Take Step 1 For a Safe Life!

Istanbul Seismic Risk Mitigation and Emergency Preparedness Project
ISMEP

Non-structural Risk Mitigation Against Earthquake

ISTANBUL AFAD
PROVINCIAL DISASTER AND EMERGENCY DIRECTORATE

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beyaz gemi

Dear residents of Istanbul,

Istanbul is a city, which is under the threat of earthquakes and many other disaster risks. In many parts of the world, precautions are taken and some preparation plans are carried out against these kinds of risks. In Turkey, there are studies, which aim at the protection of public buildings, particularly schools and hospitals, and historical monuments and there are retrofitting studies for the whole infrastructure system, especially for transportation and communication, with the participation of the professionals in our country by evaluating the studies made in developed countries.

Physical retrofitting studies have the aim of eliminating the physical threats by earthquakes. But the case of earthquake preparedness is not limited with these activities. What's more important is to change our way of life in such a way to be ready for earthquakes and to be more sensitive for our surrounding.

In order to be ready for earthquakes firstly at individual and then at the national level, we should know about earthquakes, we should develop ourselves by having safe life awareness at our home, in our offices and surrounding, we should get training and above all we should become conscious about what we can do before a possible earthquake strike.

Therefore, we have prepared these awareness raising and training materials to reach you by the means of ISMEP (Istanbul Seismic Risk Mitigation and Emergency Preparedness Project), which is conducted by Istanbul Governorship Provincial Disaster and Emergency Directorate and Istanbul Governorship Special Provincial Administration Istanbul Project Coordination Unit. The documents, which are prepared with the help of specialists from civil and private sectors, are given the last shape after the controls of experts and relevant departments.

Fifteen different training titles have been defined for our editions, which require the preparation of different documents with different themes and appropriate contents for them have been developed to reach all our citizens living in Istanbul and to ensure the institutional preparedness in every sense. We wholeheartedly believe that these training materials which are thought to be appreciated by each institution and individual would meet an important need. Before anything else, to know that our dear citizens would benefit from these activities that would help earthquake preparedness, gratifies us and enlivens our studies.

In Istanbul, where the future is strengthened by us, we share happiness of looking to the future with confidence.

Best regards,
Muammer Güler
Governor of Istanbul

Within the context of Enhancing Emergency Preparedness Capacity, which is the A component of Istanbul Seismic Risk Mitigation and Emergency Preparedness Project, multiple cooperation has a significant role in Community Disaster Preparedness Training Materialsí shaping within the framework of best practice and achieving objectives.

Within the framework of this project, which is a product of long and intensive study, and emerged in the light of profound knowledge and experiences of a good deal of people and institutions, we thank all public corporations and institutions who do not withhold their contributions from us;

Republic of Turkey Prime Ministry 'The Presidency of Disaster and Emergency Management Agency'
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Center of Excellence for Disaster Management
Middle East Technical University (METU)
Disaster Management Implementation and Research Center
Yıldız Technical University
Union of Municipalities and Straits of The Marmara Region
The Turkish Contractors Association
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Turkish Red Crescent Society Training Department
Neighbourhood Disaster Volunteers Foundation
Istanbul Anatolian Side Neighbourhood Disaster Volunteers Association
Search and Rescue Association (AKUT)
Istanbul Union of Chamber of Merchants and Craftsmen
Radio Amateurs Association
Confederation of Turkish Chamber of Merchants and Craftsmen Union
Confederation of Turkish Labor Unions
Social Service Employees Association
Turkish Psychological Association
The Psychiatric Association of Turkey
Turkish Federation for the Physically Disabled
Japan International Cooperation Agency Istanbul Office (JICA)

And we thank non-governmental organizations, all publication owners in the bibliography, and project team for their meticulous and devoted efforts.

Republic of Turkey Governorship of Istanbul
Provincial Disaster and Emergency Directorate

CONTENT

INTRODUCTION

The fact that part of Turkey's lands are located on a seismic belt and previous earthquakes for years remind us that we can confront with an earthquake at any time. During a probable earthquake we might be in the house, school, shopping center, working place or any health institution.

The probability of an earthquake in these places is considerably high. Whatever place we are, however the structure is earthquake-resistant, inevitable truth is that we might confront with the risks arising from nonstructural components.

At home we might get wounded by falling electronic items on us or be trapped under the furniture. In working places we might get wounded or lose our lives by falling objects that are stocked high as well. It is possible to multiply these stated examples. In all earthquakes buildings swing and in those buildings all objects and equipments might fall because of their sizes and living beings near them might get wounded and lose their lives. Again for this reason all of those objects might cause financial damage by falling.

In Marmara Earthquake which occurred in 1999, 50% of physical injuries, 3% of deaths were due to the nonstructural components. In other words we can reduce 50% of physical injuries and 3% of deaths after an earthquake by fastening our big white goods and electronic items with simple methods. Besides, in consequence of the stated simple precautions we would prevent 30% of the financial damage of survivors.

For the purpose of guiding for these stated topics, with "non-structural risk mitigation" book, we try to explain that in our house, working place, school, shopping centers, and surrounding there are objects which can fall over or tumble after a probable earthquake and if necessary precautions are not taken they can give harm to living beings near them and cause financial damage. Above all, with the well-known simple methods we try to give information about the degradability of these risks arising from those kinds of objects.

It should be remembered that in order to reduce the probable disaster harms, non-structural risk mitigation is the simplest and the most profitable preparation method before an earthquake.

WHAT ARE THE NON-STRUCTURAL COMPONENTS?

The components in or on a building is assessed in two ways:

- "structural" components which affect the solidity of a structure
- "Non-structural components" which affect the usage and design of a structure

Structural components are those basic components which carry all load of a building and affect its solidity:

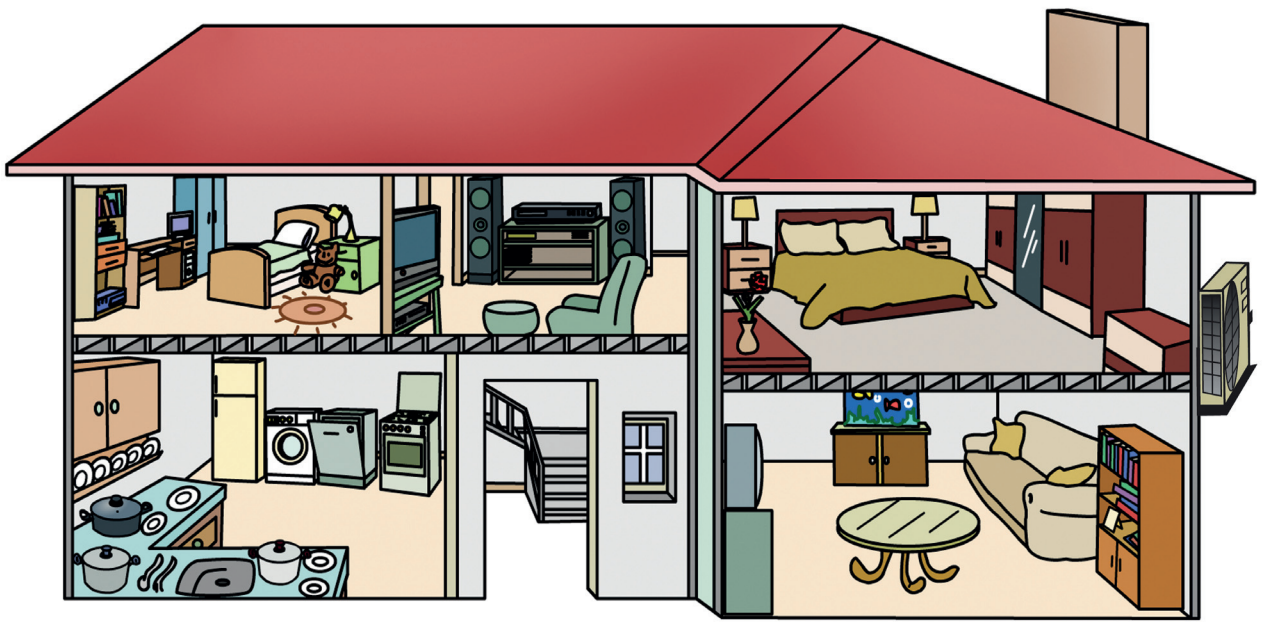
- Foundation of the building
- Columns, beams, curtain walls
- Roof

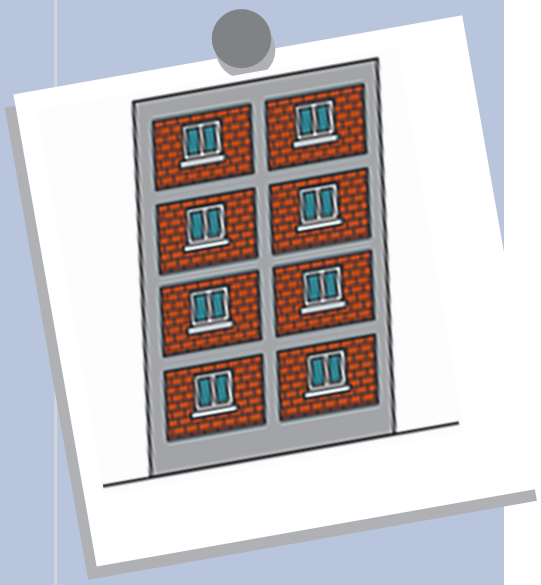
Basically the roof is not responsible for the solidity of a building; it only protects the building from the natural events like rain, snow and sun. For this reason, it is pointed out among the structural components but roofs act as non-structural components during an earthquake.

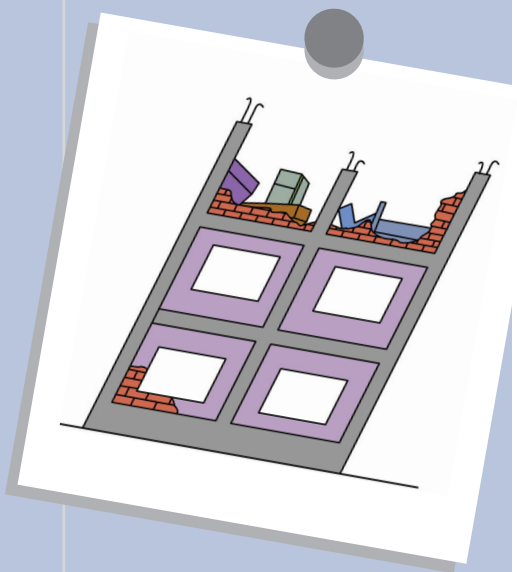
Non-structural components are related to inside usage and aesthetic of a building rather than the solidity of it. These are examined in two groups as movable and stable objects depending on the situation of a building.

Non-structural Movable Objects

The objects given below and so forth are named as "movable objects" as a result of their ability to move constantly.







The elements that are not belong to the structure are called "Non-structural Elements"

- Furniture
  -Glass cases, wardrobes, bookshelves with different sizes
  -Dressers and their mirrors, coat hangers
  -Doors and drawers of kitchen cupboards
- All electronic items (computer, television, music set, etc.)
- All white goods (refrigerator, washing machine, etc.)
- Stoves with different qualities (with electric, coal, wood, etc.)
- Frames
- Bathroom accessories
- Cabinets, desks, lightening items, laboratory materials in schools
- Operating room equipments, laboratory materials in hospitals
- Display shelves and objects on these shelves in shopping centers
- Display on shelves and historical objects in art galleries museums

Non-structural Stable Objects

The objects given below and so forth are named as "stable objects" as they are fastened once and generally remain at the same place.

- All doors and windows
- Elevators
- Panel radiators and junction pipes
- Central heating boilers, water heaters
- Lightening systems
  -Chandeliers
  -Lamps, fluorescent lamps
  -Spot lamps and their equipments used on suspended ceiling
- Fire-escape stairs
- In display windows/shelves

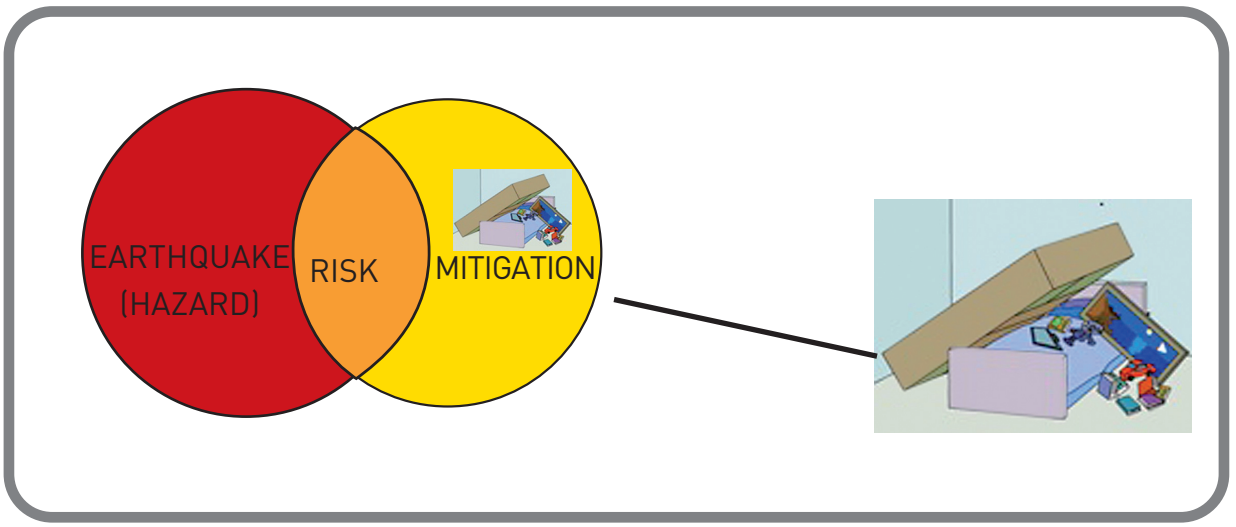
PERFORMANCE OF NON-STRUCTURAL COMPONENTS IN AN EARTHQUAKE

Non-structural components which make our daily life easy might fall and break during an earthquake. The mobility of these objects in any earthquake are related to the qualities stated below:

- Size (objects with height 1.5 times bigger than their dimension or depth)
- Weight (objects with upper part heavier than under part)
- Equipment (wheeled objects)
- Its place (books on shelves or products in markets)

WHAT ARE THE NON-STRUCTURAL RISKS? WHY ARE THEY IMPORTANT?

Because of their tendency to move, non-structural components cause financial loss, physical injuries even deaths. We name these hazards and risks related to non-structural components as "Non-structural Risks".



As it could be seen above, the degree of a risk that we might confront in a possible earthquake is in direct proportion to vulnerability of the non-structural components during an earthquake. In other words, the more damage non-structural components suffer, the bigger risks we might confront; so financial losses, physical injuries, deaths, job losses severely increase. Time of overcoming the crisis for an area which has experienced an earthquake is postponed too much later. In order to enhance the quality of life, a long time might be needed.

Turkey is located on a seismic belt; experienced previous earthquakes on this land for years remind us that we can confront with an earthquake at any time. In the light of this truth instead of wasting time with the anxiety of "when an earthquake is going to happen?" making preparations as if at any moment an earthquake might occur, is more appropriate.

