
# Transit Architecture in the COVID-19 Era

IBI Transit Architecture Studio

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Transit stations must incorporate new design principles to respond to a future pandemic and promote the safety of passengers. The end result will be an improved transit environment based on the following design elements:

## A simplified, streamlined station experience

Removing unnecessary transactions and surfaces that can be touched, while providing for a new set of station amenities: screening areas and sanitizing stations.

## Flexible and resilient space that allows for agility in transit operations

Designing for multiple scenarios and maximizing both interior and exterior spaces to allow for physical distancing and enhanced screening/ticketing.

## Station architecture that incorporates new standards of safety and hygiene

Analysis of station capacity, improved air quality, antimicrobial surfaces and enhanced signage that supports both regular transit operations and a potential emergency mode.

# Pandemics and Urban Infrastructure

Advancements in the quality and design of public infrastructure have often been linked to public health crises. From the Bubonic Plague leading to advancements during the Renaissance; Cholera leading to advancements in wastewater treatment, indoor plumbing and paved streets, disease is often a driving force in the development of urban design and infrastructure standards.[1] As a global pandemic exposes potential weaknesses in the way we live, travel and build, architects, planners and engineers are implicated in the causes and potential solutions to this crisis. The current crisis challenges us to contemplate permanent changes to our city's development.

The transmission of COVID-19 occurs in environments where proximity, density and ease of mobility drives the design of the urban form. While urban environments have traditionally been held as examples of progress in urban design as well as the solutions to many of our problems --climate change and economic stagnation--they have also become the ideal environment for the rapid spread of this disease.[2] Subway systems, bus networks and train stations enable our urban patterns and are, themselves, environments of increased density, movement and co-habitation. Meeting the challenge in adapting cities to fight against COVID-19 and similar diseases will depend on the resiliency of our transit systems.

# The Role of Mass Transit

At the time of this writing, rapid transit use in cities has decreased to approximately 15% of its pre-COVID-19 levels.[3] While this does enable transit systems to maintain physical distancing, it illustrates the challenges ahead for cities in restoring full capacity for their transit networks during a pandemic. This capacity will not be easily accommodated with an unprecedented surge in ridesharing or private automobile trips and, therefore, must be addressed within the transit system.[4]

At the same time, the ongoing functioning of transit networks during the pandemic has enabled essential workers to continue to reach centres of employment, grocery stores and hospitals to maintain vital services for all citizens. In Toronto, Canada, the Toronto Transit Commission (TTC)--like many other transit operators worldwide--is currently assessing their service with respect to physical distancing and prioritizing routes that serve these areas.[5] A reimagined transit station will need to accommodate strict physical distancing and hygienic protocols during "lockdown" as well as enable a recovery when most of a city's inhabitants are able to return to work.


Pioneer Village Station, Toronto, Canada

# The Transit Context

In considering changes to the immediate transit environment, there are several related issues that will undoubtedly affect how the transit environment evolves in the future:

• Retail patterns are being transformed by the current pandemic, as the shift to online and curbside pickup models are accelerating.[6] As buildings that typically interface or contain retail areas, station layouts and program requirements may evolve to reduce the dependence on traditional retail or incorporate new models of retail.

• Transit Oriented Communities which comprise residential, commercial and office space will undergo fundamental transformation as the traditional workplace-home commuting pattern is disrupted in the years to come.[7]

• Development of personal rapid transportation comprising a driverless pod (i.e. SkyTran) could see renewed interest from forward-thinking jurisdictions that seek an alternative to mass transportation.[8]

• The development of autonomous vehicles (AVs) has been given renewed purpose as all businesses seek contactless forms of transport and delivery. While there is little evidence to show that AVs are a replacement to rapid transit systems, the anticipated reductions in parking area and traffic congestion in the urban environment may support a reallocation of space towards resilient transit functions: queuing, screening, and social distancing.

The task of designing agile, flexible and responsive transit facilities to protect against the current pandemic is the best opportunity to future-proof our public infrastructure taking into consideration the following questions:

**Looking Past the Pandemic**

How can these measures protect us against other disasters, natural and man-made?

What innovations can be carried forward into other public spaces?

Can transit stations be designed to expand their function in a pandemic, lending space where needed to the healthcare system or essential businesses?

