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From Fire Code to Fire Drill: A Practical Framework for Fire, Emergency and Health Safety in Saudi Schools

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A B S T R A C T :

Schools hold large numbers of children, combustible materials and, often, buildings that were not designed as schools. Two Saudi school fires show what is at stake. In Makkah in 2002, fifteen girls died, most on a narrow stairway that collapsed. In Jeddah in 2011, three teachers died in a three-storey private school, and pupils escaped by jumping from upper windows. This paper brings together the Saudi rules, international codes and published evidence into a practical framework for school fire, emergency and health safety. It then illustrates the framework with worked examples. The review covers Civil Defense and Saudi Building Code requirements, the Ministry of Education's school safety administration and its four-drills-a-year rule, and national accreditation. Published Saudi survey data show rented school buildings scoring 49% on safety preparedness against 75% for purpose-built schools. It also covers the causes of school fires, the Class A fire load of classrooms and libraries, egress and evacuation design, assembly points, and the prevention of influenza and other common infections. Three worked examples show how a school can apply the framework. First, an occupant-load and evacuation-time calculation for a hypothetical three-storey school. With two 1.2 m stairs, automatic detection and drilled pupils, the two upper floors clear in about 8 minutes. The same building takes about 14 minutes if one stair is locked. A converted building with one narrow stair, no detection and no drills takes about 23 minutes. Second, a twelve-hazard risk register, in which the proposed controls halve the total risk score and remove every high and very high rating. Third, a schematic of assembly point siting suited to a hot climate. The framework links four layers: building safety, risk assessment, emergency response, and people (students, staff and management). Each layer has a clear owner, a check and a record. It treats drills as tests of the whole system, not as rituals, and adds heat and infection control to the usual fire focus. The paper ends with a school self-audit checklist and an agenda for field validation in Saudi schools.

Keywords: school safety, fire safety, emergency evacuation, assembly point, risk assessment, Class A fire, influenza, Saudi Arabia, Civil Defense, Vision 2030

1. Introduction

A school is a place of work for its staff and a place of care for its pupils, and in an emergency the staff must act for both. In 2017 the Saudi Ministry of Education reported that its Schools Security and Safety Administration was responsible for more than 38,000 school facilities and more than 5 million students (Arab News, 2017). At that scale, rare events become certain somewhere, every year.

Two Saudi fires show how school emergencies go wrong (Table 1). In both, people died not mainly from flames but from the way the building and the response failed: a converted house with barred windows and one narrow stair in Makkah, and escape through upper windows in Jeddah, where staff later said drills were not remembered.

Table 1 - Two Saudi school fires and their lessons

	Makkah, Intermediate School No. 31, 11 March 2002	**Jeddah, Baraim Al-Watan private girls' school, 19 November 2011**
Casualties	15 girls died, more than 50 injured	3 teachers died, about 50 injured
Building	Three-storey former house, rented in 1990 and not suitable as a school; more than 800 pupils	Three-storey private school; about 700 pupils, 110 teachers and 32 other staff evacuated
What went wrong	No extinguishers, alarms, emergency stairs or exits; windows barred with iron grilles; most deaths on a narrow stairway that collapsed; school reported locked	Fire reportedly started accidentally by pupils; pupils and a teacher jumped from upper windows; a teacher said pupils and staff do not remember drills
Response	Girls' education administration merged into the Ministry of Education	Investigation committee; ministry pledged accountability
Sources	Arab News (2020); BBC News (2002); Human Rights Watch (2002)	Al Arabiya (2011); Arab News (2011a, 2011b, 2011c, 2012)

Since then, Saudi Arabia has adopted a national fire code based on the International Fire Code, created a school safety administration within the Ministry of Education, and set up national school accreditation under the Education and Training Evaluation Commission (ETEC). Vision 2030 has

also made occupational safety a national priority (Abdul Salam, 2026b). Yet rules on paper do not evacuate a building. A recent study of girls' public schools in the Eastern Province found overall safety preparedness of 70–90%, with some items poorly applied or completely absent (Al-Ansary et al., 2023).

This paper asks a practical question: **what does a school need to have, know and do so that everyone gets out safely, and stays healthy, when something goes wrong?** It makes three contributions:

1. A review of the Saudi rules, international codes and evidence that bear on school fire, emergency and health safety, in one place.
2. Three worked examples that show the reasoning a school can repeat: evacuation time, risk scoring and assembly point siting.
3. A four-layer framework (Figure 1, Section 10) and a self-audit checklist that schools can use without specialist software.

2. Method

Review. We carried out a structured narrative review of four types of source:

1. Saudi regulations and official statements: Saudi Building Code SBC 801, Ministry of Education, Ministry of Human Resources and Social Development, and the Ministry of Health.
2. International codes and standards: the International Building and Fire Codes, the NFPA standards and EN 1991-1-2.
3. National fire statistics: NFPA and the US Fire Administration.
4. Peer-reviewed studies on school safety preparedness, evacuation and infection control.

Sources were included if they gave a requirement, a statistic or a tested intervention relevant to schools. Saudi sources were preferred where available. US statistics are used because Saudi school fire data are not published in comparable detail, and the paper says so wherever they are used.

Worked examples. The examples are calculations, not observations. They use a hypothetical "School X" whose size is similar to the 2011 Jeddah school: three storeys and about 700 pupils. Table 2 lists every input and its source. Where no source fixes a value, the value is stated as an assumption so readers can substitute their own.