During an earthquake, the possibility of our being at home, in school, working place or in a medical institution is high. Wherever we are, however the structure is earthquake-resistant, the possibility of confrontation with non-structural risks arising from non-structural components is considerably high. At home we might get wounded by falling objects and electronic items or being trapped under furniture. In working places we might get injured or we might lose our lives, negatively affected by office furniture or falling down of high stocked products on us. In a shopping center we might get wounded by breaking of a big shopping window or by falling down of any product stocked high in construction markets.

It possible to increase these examples. These kinds of examples might be experienced at the same in all countries which are prone to earthquake and landslide all over the world because in all earthquakes and landslides structures shake and in those structures objects and equipments might fall down, there might be financial losses, living beings near them might get wounded or lose life.

After 1999 Marmara Earthquake it is seen that 30% of financial losses, 50% of physical injuries, 3% of deaths caused by non-structural components.

In different parts of the world although a good deal of hospitals, schools, public institutions, private business firms have not serious trouble with their structures in earthquakes, they were unable to discharge their duty because objects within them suffered damage, for days, for months, they had job losses. For this reason, mitigation of non-structural risks is extremely important.

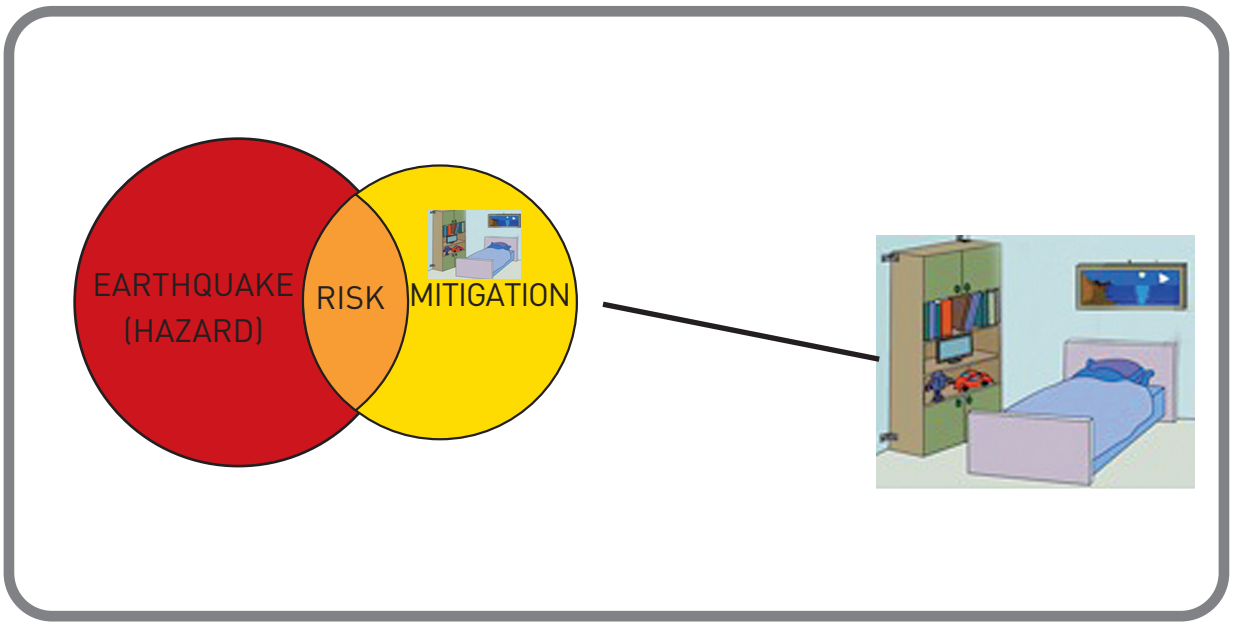
Based on these, it is possible to make this comment: "During a possible earthquake in any case most of the buildings will collapse. So, living beings and furniture will be trapped under the debris. Then non-structural risks have no importance."

Answer for this approach will be as such: "In 99 Marmara Earthquake only 3-5% of damaged buildings were completely demolished ones. For this reason, at first the solidity of our building should be controlled and assessed by experts. Later, in order to mitigate non-structural risks, appropriate methods should be adopted. "

By defining building quality and confirming that there are no structural risks, it should be guessed that in an earthquake non-structural components might suffer damage because of shake and issue of taking necessary precautions to minimize these risks should be considered. On the subject of structural hazards, although we can lay responsibility on local or government authorities we cannot blame someone for deaths, physical injuries and financial losses arising from non-structural objects within the house. Here we are all alone with our conscience. For this reason, on the subject of non-structural risks, without getting affected by someone's self-indulgence, without being in expectation for assistance we have to generate solutions.

NON-STRUCTURAL RISKS

During an earthquake, non-structural risks could be predicted. So primarily at home, in schools, hospitals and offices non-structural objects, which might fall down, move and break during an earthquake. After this kind of study, hazards and risks related to non-structural objects in an earthquake are defined as well. If risks are defined beforehand and precautions are taken, probable harms after an earthquake could be minimized.



As an example in our house, we should try to find possible danger and risks before an earthquake strikes. In our kitchen there are white goods, in cupboards there are glass and porcelain dishes, saucepans. During an earthquake these objects might get damage by falling, sliding, or overturning; a person in the kitchen might exposed to injury and death. It is clear that broken objects cost financial losts. If we know the possibility of our encountering with these risks, by carrying out some small steps before an earthquake we can minimize some risks. These steps can be carried out with simple methods such as locking kitchen closed doors, fastening white goods with proper way.

After an earthquake non-structural component originated risks are these:

- Financial loss
- Injury
- Death
- Job and service loss
- Psychological problems

SOURCE OF HAZARD	POSSIBLE RISKS
Turning over or falling down of wardrobes, glass-case, closets or bookshelves.	People near them might get harm and cause financial loss.
Dislocation and falling down of comb boiler, water heater, panel radiators that are hanged high.	People near them might get harm, fires would break out, and cause financial loss.
Falling down of coal, LPG cylinder, electric stoves' heaters.	People near them might get wounded, fires would break out and cause financial loss.
Falling down of white goods such as refrigerator, washing machine and oven.	People near them might get harm and cause financial loss.
Dislocation of kitchen cupboards and falling down of big and breakable objects in them as a result of opening doors of cupboards that remained fastened.	People near them might get harm and cause financial loss.
Falling down or sliding of electronic items like television, computer, music set.	Causes severe financial loss.
Falling down and breaking of fluorescent etc. lamps, dislocation of hanging chandeliers, turning over of floor lamps.	People under and near them might get harm and cause financial loss.
Falling down and breaking of mirrors and heavy frames with different sizes from where they are hanged.	Might give serious harms in different ways to people near them.
Windows and glass doors with different sizes.	Might give fatal injuries to people near them.
Getting damage of objects like glass objects, vases with different sizes by falling down and sliding which might have immaterial values as well.	Common past memories disappear and there is financial loss.
Detaching of ventilation systems from connection points.	Ventilation system does not function properly and cause financial loss.
Departing of lifts from guide rail or being trapped in mezzanine floor.	Might give serious harms to people inside them and cause financial loss.

NON-STRUCTURAL RISK MITIGATION

Possible hazards and risks after an earthquake can be mitigated with a few steps or with the technical support of an expert. Small preparations before the earthquake non-structural risks can be mitigated.

The procedure of mitigating non-structural component originated risks and hazards are called "Non-structural Risk Mitigation". In order to do that, at first in what way a person might get damage from the source of risks should be determined and possible hazard situation should be improved before the earthquake.

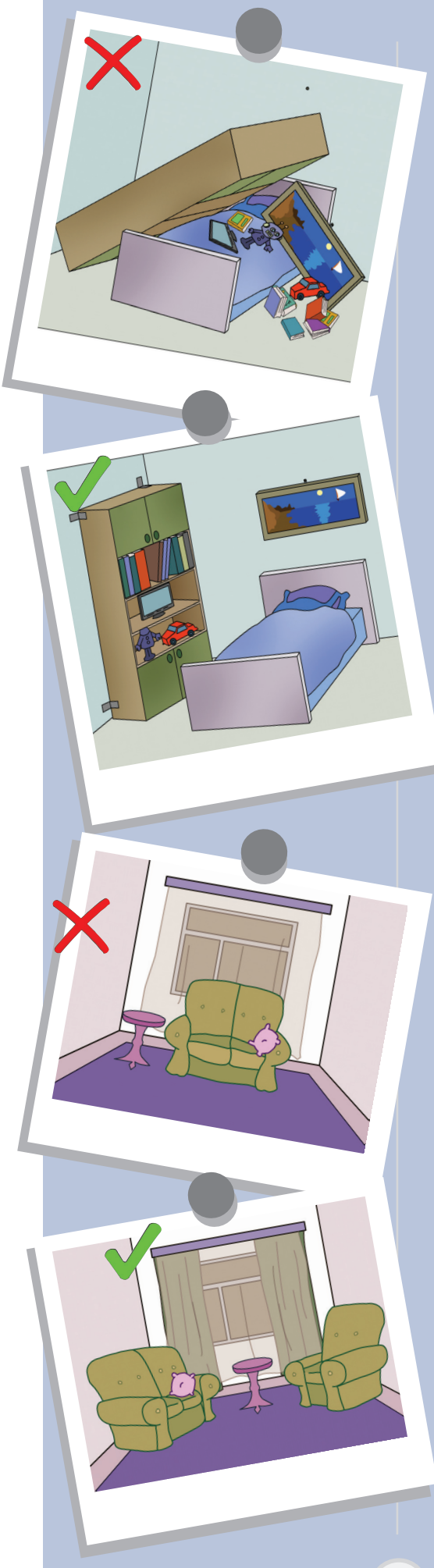
In order to reduce harm of non-structural objects during a probable earthquake, in other words, to minimize the risks, how these kinds of objects fall down, roll, and break during an earthquake should be known and made amendments in this direction.

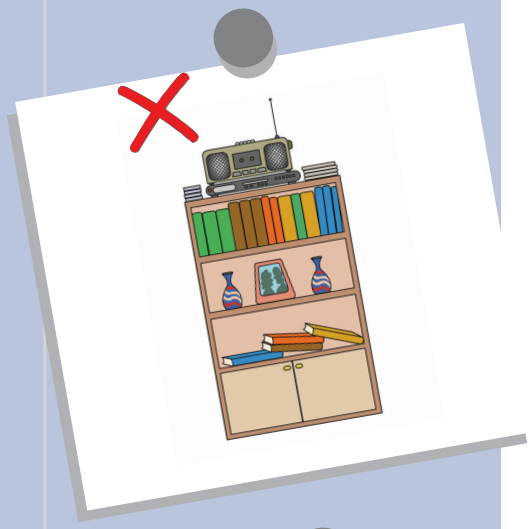
For instance, because of their dimensions, objects with their heights 1.5 times bigger than their width or depth or objects with their upper parts heavier than bottom parts can easily fall down. Heavy objects on a slippery ground easily roll. Wheeled objects easily move around. Books on shelves, products on shelves in the markets can easily fall down. Frames asserted with simple nail or screw can easily fall down. It is possible to multiply examples about this stated source of risks. The important thing here is to know the reason of harm of risk source well and create a solution according to this.

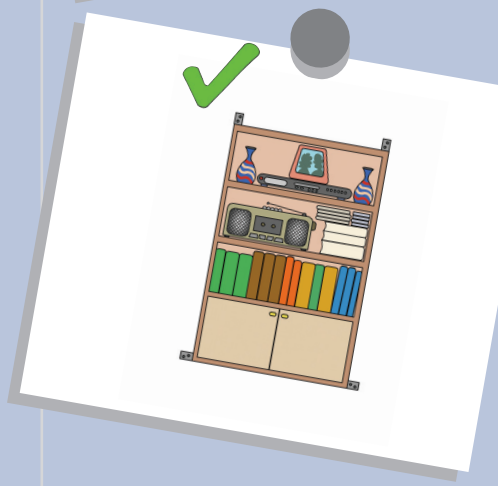
The most effective way to mitigate non-structural component is to fasten fragile objects in a proper way. Sometimes even methods like relocating some objects, using drapes, in our daily life displacement of under-used big objects, using disused objects for outside purposes would be important.

Relocation of Furniture

The most simple and cheapest method for minimizing the non-structural risks is to relocate furniture.







An appropriate fastening is one of the safest ways of non-structural risk mitigation.

With the small steps in the subjects below, important differences can be created for minimizing the hazards and risks:

- To move heavy and high furniture to safer places.
- To relocate frequently used furniture away from windows.
- To use drape (etc.) to avoid risks from windows.
- To put heavy furniture to lower shelves and to place lighter furniture to upper shelves.
- To get rid of redundant furniture.

Fastening of Furniture

The most effective way for minimizing the risks caused by non-structural items is fastening the furniture that can slip and fall down, and for this reason might get damage during an earthquake.

Basic aim in this process is to prevent falling or relocation of furniture during shake. For this, furniture are fastened by fastening structural (column, girder, reinforced concrete wall, etc.) or non-structural but certainly a strong element(brick, wall, etc.); in this way, we make furniture move with the elements they fastened to.

In order to fasten in an appropriate way, it is necessary to pay attention to some basic points. Knowing which furniture will be fastened from which point, with which fastening material and to where it would be fastened, forms the most important technical steps. These steps are:

Choice of furniture location that will be fastened: At first the most proper fastening location of furniture to be fastened, should be determined. While this place is determined, some features such as wall type behind the furniture, parallel to the wall, closed to windows should be considered.

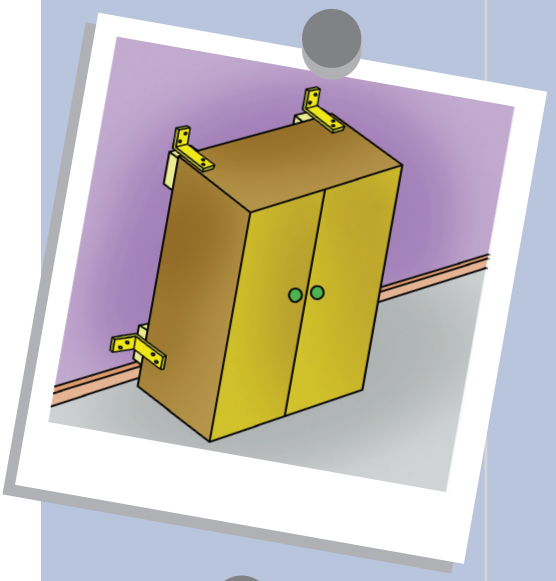
For instance, it is rather hard to fasten a glass ware/dishes cabinet standing across the corner. In order to fasten such glass ware/dishes cabinet in a healthy way, primarily it is necessary to relocate it in a way it will be parallel to the wall. For such furniture (television table, etc.) the most suitable fastening places must be determined in the same way.

