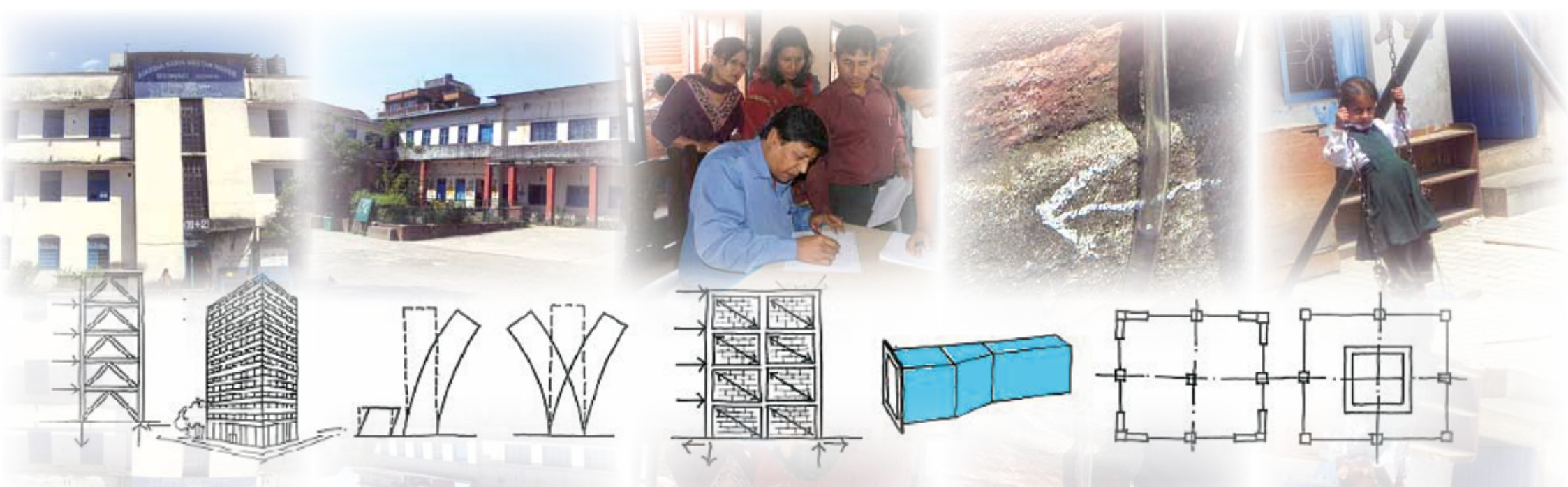


# TOOLS FOR THE ASSESSMENT OF SCHOOL AND HOSPITAL SAFETY FOR MULTI-HAZARDS IN SOUTH ASIA

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







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

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The expert inputs from the SDMC were provided by O. P. Mishra, M. B. Rao and Mriganka Ghatak under the guidance of Satendra, Director SDMC. The preparation of the publication was coordinated by Mariko Sato, UN-Habitat and Madhavi Malalgoda Ariyabandu, UNISDR, supported by the team comprising Padma Sunder Joshi, Ilija Gubic, Pornpun Pinweha, under the guidance of Toshi Noda, former Regional Director, UN-Habitat ROAP; Hang Thi Thanh Pham and Nasikarn Nitiprathananun, under the guidance of the Senior Regional Coordinator, UNISDR Asia Pacific Secretariat, German Velasquez.

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### **Peer Reviewers**

The following experts contributed to the Toolkit with reviews of earlier drafts: Manohar Lal Rajbhandari, Rajan Suwal, Jishnu Subedi, Ramesh Guragain, Sunil Khadka, Chandan Ghosh, and Ranjini Mukherjee.

### **Expert Group Meeting, March 25-26, 2012, Kathmandu, Nepal**

The earlier drafts of the Toolkits were reviewed by the following experts at the EGM: Damodar Adhikary, Mukunda Adhikari, Lin Aung, Deepak Raj Bhatt, Tanka Prasad Bhattarai, Bal Krishna Bhusal, Tirtharaj Burlakoti, P. B. Chand, Meen Bahadur Chhetri, Tulsi Prasad Dahal, Mriganka Ghatak, Ramesh Guragain, Sabina Joshi, Sagar Joshi, Sunil Khadka, Hamid Mumtaz Khan, Sardar Muhammad Nawaz Khan, Sarosh Hashmat Lodi, Ram Luetel, Arun Mallik, Rajesh Manandhar, Prem Nath Maskey, Abha Mishra, Giridhar Mishra, Prafulla Man Singh Pradhan, Manohar Lal Rajbhandari, Shreejana Rajbhandari, Moira Reddick, Sujata Saunik, Gyanandra Shakya, Arinita Maskey Shrestha, Deepak Shrestha, Hari Darshan Shrestha, Rekha Shrestha, Santosh Shrestha, Sudha Shrestha, Tulasi Sitaula, Paolo Spantigati, Jishnu Subedi, Rajan Suwal, Kishore Thapa, Man Bahadur Thapa, Bhushan Tuladhar, Sainendra Uprety, Jhapper Singh Vishokarma and Syed Arsalan Sabah Zaidi. UN-Habitat Nepal Office team has provided the logistic support.

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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 (NRRRC), 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.



A handwritten signature in black ink, appearing to read 'Satendra', written over a horizontal line.

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




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THIS IS BOOK 1

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 INDEPENDENT BOOKS ON  
 MULTI HAZARD SAFETY  
 COMPLIANCE ASSESSMENT  
 OF NEW DESIGN AND  
 EXISTING HOSPITALS AND  
 SCHOOLS



# 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

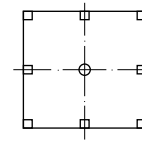
**Ductility:** Any metal that has the ability to get stretched without being damaged is a ductile material and this property of materials is called ductility. Mild steel, copper, etc. are ductile materials.

**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.

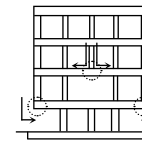
**Geotechnical investigation** is performed by geotechnical engineers or engineering geologists to obtain information on the physical properties of soil and rock around a site to design earthworks and building foundations.

**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.

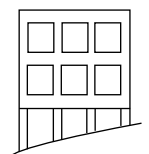
**Retaining wall** is built in order to hold back earth which would otherwise move downwards.

**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 ground [http://en.wikipedia.org/wiki/Seismic\\_loading](http://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 wind 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<sup>1</sup>** 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 forms. The supplement has been designed within the capability of school teachers and medical staff

- 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.

