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From Prescription to Performance: A Comparative Analysis of SBC 801 and ADB Fire Codes

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Abstract

This report is intended to compare the main elements of fire safety regulations across the Saudi Fire Code (SBC 801) and the UK's Approved Document B (ADB). It studies how SBC 801 was first introduced, the logic behind its development, and how it is based on the county specific features of Saudi Arabia while supporting Vision 2030. A detailed comparison with ADB is shown focusing on key areas of fire safety such as occupancy classification, means of warning, and access to the building for fire services. The report summarizes comments from professionals on the simplicity of applying SBC 801, how well it works, its weaknesses and the cost factors involved. This analysis points out the significance of SBC 801 for a safe and environmentally sound built environment in Saudi Arabia and explains the different factors involved in its regulations.

Keywords: ADB; Approved Document B; Building Regulations; Comparative Analysis; Fire Safety; Performance-Based Code; Prescriptive Code; SBC801; Saudi Fire Code.

1. Introduction

1.1. Unique characteristics of Saudi Arabia and the need for SBC 801

Extreme temperatures and the arid conditions in the Kingdom of Saudi Arabia means that many international safety standards do not address its situation [1]. This was the main reason behind the formulation of domestic codes. Code developers have considered the sandy and desert landscapes of the country when developing the SBC 801. As the country's economy is developing rapidly with many giga projects proposed, it is vital to have up-to-date codes and standards [2].

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By creating domestic codes, Saudi Arabia can strengthen its national independence and boost its image as a global leader in construction standards helping in attracting foreign investments. A critical driver for the Saudi Fire Code (SBC801) is the high fire-related death rate in the KSA (0.62% of total deaths, ranking among the top 65 globally), underscoring the need for tailored regulations [3]. The code's philosophy prioritizes robust passive and active fire protection to mitigate risks associated with varying occupant preparedness.

1.2. Overview of SBC 801 and Approved Document B

The SBC was created by the national committee called Saudi Building Code National Committee (SBCNC) [4]. The committee started working on the code in 2000 and the initial draft was made available to the public in 2007. A revision was made in 2018 to the original version to ensure that it lines up with Vision 2030. The SBC is made up of specific construction codes, each named numerically from SBC 201 to SBC 1201, for different construction aspects and holds minimal acceptable requirements for all construction standards. On the other hand, Approved Document B (ADB) gives general fire safety guidance in England and is part of a larger set of publications called Approved Documents which are revised from time to time. ADB is available in two volumes: the first for residential buildings and the second for non-residential construction. An important point of difference is that ADB’s principles are advisory and same results with alternative solutions are allowed. This makes it a performance-oriented code when compared to SBC where any construction that does not follow the codes may not get the required approvals. As a result, SBC 801 focuses on specific rules while ADB focuses on achieving performance.

2. Evolution and strategic rationale of the Saudi Fire Code

Saudi Arabia has experienced rapid urbanization, with nearly 85% of its population now urban residents, shifting from 55% rural in the 1970s [5]. This, combined with its desert terrain and historical urban planning deficiencies, has impacted on the country's economy causing them to be overdependent on oil. This restricted the country in setting sustainable goals which are important to attract investments. One of the initiatives taken by the government to counter this overdependence on oil is the 'Vision 2030' [6].

2.1. Historical context and development of SBC 801

Historically, KSA's built environment relied on American and British standards, which lacked specific details for the unique Saudi context, leading to inconsistencies. The national committee developed the SBC by collaborating with many approved standards worldwide. The SBC leveraged International Code Council (ICC) codes as foundational documents. The ICC authorized SBCNC to adapt ICC standards, with the committee integrating regional factors like culture, climate, and soil types into the base code. For fire safety, SBCNC formulated SBC 801, 'The Saudi Building Code Fire Protection Requirements,' based on the 2015 edition of the International Fire Code (IFC) and National Fire Protection Association (NFPA) standards, with modifications made for KSA's needs, especially considering the high fire-related death rate. Drafts were circulated among professionals for feedback to ensure practicality.

2.2. Impact on construction economy

The SBC's introduction initially increased construction costs in the country by an estimated 5.8% due to stricter set of rules [7]. However, this is viewed as a strategic investment, with long-term benefits outweighing initial costs. Buildings compliant with the new standards are expected to be more durable, reducing maintenance costs, and the enhanced safety requirements are anticipated to minimize financial outlays from catastrophic events. Mandates for energy-efficient materials are projected to lower operational costs (e.g., 15% average decrease in energy consumption for private residences), and promotion of green buildings is expected to increase property values.

