UN-HABITAT
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SAARC

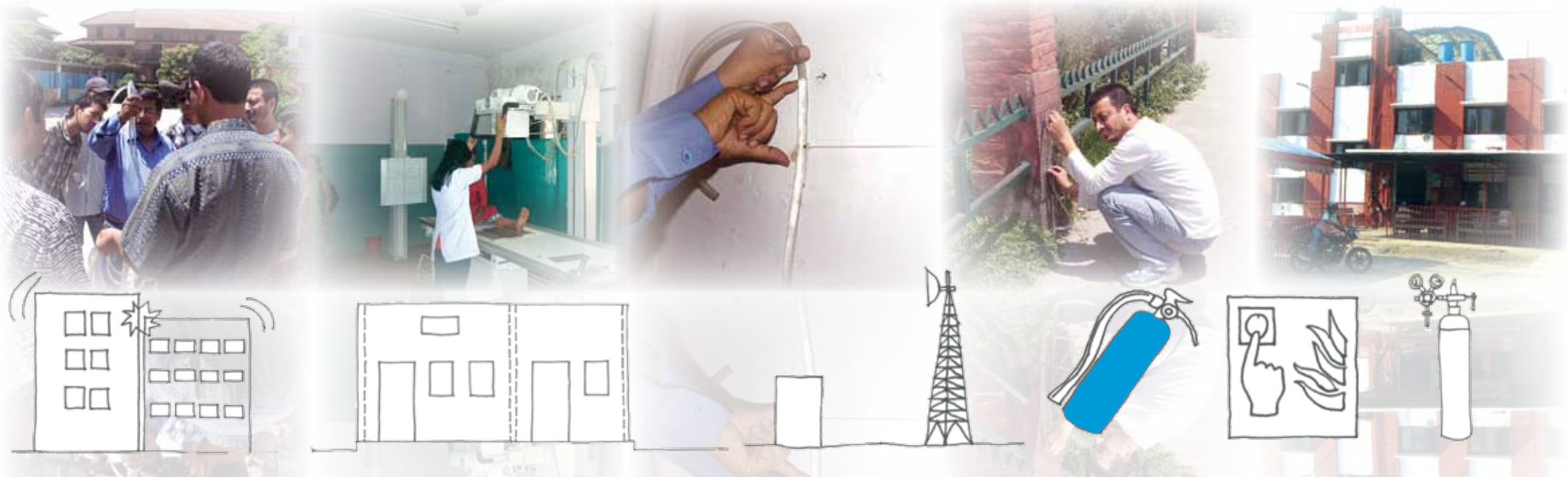
UNISDR
The United Nations Office for Disaster Risk Reduction

TOOLS FOR THE ASSESSMENT OF SCHOOL AND HOSPITAL SAFETY FOR MULTI-HAZARDS IN SOUTH ASIA

HOSPITAL SAFETY

TOOLKIT BOOK 1: NEW DESIGN

MULTI-HAZARD SAFETY COMPLIANCE



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The lead technical advisor for developing the Toolkit is Prabir Kumar Das. Drawings in the Toolkit were contributed by Peu Banerjee Das.

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The preparation of the Toolkit has drawn upon the existing tools and good practices including materials shared by UNESCO Pakistan, UNDP India, WHO, PAHO, ADB, National Institute of Disaster Management (NIDM) India, Nepal Risk Reduction Consortium (NRRC), National Society for Earthquake Technology (NSET) Nepal, Nepal Health Sector Support Programme, UN-Habitat Myanmar, Nepal and Pakistan Offices.

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FOREWORD

South Asia is a hotspot of disasters. The tectonic, geomorphological and hydro meteorological set up of the region along with socio- economic conditions make it extremely vulnerable to various natural disasters. The South Asian countries located in the seismically active northern fringes like Afghanistan, Bhutan, India, Nepal and Pakistan have been witness to several devastating earthquakes in the past. Similarly, the countries with exposed coastline like Bangladesh, India, Maldives and Sri Lanka have borne the fury of cyclones, tsunamis and coastal erosion. In addition to these, floods, landslides, droughts have also caused devastation in the countries of South Asia.

It has been observed that in case of natural disasters the important community and lifeline structures such as schools and hospitals receive irrecoverable damages and it takes a long time to restore them to function for the communities. The safety of these structures becomes even more important in light of the fact that, when disasters strike, they also serve as vital centers for community shelter extended to the affected. The safety and resilience of lifeline structures and a strong need to adopt a toolkit which addresses the critical aspects of safety of schools and hospitals in vulnerable areas thus has been identified as a priority. South Asian Association for Regional Cooperation (SAARC) Disaster Management Centre (SDMC), New Delhi India identified the vitality of the issue and in follow up to the SAARC Road Map for Earthquake Risk Mitigation; a toolkit for Rapid Visual Assessment (RVA) of schools and hospitals has been developed in 2011.

Extending this initiative further, UN-Habitat, in partnership with UNISDR Asia Pacific Secretariat and the SDMC has taken up the mission of developing a standardized Tool Kit for the assessment of safety of school and hospital structures to multiple hazards in the region. This Tool Kit adopts the basic framework from the SDMC template on Risk and Vulnerability Analysis of Schools and Hospitals, and extends to the multiple hazards, the region is prone to such as earthquake, flood, cyclone, fire etc.. It addresses the safety of new lifeline structures as well as retrofitting of existing structures to make them resilient and safe for the communities during disasters. The Tool Kit targets two groups placed at the extreme ends of disaster management spectrum: the Top Level Management and the End Users. The development of the Tool Kit has undergone several rigorous stages of review and feedback from experts from the region and field observations. Finally at a stimulating Expert Group Meeting (EGM) held in Kathmandu a distinguished panel of experts assembled and deliberated on the finer technical aspects. Incorporation of the recommendations of the EGM has further enriched the contents of the Tool Kit.

The Tool Kit is placed in the hands of the intended users at a very crucial juncture of disaster risk reduction initiatives evolving in the SAARC region, through various consultative, research and policy planning endeavours. It is expected that the Tool Kit will be useful to a myriad cross section of players engaged in disaster risk reduction in the SAARC region.

Satendra
Director
SAARC Disaster Management Centre

FOREWORD

It gives us great pleasure to introduce this toolkit entitled **Tools for the Assessment of School and Hospital Safety for Multi-Hazards in South Asia.**

South Asia is one of the most disaster prone regions in the world. A combination of multiple layers of geo-physical and climatic hazards, as well as a complex range of physical, social and economic vulnerabilities contribute to this. In 40 years, from 1967 – 2006, some 784 reported disasters took 800,000 lives and affected over two billion people. Economic losses amounted to an estimated $80 billion. This region also has an exceptionally high annual urban growth rate, with the accompanying challenges of increased urban risk and vulnerability.

Six out of the eight countries of South Asia - Afghanistan, Pakistan, India, Nepal, Bhutan and Bangladesh, are located in the highly seismically active Himalayan-Hindu Kush belt. Sri Lanka, Maldives and large parts of the coastal areas of Bangladesh, India and Pakistan are vulnerable to tsunamis, cyclones and flooding. Substantial damages were caused to education and health facilities by a series of disasters in the recent years such as the 2004 Indian Ocean Tsunami, the 2005 Kashmir earthquake, Cyclone Sidr in 2007, and the 2010 and 2011 floods in Pakistan. The resultant loss of life of students, teachers and health workers, and the collapse of school and hospital buildings clearly indicate the need to ensure the safety of these critically important facilities.

This toolkit, which comprises four sets of assessment tools for both existing and new schools as well as hospitals, is a result of cooperation amongst the South Asian Association for Regional Cooperation (SAARC), the United Nations Human Settlements Programme (UN-Habitat) and the United Nations Office for Disaster Risk Reduction (UNISDR).

The Toolkit serves Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, and complements the recent work of the SAARC Disaster Management Centre and its publication ***'Rapid Structural and Non-Structural Assessment of School and Hospital Buildings in SAARC Countries'***. The aim is to offer user-friendly tools for the multi-hazard context of South Asia, targeting policy makers, experts, and end-users responsible for local level planning and implementation.

The toolkit explains the complex process of retrofitting existing facilities as well as ensuring safe construction of new infrastructure in a practical manner. It facilitates informed decision-making and actions to achieve school and hospital safety. Importantly, the tools have been reviewed by a group of experts including policymakers, professionals and users, and have undergone field testing in several locations in India, Nepal and Pakistan.

This new approach will provide concrete indices in support of the recommendations of the 2011 Chair's summary of the Global Platform for Disaster Risk Reduction, the global advocacy campaigns: ***One Million Safe Schools and Hospitals, Making Cities Resilient - My City is Getting Ready and, the World Urban Campaign***. We believe this is an important step towards achieving risk reduction targets and building the resilience of nations and communities in the South Asian sub-continent. The toolkit demonstrates that making critical infrastructure safe from disasters is achievable.

Joan Clos,
UN Under-Secretary-General and Executive Director, UN-Habitat - United Nations Human Settlements Programme

Margareta Wahlstrom,
UN Special Representative of the Secretary-General for Disaster Risk Reduction (DRR), UNISDR

SCHOOL SAFETY
TOOLKIT BOOK 1: NEW DESIGN
Multi-Hazard Safety Compliance

CONSULTANTS WILL FILLIN TOOLKIT I & PRESENT IT TO TLM, EDUCATION

SCHOOL SAFETY
TOOLKIT BOOK 2: RETRO MAINTENANCE
Multi-Hazard Safety Compliance

SURVEY AGENCY/NGO WILL FILLIN TOOLKIT II & PRESENT IT TO TLM, EDUCATION

TEACHERS+SMC WILL FILL IN SUPPLEMENT, A SUPPORT TO EMIS & PRESENT IT TO TLM, EDUCATION

THIS IS BOOK 1

CONTENTS

THERE ARE FOUR INDEPENDENT BOOKS ON MULTI HAZARD SAFETY COMPLAINCE ASSESSMENT OF NEW DESIGN AND EXISTING HOSPITALS AND SCHOOLS

HOSPITAL SAFETY
TOOLKIT BOOK 1: NEW DESIGN
Multi-Hazard Safety Compliance

CONSULTANTS WILL FILL IN TOOLKIT I & PRESENT IT To Top Level Management (TLM), HEALTH

HOSPITAL SAFETY
TOOLKIT BOOK 2: RETRO MAINTENANCE
Multi-Hazard Safety Compliance

SURVEY AGENCY/NGO WILL FILLIN TOOLKIT II & PRESENT IT TO TLM, HEALTH

MEDICAL STAFF WILL FILL IN SUPPLEMENT, A SUPPORT TO HIIS & PRESENT IT TO TLM, HEALTH

GLOSSARY

Buoyancy effect: Sometimes, floodwater level in a place may rise considerably higher than the bottom of a building's basement or an underground tank. In such case, the building or the water tank will experience upward push. This is called buoyancy. Such movement may cause a breaking and/or separation of the connecting pipes and other service lines

Design flood elevation is a regulatory flood height level adopted by a community at local level. Such level is based on observed data for a long time. It helps to determine the safe plinth height of buildings in a flood prone area.

Drift is the horizontal displacement of a building due to seismic, wind or any other horizontal force

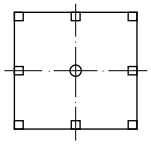
Ductility: Any metal that has the ability to get stretched without being damaged is a ductile material and this property of materials is called ductility. Mild steel, copper, etc. are ductile materials.

Fault is a discontinuity in a volume of rock, across which there has been significant displacement as a result of earth movement. A fault is called active if it is likely to have another earthquake in future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.

Frame structure is the skeleton of a building made of wood, steel, or reinforced concrete that supports all kinds of loads. In a frame structure load is transferred from slabs → beams → columns → foundation. All member joints in framed structure can withstand bending.

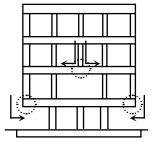
Geotechnical investigation is performed by geotechnical engineers or engineering geologists to obtain information on the physical properties of soil and rock around a site to design earthworks and building foundations.

Grid is defined principally by column positions and the main beams spanning between them. The sketch on the right is a building plan showing column locations. The dotted lines are the grids.



Liquefaction is a state in which un-compacted saturated soil acts more like a dense liquid than solid during earthquake. Water saturated granular soil such as silts, sands, and gravel that are free of clay particles are prone to liquefaction. Buildings undergo severe damage/sinking when the soil beneath suddenly behaves like a liquid due to liquefaction.