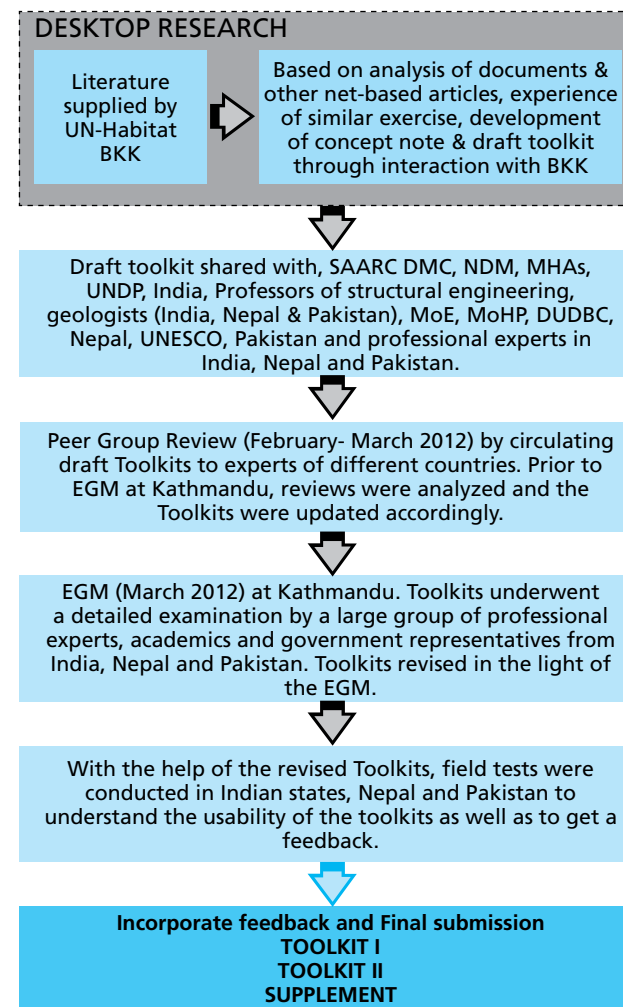
### 1.5 DESKTOP RESEARCH

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  
School Safety Toolkit Book 1:  
New Design: Multi-Hazard Safety Compliance**

## 1.6 PROCESS

Figure 1.1: Diagram showing steps of the toolkit development

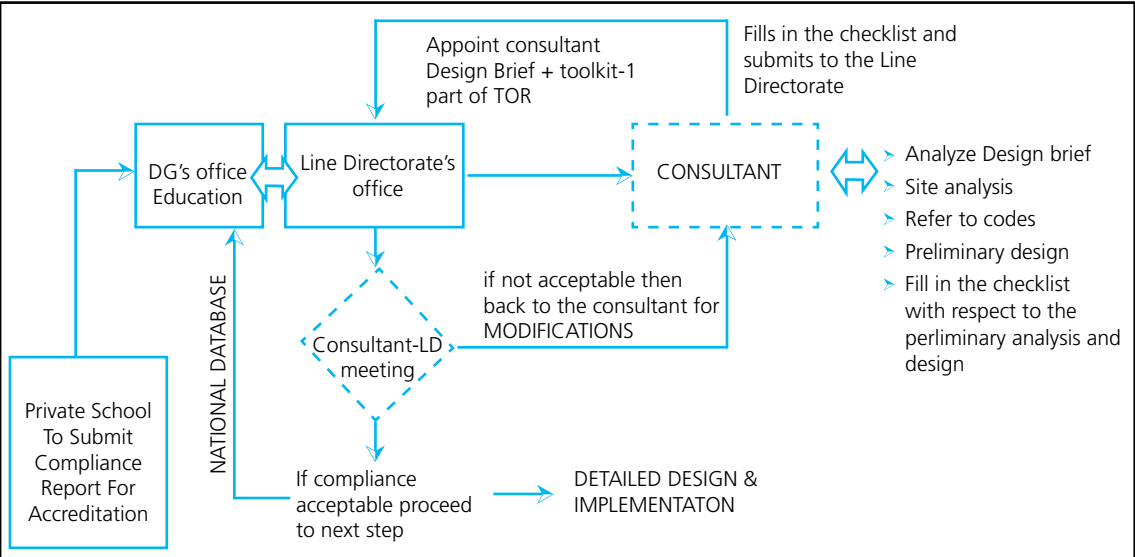


<sup>1</sup> Education Management Information System (EMIS), Health Infrastructure Information System (HIIS)

# CHAPTER 2

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

THE TARGET GROUP	IT IS FOR THE EDUCATION DEPARTMENT'S TOP LEVEL MANAGEMENT (TLM), i.e.,	LINE DIRECTOR (INFRASTRUCTURE) & TEAM
A	<p>This will enable Top Level Management to act as Informed Client in the context of safe school design</p> <p>The toolkit enables proactive participation of TLM &amp; creates documentary evidence of multi-hazard safety compliance of new schools</p> <p><b>What does the toolkit do?</b></p> <ul style="list-style-type: none"> <li>The TOOLKIT evaluates MULTI-HAZARD SAFETY of school at design stage for a particular site &amp; design brief</li> <li>It uses a checklist to calculate the safety compliance level of schools based on a semi-objective method</li> </ul>	
B	<p><b>How does the management system work?</b></p> <ul style="list-style-type: none"> <li>Top Level Management will appoint a design consultant and provide the design brief and this Toolkit as part of TOR</li> <li>Designer will visit the site, carry out analysis and prepare A SKETCH design--&gt; then use the toolkit to evaluate its safety-compliance level</li> <li>Once satisfied with the design and compliance level, she/he will present the design along with safety compliance level to line director</li> <li>The Top Level Management will study the compliance level of the design and raise questions on short comings, if any</li> <li>The designer will act upon the suggestions by the Top Level Management and get back to them</li> <li>Such iterative process will lead to a satisfactory compliance level of the school design, which will be stored in database of Education Ministry</li> <li>Submission of compliance report along with design of every privately run schools should be made mandatory for accountability and accreditation</li> <li>The above steps have been summarised in the following Figure</li> </ul>	
C	<p><b>How does a designer use the toolkit?</b></p> <p>Safety compliance status of a design will be done by answering CHECKLISTs in the four worksheets 1) Seismic, 2) Wind, 3) Flood, 4) Fire</p> <p>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</p> <p>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</p>	