Can the changes proposed to address these current challenges also serve to make a transit station accessible to a wider range of the public?

Can public transportation facilities act as hubs of active transportation to support the ongoing health of the urban population and air quality?


OLRT Parliament Station Exterior, Ottawa, Canada

# 10 Design Solutions

The current crisis illustrates that mass transit and any associated facilities will need to function safely and continually from response to recovery. In designing a mass transportation network that is ready for the next pandemic, the following solutions have been identified for the design of rapid transit stations:

## 1 Integrated Physical Distancing

The use of distinctive materials and finishes as well as temporary barriers can guide passengers safely to maintain physical distance.

## 2 Assessing Station Capacity at the Concept Stage

Station layouts can be designed to accommodate adequate distancing and the logical separation of pedestrian traffic.

## 3 Development of the Exterior Realm

Exterior transit plazas can perform additional functions to aid in a pandemic response.

## 4 Reconfiguring the Touch Zone

The transit environment will be transformed by the removal of unnecessary physical transactions.

## 5 Enhanced Screening & Sanitization Measures

The new spaces will be required to accommodate added health measures to instill confidence in ridership.

## 6 Material Performance Requirements

New standards for material selection, based on scientific research, will decrease virus transmissibility in the transit environment.

## 7 Standards for Air Quality

Air quality will become a central design criterion in station design.

## 8 Growth in Active Transportation

Integration with an urban cycling strategy will be critical for a future pandemic response.

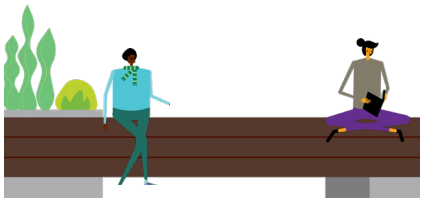
## 9 Improved Messaging

Frequent communication with passengers and the public during an evolving pandemic response will require a flexible messaging strategy.

## 10 Flexibility in Station Design

Station designs will need to support to a multitude of pandemic response strategies.

# 1 Integrated Physical Distancing



**The use of distinctive materials and finishes as well as temporary barriers can guide passengers safely to maintain physical distance.**

Guiding and restricting passenger movement has been a key component of transit station design allowing orderly boarding/alighting on station platforms, even loading of trains and the separation of paid/unpaid areas. Additional requirements to maintain safe physical distancing during a pandemic can be integrated into the station in architecture several ways:

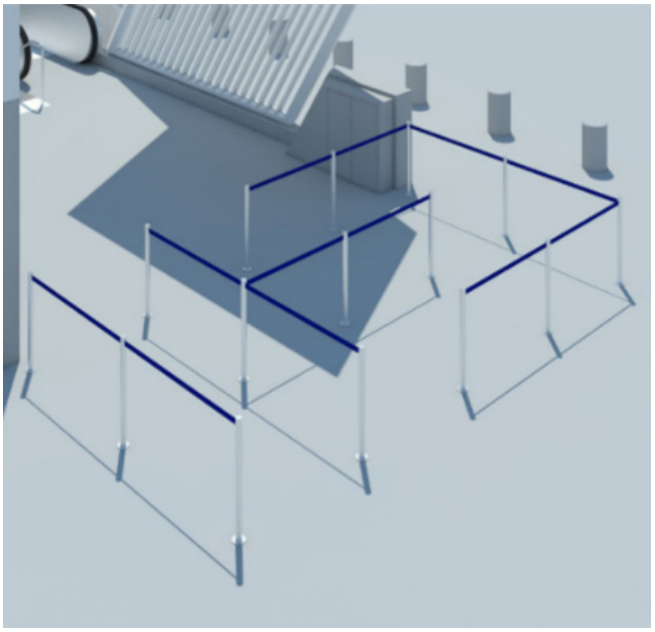
• Decals or contrasting/tactile tiles are currently used in transit stations to indicate accessible routes, platform loading areas and fare paid zones. The same devices can be used to indicate a safe 2m distance at platforms and waiting areas. These markings can be further integrated into the station architecture with accent tiles or alternating bands of colour in the floor finish.

• The current practice of locating seating must be reconsidered to provide physical distance. For example, combining clusters of seating with payphones, vending machines and refuse bins creates an area of congregation that needs to be planned carefully to ensure that physical distance can maintained.