Load path means a path that forces pass through to the foundation of a structure. A continuous load path is like a chain that ties the house together from the roof to the foundation. The sketch on the right shows a discontinuous load path, which is not good for seismic or wind load.



Masonry structure: When brick, stone, blocks, etc are laid in courses with cement/lime/mud mortar as bed is called a masonry structure. Usually used in wall, roof, etc.

Reinforced Cement Concrete (RCC): Concrete consists of cement, sand, aggregate and water. The solid portions are first mixed thoroughly and then water is added and then mixed further. This is cast with mild steel rods embedded inside. It is called RCC when it turns solid. RCC can take both tension and compression.

Retaining wall is built in order to hold back earth which would otherwise move downwards.

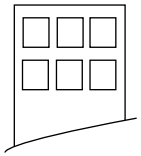
Seismic load is caused due to earthquake-generated agitation to a building or structure. Seismic load acts at contact surfaces of a structure either with the groundhttp://en.wikipedia.org/wiki/Seismic_loading - cite_note-1, or with adjacent structures

Seismic micro zoning is the process of subdividing an earthquake prone area into zones with respect to geological and geophysical characteristics of the sites. It provides information on ground shaking, liquefaction susceptibility, landslide and rock fall hazard, earthquake-related flooding. Seismic micro zoning maps of construction areas must be consulted when designing earthquake-resistant structures

Seismic zone is a region in which the rate of seismic activity remains fairly consistent. e.g. IS 1893, 2002 shows that there are four seismic zones in India- Zone V, the severest earthquake prone and Zone II the least.

Short column effect: Column heights within the same storey could be different if a building is on a slope or if there is a part mezzanine floor within the storey. In such case the columns of shorter heights

are stiffer and attract more earthquake forces than the taller ones. If not designed adequately, the shorter ones may fail, which is attributed as failure due to short column effect.



Storm surge is an offshore rise of water due to a low pressure weather system, e.g., during cyclones. Storm surges are caused primarily by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than the ordinary sea level. This could be highly damaging for the buildings along coast lines.

Tsunami, in Japanese, is "harbour wave". It is a series of water waves caused by the displacement of a large volume of water in an ocean or a large lake. The various reasons for tsunami could be earthquakes, volcanic eruptions and other underwater explosions, landslides, meteorite impacts etc.

Unreinforced masonry is a type of building where the structural walls are made of brick, block, tiles, adobe or other masonry material, that is not braced by reinforcing rods.

Wind born missile: If a site has trees, waste bins/ cans, debris or other materials that can be moved by the wind, during cyclone or high wing they may fly and strike your building by damaging windows, doors, etc. Elements that can fly in high wind and damage buildings are called wind borne missiles. One must consider this effect in design.

Wind Tunnel effect: if one takes a walk between tall buildings, or in a narrow mountain pass, one will notice that the wind speed is much higher than the general level. The air becomes compressed on the windy side of the buildings or mountains, and its speed increases considerably between the obstacles to the wind. This is known as a "tunnel effect". If your building site is prone such effect, it must be considered in design.

CHAPTER 1

1.1 BACKGROUND

Major Asian cities are located, by and large, across flood plains or in coastal areas. Over 50% of the urban populations are living in small and medium size cities with less than 500,000 populations that are growing faster and may not be able to cope with emerging urban issues. Considering the increased urban risks many of our cities are facing, it is clear that there is a need to integrate disaster risk reduction into the urban planning and local planning practices.

The Chairs summary of the GPDRR 2009 calls for specific targets to achieve critical infrastructure safety, as stated: "By 2011 a global structural evaluation of all schools and hospitals should be undertaken and that by 2015 concrete action plans for safer schools and hospitals should be developed and implemented in all disaster prone countries".

To respond to such a situation, UN-Habitat Bangkok Office in partnership with UNISDR Asia Pacific Secretariat decided to develop Toolkits which will facilitate the assessment of the safety of critical infrastructure, focusing on schools and hospitals in South Asia.

The obvious question in the beginning was why one needs another toolkit when there is a large body of available technical literature on disaster safe school and hospitals. Detailed examination of the existing literature and interviewing people directly involved with the supply and maintenance revealed that disaster safety of hospitals and schools from the owners' and users' perspective is inadequately covered. This is an important area since disaster safety is not just a technical issue; it needs proactive participation of both the owners and end-users in the endeavor of safe schools and hospitals.

Under such circumstance, ***this project viewed the top level management and the end-users as the two most important key role players.*** Top level management here means the Director Generals (Health/education) along with the line directors. The end users are the school teachers and the doctors and medical staff at school and hospital respectively.

Any hospital or school is planned, designed, constructed and handed over to the end-users, who use the facilities for at least fifty years before being replaced with a new one. The top level management is responsible for ensuring that the buildings conform to the safety standards throughout their whole life cycle. Safety is a complete package spanning over the entire lifespan of a building.

1.2 THE TOOLKITS

New Construction: For supply of new buildings, while management has to rely on architect(s) and engineers, it is equally important for them to act as **INFORMED CLIENTS** while interacting with the architects and engineers, in the endeavour to make the hospital/ school safe. The focus of the toolkit is to get an idea on the level of compliance of a new design with safety norms/codes/standards. This is possible only if the toolkit is simple, objective type and graphical. It should also be comprehensive enough to suit the busy schedule of the top level management. This has been termed as **TOOLKIT I**.

The Toolkit I is designed to enhance awareness and capacity of the top level management to take meaningful role in creating safe new hospital and school. The output of the Toolkit I will form part of a national database on safety compliance for future reference and as a commitment from the architect's and engineer's side.

Existing Buildings & Facilities: For the existing buildings, it is most important to know whether they are safe according to the latest building codes, failing which there may be a need for retrofitting. The second important issue is the current physical condition of the existing infrastructure. Buildings tend to live long in a cost effective manner, if maintained periodically.

It may be noted that there is a lack of awareness on retrofitting, though all are aware of maintenance. Currently the data collection system in health and education departments are maintenance-centred. As a result, these two aspects of safety are mostly dealt in isolation. It will be cost effective and consistent with safety if these two are viewed as a single whole - retrofit cum maintenance. To bring in a paradigm shift in this regard, it is important to develop the following;

A suitable toolkit for the top level management to keep track with the retrofitting requirements of the hospitals and schools - termed as **TOOLKIT II**

- While Toolkit II will provide a comprehensive picture on the retrofitting requirements, it needs data on existing physical conditions of the buildings to make rationalised decision on retrofit cum maintenance actions. A supplement has been designed to address this.

It addresses two issues, a) makes additions and modifications to the existing **EMIS/HIIS**[1] systems, b) provides a graphical guide book to help the end users to acquire more objective type data on maintenance and some aspects of retrofitting within the framework of existing HIIS and EMIS forms. The supplement has been designed within the capability of school teachers and medical staff.

[1] *Education Management Information System (EMIS, Health Infrastructure Information System (HIIS)*

- The Toolkit II and the Supplement will enable the line directorates to screen those which would need further investigation for retrofitting need assessment by experts. For the rest, the toolkit and the supplement will help in prioritizing the maintenance needs

1.3 WHO DOES WHAT AND HOW

Toolkit I (Multi-Hazard safe New Design: Hospital & School): The appointed architect/ engineer will use toolkit I and report to the top level management on the level of compliance of the design with safety norms. Once top level management is satisfied with the level of safety compliance of design, the filled-in Toolkit I will be archived in the computer for future reference.

Toolkit II: (Multi-Hazard safe Retrofitting: Existing Hospital & School): The top level management will appoint NGO/agency or similar group of people to do the retrofitting need assessment once in three to four years.

Supplement to Toolkit II (The medical staff and the school teachers with school management committee will use this as an extension to the HIIS and EMIS data format. This will be done annually.

The toolkit II and the supplement will enable top level management to estimate and prioritize the retrofit cum maintenance works in a holistic manner. This will also enable one to decide whether detailed investigation is required at a particular hospital or school.

1.4 TYPES OF HAZARDS

Since adequate literature is available on seismic, wind, flood and fire hazards, the toolkit had address all four of them.

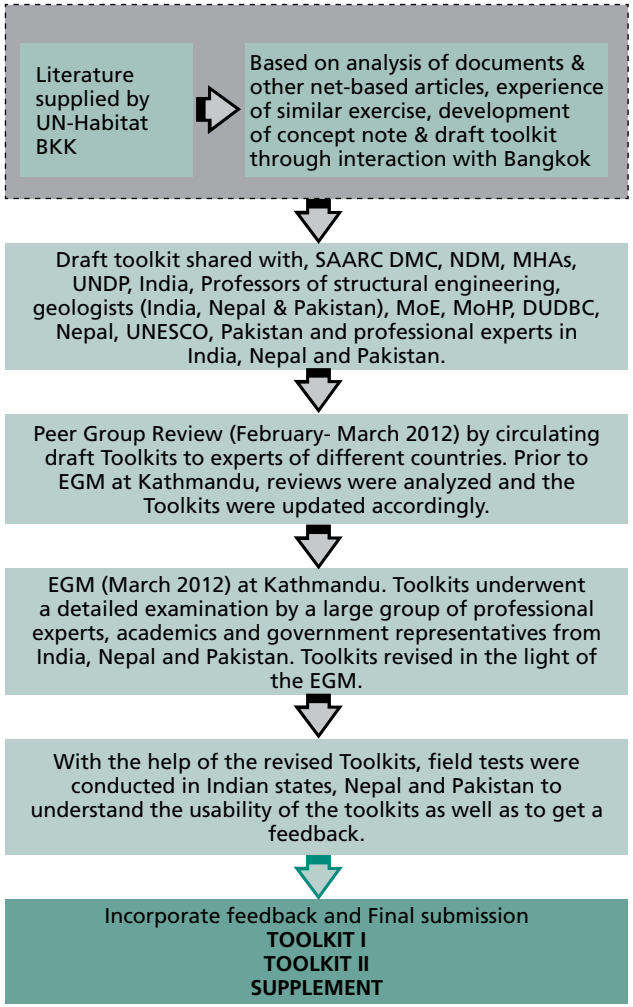
1.5 DESKTOP RESEARCH

The biggest challenge in this project was to identify the area where Toolkit could be developed amidst a large number of existing books, manuals and other literature on safe Hospital and school. Majority of the existing literature in this domain were on seismic safety and primarily addressed to the technical people. Considering the shortage of time for the toolkit development, utmost care was taken to make sure that the optimum amount of documents from the best sources are examined. The Toolkits developed in this publication are heavily indebted to FEMA 577, FEMA P-424, SDMC, NSET, and other sources, which have been put up in the References.