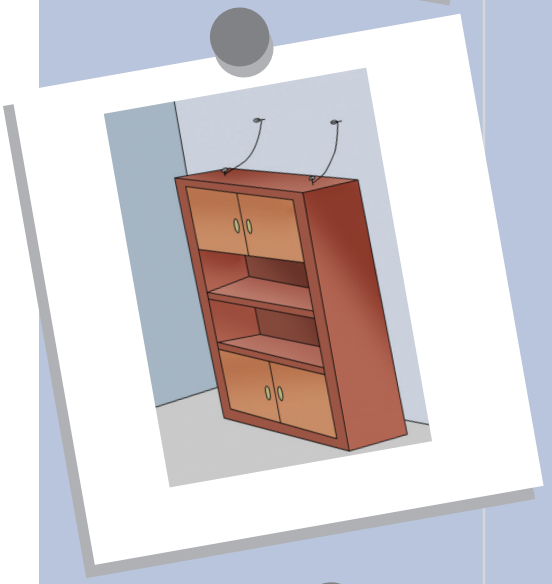
Fastening place choice of furniture that will be fastened: Knowing which way and how the furniture has the possibility of moving or falling, fastening should be done. That is, furniture should be fastened from where it will start its first move during roll or fall. For instance the most suitable fastening place for closets is close parts to top and bottom.

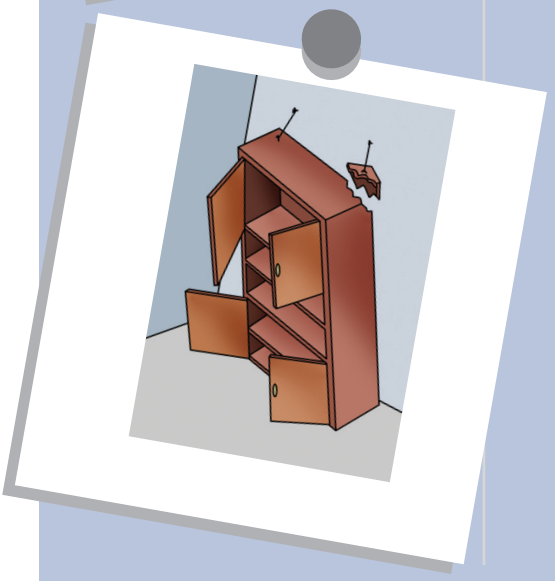
Right selection of fastening material and effective fastening: Furniture can be fastened with different materials according to their features and places they will be fastened to. With fastening element that would be chosen, aim is to fasten tightly to the place where it is fastened. For example, unless a fastened storage with the help of steel rope, is not fastened tightly in a way it will become as a whole with the wall, during an earthquake it will rupture in its leanest part moving apart from the wall where it was fastened. In this circumstance although a very strong fastening element like steel rope is used, effective fastening could not be done. To fasten such furniture in an effective way, using L profile is a good way according to furniture type and weight and backfill material if necessary, will be enough for fastening tightly.

Selection of structural or non-structural component that will be fastened: Furniture can be fastened to non-structural components like brick wall which has appropriate features for fastening. Drywall, gas concrete and cob walls are not suitable for fastening. But when they are equipped with enough precautions, they can be suitable for fastening of furniture of which weight is up to 75 kg.

Protection of fastened furniture balance: It is necessary to protect balance of furniture which will be fastened. For example together with televisions that are fastened on tables, tables have to be fastened by drawing up the nearest wall. Because, with the fastening of television to the coffee table where television is on it, with its passage to a furniture type of which top is heavy and bottom is light, and therefore it becomes a defastened object and can fall easily. Such furniture can fall much easier.







BEFORE STARTING TO FASTEN

Before starting to fasten non-structural components that cause risk by falling or slipping during an earthquake, some preparations are necessary to be made.

To be able to fasten appropriately to its technique, before starting to process, we should pay attention to those:

- Knowing the approximate weight of furniture to be fastened.
- Bracing member choice according to the type and weight of furniture to be fastened.
- Determining the fastening place of furniture to be fastened.
- Dowel and screw selection used in fastening.
- Selection of fastening elements that will be used in minimizing the risks caused by furniture closet doors and drawers.
- Selection of other fastening elements.

Knowing Furniture Weight

Before starting to fasten, it is important to know beforehand the weight of machines or mechanic device or various electronics and furniture to be fastened approximately, this information will be useful for choosing dowel, screw and bracing member that will be used for fastening according to its technique.

We need to evaluate the objects to be fastened in three different types of weight:

- Furniture between 0-75 kg
- Furniture between 75-150 kg
- Furniture heavier than 150 kg

It is necessary to consult to an expert for fastening of furniture heavier than 150 kg.

Bracing Member Selection According to Furniture's Type and Weight

Bracing members are chosen primarily according to types of furniture to be fastened. For example furniture made from products such as wood, slat, MDF (wardrobe, closet, drawer, commode, television table, etc.) or furni-

Example to the furnitures between 0-75 kg.

Example to the furnitures between 0-75 kg.

ture produced from metals (metal cabinet, archival file lockers, vb.) are fastened using metal L profiles with screwing method.

White goods, electronic items and some of laboratory equipments that have various features are fastened sticking with fabricbings and self adhesive tapes to their own tops and screwing with dowel and screwing to the other side (if there is wall, etc.). Number of bracing member with which these furniture will be fastened changes according to the approximate weight they have. For example it is enough to use 4 medium sized metal L profile for approximately 100 kg wardrobe.

Metal L Profiles

Metal L profiles

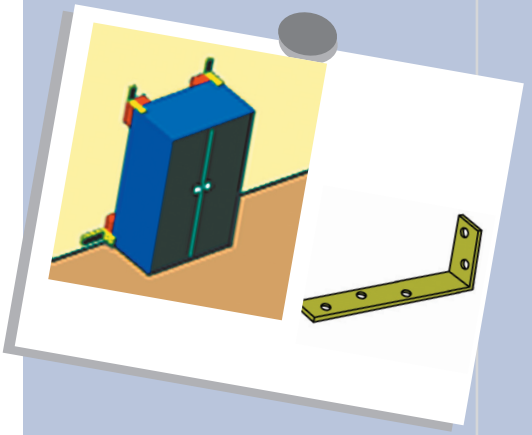
Metal L profiles are used for fastening of all furniture which is in furniture type according to their dimensions and where they will be used, these profiles must have the features below:

- Small sized L profiles at least 20 mm breadth and 2,5 mm thickness (recommended for furniture between 0-75 kg).
- Middle sized L profiles at least 30 mm breadth and 3 mm thickness (recommended for furniture between 75-150 kg).
- If furniture is distant from the wall on which it will be fastened, one leg of metal L profile would be longer than the other leg.
- Holes on chosen L profiles are not single row but cross row.

Medium sized Metal L Profile

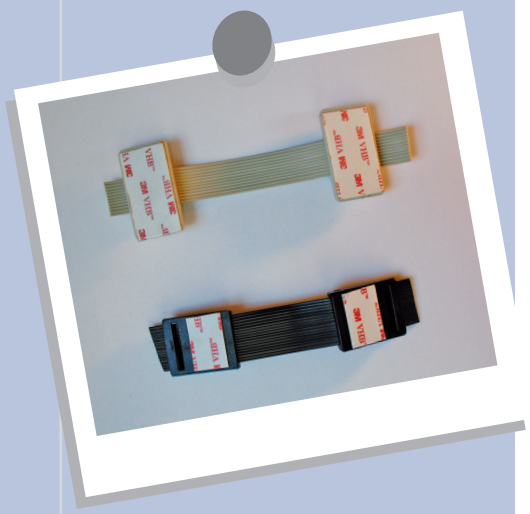
Fabric Belts

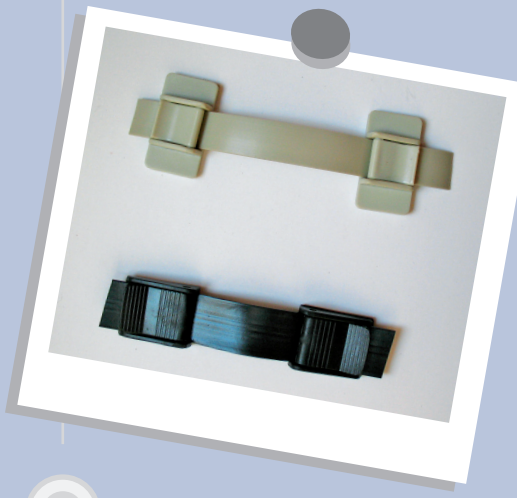
As screwing method is not applied in fastening of electronic items or white goods, adhesive fabric belts are used. Fabric belts can be double sided adhesive, or single sided adhesive, other side screwed according to the places it will be used. Also on some belts there are plastic buckles to adjust their length and if necessary to be able to remove and fasten the device to its place again. There are fabric belts in various sizes and thickness according to the size of device that will be fastened. Fabric belts are chosen according to furniture's weight.



Metal L Profile which have a long leg

- Narrow fabric belts: for furniture up to 75 kg approximately.
- Wide fabric belts: can be used for furniture between 75-150 kg approximately.





Belt with Clip

For electronic devices on the table and not heavy, use of belts with clip is recommended. Belts with clip are attached to the devices and counters or tables with self adhesive tapes and they are combined being passed through plastic or fabric belts. As they are opened and closed easily, they enable to fasten devices to their former places if necessary.

Belt with clip can be used for fastening of goods given below:

- Computer case or monitor
- Small televisions
- Small or middle sized electronic furniture
- Over-the-counter laboratory devices
- Over-the-counter devices

Self-adhesive Velcro

Self-adhesive Velcro can be used for fastening low, light electronic devices that do not have the risk of falling; these bands have one hard and one smooth side that when they pressed to each other, they become attached. Self-adhesive back side can be attached to different surfaces. Velcro enable removing of furniture easily and fastening to their places again when necessary and produced with different width and length for different applications.

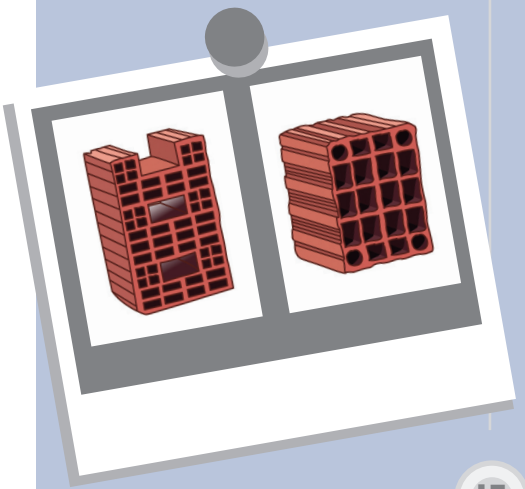
Self-adhesive Velcro can be used in fastening of the furniture below:

- Small fax machines, printers and similar devices
- Video and DVD players or small music sets
- Telephones, clocks and similar devices

Determining Walls That Will Be Fastened

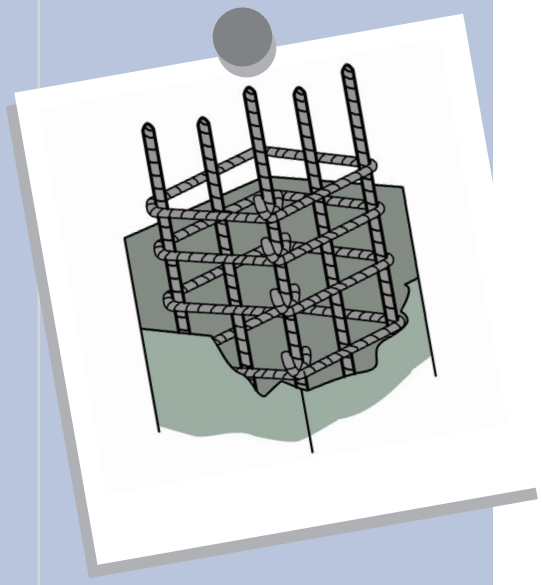
Knowing which type of the wall that non-structural furniture will be fastened is the most important factor in mitigating risk and danger.

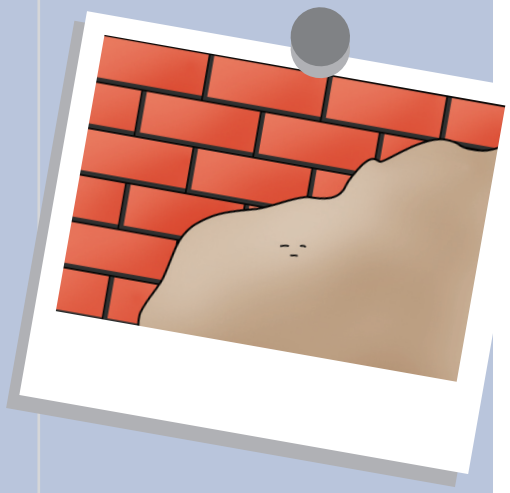
For such type of furniture, the best wall type is reinforced concrete wall. Unless our furniture that will be fastened is not heavy, well built holey brick walls give good results. Relocating furniture in a way that furniture can be fastened to this type of walls will be an important step for effective fastening. Also it is certainly important to know the kind of place which is going to be fastened while choosing screw and bracing members used for non-structural risk mitigation. The most used wall types in construction sector are brick and reinforced concrete walls. But in the recent periods, use of walls produced by gas concrete and drywall in the name of insulation has been increased.

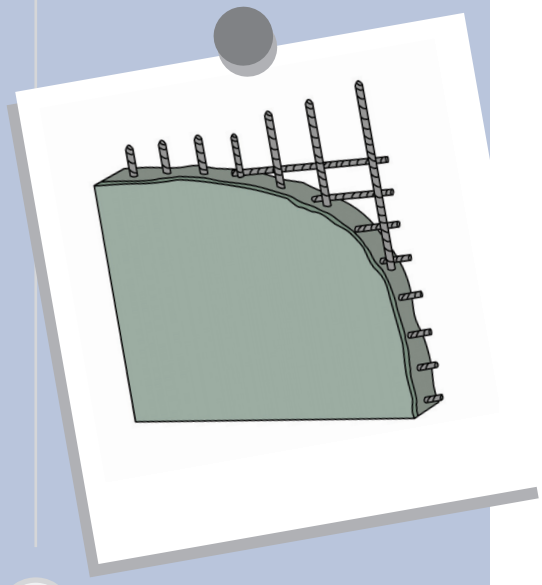


Brick Backfill Walls

Brick backfill walls are usually produced from red bricks and in different sizes. Their outer dimensions and skeletons that form internal part are different from each other. Ones with small holes inside enable to make more efficient walls than others. Bricks are sticked to each other with soil mixture prepared as a







result of mixture of sand and cement in decided amount. Also, the advantage of rendering plastered on brick walls is known. Especially, rendering on plastered brick walls is suitable for using plastic concrete insert.

One of the most important subjects is the maintenance of brick walls; because it is very difficult to fasten objects on a humid wall which is not protected well. Batch bricks which are filled inside have been used while building walls in structures constructed before in our country.

If they are protected well, this type of walls is accepted as suitable walls for fastening, too. It is technically possible to fasten furniture which are up to approximately 150 kg to the walls made from bricks. Fastening problem of goods which are heavier than 150 kg can be solved with the help of experts. Use of plastic concrete insert in this type of walls is accepted as the best choice.

