

ASSESSMENT OF DISASTER RESILIENCE IN HOSPITALS: A CASE STUDY BASED FRAMEWORK DEVELOPMENT FOR SRI LANKAN CONTEXT

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Hospitals are essential infrastructures that must maintain continuous operation during and after disasters to ensure the safety of patients and staff while providing medical services, even under surge conditions. Given the critical nature of these facilities, assessing their disaster preparedness is of utmost importance. This study addresses the limitations of the World Health Organization's Hospital Safety Index (HSI) when applied to Sri Lankan hospitals, leading to the development of the Structural Safety of Hospitals Assessment for Sri Lanka (SSH-SL). The study presents a comprehensive framework for evaluating hospital safety, divided into three primary modules: structural safety (utilizing SSH-SL), functional safety, and emergency and disaster management. Enhancements were made to the latter two modules to better align with the specific needs of the Sri Lankan context. The framework introduces a set of equations to calculate the safety index for each module, which then assigns safety levels and provides recommendations for improvement. This framework was applied to assess 15 government hospitals, revealing significant concerns across all three modules, underscoring the need for targeted interventions to enhance hospital resilience in Sri Lanka.

The results from the assessment indicate that the structural safety levels of the 15 hospitals are generally at or above average level, suggesting that these facilities can operate during disaster conditions, though steps must be taken to ensure safety of both patients and staff. In terms of functional aspects, the majority of hospitals demonstrated a safety level of average or above, with two hospitals exhibiting below-average safety levels. Regarding Emergency and Disaster Management, 11 out of the 15 hospitals displayed high safety levels, whereas two hospitals had low safety levels. Immediate actions are necessary for hospitals with below-average safety levels, with a focus on implementing both short-term and long-term remedies.

Additionally, limitations of the framework were identified during the hospital assessment process. The architectural safety submodule, under functional safety, was recognized as a critical submodule requiring modifications. Several assessment criteria specific to the Sri Lankan context were identified and subsequently incorporated into the existing submodule. Following these adjustments, a Delphi Study was conducted on the enhanced submodule, utilizing a panel of experts to gauge their consensus. Based on the survey results from the Delphi Study, weights were assigned to each assessment criterion within the submodule, leading to the derivation of a comprehensive safety score for the architectural safety of hospital buildings.

Keywords: Disaster risk reduction, Hospital safety index, Resilience, Safe hospitals

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Aim

To assess the resilience of hospital buildings in Sri Lanka against disaster conditions and modify the global guidelines to suit the Sri Lankan context.

Background



Methodology

Structural Safety Index (SSI)

$$SSI = \frac{SSI^C + \min\{SSI^M, SSI^F, SSI^E, SSI^P\}}{2}$$

Functional Safety Index (FSI)

$$FSI = \frac{\sum \text{basic scores of each applicable parameter}}{\text{number of applicable parameters}}$$

Emergency and Disaster Management Index (ESI)

$$ESI = \frac{\sum \text{basic scores of each applicable parameter}}{\text{number of applicable parameters}}$$

Safety Index		Safety Level
Structural	Functional/ Emergency & Disaster Management	
1.01 – 1.75	1.01 - 2.0	Very Low Safety (D)
1.76 – 2.66	2.01 - 3.0	Low Safety (C)
2.67 – 3.75	3.01 - 4.0	Average Safety (B)
3.76 – 5.0	4.01 - 5.0	High Safety (A)

Results

Hospital	Structural		Functional		Emergency and Disaster Management	
	Safety Index	Safety Level	Safety Index	Safety Level	Safety Index	Safety Level
Akkareipattu BH	3.71	Average	3.78	Average	4.03	High
Colombo East BH	3.42	Average	3.60	Average	3.15	Average
Dehiattakandiya BH	3.52	Average	2.93	Low	3.38	Average
Elpitiya BH	3.55	Average	3.08	Average	4.18	High
Hambantota GH	3.93	High	4.31	High	4.21	High
Kuliypitiya TH	3.52	Average	3.51	Average	4.03	High
Mahiyanganaya BH	3.51	Average	3.30	Average	4.94	High
Marawila BH	3.38	Average	2.84	Low	3.11	Average
Nikaweratiya BH	3.61	Average	3.65	Average	2.04	Low
Nuwara Eliya DGH	3.39	Average	3.27	Average	4.54	High
Panadura BH	3.32	Average	3.57	Average	3.94	Average
Rathnapura TH	3.44	Average	3.85	Average	4.16	High
Peradeniya TH	3.52	Average	3.23	Average	4.04	High
Tangalle BH	3.49	Average	3.64	Average	4.08	High
Warakapola BH	3.71	Average	3.65	Average	4.11	High

Functional Safety Module

- 1) Architectural safety
- 2) Infrastructure protection, access and physical security
- 3) Critical systems
- 4) Equipment and supplies

Modified Architectural Safety submodule

Attribute	Weight	Attribute	Weight
Major damage and repair of non-structural elements	0.050	Condition and safety of internal walls and partitions	0.097
Condition and safety of doors, exits and entrances	0.055	Condition and safety of false or suspended ceilings	0.108
Condition and safety of windows and shutters	0.055	Condition and safety of the elevator system	0.141
Condition and safety of other elements of the building envelope	0.047	Condition and safety of stairways and ramps	0.162
Condition and safety of roofing	0.070	Condition and safety of floor coverings	0.171
Condition and safety of railings and parapets	0.067	Level of visibility in the medical wards	0.207
Condition and safety of perimeter walls and fencing	0.053	Availability of adequate space for storage and critical operations	0.424
Condition and safety of other architectural elements	0.055	Condition of the internal ventilation/Air quality	0.284
Safe conditions for movement outside the hospital buildings	0.080	Condition and adequacy of sanitary appliances	0.736
Safe conditions for movement inside the building (e.g. corridors, stairs)	0.105		