CANADIAN ASSOCIATION OF FIRE CHIEFS

Single Stair Design/Single-Egress Construction

Ensuring one way out doesn't become no way out

1. What is Single Egress Construction (SEC)/Single Stair Design (SSD), and why is it so popular?

What is SEC/SSD? Single-stair design (SSD) or single-egress construction (SEC) is an architectural approach for small-to-medium residential buildings that utilizes a single, central, fire-protected staircase for all occupant entry and exit instead of the traditional two separate stairwells and exits, resulting in only one way out.

Why is SEC/SSD discussed? This design is believed by some to maximize land use, building efficiency, enable dual-aspect, naturally lit apartments, and reduce construction costs. To date, fire chiefs have not been presented with any data supporting these propositions.

2. Why are Fire Chiefs Concerned?

Why are Fire Chiefs concerned? A two-exit standard was introduced for residential construction in Canada in 1941 in response to devastating fires compromising residents across North America. While removing this safety feature is seen as an architectural innovation, it is a regression in fire and life safety standards to those of pre-World War II construction. This section outlines some of the fire, emergency and life safety concerns.

OVERVIEW: Time is life (Evacuation times and egress behaviour + Exit choice + Flashover and fire behaviour + Fires in exits + Removing an exit means removing an entrance) + Fire Operations (Ladder operations + Last resort tactics + Access challenges and road width + Fire alarms and sprinklers + Elevators + Smoke in exit) + NFPA Standards (Single point of failure + Combustible materials + Deployment and response time requirements + Standards for the installation of standpipe and hose systems) + Over-taxing the system (Confluence of fire sector pressures + Compounding code changes + Intersection of risks + Municipal resources + Training burden + Intersection of social risk) = Not the right time to remove an emergency exit

Time is Life

Evacuation times and egress behaviour: Evacuation times increase when we decrease exits (Wei et al, 2023, Johnson and Feinberg, 1997). "... designers do not always anticipate how occupants will behave in emergency" (Kinateder and Warren, 2021).

Exit choice: During evacuation the choice of exit and whether people exit are influenced by the size and proportion of the egressing crowd (Kinateder and Warren, 2021).

Flashover and fire behaviour: Fire grows exponentially by the minute, and within 5 minutes, it is expected to flashover (NFPA 1700). This means all exposed combustible materials will ignite simultaneously. Time is life.

Fires in exit: The 2024 Jensen Hughes report suggests that 8-10% of fires start in stairwells. This means that for single-egress construction, 1 in 10 fires will have no entry or exit, if the single stair is compromised.

Removing an exit means removing an entrance: Removing one emergency exit also means removing one entrance, hampering entry and arrival times, not only for fire, but also for police and paramedics.

Fire Operations

Aerial operations: SEC/SSD assumes aerial operations can be used for rescue. These are last resort tactics. They are high risk, dangerous and expensive, require advanced skills and are not suitable for individuals with vulnerabilities.

Ladder heights: Ground ladders are only effective up to 28 feet. Aerial ladders range from 75-125 feet and require a firm area, typically 25x45 feet for setup, and can only serve 2 sides of a building. Two are required to affect full rescue access.

Access challenges and road width: Fire-rescue requires access free from parked cars, alleyways, dumpsters, and other obstructions. Current efforts to reduce roadway widths may also further complicate access.

Fire alarms and sprinklers: SEC/SSD safety considerations over-rely on fire alarms and sprinklers. The code can require these, but cannot ensure they are maintained and working.

Smoke in exit: Firefighting typically uses one entrance or exit for fire equipment, and the other for residents. One stairwell will become smoke-filled and will require a roof hatch to get rid of smoke. One entry or exit does not permit these considerations.

Elevators: In SEC/SSD, one elevator will be required as an Occupant Evacuation Elevator (OEE). These are designed to be used for self-evacuation during an emergency by people unable to use the stairs.

NFPA Standards

Single points of failure: SEC/SSD creates single points of failure through over reliance on the sprinkler system, egress ventilation, or availability of the exit stair. These can have catastrophic consequences for residents and firefighters (NFPA 1710/1750, GVFCA).

Combustible materials: Canada has increased its commitment to building with combustible materials compared to other international jurisdictions using single-egress construction (NFPA 1710, NFPA 1750, GVFCA).

Deployment and response time requirements: There are significant differences in deployment and emergency response time requirements for a 3-story building compared to a 6-story building (NFPA 1710, NFPA 1750, GVFCA).