Reinforced Concrete Components

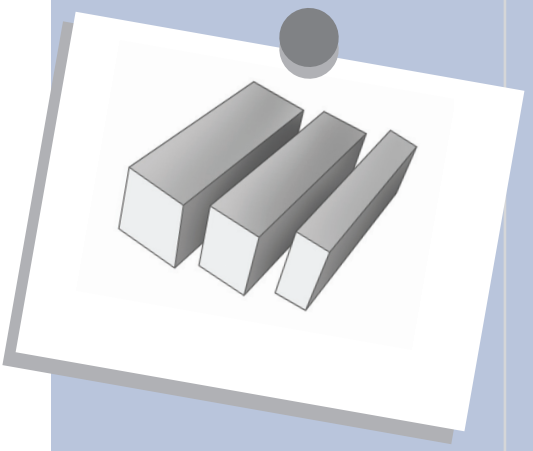
Bearing elements such as reinforced concrete components, column and girders represent the strongest part of the structure. Therefore, they are the most dependable structure elements in fastening of non-structural furniture. Especially these are the most suitable parts for fastening of furniture, machines or mechanic or electronic devices (heavier than 150 kg).

It will be more cheaper to use steel for heavy furniture and plastic concrete insert for light furniture in reinforced concrete structures. It is necessary not to give any damage to steel reinforcement when making a hole to this type of structural elements. When drill point hits steel equipment during process of drill, process must be stopped.

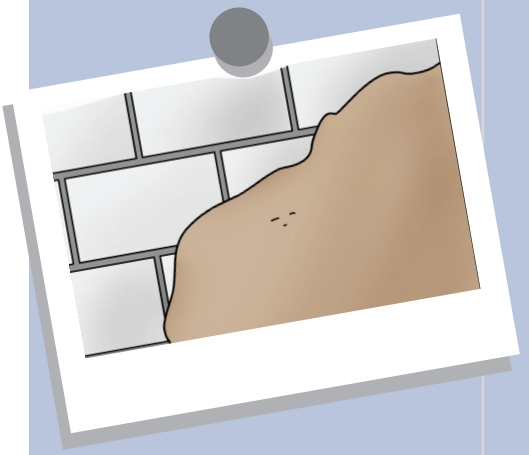
To make a new hole, it is necessary to move off in cross way from hole drilled incorrectly. Hole made incorrectly must be covered with a preservative material in order not to damage steel reinforcement in structure.

Gas Concrete Backfill Walls

Gas concrete is produced from natural materials, that is calcite and/or quartzite, sand, and other Silicious materials, water and a little bit of aluminium powder and cement. Such bricks have become one of the most important choices in construction of wall as they are light and give good results in noise and heat insulation. As they are light, they support the force which influences foundation of building to be light, too; also they provide high safety against fire. But as such bricks are produced from a cavernous and special material and as they have a soft structure, it is not recommended to use in fastening of non-structural furniture heavier than middle weight (approximately 100 kg).



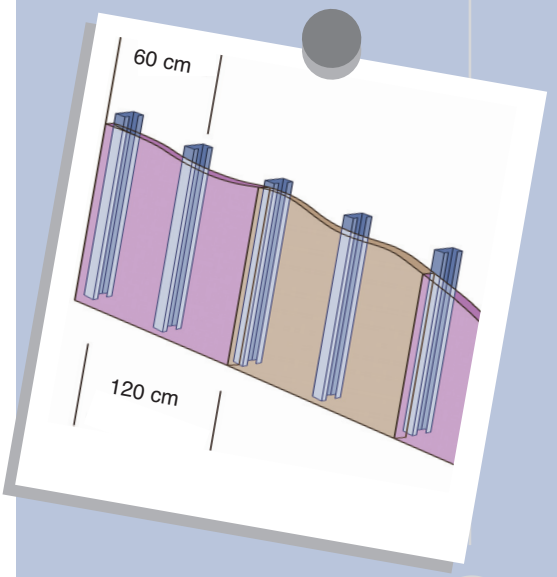
When it is necessary efficient results can be obtained by using wall bridge for the fastening of middle weight furniture. Wooden or aluminium materials can be used as wall bridge. Heavy non-structural furniture can be fastened with special metal material by being attached to floor and ceiling in structures where such walls are extensively used. Gas concrete bricks are mostly used in outer front of structures. If structure's interior walls are constructed by convential holey bricks, use of such walls will be more useful in fastening of non-structural furniture.

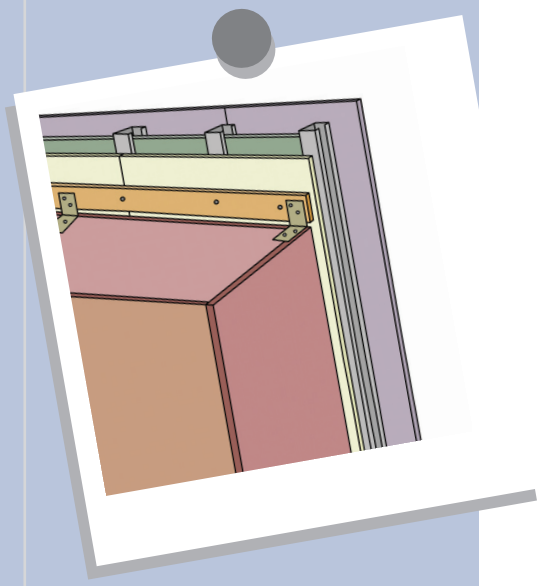


Drywall Backfill Walls

Drywall consists of smooth surface disks produced as mid plaster, cartoon covered with double sides, serial and in standart or special sizes and in decided forms. This material can be used inside of the buildings where the outer walls are completed, in every area from floor to wall.

Use of drywall system in buildings causes efficient force in structure to be smaller; and this contributes to structure's moderation and compulsion with less earthquake force in an earthquake. Drywalls which accord with building's move are ideal systems for structures in an earthquake area as they are light. But in fastening of non-structural furniture they need some assistant techniques. To be attached to plaster disks first, metal profiles of which inters 60 cm fastened to floor and to ceiling in construction of such wall types. Then drywall disks are screwed on metal construction constituted in every 60 cm, because of



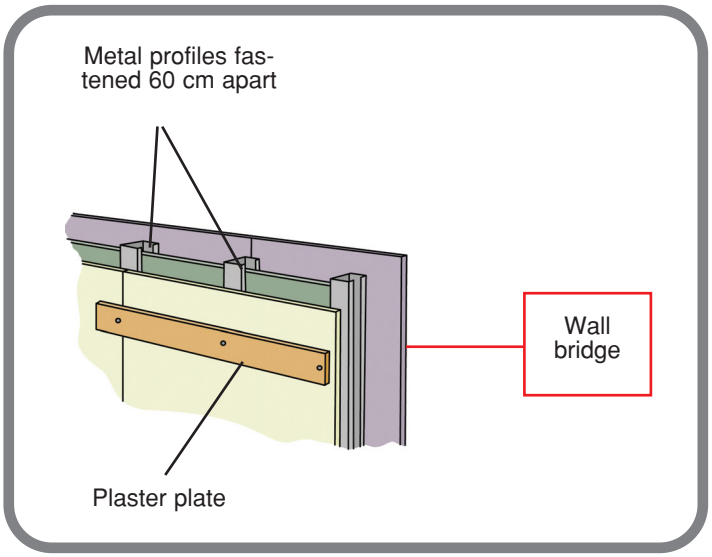


softness of drywalls, it is a must to fasten non-structural furniture to a metal or to a wall bridge that is attached to a profile inside the wall.

Bridge Practice for Drywalls

Wall bridge can be used for light furniture (up to 75 kg) in fastening of non-structural furniture to this type of walls. This material which can be chosen from wooden or aluminium profiles depending upon the aesthetic likes or demand that provides diffraction of weight of furniture that will be fastened to more than one profile instead of its laden to one profile. The most important problem we can face in fastening wall bridge to these walls is to find profiles presence inside of drywalls where plaster disk is fastened and bridge wall will be fastened.

It is necessary to know some technical detail in order to find profiles, which slabs are fastened, behind plaster slabs in a complete and dyed drywall. Firstly, it is possible to find profiles in unseen parts by using magnetic profile locator. But buying such a device only for some furniture that will be fastened will not be economical. Therefore, in order to find these profiles we can use some practical techniques. For example, by detecting two drywalls height gropely on dyed areas, we can find the first combination point of drywall slabs. After defining the first point, it will be easy to find other profiles which belong to the system: As the standard of slabs' width is up to 120 cm, profiles, which plaster slubs fastened to, 60 cm apart fasten to floor and the ceiling. In other words, distance of profiles in drywall system is usually near 60 cm.

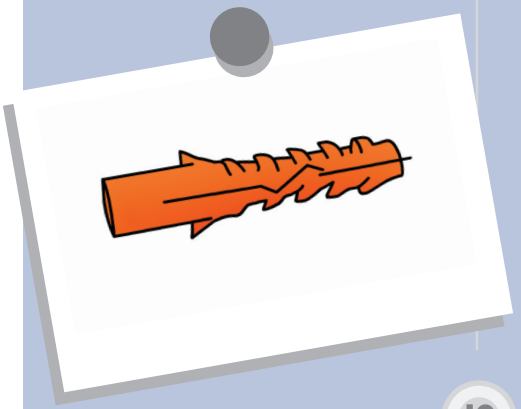


Dowel and Screw Selection for Fastening

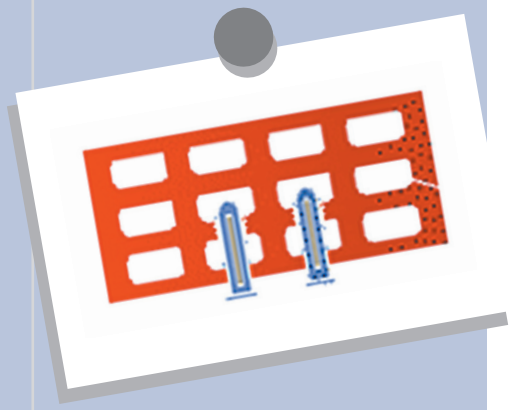
Dowel and screw types for fastening change depending on types and weight of furniture which we are going to fasten, type of wall where they will fasten to, and bracing member we choose for fastening. Different dowels are used for hollow brick walls, reinforced concrete walls, purous filled bricks (gas concrete bricks) and panels (drywall, plywood, etc.). Also in selection of screw which will be used in fastening bracing member to furniture, furniture type would be taken into consideration. For metal goods, woodenware, MDF or goods which are produced from slat, different screws are used.

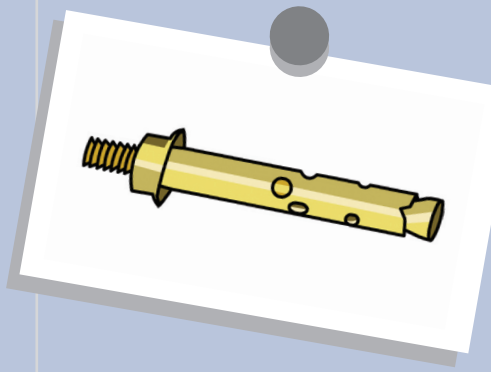
Plastic Dowels

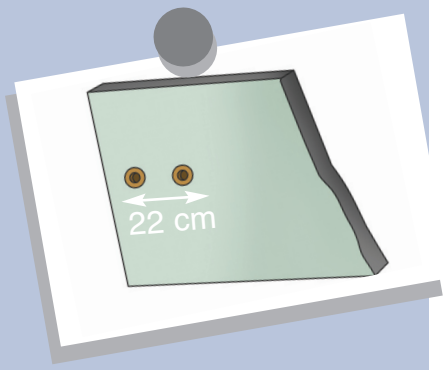
Plastic dowels are the most used, easily found and the cheapest dowels in the market. Plastic dowels with different features under various names provide easy and reliable assembly facility, and because of their special profile, they have high traction force. This material must be agreeable to TSE labelled plastic quality, and it should not crack, break or fold during practice.



In accordance with dowel size in practice, slat screw, trigon, even metal screws can be used. Wide wings and deep teeth in dowel prevent turning from beginning; and cross teeth in them increase expansion that arises as screw proceeds.







For different types of dowels, screws given below are suggested:

- For hexade dowel 4-5 mm
- For octal dowel 5-6 mm
- For dec dowel 6-8 mm

Steel Sleeve Dowels

It is suggested to use steel sleeve dowels only in reinforced concrete walls or floors. This material, which provides economical and quick installation can be used in middle weight forces and average quality reinforced concretes, has safe pinning and clamping feature with easily opened sleeve type even in short holes and low heads. Therefore, it can be easefully used in vibrating parts. Also, it provides opportunity of drilling and assembling while the part that will be fastened is on it.

Using steel dowels for fastening is certainly not recommended in brick walls or walls produced from soft featured materials. Only in necessary situations, chemical dowels which are used with special metal nets, can be suggested. If there will be a fastening with steel dowels, distance between two steel dowels must be at least 16-22 cm depending on the caliber of steel dowel which will be used.

In addition to the steel sleeve dowels those dowels would be used according to the intended use:

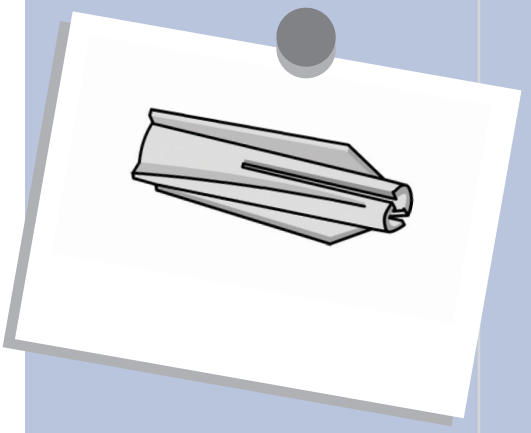
- Draw-in dowels
- Steel drop-in dowels
- Steel chemical dowels

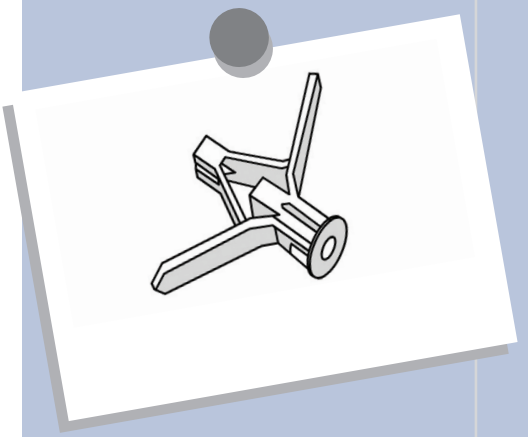
The technicalities of these materials are different from each other therefore it is suggested to get information from an expert before using them.

Aerated Concrete Dowels

This plastic dowel which is designed for aerated concrete surfaces makes a safe instillation on the material. And also with its spiral wings the friction surface and diameter is almost double of the core diameter. It has a high quality plastic as well.