• Individual benches can be designed to indicate this distancing module with removable seats/backrests and changes in material finish.

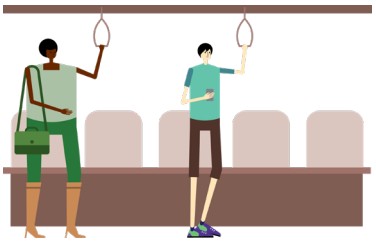
• In stations with high volumes of passengers or where queuing space is anticipated, temporary barriers may be required to separate and channel passengers. Stanchion and belt systems are widely used in airports to separate traffic and have also been integrated into the entrances on the Tel Aviv Red Line LRT to create a flexible screening area at each entrance.


Parliament Station, Ottawa LRT



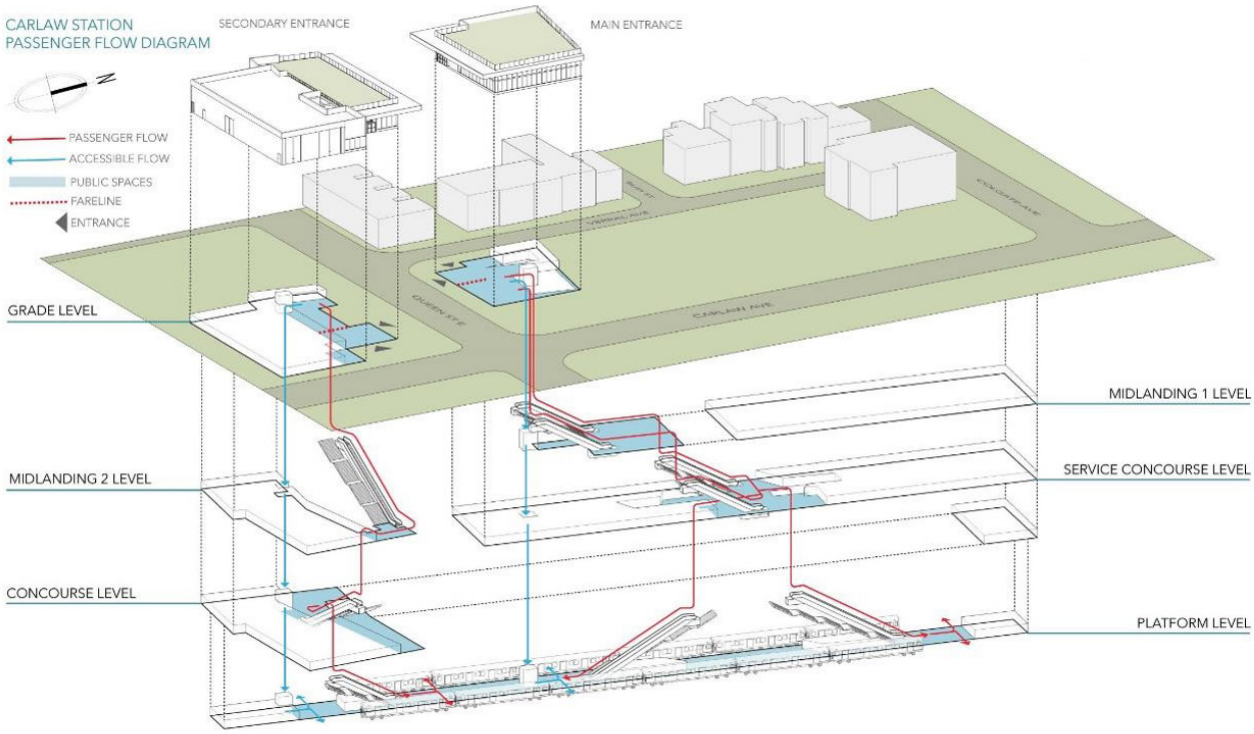
NTA Red Line, Tel Aviv

# 2 Assessing Station Capacity at the Concept Stage



**Station layouts can be designed to accommodate adequate distancing and the logical separation of pedestrian traffic.**

Beyond offering guidelines for physical distancing to passengers, stations themselves will need to be sized and organized to allow for a separation of passengers and streams of movement. Transit stations are currently sized for a peak period to handle a maximum amount of crowding. To account for a pandemic scenario, the planning of the station areas must begin to consider the capacity of the station with physical distancing measures in place. As designers, further review during the planning stages will be required to reduce areas of congregation and eliminate cross-flows of passengers. If needed, additional surge spaces can include temporary barriers and allow passengers to safely distance while waiting for escalators, elevators and ticket machines.