2.3. Challenges encountered during adoption

A significant challenge was educating the public about the new standards. This involved public campaigns via various media, community workshops by SASO for professionals and homeowners, and development of handbooks and user guides. The proposed 'Saudi Building Academy' aims to offer courses on codes and design, enhancing knowledge and awareness. Despite efforts, challenges persist, including the impact of oil price fluctuations on funding and a shortage of skilled and unskilled construction professionals, leading to increased labor costs and project delays. However, giga-projects like Neom are attracting international professionals and are expected to alleviate labor shortages. The effectiveness of codes relies not only on technical content but also on public education, enforcement, and addressing socio-economic barriers.

3. Special occupancies in SBC 801

The revised version of SBC 801 released in 2018 is a very long document with 832 pages. It is divided into seven parts, with Part Four uniquely dedicated to 'Special Occupancies' for fire and explosion protection in select industries.

3.1. Rationale for inclusion

The committee selected 18 special occupancies providing tailored guidance for each. Examples include:

- Aviation industry: Included due to daily handling of highly flammable materials and potential for catastrophic damage, reflecting a proactive safety culture despite low accident rates.
- Dust producing Industry: (e.g., lumberyards) added due to the inherent ignition risk from combustible dust, exacerbated by hot, low-humidity weather, and historical fires.
- Paint industry: Included due to common fires in the Middle East, linked to high volatility of organic solvents and high regional temperatures promoting flammable mixtures.
- Semiconductor Manufacturing Facilities: This addition aligns with KSA's 'National Semiconductor Hub' initiative (Vision 2030), as these units use explosive gases and volatile solutions, with exothermic reactions and high-voltage devices posing elevated ignition risks and substantial financial losses.
- Tent production and assembling facilities: An interesting addition due to the flammability of materials, sleeping risk and close operating distance leading to uncontrollable fire spread, and significant danger to occupants. This inclusion is directly influenced by the 1997 Mina fire that claimed 300 lives [8].

This exemplifies a dual regulatory approach: reactive (addressing known historical risks) and proactive (anticipating future risks, especially Vision 2030 initiatives), shaping future safety landscapes. Most handle hazardous materials, with operations becoming more dangerous in KSA's hot, dry environment.

3.2. Oil and petroleum industry – A notable omission

One of the most surprising absences from SBC 801's special occupancy list is the oil and petroleum industry, despite its significant contribution to Saudi Arabia's GDP and inherent high fire hazards. Notable accidents (e.g., Hawiyah gas pipeline fire [9] and Jubail petrochemical plant fire [10]) and frequent intentional attacks (e.g., drone attacks on Shaybah Oil field, missile strikes on Abqaiq-Khurais oil processing plant [11], attacks on Ras Tanura Port) underscore the massive fire threat. The most probable explanation is that this industry operates under its own stringent, internationally recognized safety documents (e.g., Saudi Aramco Engineering Standards, API standards), suggesting a deliberate regulatory choice to defer to existing robust industry-specific regulations.

3.3. Assessment of SBC 801's success in addressing prevalent fire causes in KSA

While SBC 801 addresses high-probability fire facilities, statistics indicate most fires in KSA originate from other sectors. As seen in Figure 1., residential fires are the most common, often attributed to human factors like negligence, carelessness, lack of awareness (e.g., unattended cooking, improper electrical appliance use, cultural practices), and noncompliance due to financial reasons. Waste and garbage fires consistently dominate incident frequency due to improper disposal, mismanagement, and inadequate infrastructure, often linked to cultural practices and lack of public awareness [12]. Transportation fires are outside building codes. The persistence of residential and waste fires, despite SBC 801 covering "almost all of the major hazards," highlights a gap between code prescription and real-world compliance, indicating that socio-cultural and economic factors can undermine the code's technical robustness.