In the application phase you should be careful about breaking, bending and cracking during the setting. A partition joint which is appropriate for the connected part should be used. As we have suggested before, aerated concrete dowels should be used in order to fix the wall bridge to the wall made from gas concrete brick with 15 cm distance between the dowels.





Butterfly Dowels

This plastic dowel type, which is used on gypsum plasterboards and thin wall mountings for fastening, provides a safe instillation with its special wing design. For a good installation appropriate lag or particle board screw should be used. The thickness of the wall must be suitable for the head length of screw.

Butterfly dowels are not suggested for fastening heavy objects. It can be used for fastening the objects max 5 kg. Wall bridges are suggested for fastening the heavy objects.

The Choice of The Screw in Fastening

In the choice of the screw, which is going to be used for fastening of the connector to the object, the material of the object should be known as well. For instance, using "lag screws" for the furniture made from wood, "particle board

	TYPE OF THE WALL			
	BRICK	**CONCRETE**	**GAS CONCRETE**	**PLASTERBOARD**
Weight to be fastened	Plastic dowel	Steel dowel	Plastic dowel for aerated concrete	Plastic Butterfly dowel
0-5 kg	6	-	10	Number 2 or 3
5-75 kg	7	6	Wall Bridge	
75-150 kg	8	8		
More than 150 kg	Consult an expert for fastening objects in such weight!			
Notes	The same diameter is suggested for the plastic dowels with different qualities	The distance between two steel dowels should be min. 16 cm.	The distance between two dowels should be min. 15 cm.	No: 2 is for 10 mm plasterboard. No: 3 is for 12 mm plasterboard.

screws" for the furniture made from MDF or particle board and "metal screws" for the furniture made from metal is going to be the best choice. In brief, for almost all kind of materials different special formed screws should be used. Using the proper screw in doweling would promote the efficiency of the work.

Log and Particleboard Screws

- The screws which are used for fastening the L profile on the furniture might cause breaking or cracking on the material because of their size and length. To prevent this, a pilot hole should be drilled while using the screws which are broader than size 4 and longer than 45 mm.
- For these holes the drill bits which have the half size of the screw should be used (for instance, for a 5 size screw a 2,5 mm pilot drill bit might be used).
- In order to prevent the damage by the screws that might be exposed from the furniture the screws which are a little shorter than the thickness of the wood, MDF or particle board should be used.
- If it is obligatory to use longer screws then the exposed parts of the screws should be covered with hot silicon in order to prevent people and the furniture to get harm.

Sheet Metal Screws

- Metal furniture is produced from sheet metals. In the fastening of these items sheet metal screws are used. In the choice of the screw, the thickness of the sheet material that is going to be fastened should be taken into account.
- The distance between the threads should not be less than the sheet material of metal.
- To prevent the damage by the exposed parts of sheet metal screws hot silicon should be used.

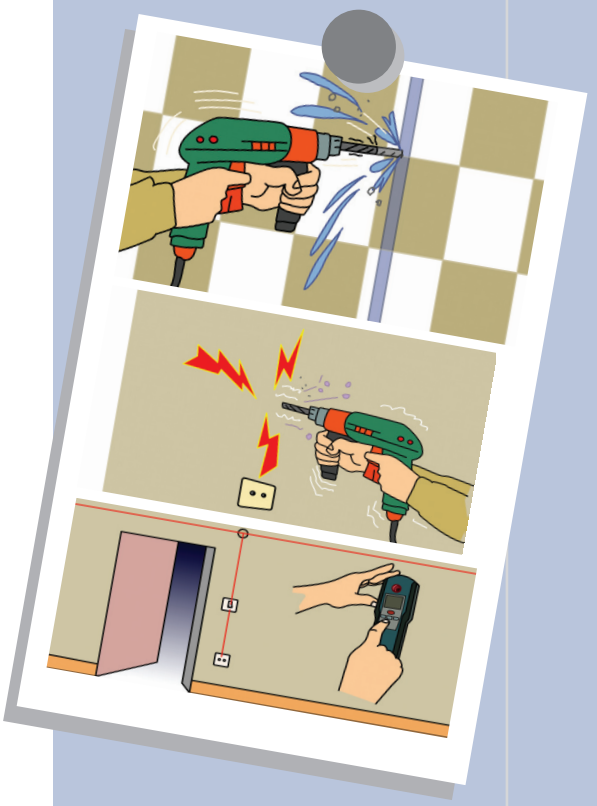
Drilling Process

Before the drilling phase the wall should be checked completely. The electric wirings and the water installations in the unseen parts of the wall might get harm during this process.

In electric wirings, the line between the switch-junction-fuse box and the plug should be observed, there should be no

drilling other than the areas which are not the passing spots of an electric wiring.

The path of the water installations is a little complex. The line between the tap- combi boiler and the thermosiphon can be checked for possible spots of the water installation. But since this process would not be enough using a digital scanner might give a better result.



The Methods of Drilling and The Use of Dowels

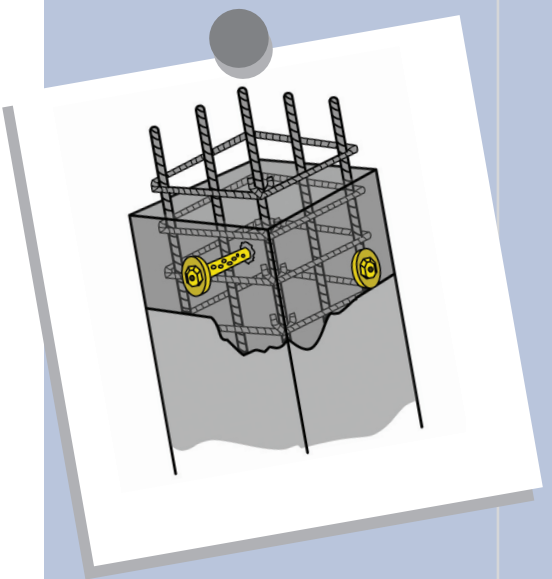
The method of perforation is selected according to the condition of the construction material that is going to be drilled. These methods might be grouped as:

Drill: Hollow brick walls, porous bricks (aerated concrete bricks) and panels (gypsum boards, plywood, etc.)

Hammer drill: Concrete walls, between two bricks which are made from the mortar with proper consistent cement

During the drilling process these points should be taken into account:

- To have the hole depth approximately more than 0,5 cm from the dowel that is going to be used.
- To clean the dust after the drilling process.
- Hammering the screw with zero space between the hole surface and then not to stop clamping before the hammering process.
- To have the screw's length max. 0,5 cm longer than the used dowel.
- Hammering the screw with zero space between the whole surface and first stop hammering then stop clamping.
- Not to cause damage within the steel reinforcement while drilling the concrete structures.

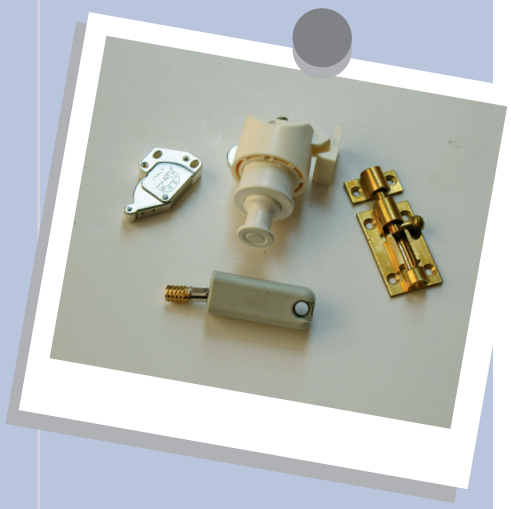


In the process of drilling the concrete structures the hole, which is going to be drilled, should be at least 6 cm inside from the corner points. Besides that while drilling close to the corner points of columns and girders the drilling should be applied min 6-7 cm inside from the corners. After such a procedure not only the protection of columns and girders are provided but also a stronger instillation is done. In case of using steel dowel for the concrete walls, columns, girders, on gir-

ders in hollow-tile floor slabs, and fastening the non-structural objects, the distance between two steel dowels should be min 16-22 cm according to the used steel dowel's diameter.

Fastening Elements for Cabinet Doors and Drawers

Mechanical locks should be used especially for the furniture containing heavy objects in order to eliminate the risks arising from the cabinet doors and the drawers. Mechanical locks enable the cabinet doors of the furniture which contain heavy objects, to be closed tightly. Those locks which close and disclose manually, might work by locking, doweling or pressing a button according to the intended use.



In elimination of the risks by the cabinet doors, the child-resistant safety locks are also preferable. The child-resistant safety locks are easily jointed and disjointed from the kitchen cabinet doors, kitchen drawers, wardrobe doors, cabinet doors and fridge doors.

To eliminate the risk of opening of the cabinet doors and drawers containing light objects in them, the furniture accessories called magnetic locks can be useful. But these should not be used for the cabinet doors containing big and heavy objects because they can open in case of any shift to themselves.

Other Fastening Elements

Different fastening elements should be used for different objects in our environment.

The Objects Hanging on The Wall or Ceiling

Fastening the medium size tableaus, plants, chandeliers, mirrors and clocks hanging on the wall or ceiling by "S Hooks" will reduce the hazards. The metals "S Hooks" are in various lengths according to the weight of the fastened objects. The "S Hook" and the suitable dowel for the "S Hook" should be chosen according to the weight of the item to be fastened.

Ceramic, Glass and Other Breakable Objects

A kind of substance called "earthquake wax", a kind of sticky paste, might be used in order to prevent the damage by ceramic vases, baubles or that kind of ornaments which might break when they fall or roll during an earthquake. The reusable pasty glues, which can be bought from stationeries, or the products like museum wax can prevent the ornaments from falling during an earthquake. But some products would leave a mark on the used surface or move the wall paint. Therefore these kinds of products should be tried beforehand. The applications of these products should be controlled semi annually and if it is necessary they should be refreshed.

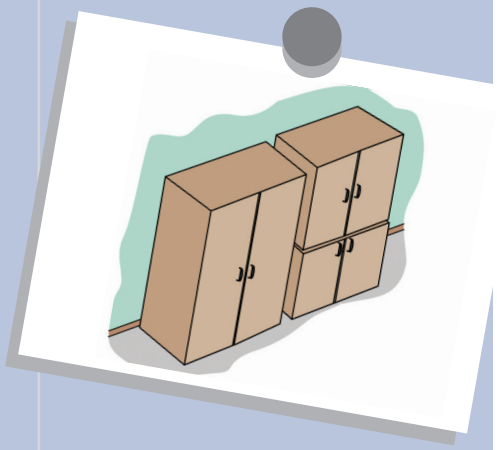
Fax Machines, Printers and Similar Devices

For small devices like fax machines, printers, video and DVD players or tape players which do not have the fall risk but the slip risk self adhesive Velcro tapes might be used in order to mitigate the damage by these items. These tapes in various length and breadth have holder soft and hard binding sides when they are pressed to each other. The adhesive back parts of these tapes can be used in many different surfaces. The Velcro enables you to disjoint the objects and to fasten them again easily if required.

Over Counter Microwaves and Similar Devices

The over counter microwaves, mini electric grills and similar devices do not have the risk of falling but they have the risk of slipping. Since there is a calefaction on the upper parts, the adhesive fabric belts are not suggested for mitigating the risk of such devices. Aluminum angle profiles (30x30x1,5 mm), which are fastened on the ground and remove the risk of slipping, can be used instead of these belts. Aluminum angle profiles can be found in various lengths in the market.

FASTENING OF OBJECTS



Now we can make a little practice with what we have learned so far. Let's mention a few technical aspects on fastening or eliminating the risks by furniture, electronic goods, white goods, hanging objects, objects on shelves, ornaments, glass wares and cases, lightening equipments, heating systems and so on in our homes, schools or offices.

Fastening The Furnitures

To prevent the falling risk of the furniture during an earthquake first of all, the most suitable "fixing position" is determined considering the position of the furniture in its place and some changes can be done if it is necessary.

While defining this position the type of the wall behind the furniture and its closeness to the windows are taken into consideration as well. And then the connector is chosen according to the furniture's type, weight and distance from the wall.

The choice of dowel and screw can be done according to the wall type. And also considering the modular design of the furniture the modules can be jointed each other.

The aim of jointing the modules is to defragment the modules which are disorderly and fragmented (especially the imbricative parts) and to enlarge the floor space to prevent the furniture collapsing easily. But the weight of the furniture should not be over 150 kg after jointing the modules.

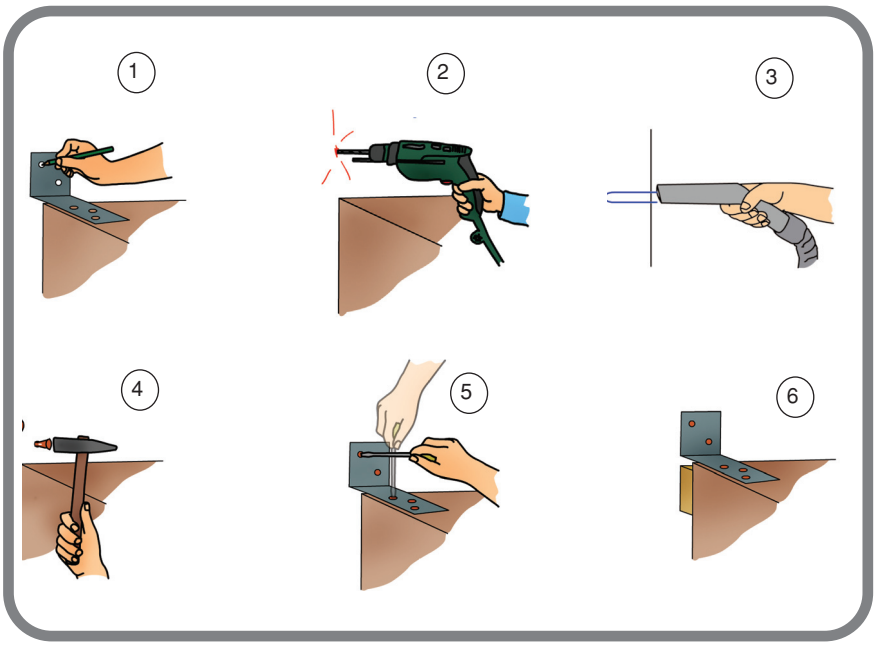
Fixing Steps

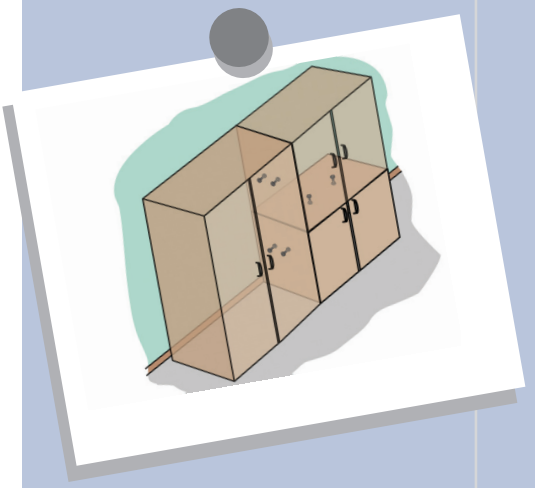
During the process of fastening, the objects the procedures below are followed in turn:

1. The fixing position is defined.
2. The connector is chosen.
3. The dowel and screw is chosen.
4. The modules are jointed
5. The furniture is located as close as to the wall.
6. The marking is done in a way that fastening element is

on the upper side of furniture.