Circulation Diagram, Carlaw Station, Relief Line South, Toronto, Canada

# 3 Development of the Exterior Realm

**Exterior transit plazas can perform additional functions to aid in a pandemic response.**

As transit networks throughout the world explore ways to shift ridership off peak travel times during the pandemic, the transit environment may evolve to accommodate waiting areas and provide real-time messaging to passengers. In New York City, the MTA has contemplated timed ticketing, which would restrict entrance to passengers within a defined window to limit crowding of the system.[9] To accommodate this and similar pandemic scenarios, where capacity is being closely monitored, adequate space for queuing outside of stations with enhanced messaging may become a requirement of transit station planning. Where it is possible, exterior plazas may serve additional transit functions to accommodate queuing, screening and additional bike parking. As public buildings that face onto prominent streets, it is worth considering other functions that a transit plaza can contribute to a city during a pandemic response: open-air markets, community testing sites, food banks, etc.


Eglinton Crosstown LRT, Toronto, Canada

# 4 Reconfiguring the Touch Zone

**The transit environment will be transformed by the removal of unnecessary physical transactions.**

From arriving at a station to entering a train/bus, a passenger typically encounters several shared surfaces in the transit environment:

**The Touch Zone**

- Door Handles
- Elevator Buttons
- Escalator & Stair Handrails
- Ticketing Machines & Booths
- Payphones
- Benches
- Information Kiosks
- Washrooms

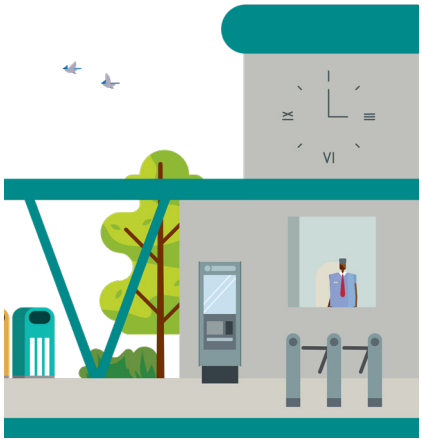
In the short term, an increased focus on cleaning and disinfecting these areas may reduce the likelihood of virus transmission. As new stations are built, it will become favorable to replace many of these surfaces by emerging "touch-free" technologies like voice activated commands, motion/gesture recognition and holographic buttons. Where physical contact is required, automated cleaning devices will require additional design considerations to be seamlessly integrated into the station environment. The use of contactless, mobile payment methods is ubiquitous in many urban centres. As the move to cloud-based contactless payment accelerates and transactions move to individual mobile devices, this presents further opportunities for station designers:

- The station environment may become more sparsely populated by removing kiosks, fare gates, buttons and other passenger-transit interfaces. This will dramatically affect the planning of stations and potentially improve the transit experience for all passengers.

- As personal devices collect and share data with the transit systems, the network can monitor station capacity during a pandemic and aid in contact tracing of people and spaces.

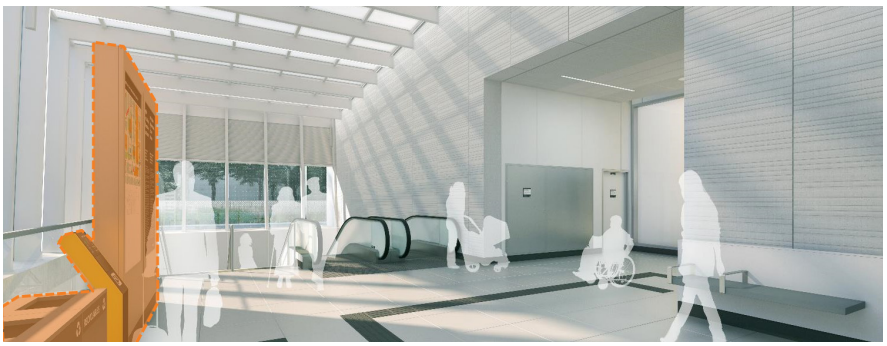

Eglinton Crosstown LRT, Toronto, Canada

# 5 Enhanced Screening & Sanitization Measures



**New spaces will be required to accommodate added health measures to instill confidence in ridership.**

The post-COVID-19 transit facility will need to support measures for passenger hygiene as well as an enhanced cleaning regiment. At entrances this will likely mean reserving areas to deploy screening checkpoints and hand sanitizing stations. To clean the station, transit systems are exploring new technologies such as automated disinfecting robots and UV lights.[10] In back of house areas, additional space may be required to accommodate cleaning equipment as well as staff rooms for cleaning personnel.

