The American Institute of Architects

Re-occupancy Assessment Tool V1.0

May 6, 2020

Background

Stay-at-home orders that began in California on March 19, 2020, quickly swept the nation. More than a month later, federal and state governments are debating the process by which businesses, schools, and other non-essential facilities can reopen. The CDC, WHO, OSHA, ASHRAE, and others have already developed administrative and behavioral resources for reoccupying buildings; however, guidance that holistically addresses the CDC's Hierarchy of Controls is needed to ensure the public's health, safety, and welfare.

Architects and allied professionals are in a unique position to coordinate a range of mitigation strategies that, in aggregate, reduce the risk of exposure to and transmission of COVID-19 within non-health care settings. Our goal is to promote best practices that protect the health, safety, and welfare of the public while creating opportunities for businesses, schools, restaurants, and other non-essential facilities to provide services.

The purpose of this document is to provide architects, private clients, and civic leaders a framework of strategies for reoccupying buildings and businesses that are in the process of transitioning from being fully closed to fully open. This document aims to provide a range of general mitigation measures to consider, with the understanding that the risk of infection can only be "flattened" and not eliminated entirely. Solutions require a coordinated approach between building features and operational practices.

It should be noted that certain COVID-19 measures listed within this assessment tool may be inconsistent with other site needs, such as security, accessibility, and sustainability; the totality of these considerations must be prioritized during this public health emergency. Furthermore, decision makers and design professionals are encouraged to evaluate the vulnerability of these buildings with a biological and natural disaster confluence.[1]

1. It is recommended that businesses perform a rapid assessment to provide an initial determination of the ability and capacity of a building and its spaces to respond to and accommodate its occupants and the community in the event of a natural disaster as well as a biological disaster.

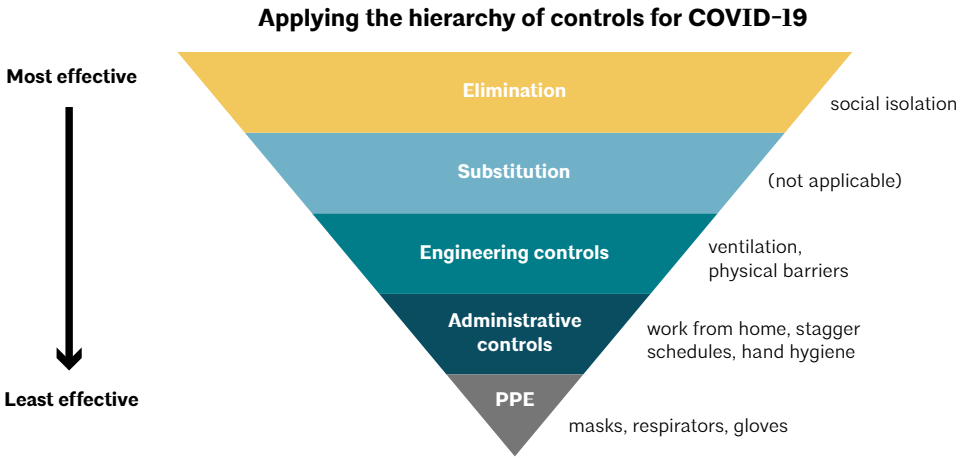
About the Re-occupancy Assessment Tool

The following assessment tool is structured on the Occupational Safety and Health Administration's "Guidance on Preparing Workplaces for COVID-19, OSHA Document 3990-03-2020." This planning guidance is based on both traditional infection prevention and industrial hygiene practices; it is advisory in nature and informational in content. The intent of the assessment tool is to describe basic steps to reduce the risk of occupant exposure to SARS-CoV-2, the virus that causes COVID-19, in workplaces and places of public accommodation. Fundamental to the assessment considerations are:

- Developing infectious disease preparedness and response plans.
- Preparation to implement basic infection prevention measures.
- Developing policies and procedures for prompt identification and isolation of sick people, if appropriate.
- Developing, implementing, and communicating about workplace flexibilities and protections.
- Implementing workplace controls.

The assessment tool uses the CDC framework of "hierarchy of controls" to select ways of controlling workplace hazards. It proposes that the best ways of controlling the hazards are to systematically remove them rather than primarily relying on workers or the public to reduce their own exposure. In most cases, a combination of control measures will be necessary.

Figure 1: Applying the hierarchy of controls for COVID-19 (adapted from NIOSH)



The Re-occupancy Assessment Tool is a list of considerations that includes engineering (physical) and administrative controls, as well as PPE, that apply to both essential businesses currently operating under restrictive orders and for currently closed non-essential facilities.

The following public health findings informed the Re-occupancy Assessment Tool considerations.