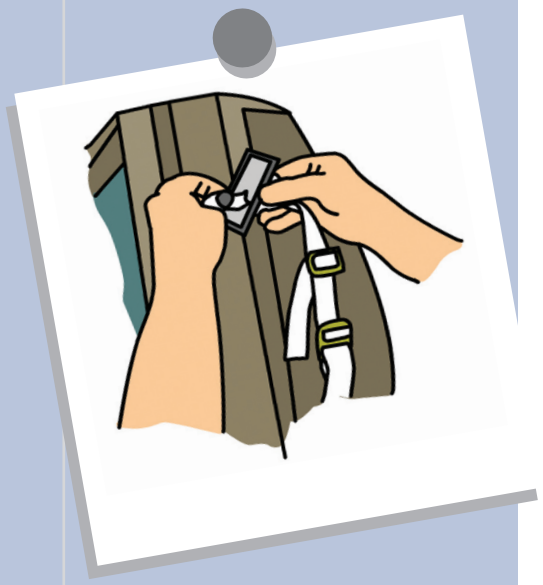
7. The marked places are drilled with the most suitable drill bit to the dowel.
8. The dust of the drilled place is cleaned.
9. The chosen dowels are hammered to the wall with the zero space between the dowel and the wall.
10. The connector is fastened to the wall with the suitable chosen screws.
11. If there is a space between the wall and the furniture some filling material is used.
12. The part of the connector which is on furniture is screwed with the suitable screw (particleboard, metal, wood screw).
13. The same procedure is followed for the each connec tor that is going to be used according to the weight and the size of the furniture.
14. And the procedure is fulfilled by taking the necessary precautions for cabinet doors that might open itself according to the objects inside them (the heavy or light).

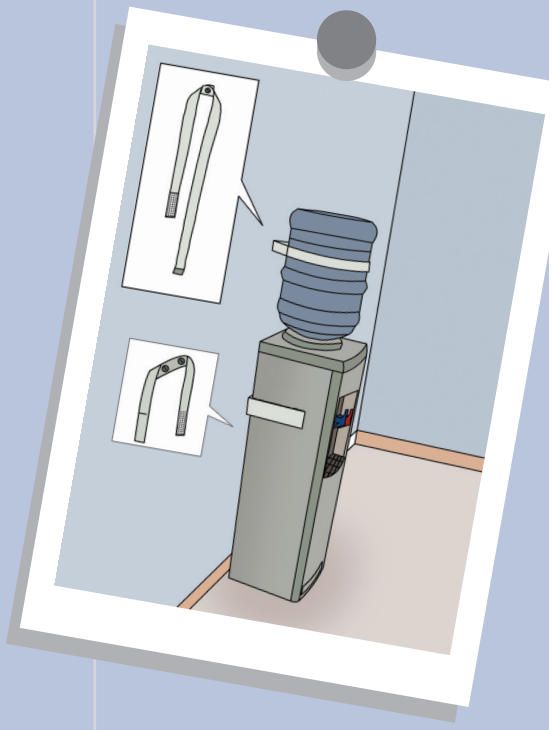




Important Notes

- The big furniture should be fixed all around as much as possible. From the top or the two parts close to the top, from two sides close to bottom part.





- Fastening elements might be installed to the upper or the above parts of the furniture in order to be unseen.
- While fastening the connectors to the top of the furniture it is a useful technique to screw the first hole to the side panel and the second hole to the top of the furniture if it is available. For a safe fastening the joint of the side and top panels should be resistant.

Fastening of The Electronic Items

The greatest financial loss happens when the electronic or electric devices are damaged during an earthquake. It is certain that there would be a great loss of data processing in information sector if the electronic devices are damaged. For this reason, such items should be fastened with suitable techniques in order to reduce the financial loss or job loss and to maintain the work continuity after the earthquake. For the fastening of electronic devices fabric belts or clip strips are used. Light devices are generally fastened over to the tables or counters. For the fastening of the heavy ones the walls and the hard grounds would be used.

Fastening with The Fabric Belts

Medium televisions, monitors, laboratory equipments and other electric devices can be fastened on the tables or other horizontal surfaces by using fabric belts. This would mitigate the risk of falling and rolling.

The process of a fabric belt application is as it follows:

1. A fabric belt is chosen according to the weight of the fastened object.
2. A nonskid material is put under the fastened object.
3. The surfaces which would be applied are completely cleaned.
4. The guard band on the edge of the adhesive surface of the fabric belt is taken away.
5. The adhesive part is applied to side surface nearly 30 seconds with pressure.
6. The other part of the belt is fastened to a table or another horizontal surface nearly 30 seconds by pasting or screwing.

7. After waiting 24 hours all the belts are stretched as much as possible.

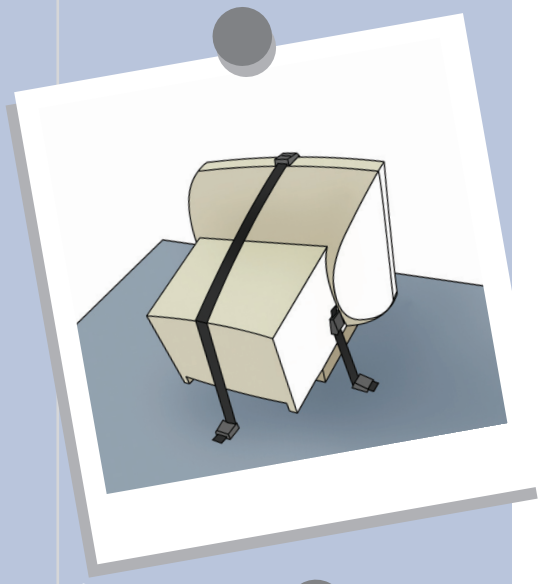
Fastening with Clips

Small or medium electronic devices, monitors or computer cases can be fastened to the tables or other horizontal surfaces with clips in order to mitigate the risk of falling and rolling.

The process of a clip application is as it follows:

1. The use position of the device to be fastened is determined.
2. The number of clip stripe is determined according to the defined position, the weight and the length of the device.
3. The lengths of the clip strips prepared beforehand are reshaped with extra 2 cm on the edges.
4. Before the fastening process suitable size nonskid material is put under the device.
5. The fastening surfaces, which are determined according to the strip's length attached to the clip, are cleaned with an alcoholic cleansing material.
6. The cleaned surfaces should dry without controlling with hand.
7. One of the clips is removed from the guard band and applied to the side of the object with nearly 30 seconds pressure.
8. When the stripe is in the clips, the clip is pasted to the horizontal surface nearly 30 seconds without much stretching.
9. All the stated clips are fastened in the same way.
10. After waiting 24 hours all the stripes are stretched as much as possible.
11. The adhered clip strips are controlled in every six months without much pressure.

While fastening the bands of clips, the clips that are pasted on horizontal surface should be fastened at least 1-2 cm away from apparatus in order not to be opened during an earthquake.



After every maintenance and repair service of the fastened electronic apparatuses, they are fastened at the same position and controlled if necessary the fastening is finished by making the repair with a new adhesive band. The adherend bands that are used cannot be used elsewhere again. In mostly sunny places, it should be controlled in every 3 months and if necessary it should be changed with a new one.

If we leave 2 cm surplus at the end of the plastic bands, it makes the stretching task of adhesive bands easier after 24 hours and the apparatuses which are fastened will be removed and put easily again after any maintenance and repair service.

High tables should be fastened by pulling them to the nearest wall together with televisions that are fastened on them. Because if we fasten televisions to tables, we make them objects which is above heavy and below light and these objects have very high potential to collapse. These kinds of furnitures can collapse more easily. In other words, it is not enough to fasten televisions on the tables that they are on.

Fastening of Small Apparatuses

Velcro connector can be used in order to prevent some risks arising from low and light apparatuses that have possibility to slip but not to collapse during an earthquake. We can specify the fastening steps with the help of Velcro tapes as this:

1) The 2 surfaces of Velcro bands will be fit together and cut in two parts as the size of the apparatus that is going to be fastened.
2) The surfaces going to be fastened are completely cleaned.
3) The backing paper is removed from the one surface of Velcro band and the Velcro band is fastened by pressing lightly and putting the opposite sides coming together at the bottom of the apparatus.
4) The backing paper of the other side is removed; the band is fastened on the surface of a cleaned table or a horizontal surface by pressing completely as long as 30 seconds.
5) After the first fastening, the apparatus is not moved in 24 hours in order to be fastened completely.

If we want to remove low apparatuses from their position that are fastened with Velcro bands, any side of the apparatus is lifted upward slowly. In case of putting it to its place again, the process should be done by considering the first position of the apparatus.

If it is not possible to apply Velcro tapes on the surface of the apparatus, we can minimize the slide risk by putting nonslip plastic materials that cover the beneath of apparatuses. This method should not be used for the apparatuses that have high potential to collapse.

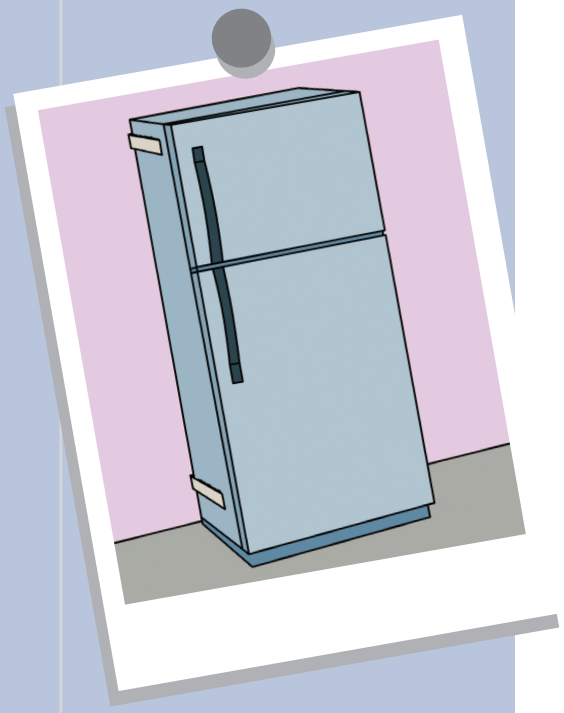
Significant Rules in Pasting Method

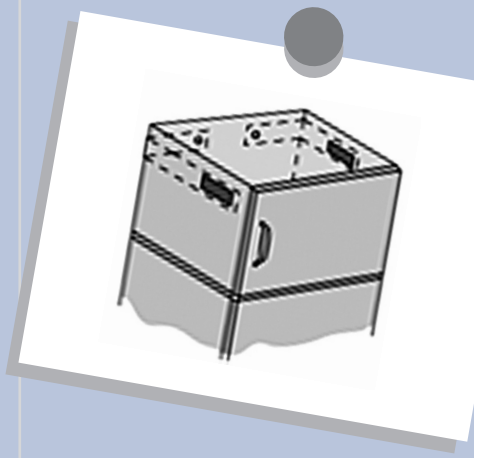
While the screwing method can be used on furnishings in types of furniture, the pasting method is used in order to fasten some apparatuses like white and electronic goods because it is not possible to apply the screwing method. In the pasting method, the surfaces that are going to be pasted should be completely cleaned. The pasting can be applied easily with the steps stated below:

1) The position of the furniture that is going to fastened is made definite.
2) The places where connectors are going to be pasted are adjusted.
3) The adjusted places are completely cleaned with alco holic cleaners.
4) The cleaned places are waited for a while in order to become dry.
5) The cleaned places are controlled without absolutely touching.
6) On the cleaned surfaces, the band of the connector that has backing band on it is removed.
7) The pasting process is finished by applying pressing process for a length of time on the pasted connectors according to the size of the pasting surface.

It is not possible to use the pasting bands on the surface of the connectors that are pull out from the pasted place. If this process is necessary, another adhesive band is used.

In sunny places, the adhesive bands should be controlled in every 3 months and in other places they should be controlled in every 6 months if necessary they should be





renewed. In case of replacing furniture that are fastened after a maintenance service, the position of the furniture should be done according to the former position of the object. So the same connectors are put in use.

Fastening of White Goods

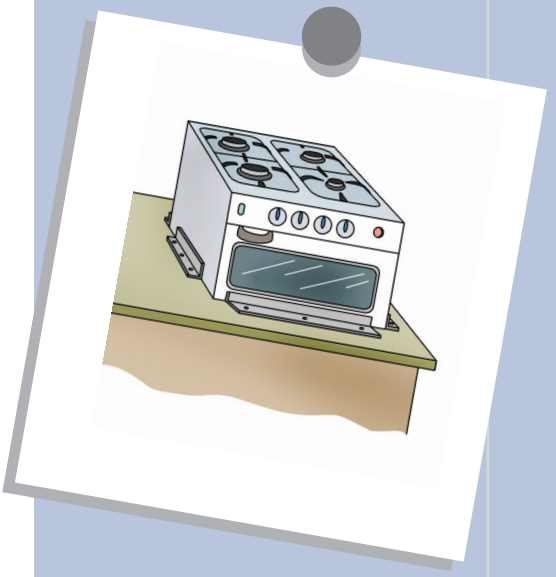
The fabric bands are suggested being used in order to prevent white goods like refrigerator, washing machine and oven from any collapse or slide during an earthquake. The fabric bands that are used to fasten such kind of furniture are used if it is fastened to a wall with screwed or if it is fastened to a white good with adhesive bands. The number of the fabric bands is determined according to the weight of the white good that is going to be fastened. While we fasten any heat generated white good such as an oven, the heat resistant bands should be used. Generally the white goods that have no support around them should be certainly fastened.

If white goods are in kitchen cupboards, by considering the position of the goods, some risks that we can encounter during an earthquake can be minimized with very simple methods. For example, it is not necessary to use fabric bands in order to fasten a refrigerator in a kitchen cupboard. It will be sufficient to use 2 or 4 styropors that is approximately at the size of the space thickness and its size is 20x20 cm from the sides. According to the situation, some very simple precautions will be enough in order to prevent the slide of the white good such as washing machine, refrigerator and oven that are in kitchen cupboards too.

We should follow these steps in order to fasten a refrigerator that is 170 cm in height, 100 kg in weight together with the things in it and has an open space around it:

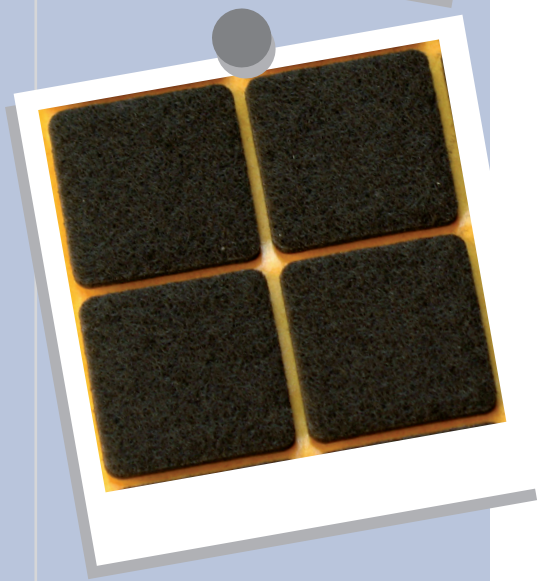
- A broad fabric band (5 cm in width) is preferred according to the weight of the white good.
- 4 piece of fabric bands are used for a refrigerator that is approximately 170 cm in height and 100 kg in weight.
- The points that are going to be fastened are roughly decided.