This is the
Hospital Safety Toolkit Book 1:
New Design: Multi-Hazard Safety Compliance

1.6 PROCESS

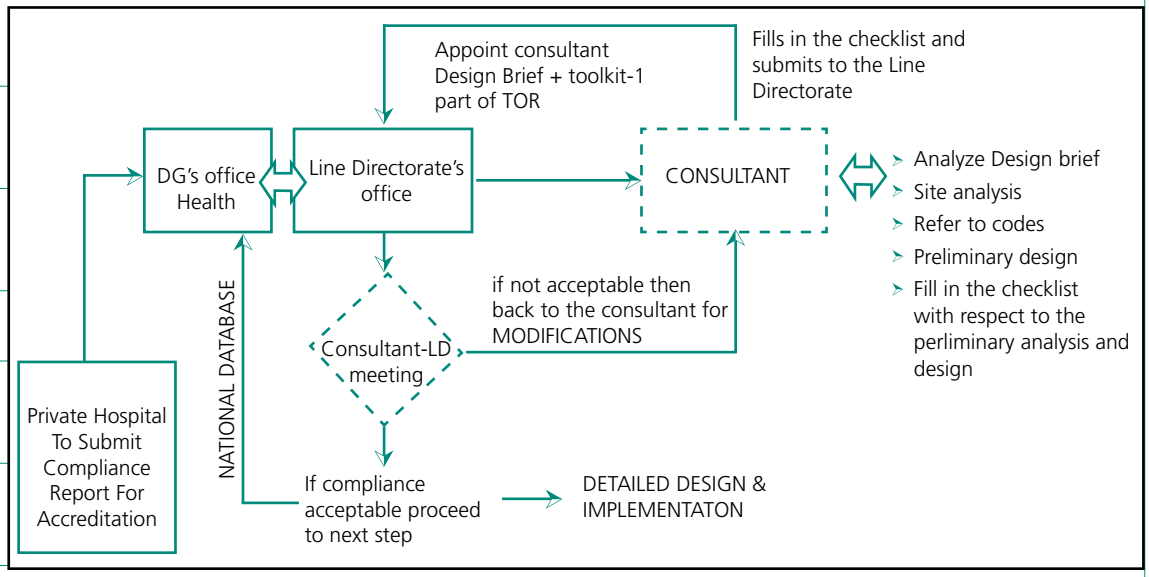
Figure 1.1: Diagram showing steps of the toolkit development



CHAPTER 2

2.1 HOW TO USE THE TOOLKIT I: NEW DESIGN (MULTI HAZARD SAFETY COMPLIANCE: HOSPITALS)

THE TARGET GROUP	IT IS FOR THE HEALTH DEPARTMENT'S TOP LEVEL MANAGEMENT (TLM), i.e.,	LINE DIRECTOR (INFRASTRUCTURE) & TEAM
	This will enable Top Level Management to act as Informed Client in the context of safe hospital design	
	The toolkit enables proactive participation of TLM & creates documentary evidence of multi-hazard safety compliance of new hospitals	
A	What does the toolkit do?	
	The TOOLKIT evaluates MULTI-HAZARD SAFETY of Hospital at design stage for a particular site & design brief	
	It uses a checklist to calculate the safety compliance level of hospitals based on a semi-objective method	
B	How does the management system work?	
	Top Level Management will appoint a design consultant and provide the design brief and this Toolkit as part of TOR	
	Designer will visit the site, carryout analysis and prepare A SKETCH design--> then use the toolkit to evaluate its safety-compliance level	
	Once satisfied with the design and compliance level, she/he will present the design along with safety compliance level to line director	
	The Top Level Management will study the compliance level of the design and raise questions on short comings, if any	
	The designer will act upon the suggestions by the Top Level Management and get back to them	
	Such iterative process will lead to a satisfactory compliance level of the hospital design, which will be stored in database of Health Ministry	
	Submission of compliance report along with design of every privately run hospitals should be made mandatory for accountability and accreditation	
	The above steps have been summarised in the following Figure	
C	How does a designer use the toolkit?	
	Safety complaince status of a design will be done by answering CHECKLISTs in the four worksheets 1) Seismic, 2) Wind, 3) Flood, 4) Fire	
	Fill in the checklists of only those hazards which are relevant your project at a particular place, e.g., in Delhi, seismic, flood and fire will be relevant	
	Take one worksheet, e.g. Seismic: Go through the Column A "CHECKLIST OF SAFETY ISSUES" one by one. The page looks as follows- Read the top line first	



READ THIS BEFORE ANSWERING THE KEY QUESTIONS									
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	**Users Input 1**	Specialists can alter scale of key question specific scoring	Specialists can change key question specific importance	DO NOT CHANGE THESE AT ALL			**User's Input 2:** Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	E	F	G	H	I	J
EXPLANATORY SKETCH	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES+OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	Compliance Status **0-1**	Issue Imporatnce VI, I, LOW	Weighted Compliance C3XC4	Ideal Case	Compliance index	REFERENCES/REMARKS
	PLANNING							0.22	
P1	Have you done (or referred to a) geological investigation report to know if there is an active major fault on or adjacent to your proposed hospital site? Special note: Consult local building department, State geologist, local university, or local geotechnical expert.	If you have done/referred to geological investigations write the source in column "REFERENCES/REMARKS" and then choose one from the following options		0.75	VI	2.25	3		
		Type "NA" if geological investigation has been referred to, which shows that the issue of fault line is not applicable in your case							
		Type 0, if you havent't done or referred to geological investigation for your site							
		Type 1, if the fault line is < 500m away from the site	1						
		Type 2, if the fault line is between500m< 1000m away from the site							
		Type 3, if the fault is > 1000m away from the site							

The column B shows the Key Questions that a Top Level Management will raise in consultant's meeting

Column C shows Guidance Notes and options for answers to the key questions, to be chosen by the consultant

Type in the right option in column D- This is the first input by the user

The compliance status is automatically calculated and appears in Column "E"

When you complete answering all issues under one category, e.g., Planning, the Compliance Index for Planning appears in column I

Wherever instructed in the column C, the consultant will write the requisites in column J "REFERENCES/REMARKS"

Repeat the process of answering questions in the remaining categories, viz., Architectural, Structural and Non-structural

Once you have answered all four categories of worksheet "SEISMIC", proceed to the next relevant worksheets and repeat the process

D On completion of this process go to the last worksheet "SUMMARY"--> you will see the following chart

WRITE NA TO THOSE HAZARDS WHICH NOT RELEVANT TO YOUR SITE

HAZARD SAFETY COMPLIANCE MATRIX

is this hazard → applicable at your site?	Applicable	NA	NA	Applicable
	MULTI HAZARD			
	Seismic	Wind	Flood	Fire
Planning	0.49	NA	NA	0.38
Architectural	0.48	NA	NA	0.34
Structural	0.20	NA	NA	0.25
Non structural	0.15	NA	NA	0.17
Multi Hazard compliance index	**0.36**			
Overall CI	0.43	0.00	0.00	0.28
	1.00	0.00	0.00	1.00

E There are four specialists' control in worksheet "SUMMARY"- each country to make country-specific modifications

ISSUE IMPORTANCE
SPECIALIST TO MODIFY THESE (1)

VI	27
I	9
LI	3

Each key question has an importance VI/I/LI. Specialists to determine this to suit country specific context. Type VI/I or LI against each key question in column F of worksheet 1 to 4. These values may be modified in "SUMMARY", Table at G22

VI→Very Important, I→Important, LI→low importance

CATEGORY WEIGHT (2)

0.2	Planning
0.3	Architectural
0.3	Structural
0.2	Non-structural

D14-E14-F14-G14 in "SUMMARY" calculates the overall compliance index based on category weight in Table at J23. Specialists may change these for each country

Compliance Index
SPECIALIST TO MODIFY THESE (3)

not addressed	0
low	0.25
medium	0.5
high	0.75
1 completely addressed	1

Scale of scoring

1. the one shown in the Table of 5 options
2. Similar linear scale with 3 to 4 options
3. non linear variation of type 1 & 2
4. Binary scale of "0" or "1"

modified in "SUMMARY", Table at G22

Specialists may change these pattern of scoring in column "E" of worksheet 1,2,3,4

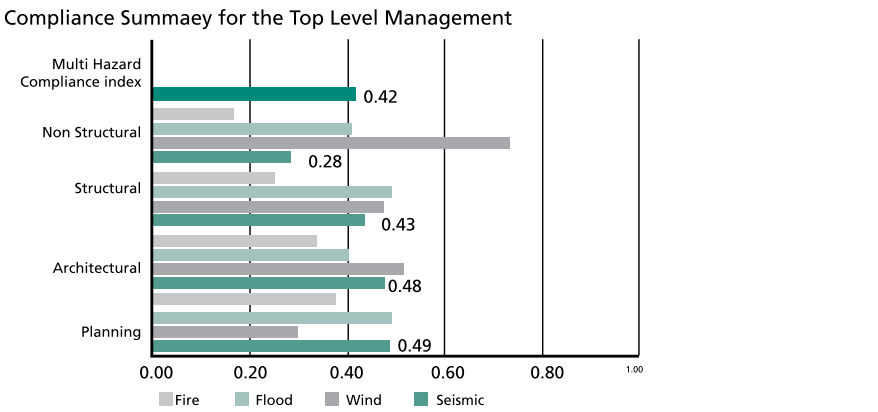
COUNTRY SPECIFIC
HAZARD WEIGHTS (4)

W seis	1
Wwind	1
Wflood	1
Wfire	1

These will depend upon hazard frequency & magnitude of a country

Specialists will make country specific hazard weights in Table at J28 of "SUMMARY"

F	Final output for the Top Level Management
	When a consultant answers all four CHECKLISTS , the compliance indexes
	will be automatically calculated
	Once you have filled in all the relevant worksheets, go to worksheet
	SUMMARY- you will see the chart on the right
	The consultant will present this chart to the Top Level Management
	In case the compliance of a category is not 1 , the consultant will
	explain the reasons as shown in the Gap Matrix shown below



G	The following list is automaically generated showing where gaps exists. This will show where
	to work on to enhance the category score (planning/architectural/structural/non-structural issues
	Special Note: The Compliance Level Cut Offis a joint decision of the TLM and the specialists- it could be modified in E39 in "SUMMARY"

TLM MAY ↓ MODIFY THIS

COMPLIANCE INDEX CUT OFF LEVEL→ 1 5

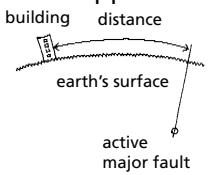
MULTI HAZARD COMPLIANCE GAP MATRIX

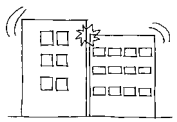
	SEISMIC		WIND		FLOOD		FIRE	
	ISSUES	seismic compliance	ISSUES	wind compliance	ISSUES	flood compliance	ISSUES	fire compliance
	PLANNING							
P1	Type 1, if the fault line is <500m away from the site	0.15	Type 5, if it is for pedestrian access only	0.05	Type 1, if the damage potential is low	0.9	Type 4, if the access road is suitable for motorbike only not for cars	0.25
P2		1	Type 4 , if the probable level of wind speed reduction is < 10%	0.15	Type 1, if the damage potential is high	0	Type 3, if flow (Hospital's exposure to external fire)	0.75
P3	Type 2, Minimum effect→i.e., if some of the neighbouring buildings may collapse, however, it will have minimum impact on evacuation	0.75	Type 2, if falling hazards can cause damage to the hospital, but will not hamper its functioning	0.5	Type 3, if the plinth is below expected flood depth	0	Type 2, if there is open space but not adequate for gathering	0.5

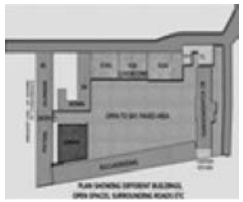
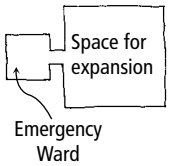
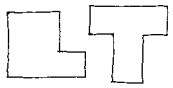
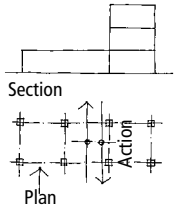
H	What is the way forward
	The top level management will have a documentary evidence on compliance index of the design
	It is a commitment from the consultant's side
	The same could be submitted to the local municipality for their record as evidence on safety compliance
	Top Level Management with this tool will be will be able to interact meaningfully with the consultants
	IN CASE THE DEPARTMENT HAS STANDARD DESIGNS, THEY SHOULD BE EVALUATED ONCE
	HOWEVER, THE SAFETY ISSUES RELATING TO THE SITE LOCATION WILL BE APPLICABLE FOR THE DESIGN
	Special Note 1
	This Toolkit has considered four types of hazards. These have been adapted from different sources mentioned
	in the References. If needed, country/zone/area specific minor modifications could be made to this Toolkit
	However, such modifications should be done only at National level by experts and only if it is absolutely necessary
	Special Note 2
	This Toolkit has considered four types of hazards. However, if a country/zone/area has other types of hazards such as landslide,
	flash flood, etc., additional worksheets could be added to the existing Toolkit to increase it's robustness
	Special Note 3
	A compact Disk has been attached with this toolkit which should be used to calculate the compliance index at National Level
	after receiving the data from all the hospitals. Hard copies of only the relevant hazard checklists should be sent to the hospitals
	from this Book 1 on multi-hazard-safe new hospital design
	Special Note 4
	The information from the "REFERENCES/REMARKS" will be of great importance. This will not only provide hospital specific safety
	informarion, it will also bring forward nationwide pattern, if any, in the context of safety at macro level.This will help in policy reforms

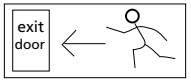
ANNEXURE I: SEISMIC SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

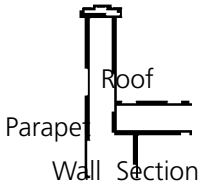
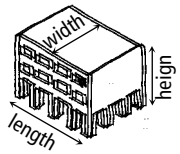
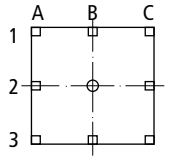
READ THIS BEFORE ANSWERING THE KEY QUESTIONS				
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	**User's Input 1**	**User's input 2:** Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