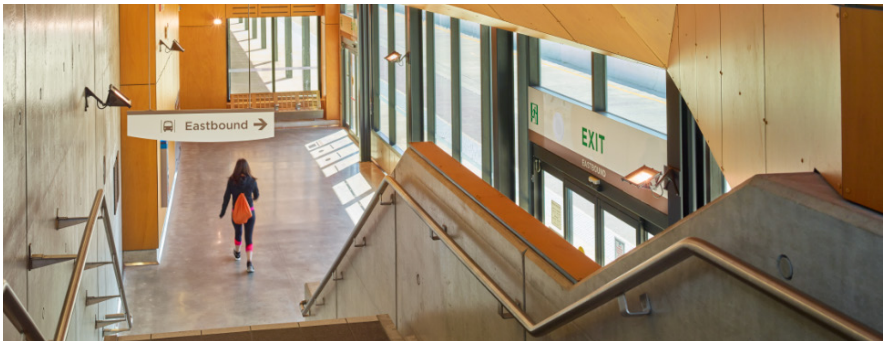


Eglinton Crosstown LRT, Toronto, Canada

# 6 Material Performance Requirements

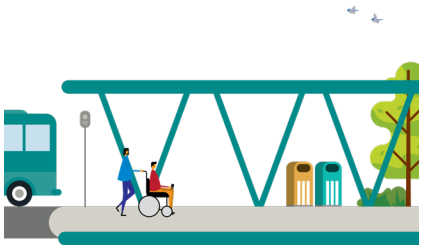
**New standards for material selection, based on scientific research, will decrease virus transmissibility in the transit environment.**

Materials in a transit environment are subjected heavy use, abuse and regular cleaning procedures. In response to the current pandemic, the selection of materials during the design stage of transit projects is expected to undergo further scrutiny as transit agencies seek to reduce the virus “half-life” on surfaces in their stations. In certain studies, both stainless steel and plastic have been shown to be favourable host surfaces for SARS-CoV-2.[11] Copper and its alloys have natural antimicrobial properties. Antimicrobial coatings which can be applied to a variety of materials, and are widely used in hospital settings, may become standard for transit facilities.




MiWay BRT Stations, Mississauga, Canada

# 7 Standards for Air Quality



**Air quality will become a central design criterion in station design.**

Recent studies have contrasted the ability of the SARS-CoV-2 to spread within poorly ventilated areas versus outdoors.[12] In response to the need for adequate air circulation, transit systems may begin to favor open air facilities at grade and devise ways to incorporate natural ventilation into the entire transit environment.

In underground subway stations, it is common for air to be unconditioned and circulated via passive ventilation as trains enter and leave the station. As designers of these high-traffic, contained spaces, a change in the acceptable criteria for air quality will have a dramatic effect on the design of transit stations. These systems can be augmented in several ways to control the spread of airborne particles:

**Mechanical Systems Upgrades**

- Enhanced Filtration
- Mechanical Ventilation
- UV Treatment of Air
- Control of Humidity/Temperature

In response to a potential pandemic, a station outfitted with air-conditioned spaces can adjust parameters as needed to minimize the risk of infection and, likewise, minimize their use when the risk of infection is lowered. The NTA Red Line LRT in Tel Aviv is an example of an underground transit line that has stations that are air conditioned with the ability to deploy enhanced air filtration during shelter mode operation.


