Guideline on

Non-Structural Mitigation Measures in Schools

GUJARAT INSTITUTE OF DISASTER MANAGEMENT
BUILDING RESILIENCE

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Gujarat Institute of Disaster Management

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Training Module on Guideline on Non-Structural Mitigation Measures in Schools

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Designed by: Shilpa Boricha, Librarian cum Asst. Manager, GIDM

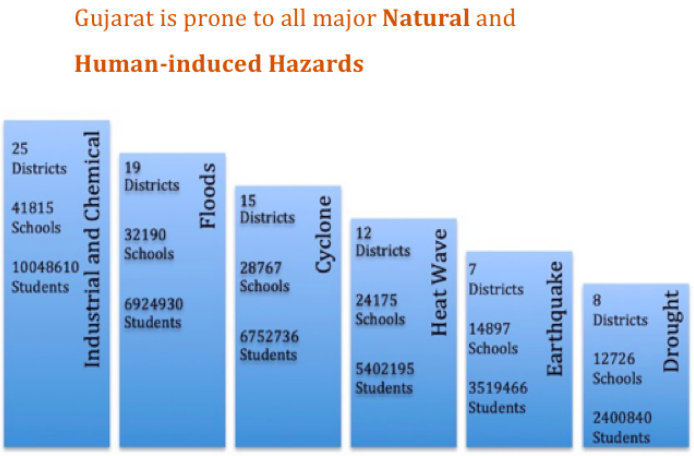
Content

Introduction

Background

Schools are the most important institutions influencing the development of a country and are primarily entrusted with the responsibility of creating the citizens of tomorrow. Creating a safe learning environment for our nation's children under the ambit of schools' safety is one of the key tasks. However, as a matter of fact, in our country the school children and school buildings have been greatly affected by natural hazards and human-made events like the stampede in Dabwali (1995), Kumbhakonam fire tragedy (2004), Bhuj earthquake (2001), Jammu & Kashmir earthquake (2005), and Bihar Mid-Day Meal Incident (2013) etc. Further, in recent times the cases of security negligence and violence inside the school campus have also increased (Ex: Ryan School, New Delhi), which have also highlighted the importance of safety & security in schools.

Like many other States in India, Gujarat is prone to various hydro-meteorological, geological, industrial, human-made and biological hazards like earthquakes, floods, droughts, cyclones, heatwave, chemicals, transportation / road accidents, epidemics, etc.



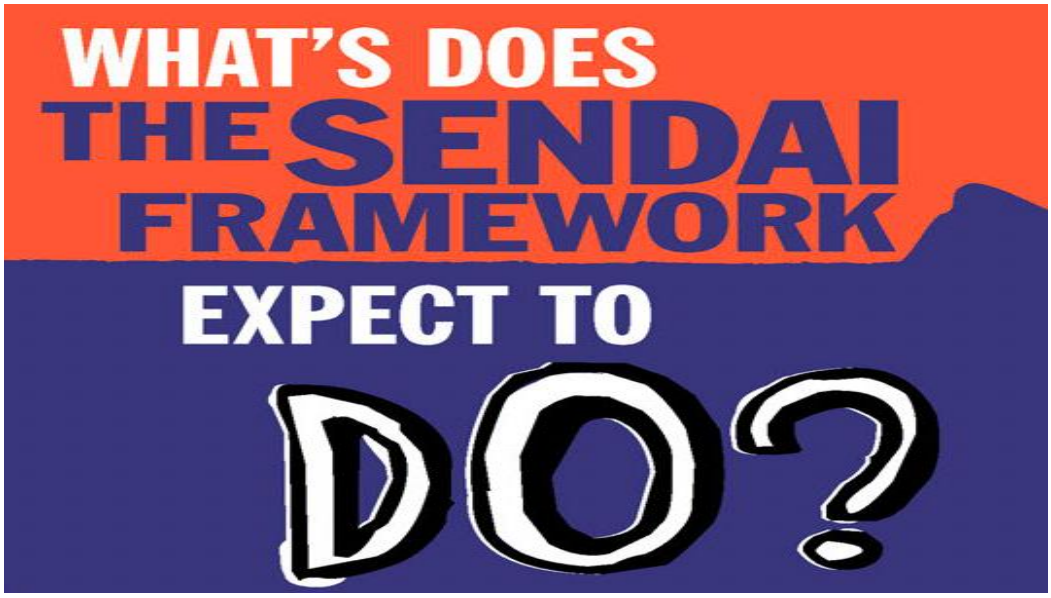
- **Floods** of 1979, 1993, 1994, 1996, 1997, 1998, 2005, 2006, 2014, 2015, 2016, 2017, 2018, 2019
- **Cyclones** of 1975, 1976, 1981, 1982, 1983, 1996, 1998, 1999, 2010, 2014, 2015, 2018, 2019, 2020
- **Droughts** of 1973, 1984-1987, 1999-2000, 2001-2002, 2012-2013, 2016
- **Earthquakes** of 1956, 1970, 2001
- **Plague, Hepatitis B, Swine flu** outbreak of 1994, 2009, 2015 respectively
- **Fire** outbreak of 2013, 2019
- **COVID-19** Pandemic

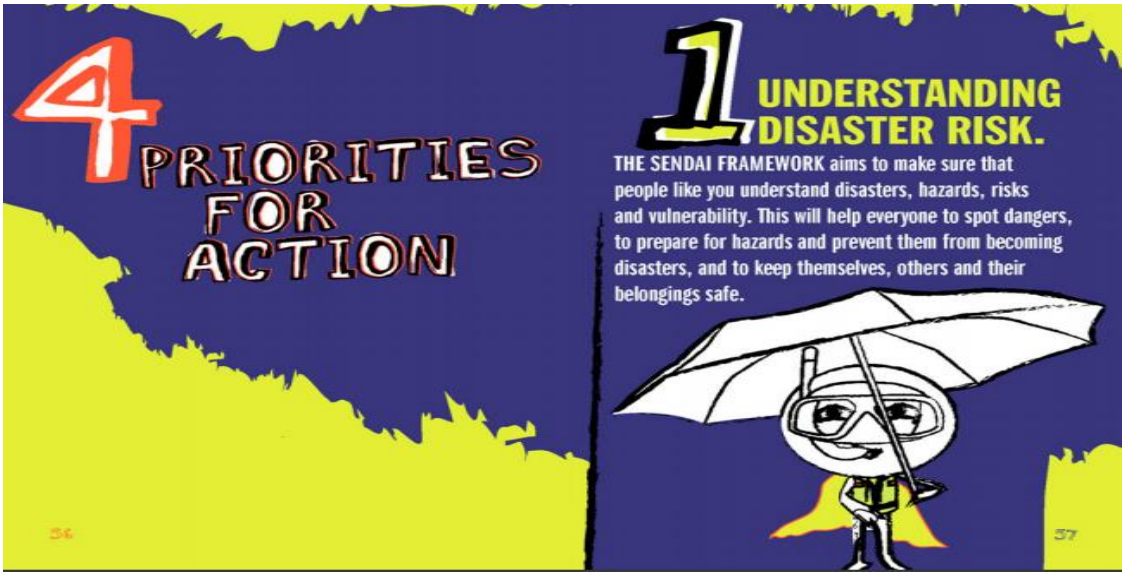
The devastating Bhuj Earthquake of 2001 resulted in the death of 921 students and 31 teachers, collapse of 1,884 school building, loss of 5,950 classrooms, 11,761 school buildings suffered major to minor damages, additional 36,584 rooms unfit for holding instruction sessions.[1]