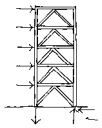
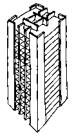
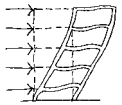
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
PLANNING				
P1  	Have you done (or referred to a) geological investigation report to know if there is an active major fault on or adjacent to your proposed hospital site? Special note: Consult local building department, State geologist, local university, or local geotechnical expert.	If you have done/referred to geologic investigations write the source in column "REFERENCES/REMARKS" and then choose one from the following options		
		Type "NA" if geological investigation has been referred to , which shows that the issue of fault line is not applicable in your case		
		Type 0, if you haven't done or referred to geological investigations for your site		
		Type 1, if the fault line is < 500m away from the site		
		Type 2, if the fault line is between 500m -1000m from the site		
		Type 3, if the fault line is >1000m away from the site		
P2  Site plan showing access	An important aspect of safety of a building is the type of access road from main road to the site of the new hospital	Depending upon the type of access road to your site choose one from the following options;		
		Type 1, if two or more roads from mainstreet to building, wide enough to allow one fire engine to reach, reverse and return to the mainroad		
		Type 2, if there is one access road suitable for fire engine access & movement		
		Type 3, if access road is for cars and not fire engine		
		Type 4, If the access road is suitable for motorbike only and not for cars		
		Type 5, if it is for pedestrian access only		

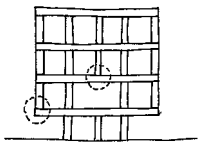
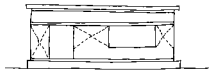
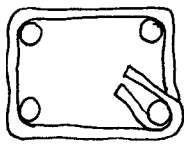
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
P3 Collapse of buildings had blocked many access roads in the old town of Bhuj, India (earthquake, 2001). It had made rescue and relief extremely dificult	During earthquake, buildings along the access road to your site may collapse and block it, thus affecting post earthquake evacuation and entrance for service	Visit the site and visually assess the severity of impact on safe evacuation and access of services to the site immediately after an earthquake ? Choose one from the following options		
		Type 1, No effect? i.e., if the existing road is wide enough and the surrounding buildings are unlikely to fall during earthquake or there is/are alternative routes to the hospital, unlikely to be blocked by falling buildings, power lines, etc.		
		Type 2, Minimum effect ? i.e., if some of the neighbouring buildings may collapse, however, it will have minimum impact on evacuation		
		Type 3, Medium effect? i.e., if part collapse may take place, however, it will have medium impact on evacuation		
		Type 4, Maximum effect?i.e., if possible collapse of neighbouring buildings are likely to completely block the road from evacuation		
P4 Providing onsite backup for water, power gas, etc. is not adequate. They need housekeeping and periodic maintenance as well	Municipal utilities such as water, power, and gas, are often disrupted in strong shaking. Therefore, onsite backups should provide 48 hours of use.	Additional systems increase the probability of a hospital remaining functional after disaster. Choose one from the following options		
		Type 1, If in-house backup sources of a)water, b)power and c)gas have been provided in the hospital for 24-48 hrs		
		Type 2, If in-house backup sources of a)water and b)power or c)gas have been provided in the hospital for 24-48 hrs		
		Type 3, If inhouse backup sources of only b)power or c)gas have been provided in the hospital for 24-48 hrs		
		Type 4, If inhouse backup sources of only a)water have been provided in the hospital for 24-48 hrs		
		Type 5, If there are no inhouse backup sources of a)water, b)power & c)gas in the hospital		
P5  Buildings too close may lead to pounding	If your building is in seismic Zone V,IV or III, then have you provided adequate distance from adjacent buildings or other structures from the project building to avoid pounding effect?	Write the distance (in meters) of the nearest building/ structure from the hospital under consideration in column "REFERENCES/REMARKS"		
		Type 1, if adequate gap has been provided to avoid pounding effect		
		Type 0, if adequate gap not provided to avoid pounding effect		

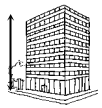
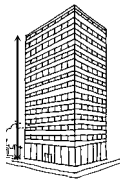
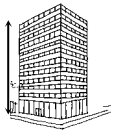
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
P6  Site plan showing open space	Whether open space is available adjacent to the building for people to assemble during/immediately after earthquake ?	In the column "REFERENCES/REMARKS, write the approximate length and width of such open space and the number of people who will need it ?Choose one from the following options		
		Type 1, if there is adequate open space for gathering		
		Type 2, if there is open space, but not adequate for gathering		
		Type 3, if there is no open space for available for gathering		
P7 	Is there space available for expansion in case of emergency/mass casualty? For example emergency department near outpatient deptt. will help to expand emergency service and increase emergency capacity of the hospital.	Choose one from the following options		
		Type 1, If there is space to expand the existing emergency unit to twice its present area		
		Type 2, If there is space to expand the existing emergency unit to 1.5 times its present area		
		Type 3, If there is space to expand the existing emergency unit to 1.25 times its present area		
		Type 4, If there is no space to expand the existing emergency unit		
ARCHITECTURAL ISSUES				
A1  Plan forms such as T,L etc are irregular	Is the architectural/structural configuration irregular in plan?	Look at building plans & assess the level of symmetry and then choose one from the following that is appropriate		
		Type 1, if the shapes is regular, structure has uniform plan, and there are no elements that would cause twisting of building		
		Type 2, if Shape is irregular but structure is uniform		
		Type 3, if Shapes are irregular and structure is not uniform		
A2  Two portions of the same building have different masses: vertical irregularity	Is there vertical irregularity in architectural/structural configuration?	Look at sections of the design & assess the level of symmetry, e.g., having set backs, open first stories,etc., and then choose one from the following		
		Type 1, if storey heights are of very similar (i.e., they differ by < 5%); there are no discontinuous or irregular elements.		
		Type 2, if storey heights are similar (they differ by > 5% but <20%) and there are few discontinuous or irregular elements;		
		Type 3, if storey heights differs by >20% and there are significant discontinuous or irregular elements		

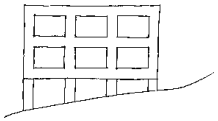
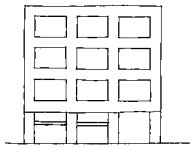
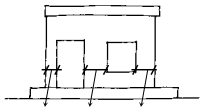
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A3  Ramps to be provided for people to be wheeled out quickly	Are there provisions for physically challenged-friendly access to the buildings and functional areas?	If you have referred any codes/standards in this matter, mention it in the column "REFERENCES/REMARKS ?Choose one from the following options		
		Type 1, if the design has provision for easy evacuation of physically challenged people		
		Type 2, if the design has average level of provision for evacuation of physically challenged people		
		Type 3, if the design is poor for evacuation of physically challenged people		
A4  Wide corridor with signage for easy evacuation in emergency	Is there a provision for emergency exit in the building plan?	Examine the design to assess if exits have been provided for easy evacuation of the occupants. Choose one option from the following		
		Type 1, if one or more exit corridors of at least 2.4 meters width exists, which are well lit, easy to identify and use in emergency		
		Type 2, if one or more exit corridors of width less than 2.4 m but greater than 1.2m exists, which are well lit, easy to identify and use in emergency		
		Type 3, if only one corridor of less than 1.2m width exists for emergency exit		
		Type 4, there is no emergency exist in design		
A5 Glass must be installed in the openings with adequate space/cushioning between glass and the lintel, jambs and sill to accommodate drift of the structural system	Are glass and other panels fixed in openings in a way so that they will not be affected due to drift of the main structural frame during earthquake?	Have you considered this in your design & done safe detailing? Choose one from the following options		
		Type NA, this is not applicable		
		Type 1, if the detail of glass in openings is safe for drift of the structure		
		Type 0, if the detail of glass in openings is not safe for drift of the structure		
A6 If not fiixed adequately, such tiles may come off during earthquake, making exit of the occupants unsafe or impossible	Are there tiles fixed on the walls particularly those surrounding exit staircases? If yes, then are those adequately fitted with bolts (or equivalent glue) for seismic safety?	Choose one from the following options		
		Type NA, if this is not applicable		
		Type 1, If the tiles are fixed to the walls with bolts or equivalent glue or other methods		
		Type 0, If the tiles are not fixed to the walls with bolts or equivalent glue or other methods		

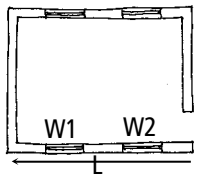
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A7  RCC band or equivalent as top arrester	Are parapets securely attached to the building structure to stop it from falling during earthquake?	Unreinforced masonry parapets are especially vulnerable if the wall top is not secured		
		Type NA if there is no parapet in your building		
		Type 1, if the parapet wall has a RCC band on top with vertical reinforcements anchored to the slabs at regular intervals		
		Type 2, if similar arrangement as RCC band exists to stop the parapet wall from falling		
		Type 3, if parapets are not restrained at all		
A8  	Length/breath ratio and Height/width ratio of the building within permissible limit as per code?	Mention the code name in the column "REFERENCES/ REMARKS"		
		Type 1, if the length/ breadth/ height ratios are within safe limit		
		Type 2, if the length/ breadth/ height ratios are marginally out of safe limit		
		Type 3, if Medium level of variation of length/ breadth/ height ratio from safe limit		
		Type 4, if major variation from safe limit of length/ breadth/ height		
A9  Good example: Building plan shows that the columns are in grid lines in both directions	Are the walls and/or columns provided in grid lines in each direction of the plan?	Choose one from the following options		
		Type 1, if all walls and/or columns are in grid in both directions		
		Type 2, if all walls &/or columns are in grid in one direction & some (<15%) not in grid in other direction		
		Type 3, if some walls &/or columns are in grid >15% but <25%		
		Type 4, if >25% of walls and/or columns are not in grid		

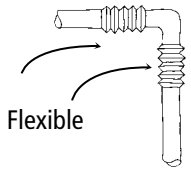
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	STRUCTURAL ISSUES			
S1 In many places micro zoning maps may not be available. However, if it exists, the engineer must follow the micro zoning recommendations in design	Have you considered the seismic micro zoning factors in your design?	If Micro-Zonation map is available then mention the source in the column "REFERENCES/ REMARKS" and; choose one from the following options		
		Type "NA" If Micro-Zonation map is not available and also write "not available" in the column "REFERENCES/ REMARKS"		
		Type 1, if you have considered micro zonation recommendations for your site		
		Type 0, if you have not considered micro zonation recommendations for your site		
S2 Steel braced frame  Shear walled structure  RCC frame structure 	Are you aware of Geotechnical set up of the areas (soil condition) & have you chosen structural system based on soil type & sesimic zone If your site has soft/poor soil (<10 t/sqm)? If your site has medium soil (10-30 t/sqm) ? If your site has hard soil (>30t/sqm) ?	If you have investigated/ referred to the information on geological setup in which your site is located, please mention the source in the column "REFERENCES/ REMARKS";		
		Type 1, If you have adopted light weight rigid structural systems, e.g., steel braced frame, steel tube frames, etc. on pile or similar deep foundations		
		Type 2 If you have not adopted structural system according to soil condition		
		Type 3, If you have adopted rigid structural systems with short period, e.g., shear walled, steel braced, confined masonry, etc		
		Type 4, If you have not adopted the above		
		Type 5 If the building has a flexible system with long period, e.g., RCC frame structure, base isolation, etc		
		Type 6 If you have not adopted the above		
S3 Before earthquake: interlocking forces in soil particles  During earchquake: reduced interlocking forces in soil particles  During earchquake: when liquefaction happens 	Have you considered the criteria regarding liquefaction- if applicable for your site? Soft soil that can lead to force amplification or liquefaction	Mention the source of information on this issue regarding your site in column "REFERENCES/ REMARKS" and choose one from the following options.		
		Type NA, if you have referred to the source of information and found it not applicable in your case		
		Type 1, if you have referred to the source of information and found it applicable in your case and have considered liquefaction effect in design		
		Type 2, if you have referred to the source of information and found it applicable in your case. However you have not considered liquefaction effect in design		
		Type 3, if you have not referred to any source of information neither you have considered liquefaction effect in design		