Victoria Park Station, Toronto, Canada

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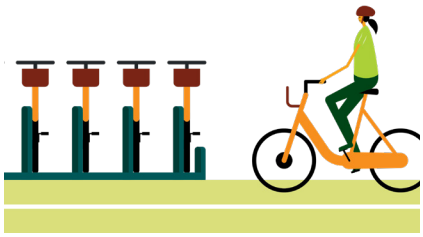
# 8 Growth in Active Transportation

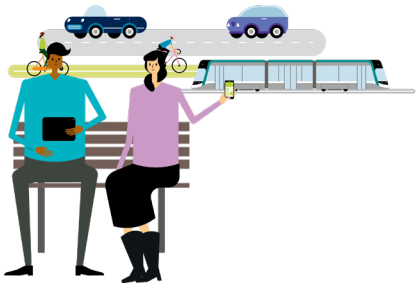


**Integration with an urban cycling strategy will be critical for a future pandemic response.**

Cycling infrastructure is a necessary component of station design--ensuring that passengers can use nearby cycling routes to access rapid transit safely--providing space for the convenient storage of bicycles and providing accessible routes and bike rails for cyclists to use within the station environment. As commuters seek alternate routes to work, active transportation is expected to become a preferred option to allow physical distancing and avoided crowded platforms and transit vehicles.[13] While some may choose to avoid transit altogether, an aggregate increase in bicycle use may lead to a greater need for safe storage and convenient use of bicycles within the transit system. Beyond facilitating ease of transfer between transit and cycling, transit stations can contribute to a pandemic response by simply supporting bicycle usage within the station catchment area.

West Harbour GO Station, Hamilton, Canada

# 9 Improved Messaging



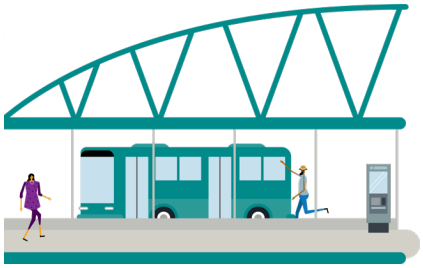
**Frequent communication with passengers and the public during an evolving pandemic response will require a flexible messaging strategy.**

To support an agile and flexible transit network, improved messaging will be required to communicate effectively with passengers. As service shifts between routes, stations enter alternate modes of operation and passengers are continually asked to follow new protocol. The signage of the station will be critical in informing passengers approaching and within the station. An enhanced messaging strategy can communicate additional layers of information in real time:

**Critical Messaging in a Pandemic**

- Live Updates of Station Capacity
- Public Heath Messaging
- Route Disruptions
- Directions to Essential Services
- Messaging for Healthcare Workers

# 10 Flexibility in Station Design



**Station designs will need to respond to a multitude of pandemic support strategies.**

The underlying aspect that unites nearly all of the solutions presented is the need for flexibility in the planning of transit stations. An appropriate pandemic response within a mass transit system will consist of a multitude of different stages and operating modes that will vary in duration. Some of the unique transit scenarios that need to be accommodated include:

• Bus terminal boarding has shifted to rear-door only. Capacity on vehicles is being limited.

• New transit routes have been created to serve essential workers who rely on transit to reach centres of employment, existing routes have been prioritized to serve pharmacies, drugstores and hospitals.[14]

• Measures to increase station platform capacity i.e. dedicated boarding vs. alighting platforms/entrances.

Some of these measures may remain in place long after restrictions are lifted, and some may be phased out during a recovery. In the planning stages of station design, a new set of operational modes must be considered to ensure that an adaptable pandemic response can be implemented in a timely manner. As an example, LRT stations in the NTA Red Line in Tel Aviv have been designed to operation in two distinct modes. In regular transit mode, the station resembles a conventional transit environment with respect to material finishes, layout and amenities. In shelter mode, blast doors and other shelter amenities are pulled from dedicated storage and deployed using built-in power and mechanical infrastructure. It is possible that the next generation of transit stations will be designed to function in one or several “pandemic” modes, with the built-in flexibility to reconfigure passenger movement and route messaging as well as to deploy additional safety measures.

# Conclusion

The forceful response from governments and transit agencies to the current pandemic has shown us that the effects on our daily lives will be widespread and dramatic in the face of a pathogen such as SARS-CoV-2. As we move through the response, reopening and recovery phases, these changes to the transit environment are inevitable. It is incumbent on designers of future transit facilities to consider these changes holistically and realize potential opportunities to transform our built environment for the better. While the coronavirus pandemic is an immediate challenge for public transit, there will be other challenges in the near future that will require a similarly coordinated response, the most obvious being the effects of global climate change. Both the primary effects (flooding, extreme weather) and secondary effects (migration, scarcity of resources) will require transit networks that are supported by resilient and agile infrastructure.