**READ THIS BEFORE ANSWERING THE KEY QUESTIONS**

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	<b>Users Input 1</b>	Specialists can alter scale of key question specific scoring	Specialists can change key question specific importance	DO NOT CHANGE THESE AT ALL			<b>User's Input 2:</b> 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 SCHOOL	GUIDANCE NOTES+OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	Compliance Status <b>0-1</b>	Issue Imporatnce VI, I, LOW	Weighted Compliance C3XC4	Ideal Case	Compliance index	REFERENCES/REMARKS
<b>PLANNING</b>								0.22	
P1	Have you done (of referred to a) geological investigation report to know if there is an active major fault on or adjacent to your proposed school 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 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 Type 2, if the fault line is between 500m< 1000m away from the site Type 3, if the fault is > 1000m away from the site	1	0.75	VI	2.25	3		
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
<b>Multi Hazard compliance index</b>	<b>0.36</b>			
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
LOW	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

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

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

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"

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

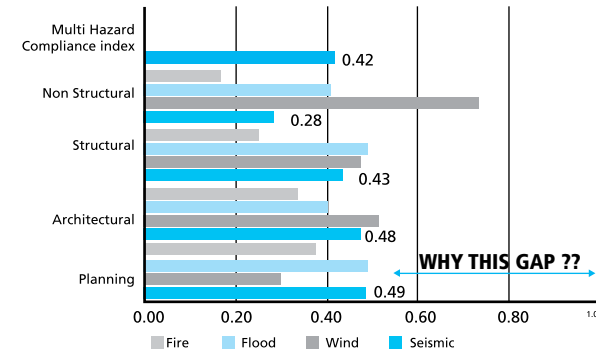
When a consultant answers all four CHECKLISTS , the compliance indexes will be automatically calculated

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

Compliance Summary for the Top Level Management



**G** The following list is automatically generated showing where gaps exist. This will show where to work on to enhance the category score (planning/architectural/structural/non-structural issues)

Special Note: The Compliance Level Cut Off is 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

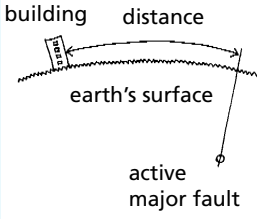

SEISMIC		WIND		FLOOD		FIRE	
ISSUES	Seismic compliance	ISSUES	Wind compliance	ISSUES	Flood compliance	ISSUES	Fire compliance
PLANNING							
P1	Type 1, if the fault line is <500m away from the site <u>0.15</u>	Type 5, if it is for pedestrian access only <u>0.05</u>	Type 1, if the damage potential is low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

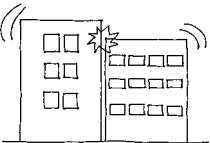
H	What is the way forward
	The top level management will have a documentary evidence on compliance index of the design
	It is a commitment from the consultant's side
	The same could be submitted to the local municipality for their record and commitment
	Top Level Management with this tool will be will 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 schools. Hard copies of only the relevant hazard checklists should be sent to the schools
	from this Book 1 on multi-hazard-safe new school design
	Special Note 4
	The information from the "REFERENCES/REMARKS" will be of great importance. This will not only provide school specific safety gaps,
	it will also bring forward nationwide pattern, if any, in the context of safety at macro level. This will help in policy reforms


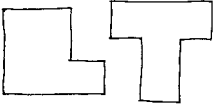
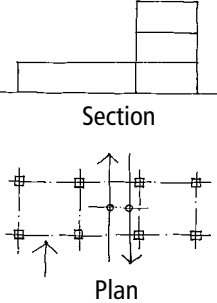


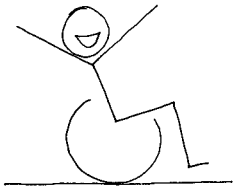
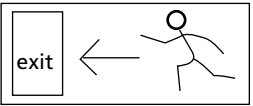
## ANNEXURE I: SEISMIC SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

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	<b>User's Input 1</b>	<b>User's input 2:</b> Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

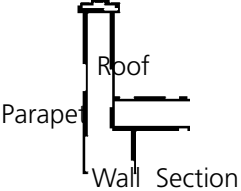
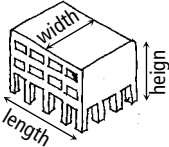
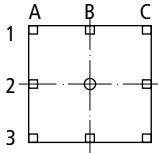
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
PLANNING				
<p style="text-align: center;">p1</p>  <p style="text-align: center;">building distance earth's surface active major fault</p>	<p>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 school site?</p> <p style="margin-top: 20px;">Special note: Consult local building department, State geologist, local university, or local geotechnical expert.</p>	<p>If you have done/referred to geologic investigations write the source in column "REFERENCES/REMARKS" and then choose one from the following options</p> <p>Type "NA" if geological investigation has been referred to , which shows that the issue of fault line is not applicable in your case</p> <p>Type 0, if you haven't done or referred to geological investigations for your site</p> <p>Type 1, if the fault line is &lt; 500m away from the site</p> <p>Type 2, if the fault line is between 500m -1000m from the site</p> <p>Type 3, if the fault line is &gt;1000m away from the site</p>		
<p style="text-align: center;">p2</p>  <p style="text-align: center;">Site plan showing access</p>	<p>An important aspect of safety of a building is the type of access road from main road to the site of the new school</p>	<p>Depending upon the type of access road to your site choose one from the following options;</p> <p>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</p> <p>Type 2, if there is one access road suitable for fire engine access &amp; movement</p> <p>Type 3, if access road is for cars and not fire engine</p> <p>Type 4, If the access road is suitable for motorbike only and not for cars</p> <p>Type 5, if it is for pedestrian access only</p>		

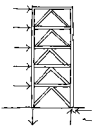
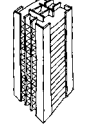
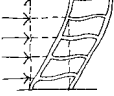