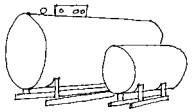
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S4  Section shows that load path of the building is discontinuous- this is not desirable	Is there a continuous load path from all structural components of the building to the foundation? A continuous load path enables a structure to act together as a whole when shaken. Connections from walls to floors and roofs should also form part of this load path.	Look at the drawings of your building, especially the sections and check		
		Type 1, if the load path is continuous		
		Type 2, if there is a minor deviation from the load path		
		Type 3, if there is a major deviation from load path		
S5  For seismic safety, a masonry building should have; 1. RCC bands at plinth & lintel level 2. vertical reinforcements at wall junctions & on two sides of each door/ window,	If the hospital is a Masonry Structure, have you provided vertical reinforcements & horizontal bands in walls according to code? Unreinforced masonry has proven very vulnerable in strong shaking. To improve seismic performance of masonry buildings one needs to provide, reinforcements at all wall corners and RCC bands at plinth, window sill and lintel level	Have you provided seismic reinforcement in the masonry building as per the latest code? Mention the code no in cloumn "REFERENCES/ REMARKS"		
		Type "NA", if it is not a masonry structure		
		Type 1, if reinforcement at all wall corners and horizontal RCC bands at plinth and lintel levels have been provided		
		Type 2, if only the RCC bands have been provided		
		Type 3, if only corner reinforcments have been provided		
		Type 4, none of the above provided		
S6  Ductile detail enables a structure to undergo large deformation before failure. It gives adequate warning to the occupants before failure	Have you done the reinforcement detailing as per code to ensure ductility of the structure?	Choose one from the following options		
		Type "NA", if not applicable		
		Type 1, of ductile detailing has been adopted as per codes		
		Type 2, if ductile detailing is partially done		
		Type 3, if ductile detailing has not been done as per code		

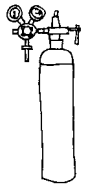
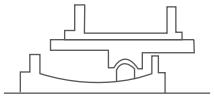
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S7 It is mandatory to consider seismic force on a building if it is in earthquake prone area. There are codes on seismic safety, e.g., IS 1893,2002 (Indian Code)	Has seismic load been considered in the building design?	Choose one from the following options		
		Type "NA", if not applicable		
		Type 1, If sesimic load has been considered in design		
		Type 0, If sesimic load has not been considered in design		
S8 H>=40m Zone IV/V  H>=90m Zone II/III  H>=12m Zone IV/V  H>=40m Zone II/III 	The code (e.g. IS 1893, 2002) has recommended dynamic analysis for buildings of certain heights, vertical and plan symmetries and seismic zones. Read the following and identify the combination of symmetry, height and seismic zone your building belongs to? Category 1: if row E57= 1, & E61=1, i.e., building is symmetric and it's height >= 40 meters and the site is in seismic zone IV or V ?	Answer only the option that is applicable for your hospital		
		Type 1, if you have done dymanic analysis of seismic force		
		Type 2, if you have not done dymanic analysis of seismic force		
	Category 2:if row E57= 1, & E61=1, i.e., building is symmetric and it's height >=90 meters and the site is in seismic zone II or III ?	Type 3, if you have done dymanic analysis of seismic force		
		Type 4, if you have not done dymanic analysis of seismic force		
	Category 3: if row E57 or E61<1, i.e., building is assymmetric and it's height >=12 meters and the site is in seismic zone IV or V?	Type 5, if you have done dymanic analysis of seismic force		
		Type 6, if you have not done dymanic analysis of seismic force		
	Category 4:if row E57 or E61 <1, i.e., building is assymmetric and it's height>= 40 meters and the site is in seismic zone II or III?	Type 7, if you have done dymanic analysis of seismic force		
		Type 8, if you have not done dymanic analysis of seismic force		
	Category 5: None of the categories 1 to 4	Type 9, If your building does not fall under anyone of the categories		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S9 Mechanical equipment/ batteries can have considerable self weight and will transfer a part of their loads to the structure during earthquake- this must be considered in design	Has load of mechanical equipements, batteries been considered in design?	Choose one from the following options		
		Type "NA", if not applicable		
		Type 1, if load of mechanical equipement, batteries have been considered in design		
		Type 0, If load of mechanical equipement, batteries have not been considered in design		
S10 Different column heights: building on slope  Different column heights: mezzanine 	Has Short column effect been considered in structural analysis and design? Special note: short columns attract more seismic load than tall columns. In framed structure, short column effect may be highly detrimental and hence, such effect must be considered in design	In framed structure, short column effect may be highly detrimental and hence, such effect must be considered in design		
		Type "NA", if not applicable		
		Type 1, if you have considered short column effect in the structure?		
		Type 0, if you have not considered short column effect in the structure?		
S11  In masonry buildings, these should be at least 600mm	For Masonry buildings, the locations of doors & windows are very important. Check if they are as per safety If not followed, there could be severe damage to the building	Each door or window should be at lease 600mm away from wall corners. The space between two openings should also be at least 600mm. Choose one from the following options		
		Type "NA", if not a masonry building		
		Type 1, if doors, windows are at least 600mm away from wall corner and there is at least 600mm wide wall between two openings		
		Type 0, if doors, windows are not 600mm away from wall corner and/or there is < 600mm wide wall between two openings		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S12  W1+W2<= 0.5L	Check if the total width of doors and windows in a wall is > = half the total wall length If this is is not followed, there will be possibility of sliding of the portion of the wall above window sill	Add the door and window widths on a wall and check if it is > the wall length. Choose one from the following		
		Type "NA", if not a masonry building		
		Type 1, If total door+window width in a wall is < its wall length & this is true for all walls of the building		
		Type 0, If total door+window width in a wall is > its wall length		
	NON STRUCTURAL ISSUES			
NS1  Needs flexible connection to accommodate seismic movement and to avoid joint failure	Are AC ducts, AC piping provided with flexible connections? Differential movement between sections of the building can cause breakage and leaks in pipe and duct joints if no provision is made for movement.	Choose one from the following options		
		Type "NA" if there is no Airconditioning system in the hospital		
		Type 1, if both AC ducts and AC piping have been provided with flexible connections		
		Type 2, if either AC ducts or AC piping is provided with flexible connections		
		Type 3, if neither AC ducts or AC piping is provided with flexible connections		
NS2 During earthquake plumbing lines may break and roof top water tanks may topple leaving no water for drinking	Are plumbing lines, rooftop/overhead water tank safely placed and anchored adequately	If there is no water supply then mention it in column "REFERENCES/REMARKS"		
		Type 1, if plumbing lines & rooftop/overhead water tank are adequately supported & secured or there is a hand pump		
		Type 0, if plumbing lines & rooftop/overhead water tank are not supported & secured or there is no water supply		
NS3 During earthquake fire protection lines may break leaving no water for fire fighting	Is fire protection piping correctly installed and braced?	If fire protection piping does not exist, mention this in the column "REFERENCES/ REMARKS". Choose one from the following options		
		Type "NA", if fire protection piping does not exist		
		Type 1, if fire protection piping correctly installed and braced		
		Type 0, if fire protection piping not correctly installed and braced		

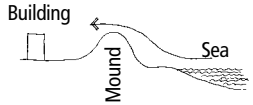
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS4  	Are gas lines to laboratories provided with flexible connection? Otherwise thay can cause dangerous leaks & may cause fire	If there is no lab in the hospital, mention this in the column "REFERENCES/ REMARKS" ?Choose one from the following options		
		Type "NA", if there is no lab.		
		Type 1, if you have provided flexible joints and the lines are clamped at suitable points		
		Type 0, if you have not provided flexible joints and the lines clamped at suitable points		
NS5 This could be a falling hazard	Are suspended lighting fixtures securely attached, braced, or designed to stop sideway movement?	Choose one from the following options. If suspended lighting fixtures do not exist, mention this in the column "REFERENCES/REMARKS"		
		Type "NA", if suspended lighting fixtures do not exist		
		Type 1, if suspended lighting fixtures are securely attached and braced		
		Type 0, if suspended lighting fixtures are not securely attached and braced		
NS6 Make sure that that they do not topple or slide	Are boilers and other tanks securely braced?	Have you addressed this issue? If there is no Boiler, Mention this in the column "REFERENCES/ REMARKS"		
		Type "NA", if the building does not have a Boiler		
		Type 1, if boilers and other tanks securely braced		
		Type 0, boilers and other tanks not securely braced		
NS7 The generator, batteries, and other electrical equipment are necessary for emergency operation.	Is emergency generator and associated equipment secured against movement?	Have these been secured against movement? If emergency generator does not exist, mention this in the column "REFERENCES/REMARKS"		
		Type "NA", if emergency generator does not exist		
		Type 1, if emergency generator etc. are secured against movement		
		Type 0, if emergency generator etc. are not secured against movement		
NS8 Switch gear and transformers are heavy and sliding or movement failure can shutdown the electrical system.	Is heavy electrical equipment adequately secured?	Have you addressed this issue? If heavy electrical equipment does not exist, Mention this in the column "REFERENCES/REMARKS";		
		Type "NA", if heavy electrical equipment does not exist		
		Type 1, if heavy electrical equipment is adequately secured		
		Type 0, if heavy electrical equipment is not secured		

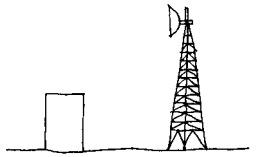
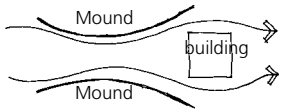
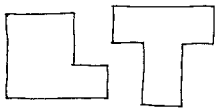
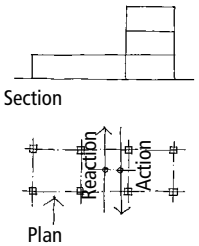
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS9  Heavy equipment may slide and break utility connections.	Is heavy mechanical equipment adequately secured (anchored)?	Are they adequately secured by appropriate anchorage? If there is no such equipment, mention this in the column "REFERENCES/REMARKS" ? choose one from the following		
		Type "NA", if your building does not have such equipment		
		Type 1, if heavy mechanical equipment is adequately secured		
		Type 0, if if heavy mechanical equipment not secured		
NS10 The architect should co-ordinate with the lift supplier to address this issue	Are the elevator cars, counterweights, and equipment anchored for seismic forces?	Mention it in the column "REFERENCES/REMARKS, if the hospital does not elevators ?Choose one from the following options		
		Type "NA", if elevators do not exist		
		Type 1, if the elevator cars, counterweights, and equipment are anchored for seismic forces		
		Type 0, if the elevator cars, counterweights, and equipment are not anchored for seismic forces		
NS11 Elevator needs power to enable vertical patient movement.	Is at least one elevator in each wing connected to the emergency power system?	Have you provided it? If elevators do not exist, mention this in the column "REFERENCES/REMARKS"		
		Type "NA", elevators do not exist		
		Type 1, if at least one elevator in each wing is connected to the emergency power system		
		Type 0, if none of the elevators are connected to the emergency power system		
NS12 Make sure that the anchorage, bracing and connections are adequate against horizontal force	Are the bulk Oxygen tank and associated equipment secured? Especially the legs, anchorage, and foundations of large tanks	If the hospital does not have Oxygen tank, mention it in the column "REFERENCES/REMARKS" ?Choose one from the following options		
		Type "NA", if bulk oxygen tank does not exist in the hospital		
		Type 1, if the bulk oxygen tank and associated equipment are secured		
		Type 0, if the bulk oxygen tank and associated equipment are not secured		
NS13 Strap them with the wall at base. mid height and top	Is Nitrogen storage secured? Loose tanks may fall and break connections.	If the hospital does not have Nitrogen Storage, mention it in the column "REFERENCES/REMARKS" ?Choose one from the following options		
		Type "NA", if Bulk Nitrogen Store does not exist		
		Type 1, if nitrogen storage is secured		
		Type 0, if nitrogen storage is not secured		

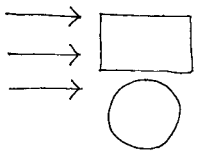
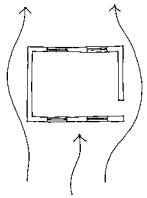
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS14  Make sure that the anchorage, bracing and connections are adequate against horizontal force	Is fire alarm equipment secured against movement? Equipment can slide or topple, breaking connections.	if there is no fire alarm equipment in the hospital, mention this in the column "REFERENCES/REMARKS" ?Choose one from the following options		
		Type "NA", if there is no fire alarm equipment		
		Type 1, if fire alarm equipment is secured against movement		
		Type 0, if fire alarm equipment not secured against movement		
NS15  Communication antenna: make sure that the anchorage, bracing and connections are adequate against horizontal force	Are communications components, including antennas, adequately secured for seismic forces?	if there is no such equipment in the hospital, mention this in the column "REFERENCES/ REMARKS" ?Choose one from the following options		
		Type "NA", if there is no such equipment		
		Type 1, if communications components, including antennas are adequately connected and supported		
		Type 0, if communications components, including antennas are not connected and supported		
NS16  An example of base isolator	Is there base isolation for generator?	if there is no generator in the hospital, mention this in the column "REFERENCES/ REMARKS" ?Choose one from the following options		
		Type "NA", if there is no generator.		
		Type 1, if base isolation has been done for generator		
		Type 0, if base isolation has not been done for generator		