Physical distancing. COVID-19 is thought to spread mainly through close contact (within about six feet) from person to person in respiratory droplets.[i] [ii]

Contact transfer. It may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly eyes.[iii] Based on studies of SARS and MERS-CoV, preliminary data on SARS-CoV-2, and CDC recommendations, it seems likely that SARS-CoV-2, the virus that causes COVID-19, can potentially persist on fomites (abiotic surfaces) ranging from a couple of hours to five days.[iv] [v] [vi] There is also developing research on fecal/oral transmission of COVID-19, which makes bathroom environments especially important to consider from an occupancy, cleaning, and maintenance standpoint.[vii] [viii] [ix] [x]

Aerosols. While HVAC systems in most non-medical facilities play only a small role in infectious disease transmission, including COVID-19,[xi] a CDC report cites an outbreak of COVID-19 possibly stemming from strong air conditioner airflow.[xii]

Waterborne contaminants. The virus that causes COVID-19 has not been detected in drinking water. Conventional water treatment methods that use filtration and disinfection, such as those in most municipal drinking water systems, should remove or inactivate the virus that causes COVID-19.[xiii] However, other public health risks—such as Legionella—may develop in the stagnant water of unoccupied buildings.[xiv]

Business owners are encouraged to communicate their mitigation measures to occupants to foster a transparency that could help the public make informed decisions about their own health and safety. Reduced public uncertainty may help bolster economic and civic activities.[xv]

A. General conditions—baseline parameters

If the intended operation of the facility cannot satisfy certain prerequisites, then the facility is likely not a good candidate for utilizing the following expansion/reopening considerations for minimizing the risk of spreading SARS-CoV-2. The below goals, operating authority, facility authority, and risk management categories are set forth as baseline prerequisites. The facility under evaluation may have additional prerequisites.

	Yes	No
Goals		
Provide a clear path for the restart of businesses to re-establish the economy.	☐	☐
Mitigate the risk of spreading pathogens, including SARS-CoV-2, among the business workers and the general public.	☐	☐
Operating authority		
Verify that the facility re-establishment orders come from the proper governing authorities.	☐	☐
Evaluate whether the authority instructions may or are intended to change over the implementation period.	☐	☐
Facility authority		
Verify that the business facility management has the legal authority to make physical alterations to the premises.	☐	☐
Determine the Authority Having Jurisdiction (AHJ) requirements for permitting facility alterations.	☐	☐
Risk management		
Comply with federal, state, and local laws including ADA, OSHA, and Department of Health regulations and requirements.	☐	☐
Does your facility require physical contact between occupants? Different facility or building types present different levels of contact intensity or modification potential.[xvi] See Appendix A of Public Health Principles for a Phased Reopening During COVID-19: Guidance for Governors for building type-specific risk levels.	☐	☐

B. Workplace controls

The assessment tool does not describe mandatory requirements but lists general controls applicable to building attributes that architects may adjust depending on the differing building typologies. This listing of controls, ranked by efficiency, may be applied to essential facilities needing to expand their services when governmental restrictions are removed. It also applies to closed non-essential facilities that are to initially reopen with required limitations (short-term) and eventually operate without imposed restrictions (long-term). Not all controls may be applicable to all building types under all situations. Additional controls specific to the building type under evaluation may be required. The relevant controls may be further identified as "essential" or "desirable" to create a list of recommended design requirements to evaluate each particular building type and measure the overall effectiveness of adopted physical controls and policies.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
1. First priority: Elimination Institute social isolation. Wherever possible, occupant should work or access the business form home. This should include restructuring responsibilities to minimize the number of occupants that need to be physically present.[xvii]						
2. Second priority: Substitution Replace the hazard. There is no available substitution for COVID-19; thus the control measure is not applicable.[xviii]	**N/A**		**N/A**		**N/A**	
3. Third priority: Physical controls Involves isolating persons from workplace-related SARS-CoV-2 exposure. Where appropriate, these controls reduce exposure to hazards without relying on worker behavior and can be cost-effective to implement.						
3.1 Site and site arrival						
Convey recommended guidance for ride-sharing services, delivery services, and taxi services that define cleanliness standards and protocols.[2]	☐	☐	☐	☐	☐	☐
Provide area for customer social distancing exterior queuing not subject to winds.	☐	☐	☐	☐	☐	☐
Provide temporary or permanent outdoor sun/rain covering to allow queuing outside of front door.	☐	☐	☐	☐	☐	☐