Table 2 - Inputs to the worked examples

Input	Value	Basis
Classrooms per upper floor	10, each 56 m² net	Assumed, typical 7 × 8 m classroom
Occupant load factor, classroom	1.86 m² net per person (20 ft²)	IBC Table 1004.5
Stair capacity factor	7.6 mm per occupant (unsprinklered)	IBC 1005.3.1
Other egress capacity factor	5.1 mm per occupant (unsprinklered)	IBC 1005.3.2
Maximum specific flow, stair (165 mm riser, 305 mm tread)	1.09 persons/s per metre of effective width	SFPE hydraulic model
Boundary layer, stair	0.15 m each side	SFPE hydraulic model
Walking speed, level / stair	1.19 / 0.85 m/s	SFPE-type low-density values
Longest path to stair, stair path for two storeys	45 m, 20 m	Assumed
Detection and alarm time	60 s automatic, 180 s manual	Assumed for illustration
Pre-movement time	60 s drilled, 180 s not drilled	Assumed for illustration
Risk scores	Likelihood and severity, 1–5 each	Illustrative judgement by the authors

The evacuation calculation uses the hydraulic method. Movement time is the time for the first person to reach the exit plus the time for everyone to flow through the narrowest component. The required safe escape time is the sum of detection, pre-movement and movement time. It is not compared with an available safe escape time, which would need fire modelling for a specific building.

3. Saudi regulatory and accreditation context

Four bodies shape school safety in the Kingdom, and a school must satisfy all four at once (Table 3).

Table 3 - Who governs what in Saudi school safety

Body	Role in school safety	Key requirement for a school
General Directorate of Civil Defense (Ministry of Interior)	Enforces the fire code at occupancy and in inspections; coordinates drills with the Ministry of Education	Approved fire safety and evacuation plan, working fire systems, drills coordinated with Civil Defense
Saudi Building Code National Committee	Issues SBC 801 (fire) and SBC 201 (building), based on the International Fire and Building Codes	Schools for pupils up to Grade 12 are Educational Group E: rules on exits, detection, compartments and drills
Ministry of Education, Schools Security and Safety Administration	Sets school-level safety duties	Four evacuation drills per school per year, each timed and evaluated
Education and Training Evaluation Commission (ETEC)	National school evaluation and accreditation	School environment is one of four evaluation domains

The fire code. SBC 801 classifies buildings used for education through the 12th grade as Educational Group E. Its 2018 edition is based on the 2015 International Fire Code, and a 2024 edition has since been issued (Saudi Building Code National Committee, 2018, 2024). In that model code, Group E occupancies must hold an evacuation drill every month, with all occupants taking part. The first drill must take place within 10 days of the start of classes, and the fire official may modify the frequency in severe climates (ICC, 2015, Table 405.2). Saudi practice sets the Ministry of

Education's own minimum: in 2017 the ministry required each school to hold four evacuation drills a year and to time each one, and it reported 35,000 drills in the previous year (Arab News, 2017). The national emergency plan also gives the Ministry of Education duties to carry out drills in coordination with Civil Defense and to form awareness committees in schools (General Directorate of Civil Defense, n.d.).

Egress rules that matter most for schools. Table 4 lists the International Building Code values (ICC, 2021) on which the SBC egress chapter is modelled. A school should confirm the exact values in the SBC edition that applies to its building.

Table 4 - Selected egress values for Educational Group E (IBC basis)

Item	Value
Occupant load factor, classroom	1.86 m² net per person
Stair width per occupant	7.6 mm (5.1 mm if sprinklered with voice alarm)
Door and corridor width per occupant	5.1 mm (3.8 mm if sprinklered with voice alarm)
Maximum exit-access travel distance	61 m unsprinklered, 76 m sprinklered
Rooms allowed one exit	Occupant load of 49 or fewer

Accreditation. ETEC launched the National Program for School Evaluation, Classification and Accreditation at the end of 2023. It evaluates schools in four domains: school administration, teaching and learning, learning outcomes, and the school environment (World Bank, n.d.). International schools may also hold Cognia accreditation. Cognia's 2022 Performance Standards place learner well-being at the centre of an institution's guiding principles (Cognia, 2023). Neither framework sets fire rules; they test whether the school manages its environment. A safety system that produces evidence, such as drill records, inspection logs and a current risk register, serves both the regulator and the accreditor.

Evidence from Saudi schools. The most detailed recent Saudi data come from a survey of 17 randomly selected girls' public schools in the Eastern Province, assessed against 58 items (Al-Ansary et al., 2023). Overall preparedness was 74.9% in government-built schools but only 49.4% in rented buildings (Figure 2A). Rented schools scored lower in every category, most of all in classroom safety (47.6% against 84.7%). Across all 17 schools, only 47% had enough, evenly spread emergency exits, while 94% had checked extinguishers in the canteen (Figure 2B). In other words, equipment is usually present; what lags is the building itself, especially its exits. That pattern matches the Makkah fire, which happened in a rented former house.

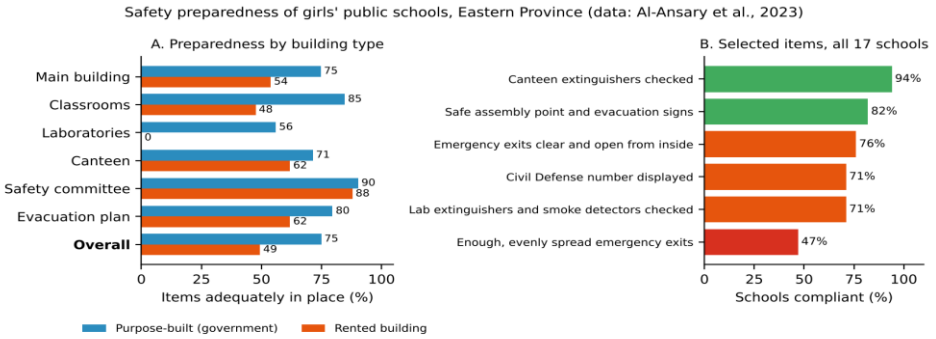


Fig. 2 - Safety preparedness of girls' public schools in the Eastern Province: (A) by building type and (B) for selected items across all 17 schools. Data from Al-Ansary et al. (2023), redrawn by the authors. Laboratory items were not present in the rented schools surveyed.

Heat. Each summer, the Ministry of Human Resources and Social Development has banned outdoor work under direct sun from 12:00 to 15:00 between 15 June and 15 September, with 94% reported compliance in 2025 (Saudi Gazette, 2025). The ban protects workers, not pupils, but it shows the national view of midday heat risk. That view matters for outdoor assembly points and for drills held in hot months (Abdul Salam, 2025).