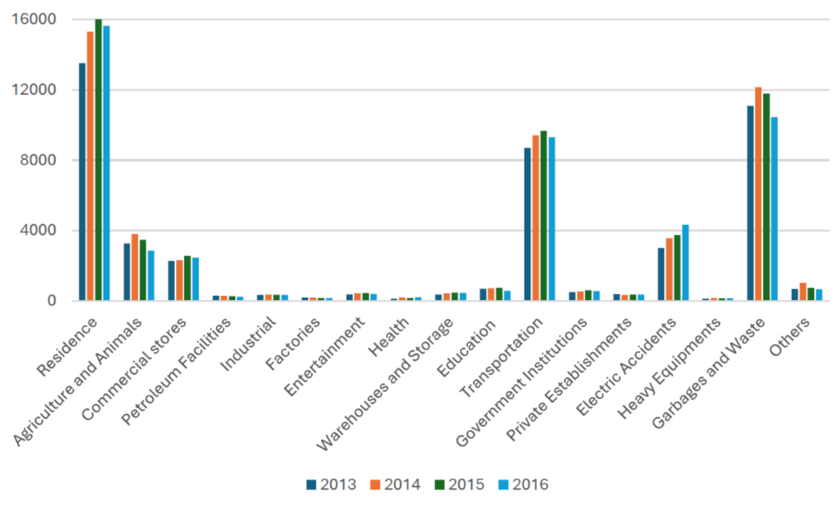

Figure 1: fire statistics in KSA (2013 to 2016) [13]

4. Comparative analysis: SBC 801 vs. Approved Document B (ADB)

This chapter compares SBC 801 and ADB across key fire safety requirements, excluding ADB's Requirement B4 ("External Fire Spread").

4.1. Occupancy Classification

ADB classifies buildings into seven general "Purpose Groups" based on intended use, recommending the more stringent group in ambiguous cases. SBC employs a more specific and granular classification system (Assembly (A), Business (B), Education (E), Factory Industrial (F), High Hazard (H), Institutional (I), Mercantile (M), Residential(R), Storage(S), Miscellaneous(U)), with many subdivisions, allowing for highly tailored requirements. This granularity suggests a need for explicit, detailed guidance in a developing regulatory environment.

4.2. Means of warning and escape

- Detection and Alarm Systems: ADB sets a straightforward objective for detection and alarm, allowing human sensory detection for small buildings but requiring dedicated systems for larger ones, with automatic detection for sleeping risks or where fires might go undetected (referencing BS5839-1). SBC 801 has more specific requirements, mandating compliance with NFPA 72, generally requiring manual fire alarm boxes unless sprinklers are present and requiring automatic smoke detection in corridors serving sleeping units. SBC 801's risk-based approach, with automatic alarms linked to sprinklers, emphasizes early warning and life protection, potentially due to lower awareness of emergency response in KSA.
- Horizontal Escape Design: ADB stipulates clear paths to storey exits, with the number and capacity of routes dependent on occupant load and travel distance. Single escape routes are permissible under specific occupant limits, and travel distances can increase with multiple directions of travel. ADB also introduces "discounting" the largest storey exit, assuming one might be blocked. SBC 801's horizontal egress depends on occupant load and space usage, requiring at least two exits if common path or occupant load exceed values, with more exits for higher loads. Maximum travel distance is generally increased by sprinkler systems. Minimum width is calculated by a 'Means of Egress Capacity Factor (5.1 mm/occupant). Remaining exit capacity after discounting should not be less than 50% of total. SBC 801's reliance on sprinklers for increased travel distances demonstrates confidence in modern sprinkler technology, allowing greater flexibility in passive design.
- Vertical Escape Design: ADB addresses the number of stairs, requiring refuges (900 mm x 1400 mm, wheelchair accessible, EVC) on each storey of protected stairways. Escape stairs must be at least as wide as leading exits and not less than minimum widths, varying by evacuation plan. Discounting of stairs is required unless protected by a lobby or smoke control. SBC 801 calculates stair width by a 'Means of Egress Capacity Factor (7.6mm/occupant), with a minimum 1100 mm width, unaffected by evacuation type. It does not explicitly mention discounting stairways. Areas of refuge (750 mm x 1200 mm per 200 people) are required unless two-way communication is available at lift landings or for R-2 sprinklered buildings. The significant difference in allowable residential travel distance (ADB 7.5 m vs. SBC 38 m) is striking, attributed to SBC's integration of advanced fire safety solutions like widespread sprinkler mandates, allowing longer evacuation times.