2. In recent years, the sharing economy has created environments and added new components related to how multiple people share the same spaces. Shared spaces and items, such as co-work environments, rooms in homes, cars, bikes, and other elements of the built environment, may increase the potential for environmentally mediated pathways of exposure and add complexity to enacting social distancing measures. For more, see: Dietz L, Horve PF, Coil DA, Fretz MA, Eisen JA, Van Den Wymelenberg K. Apr 2020. 2019 novel coronavirus (COVID-19) pandemic: Built environment considerations to reduce transmission. mSystems, 5(2). e00245-20; DOI: 10.1128/mSystems.00245-20.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Ensure the designated building/space ingress and egress pathways support clearly separated directional traffic that also provide ADA accessibility.[3]	☐	☐	☐	☐	☐	☐
Consider an exit separate from the entrance.	☐	☐	☐	☐	☐	☐
3.2 Building envelope						
Utilize natural daylight when possible.[xix] [xx] [xxi]	☐	☐	☐	☐	☐	☐
Install drive-thru and/or pick-up service windows.	☐	☐	☐	☐	☐	☐
Utilize operable windows for outside air intake if possible.[4] [xxii] [xxiii]	☐	☐	☐	☐	☐	☐
3.3. Fixtures and furnishings						
Install physical barriers such as clear plastic sneeze guards.[xxiv]	☐	☐	☐	☐	☐	☐
Utilize temporary, movable partitions to subdivide large working spaces.[xxv]	☐	☐	☐	☐	☐	☐
Reduce density and/or increase spacing of furniture.	☐	☐	☐	☐	☐	☐
Stagger work stations where possible.	☐	☐	☐	☐	☐	☐
Replace manual door locks with touchless RFID entry system.	☐	☐	☐	☐	☐	☐
Provide cleanable, transparent films over surfaces such as elevator buttons.	☐	☐	☐	☐	☐	☐
Consider installing antimicrobial coatings/surfaces where human touch is required.[5]	☐	☐	☐	☐	☐	☐

3. Multiple paths will require consideration of supplemental surveillance/security provisions to address the public's proper usage, loss-prevention, and possible violent intruders (active-shooter scenario).

4. There are multiple side effects of altering or increasing the airflow in a space. Higher airflow rates could increase resuspension from fomites and increase the potential for contamination throughout the building by distributing indoor air more quickly, at higher velocities and volumes, potentially resuspending more ultrafine particles. For more, see Fahimipour AK, Hartmann EM, Siemens A, Kline J, Levin DA, Wilson H, Betancourt-Román CM, Brown GZ, Fretz M, Northcutt D, Siemens KN, Huttenhower C, Green JL, Van Den Wymelenberg K. 2018. Daylight exposure modulates bacterial communities associated with household dust. *Microbiome* 6:175. DOI:10.1186/s40168-018-0559-4.

5. Metal compounds, such as metal-based antimicrobials (MBA), can be used as toxics to communicable diseases. With exposure to copper, copper alloys (brass and bronze), and silver coating surfaces, the bacteria is viable for minutes to a few hours, an improvement over other surfaces such as stainless steel, PVC, and aluminum bronze. Both copper and silver are now found in numerous consumer products as a method to kill microbes. Keep in mind that some people have material sensitivities, particularly to copper. For more, see Bushmaker T, de Wit E, Gamble A, Gerber S, Harcourt J, Holebrook M, Lloyd-Smith J, Morris D, Munster V, Tamin A, Thornburg N, van Doremalen N, Williamson B. 2020. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *The New England Journal of Medicine*. DOI: 10.1056/NEJMc2004973.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
3.4 Plumbing						
For buildings experiencing extended closure, flush and test potable water systems.[xxvi]	☐	☐	☐	☐	☐	☐
3.5 HVAC						
Increase ventilation and air changes.	☐	☐	☐	☐	☐	☐
Create negative air pressure.[xxvii]	☐	☐	☐	☐	☐	☐
Consider a fixed maximum number of occupants per HVAC zone.	☐	☐	☐	☐	☐	☐
Change HVAC air filters prior to re-occupancy.[6]	☐	☐	☐	☐	☐	☐
Clean ducts that have been dormant.	☐	☐	☐	☐	☐	☐
Keep systems running longer hours, if possible 24/7.[xxviii]	☐	☐	☐	☐	☐	☐
Prioritize fresh air intake versus recycled air where possible.[7]	☐	☐	☐	☐	☐	☐
Monitor and maintain relative humidity levels, preferably to RH 40–60%.[8]	☐	☐	☐	☐	☐	☐
Disable demand-controlled ventilation (DCV).[xxix]	☐	☐	☐	☐	☐	☐
Consider the use of portable room air cleaners with HEPA filters.[xxx]	☐	☐	☐	☐	☐	☐

6. High-efficiency MERV-13 air filters are recommended if the existing HVAC system is designed to handle the MERV-13 level of resistance. For more, see Schoen LJ. Mar 24, 2020. Guidance for building operations during the COVID-19 pandemic. *ASHRAE Journal Newsletter*.