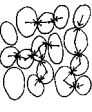
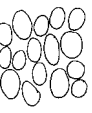
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>P3 Collapse of buildings had blocked many access roads in the old town of Bhuj, India (earthquake, 2001). It had made rescue and relief extremely difficult</p>	<p>During earthquake, buildings along the access road to your site may collapse and block it, thus affecting post earthquake evacuation and entrance for service</p>	<p>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</p> <p>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 school, unlikely to be blocked by falling buildings, power lines, etc.</p> <p>Type 2, Minimum effect i.e., if some of the neighbouring buildings may collapse, however, it will have minimum impact on evacuation</p> <p>Type 3, Medium effect i.e., if part collapse may take place, however, it will have medium impact on evacuation</p> <p>Type 4, Maximum effect i.e., if possible collapse of neighbouring buildings are likely to completely block the road from evacuation</p>		
<p>P4 Providing onsite backup for water, power gas, etc. is not adequate. They need housekeeping and periodic maintenance as well</p>	<p>Municipal utilities such as water is often disrupted in strong shaking. Therefore, onsite backups should provide 48 hours of use.</p>	<p>Additional systems increase the probability of a school remaining functional after disaster. Choose one from the following options</p> <p>Type 1, If in-house backup sources of water has been provided in the school for 24-48 hrs</p> <p>Type 0, If in-house backup sources of water has not been provided in the school for 24-48 hrs</p>		
<p>P5</p>  <p>Buildings too close may lead to pounding</p>	<p>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?</p>	<p>Write the distance (in meters) of the nearest building/structure from the school under consideration in column "REFERENCES/REMARKS"</p> <p>Type 1, if adequate gap has been provided to avoid pounding effect</p> <p>Type 0, if adequate gap not provided to avoid pounding effect</p>		

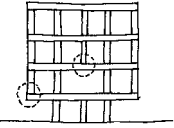
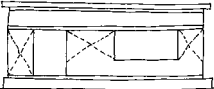
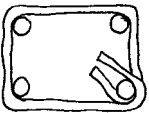
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>P6</p>  <p>Site plan showing open space</p>	<p>Whether open space is available in the school for children to assemble during/immediately after earthquake ?</p>	<p>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</p> <p>Type 1, if there is adequate open space for gathering</p> <p>Type 2, if there is open space, but not adequate for gathering</p> <p>Type 3, if there is no open space for available for gathering</p>		
<b>ARCHITECTURAL ISSUES</b>				
<p>A1</p>  <p>Plan forms such as T,L etc are irregular</p>	<p>Is the architectural/structural configuration irregular in plan?</p>	<p>Look at building plans &amp; assess the level of symmetry and then choose one from the following that is appropriate</p> <p>Type 1, if the shapes is regular, structure has uniform plan, and there are no elements that would cause twisting of building</p> <p>Type 2, if Shape is irregular but structure is uniform</p> <p>Type 3, if Shapes are irregular and structure is not uniform</p>		
<p>A2</p>  <p>Section</p> <p>Plan</p> <p>Two portions of the same building have different masses: vertical irregularity</p>	<p>Is there vertical irregularity in architectural/structural configuration?</p>	<p>Look at sections of the design &amp; assess the level of symmetry, e.g., having set backs, open first stories,etc., and then choose one from the following</p>		

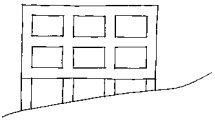
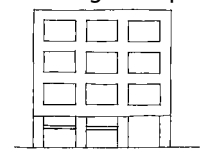
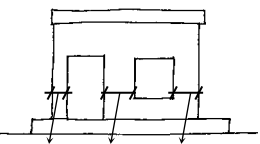
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
		Type 1, if storey heights are of very similar (i.e., they differ by < 5%); there are no discontinuous or irregular elements. Type 2, 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 	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		
Ramps to be provided for people to be wheeled out quickly				
A4 	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		
Wide corridor with signage for easy evacuation in emergency				
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 you have detailed glass in openings for drift of the structure Type 0, if you have not detailed glass in openings for drift of the structure		

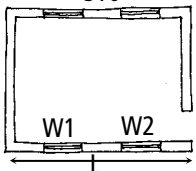
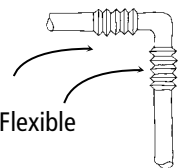



EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>A6</p> <p>If not fixed adequately, such tiles may come off during earthquake, making exit of the occupants unsafe or impossible</p>	<p>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?</p>	<p>Choose one from the following options</p> <p>Type NA, if this is not applicable</p> <p>Type 1, If the tiles are fixed to the walls with bolts or equivalent glue or other methods</p> <p>Type 0, If the tiles are not fixed to the walls with bolts or equivalent glue or other methods</p>		
<p>A7</p> <p>RCC band or equivalent as top arrester</p> 	<p>Are parapets securely attached to the building structure to stop it from falling during earthquake?</p>	<p>Unreinforced masonry parapets are especially vulnerable if the wall top is not secured</p> <p>Type NA if there is no parapet in your building</p> <p>Type 1, if the parapet wall has a RCC band on top with vertical reinforcements anchored to the slabs at regular intervals</p> <p>Type 2, if similar arrangement as RCC band provided to stop the parapet wall from falling</p> <p>Type 3, if parapets are not restrained at all</p>		
<p>A8</p> 	<p>Length/breadth ratio and Height/width ratio of the building within permissible limit as per code?</p>	<p>Mention the code name in the column "REFERENCES/ REMARKS"</p> <p>Type 1, if the length/ breadth/ height ratios are within safe limit</p> <p>Type 2, if the length/ breadth/ height ratios are marginally out of safe limit</p> <p>Type 3, if Medium level of variation of length/ breadth/ height ratio from safe limit</p> <p>Type 4, if major variation from safe limit of length/ breadth/ height</p>		
<p>A9</p>  <p>Good example: Building plan shows that the columns are in grid lines in both directions</p>	<p>Are the walls and/or columns provided in grid lines in each direction of the plan?</p>	<p>Choose one from the following options</p> <p>Type 1, if all walls and/or columns are in grid in both directions</p> <p>Type 2, if all walls &amp;/or columns are in grid in one direction &amp; some (&lt;15%) not in grid in other direction</p> <p>Type 3, if some walls &amp;/or columns are in grid &gt;15% but &lt;25%</p> <p>Type 4, if &gt;25% of walls and/or columns are not in grid</p>		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	<b>STRUCTURAL ISSUES</b>			
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 	Are you aware of Geotechnical set up of the areas (soil condition) & have you chosen structural system based on soil type & seismic zone	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";		
Shear walled structure 	If your site has soft/poor soil (<10 t/sqm)	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		
RCC frame structure 	If your site has medium soil (10-30 t/sqm)	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		
	If your site has hard soil (>30t/sqm)	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 earthquake: reduced interlocking forces in soil particles  During earthquake: 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 SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>S4</p>  <p>Section shows that the load path of the building is discontinuous- this is not desirable</p>	<p>Is there a continuous load path from all structural components of the building to the foundation?</p> <p>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.</p>	<p>Look at the drawings of your building, especially the sections and check</p>		
		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		
<p>S5</p>  <p>For seismic safety, a masonry building should have; 1. RCC bands at plinth &amp; lintel level 2. vertical reinforcements at wall junctions &amp; on two sides of each door/ window,</p>	<p>If the school is a Masonry Structure, have you provided vertical reinforcements &amp; horizontal bands in walls according to code?</p> <p>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</p>	<p>Have you provided seismic reinforcement in the masonry building as per the latest code? Mention the code no in column "REFERENCES/ REMARKS"</p> <p>Type "NA", if it is not a masonry structure</p>		
		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 reinforcements have been provided Type 4, If no horizontal band and vertical reinforcements provided		
<p>S6</p>  <p>Ductile detail enables a structure to undergo large deformation before failure. It gives adequate warning to the occupants before failure</p>	<p>Have you done the reinforcement detailing as per code to ensure ductility of the structure?</p>	<p>Choose one from the following options</p>		
		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		