4. Fire hazards in schools

Class A fire is the school's main fire. Class A fires involve ordinary combustibles such as paper, wood, cloth and many plastics (NFPA, 2022). A school is full of them: exercise books, displays on corridor walls, timber furniture, stored teaching materials and library shelves. EN 1991-1-2 (CEN, 2002) gives typical fire load densities for occupancies (Figure 3). A classroom carries a mean of 285 MJ/m², rising to 347 MJ/m² at the 80% fractile. An office or staff room carries 420 MJ/m² (511 MJ/m²), and a library 1,500 MJ/m² (1,824 MJ/m²). At the 80% value, a 56 m² classroom therefore holds about 19,400 MJ of fuel, the energy of roughly 1.1 tonnes of wood. An 80 m² library holds about 146,000 MJ, roughly 8.3 tonnes. A library is therefore a high-load room in a low-load building, and it should be separated from escape routes and protected by detection.

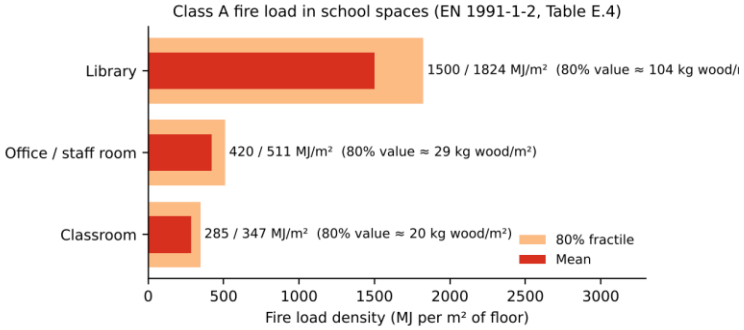


Fig. 3 - Class A fire load density of school spaces, mean and 80% fractile (EN 1991-1-2, Table E.4), with the equivalent mass of wood.

What starts school fires. Saudi school fire statistics are not published in enough detail to show causes. The best available pattern comes from the United States (Figure 4). In 2009–2011, US fire departments attended about 4,000 school building fires a year. Cooking caused 42% of them, intentional fire-setting 24% and heating 10% (USFA, 2014). Among the more serious non-confined fires, intentional fire-setting caused 41% and electrical malfunction 15%. The bathroom was the leading room of origin, at about a quarter of these fires. Fires peaked between 8 a.m. and 5 p.m., when 71% occurred, that is, when the building is full. Encouragingly, 75% of school building fires stayed confined to the object where they started (USFA, 2014). A later NFPA analysis found an average of 3,230 school structure fires a year in 2014–2018, with intentional fires the leading cause at almost two in five (NFPA, n.d.).

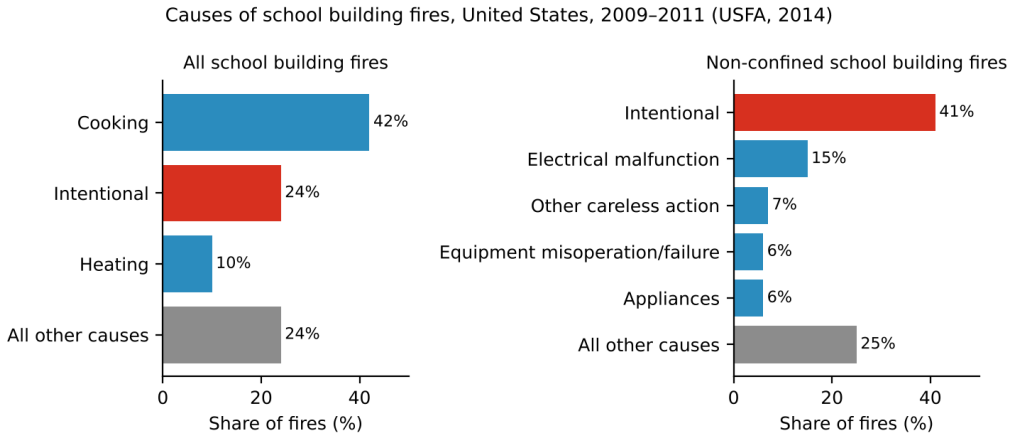


Fig. 4 - Causes of school building fires in the United States, 2009–2011 (data from USFA, 2014). Comparable Saudi data are not published.

Three lessons carry over to Saudi schools, whatever the exact local figures. First, **supervision and housekeeping** matter: unsupervised toilets, stores and stairwells are where fires are set. The 2011 Jeddah fire was reportedly started accidentally by pupils (Arab News, 2011c). Second, **kitchens and canteens** need their own controls: cooking fires are frequent but usually small when staff are present. Third, **electrical loads** grow faster than school wiring, with chargers, projectors, air conditioners and extension leads.

Hot work by contractors. Maintenance and building works often continue during term. Cutting and welding near stored paper or furniture is a classic ignition source. In industry, simultaneous operations are controlled by a permit system that checks how hazards interact before work starts (Abdul Salam, 2024). Schools need the same rule in simple form: no hot work in an occupied building without a written permit, a fire watch and a check one hour after the work ends.

5. School risk assessment

A school risk assessment answers three questions for each hazard: what can go wrong, how likely and how bad is it, and what control brings it down? A simple 5 × 5 matrix (likelihood × severity) is enough for most schools if it is used honestly. That means scoring the risk as it is today, naming the control that changes the score, and naming the person who owns that control.

Method in five steps

1. **Walk the building** with the checklist in the Appendix, at a busy time as well as an empty one.
2. **List hazards** under four headings: fire, structure and crowding, environment and health, and security.
3. **Score the current risk**: likelihood 1–5 × severity 1–5. Bands are low (1–4), medium (5–9), high (10–14) and very high (15–25).
4. **Choose controls** in the order of the hierarchy: remove the hazard, engineer it out, then procedures and training, then personal protection. Re-score the risk with the controls in place.
5. **Assign and review**: each control gets an owner, a check frequency and a record. Review the register after every drill, incident, building change or new term.