7. Higher outside air fractions and higher air exchange rates in buildings may help to dilute the indoor contaminants, including viral particles, from air that is breathed within the built environment. Higher outside air fractions may be achieved by further opening outside air damper positions on air-handling units, thus exhausting a higher ratio of indoor air and any airborne viral particles present. Be mindful of air quality in the surrounding area of the building. For more, see: Dietz L, Horve PF, Coil DA, Fretz M, Eisen JA, Van Den Wymelenberg K. Apr 2020. 2019 novel coronavirus (COVID-19) pandemic: Built environment considerations to reduce transmission. *mSystems*, 5(2). e00245-20; DOI: 10.1128/mSystems.00245-20; US Department of Labor, Occupational Safety and Health Administration. 2020. Guidance on Preparing Workplaces for COVID-19; Schoen LJ. Mar 24, 2020. Guidance for building operations during the COVID-19 pandemic. *ASHRAE Journal Newsletter*.

8. Based on studies of SARS-CoV-2 and MERS, the viability of the COVID-19 virus in aerosol form and on surfaces is highest at low relative humidity levels (i.e., 30–40 percent RH). Relative humidity (RH) above 40 percent is detrimental to the survival of many viruses, including CoVs in general. Although the current ventilation standard adopted by health care and residential care facilities, ASHRAE 170-2017, permits a wider range of RH from 20 to 60 percent, maintaining a RH between 40 and 60 percent indoors may help to limit the spread and survival of SARS-CoV-2 within the BE while minimizing the risk of mold growth and maintaining hydrated and intact mucosal barriers of human occupants. For more, see: Dietz L, Horve PF, Coil DA, Fretz M, Eisen JA, Van Den Wymelenberg K. Apr 2020. 2019 novel coronavirus (COVID-19) pandemic: Built environment considerations to reduce transmission. *mSystems*, 5(2). e00245-20; DOI: 10.1128/mSystems.00245-20.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Consider installing UV germicidal irradiation (UVGI) in mechanical ventilation paths or in upper-room applications to indirectly treat air through convective air movement.[9]	☐	☐	☐	☐	☐	☐
Consider utilizing ultraviolet C (UVC) during non-occupied hours for sterilization.	☐	☐	☐	☐	☐	☐
For larger buildings, check cooling and water tower condensate for bacterial growth.[10]	☐	☐	☐	☐	☐	☐
4. Fourth priority: Administrative controls Requires action by the person or business and are typically changes in work policy or procedures to reduce or minimize exposure to hazard.						
4.1 Policies						
Develop an emergency communications plan.	☐	☐	☐	☐	☐	☐
Identify necessary revisions to human resources policies.[11]	☐	☐	☐	☐	☐	☐
Provide up-to-date education and training on COVID-19.	☐	☐	☐	☐	☐	☐
Identify occupants in higher health risk categories.	☐	☐	☐	☐	☐	☐
Allow paid time off for sick employees to reduce incentive to work while sick.[xxxi]	☐	☐	☐	☐	☐	☐
Establish a protocol for anyone not feeling well.	☐	☐	☐	☐	☐	☐
Establish procedures for immediately isolating those who have signs or symptoms of COVID-19.	☐	☐	☐	☐	☐	☐
Develop organizational policies to guide what happens if and when a person at the workplace is found to be COVID-19 positive.[12]	☐	☐	☐	☐	☐	☐

9. UV light in the region of shorter wavelengths (254-nm UV C [UVC]) is particularly germicidal, and fixtures tuned to this part of the light spectrum are effectively employed in clinical settings to inactivate infectious aerosols and can reduce the ability of some viruses to survive. However, UV germicidal irradiation (UVGI) has potential safety concerns if the room occupants are exposed to high-energy light. For this reason, UVGI is safely installed in mechanical ventilation paths or in upper-room applications to indirectly treat air through convective air movement. For more, see: Dietz L, Horve PF, Coil DA, Fretz M, Eisen JA, Van Den Wymelenberg K. Apr 2020. 2019 novel coronavirus (COVID-19) pandemic: Built environment considerations to reduce transmission. mSystems, 5(2). e00245-20; DOI: 10.1128/mSystems.00245-20; Schoen LJ. Mar 24, 2020. Guidance for Building Operations During the COVID-19 Pandemic. *ASHRAE Journal Newsletter.*

10. Such conditions may pose a Legionella risk.

11. Policies may include hazard pay, the identification of essential personnel, flexible work schedules for caregivers, revised PTO carryover policy and/or travel policy, etc.