4.3. Internal fire spread

- Wall and Ceiling Linings: ADB focuses on restricting flame spread over internal linings, especially in circulation spaces, to prevent hindrance to escape. It classifies linings (e.g., Class D-s3, d2, Class C-s3, d2, Class B-s3, d2 for circulation spaces) and limits areas of lower-performing linings. SBC 801 provides distinct guidance for new and existing buildings, referencing SBC 201 and ASTM E84 for material classification based on flame spread and smoke development index. It specifies material classes for different occupancies, allowing fire-retardant coatings (NFPA 703) or NFPA 286 as alternatives.
- Load Bearing Structures: ADB specifies minimum fire resistance ratings for load-bearing members (e.g., floor structures, walls, beams, columns) using European classifications (R, E, I) or BS 476, with ratings generally increasing with building height. SBC 801 refers to SBC 201 for fire ratings, determined by ASTM E119 or UL 263 tests, based on construction types (I, II, III, IV, V). The highest prescribed fire resistance in SBC 801 is three hours (180 minutes), 60 minutes more than ADB's 120 minutes. This prescriptive rigor in SBC 801 demonstrates a more conservative approach, prioritizing robust passive fire protection.
- Compartmentation: ADB advocates for effective compartmentation to prevent fire spread within and between buildings, with fire resistance of compartment floors and walls aligning with Table B3 in the document. Compartment walls are required between different buildings and purpose groups within a building. Non-residential buildings over 30 meters high and basements deeper than 10 meters must have compartment floors. SBC 801 does not explicitly use 'compartmentation' but employs 'fire wall,' 'fire barrier,' and 'fire partition' to restrict fire and smoke spread. Fire walls are continuous, structurally stable, with protected openings and a fire resistance rating (e.g., 3 hours). Fire barriers have varying ratings (e.g., 1–2 hours for shaft enclosures), and fire partitions (e.g., corridor walls, dwelling unit separations) generally require one-hour fire resistance. This specificity in SBC 801 reflects its prescriptive philosophy, detailing how to achieve safety.
- Cavity Barriers and Opening Protections: Both codes require cavity barriers to divide cavities and seal edges to prevent fire spread in concealed spaces, with maximum allowable cavity sizes. Both emphasize appropriate opening protection and fire-stopping methods to maintain fire-rated construction performance. ADB specifies fire door ratings (BS 476) and provides three fire-stopping options for pipes. SBC 801 requires fire doors to meet NFPA 288 and have the same fire resistance as the construction, and fire-stopping systems (ASTM E814 or UL 1479) for openings through fire/smoke barriers.

4.4. Fire service access

- Fire fighting Vehicle Access: ADB recommends vehicle access for pump appliances within 15% of the perimeter or 45 meters of every point for small buildings, with specific requirements for other buildings (e.g., 750 mm wide doors every 60 meters) and turning facilities for dead-end routes more than 20 meters. SBC 801 mandates an approved fire apparatus access road within 45 meters of all portions of the facility and first floor exterior walls (extendable if sprinklered). Roads must be at least 6 meters wide without obstructions, with turning areas for dead-end roads more than 45 meters. Two exits or exit access doorways must be placed at half the maximum diagonal dimension, or one-third if sprinklered. SBC 801's 6-meter-wide road provides a higher safety margin, possibly due to more available open space in KSA.
- Fire Mains and Hydrants: ADB emphasizes fire mains (dry or wet) for connecting hoses, required in

firefighting shafts and protected escape stairs. Outlets must be within 45 meters hose distance. Wet fire mains are required for buildings with floors more than 50 meters above vehicle access. Additional hydrants are needed if a building is more than 100 meters from an existing hydrant or has a compartment more than 280 m^2. SBC 801 requires access to an approved water supply (NFPA 24 for mains, NFPA 22 for tanks). On-site hydrants may be required if a facility is more than 120 meters from a hydrant (180 meters if sprinklered). Dry systems are generally not used unless freezing is a concern.

- Access for Firefighting Personnel: ADB requires firefighting shafts with lifts for buildings 18 meters or more in height, serving every floor, with positioning based on hose-laying distance (60 m/45 m if not sprinklered). Basements deeper than 10 meters or large basements also require shafts. SBC 801 does not have a dedicated section for firefighting shafts but requires at least two fire service access elevators for buildings more than 36 meters, installed in a two-hour fire-rated protected shaft with a one-hour lobby. Standpipe systems (NFPA 14) are required, with Class 3 for buildings more than 9 meters (Class 1 if sprinklered). ADB’s stricter shaft requirement at lower heights ensures protected access, while SBC 801's broader sprinkler mandates might implicitly offset this.
- Heat and Smoke Venting from Basements: ADB requires smoke outlets in each basement space (1/40 of floor area) or connecting doors for indirect venting. Natural smoke outlets or mechanical smoke extraction (10 air changes/hour, 300°C for 1 hour) are options if sprinklered. SBC 801 mandates ventilation for all basements (natural or mechanical). Basements more than 9 meters deep must have a smoke control system (NFPA 92), unless sprinklered, aiming to maintain the smoke layer at 1.8 meters above walking surfaces.