Worked example. Table 5 shows an illustrative register for School X. The scores are the authors' judgement for a typical older Saudi school building, not measurements. Figure 5 shows how each risk moves when the controls are in place.

Table 5 - Illustrative risk register for School X

Code	Hazard	Before (L × S)	Key controls	After (L × S)	Owner
H1	Class A fire in classroom or store	3 × 5 = 15	Detection in stores and library; limit wall displays on escape routes; housekeeping round	2 × 4 = 8	Facilities lead
H2	Locked or blocked exit	3 × 5 = 15	Panic hardware on all exit doors; morning exit check; no storage in stairs	1 × 5 = 5	Principal
H3	Canteen cooking fire	3 × 3 = 9	Wet-chemical extinguisher and fire blanket; trained canteen staff	2 × 2 = 4	Canteen supervisor
H4	Electrical overload	3 × 4 = 12	Ban daisy-chained extension leads; annual electrical inspection	2 × 3 = 6	Facilities lead
H5	Contractor hot work in term time	2 × 5 = 10	Hot-work permit, fire watch, one-hour post-work check	1 × 4 = 4	Facilities lead
H6	Laboratory chemicals	2 × 4 = 8	Locked chemical store, inventory, safety data sheets	1 × 3 = 3	Science head
H7	Crowding on stairs at	3 × 4 = 12	Staggered dismissal by floor; staff on each stair	2 × 3 = 6	Deputy

	dismissal				principal
H8	Heat illness at outdoor assembly	4 × 3 = 12	Shaded assembly area, water, heat-index check before outdoor events	2 × 3 = 6	Health officer
H9	Influenza outbreak	4 × 2 = 8	Hand-hygiene stations; sick pupils stay home; vaccination promotion	3 × 2 = 6	School nurse
H10	LPG gas leak	2 × 5 = 10	Cylinders outside; gas detector; isolation valve known to staff	1 × 4 = 4	Facilities lead
H11	Slips and trips on stairs	4 × 2 = 8	Nosings, handrails both sides, no running rule	3 × 2 = 6	Facilities lead
H12	Intruder or security threat	2 × 5 = 10	Single controlled entrance; visitor log; lockdown drill	1 × 4 = 4	Principal

Before controls, two risks were very high (H1 and H2), six were high and four were medium. After controls, none was high or very high: seven were medium and five low. The total risk score fell from 129 to 62, a 52% reduction. The two very high risks, fire and locked exits, are the two that killed people in Makkah and Jeddah. The biggest single gain comes from a control that costs very little: keeping exit doors openable from inside at all times.

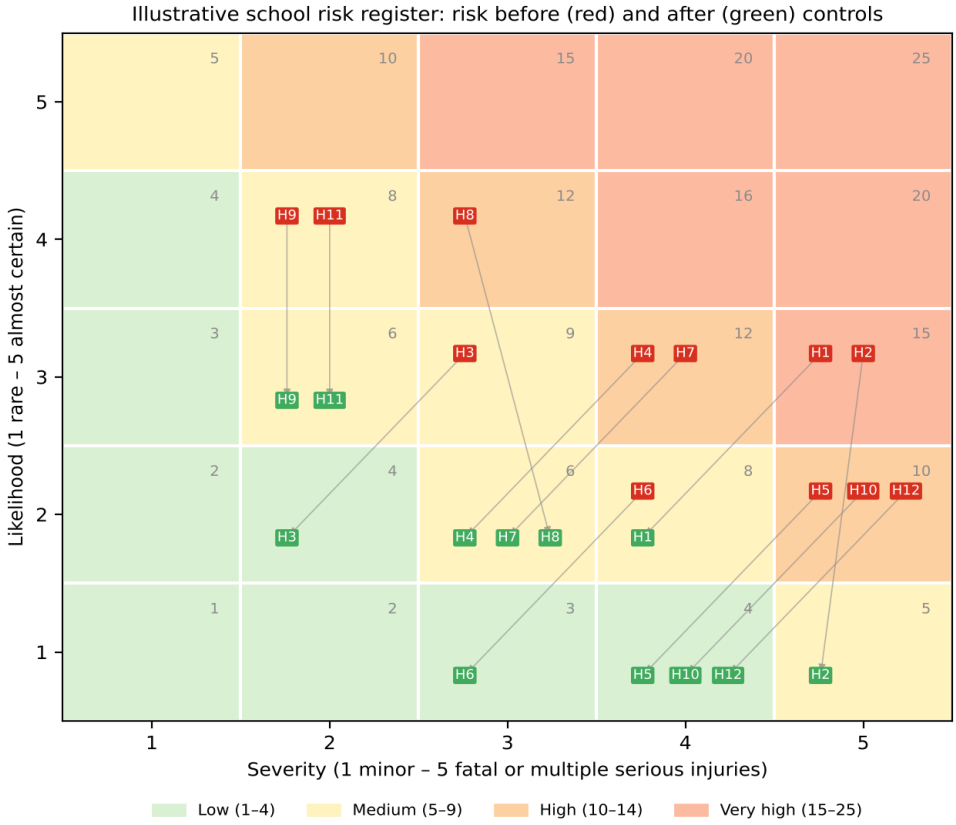


Fig. 5 - Illustrative risk register for School X: each hazard's position before controls (red) and after controls (green). Scores are the authors' judgement, not measurements.

6. Means of egress and evacuation time

Escape routes decide who lives in a school fire. A safe route has three parts: enough width for the number of people, short enough distances to reach it, and nothing that stops people using it. That means no locks, no storage and no smoke.

Worked example: how wide must the stairs be? In School X, each upper floor has ten 56 m² classrooms. At 1.86 m² per person, each classroom has a code occupant load of 31, so each upper floor holds 310 people and the two upper floors 620. Without sprinklers, the stairs serving one floor need 310 × 7.6 mm = 2,356 mm of total width. Two stairs of 1.2 m each (2,400 mm) meet this, and each also exceeds the usual 1,120 mm minimum for stairs serving 50 or more people. Doors and corridors on each floor need 310 × 5.1 mm = 1,581 mm in total. Each stair must also be reachable within the travel-distance limit of 61 m, and a fire at one end must not be able to block both stairs.