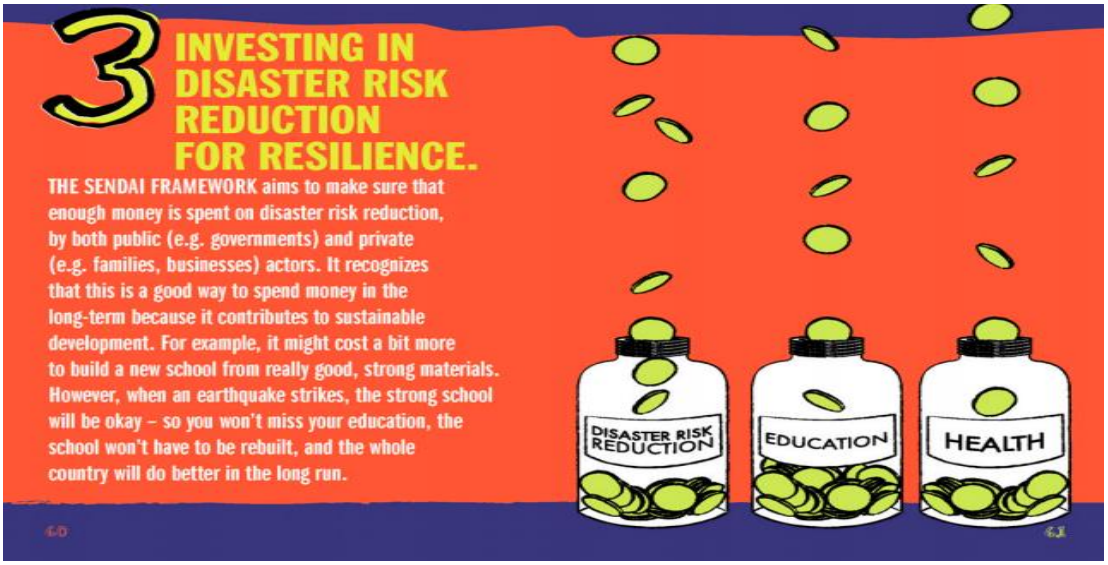
A safe and secure environment in & around the school is a prerequisite for effective

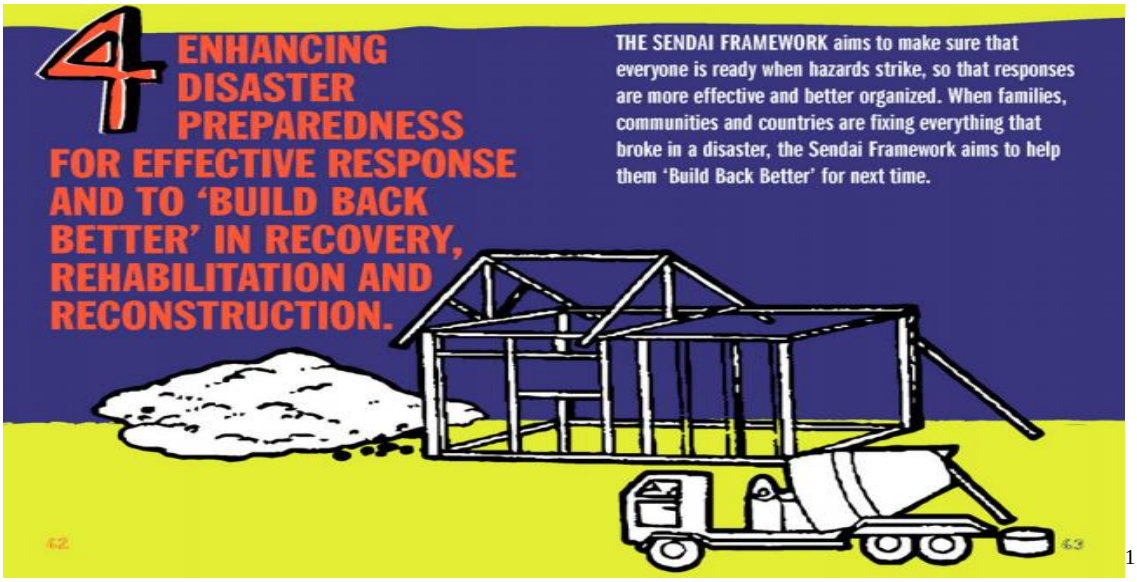
teaching and learning. Amongst all the public facilities, children in schools are most vulnerable groups during any extreme event / situation. Hence, the importance of school safety is gaining momentum since disasters and unprecedented events related to safety & security in schools are on the increase. School Safety has been defined as the creation of safe environments for children starting from their homes to their schools and back, in a comprehensive manner.

The Sustainable Development Goals and Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 reflect school safety concerns at the global level. In India, these international pacts acted as a catalyst in adopting the National Disaster Management Plan (NDMP).





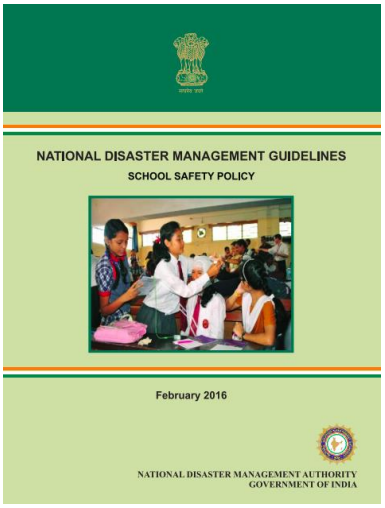




[1]

[1] https://www.preventionweb.net/files/46959_cfsfdrrforwebrasterizedsm.pdf

Guidelines on School Safety Policy in 2016 with a vision of safety of school children. This is a mandatory requirement to be implemented in each of the schools in the country. These guidelines spell out the roles & responsibilities of all concerned stakeholders for preparing plans, capacity building, risk reduction, coordination and synergy at all the levels.



The State Governments/UTs are directed to prepare a State specific action plan along with time frame for implementation of the Guidelines and submit the in stipulated plan with the timeline to the Department of School Education and Literacy, MHRD and NDMA. Further, MHRD has also issued necessary instructions to each of the States to for ensuring adherence and compliance of the aforesaid guidelines.

The School Safety Programme aims to reduce the risks of all potential hazards to protect students and educators from death, injury and harm in and around the schools. It rests on two pillars, including disaster risk education and safe school facilities & safe environment, and protection from violence & other forms of abuse.

Purpose

The primary intent of this document is to explain the identification of potential hazard associated with non-structural components of school building and its campus. This guide has also provided information on effective methods of reducing the potential risks. The guidelines are primarily for the use of Principals, teachers, students, staff, etc.

Its purposes are:

- To guide administrators and staff in identifying potential non-structural hazard and disaster risks.
- To carry out physical mitigation measures and presumes that the advice will be applied wisely and expert assistance will be obtained where necessary.
- To develop skills and provisions for non-structural disaster mitigation.
- To mitigate non-structural components, risk with relatively low cost and within the existing capacities of the school management.

Mitigation

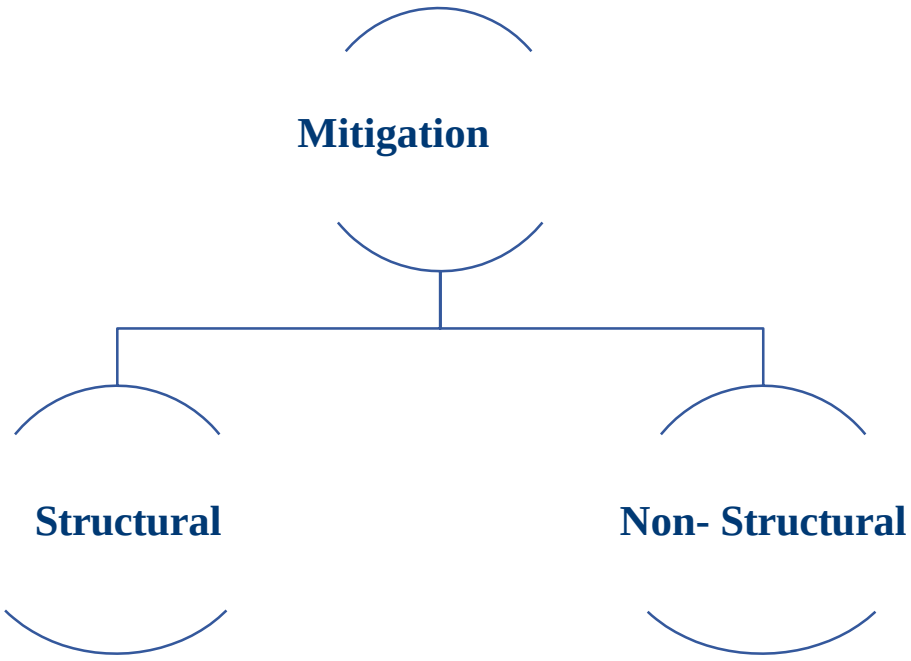
Introduction

Mitigation can be defined as "The lessening or minimizing of the adverse impacts of a hazardous event."[2] The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness.