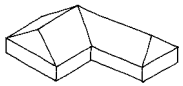
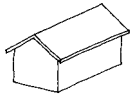
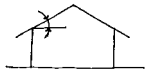
ANNEXURE II: WIND SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

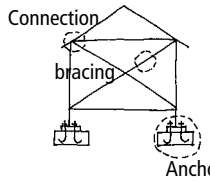
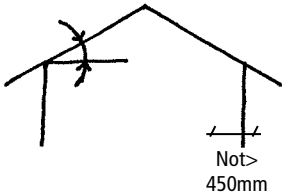
READ THIS BEFORE ANSWERING THE KEY QUESTIONS				
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	**User's Input 1**	**User's input 2:** Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

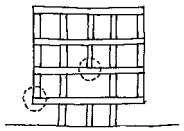
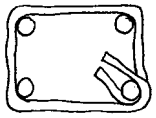
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
PLANNING				
P1  Site plan showing access roads	An important aspect of safety of a building is the type of access road from the main road to the site of the new hospital	Depending upon the type of access road to your site, choose one from the following options;		
		Type 1, if two or more roads from mainstreet to building, wide enough to allow one fire engine to reach, reverse and return to the mainroad		
		Type 2, if there is one access road of the above type		
		Type 3, if access road is for cars and not fire engine		
		Type 4, If the access road is suitable for motorbike only and not for cars		
		Type 5, if it is for pedestrian access only		
P2  The mound reduces wind load on the building from the sea side	Will the surrounding landscape and topography reduce wind speed on your building?	Based on historical data and community experience judge this issue. Mention the source of information in column "REFRENCES/ REMARKS", if referred to		
		Type 1 , if the probable level of wind speed reduction is > 50%		
		Type 2 , if the probable level of wind speed reduction is > 25% but <50%		
		Type 3 , if the probable level of wind speed reduction is > 10% but <25%		
		Type 4 , if the probable level of wind speed reduction is < 10%		

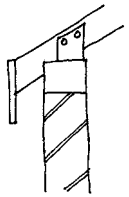
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
P3  Tower too close to the building	Are there trees and/or towers too close to the building that may fall on it during high wind/cyclone?	Depending upon the type of falling hazards at your site, choose one from the following options		
		Type 1, if falling hazards can stop the hospital from functioning		
		Type 2, if falling hazards can cause damage to the hospital, but will not hamper its fucntioning		
		Type 3, if there is no threat of falling of trees/towers, etc		
P4  Plan showing wind tunnel effect on building	Is there a potential wind tunnelling effect at site due to the surrounding topography and/or adjacent buildings and structures	Choose one from the following options		
		Type NA, if wind tunnelling effect does not exist		
		Type 1, if wind tunnelling effect exists and you have considered it in design		
		Type 0, if wind tunnelling effect exists but you did/ could not consider it in design		
ARCHITECTURAL ISSUES				
A1  Plan forms such as T,L etc are irregular	Is the architectural/structural configuration irregular in plan?	Look at building plans & assess the level of symmetry and then choose one from the following that is appropriate		
		Type 1, if Shapes are regular, structure has uniform plan, and there are no elements that would cause torsion		
		Type 2, if Shapes are irregular but structure is uniform;		
		Type 3, if Shapes are irregular and structure is not uniform		
A2  Two portions of the same building have different masses: vertical irregularity	Is there vertical irregularity in architectural/ structural configuration?	Look at sections of the design & assess the level of symmetry, e.g., having set backs, open first stories,etc., and then choose one from the following that is appropriate for your building		
		Type 1, if storey heights are of very similar (i.e., they differ by < 5%); there are no discontinuous or irregular elements.		
		Type 2, if storey heights are similar (they differ by > 5% but <20%) and there are few discontinuous or irregular elements;		
		Type 3, if storey heights differs by >20% and there are significant discontinuous or irregular elements		
A3 Uniform shapes presenting minimum obstruction to the wind	Does the building have a uniform shape presenting minimum obstruction to the wind	How does your building feature in this context? Choose one from the following options		
		Type 1, if regular in plan and masing		
		Type 2, if regular in plan and irregular in massing		
		Type 3, if both plan and massing are irregular		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A4  If you know the geo-climatic conditions of the site based on historical data, it is best to orient the building to face the least wind force.	Is the building suitably oriented considering the prevailing wind direction	In terms of orientation of the building what is your assessment on probable performance against wind forces		
		Type 1, if good (building suitably oriented considering the prevailing wind direction)		
		Type 2, if medium (building more or less suitably oriented considering the prevailing wind direction)		
		Type 3, if low (building not really oriented considering the prevailing wind direction)		
		Type 4, if very low (building not oriented considering the prevailing wind direction)		
A5 It is important to have latches located for easy manoeuvring during high wind	Do the door and windows have a good and accessible latch?	Choose one from the following options		
		Type 1, if both doors and windows have accessible and good latches		
		Type 2, if some of the doors & windows have accessible and good latches		
		Type 3 if niether doors or windows have accessible and good latches		
A6  Plan showing balanced opening on opposite walls	Is there a balance of the size of openings on opposite walls	Choose one from the following options		
		Type 1, if good balance of the size of openings on opposite walls		
		Type 2, if medium balance of the size of openings on opposite walls		
		Type 3, if low balance of the size of openings on opposite walls		
		Type 4, if very low balance of the size of openings on opposite walls		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A7  Hip roof the best  Pitch roof slope (30-45deg)  Safe slope (30-45 deg)	Have you used a pitch or hip roof? Roof pitch between 30-45 deg to minimize suction caused by negative pressure	Hip roofs have the best record of resistance, the next best is gable roof with a pitch of 30-450 , low gable roof and flat roof have the worst record		
		Type NA, if not applicable		
		Type 1, if you have used a hip roof of slope > 20deg		
		Type 2, if you have used a pitch roof and the slope is 30-450		
		Type 3, if you have used a pitch roof and the slope is 20-290		
		Type 4, if you have used a pitch roof and the slope is <190		
A8 Ideally the entire building should be safe from missiles/debris. If not, then a few encosures should be designed as shelter for the occupants during cyclone/high wind	In places where missile/debris are highly likely to pound on a building, then have you built an enclosure to provide debris protection?	Choose one from the following options		
		Type "NA" if missile/debris are not likely to pound on the building		
		Type 1 , if missile/debris are highly likely to pound on a building, and you have built an enclosure to provide debris protection?		
		Type 0 , if missile/debris are highly likely to pound on a building, and you have not built an enclosure to provide debris protection?		
A9 Suitable detail should be made to make sure that the storm shutter does not hamper easy handling of the glass shutters in normal circumstances	In case there is a possibility of occurance of missile, have you provided storm shutters to protect the glass panes of the windows and openings?	Choose one from the following options		
		Type "NA" if not applicable in your case		
		Type 1, if building is in missile prone area and you have provided storm shutters		
		Type 0, if building is in missile prone area and you have not provided storm shutters		
	STRUCTURAL ISSUES			
S1 The engineer should take account of the local conditions such as wind tunneling effect, obstructions reducing wind speed, etc.	Have you considered the design wind speed at the site along with a) building height, b)width, c) height and d) topographic features? (e.g., IS 875 Part 3, 1987: Vz ? design wind speed, k1? risk co-efficient ,k2?terrain, height & size factor & k3 topograp	Have you considered all the factors. If you have you referred to the wind map of the code, mention the code name in column "REFERENCES/REMARKS".		
		Type 1, if you have considered design wind speed along with a)building height, b)width, and c)risk, terrain and topographic features		
		Type 0, if you have not considered design wind speed along with a)building height, b)width, and c)risk, terrain and topographic features		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S2 Engineers should be careful about the presence of such walls since one might overlook this important issue in the complex process of analysis of the main structural system	Are there interior non-load-bearing walls? Unreinforced brick, concrete, and other types of masonry walls are vulnerable in wind load	Have you designed interior non-load-bearing walls for wind load?		
		Type "NA" if not applicable in your case		
		Type 1, if interior non-load-bearing walls have been designed for wind		
		Type 0, if interior non-load-bearing walls have not been designed for wind		
S3  ABC (anchorage, bracing and connection)- three prerequisites for wind safety	Have you considered A, B & C (anchorage, bracing, connection) of safety in your design? Make sure of strong fixings and joints between all elements: foundations- walls-cladding walls-roof frame-coverings. cross bracing, anchor, connections. reinforce vertical and horizontal diagonal bracing (triangulation)	Choose one from the following options		
		Type 1, if you have considered all A,B,C in your design		
		Type 2, if you have considered two out of A,B,C in your design		
		Type 3, if you have considered only one out of A,B,C in your design		
		Type 4, if you have not considered any of A, B, C		
S4 Wind-borne debris can cause injury to the people during high wind.	Is there a covered walkway for building to building connection?	Choose one from the following options		
		Type 1, if there is a covered walkway which is designed for debris		
		Type 2, if there is a covered walkway which has not been designed for debris		
		Type 3, if there is no covered walkway		
S5 For large span structures such as gymnasium, auditorium, etc., one should consider the wind uplift forces in design and detailing	Do portions of the existing facility have long-span roof structures	Has it been duly addressed in the design?		
		Type "NA" if not applicable in your case		
		Type 1, if large span exists and you have evaluated the structural strength for wind uplift resistance, which is safe.		
		Type 0, if large span exists and you have not evaluated the structural strength for wind uplift resistance.		
S6  If the overhang is >450mm one needs to design for wind uplift	Are there existing roof overhangs that cantilever more than 450mm?	Overhangs on buildings often have inadequate uplift resistance.		
		Type NA, If not applicable		
		Type 1, If it is applicable in your case and if you have considered wind uplift, which is safe		
		Type 0, If it is applicable in your case and if you have not considered wind uplift		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S7  Section shows that load path of the building is discontinuous- this is not desirable	Is there a continuous load path from all components of the building to the foundation? A continuous load path enables a structure to act together as a whole when subjected to dynamic force. Connections from walls to floors and roofs should also form part of this load path.	Look at the drawings of your building, especially the sections and check and choose one from the following options		
		Type 1, if the load path is continuous		
		Type 2, if there is a minor deviation from the load path		
		Type 3, if there is a major deviation from the load path		
S8 The critical areas are the J bolt connections at the ridge line, hip lines, etc	Have you made sure that the roof covering elements such as tiles, corrugated ganvanized iron sheets, etc., cannot be lifted off by wind	Choose one from the following options		
		If not applicable type in "NA"		
		Type 1, if you have done design & detailng of roof covering for wind uplift		
		Type 0, if you have not done design & detailng of roof covering for wind uplift		
S9 Choice of materials and detailing are crucial	Are existing exterior walls resistant to wind-borne debris?	If the building is in a cyclone/high wind-prone region, consider enhancing debris resistance, particularly in detailing		
		If not applicable type in "NA"		
		Type 1, if you have done the design and detailng to make the existing exterior walls resistant to wind-borne debris		
		Type 0, if you have not considered the effect of wind-borne debris on existing exterior walls		
S10  Ductile detail enables a structure to undergo large deformation before failure. It gives adequate warning to the occupants before failure	Have you done the reinforcement detailing as per code to ensure ductility the structure?	Choose one from the following options		
		Type 1, of all reinforcements are designed & detailed for ductility as per codes		
		Type 2, reinforcements are designed & detailed for ductility (partially) as per codes		
		Type 3, if the issue of ductile reinforcement has not been addressed		
	NON STRUCTURAL ISSUES			
NS1 Material specification and detailing are crucial	Have you designed the hinges, wind stays, latches, handles and bolts to ensure easy and low maintenance intensive openings that can be closed quickly	Choose one from the following options		
		Type 1, if you have done design and detailng of hinges, wind stays, latches, handles and bolts of openings for high wind		
		Type 0, if you have not done the design and detailng of hinges, wind stays, latches, handles & bolts of openings for high wind		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS2 Material specification and detailing are crucial	Have the exterior doors, windows, and skylights been designed and detailed for high wind?	Have you selected materials and systems, and detailed to resist wind and wind-driven rain		
		Type NA if not applicable		
		Type 1, if you have selected materials and systems, and detailed to resist wind and wind-driven rain		
		Type 0, if you have not selected materials and systems, and detailed to resist wind and wind-driven rain		
NS3 Roof sheets, tiles, coconut, flower pots, garbage bins, small stones, etc., could act as missiles	Damage to windows, doors and other openings are commonly caused by missiles . If your building is in such zone, then have you considered this in your design?	Have you selected materials and systems, and detailed to resist missiles/debris?		
		If not applicable type in "NA"		
		Type 1, if you have designed and detailed doors & windows for missile		
		Type 0, if you have not designed and detailed doors & windows for missile		
NS4 It is very important that you also consider the effect of thermal expansion and contraction related deterioration of the connection?	Are there tiles, veneer or stucco as exterior claddings? If applicable then have you evaluated strength of such attachments against wind?	Choose one from the following options		
		If not applicable--> "NA"		
		Type 1, if you considered the effect of high wind while selecting materials and detailing the joint		
		Type 0, if you have not considered the effect of high wind while selecting materials and detailing the joint		
NS5 If not held down adequately, tiles may be blown off by high wind	Does the roof have surfacing with tiles, or insulation boards? Are the tiles safe in high wind?	If applicable, have you considered the wind blow off effect in design and detailing?		
		If not applicable -->"NA"		
		Type 1, if you have considered the wind blow off effect in design and detailing of surface tiles, or insulation boards		
		Type 0, if you have not considered the wind blow off effect in design and detailing of surface tiles, or insulation boards		
NS6  Consider wind blow off effect while designing the flashing or coping	Does the existing roof have edge flashing or coping? Is it safe in high wind?	If applicable, have you considered the wind blow off effect in design and detailing?		
		Type "NA", If not applicable		
		Type 1, if you have considered wind blow off effect in design and detailing of edge flashing or coping of existing roof		
		Type 0, if you have not considered wind blow off effect in design and detailing of edge flashing or coping of existing roof		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS7 Heavy equipment may slide and break utility connections in high wind/cyclone	If you have mechanical equipment mounted outside at ground or on the roof, then have you anchored the equipment to resist wind loads?	Choose one from the following options		
		Type "NA", If not applicable		
		Type 1, if there are mechanical equipment mounted outside and are anchored adequately		
		Type 0, if there are mechanical equipment mounted outside and are not anchored		
NS8 Architect should use time-tested systems	Are there penetrations through the roof or walls? If yes then have you designed the intakes and exhausts to avoid water leakage?	Choose one from the following options		
		Type "NA", If not applicable		
		Type 1, if you have considered water penetration through intakes/ exhaust in detailing		
		Type 0, if you have not considered water penetration through intakes/exhaust in detailing		
NS9  Communication antenna: make sure that the anchorage, bracing and connections are adequate against horizontal force	Are there antennae (communication masts) or satellite dishes anchored with structural part?	If yes, then have you designed the installations, ties, etc. for wind resistance?		
		Type "NA", If not applicable		
		Type 1, if you have designed the antennae (communication masts) or satellite dishes, ties, etc. for wind resistance		
		Type 0, if you have not designed the antennae (communication masts) or satellite dishes, ties, etc. for wind resistance		
NS10 Roof sheets, tiles, coconut, flower pots, garbage bins, small stones, etc., could act as debris	Is the emergency generator(s) housed in a wind- and debris-resistant enclosure?	If applicable have you built an enclosure to provide debris protection?		
		Type "NA", If not applicable		
		Type 1, if you have built an enclosure to provide debris protection for the emergency generators		
		Type 0, if you have not built an enclosure to provide debris protection for the emergency generators		