Worked example: how long does it take to get out? Code widths say a school is compliant, not how long evacuation takes. Using the hydraulic method (Section 2; Gwynne & Rosenbaum, 2016), each 1.2 m stair has an effective width of 0.9 m and carries about 0.98 persons per second, so two stairs carry 1.96 persons per second. Moving 620 people therefore takes about 316 seconds of queuing flow, plus about 62 seconds for the first person to walk to the exit. Figure 6 adds detection and pre-movement time for four scenarios:

- **A. Design case** (two stairs, automatic detection, pupils drilled): about **8.3 minutes**.
- **B. Same building, not drilled**: about **10.3 minutes**. The extra two minutes are spent deciding to leave, not walking.

- **C. One stair locked or filled with smoke**: about **13.6 minutes**. The remaining stair halves the flow, adding over five minutes.
- **D. A converted building with one 0.9 m stair, no detection and no drills**: about **22.8 minutes**, almost three times the design case.

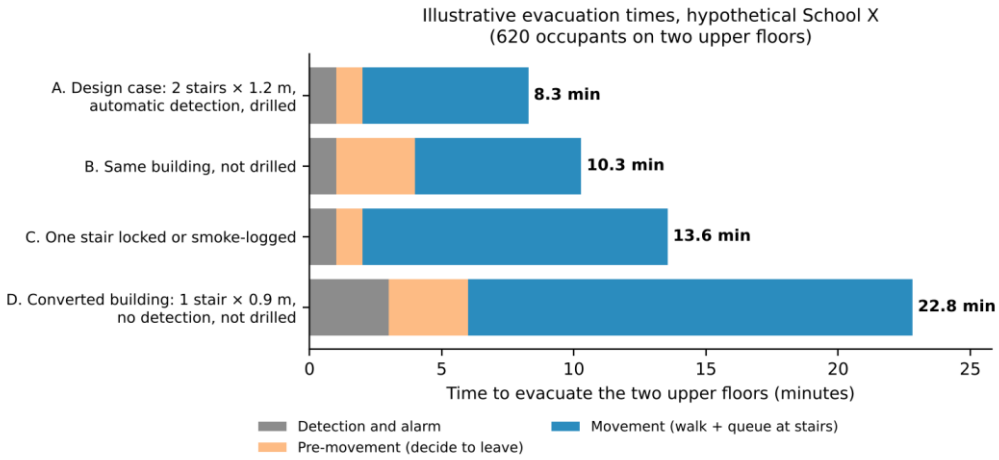


Fig. 6 - Illustrative time to evacuate the two upper floors of School X (620 occupants) in four scenarios, split into detection, pre-movement and movement. Detection and pre-movement times are assumptions (Table 2).

Scenario D is not a model of the Makkah or Jeddah fires; it shows why the same features recur in both. The most dangerous combination is not a large fire but a slow alarm, a slow decision and a single narrow stair. Each of these is cheap to fix compared with a death: detection, drilling and keeping a second stair open. The calculation also shows where drills help. Drills cannot widen a stair, but they cut the pre-movement time, which is the part of evacuation that people control.

Figure 7 breaks the 14.5-minute difference between scenarios D and A into its parts. Automatic detection and practised drills each save about 2 minutes, and both cost little. The building changes, a wider stair and a second stair, each save about 5.3 minutes. In an existing building these are the hardest to change, which is why converted premises are so dangerous and why keeping every existing stair open and clear matters so much.

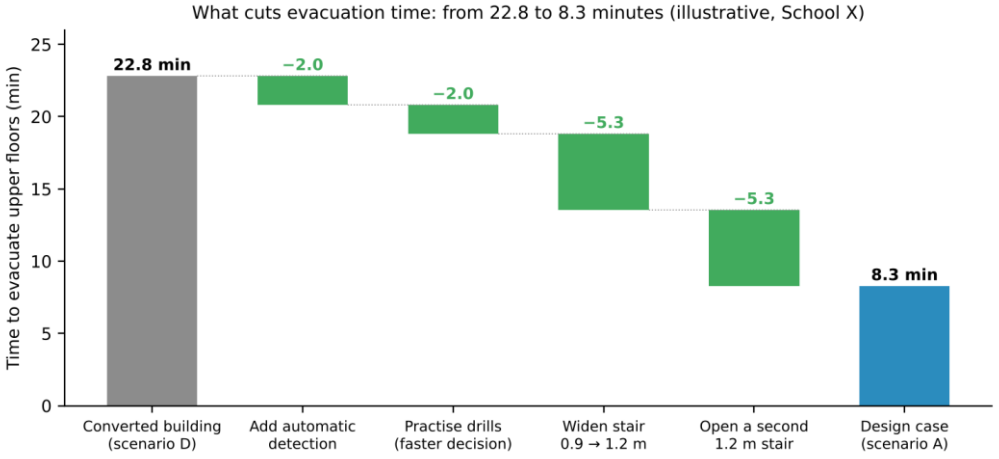


Fig. 7 - Stepwise reduction in the illustrative evacuation time of School X, from scenario D to scenario A. Each step uses the same model and assumptions as Figure 6; the size of each step depends on the order in which improvements are added.

Design and daily rules for escape routes

- Every exit door opens with one action from inside, without a key, at all times the building is occupied. Panic hardware is fitted where the occupant load requires it.
- Stairs are enclosed and fire-separated from corridors, with self-closing doors that are never wedged open.
- Nothing is stored in stairs, under stairs or in corridors, and wall displays are kept off escape routes.
- Emergency lighting and exit signs are tested monthly. Evacuation plans showing two routes are posted in every classroom.
- Pupils with disabilities have a personal evacuation plan and a named helper, and refuge areas are identified on upper floors.