Mitigation reduces the impact of hazards by supporting protection and prevention activities, easing response, and speeding recovery to create better- prepared and more resilient communities.

Types

Mitigation is divided into two types i.e. structural and non-structural.



[2] https://www.undrr.org/terminology/mitigation

What are structural elements?

The structural elements of a building carry weight of the building itself, the people and the things inside and the forces of nature. These "load bearing" elements include the frame (columns, beams) and in masonry or construction also the "shear walls". School needs to check for structural elements withstand hazard like earthquake, flood, cyclone, tsunami or another hazard they are prone to. It should be certified by the relevant government authorities/engineers on the basis of the standards of National Building Code (NBC). A basic awareness on typology, load travel path, construction, material, damage to building, similar basic information.

What are non-structural elements?

The "non-structural elements of a building do not carry the weight of the building, and include windows, doors, stairs, partition walls, pipes and ducts. They include building contents that users bring with them such as furniture, appliance, coolers, water tanks, etc. In other words, non-structural elements are those which are either attached to building or kept in building. The school is prone to non-structural hazards 'on site' and 'off site'

There are some other elements which are not actually part of building – attached to it or placed in it within the school campus or not part of load travel or bearing. Such as open wall, no fencing, no grab bar. These elements are of course doesn't directly form of seismic hazard but increases threats to students and staff or in other word form and add certain degree of vulnerability. These threats are also to be dealt appropriately. Removal of these elements does not solve purpose but it is important to learn., that what safety measures can be adopted so that it becomes a fully-fledged resource and no way a threat. [4]

Within school building

- For ensuring mass evacuation dimensions of halls and staircase
- Smoke in the hallway
- Doors and windows opening inward
- Glass panes
- Electrical wires
- Tall bookcases or cabinet not properly secured to the wall
- Areas where flammable liquids are stored-science labs
- Fire extinguishers
- Other movable, falling and blocking hazards

Outside school building

- Power lines
- Trees
- Parapets, roof tiles, glass etc.
- Routes past concrete walls
- Rivers, seacoast, main roads, market place, inflammable goods storehouse, a bus stand, railway tracks etc.
- Open well
- Fencing
- Ramp, grab bars, etc.

Structural Mitigation

Definition

The United Nations for Disaster Risk Reduction defines Structural measures as "Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems"[5]

The "structural elements" of a building carry the weight of the building itself, the people and the things inside, and the forces of nature. Common structural elements for buildings include "load-bearing" elements such as frame (columns, beams) and in masonry or construction also the "shear-wall". School needs to check for structural validity to withstand hazard like earthquake, flood, cyclone, tsunami and other hazards. The relevant government authorities/engineers on the safety standards should certify it.

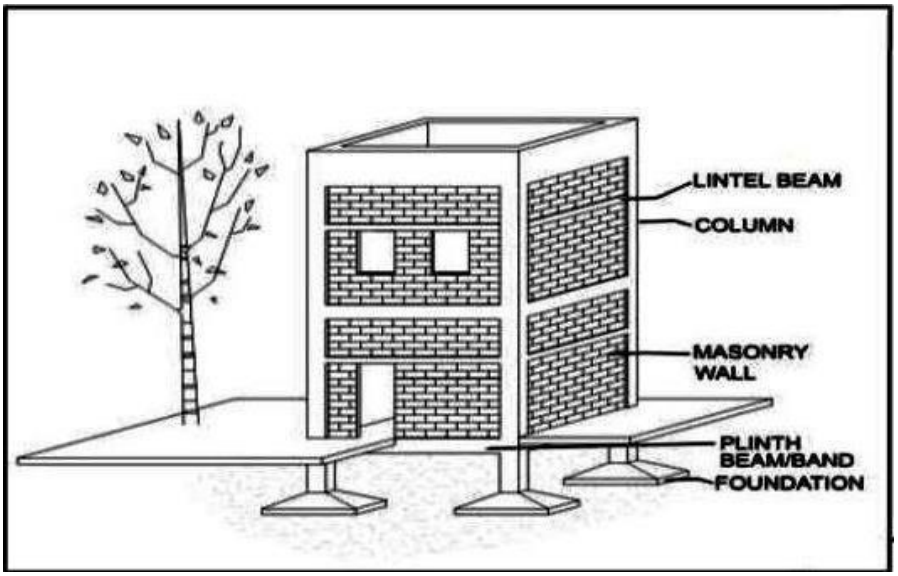


Figure 1 Common structural components in building.

Structural Components of Building

Various aspects of the building such as geographic location, structure, design, age etc. determine the structural hazard that can cause injuries or losses. The structural components such as foundation, design and construction of a building can increase or decrease school's vulnerability in case of any hazard. Ideally, structural safety measures need to be taken in the course of school site selection and school construction, retrofit or remodeling. Following are

the few lists of structural components of building which may cause be the cause of risk:

- Foundation
- Load bearing system
- Building height
- Design as per the occupancy
- Construction detailing
- Water damage

Know Your Building

All structures and materials are degraded and destroyed with times. The only thing which varies is the time-scale of the degradation. A sandcastle on the beach can perhaps survive for a few hours whereas the breaking down of the mountain can take billions of years. To understand the structural risk of the building, the simple parameters are given with a help of which anyone can assess the building by collecting the information on following parameters:

Geographical Area of Building Construction

- Coastal Area
- Desert area
- River bank area
- Flood prone area
- Rural & Urban
- Nearby Industrial area or Hazardous industries

Foundation and Soil

- Marshy soil
- On a steep slope
- Below or on a landslide-prone slope
- In a flood plain or stream bed

Earth Quake Zoning of Building Construction

- Zone II
- Zone III
- Zone IV
- Zone V

Roofing pattern

- RCC
- Tile
- Cement or Asbestos sheet
- Wooden

Types of Structure

- RCC Frame
- Brick Masonary
- Wooden
- Mud Construction
- Confined Masonary

Age of the Building

- Less than 5 years
- 5-10 years
- 11-20 years
- 21-50 years
- More than 50 years

Damage

- Rainwater leaks from roof inside the building
- Interior dampness
- Exposed reinforcement bars
- Carcks on walls and roofs
- Flaking of plaster

Building Insurance

- Yes
- No

Non-Structural Mitigation

Definition

The Non-Structural elements of a building do not carry the weight of the building, and include windows, doors, stairs, partition walls, pipes and ducts. They include "building contents" that users bring with them such as furniture, appliances, coolers, wat tanks, etc. In other words, non- structural elements are those, which are either attached building or kept in building. The school is prone to non-structural hazards -on site and -off sit the other elements, which are not the part of the actual building but placed within the school campus are open well, no fencing, no grab bar etc. These elements do not form direct hazard but increases threats to students and staff. Removing them will not solve the purpose. However, it is important to learn what safety measures can be adopted so that it becomes fully-fledge resource and not a threat.