Standard for the installation of standpipe and hose systems: SEC/SSD construction has not considered the size, location, and quantity of water needed for standpipe and hose systems, which may be in the only stairwell (NFPA 14, CASA).

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Over-Taxing the System

Confluence of fire sector pressures: Increases in climate emergencies, construction fires, and complexities of fires suggest that now is not the right time to alter a fundamental fire and life safety principle.

Compounding code changes: Event if construction materials such as encapsulated mass timber construction introduced in the code are tested for fire safety, assemblies of those materials are not currently tested which compounds risks for SEC/SSD.

Intersection of risks: Increased use of lithium ion batteries, chargers, hydrogen, solar panels, and green technologies all lead to higher risks of fire as SEC/SSD is considered.

Municipal resources: Single-egress changes the NFPA risk standard of buildings requiring additional firefighters and equipment, which will be costly to the municipalities (Ontario Fire Marshall's office, Greater Vancouver Area Fire Chiefs Association letter).

Training burden: NFPA training assumes two exits. Training would need to be revised at a time when other risks are emerging.

Intersection of social risk: Aging demographic, lower mortality, higher morbidity, and decreased mobility call for increased fire safety considerations, not relaxed considerations.

What policy makers, architects, engineers, and builders need to know about SEC fire and life safety analyses?

1. International comparisons are unreliable if they compare construction in countries with different building materials, non-combustible construction, fire operations, hydrants, and zoning requirements.
2. The safety of single-egress construction can't be analyzed without assessing all concurrent changes in the code. In the past code cycle there have been close to 400 code changes.
3. Sprinklers can save lives when they are part of the standard fire, emergency, and life safety practices. They are not intended to displace an emergency exit because there is no capacity or sufficient municipal budget to inspect or enforce maintenance.
4. Equating single-egress construction to small sprinklered buildings and comparing these to larger sprinklered buildings is false logic. The correct comparison is a building with single stair design compared to the same building with two exits.
5. Incorrect information is being perpetuated about ground ladder and aerial operations. It is not advisable for architects, engineers, and policy makers to make assumptions about fire, emergency, and life safety implications of SEC/SSD.
6. NFPA 1710 (now 1750) is being misquoted as simply requiring the first truck to arrive in 5 minutes and 20 seconds. It requires >28 firefighters in 8 minutes for most single-family homes and >42 firefighters in 10 minutes for six-story buildings.
7. External staircases won't work in areas where there is high snowfall or ice, nor are they practical in buildings, housings, individuals with diverse fire, emergency, or evacuation needs.

What do individuals with diverse needs during fire or emergency say about SEC/SSD?

A study funded by Accessibility Standards Canada and led by the Canadian Association of Fire Chiefs, in collaboration with the Rick Hansen Foundation, identified the removal of an emergency exit as a significant concern alongside steps without ramps, elevator failure, and the absence of adequate safe refuge or waiting areas of sufficient protection and capacity.

How are some municipalities allowing SEC/SSD?

- By requiring a second stairwell on the outside of a building, only viable where weather conditions are temperate.
- By ensuring the building has mechanical pressure in the egress stairway, the vestibule has positive mechanical pressure, door closes, and two entry points per floor to an egress stairway in the same square footage allotted to SEC.
- By installing backup power supply to power the mechanical positive pressure should the power grid fail, including elevators.
- By requiring separated dual access scissor stairways in the building's egress stairway space.
- By ensuring that maintenance requirements and frequency are clearly defined and that the building face is 10 meters away from any overhead primary hydro power lines.
- By ensuring the building is required to allow access for an aerial ladder truck on all 4 faces/sides of the building.
- By having a robust, equipped, full-time career department which can handle the additional pressure.

Avoid the tragic conclusion of the Grenfell study

"We conclude that the fire at **[INSERT]** was the culmination of decades of failure by central government and other bodies in positions of responsibility **[INSERT]** to look carefully into **[INSERT]** and to act on the information available to them".

Adapted from: Rt. Honourable Sir Martin-Brooke, Executive Summary of the Grenfell Tower Report Part II.

Fire Sector by the numbers

***3200** fire departments*
***80%** volunteer*
***90%** concerned about SEC*
***60%** experience rapid construction*
***19%** require new resources for firefighting*
***45,000** residential fires in 2025*
***50%** using equipment older than industry standards.*
***70%** believe firefighting practices need to change, given the changes in code*

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