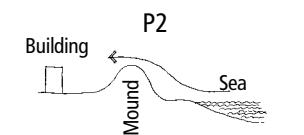
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>S7</p> <p>It is mandatory to consider seismic force on a building if it is in earthquake prone area. There are codes on seismic safety, e.g., IS 1893,2002 (Indian Code)</p>	<p>Has seismic load been considered in the building design?</p>	<p>Choose one from the following options</p> <p>Type "NA", if not applicable</p> <p>Type 1, If seismic load has been considered in design</p> <p>Type 0, If seismic load has not been considered in design</p>		
<p>S8</p>  <p>Different column heights: building on slope</p>  <p>Different column heights: mezzanine</p>	<p>Has Short column effect been considered in structural analysis and design?</p> <p>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</p>	<p>In framed structure, short column effect may be highly detrimental and hence, such effect must be considered in design</p> <p>Type "NA", if not applicable</p> <p>Type 1, if you have considered short column effect in the structure?</p> <p>Type 0, if you have not considered short column effect in the structure?</p>		
<p>S9</p>  <p>In masonry buildings, these should be at least 600mm</p>	<p>For Masonry buildings, the locations of doors &amp; windows are very important. Check if they are as per safety</p> <p>If not followed, there could be severe damage to the building</p>	<p>Each door or window should be at least 600mm away from wall corners. The space between two openings should also be at least 600mm. Choose one from the following options</p> <p>Type "NA", if not a masonry building</p> <p>Type 1, if doors, windows are at least 600mm away from wall corner and there is at least 600mm wide wall between two openings</p> <p>Type 0, if doors, windows are not 600mm away from wall corner and/ or there is &lt; 600mm wide wall between two openings</p>		
<p>S10</p>	<p>Check if the total width of doors and windows in a wall is <math>\geq</math> half the total wall length</p> <p>If this is not followed, there will be possibility of sliding of the portion of the wall above window sill</p>	<p>Add the door and window widths on a wall and check if it is <math>&gt;</math> the wall length. Choose one from the following</p> <p>Type "NA", if not a masonry building</p> <p>Type 1, If total door+window width in a wall is <math>&lt;</math> its wall length &amp; this is true for all walls of the building</p> <p>Type 0, If total door+window width in a wall is <math>&gt;</math> its wall length</p>		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<b>NON STRUCTURAL ISSUES</b>				
<p>NS1 S10</p>  <p>During earthquake plumbing lines may break and roof top water tanks may topple leaving no water for drinking</p>	<p>Are plumbing lines, rooftop/overhead water tank safely placed and anchored adequately</p>	<p>If there is no water supply then mention it in column "REFERENCES/REMARKS"</p> <p>Type 1, if plumbing lines &amp; rooftop/overhead water tank are adequately supported &amp; secured or there is a hand pump</p> <p>Type 0, if plumbing lines &amp; rooftop/overhead water tank are not supported &amp; secured or there is no water supply</p>		
<p>NS2</p> <p>During earthquake fire protection lines may break leaving no water for fire fighting</p>	<p>Is fire protection piping correctly installed and braced?</p>	<p>If fire protection piping does not exist, mention this in the column "REFERENCES/REMARKS". Choose one from the following options</p> <p>Type "NA", if fire protection piping does not exist</p> <p>Type 1, if fire protection piping correctly installed and braced</p> <p>Type 0, if fire protection piping not correctly installed and braced</p>		
<p>NS3</p>  <p>Flexible</p>	<p>Are gas lines to laboratories provided with flexible connection? Otherwise they can cause dangerous leaks &amp; may cause fire</p>	<p>If there is no lab in the school, mention this in the column "REFERENCES/REMARKS" Choose one from the following options</p> <p>Type "NA", if there is no lab.</p> <p>Type 1, if you have provided flexible joints and the lines are clamped at suitable points</p> <p>Type 0, if you have not provided flexible joints and the lines clamped at suitable points</p>		
<p>NS4</p> <p>This could be a falling hazard</p>	<p>Are suspended lighting fixtures securely attached, braced, or designed to stop sideways movement?</p>	<p>Choose one from the following options. If suspended lighting fixtures do not exist, mention this in the column "REFERENCES/REMARKS"</p> <p>Type "NA", if suspended lighting fixtures do not exist</p> <p>Type 1, if suspended lighting fixtures are securely attached and braced</p> <p>Type 0, if suspended lighting fixtures are not securely attached and braced</p>		

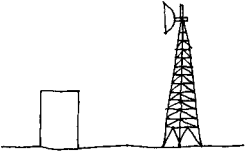
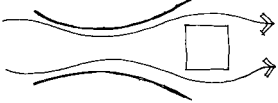
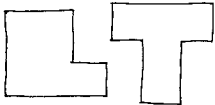
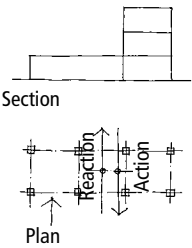
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON SEISMIC- SAFETY OF NEW SCHOOL	GUIDANCE NOTES + OPTIONS FOR ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>NS5 The generator, batteries, and other electrical equipment may slide/topple during earthquake, if not designed adequately</p>	<p>Is emergency generator and associated equipment secured against movement?</p>	<p>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</p>		
<p>NS6 Make sure that the anchorage, bracing and connections are adequate against horizontal force</p>	<p>Is fire alarm equipment secured against movement? Equipment can slide or topple, breaking connections.</p>	<p>if there is no fire alarm equipment in the school, 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</p>		
<p>NS7  Communication antenna: make sure that the anchorage, bracing and connections are adequate against horizontal force</p>	<p>Are communications components, including antennas, adequately secured for seismic forces?</p>	<p>if there is no such equipment in the school, 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</p>		