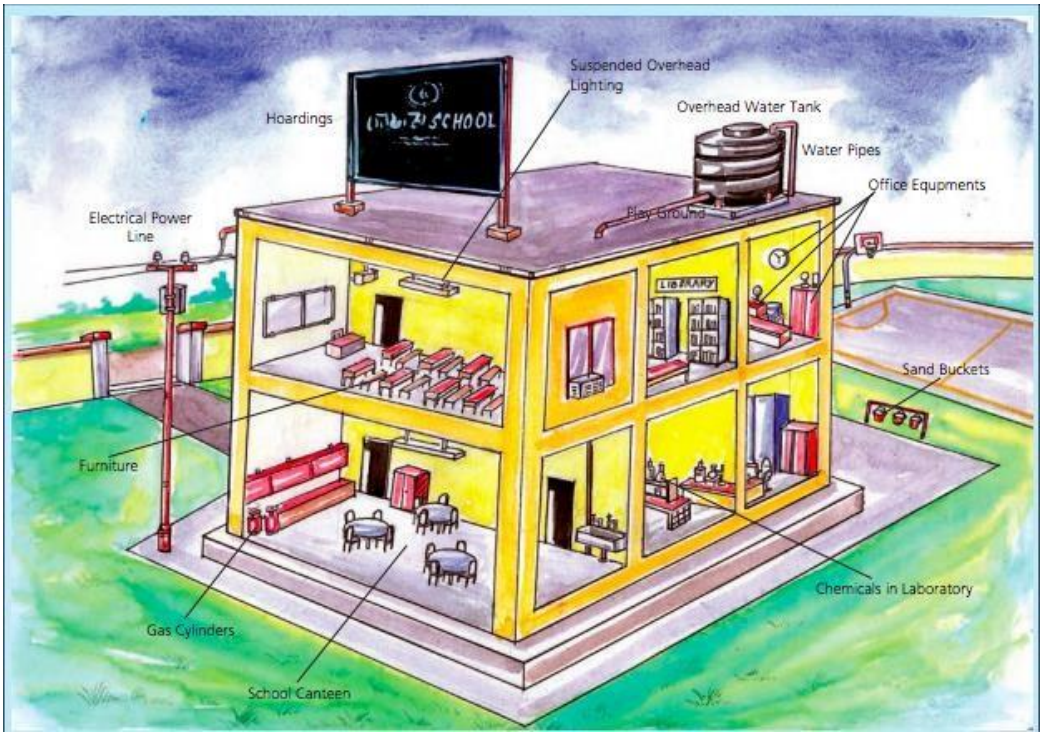


Figure 2. Common non- structural components in building.
Source: NIDM training module for Master Trainers on School Safety

As per The United Nations for Disaster Risk Reduction, non-structural mitigation measures also include "any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public

awareness raising, training and education".[6]

Non-Structural Components

Non-structural components are those which are attached to or housed in a building or building system, but are not part of the main load-resisting structural system of the building. Non-structural components can be classified under three groups based on their use and function, namely:

1. Contents of buildings: Items required for functionality enabling the use of spaces, such as (i) furniture and minor items, e.g., storage shelves, (ii) facilities and equipment's, e.g., refrigerators, washing machines, gas cylinders, TVs, multi-level material stacks, false ceilings, generators and motors, and (iii) door and window panels and frames, large-panel glass panes with frames (as window of infill walling material), and other partitions in buildings
2. Appendages to buildings: Items projecting out of buildings or attached to their exterior surfaces, either horizontally or vertically, such as chimneys projecting out from buildings, glass or stone cladding used as facades, parapets, small water tanks rested on top of buildings, sunshades, advertisement hoarding affixed to the vertical face of the buildings or anchored on top of the building, and small communication antennas mounted atop buildings. Thus, some of these are architectural elements, while the rest are functional.
3. Services and utilities: Items required for facilitating essential activities in the buildings, such as plumbing lines (e.g., water supply mains, sanitary pipelines, rainwater drain pipes and gas pipelines), electricity cables, and telecommunication wires from outside to inside of building and within the building, air-conditioning ducts, elevators, fire hydrant systems (including water pipes through the buildings). Non-structural components are popularly referred as non-structural hazards as they have been the cause of a huge number of avoidable injuries and deaths during disasters. Typical examples of non-structural damage include: brick chimneys and parapets falling away from the building; ceiling tiles and light fixtures falling; exterior glass windows cracking; spilling contents of shelves; breakage and leakage of pipes, including sprinkler pipes, gas pipes, water pipes and sewerage; building utility equipment sliding off from their supports or overturning etc. There are many ways that risks posed by Non-structural components can be reduced. These range from simple solutions that one can do oneself to complex solutions that require professional help. The process of risk reduction of Non-structural components is called Non-Structural Mitigation (NSM). Though there is very less or scope for the teachers and students to work directly on structural issues but has a major stake in dealing with non-structural elements.
4. Any building including schools have locations (within and outside the building) with several non-structural components that can cause injuries or losses in future unless these are mitigated. Following

are the few lists of non-structural components of building which may cause be the cause of risk:

➢ Within the school building:

- Furniture and Fixture
- School Equipment (Electrical, Electronics, Gaming)
- Utensils
- Electricals wirings (Open or Pipe fitting)
- Show case, frames & notice boards
- Storage cabinet (In the Wall, Outside of the wall)
- Laboratory Material (Chemicals, Microscope, Beaker/Test Tube etc.)
- Cupboard/ Shelves
- Doors and windows opening inward
- Glass panes
- Tall bookcases or cabinets not properly secured to the wall
- Areas where flammable liquids are stored – science labs
- Fire extinguishers
- Other movable, falling and blocking hazards

Figure 3. Pictures showing falling hazards in building.

Source: NIDM training module for Master Trainers on School Safety

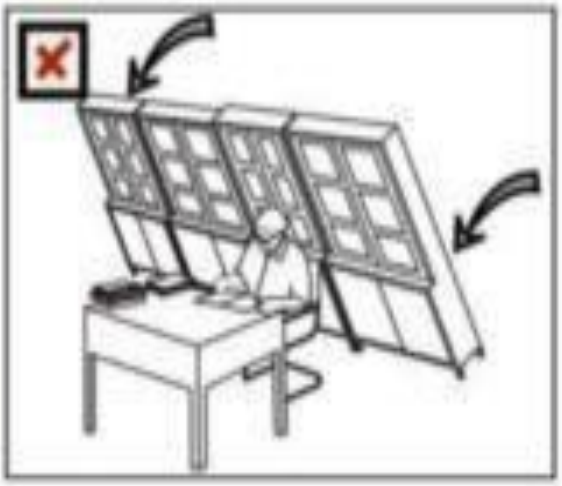
Figure 4 Picture showing the heavy storage items on shelves and unanchored sound equipment.

- Hazard outside the school building:
    - Power lines
    - Trees
    - Parapets, roof tiles, glass etc.
    - Routes past concrete walls
    - Rivers, seacoast, main roads, market place, inflammable goods storehouse, a bus stand, railway tracks etc.
    - Open well
    - Fencing
    - Ramp, grab bars, etc.

Figure 5 Picture showing non-structural hazard from trees outside the school buildings.