12. Strategies might include isolation, enhanced cleaning and sanitization, temporary office closure, contact tracing, etc.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Establish procedures for returning to work after COVID-19 positive infections.	☐	☐	☐	☐	☐	☐
Establish an official guide of an approved protocol to manage employee and customer safety.	☐	☐	☐	☐	☐	☐
Institute social distancing strategies.	☐	☐	☐	☐	☐	☐
Create virtual communications and telework policies.	☐	☐	☐	☐	☐	☐
Implement occupancy-reduction policies.[13]	☐	☐	☐	☐	☐	☐
Develop policies to reduce risk related to high-touch practices.[14]	☐	☐	☐	☐	☐	☐
Establish procedures and places to quarantine deliveries.	☐	☐	☐	☐	☐	☐
4.2 Procedures to reduce the spread of pathogens						
Provide dedicated staff member(s) at building entrance to guide queuing of incoming occupants.	☐	☐	☐	☐	☐	☐
Institute workplace entrance screening.[15]	☐	☐	☐	☐	☐	☐
Promote hand washing and personal hygiene.	☐	☐	☐	☐	☐	☐
Post hygiene signage.	☐	☐	☐	☐	☐	☐
Provide tissues.	☐	☐	☐	☐	☐	☐
Provide touchless hand soap and towel dispensers.[xxxii]	☐	☐	☐	☐	☐	☐
Provide alcohol-based hand rubs containing at least 60% alcohol disinfectants.[xxxiii]	☐	☐	☐	☐	☐	☐
Educate occupants on respiratory etiquette.	☐	☐	☐	☐	☐	☐
Encourage self-monitoring for symptoms.	☐	☐	☐	☐	☐	☐
Provide safety training for staff to assist incoming occupants/customers.[xxxiv]	☐	☐	☐	☐	☐	☐
Conduct regular housekeeping.	☐	☐	☐	☐	☐	☐

13. Strategies might include alternate days or shifts that reduce the total number of employees in a workplace at a given time, class size, shop by appointment, or appointments to minimize waiting area crowding.

14. High-touch practices might include trying on clothing, alterations being permitted after a confirmed purchase, "quarantining" products that come back to the retailer through exchanges or returns for a sufficient period of time.

15. Screening may include practices such as temperature checks.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Consider periodic operational break(s) during business hours for cleaning.[xxxv]	☐	☐	☐	☐	☐	☐
Consider periodic third-party enhanced cleaning services.[xxxvi]	☐	☐	☐	☐	☐	☐
Where known infected persons were present, consider third-party deep cleaning (sterilization) services.[16] [xxxvii]	☐	☐	☐	☐	☐	☐
Institute guidelines for cleaning and disinfecting the surfaces of chairs and tables, equipment, etc.	☐	☐	☐	☐	☐	☐
Provide disposable towels to clean work surfaces.	☐	☐	☐	☐	☐	☐
Install no-touch trash cans.	☐	☐	☐	☐	☐	☐
Provide additional rubbish bins at entrances to aid in disposing of masks and gloves.	☐	☐	☐	☐	☐	☐
Avoid and/or greatly limit the use of common equipment.[17] [xxxviii]	☐	☐	☐	☐	☐	☐
Institute options for contactless payment processes for retailers to further limit contact with credit card readers, pens, or surfaces.	☐	☐	☐	☐	☐	☐
4.3 Procedures to support physical distancing						
Limit access to work areas.	☐	☐	☐	☐	☐	☐
Restrict number of persons in publicly designated waiting areas.	☐	☐	☐	☐	☐	☐
Restrict number of personnel entering isolated areas.	☐	☐	☐	☐	☐	☐
Limit the number of workers allowed simultaneously in break areas.	☐	☐	☐	☐	☐	☐
Use communication boards or digital messaging to convey pre-shift meeting information.	☐	☐	☐	☐	☐	☐
Design a process to ensure customers stay distanced while waiting.	☐	☐	☐	☐	☐	☐
Limit the number of customers in a space at a time.	☐	☐	☐	☐	☐	☐

16. Sterilization services are ideally performed by a IICRC-certified mitigation company.

17. Common equipment may include coffee pots, refrigerators, and drinking fountains as well as conference room technology and other shared devices.