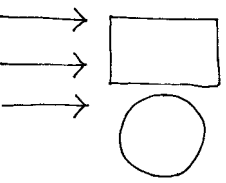
## ANNEXURE II: WIND SAFETY EVALUATION: FOR EASE OF FILLING ANSWERS TO KEY QUESTIONS, ONLY THE COLUMN A,B,C,D & J HAVE BEEN SHOWN HERE

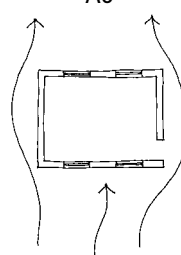
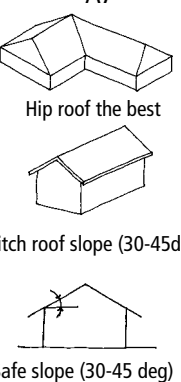
R E A D T H I S B E F O R E A N S W E R I N G T H E K E Y Q U E S T I O N S				
	User will read the following key questions in this column	Against each Key Question, the User will choose the appropriate answer from the given options shown in this column	User's Input 1	User's input 2: Follow the instructions in column C and type in the necessary information in this column
A	B	C	D	J

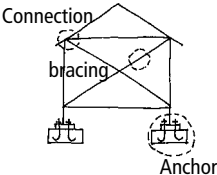
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	PLANNING			
<p>P1</p>  <p>Site plan showing access roads</p>	An important aspect of safety of a building is the type of access road from the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

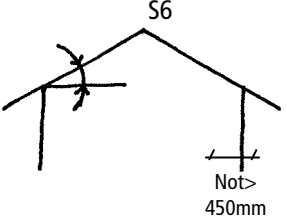
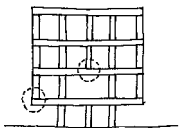


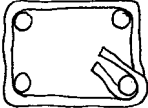
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>P3</p>  <p>Tower too close to the building</p>	<p>Are there trees and/or towers too close to the building that may fall on it during high wind/cyclone?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

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>A3</p>  <p>Uniform shapes presenting minimum obstruction to the wind</p>	<p>Does the building have a uniform shape presenting minimum obstruction to the wind</p>	<p>How does your building feature in this context? Choose one from the following options</p> <p>Type 1, if regular in plan and massing</p> <p>Type 2, if regular in plan and irregular in massing</p> <p>Type 3, if both plan and massing are irregular</p>	<p>3</p>	
<p>A4</p> <p>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.</p>	<p>Is the building suitably oriented considering the prevailing wind direction</p>	<p>In terms of orientation of the building what is your assessment on probable performance against wind forces</p> <p>Type 1, if good (building suitably oriented considering the prevailing wind direction)</p> <p>Type 2, if medium (building more or less suitably oriented considering the prevailing wind direction)</p> <p>Type 3, if low (building not really oriented considering the prevailing wind direction)</p> <p>Type 4, if very low (building not oriented considering the prevailing wind direction)</p>	<p>4</p>	
<p>A5</p> <p>It is important to have latches located for easy manoeuvring during high wind</p>	<p>Do the door and windows have a good and accessible latch?</p>	<p>Choose one from the following options</p> <p>Type 1, if both doors and windows have accessible and good latches</p> <p>Type 2, if some of the doors &amp; windows have accessible and good latches</p> <p>Type 3 if neither doors or windows have accessible and good latches</p>	<p>3</p>	