In the wake of past pandemics, city-builders, designers and planners took on the task of transforming our public infrastructure to create a safer, productive and vibrant city. Our next challenge as designers is to continue this tradition as we re-think the transit environment.

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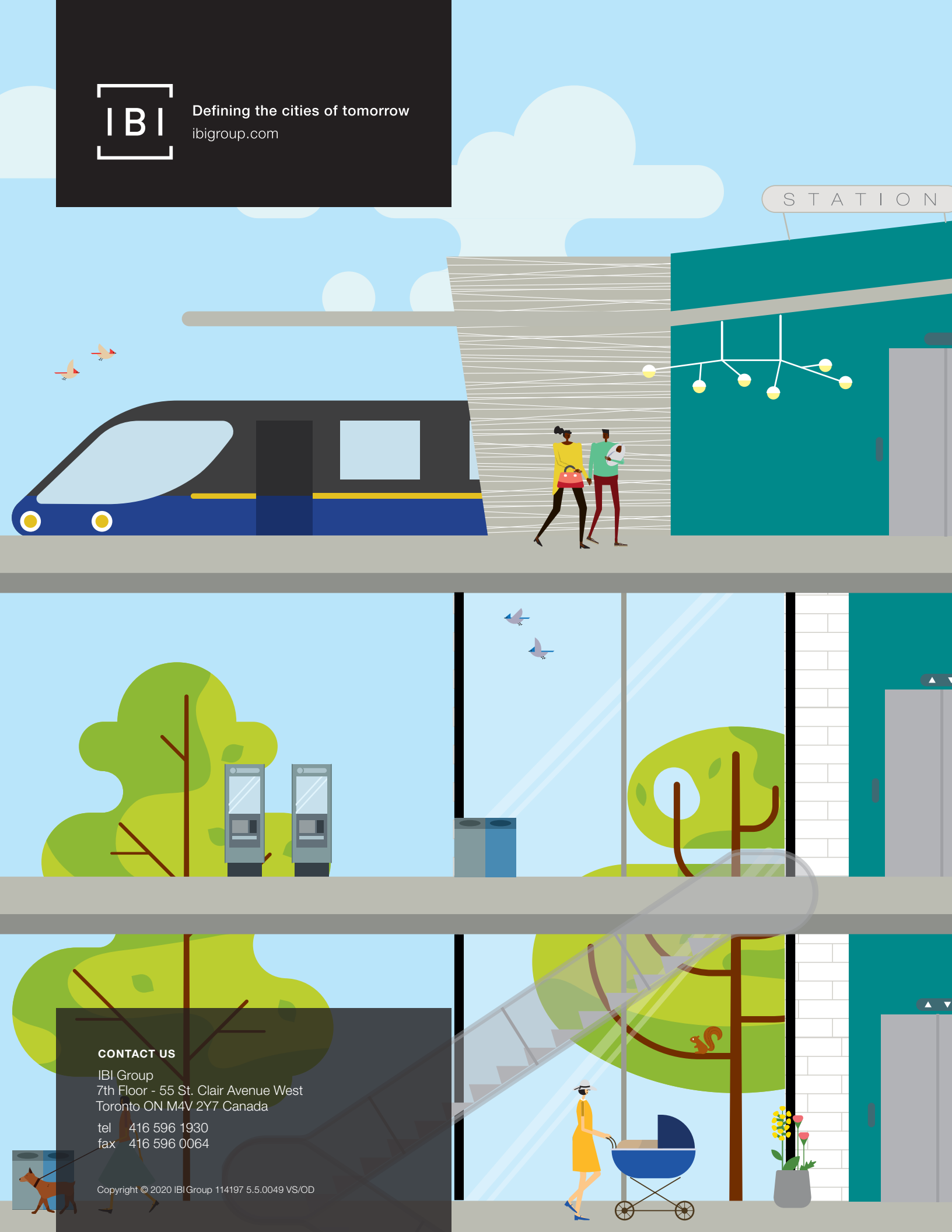


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