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Schedule customer appointments to avoid waiting groups.	☐	☐	☐	☐	☐	☐
Shorten public time within the facility by encouraging the use of shopping lists, pre-ordering, and designated pick-up within or outside.	☐	☐	☐	☐	☐	☐
Provide dedicated staff member(s) to retrieve goods for customers in retail settings.	☐	☐	☐	☐	☐	☐
Manage the check-out line process to reduce COVID-19 transmission.	☐	☐	☐	☐	☐	☐
Consider limiting the occupancy of restrooms to single use where possible.	☐	☐	☐	☐	☐	☐
Determine ingress/egress to and from restrooms to establish paths that mitigate waiting and proximity for guests and staff.	☐	☐	☐	☐	☐	☐
Install markings/signage encouraging one-way travel where practical.	☐	☐	☐	☐	☐	☐
Implement floor/pavement markings (i.e., paint/tape) to visualize recommended spacing among occupants.	☐	☐	☐	☐	☐	☐
Institute mandatory six-foot spacing or as otherwise required by governing jurisdiction.	☐	☐	☐	☐	☐	☐
Establish dedicated hours for higher-risk customers.	☐	☐	☐	☐	☐	☐
Implement technologies that support buy online, pickup in store.	☐	☐	☐	☐	☐	☐
Increase access to delivery services for products to reach customers.	☐	☐	☐	☐	☐	☐
Avoid types and dispersion of displays and service areas that result in close public proximity.	☐	☐	☐	☐	☐	☐
Discontinue nonessential travel in lieu of virtual communications.	☐	☐	☐	☐	☐	☐
5. Fifth priority: Personal protective equipment (PPE) Properly used PPE may be needed to prevent certain exposures but should not take the place of other preventative measures.						
5.1 Policies						
Utilize CDC guidelines to identify when and what type of protection is to be used.	☐	☐	☐	☐	☐	☐

Actions	Essential businesses		Non-essential businesses			
	Maximize operations		Restricted occupancy		Full occupancy	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
Regularly inspect, maintain, and replace supplies.	☐	☐	☐	☐	☐	☐
Secure necessary supplies and proper on-site storage facilities.	☐	☐	☐	☐	☐	☐
5.2 Procedures						
Select based on hazard to worker.	☐	☐	☐	☐	☐	☐
Ensure proper fit and periodically refit.	☐	☐	☐	☐	☐	☐
5.3 Equipment						
Provide gloves.[xxxix]	☐	☐	☐	☐	☐	☐
Provide goggles.	☐	☐	☐	☐	☐	☐
Provide face shields.	☐	☐	☐	☐	☐	☐
Provide face masks.[xl]	☐	☐	☐	☐	☐	☐
Provide respiratory protection.	☐	☐	☐	☐	☐	☐

C. Definitions

Essential and desirable: Planning actions depending on the level of priorities and resources generally required to implement them. This is for guidance only. State and national authorities should determine which actions are truly essential and desirable in their context, based on their own vulnerability profile and level of available resources.[xli]

Very high risk: Persons with high potential for exposure to known or suspected sources of COVID-19 during specific medical, postmortem, or laboratory procedures. Includes health care workers, laboratory personnel, and morgue workers performing autopsies.[xlii]

High risk: Persons with high potential for exposure to known or suspected sources of COVID-19. Includes health care delivery and support staff, medical transport workers, and mortuary workers involved in preparing bodies.[xliii]

Medium risk: Persons who require frequent and/or close contact with people who may be infected with SARS-CoV-2 but who are not known or suspected COVID-19 patients. Include persons who are in frequent contact with travelers, often in areas of ongoing community transmission, involved with schools, in high-population-density work environments, and in some high-volume retail settings.[xliv]

Low risk: Persons who do not require contact with people known to be, or suspected of being, infected with SARS-CoV-2 nor in frequent contact with the general public. Includes those with minimal occupational contact with the public and other coworkers.[xlv]

SARS: Severe acute respiratory syndrome illness.[xlvi]

SARS-CoV: The virus that causes SARS.[xlvii]

SARS-CoV-2: The virus that causes COVID-19.[xlviii]

COVID-19: Novel coronavirus disease-2019 is the disease.[xlix]

Coronavirus: A member of a family of single-stranded RNA viruses that infect people and animals. The disease COVID-19 is caused by a newly discovered coronavirus called SARS-CoV-2.[l] [li]

Isolation: The separation of sick people with a contagious disease from people who are not sick.[lii]

Quarantine: The separation and restriction of the movement of people who were exposed to a contagious disease to see if they become sick.[liii]

D. Annotated bibliography

2019 Novel Coronavirus (COVID-19) Outbreak: A Review of the Current Literature and Built Environment (BE) Considerations to Reduce Transmission
Researchers from University of Oregon's Biology and the Built Environment (BioBE) Center and the CDC's online pathogen identification database, named MicrobeNet, moved quickly to aggregate multiple sources of both developing knowledge of COVID-19 and previous research focused on SARS-CoV-2. It also provides basic guidance for users and managers of the built environment (BE) to more effectively deal with pathogens in the built environment. This paper forms a critical text for this checklist in its interdisciplinary literature review, which aggregates a myriad of relevant sources from around the world, leveraging the diverse research team. We have used this source to help translate and coalesce developing COVID-19 research from multiple parties into actionable guidance that bases recommendations on minimizing infectious disease transmission through environmentally mediated pathways.

Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1
An evaluation of the stability of SARS-CoV-2 and SARS-CoV-1 in aerosols and on various surfaces with estimates of their decay rates.

CDC: Implementation of Mitigation Strategies for Communities with Local COVID-19 Transmission
This document provides a framework for actions that local and state health departments can recommend in their community to prepare for and mitigate community transmission of COVID-19. Major building types are put forward as mitigation examples: individuals at home, schools and child care, assisted living, and workplaces. These mitigations are divided among three degrees of intensity: minimal, moderate, and substantial.

CDC: Guidance for Business Response to COVID-19

The CDC provides interim guidance based on what is currently known about COVID-19. The guidance is particularly focused on workplaces in non-health care settings. The key sections in this document include preparing workplaces for a COVID-19 outbreak, reducing transmission among employees, maintaining healthy business operations, and maintaining a healthy work environment.

WHO: Checklist for Pandemic Influenza Risk and Impact Management

This document provides the WHO's most recent pandemic guidance and recommendations prior to the COVID-19 outbreak. Section 4.1.2 "Facilities" mentions developing facility-level plans, including floor plans for essential facilities. Other key principles in this document provide the basis for more detailed guidance from other specialist groups.

Johns Hopkins Bloomberg School of Public Health, Center for Health Security: Public Health Principles for a Phased Reopening During COVID-19: Guidance for Governors

This paper provides guidance for the reopening of various building typologies and offers numerous matrices detailing modified occupancy loadings for a variety of building typologies and programming needs.

Considerations for Large Building Water Quality after Extended Stagnation

This paper was created to help public health officials, building owners, and water utilities managers better understand building water quality due to low or no occupancy. This will be a pertinent issue for buildings that were not completely decommissioned or have sat stagnant for long periods of time.

AIHA: Recovering from COVID-19 Business Closures

This document provides practical recommendations for preparing a closed building for re-occupancy, including maintaining mechanical and plumbing systems as well as cleaning and disinfecting surfaces.

OSHA: Guidance on Preparing Workplaces for COVID-19

While this seminal document creates no new legal obligations, its recommendations and informational content are intended to assist employers in providing a safe and healthful workplace. Important sections include: Engineering Controls, Administrative Controls, Safe Work Practices, and other administrative best practices for a facility's workforce.

ASHRAE: Guidance for Building Operations during COVID-19

This document provides specific HVAC-related recommendations for helping reduce the risk of COVID-19 within buildings, including fresh air intake and filter ratings.

Appendix

This appendix includes design tools and methods to support physical distancing guidelines.

Space syntax diagrams

While initially developed as a graphical tool to investigate the privacy, security, or connectivity/division of space at the urban to the building scale, the term "space syntax" is in actuality the combination of theories and techniques developed by Julienne Hanson,[liv] Bill Hillier,[lv lvi lvii] and colleagues at The Bartlett, University College London, in the late 1970s to early 1980s. As space syntax has evolved, certain measures have been found to correlate with human spatial behavior, and space syntax is now used to forecast likely effects of architectural and urban space on users.

In the paper *2019 Novel Coronavirus (COVID-19) Outbreak: A Review of the Current Literature and Built Environment (BE) Considerations to Reduce Transmission*,[lviii] the authors utilize this type of analysis to graphically describe the connectivity or exclusivity of certain spaces from one another from a vector-control perspective. Within complex built environments, this diagrammatic strategy could begin to base its operational flow models on rules gleaned from diagramming spaces in this way.