5. Professional perspectives on SBC 801

A survey of 16 professionals working with SBC 801 provided practical insights.

5.1. Participant demographics

Participants included fire safety engineers, civil engineers, mechanical engineers, project operations directors, safety engineers, electrical engineers, and general managers from the middle east with familiarity ranging from "Moderately Familiar" to "Very Familiar".

5.2. Ease of Application and Effectiveness

Most participants found SBC801 "easy" to use, with familiarity improving the experience. A majority found it comprehensive and effective in enhancing fire safety (80%), with 57% observing a reduction in fire incidents.

5.3. Challenges and Drawbacks

Most challenging aspects were implementing technical requirements and interpreting guidelines, linked to the code's structure, external references, and lack of worked examples. "Compliance documentation" was also a frequent challenge. Main drawbacks included lack of clarity, incompatibility with international standards, high cost of compliance, and complexity. This suggests that even prescriptive codes can suffer from usability issues if poorly structured.

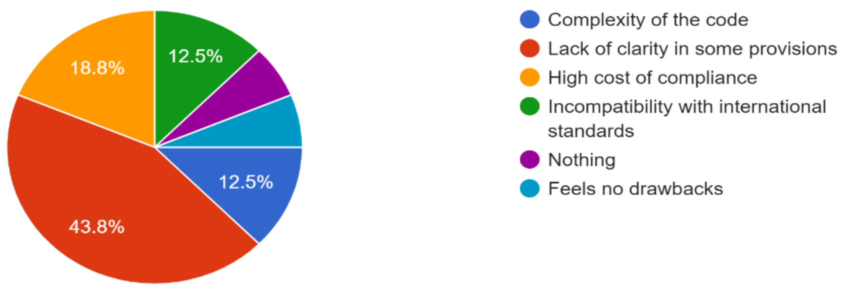

Figure 2: challenges mentioned [13]

5.4. Cost-Effectiveness

Seven participants found the costs reasonable, three thought it similar to other building projects and four considered the costs troubling. Yet, all but one participant agreed that the benefits were worth those costs.

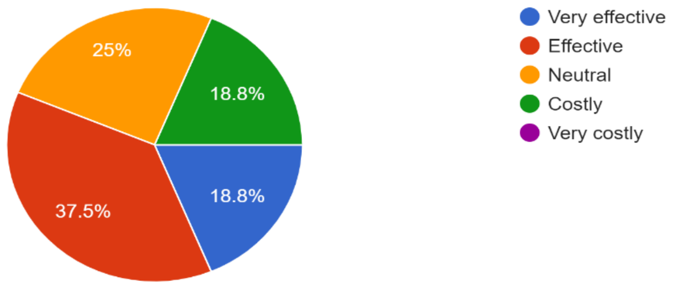

Figure 3: perspective on cost effectiveness [13]

6. Conclusion

SBC has greatly enhanced the quality of construction in the country and responded well to issues related to infrastructure, safety and sustainable development that are in line with Vision 2030. The implementation of SBC 801 has raised fire safety levels, essential as KSA is developing rapidly. Designed to suit the region, the code provides a solid base for safety practices in the country. Most fire safety concerns are dealt through SBC 801 which reacts by identifying industries with higher hazards, especially in Saudi Arabian conditions. The available data on fires indicates that the code has mostly handled primary fire concerns, except in the case of residential and garbage fires which continues to be a worry due to the lack of awareness among the public.

Comparing SBC to ADB reveals that regulatory approaches are different between the two. While SBC 801 specifies every requirement, ADB offers flexibility and prizes creativity, but experts are needed in the latter case. Most professionals were happy with SBC 801, praising its effectiveness. Its range of instructions was considered a strong point. They found it challenging to implement certain points and interpreting some parts of the document. However, a large number believe it is well worth spending time on. Most views on solutions were that guidelines should become simpler, training should be reinforced, the alignment across countries should improve and authorities should supply better support.

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