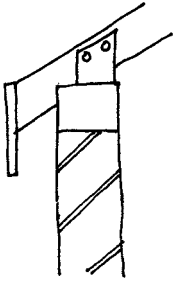

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>A6</p>  <p>Plan showing balanced opening on opposite walls</p>	Is there a balance of the size of openings on opposite walls	<p>Choose one from the following options</p> <p>Type 1, if good balance of the size of openings on opposite walls</p> <p>Type 2, if medium balance of the size of openings on opposite walls</p> <p>Type 3, if low balance of the size of openings on opposite walls</p> <p>Type 4, if very low balance of the size of openings on opposite walls</p>	4	
<p>A7</p>  <p>Hip roof the best</p> <p>Pitch roof slope (30-45deg)</p> <p>Safe slope (30-45 deg)</p>	<p>Have you used a pitch or hip roof?</p> <p>Roof pitch between 30-45 deg to minimize suction caused by negative pressure</p>	<p>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</p> <p>Type NA, if not applicable</p> <p>Type 1, if you have used a hip roof of slope &gt; 20deg</p> <p>Type 2, if you have used a pitch roof and the slope is 30-450</p> <p>Type 3, if you have used a pitch roof and the slope is 20-290</p> <p>Type 4, if you have used a pitch roof and the slope is &lt;190</p>	4	
<p>A8</p> <p>Ideally the entire building should be safe from missiles/debris. If not, then a few enclosures should be designed as shelter for the occupants during cyclone/high wind</p>	In places where missile/debris are highly likely to pound on a building, then have you built an enclosure to provide debris protection?	<p>Choose one from the following options</p> <p>Type "NA" if missile/debris are not likely to pound on the building</p> <p>Type 1 , if missile/debris are highly likely to pound on a building, and you have built an enclosure to provide debris protection?</p> <p>Type 0 , if missile/debris are highly likely to pound on a building, and you have not built an enclosure to provide debris protection?</p>	0	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>A9</p> <p>Suitable detail should be made to make sure that the storm shutter does not hamper easy handling of the glass shutters in normal circumstances</p>	<p>In case there is a possibility of occurrence of missile, have you provided storm shutters to protect the glass panes of the windows and openings?</p>	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	0	
<b>STRUCTURAL ISSUES</b>				
<p>S1</p> <p>The engineer should take account of the local conditions such as wind tunneling effect, obstructions reducing wind speed, etc.</p>	<p>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 coefficient, k2 terrain, height &amp; size factor &amp; k3 topography factor)</p>	Have you considered all the factors. If you have 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	0	
<p>S2</p> <p>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</p>	<p>Are there interior non-load-bearing walls? Unreinforced brick, concrete, and other types of masonry walls are vulnerable in wind load</p>	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	0	
<p>S3</p>  <p>ABC (anchorage, bracing and connection)- three prerequisites for wind safety</p>	<p>Have you considered A, B &amp; C (anchorage, bracing, connection) of safety in your design?</p> <p>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)</p>	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	4	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>S4</p> <p>Wind-borne debris can cause injury to the people during high wind.</p>	<p>Is there a covered walkway for building to building connection? Wind-borne debris can cause injury to the people during high wind.</p>	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	3	
<p>S5</p> <p>For large span structures such as gymnasium, auditorium, etc., one should consider the wind uplift forces in design and detailing</p>	<p>Do portions of the existing facility have long-span roof structures (e.g., a gymnasium)?</p>	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.	0	
<p>S6</p>  <p>If the overhang is &gt;450mm one needs to design for wind uplift</p>	<p>Are there existing roof overhangs that cantilever &gt; 450mm?</p>	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	0	
<p>S7</p>  <p>Section shows that load path of the building is discontinuous- this is not desirable</p>	<p>Is there a continuous load path from all components of the building to the foundation?</p> <p>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.</p>	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	3	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>S8</p> <p>The critical areas are the J bolt connections at the ridge line, hip lines, etc</p>	<p>Have you made sure that the roof covering elements such as tiles, corrugated galvanized iron sheets, etc., cannot be lifted off by wind</p>	Choose one from the following options		
		If not applicable type in "NA"		
		Type 1, if you have done design & detailing of roof covering for wind uplift		
		Type 0, if you have not done design & detailing of roof covering for wind uplift	0	
<p>S9</p> <p>Choice of materials and detailing are crucial</p>	<p>Are existing exterior walls resistant to wind-borne debris?</p>	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 detailing 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	0	
<p>S10</p>  <p>Ductile detail enables a structure to undergo large deformation before failure. It gives adequate warning to the occupants before failure</p>	<p>Have you done the reinforcement detailing as per code to ensure ductility the structure?</p>	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	3	
<b>NON STRUCTURAL ISSUES</b>				
<p>NS1</p> <p>Material specification and detailing are crucial</p>	<p>Have you designed the hinges, wind stays, latches, handles and bolts to ensure easy and low maintenance intensive openings that can be closed quickly</p>	Choose one from the following options		
		Type 1, if you have done design and detailing of hinges, wind stays, latches, handles and bolts of openings for high wind		
		Type 0, if you have not done the design and detailing of hinges, wind stays, latches, handles & bolts of openings for high wind	0	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	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	0	
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 (roof sheets, tiles, coconut, flower pots, garbage bins, small stones, etc). 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	0	
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	0	
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	0	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON WIND-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>NS6</p>  <p>Consider wind blow off effect while designing the flashing or coping</p>	<p>Does the existing roof have edge flashing or coping? Is it safe in high wind?</p>	<p>If applicable, have you considered the wind blow off effect in design and detailing?</p> <p>Type "NA", If not applicable</p> <p>Type 1, if you have considered wind blow off effect in design and detailing of edge flashing or coping of existing roof</p> <p>Type 0, if you have not considered wind blow off effect in design and detailing of edge flashing or coping of existing roof</p>	<p>0</p>	
<p>NS7</p>  <p>Communication antenna: make sure that the anchorage, bracing and connections are adequate against horizontal force</p>	<p>Are there antennae (communication masts) or satellite dishes anchored with structural part?</p>	<p>If yes, then have you designed the installations, ties, etc. for wind resistance?</p> <p>Type "NA", If not applicable</p> <p>Type 1, if you have designed the antennae (communication masts) or satellite dishes, ties, etc. for wind resistance</p> <p>Type 0, if you have not designed the antennae (communication masts) or satellite dishes, ties, etc. for wind resistance</p>	<p>0</p>	
<p>NS8</p> <p>Roof sheets, tiles, coconut, flower pots, garbage bins, small stones, etc., could act as debris</p>	<p>Is the emergency generator(s) housed in a wind- and debris-resistant enclosure?</p>	<p>If applicable have you built an enclosure to provide debris protection?</p> <p>Type "NA", If not applicable</p> <p>Type 1, if you have built an enclosure to provide debris protection for the emergency generators</p> <p>Type 0, if you have not built an enclosure to provide debris protection for the emergency generators</p>	<p>0</p>	



## 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

R E A D T H I S B E F O R E A N S W E R I N G T H E K E Y Q U E S T I O N S				
	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 SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	<b>PLANNING</b>			
<p style="text-align: center;">P1</p> <p>In coastal communities, even sites at some distance inland from the shoreline may be exposed to extreme storm surge flooding.</p>	<p>Is the site located in a storm surge inundation zone (or tsunami inundation area)? In coastal communities, even sites at some distance inland from the shoreline may be exposed to extreme storm surge flooding.</p> <p>If yes, then, make an assessment on damage potential due to storm surge based on historical data- consult the meteorology departments</p>	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	3	
<p style="text-align: center;">P2</p> <p>Consult local people for historical data- also consult the state geology department</p>	<p>Is the site located in a zone with possible water surge from glacial lake/lake casued by land slide or due to earthquake</p>	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	0	
<p style="text-align: center;">P3</p> <p>Refer to historical data for a safe decision</p>	<p>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.</p>	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	3	

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


EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	<b>ARCHITECTURAL ISSUES</b>			
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	3	
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)	3	
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)	0	
	<b>STRUCTURAL ISSUES</b>			
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?	0	

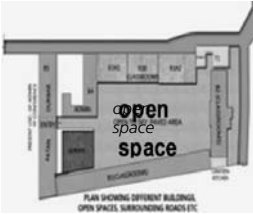
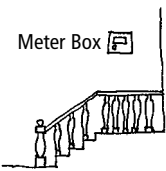
EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
S2 Waves can exert considerable dynamic forces on buildings and contribute to erosion and scour.	Is the site prone to wind driven waves, which can take place in the coastal areas, riverine areas and site next to lakes? Waves can exert considerable dynamic forces on buildings and contribute to erosion and scour.	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	0	
S3 If applicable, one can provide flood openings to automatically allow for inflow and outflow of floodwaters to minimize differential hydrostatic pressure	Does the school have enclosures below the flood elevation, meant for limited storage	Choose one from the following options If not applicable --> "NA" Type 1, if school 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 school 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?	0	
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	0	
S5 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 addressed adequately Type 0, if the issue of scouring has not been addressed	0	
<b>NON STRUCTURAL ISSUES</b>				
NS1 Critical facilities in schools 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	0	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FLOOD-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
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	1	
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? Is the tank openings and vents are elevated above the recorded elevation or the Design Flood Elevation?	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	1	
NS4 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		
NS5 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		
NS6 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 exist, 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	0	

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

R E A D T H I S B E F O R E A N S W E R I N G T H E K E Y Q U E S T I O N S				
	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