- Dowels are used in the parts that are coming to the wall and adhesive bands are used in parts that are coming to the refrigerator.
- The holes that are drilled on the wall are marked in a way from the back part of the refrigerator to the at least 20 cm in (to the back of the refrigerator).
- The wall is drilled with a drill bit that is suitable for the dowel size that will be used.
- The selected dowels according to the structure of the wall and the hole size are hammered.
- The part of the fabric bands that is coming to the wall is fastened with a screw according to the selected dowel.
- The refrigerator is drawed up to the wall by bringing it to the fastening position.
- If required, fire resistant filling materials can be used.
- Especially, the fabric bands that are going to used at the upper part are arranged in a way that are not going to be pull away from the top corner (at least 5 cm downward).
- The places that are going to be fastened on the refrigerator are approximately determined and are cleaned with alcoholic cleansing material and waited to become dry.
- The cleaned parts are controlled without touching.
- The sticking part of the fabric band is pasted by pressing approximately 30 seconds on the cleaned surfaces of the refrigerator.
- All these steps are completely applied for all the fabric bands.
- After 24 hours, the process of fastening is ended by stretching the fabric bands from the suitable parts.



We can apply these steps to all the white goods that are going to be fastened according to the weight, size and position of them. Different solutions can be found for some exceptional furniture. For example, the fabric band is not used on toaster oven because of the overheat of the upper parts and sliding tendency in respect of its size. Instead of this, angle bracelets and special materials made of marble are used to wrap the round of the toaster oven and prevent them sliding during an earthquake.

The most significant point as fastening these kinds of furniture is to make the materials that we are going to use in order to fasten the toaster oven wrap the object tightly.



The adhesive bands are not used at the part of the fabric bands that are going to be used in order to fasten white goods to wall and only screwing is used.

As the screwing method is used, the fastening from the back side of the refrigerator to outward makes velcro band to be opened easily during an earthquake. For this reason, the fastening can be done only from the back part of the refrigerator to the inward at least 20 cm.

Fastening of Hanging Furniture

We should take some precautions in order to prevent some furniture that are used in schools, houses and working places such as charts, paintings that give various messages and pots that are hanged from ceiling from breaking by falling during an earthquake. It can be sufficient to use hook screws in various sizes for this.

We should follow these steps as fastening hook screws:

- The hook screw is chosen according to the size of the object that is going to be fastened.
- The dowel is chosen that is fit for the hook screw.
- The drill bit is chosen according to the dowel.
- The wall is drilled with a suitable drill bit.
- The dowel is placed into the hole that is drilled according to its method.
- The hook screw is screwed without any hammering process.
- The hook screw is tightened as much as shroud line will pass through.
- The below parts of the paintings are supported by soft materials in order to prevent any damage that can occur by hitting wall during a shake.
- For the very big paintings-if necessary- 2 or 3 hook screws can be used.

The same methods can be applied for chandeliers and decorations plants which are hanged from ceiling. If it is required, expansion bolt can be used according to the weight of chandeliers or steel reinforcements at the ceiling part of the structure are made use of fastening very heavy chandeliers.

Fastening of Cupboard Doors and Drawers

During an earthquake, the opening of cupboard doors and drawers is one of the significant matters; because there are lots of things in the kitchen cupboards that are going to be broken and fall and create danger. At that point, these things can cause very serious damages for the people around them. So the opening of kitchen cupboards should be prevented during an earthquake.

During an earthquake, these points should be kept in mind in order to prevent the opening of kitchen cupboards:

- The kitchen cupboard design.
- The positions of cupboards (whether it is opened to one side or both side).
- The handles of cupboards (a suitable method is chosen according to the handle of cupboard).
- The weight of the existing load at the back of the cup board door.

It is possible to minimize or cancel out the danger with the suitable elements by considering these factors that we have mentioned. The door locking system that is mechanical and works with manual interference should be used in order to prevent the opening of the cupboard doors during an earthquake.

Different materials are used in order to fasten the cupboard doors that carry heavy and light weight at the back and are opened to both sides.

It is very significant to use mechanical lock-up or child safety lock-up at the cupboards that contain very heavy objects in them.

The nonslip material can be used in order to prevent the sliding of the objects that are on the shelves in the kitchen cupboards. Furthermore, between the each of the porcelain plates that are piled same nonslip material can be put.

The nonslip material can be used in order to minimize the sliding tendency of the low objects that are on the shelves of the cupboards.

The Decorative Furniture

The decorative objects that have very high material and immaterial value; have a risk of being broken and sliding during an earthquake. We should consult experts who use various professional methods in museums in order to minimize the risks of these objects. Except from these, earthquake wax can be used to minimize the risk of sliding and collapsing of our decorative objects which have more aesthetic value than material one. It should be enough to do these steps mentioned below in such a case:

- Putting some earthquake wax around and at the bottom of vase or the other decorative objects like this.
- Pressing strongly (to the shelf or glass case) the object that we put earthquake wax around and at the bottom of it.

If we want to take these objects for cleaning or changing their places after fastening those with earthquake wax, it will be enough to pull them by turning and withdrawing. Furthermore we should be careful not to leave a mark at the place where the object is pasted before.

The Furniture on Shelves

All kinds of books on shelves, files in archives, medicines in hospitals or drugstores, laboratory materials in schools and working places, chemicals in various sectors, products that are put on the market or stored, products that are exhibited in museums and stored there and many products such as these ones can be risky by falling from shelves due to the shake during an earthquake. The risk that occurs causes some adverse outcomes as a result of various factors such as financial losses, various injuries or deaths, job loss and fire.

Primarily, some systems that have shelves on them are fastened to the various places of the suitable parts of the structure in order to minimize the risks that are above mentioned. After this process, various methods can be produced for the materials on the shelves. The risk mitigation methods about earthquake safety are hardly applied for the materials on the shelves.

A wooden mechanism for books can be used at the bottom of shelves that is chosen according to the height of the

books. And also stretched and durable rubber bands can be used a little above of the middle part. Furthermore, if the shelves are completely full with books during an earthquake, this can prevent books on the shelves from falling. Putting heavy books to the lower shelves is accepted as one of the significant precautions.

The medicines in hospitals and drugstores should be placed in glassed and covered shelves. These cupboard doors prevent medicines from falling on the shelves. The medicines in glass bottles should be stored in mechanisms in such a way that they cannot hit each other and the heavy medicine bottles should be place on the lower shelves. They can be also stored in mechanisms that are made of plywood with holes to put the bottles in and this method prevents bottles from hitting each other. Also styropors in medium hardness can be put between the glass bottles to prevent them hitting. Medicines are among the things that are needed after an earthquake.

The mechanisms made from pleksiglas, plywood and styropor are suggested being used in schools, working places and various laboratories in order to prevent breakable experiment materials from breaking after an earthquake.

The Glasses and Glass Wares/Dishes Used in Structures

Glass wares, glass cabinets, glass framed pictures, glassed tables and coffee tables, aquariums, windows and such glassed wares as these ones that we use in our houses can cause injuries and deaths by being broken during an earthquake. As a result of this, financial loss is accurate. These things are also valid for the glass wares in our working places and also the glass doors and glassed shop windows of the shopping centers that are common use areas. It is inevitable that serious financial losses and injuries occur in such a case. Consequently, it is a necessity to take some precautions about the glassed wares that we use in our houses, working places, shopping centers and the other common use areas.

For example, using lamination glass instead of normal glass for glassed shop windows in big shopping centers,

using tempered glass for the glass made tables and coffee tables that we use in our houses and using transparent materials like PVC for big glass framed pictures are accepted as significant steps in order to minimize risks that we can encounter during an earthquake. Applying all the adjustments in this way is the most costless method about risk and hazard mitigation. Relocating sitting and bedroom group and using thick curtains and drapes in front of windows are the first things of them coming to mind.

The Lamination Glasses

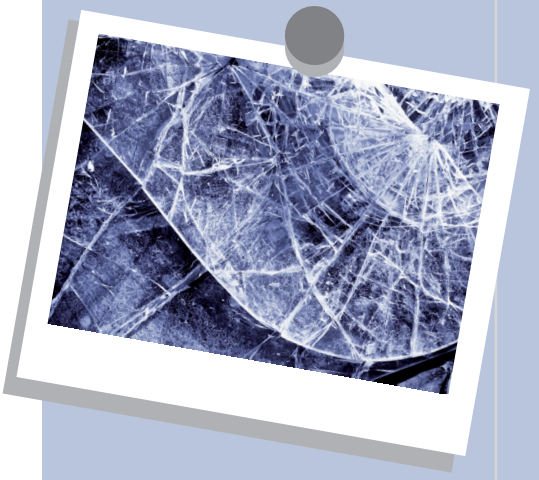
The lamination glasses are produced by combining two or more glass plates with special bond layers under heat and pressure. They are accepted as a security glass in consequence of minimizing the risk of injuries by retaining the broken parts. The lamination glasses are suggested to be used in the shop windows of big shopping centers, glass doors, and decorative glass wares in shopping centers and for construction elements in the other common use areas.

The Tempered Glasses

Tempering is a thermal processing applied to the glass being gauged as a result of rapid cooling and heating to make it 2 -5 times more durable in comparison with a normal glass. The glass prepared according to measurement becomes a glass that is reinforced against heat and hitting after the thermal processing in melting furnace. So the tempered glasses are not broken as easily as normal glasses. If they are broken, they are separated more safe and small spherical particles. The use of tempered glasses will be considerably advantageous for the safety of children who are injured excessively because of pieces of broken glass in houses. At the same time, during the evacuation after an earthquake, using tempered glasses at exit way and doors in crowded places will make the exit easier by minimizing the injury risk because of pieces of broken glasses. The tempered glasses can especially be used at dining table, coffee table, television tables, cabinets and shelves, refrigerator doors, shower cabins, the exits of subway, architectural facing designs, bus stations, balconies and the exits of hotels.

The Safety Glass Films

The safety glass films are used to protect the big glasses of structures or the stable furniture made of glass, tall dressing mirrors from any damage during an earthquake. These films vary between 50 or 350 microns thickness and used as transparent or painted, increase considerably the feature of durability of the glass against the risk of breaking. The film is applied to the inner part of a glass. The glasses that are not reinforced with any method can be covered with a protecting safety film by a professional person. The safety film plate should be applied in such a way that when the glasses are broken, it will prevent them from being separated into small and sharp pieces. The expected life of these products which prevent glasses being broken and scattered around in every applied place changes according to the places applied.



The Lighting Elements

The lightening elements like lamps generally break by falling, collapsing and coming out from the places during an earthquake and therefore cause financial losses. As a second risk, they sometimes cause fire and in some cases injuries. The stated risk circumstances can be minimized with simple technical methods that are suitable for production technologies and usage aims.

The Lightening Hanging from Ceiling

Chandeliers are the most risky one among the heavy lightning elements hanging from ceiling. These objects that are very heavy because of their glass decorations impose burden on the connectors from which they are fastened to the ceiling. These kinds of lightning elements should be fastened with special closed edge hooks or closed circle system instead of weak and opened edge hooks. Chandeliers are hanged with special screwed safety collar that are named as carabine to these closed edge hooks. Very heavy chandeliers should be fastened with special methods to the steel reinforcement at floorings. Furthermore, the lightning elements that are hanged side by side, should be fastened apart from each other and so they should not hit each other during a shake.

Heavy Cables

In big shopping centers there is a great need of cables because of the items that runs with electricity like shop window lightening, floor lightening, air conditioners, aspirations, etc. This leads to a risky situation since when many cables come together they become heavy and hot. In such places cables must comply with the standards and must be chosen among the best quality cables. The cables must be in the steel cable channels which are strong enough to carry their heaviness. These steel channels must be fastened carefully according to the heaviness of the cables that they bring to structure.

Other Lightening Elements

Fluorescent lamps which are located in the band armatures in our houses, schools or other places fall down from the lampholder during an earthquake. Especially in schools band armatures are widely used. In order to prevent fluorescent lamps' easy downfall from the lampholders during an earthquake, using simple items like cable attachments will be enough. Using armatures which have sheltered mechanisms instead of fluorescents will be safer.

Floor lamps which are more preferred these days may cause fires because they are used with high watt bulbs which easily get hot and fall down at the moment of an earthquake then fire may breakout when they contact with flammable materials like clothes. That's why such kind of lightening elements must be fastened to the walls with steel mechanisms. Furthermore weight of lightening elements which are in hanged ceiling systems should not be on the system but these elements must be fastened to the structure. Lightening elements like glass lamp shades should be fastened to the tables.

Actually the best solution is to prefer small accessories in lightening elements.

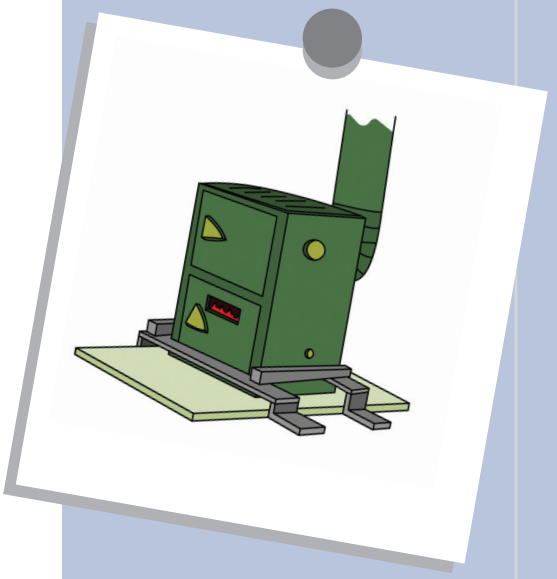
Heating Systems

Coal or wood stoves or electric heaters that we use to heat up the environment in winters can fall down or slip and injure the people who are around during an earthquake. The most important thing is that they can cause a fire and as a result there can be an increase in the number of injured or dead people.

Electric Heating System

The most dangerous side of electric heating systems is that they can fall down and cause a fire. So in order to minimize the risks, electric heating systems should be in a size that cannot fall down or their circuits should be cut off when they fall down during an earthquake. For example, instead of an element that is high and that can fall down easily, a short and wider element should be chosen to prevent them falling down in case of an earthquake.