ANNEXURE III: FLOOD SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

READ THIS BEFORE ANSWERING THE KEY QUESTIONS				
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	**User's Input 1**	**User's input 2:** Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
PLANNING				
P1 In coastal communities, even sites at some distance inland from the shoreline may be exposed to extreme storm surge flooding.	Is the site located in a storm surge inundation zone (or tsunami inundation area)? If yes, then, make an assessment on damage potential due to storm surge based on historical data- consult the meteorology departments	Storm surge maps may be available at State or local emergency management offices. Mention in the column "REFERENCES/ REMARKS" whether it is available or not available		
		Type "NA", If you have referred to the map and found your site not in such zone		
		Type 1, if the damage potential is low		
		Type 2, if the damage potential is medium		
		Type 3, if the damage potential is high		
P2 Consult local people for historical data- also consult the state geology department	Is the site located in a zone with possible water surge from glacial lake/lake casued by land slide or due to earthquake	Mention the source in column "REFERENCES/ REMARKS" if you have referred to any document or department? Choose one from the following options		
		Type "NA" if not applicable		
		Type 1, if the damage potential is high		
		Type 0, if the damage potential is very low		
P3 Refer to historical data for a safe decision	What is the expected level of inundation at the site? i.e., expected maximum flood elevations with respect to the plinth level of the building, e.g., the score will be high if the maximum flood elevation is 300mm below the plinth level.	Mention the max. flood level (+/-) in mm with respect to the plinth level in the column "REFERENCES/ REMARKS"? Choose one from the following options		
		Type 1, if the plinth is atleast 300mm above the maximum inundation level		
		Type 2, if the plinth is atleast 150mm above the maximum inundation level		
		Type 3, if the plinth is below expected flood depth		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
P4 Duration has bearing on the stability of earthen fills, access to a site and emergency response and durability of materials that come into contact with water. Records of actual flooding are the best indicator of duration as most floodplain analyses do not examine duration.	What is the potential damage level due to the expected duration of flooding?	Mention the duration of flooding in column "REFERENCES/ REMARKS ? what is the damage potential due to stagnation of flood water		
		If not applicable -->"NA"		
		Type 1, if damage potential is low in expected duration of flooding		
		Type 2, if damage potential is medium in expected duration of flooding		
		Type 3, if damage potential is high in expected duration of flooding		
P5 Although dam failure generally is considered an unlikely event, the potential threat should be evaluated due to the catastrophic consequences.	Is the site in an area predicted to be inundated if an upstream dam were to fail?	Choose one from the following options		
		If not applicable -->"NA"		
		Type 1, if potential threat of upstream dam failure is very low		
		Type 2, if potential threat of upstream dam failure is medium		
		Type 3, if potential threat of upstream dam failure is high		
P6 If areas with poor local drainage and frequent flooding cannot be avoided, filling, regrading, and installation of storm drainage facilities may be required.	Does the surrounding topography contribute to flooding at the site? Is there a history of local surface drainage problems due to inadequate site drainage?	Mention in the column "REFERENCES/REMARKS" if such incidences have happened in the past also mention the severity of such flooding		
		If not applicable -->"NA"		
		Type 1, if low chance of surrounding topography contributing to flooding		
		Type 2, if medium chance of surrounding topography contributing to flooding		
		Type 3, if high chance of surrounding topography contributing to flooding		
P7 Access is increasingly important as the duration of flooding increases. For the safety of occupants, most critical facilities should not be occupied during flood events.	Is at least one access road to the site/building passable during flood events?	choose one from the following options		
		Type 1, if at least one access road to the site/building is passable during flood events		
		Type 0, if no access road to the site/building is passable during flood events		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
P8 Areas where vehicles could be affected should have signage to warn users of the risk. Emergency response plans should include notification of car owners.	Are ground level parking lots located in flood-prone areas?	How susceptible is it to flooding?		
		Type NA, if not applicable		
		Type 1, if flooding of ground level parking lot's susceptibilty is low		
		Type 2,if flooding of ground level parking lot's susceptibilty is medium		
		Type 3, if flooding of ground level parking lot's susceptibilty is high		
	ARCHITECTURAL ISSUES			
A1 New critical facilities built in flood hazard areas should not have any functions occupying flood-prone spaces (other than parking, building access, and limited storage)	Are any critical building functions occupying space that is below the elevation of the past record of flood or the Design Flood Elevation?	Choose one from the following options		
		Type NA, If not applicable		
		Type 1, if critical functions could be relocated to upper levels that are above predicted flood elevations		
		Type 2, if critical functions cannot be relocated, but flood proofing could be done		
		Type 3, if critical functions cannot be relocated, neither flood proofing could be done		
A2 These issues should be addressed right at the schematic design level by the architect	If critical functions must continue during a flood event, have power, supplies, and access issues been addressed?	Choose one from the following options		
		Type NA, If not applicable		
		Type 1, completely addressed (critical functions can continue during a flood event with power, supplies, and access)		
		Type 2, partly addressed (critical functions can partially continue during a flood event with power, supplies, and access)		
		Type 3, not addressed at all (critical functions cannot continue during a flood event with power, supplies, and access)		
A3 If critical contents cannot be permanently located on higher floors, a flood response plan should take into account the time and attention needed to move such contents safely.	Have critical contents (files, computers, servers, equipment, research, and data) been located on levels of the facility above the flood elevations? Suggestions: since the facility may require continued use even during flood, the potential for flooding should be recognized and steps taken to minimize loss of expensive equipment and irreplaceable data.	Choose one from the following options		
		Type1, if located above flood elevation (critical contents -files, computers, servers, equipment, research, and data)		
		Type0, if not located above flood elevation (critical contents -files, computers, servers, equipment, research, and data)		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	STRUCTURAL ISSUES			
S1 If siting in a floodplain is unavoidable, new facilities are to be designed to account for all loads and load combinations, including flood loads	Do the construction type and the foundation type have the required load bearing capacity against flood water?	If applicable, then has it been considered in design?		
		If not applicable--> NA		
		Type 1, if the facilities have the required load bearing capacity against flood water?		
		Type 0, if the facilities do not have the required load bearing capacity against flood water?		
S2 Waves can exert considerable dynamic forces on buildings and contribute to erosion and scour.	Is the site prone to wind driven waves, which can take place in the coastal areas, riverine areas and site next to lakes?	Choose one of the following options		
		If not wave prone--> NA		
		Type 1, If in wave prone areas, and you have adressed this issue		
		Type 0, If in wave prone areas, and you have not adressed this issue		
S3 If applicable, one can provide flood openings to automatically allow for inflow and outflow of floodwaters to minimize differential hydrostatic pressure	Does the hospital have enclosures below the flood elevation, meant for limited use (parking, building access, and limited storage).	Choose one from the following options		
		If not applicable --> "NA"		
		Type 1, if hospital has enclosures below the flood elevation and you have provided flood openings to automatically allow for inflow and outflow of floodwaters to minimize differential hydrostatic pressure?		
		Type 0, if hospital have enclosures below the flood elevation and you have not provided flood openings to automatically allow for inflow and outflow of floodwaters to minimize differential hydrostatic pressure?		
S4 Refer to historical data on flooding to ascertain whether the expected water level is considerably higher than the bottom of the basement	If the ground water table is high and there is a basement, have you considered water load on retaining wall?	Choose one of the following options		
		Type "NA", if not applicable		
		Type 1, If water table is high & you have designed retaining wall accordingly		
		Type 0, If water table is high & you have not designed retaining wall accordingly		
S5 In case of significant buoyancy effect, plumbing and other service lines may break	If the ground water table is high and there is a basement, have you considered buoyancy effect?	Choose one of the following options		
		Type "NA", if not applicable		
		Type 1, If this is applicable & you have addressed bouyancy effect		
		Type 0, If this is applicable & you have not addressed the issue of bouyancy effect		