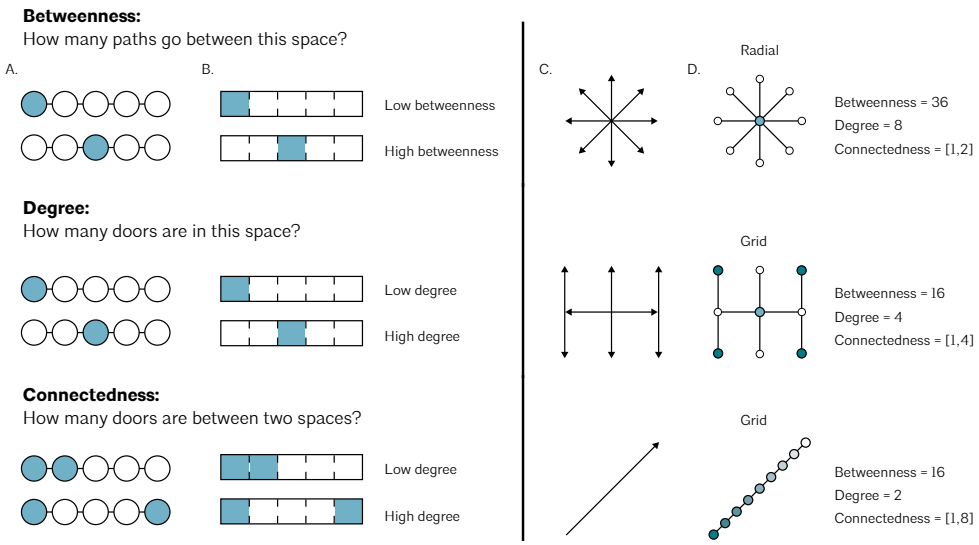


Figure 2: Spatial connectivity, highlighting betweenness and connectance of common room and door configurations

This figure about spatial connectivity, highlighting betweenness and connectance of common room and door configurations is from *2019 Novel Coronavirus (COVID-19) Pandemic: A Review of the Current Literature and Built Environment (BE) Considerations to Reduce Transmission*. (A) Circles and lines follow the classic network representation. (B) The rectangles follow the architectural translation of networks. Shaded areas correspond to a measure of betweenness (the number of shortest paths between all pairs of spaces that pass through a given space over the sum of all shortest paths between all pairs of spaces in the building), degree (the number of connections a space has to other spaces between any two spaces), and connectance (the number of doors between any two spaces). (C) The arrows represent possible directions of microbial spread

as determined by the layout of the BE. (D) The circles represent the current knowledge of microbial spread based on microbial abundance through BEs as determined by layout. Darker colors represent higher microbial abundance, and lighter colors represent lower microbial abundance.

Occupancy evaluation

The common measure recommended for social distancing in this COVID-19 pandemic is to keep six feet between yourself and others. That places you as the center of a circle with a six-foot radius. The area of that circle is 113.097 square feet with a close packing of those occupant circles. Let's call it 114 square feet, which is larger than a 10-foot by 10-foot room. The six-foot radius of social distancing allows for human access (i.e., travel) through an occupancy at the tangents of the circles formed by the radius.

If 100 square feet is used as a nominal social distancing measure, the occupancies impacted the most are the following, with current maximum floor area allowances per occupancy (International Building Code, Table 1004.1.1, various editions). Occupancies allowing 100 gross or net square feet per occupant are not listed here since they can be considered to meet a nominal 100 square foot social distancing.

- Airport: baggage claim—20 gross; waiting areas—15 gross
- Assembly: gaming floors—11 gross
- Assembly with fixed seats: refer to 1004.7 of International Building Code
- Assembly without fixed seats: concentrated—7 net; standing space—5 net; unconcentrated (tables and chairs)—15 net
- Bowling centers: 7 net; check with allowances of five persons/lane including 15 feet of runway
- Courtrooms: 40 net
- Day care: 35 net
- Dormitories: 50 gross
- Education: classroom area—20 net; shops, vocational rooms—50 net
- Exercise rooms: 50 gross
- Library: reading rooms—50 net
- Locker rooms: 50 gross
- Mercantile: areas on other floors—60 gross; basement and grade floor areas—30 gross
- Skating rinks, swimming pools: rink and pool—50 gross; decks—15 gross
- Stages and platforms: 15 net

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Acknowledgements

The American Institute of Architects would like to recognize the expertise, time, and significant effort of the AIA 2020 Disaster Assistance Committee in cultivating this tool.

2020 Disaster Assistance Committee
J. Scott Eddy, AIA, Chair
Janine Glaeser, AIA, Vice Chair

Project team
Kenneth J. Filarski, FAIA
Christopher Kiefer, AIA
Lester G. Meu, AIA
Matthew Tierney, AIA

Peer reviewers
Andrew Dannenberg, MD, MPH
Robert Phinney, AIA
Molly M. Scanlon, PhD, FAIA, FACHA
Catherine Wemette, CAE

Editors
Lindsay Brugger, AIA, Sr. Manager, Resilient Communities
Rachel Minnery, FAIA, Sr. Director, Resilience, Adaptation, and Disaster Assistance

Questions, feedback, ideas? We'd love to hear from you. Email resilience@aia.org

The American Institute of Architects
1735 New York Ave., NW
Washington, DC 20006
aia.org