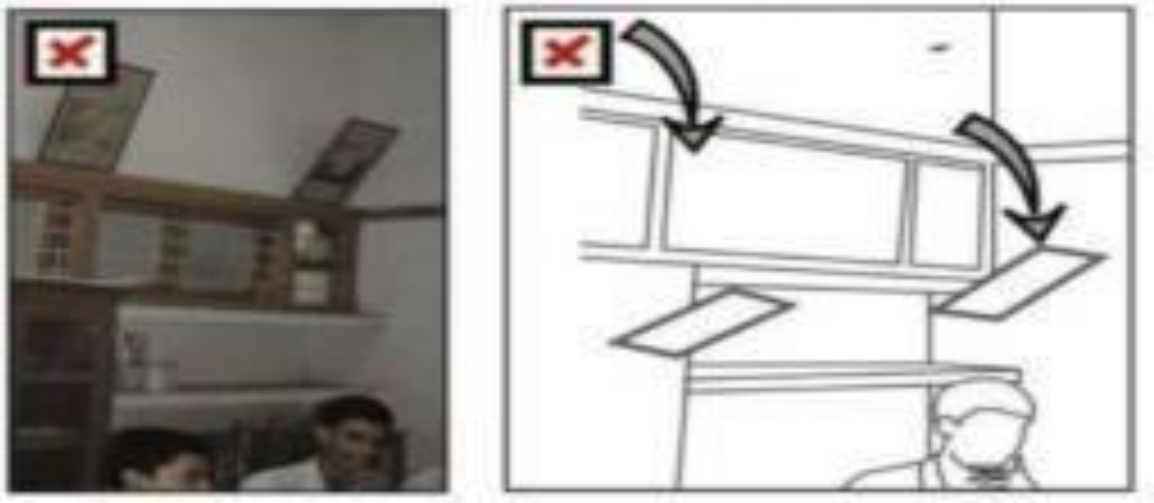
Non-Structural Hazards

- Hazards inside the building
- Heighted or low width items may fall



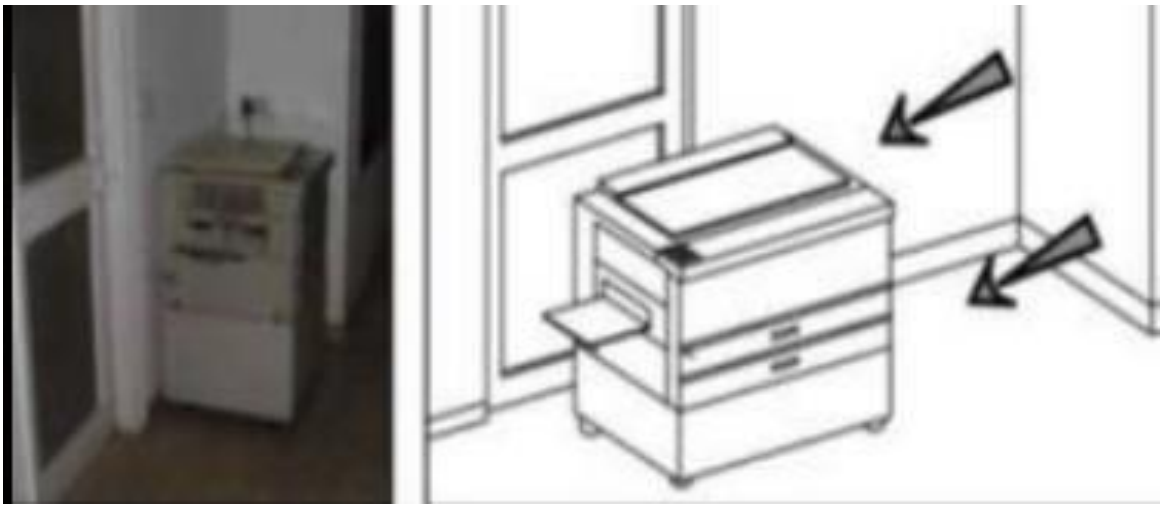
Heighted furniture and shelves with heavy stuff placed in the upper racks rather than the lower part can easily overturn to the front, back or in sides.

- Hanging objects or roof tiles can fall



Objects hanging to the roof or placed at height such as ceiling fans, photo frames, trophies etc. in racks may fall and can cause damage to life and property.

- Items with wheel can be rolled



Furniture or equipment with wheels can roll and objects can be slipped from the smooth surface. This may cause damage to valuable items and block the exit pathways.

- Items may collide with each other

Objects can collide and cause damage such as chemical bottles in lab may collide and cause fire. Small or glass objects may fall down and scattered posing a serious threat.

- Corridors, Doorways and Exit Paths are obstructed

  Exit pathways and evacuation routes can be obstructed due to items such as shelves, racks etc. placed in way or fall down of false ceiling etc.

- Components outside the building.

- Old and big trees may fall

  Old trees and its branches around the building may fall over the building.

- Building elements may fall

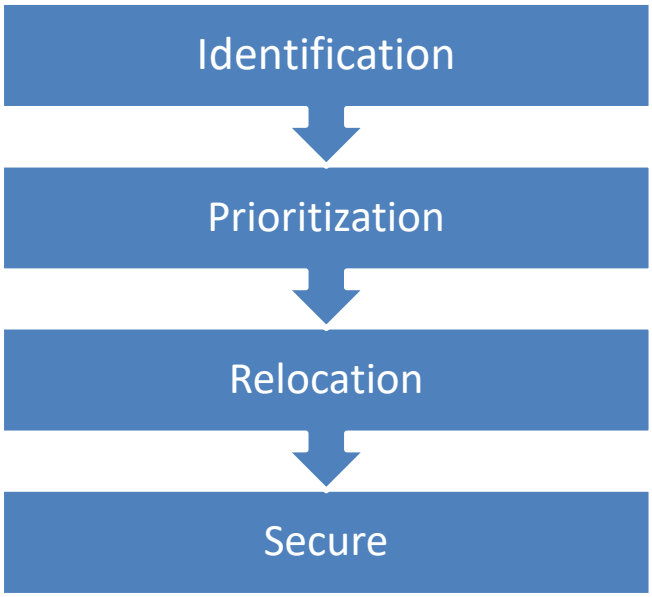
  Items such as parapets, roof tiles or glass may overturn or fall. Glass on Notice Boards can break during earthquake shaking. In addition to the hazards associated with falling notice boards, glass pieces may fall around, injuring persons and hindering smooth evacuation.

- Electric board dislodged

Electric Boards are usually placed outside the building. If these are not anchored properly, they could get dislodged causing short circuits, sparking and fires. Being located close to the exits, such fires can prevent evacuation and lead to undesirable consequences.

Non-Structural Mitigation Process

Non-Structural mitigation is a four-step process, which includes:



Source: Manual on Non-Structural (Falling Hazards) Mitigation for Schools; DEPARTMENT OF DISASTER MANAGEMENT MINISTRY OF HOME AND CULTURAL AFFAIRS ROYAL GOVERNMENT OF BHUTAN

1. Identification

First step is to identify and prioritize local hazards such as fire, earthquake, flood etc. next step is to further assess non-structural hazards/components associated with your buildings. This identify the type of threat that each item can produce, depending on the attribute. For earthquake safety think about objects that may slide, fall, or fly, and especially anything that can cause injury or block exits. For cyclone/high winds safety think about objects that can be torn away, fly away or be battered by wind outside.

The 2016 School Safety Policy Guideline issued by National Disaster Management Authority (NDMA) talks about the tool/exercise ‘Hazard Hunt’ that may be used to conduct the process of identifying needs in a participatory manner.

Hazard Hunting: a tested method in identify risks, both inside and outside the school precincts that may threaten the safety of the school community; a tool for identifying safety needs of the school though a participatory methodology involving students, teachers, and School Management Committee (SMC) members. The exercise culminates with the articulation of a well-defined micro- plan that is then pursued with the PRIs for leveraging resources from various schemes besides SSA A Hazard hunt exercise involves identifying all kinds of hazards including those that could cause physical harm such as deep potholes, a lack of a boundary wall, contaminated water sources, absent or inadequate toilets and hand-washing facilities; as well those factors that are outside the school like fast moving traffic on the road outside, low-lying access-ways that are prone to flooding during monsoons; improper location of electricity panel in the school, open electricity panels, live wire if any, improper placing of cupboards and furniture, obstruction in the escape route or object that can fall during the Earthquake such as glass panel, flowerpot etc.