7. Assembly points and emergency response

An evacuation ends at the assembly point, and a poorly placed assembly point can create a second emergency. In the Eastern Province study, about 82% of girls' public schools had a safe assembly point and evacuation signs, and 71% displayed the Civil Defense number in a visible place (Al-Ansary et al., 2023). The remaining schools are where improvement is easiest.

Siting an assembly point. The model fire code requires outdoor assembly areas to be a safe distance from the building, so that people do not interfere with fire service operations (ICC, 2015). UK school guidance sets at least 10 m from any building, far enough to protect people from heat and smoke (London Borough of Tower Hamlets, n.d.). For Saudi schools, we add three climate and site rules (Figure 8):

1. **Shade and water.** Pupils may stand outside for 20 minutes or more in temperatures above 40 °C. The primary assembly area should be shaded, with drinking water nearby, and drills in hot months should be timed for the morning. Heat and hydration risk can be managed with the same approach used for outdoor workers (Abdul Salam, 2025).
2. **Clear of the access road.** Routes from exits to assembly points must not cross the fire service access road or block hydrants. The main gate must stay free for emergency vehicles, and parents should be directed to a separate reunification point.
3. **Two points, not one.** A second assembly point on the other side of the building, ideally upwind of the prevailing wind, allows for a fire or gas leak near the first.

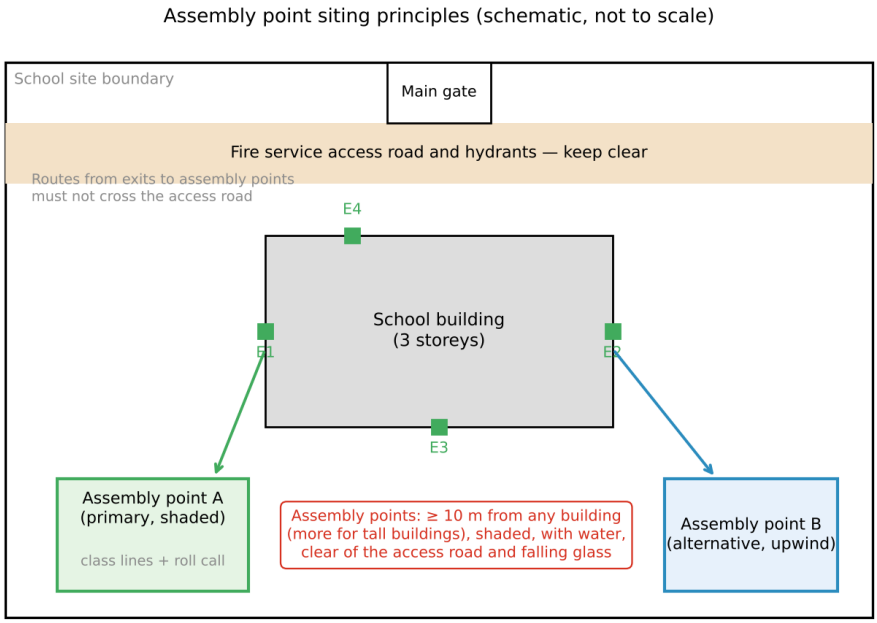


Fig. 8 - Assembly point siting principles for a Saudi school (schematic, not to scale).

At the assembly point. Each class forms a line with its teacher, who carries the class list and reports "all present" or names who is missing to the incident controller. Nobody goes back inside until the Civil Defense officer, or in a drill the principal, says so. The time from alarm to the last roll-call report is the drill's key measure; the Ministry of Education asks schools to assess each drill by the time it takes (Arab News, 2017).

Not every emergency means evacuation. Table 6 matches the response to the threat. Lockdown drills do not replace fire drills (SBC 801-CR, Section 405), and a school needs to practise both.

Table 6 - Matching the response to the emergency

Emergency	Response	Where people go
Fire or smoke in the building	Evacuate	Primary assembly point; alternative if blocked
Gas leak inside the building	Evacuate; isolate gas; no switches or phones near the leak	Alternative assembly point upwind
Gas, smoke or dust outside the building	Shelter in place; close windows; switch off fresh-air intake	Classrooms on the side away from the release
Intruder or security threat	Lockdown; lock and darken rooms; stay silent	Inside classrooms, away from doors and windows
Extreme heat or sandstorm during an outdoor event	Move indoors; postpone outdoor assembly	Hall or classrooms
Medical emergency	First aider responds; call Red Crescent (997); clear access	Casualty stays; others move away

8. Health: influenza and common infections

Fire is the rare, severe school hazard; infection is the common one. Respiratory and stomach infections spread quickly where hundreds of children share rooms, desks and washrooms, and they drive absence among pupils and staff. Close contact at school speeds the spread of seasonal influenza among pupils and then into their families (Al Ibrahim et al., 2024).

Hand hygiene works. A meta-analysis of 30 community studies, many in schools and child-care centres, found that improving hand hygiene reduced gastrointestinal illness by 31% (95% CI 19–42%) and respiratory illness by 21% (95% CI 5–34%). The most effective approach was hand-hygiene education with plain, non-antibacterial soap (Aiello et al., 2008). This is one of the cheapest health controls a school can buy: soap, water, drying, time in the timetable, and teaching.

Vaccination and staying home. The Saudi Ministry of Health offers seasonal influenza vaccine by appointment through the Sehhaty app. It lists children aged six months to five years and people with chronic diseases among the most vulnerable groups, and it reported that 96% of patients admitted to intensive care in the previous season had not been vaccinated (Arab News, 2025). Schools cannot require vaccination, but they can inform

families. A school-based education session in Al-Ahsa significantly improved secondary schoolgirls' knowledge of, and attitudes towards, the influenza vaccine (Al Ibrahim et al., 2024).

A school infection-control routine

- Hand-washing stations with soap at toilets and the canteen, checked daily; sanitiser at classroom doors.
- Short, repeated teaching on hand washing and on covering coughs and sneezes, built into science and health lessons.
- A clear rule that pupils with fever stay home, with a sick room and safe pick-up for pupils who fall ill at school.
- Daily cleaning of high-touch surfaces (door handles, desks, taps) and good ventilation.
- Absence tracking by class: a sudden rise in one class is an early warning, and the school nurse should be told.
- Information to parents each autumn on influenza vaccination, in line with Ministry of Health campaigns.

