5. Which of the following descriptions defines redundancy in a resilient system?
   a. Spare capacity purposely created within a system so that it can accommodate disruption, extreme pressures or surges in demand
   b. Well conceived, constructed and managed physical assets, so that a system can withstand the impacts of hazard events without significant damage or loss of function
   c. The need for broad consultation and engagement of communities, including the most vulnerable groups
   d. The ability to rapidly find different ways to achieve goals or meet needs during a shock or when under stress

6. When defining place identity, which of the following characteristics should be considered?
   a. Environmental
   b. Historical
   c. Cultural
   d. All of the above

7. Approximately ______% of the primary façades of all commercial ground floors that border the sidewalk or a public space should be transparent, and occupied by windows, displays and doors.
   a. 15%
   b. 25%
   c. 40%
   d. 60%

Answers
5. a
6. d
7. d