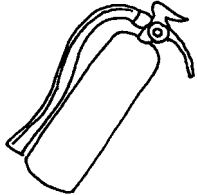

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
	PLANNING			
<p>P1</p>  <p>Site plan showing access roads</p>	An important aspect of safety of a building is the type of access road and safe entry for the school	<p>Depending upon the type of access road to your site choose one from the following options;</p> <p>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</p> <p>Type 2, if there is one access road of the above type</p> <p>Type 3, if access road is for cars and not fire engine</p> <p>Type 4, If the access road is suitable for motorbike only and not for cars</p> <p>Type 5, if it is for pedestrian access only</p>	5	
<p>P2</p> <p>Apart from site visit, the consultant should enquire about external fire hazards from local people and fire department's local office</p>	With reference to the exterior of the school building, rate the building's exposure to external fires.	<p>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</p> <p>Type 1, if very high (school's exposure to external fire)</p> <p>Type 2, if medium (school's exposure to external fire)</p> <p>Type 3, if low (school's exposure to external fire)</p> <p>Type 4, no exposure at all (school's exposure to external fire)</p>	4	

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>P3</p>  <p>Site plan showing open space</p>	<p>Whether open space is available in the school for students to get assembled during fire?</p>	<p>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</p> <p>Type 1, if there is adequate open space for gathering</p> <p>Type 2, if there is open space, but not adequate for gathering</p> <p>Type 3, if there is no open space for available for gathering</p>	<p>3</p>	
ARCHITECTURAL ISSUES				
<p>A1</p> <p>For two storey buildings the openings have to be on the corridor side</p>	<p>Have you provided two exit routes (even windows can be widened to use as escape routes) in each classroom</p>	<p>Choose one from the following options</p> <p>Type 1, if you have provided two escape routes in each classroom</p> <p>Type 0, if you have provided only one escape route in each classroom</p>	<p>0</p>	
<p>A2</p> <p>If yes, then consider relocating it</p>	<p>Is the main meter box located in the staircase block?</p>	<p>Mention in column "REFERENCES/REMARKS", if there is no electricity. Choose one from the following options</p> <p>Type NA, if there is no electricity</p> <p>Type 1, if you have located the main meter box in the staircase block</p> <p>Type 0, if the main meter box is located in safe location</p>		
<p>A3</p>  <p>If yes, then consider relocating it</p>	<p>Is the main switch located in the main entrance lobby/ passage/ corridor?</p>	<p>Mention in column "REFERENCES/REMARKS", if there is no electricity. Choose one from the following options</p> <p>Type NA, if there is no electricity</p> <p>Type 1, if main switch is in the entrance lobby</p> <p>Type 0, if main switch is located in safe location</p>		
<p>A4</p> <p>Keep away possible sources of fire, e.g., kitchen, meter box, main switch, etc. from the staircase</p>	<p>Is the the existing staircase adequately protected for safe evacuation during fire?</p>	<p>Choose one from the following options</p> <p>Type "NA", if there is no staircase</p> <p>Type 1, if the existing staircase is adequately protected for safe evacuation during fire</p> <p>Type 0, if the existing staircase is not protected for safe evacuation during fire</p>		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
A5 It should be placed at maximum distance from the main staircase	In case of a multistorey, is there a fire escape staircase?	Suggestion: keep the fire escape stairs at maximum distance from each other		
	Use signnages	Type NA, if not applicable		
		Type 1, if there is a fire escape at maximum distance from main stair		
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	Choose one from the following options		
	Use signnages	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 school, have you 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		
A8 Appropriate space planning to be carried out to ensure that the doors opening to the corridors are safe for children's movement	Do the doors open outside?	Choose one from the following options		
		Type 1, if doors open outside		
		Type 0, if the doors open inside		
A9 Resolve this problem in site planning - consider future expansion of the school	Is the kitchen located at a safe distance from classrooms	If there is no kitchen mention this in the column "REFERENCES/REMARKS" -Choose one from the following options		
		Type "NA" if there is no kitchen		
		Type 1, if kitchen is at a safe distance from classrooms		
		Type 0, if kitchen is not at a safe distance from classrooms		



EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>A10</p> <p>The architect should choose appropriate materials and detailing of the false ceiling. The supporting metal structure to be provided with fire retarding coat</p>	<p>Is the ceiling material safe from fire?</p>	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			
<p>S1</p> <p>Take special care for steel and timber members</p>	<p>Have you used less fire prone materials? Or else has the structural members been insulated to protect it in the event of fire?</p>	Did the designser provide 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			
<p>NS1</p> <p>Use only national standard's approved products and also based on past experience</p>	<p>Is the quality of wiring used of adequate quality</p>	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		
<p>NS2</p> <p>Use earthing pit of 1mX1mX2.5m deep installed with Galvanized cast Iron Plate. Alternatively, one may use specifications as per the local practice</p>	<p>Has earthing been done in the wiring system?</p>	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		

EXPLANATIONS/ SKETCHES	KEY QUESTIONS ON FIRE-SAFETY OF NEW SCHOOL	GUIDANCE NOTES + POSSIBLE ANSWERS TO KEY QUESTIONS	Answer As per Guidance	REFERENCES/REMARKS
<p>NS3</p> <p>Your building may not need it, if there are adjacent buildings provided with lightning bars</p>	<p>Has Lightning arester been fixed in the building</p>	<p>Choose one from the following options, mention in column "REFERENCES/REMARKS", if there is no electricity</p>		
		Type "NA" if no electricity		
		Type 1, if Lightning arrester been fixed or there is a nearby tall building with lightning bar or a tower		
		Type 0, if Lightning arrester not been fixed		
<p>NS4</p> <p>If yes, then consider relocating it</p>	<p>Is the emergency batteries such as Inverter located near the entrance to the building?</p>	<p>Choose one from the following options</p>		
		Type NA if not applicable		
		Type 1, if emergency batteries such as Inverter located safely in the building		
<p>NS5</p>  <p>Strap them adequately with the walls</p>	<p>Is there a fire fighting arrangements/ extinguisher kept at convenient place for fire fighting, especially in the Chemistry lab</p>	<p>Choose one from the following options</p>		
		Type 1, if a fire extinguisher kept at convenient place for fire fighting, especially in Chemistry lab		
		Type 0, if there is not fire extinguisher in the building, especially in Chemistry lab		
<p>NS6</p> 	<p>Is there a provision for fire alarm?</p>	<p>Choose one from the following options</p>		
		Type 1, if there is provision for fire alarm		
		Type 0, if there is no provision for fire alarm		

## ENDING REMARKS

This is School 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**

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.

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

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

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

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