9. Educating students and empowering staff and management

After the 2011 Jeddah fire, a Saudi teacher said that most girls and staff could not escape a fire because they did not remember the drills they had been taught (Arab News, 2011a). That is the central human problem: knowledge that is taught once is not available under stress. Training has to be short, repeated and practised in the real building.

Roles. Everyone needs to know their job before the alarm sounds (Table 7). Roles are assigned by position, not by name, so they still work when a person is absent, and each role has a named deputy.

Table 7 - School emergency roles

Role	Usually held by	Key duties
Incident controller	Principal; deputy as alternate	Decides the response, calls Civil Defense, receives roll-call reports, briefs responders
Floor wardens	One teacher per floor and per stair	Sweep toilets and stores, close doors, report "floor clear"
Class teachers	Every teacher on duty	Lead the class out by the nearest safe route, take the class list, take the roll
First aiders	Trained staff, school nurse	Treat casualties at the assembly point; meet the ambulance
Facilities lead	Caretaker or facilities officer	Isolate gas and power, meet Civil Defense at the gate with plans
Communications	Administrative staff	Visitor list, parent messages, media enquiries referred to the principal
Safety committee	Principal, facilities, nurse, teacher and parent representatives	Own the risk register; review drills and incidents each term

Educating pupils, by age

- **Primary:** know two ways out of every room; never hide during a fire; walk, do not run; follow the teacher; what to do if clothes catch fire.
- **Intermediate:** the fire triangle and Class A fuels; why doors are closed; how alarms and detectors work; hand washing and coughing etiquette.
- **Secondary:** recognising and reporting hazards; basic first aid; awareness of extinguishers (pupils are not expected to fight fires); pupil safety ambassadors who help with drills and hazard spotting.

This content fits naturally into science, health and citizenship lessons. Pupils who help audit their own school learn the material better and spot hazards adults walk past.

Empowering staff

- Induction in the first week for every new teacher, so they know their routes, roles and the location of the assembly point before the first drill.
- Annual fire-warden training, with hands-on extinguisher practice for wardens and facilities staff.
- A first-aid certificate for enough staff that one is on every floor at all times.
- Clear authority for any staff member to stop an unsafe activity, such as contractor hot work, and to report it without blame.

What management must provide. Management controls the three things staff cannot supply: money, time and follow-up. A school safety plan should have its own budget lines for maintaining detection, extinguishers, emergency lighting and signage, and time in the calendar for drills and training. It should also track a few leading indicators each month:

- the time to evacuate and complete roll call in the last drill;
- the share of exit doors found openable in morning checks;
- the share of extinguishers inspected on time;
- the number of open actions from the risk register.

Drills that test the system, not just the people. A drill that is announced in advance, held at the same time and always uses the main stair shows only that the plan works on paper. The gap between work as planned and work as done is where real failures hide (Abdul Salam, 2026c). Good drills are:

- unannounced to pupils;
- held at different times, including breaks and prayer times;
- run sometimes with one exit declared blocked;
- timed and followed by a short debrief whose actions go into the risk register.

This is the resilience cycle of anticipate, monitor, respond and learn (Abdul Salam, 2026a), applied to a school: every drill is a chance to learn before a real emergency forces the lesson.

10. An integrated school safety framework

The sections above come together in four layers, shown in Figure 1. Each layer has one owner, a few checks and a record that the regulator or accreditor can see. Health and heat run across all four, and the Saudi rules form the foundation. The learning loop is the part most often missing: every drill and every incident or near miss should change the risk register, or it was a ritual rather than a test.

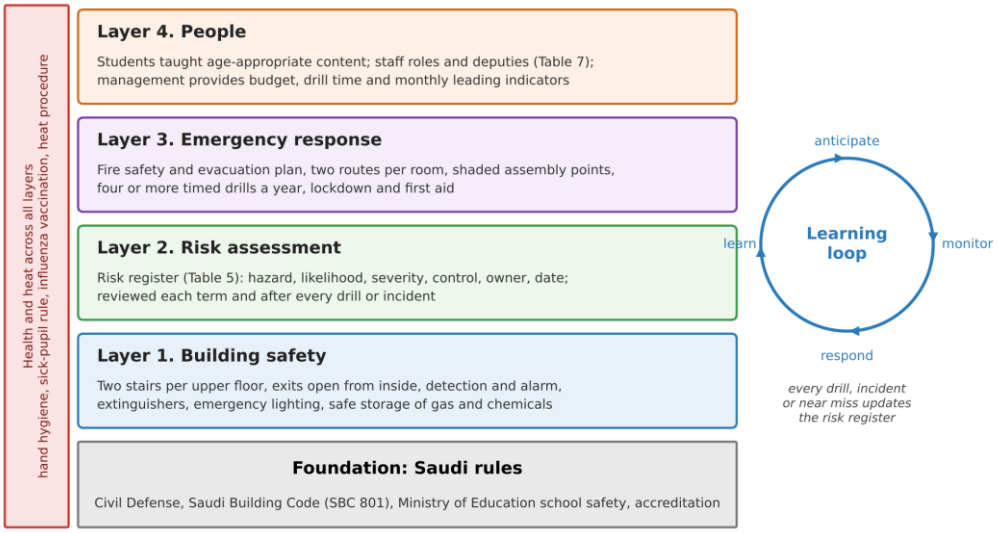


Fig. 1 - The school safety framework: four layers, a learning loop, and health and regulation across all of them

The framework is deliberately simple. A school without a safety specialist can run it with the Appendix checklist, a risk register (Table 5), the roles in Table 7 and a drill log. A larger school or group of schools can add the leading indicators in Section 9 and report them to its board each term.