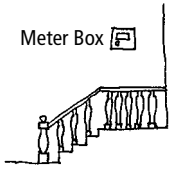
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S6 Provide adeqaute depth of foundation and other local specific measures to protect the plinth and the foundation	If the building is in a place where flood water returns with speed to the nearby canal/river or sea causing scouring	Is the plinth adequately protected and the foundation has adequate depth?		
		If not applicable --> "NA"		
		Type 1, if the issue of scouring effect has been adddressed adequately		
		Type 0, if the issue of scouring has not been adddressed		
	NON STRUCTURAL ISSUES			
NS1 Critical facilities in hospitals that depend on fresh water should be aware of the level of vulnerability of the local water supply system, and the system's plans for recovery of service in the event of a flood.	Is the potable water supply for the facility protected from flooding? If served by a well, is the wellhead protected? Can it be accessed during flood?	Choose one of the following options		
		If not applicable -->"NA"		
		Type 1, If applicable, & you have protected the potable water source during flooding		
		Type 0, If applicable & you have not protected the potable water source during flooding		
NS2 Unprotected waste water service could casue a major disaster during and after flood with a long lasting detrimental effect on public life	Is the wastewater service for the building protected from flooding? Are any manholes below the Design Flood Elevation?	Is infiltration of floodwaters into sewer lines a problem? If the site is served by an onsite system that is located in a flood-prone area, have backflow valves been installed?		
		Type NA, If not applicable		
		Type 1, if you have protected the wastewater service from flooding		
		Type 0, if you have not protected the wastewater service from flooding		
NS3 Make sure that the tank openings and vents are elevated above the recorded elevation or the Design Flood Elevation	Are there any above ground or underground tanks on the site in flood hazard areas? Are they installed and anchored to resist flotation during the design flood?	Choose one from the following options		
		Type NA, If not applicable		
		Type 1, if you have made it safe against flotation and vents elevated above recorded (historical) flood elevation		
		Type 0, if not made it safe against flotation and vents not elevated above recorded (historical) flood elevation		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS4 Make sure that the vents and inlets are elevated above the recorded elevation or the Design Flood Elevation or they are sealed adequately to prevent entry of flood water	Are air handling unit, HVAC systems, ductwork, and other mechanical equipment and systems located above the recorded flood elevation?	Are the vents and inlets located above flood level, or sealed to prevent entry of floodwater?		
		If not applicable--> "NA"		
		Type 1, if air handling unit, HVAC systems, ductwork, etc are located above the recorded flood elevation or sealed to prevent entry of floodwater		
		Type 0, if air handling unit, HVAC systems, ductwork, etc not located above recorded flood elevation or not sealed to prevent entry of floodwater		
NS5 If not possible, locate them to higher floors or into elevated additions	Are plumbing fixtures and water meters, etc.) located above the recorded flood elevation?	Choose one of the following options		
		Type NA, If not applicable		
		Type 1, of if you have located the plumbing fixtures and water meters, etc. above recorded (historical) flood elevation		
		Type 0, if you have not located the plumbing fixtures and water meters, etc. above recorded (historical) flood elevation		
NS6 Apart from the fact that electrical systems are indispensable, if flooded it can lead to a major life threat	Are electrical systems, including backup power generators, panels, and primary service equipment, located above the recorded flood elevation?	Choose one of the following options		
		Type 1, if you have located the electrical systems, panels, and primary service equipment above the recorded (historical) flood elevation		
		Type 0, if you have not located the electrical systems, panels, and primary service equipment above the recorded (historical) flood elevation		
NS7 Utility equipment that is critical for functionality should be relocated to higher floors or into elevated additions.	Is the early warning system located above the recorded (historical) flood elevation	Choose one of the following options (if this facility does not exist, mention this in column "REFERENCES/REMARKS"		
		Type NA, if this facility does not exist		
		Type 1, if early warning systemsare safely located		
		Type 0, if early warning systems are not safely located		
NS8 Adequate factor of safety should be adopted while locating the communication/IT systems	Are the communication/IT systems located above the recorded (historical) flood elevation	Choose one of the following options (if this facility does not exisit, mention this in column "REFERENCES/REMARKS"		
		Type NA, if this facility does not exist		
		Type 1, if IT/communication systems are safely located above the recorded (historical) flood elevation		
		Type 0, if IT/communication systems are not safely located above the recorded (historical) flood elevation		

ANNEXURE IV: FIRE SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

READ THIS BEFORE ANSWERING THE KEY QUESTIONS				
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	**User's Input 1**	**User's input 2:** Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
PLANNING				
P1  Site plan showing access roads	An important aspect of safety of a building is the type of access road from the main road to the site of the new hospital	Depending upon the type of access road to your site choose one from the following options;		
		Type 1, if two or more roads from mainstreet to building wide enough to allow one fire engine to reach, reverse and return to the mainroad		
		Type 2, if there is one access road of the above type		
		Type 3, if access road is for cars and not fire engine		
		Type 4, If the access road is suitable for motorbike only and not for cars		
		Type 5, if it is for pedestrian access only		
P2 Apart from site visit, the consultant should enquire about external fire hazards from local people and fire department's local office	With reference to the exterior of the hospital building, rate the building's exposure to external fires.	There could be various sources such as electrical substation, combustible materials store, etc. The consultant should visit the site to assess such potential fire hazards		
		Type 1, if very high (Hospital's exposure to external fire)		
		Type 2, if medium (Hospital's exposure to external fire)		
		Type 3, if low (Hospital's exposure to external fire)		
		Type 4, no exposure at all (Hospital's exposure to external fire)		
P3  Site plan showing open space	Whether open space is available adjacent to the buildings for people to get assembled during fire?	In the column "REFERENCES/REMARKS, write the approximate length and width of such open space and the number of people who will need it ?Choose one from the following options		
		Type 1, if there is adequate open space for gathering		
		Type 2, if there is open space, but not adequate for gathering		
		Type 3, if there is no open space for available for gathering		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	ARCHITECTURAL ISSUES			
A1 Careful consideration at schematic design level may eliminate most of the fire vulnerabilities in a cost effective manner	Have you considered the latest codes of fire safety in architectural design?	If referred to, mention the code name or similar source in Column "REFERENCES/ REMARKS" - Choose one from the following options		
		Type 1, if you have considered the latest codes of fire safety		
		Type 0, if you have not considered the latest codes of fire safety		
A2 If yes, then consider relocating it	Is the main meter box located in the staircase block?	Mention in column "REFERENCES/REMARKS", if there is no electricity. Choose one from the following options		
		Type NA if there is no electricity		
		Type 1, if you have located the main meter box in the staircase block		
		Type 0, if the main meter box is located in safe location		
A3  If yes, then consider relocating it	Is the main switch located in the main entrance lobby/ passage/ corridor?	Mention in column "REFERENCES/REMARKS", if there is no electricity. Choose one from the following options		
		Type NA if there is no electricity		
		Type 1, if main switch is in the entrance lobby		
		Type 0, if main switch is located in safe location		
A4 Keep away possible sources of fire, e.g., kitchen, meter box, main switch, etc. from the staircase	Is the the existing staircase adequately protected for safe evacuation during fire?	Choose one from the following options		
		Type NA, if there is no staircase		
		Type 1, if the existing staircase is adequately protected for safe evacuation during fire		
		Type 0, if the existing staircase is not protected for safe evacuation during fire		
A5 It should be placed at maximum distance from the main staircase	In case of a multistorey, is there a fire escape staircase? Use signnages	Suggestion: keep the fire escape stairs at maximum distance from each other		
		Type NA, if not applicable		
		Type 1, if there is a fire escape, at a maximum distance from main stair		
		Type 0, if there is no fire escape stair		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A6 In case it is not possible to provide a fire fighting water tank and there is no fire hydrant nearby, look for alternative sources such as a local perennial pond	Is there a fire fighting water tank of adequate size or if there is a local source for fire fighting Use signnages	Choose one from the following options		
		Type 1, if there is a fire fighting water tank of adequate size or if there is a local source		
		Type 0, if there is no fire fighting water tank of adequate size nor a local source		
A7 Remember that sprinklers need regular housekeeping and periodic maintenace to make sure that they work in emergency	In case of a large hospital, has it been planned for sprinklers for the building?	Choose one from the following options		
		Type NA if not applicable		
		Type 1, if sprinklers have been planned for		
		Type 0, if sprinklers have not been planned for		
A8 The architect should choose appropriate materials and detailing of the false ceiling. The supporting metal structure to be provided with fire retarding coat	Is the false ceiling material safe from fire?	Choose one from the following options		
		Type "NA" if not applicable		
		Type 1, if ceiling materials used is not fire prone		
		Type 0, if ceiling materials used is fire prone		
	STRUCTURAL ISSUES			
S1 Take special care for steel and timber members	Has the structural members been insulated to protect it in the event of fire?	Have you provided insulation as per code for RCC, steel, timber, stone structure- mention the code name/source in column "REFERENCES/ REMARKS"		
		Type 1, if structural members insulated adequately or less fire prone building materials are used		
		Type 0, if structural members not insulated and/or fire prone building materials are used		
	NON STRUCTURAL			
NS1 Use only national standard's approved products and also based on past experience	Is the quality of wiring used of adequate quality	Choose one from the following options, mention in column "REFERENCES/REMARKS", if there is no electricity		
		Type "NA" if no electricity		
		Type 1, if you have used wires of national standards' approved quality		
		Type 0, if not sure about the quality of wiring used		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW HOSPITAL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
NS2 Use earthing pit of 1mX1mX2.5m deep installed with Galvanized cast Iron Plate. Alternatively, one may use specifications as per the local practice	Has earthing been done in the wiring system?	Choose one from the following options, mention in column "REFERENCES/REMARKS", if there is no electricity		
		Type "NA" if no electricity		
		Type 1, if earthing has been done		
		Type 0, if earthing has not been done		
NS3 Your building may not need it, if there are adjacent buildings provided with lightning bars	Has Lightning bar been fixed in the building	Choose one from the following options, mention in column "REFERENCES/REMARKS", if there is no electricity		
		Type "NA" if no electricity		
		Type 1, if Lightning bar been fixed or there is a nearby tall building with lightning bar or a tower		
		Type 0, if Lightning bar not been fixed		
NS4 If yes, then consider relocating it	Is the emergency batteries such as Inverter located near the entrance to the building?	Choose one from the following options		
		Type "NA", if not applicable		
		Type 1, if emergency batteries such as Inverter located safely in the building		
		Type 0, if emergency batteries such as Inverter located in the entrance lobby of the building		
NS5  Strap them adequately with the walls	Is there a fire extinguisher kept at convenient place for fire fighting	Choose one from the following options		
		Type 1, if a fire extinguisher kept at convenient place for fire fighting		
		Type 0, if there is not fire extinguisher in the building		
NS6 	Is there a provision for fire alarm?	Choose one from the following options		
		Type 1, if there is provision for fire alarm		
		Type 0, if there is no provision for fire alarm		

ENDING REMARKS

This is Hospital Safety Toolkit Book 1: New Design, Multi-Hazard Safety Compliance

It has provided the following four sets of data collection forms

1. Seismic Safety Evaluation
2. Wind Safety Evaluation
3. Flood Safety Evaluation
4. Fire Safety Evaluation

The architects and the engineers should read these forms before initiating the design process. Only the relevant forms should be used for examining safety compliance of the design since all four hazards may not be applicable at every site. At different stages of design development, the architects and engineers will keep on evaluating the safety compliance and will interact with the clients only when they are satisfied with the safety level of the design. In some cases, the site may not be viable from safety point of view. Hence, the preliminary analysis should be carried out mostly around planning.

This toolkit was not planned to be a finished product. However, it is suggested that the toolkit be used as it is for at least a few years. Only after the full cycle of data collection, analysis and decision making one may think of making modifications to fine tune the toolkit and to make it local specific.

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The Toolkit is aimed for the policy makers and local bodies that are responsible for local planning usually in urban areas in South Asia in order to assess critical infrastructure safety, particularly making schools and hospital safe.

Tools for the Assessment of School and Hospital safety for Multi-Hazards in South Asia comprised four books:

SCHOOL SAFETY TOOLKIT BOOK 1: NEW DESIGN / MULTI-HAZARD SAFETY COMPLIANCE

SCHOOL SAFETY TOOLKIT BOOK 2: RETRO-MAINTENANCE / MULTI-HAZARD SAFETY COMPLIANCE

HOSPITAL SAFETY TOOLKIT BOOK 1: NEW DESIGN / MULTI-HAZARD SAFETY COMPLIANCE
This book provides the following four sets of data collection forms: Seismic Safety Evaluation, Wind Safety Evaluation, Flood Safety Evaluation and Fire Safety Evaluation. The architects and the engineers should read these forms before initiating the design process. Only the relevant forms should be used for examining safety compliance of the design since all four hazards may not be applicable in every site.

HOSPITAL SAFETY TOOLKIT BOOK 2: RETRO-MAINTENANCE / MULTI-HAZARD SAFETY COMPLIANCE

Lead Technical Advisor for the development of the Toolkit, Dr Prabir Kumar Das is primarily working in India and the region of South Asia promoting community based social infrastructure construction consulting Governments, UN agencies and private sectors. His specific technical experience is in project appraisal, planning, implementation and maintenance management of community based construction, specially, education and healthcare facilities.

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