Suggested format for documentation of Hazard Hunt exercise

List of Vulnerabilities that exist inside and outside the school	Risks involved	Probable Extent of Severity	Any past incident(s) relating to this risk, vulnerability

Source: NDMA Guidelines, School Safety Policy 2016

2. Prioritization

Prioritize the items as follows:

- Priority 1: secure items that can kill, injure, or block exits (e.g., heavy equipment, pipes, storage tanks, overhead lights, bookshelves, hazardous chemicals, things blocking exits).
- Priority 2: secure things can cause significant economic or cultural loss, cause injury, or impair educational continuity (e.g., computers, audio-visual equipment, school awards, and breakables).
- Priority 3: secure things that, if damaged, can impede recovery.

3. Relocation

After finalizing the priority, the items needs to be relocated and shifter to a better place where changes of damage to item and by the item is minimum. The items in the evacuation routes, exit pathways and corridors needs to be shifted to rooms or other safe places.

4. Securing

For safety from falling, sliding etc. the items must be secured with the help of various securing methods and items such as L-bracket, nylon strip, hook and loop tape, EVA anti-slip mat etc. Identify which mitigation activities will reduce the risks of damage and injury the most. Determine which activities can be accomplished at little or no cost (i.e., securing bookcases to walls, closed hooks for pictures and mirrors).

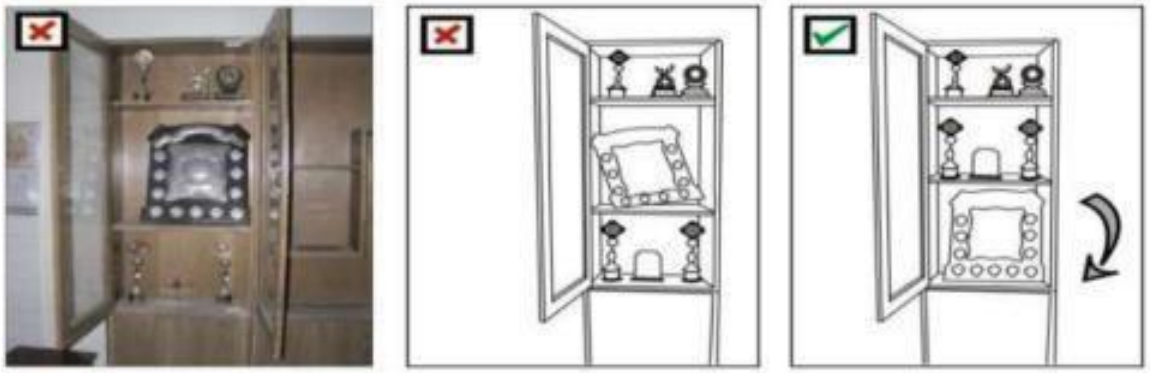
Non-Structural Mitigation Measures

Following are the ways to reduce risks from non-structural hazards in schools. Most of this can be done with easily available supplies and simple methods, such as following measures shown below:

- Clear Corridors, Doorways and Exit Paths

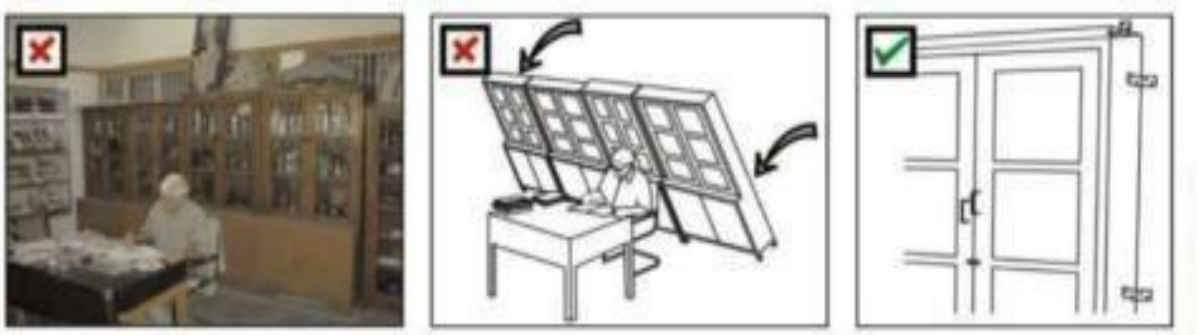
Do not keep things that cannot be restrained in the corridor, from which obstacles arise.

- Place heavy items down low



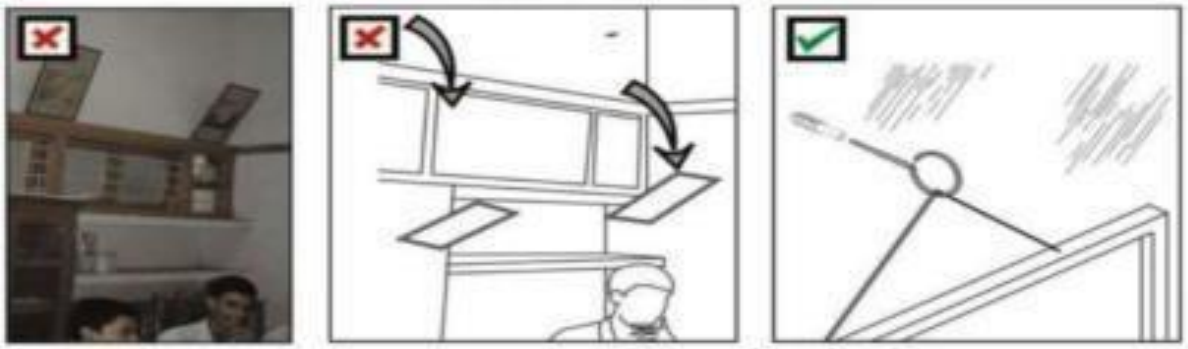
Heavy and fragile items that cannot be tied, can be placed in the lower rack while the light items may be placed in upper rack.

- Fasten Tall and heavy furnishings



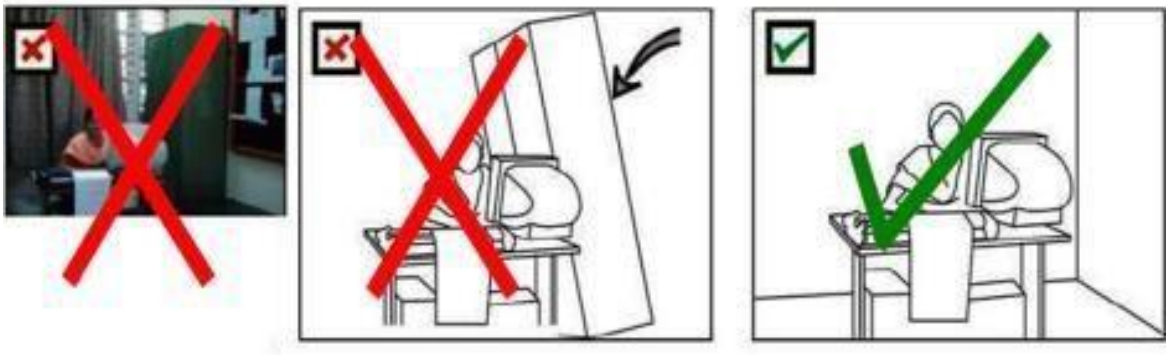
Heighted furniture can be rooted to the wall with L- bracket or screw.