11. Discussion

The rules exist; the gap is in practice. Saudi Arabia now has a fire code for educational buildings, a ministry safety administration with a drill requirement, Civil Defense enforcement and national accreditation. The weaknesses that remain sit in daily practice: exits that are locked for security, old rented buildings, drills that are announced and routine, and plans that staff have not rehearsed. The Eastern Province study found these gaps even in a sample with 70–90% overall preparedness, and it found rented schools far behind purpose-built ones, at 49% against 75% (Al-Ansary et al., 2023). The framework in this paper is designed to close that gap by giving every requirement an owner, a check and a record.

Security and fire safety must be reconciled, not traded. In Makkah the school was reported locked and its windows were barred; in Jeddah, people escaped through upper windows. Schools lock doors for good reasons: to protect pupils and control visitors. The answer is hardware that is secure from outside and openable from inside, plus one controlled entrance, not chains or padlocks on exits. In the risk register this single change cut the locked-exit risk from very high to medium.

Time is the measure that connects everything. The worked evacuation example shows that the time to safety depends on four things: detection, the decision to leave, the number of stairs and their width. Drills improve the decision time; maintenance keeps the stairs open; design fixes the width. Recording drill times, as the Ministry of Education asks, turns this into a number a school can track and improve.

Heat and health belong in the same plan. International school safety guidance is written mostly for temperate climates. In Saudi Arabia, a well-run evacuation can still expose pupils to dangerous heat at the assembly point, and an infection outbreak can close a school more often than a fire. Treating heat and hygiene as part of the same system, with the same risk register and the same owners, is a contribution suited to the Gulf setting.

Limitations

- This is a review with worked examples, not a field study. The examples use a hypothetical school, assumed detection and pre-movement times, and the authors' judgement for risk scores. They show the method, not the state of any real school.
- The fire-cause statistics are from the United States because comparable Saudi data are not published. Local causes may differ, especially for heating, which matters less in a hot climate.
- The evacuation calculation uses the simple hydraulic method and does not model smoke spread, so it gives a required escape time without an available escape time to compare with.
- Building code values are summarised from the model codes on which SBC is based. Schools must confirm the exact values in the SBC edition that applies to their building.

Future work. The checklist in the Appendix should be tested in a sample of Saudi schools with permission from the Ministry of Education. Drill times should be measured with and without the practices recommended here, and the results compared across school types: public and private, purpose-built and converted.

12. Conclusion

Saudi school fires have killed pupils and teachers in buildings where exits were shut, stairs were narrow and people did not know what to do. The national rules to prevent this now exist. What makes them work is a school-level system that is practised, checked and owned. This paper has drawn those rules and the evidence together into four layers: building, risk, response and people. It has shown with worked examples how a school can size its stairs, estimate its evacuation time, score and reduce its risks, and site its assembly points for a hot climate. In the example, two stairs, early detection and practised pupils cleared the upper floors in about 8 minutes; one narrow stair, no detection and no drills took nearly 23. The difference is not money or technology; it is preparation that is done before the alarm sounds.

Declarations

Author contributions. Shajahan Abdul Salam: conceptualisation, review of regulations and evidence, risk and egress analysis, framework design, writing of the original draft. Jannathul Firdous: school-practice perspective, pupil education and health content, review and editing. Both authors approved the final manuscript.

Conflict of interest. None declared. The first author is the author of five works cited in this paper.

Ethics. No human participants or school data were involved.

Data availability. All data used are from the published sources cited. The calculation script and figure files are available from the corresponding author on request.

Use of generative AI. A generative AI assistant (Claude, Anthropic) was used to help search the literature, run the worked calculations and draft the text. The authors checked every statement and reference and take full responsibility for the content.

Appendix. School safety self-audit checklist

Use this checklist on a walk-through at a busy time of day. Mark each item Yes, No or Not applicable. Every "No" becomes an action with an owner and a date in the risk register.

No.	Layer	Check	Yes / No	Action and owner
1	Building	Every exit door opens from inside with one action, without a key, now		
2	Building	At least two separate stairs serve each upper floor, and both are open		
3	Building	Stairs and corridors are free of storage, furniture and wall displays		
4	Building	Stair doors self-close and are not wedged open		
5	Building	Fire alarm call points work and are not obstructed; the alarm is audible in every room, toilet and yard		
6	Building	Smoke detection covers stores, library, laboratories and corridors		
7	Building	Extinguishers are in place, inspected within the last month, and suitable (water or foam for Class A; wet chemical in the kitchen)		
8	Building	Emergency lighting and exit signs were tested this month		
9	Building	Gas cylinders are outside, secured, and the isolation valve is labelled		
10	Building	No daisy-chained extension leads or overloaded sockets		
11	Risk	The risk register was reviewed this term and after the last drill		
12	Risk	Every high or very high risk has a control, an owner and a date		
13	Risk	Contractor hot work requires a written permit and a fire watch		
14	Risk	Chemicals are locked away, listed, with safety data sheets		
15	Response	A fire safety and evacuation plan approved by Civil Defense is in place		
16	Response	An evacuation plan with two routes is posted in every classroom		
17	Response	Primary and alternative assembly points are signed, at least 10 m from buildings, and clear of the access road		
18	Response	The primary assembly point is shaded, with water nearby		
19	Response	Class lists and visitor lists can be taken out in an emergency		
20	Response	The Civil Defense number is displayed in visible places		
21	Response	Four or more evacuation drills held this year, each timed and recorded		
22	Response	At least one drill this year was unannounced or used a blocked exit		
23	Response	A lockdown procedure exists and has been practised		
24	Response	Pupils with disabilities have personal evacuation plans		
25	People	Every staff role in Table 7 has a holder and a deputy		
26	People	New staff were inducted on routes and roles in their first week		
27	People	Enough staff hold current first-aid certificates for one per floor		
28	People	Pupils were taught age-appropriate fire and emergency content this year		
29	Health	Soap and water are available at every washroom, checked daily		
30	Health	There is a rule and a sick room for pupils who become ill; absence is tracked by class		
31	Health	Parents received influenza vaccine information this season		
32	Health	A heat procedure covers outdoor assembly, PE and drills in hot months		

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