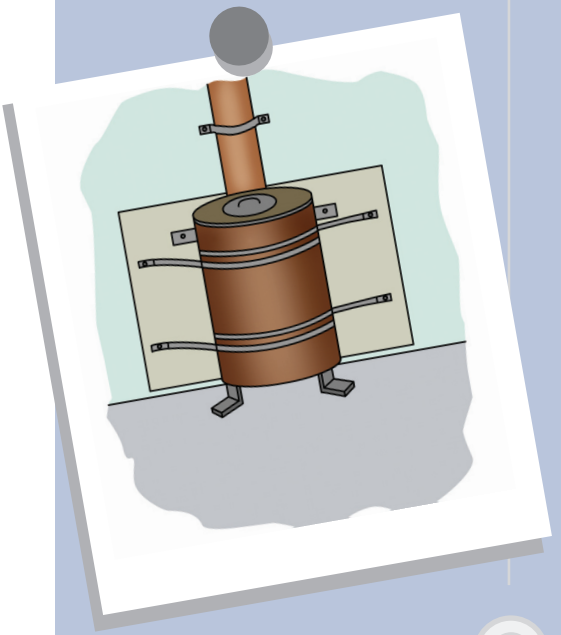
Sometimes electric heating systems are located on benches or tables. When it is considered that they can slip down from such places, it is obvious that they must be used on the ground level. Heating systems that are used by fastening on the structure minimize the risks of these systems. Such kind of heating systems must be kept away from the objects which are flammable like curtains, armchairs and carpets.



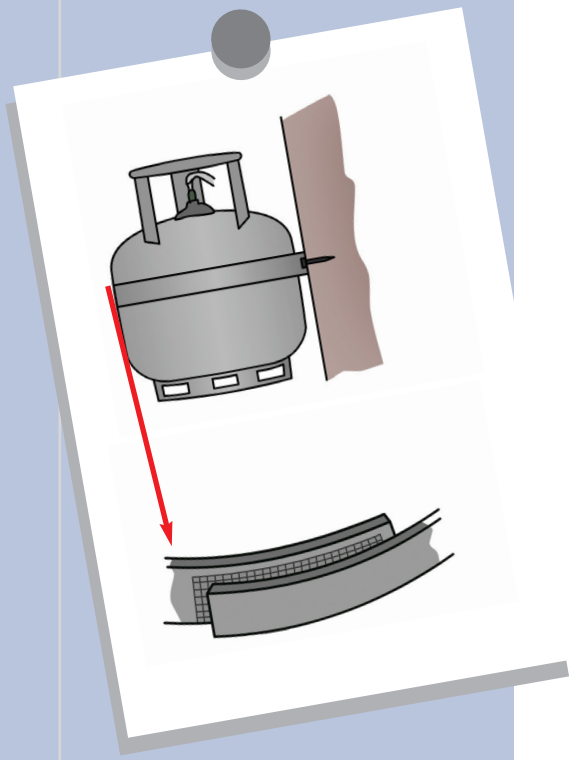
Solid Fuel Heating Systems

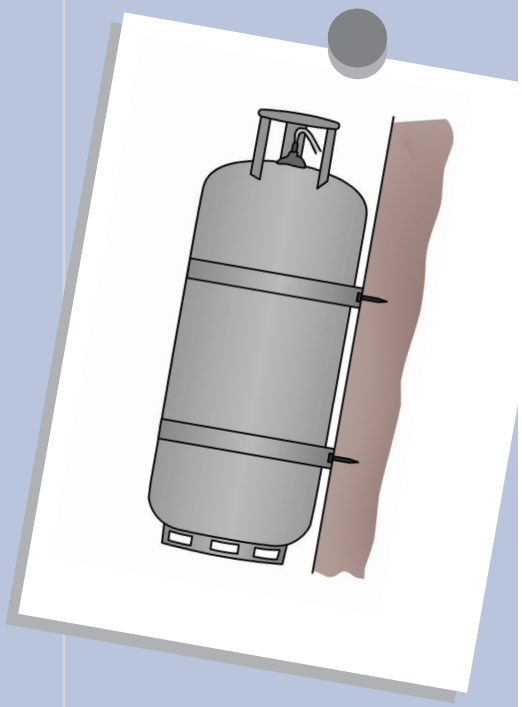
Stoves that work with coal or wood or with other solid fuels are widely used in some places where there is no natural gas. It is discovered that during an earthquake these stoves easily fall down and cause fire. Solid fuel stoves must be established near the chimney as much as possible. Those stoves must be fastened to the walls with the help of special clamps which are located at least two meters spaced from each other in the connection points of pipes.

Stoves which are near the walls are fastened to the walls from the closest point by taking a one and a half stroll both from under and over it with the help of flexible metallic bands. Solid fuel stoves which are located in the middle of the rooms can be fastened with some invalid methods. However, placing the stoves near the walls and chimneys is the most correct thing to do.



Another important subject in the use of solid fuel stoves is to arrange them without hindering the exit ways. Moreover, the covers of the stoves must be closed and nothing should be cooked unless it is necessary.





Gas Cylinders

12 kg domestic cylinders that we use for cooking and heating in our houses, 45 kg industrial cylinders that we use in our hospitals for health purposes and 25 or 45 kg industrial cylinders which we use in our working places for production purposes can slip or fall down and cause gas leakage and then fire during an earthquake. This can cause secondary risks as poisoning of living things. That's why the following points should be taken into consideration:

For domestic cylinders;

- The hose's connections, which bind the device and LPG cylinder, with the hood (regulator) and the device, must absolutely be done with clamps.
- The hose's length must be between 125-150 cm.
- Connection hose must be checked frequently and when it gets older, softer or tougher it must be changed. Furthermore even if the hose seems normal it must be changed 3 years after the production year.
- There must not be flammable materials (like plastic curtains, carpets and clothes) near the device.
- LPG stoves must not be used in places smaller than 3 m^3 and when people sleep in the room.
- If LPG devices are used in unaired and small places then the rooms must be aired regularly.
- The most important point is to fasten the cylinders to the closest surfaces with fabricbings.

The biggest risk of industrial cylinders occurs if the cylinder falls down and pressure control device is broken and this causes job loss until a new pressure control device comes.

Such kinds of cylinders are the most needed elements in the hospitals after an earthquake. Some patients will intensively need to use oxygen cylinders.

Cylinders must be fastened to the closest surfaces at least from two points. While fastening the cylinder, fabricbings can be used instead of metal chains if it is necessary. Same process can be followed when the cylinders are stored or when they are changed with the full ones. There must be 6 kg house hold fire extinguishers near the gas cylinders.

There are non-structural risks not only in our houses but

NON-STRUCTURAL RISKS IN COMMUNAL AREAS

also in the places where we work, study and we spend our time during the day. Since we cannot know where we will be during the earthquake, mitigating the non-structural risks in everywhere gain importance. In case of an earthquake, hospitals and schools must certainly remain undamaged. A hospital or a school which is free of non-structural risks will be ready to serve in a short time after an earthquake.

Schools

There are a lot of non-structural elements in the schools. There are some objects like glass boards, teachers' desks, glass door cabinets, and projectors, etc. which create non-structural risks in the classrooms. Moreover chemicals in chemistry, biology and physics laboratories, glass objects and electronic devices in computer laboratories can cause serious harm. All these risks can be minimized by applying the general rules that are given in previous chapters. Thus we can manage to minimize the possible damage of an earthquake in the schools.

Hospitals

Hospitals are the most needed places after the earthquakes. While there should not be structural problems in the hospitals so as not to lose their functionalities, in the past, hospitals became unusable after the big earthquakes due to the non-structural damages.

There are lots of non-structural components in the hospitals. Especially big medical devices, glass objects, glass cabinets, sickbeds, IV poles, medicine cabinets, laboratory equipments, microscopes create non-structural risks. Falling down of the glass cabinets and medicine cabinets and breaking of the glass materials like serums both increase the rate of injuries and also affect the evacuation during an earthquake. The sickbeds can injure the people because they can move around on their wheels. All these risks must be minimized under the control of an expert via proper equipments and methods.

Social Activity Areas

Populated places like shopping centers, cultural places and sports centers can cause serious damages during an earthquake. There are lots of non-structural components like big shop windows, benches, commodities and hazardous materials in these places. These components can cause great harm during an earthquake. Studies to minimize the risks of non-structural components in social activity areas must be done according to the dangers and risks that are defined. Selecting the equipment which is going to be used and the applications must be carried out by experts.

Outdoors

We confront with non-structural risks when we go out of the places we live in especially in the streets. When some objects like; signboards, air conditioners, billboards, outdoor windows, satellite dishes, hanging flower pots, bricks and chimneys etc. are not well assembled they might create risks. All these objects must be fastened very well or their places must be changed in the way the risks are eliminated. In this subject an expert can give support.

FREQUENTLY ASKED QUESTIONS

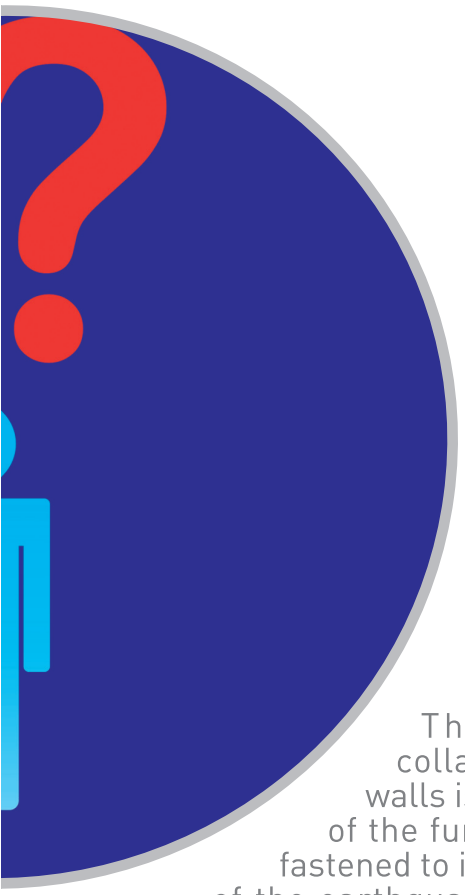
I do not trust to the building I live in, what would be different if I work for minimizing the non-structural risks?

Everyone can have some hesitations which hinder those taking precautions for non-structural risks or keep their minds busy. You can have some problems associated with your building but this should not be an obstacle for you to minimize the non-structural risks.

In 1999, 17 August Kocaeli Earthquake 3-5% of the buildings is completely destroyed and most of the people lost their lives in those buildings. On the other hand 1% of 1.5 million people who were affected from the earthquake lost their lives. The remaining 99% struggled hard to reach the standards which they had before the earthquake. We know that all the earthquakes do not destroy the buildings and cause great harms, however especially in the upper parts of tall buildings objects can fall down in a small quake even if the building itself is not damaged. That's why minimizing the non-structural risks is important.

The building I live in is very strong/safe. Do I have to take precautions to minimize the non-structural risks?

When we look at the risk related to the earthquakes we see that structural risks are in the first place. If you know your building is constructed for the regulation, how it is built and what kind of materials are used and if you are sure that they are safe or if you trust your building it means that you have eliminated the structural risks. However after eliminating the structural risks, non-structural risks should be minimized. When you do the second important thing, you minimize the effects of the earthquake.



If I fasten my furniture to the brick wall wouldn't it cause the wall to be destroyed during an earthquake?

The reason of collapse of the infill walls is not the burden of the furniture which is fastened to it but the burden of the earthquake on the sidewalls. Earthquake can damage your building. Infill side walls can crack or break down during a moderate or severe earthquake. The main reason of fastening the furniture is to enable them to move with the building. Namely it is done to prevent the furniture move in the opposite way of the building during the quake. In this way objects will not fall down.

My furniture and other objects did not fall down in the previous earthquakes. Why do they fall down in the next ones?

Seismic waves can come from different directions and your building can shake in different ways. In 17 August Kocaeli Earthquake seismic waves came from southeast and south whereas in 12 November Düzce Earthquake seismic waves came from east. Although in the first earthquake most of the objects did not fall down, they fall down in the second one. From which direction the new earthquake will come is not known. In order to eliminate all the risks working for minimizing the non-structural risks is important. In this case the objects will not fall down no matter from which direction and from how far the earthquake occurs.

GLOSSARY

Concrete drill bit: it is a kind of drill which is used to drill the concrete. Its bit is durable against concrete materials.

Glass protection film: it is a film made of polyester which is applied to the glasses with the help of special sticky materials to improve the safeness of the glass.

Steel dowel: it is a dowel made of steel materials and produced in different shapes depending on the intended use and they have high bearing capacity.

Column: columns are the structural elements which carry the burdens of the structures in vertical form.

Girder: girders are the structural elements which carry the burdens of the structures in horizontal form.

Plywood: it is a wooden panel which is composed of dried and slim tree layers. The layers are aligned cross to each other and then pasted to form plywood.

L profile: it is a material made of metal which have cross holes to fasten the objects on it and it is sized according to the intended use.

Laminated glass: it is produced with the help of special binder "ethylene vinyl acetate (EVA)". Two or more glass plates are united under pressure and heat to produce laminated glass. When it is broken it does not fall into pieces which minimize the risk of injury.

MDF: it is a product made of fibers of wood or other special cellulosic raw material as thermo mechanics. With addition of synthetic glue, fibers are dried until a certain humidity level. Then an outline of a board is pressed under heat and pressure. At last MDF is produced. MDF means medium density fiberboard and composed of the initials of Medium Density Fiberboard.

OSB: OSB means "Oriented Standard Board". It is a homogeneous material which is enduring humidity and hits. It is composed of 100% pine tree chips and they are directed and glued with special resin resistant to external factors.

Slat: it is a material composed of scraped slim calibers and they are dried in ovens with the help of special glues after they are dehumidified under a certain heat and then they are pressed.

Lag screw: lag screws are produced according to the situation of the gears which are opened to unite the sheet materials. When the leg of the right triangle is wrapped around a cylinder along the base of it, hypotenuse of the triangle creates a helical line on the cylinder. If canals are opened with equal breaks in different shapes like triangle, square or trapeze on the cylinder along the helical line, the profiles are named as screw.

Tempered glass: it is a material which is acquired from normal glass. Normal glass is made enduring to heat and hits with special techniques of heating and shock cooling.

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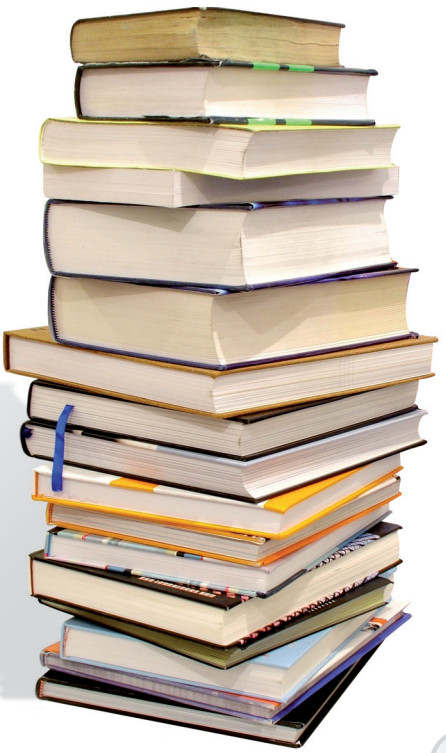

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Notes


Notes

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