- Secure picture frames and hanging objects



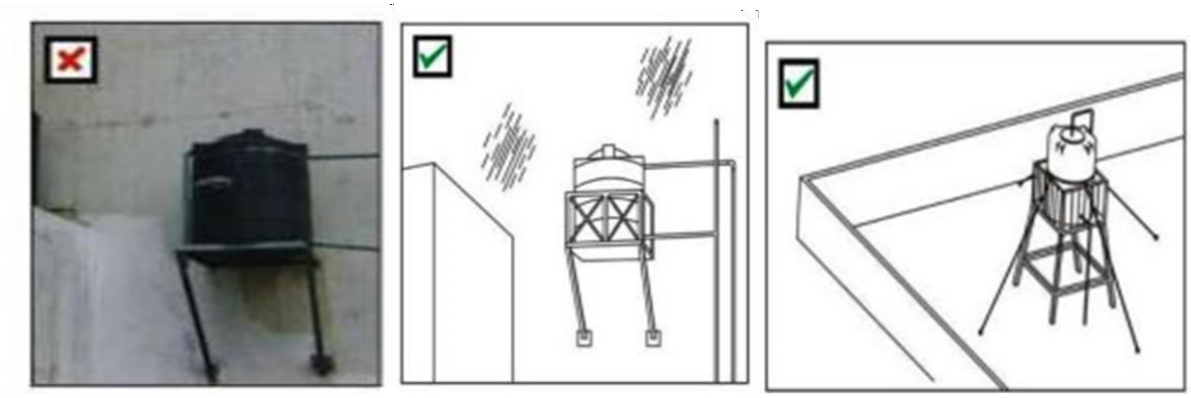
Use a hook or to avoid potential injury by the broken glass of glass of the broken frame and hanging luggage.

- Placement of non-structural objects



The furniture should be kept away from the seating area or being hooked up to the wall.

- Placement of heavy or big objects



To reinforce a very bulky or very large material, get help from a professional engineer. Heavy material like water tanks attached to the wall needs to be tied not only in vertical direction as well as in horizontal direction, so that it can be prevented from moving sideward.

Methods and Tips for safeguarding

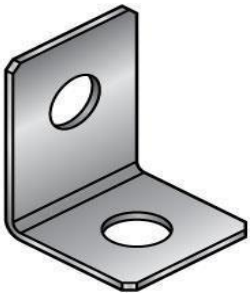
Several non-structural hazard mitigation measures that can reduce the potential risk are discussed below. The activities that can be accomplished with little or no cost are to be determined.

Furniture and equipment

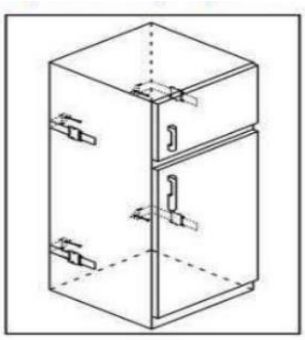
Some items or equipment will be too big or heavy but the contents of up to 150 kg can be tied up without engineering advice. The easy method is to keep such materials in a place where there is no danger of fire or dangerous situation and which do not obstruct the pathways or exit routes.

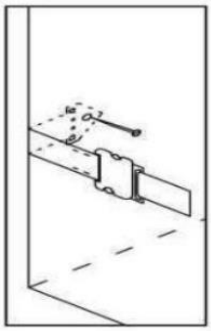
- L-bracket

Wooden furniture can be bracketed with screw and metal furniture with nuts-bolt. Screw the L-bracket with wall or wood frame. Make sure to use the appropriate screw or anchor for wall type and weight of items.



- Nylon strip

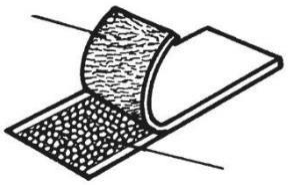




To tighten metal equipment / accessories and other large materials, finely knitted nylon stripe can be used. Use the nylon strip with buckle for length adjustment if needed. To attach the metal items from back, attach the straps on the metal item, by attaching the other edge of the buckle in the wall with an anchor or hook.

- Hook and loop tape

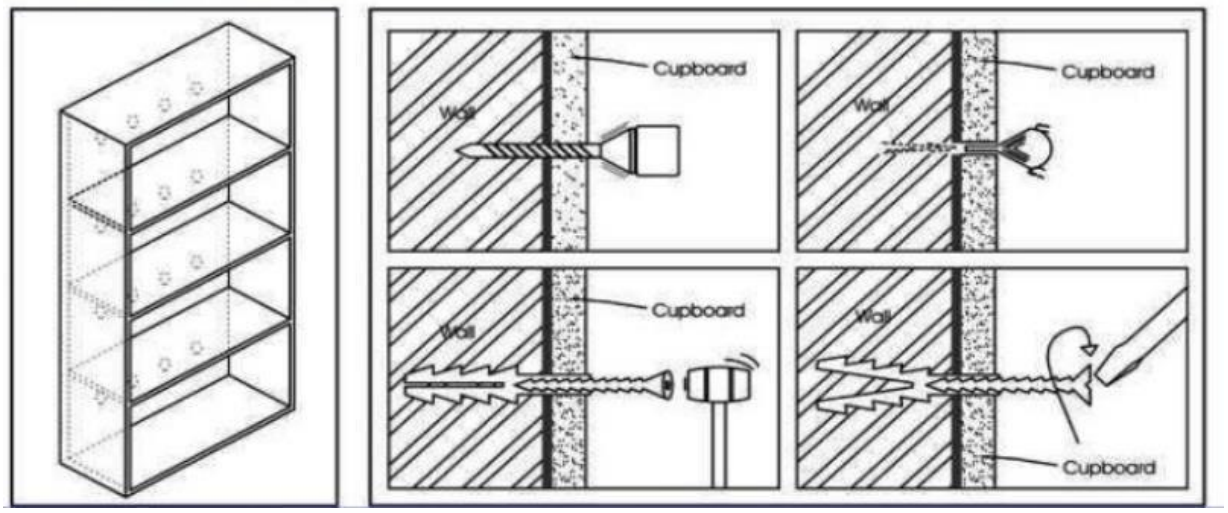
You can use hooks and loop tape to bind. By hooking the hook tape on the metal, the other edge of the loop tape can be strengthened by putting an anchor or hook in the wall.



The weight of the material	Hook and loop tape
35 kg	2nos, 5 cm
35- 60 kg	4nos, 5cm, or 2nos, 10 cm
130 kg	4 nos, 10 cm

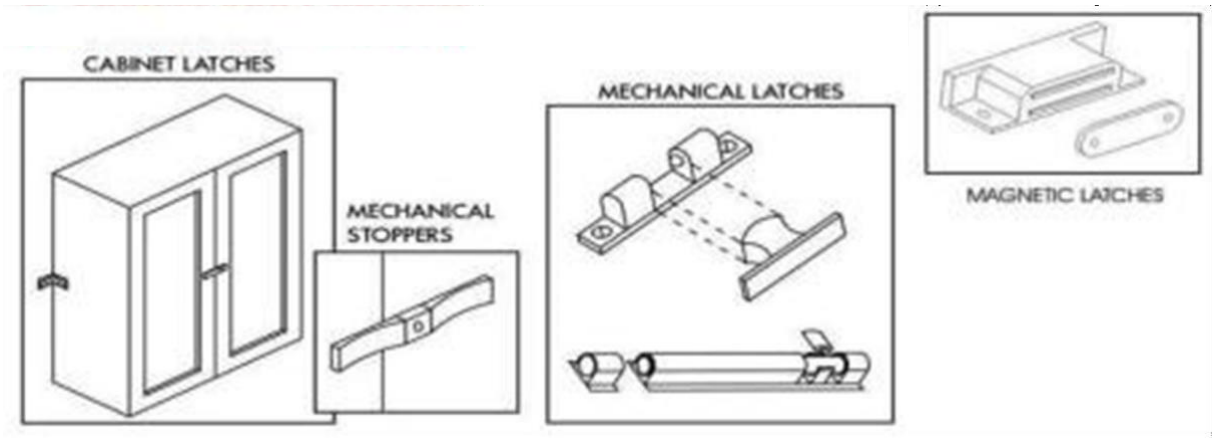
- Screw

Some steel shelves can screw straight from inside or back. According to the wall type, select the correct anchor and screw. Before inserting the anchor into the wall, make a size bigger from the screw and give it to the dust. Put plastic or metal in the wall with the help of anchor hammer. After that, screw the screw with the help of the screwdriver.

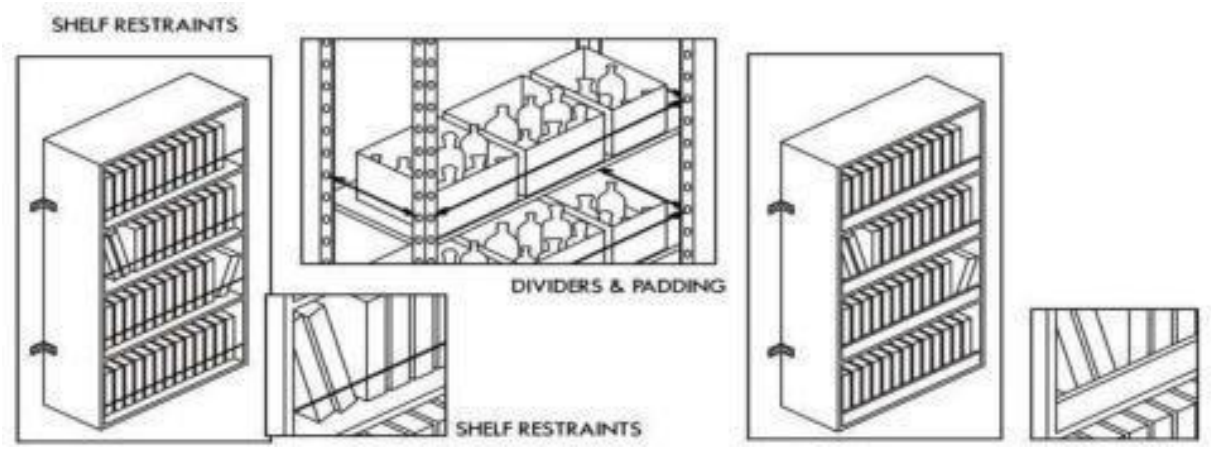


- Shelf and material

The cabinet can be put closed or safe with the help of mechanical stopper, magnetic catcher or mechanical latch. If stopper will not able to bear the shock of the contents inside, then you need to take additional remedies. To keep the trophy and other display materials stable, EVA anti slip can be used.



Shelf restraints can be made from wooden pieces, rods, chains, ropes, strips and similar such objects. Remember to keep the stuff loaded down in the rack and lightly on the upper side.

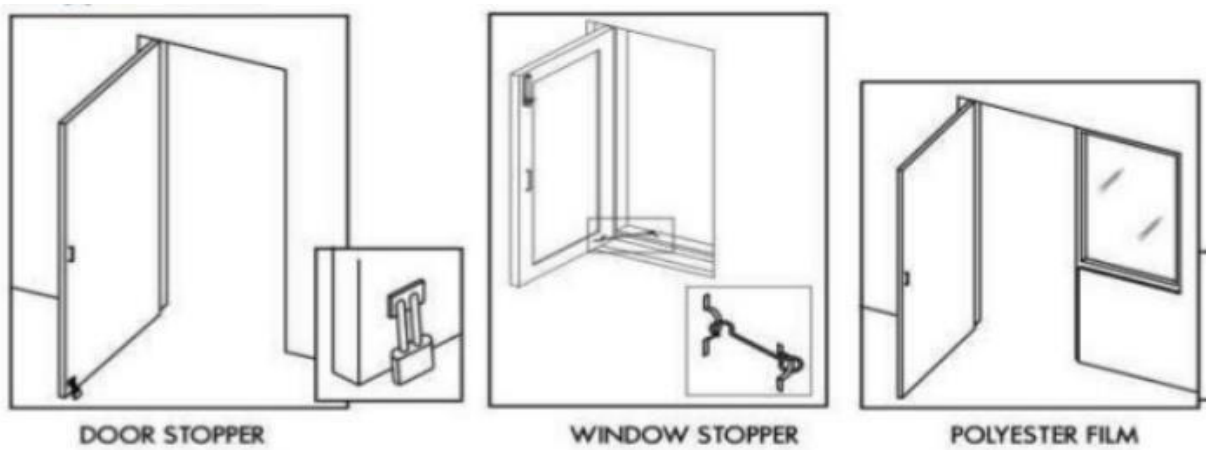


- Electronic items

The computer or electronic device can be attached to the nylon lace containing the buckles or clips. Hook and loop tape can bundle up together to attach electronic items. They can be opened whenever in need. These industrial power-rich tapes should be pasted on the clean dry surface of the metal.

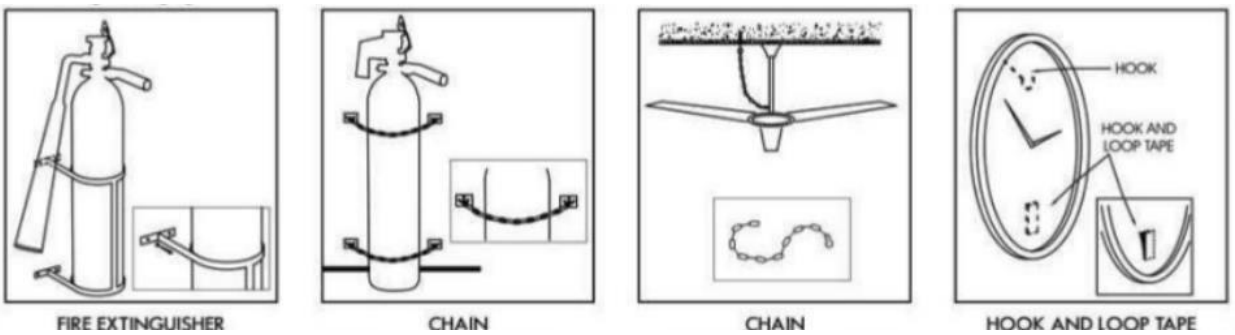
- Doors, windows and glasses

The stoppers in the doors are helpful in keeping the door open when in need or in case of emergency exit. The insulators sheets on windows save the glass from breaking down and cause damage. Near the exit, it is important to put a polyester film to prevent breaking down large pieces of glass.



- Hanging objects from the wall and ceiling

The items hanging from the ceilings and walls should be attached with hook, chain, anchors and other such items. Self-adhesive or loop tapes should not be used for heavy items as they will be unable to bear the load of item. This type of lace is applied to prevent light weight objects from slipping.



FIRE EXTINGUISHER CHAIN CHAIN HOOK AND LOOP TAPE

Non-structural Assessment checklist for school (ToT module on School safety)

Table 2 School Building Non-Structural Safety Checklist

School Name:	**Date:**
Address:	**Assessment conducted by:**

Items	**Potential hazard**	**Mitigation measure (Relocate or secure)**	**Priority (High, Medium, Low)**	**Remarks**
Furniture and equipment				
Bookshelves				
Storage Cabinet				
Display shelves				
Filing cabinets				
Computer equipment				
Laboratory Equipment				
Fire Extinguishers				
Black/Green Boards				
Ceiling Fan				

Sound equipment's				
Computer/Printer/ Photo copy Machine				
Moveable Wooden Partition				
Kitchen Equipment				
Others				
Ceiling and Overhead items				
Ceiling Fan				
Flower pots				
Photo frames				
Wall clocks				
False ceiling				
Cement plaster				
Roof tiles				
Coolers				
Other				
Wall Mounter Items				
Shelves				
Equipment, LCD TV				
Air Conditioner				
Acqua Guard Wall Mounted				
Others				
Outside the building				
Cement Plaster				
Sun shade				
Trees				
Electricity pole and wires				

Source: NDMA Checklist for Non-Structural Elements in Schools under National School Safety Programme https://ndma.gov.in/sites/default/files/PDF/school_safety/checklist-22-1-13.pd

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GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

Gujarat Institute of Disaster Management

Koba-Gandhinagar Road, Village Raisan, B/h Pandit Deendayal Petroleum University, Raisan, Gandhinagar - 382007, Gujarat, India.

Ph. (079) 23275804 to 25 | Fax: (079) 23275814

Email: info-gidm@gujarat.gov.in | Website: www.gidm.gujarat.gov.in