Earthquake Resistant Architecture

Lecture 10

Urban Planning and Design

Why and when do we usually do a urban planning urban planning is a very different specialization it's not something that can be a minimize and put into one subjects of why are we still learning urban planning in this particular lecture it is because urban planning kind of help you know every time you learn urban planning you actually learn about what are the various factors that has to be plan in order to make City what are the various planning aspiration considerations when you do and urban area but this particular lecture we would be seeing a more of urban planning from a very different perspective that is a seismic perspective like what are the various factors that has to be considered while creating an urban area a building for urban area while make your mind Keeping It earthquake resistant that is the major thing consider here,

Urban planning is a technical and political process concerned with the development and use of land, planning permission protection and use of the environment public welfare and the design of the urban environment including air water and infrastructure passing into and out of the urban area such as transportation communication and distribution networks so first and foremost thing that will be seeing right now is the vulnerability of existing buildings if you can see in the picture every town will have one side of buildings that already existing in it so what happens when an earthquake strike in the particular area would those building able to stay intact and not be vulnerable to earthquake or would actually Come down and fall down as a part of the earth we can see this city before earthquake look like this in one earth quake strikes look like that there are some building that still stays there are some building that prove to be earthquake resistant there are many building that actually give up and that fell down so you can see all the buildings that fell down only one or two are still existed only one or two are still staying others all fell down.

Talking about the vulnerability of existing buildings the problems of repairs reservation and seismic strengthening of buildings briefly stated so before the occurrence of the probable earthquake required strengthening of seismically week building is to be determined by survey and an analysis of an structures to just after the more damaging earthquake temporary supports and emergency repair has to be carried so that a precautionary standing buildings may not collapse during aftershock and the less damage once could be quickly brought back into use.

The real pair and strengthening problems are faced at the stage after the earthquake when the things not settling down at this stage distinction has been made in the type of action required

that is prepared, reservation and strengthening since the cost time and skill required in the three may be quite different the decision whether a given building needs to be strengthened and to what degree must be based on calculations and show the levels of safety demanded by process codes and recommendations met. Difficulties in establishing actual strength arise from the uncertainties Constable related with material properties and with the amount of strength duration due to age or to damage suffer from the previous earthquakes.

The method of repair and strengthening would natural depend very largely on the structural scheme and the materials used for the control of the building in the first instant the technology that is feasible to adopt quickly and on the amount of funds and can be assigned to that are strongly very limited some methods like bandages wire mesh epoxy injection extra already been tried and applied in various countries for repairing as well strengthening earthquake damage building.

Moving on to the next wind up the topic that is repair restoration strengthening concept so the underlying concepts in the three operations are for the repair the main purpose of repair is to bring back the architectural shape of the building so that also will start working and the functioning of the building received quickly.

Repair does not pretends to improve the structural strength of the building and can be very deceptive for meeting this strength requirements of the next earthquake so what happen when there is a building and a building fails during the earthquake it falls at it it's half of it is regarding most of it is still Standing and if the damage caused by that earthquake on the buildings very limited then that can be repaired in order to use again immediately, So once and earthquake strikes a place there might be many reasons why a building needs to be recovered because I were many people many people there will be homeless then there will be many people who will immediately need the house back into full form that's when they do repair usually the fund effective in allowed for the repair works after the earthquake is very limited so what does repair do they usually bring back the building no into full working from where it have all the services in all the functionalities of the building we know that would be working again but structurally being stable or not is not sure of am and repair was the being carried out because basic structural stability can be promised .

The actions will include patching up of defects such as crash and fall of plaster repairing doors Windows replacement of Glass pane checking and repairing electrical wiring checking and repairing gas pipes water pipes in farming services rebuilding non structural walls smoke chimneys boundary wall. So in the picture you can see how a one part of the building has fallen down and after repairing it was brought back into functioning building so the structural stability of this building is unsure of like will that stand another earthquake is not unsure but the patching works and the patching work of repairs like cracks in plaster cracks and the doors and

windows replacement and electrical, The gas line checking and plumbing and checking and the water pipe checking all that is running that is repaired .

Action will include Re plastering of walls is required rearranging distributed roofing tiles relaying cracked flooring in ground level and redecoration whitewashing painting etc.

The architectural repair the state do not restore the original structural strength of the crack walls or columns as I said before and may sometimes I'm very used, since decorations between will hide all the weaknesses and the building will suffer even more severe damage if she can again by an equal shock original capacity will not be available so once a building is trying to hit it by now earthquake and all the repair work done in looks really finished and from outside it gives your perspective as the as soon as like it would it looked really complete and neat so it kind of heights the camouflage is the original structural deficiency of the particular building so once the aftershock is as strong as the original earthquake or another earthquakes try the same area the building will be even more prone to that earthquake then how it was before the first equator earthquake strike did because repair doesn't give it structural stability because it will already be hit by the earthquake is structurally to be even though even less stronger than what it was before the first earthquake strike with the damage would be more.

Restoration is a restitution of the string the building had before the damage occurred this type of action must be undertaken when there is evidence as structural damage can be attributed to exceptional from another and not likely to happen again and again and the originals strength provide adequate level of safety.

The main purpose of restoration to carry out structural repairs to load bearing element in may involve cutting portions of the elements and rebuilding them or simply adding more structural material so that the original strength is more or less restore the process involved inserting temporary support underpinning extra.so maybe once an earthquake strikes a building and the building is completely Architecture finishers of the building is completely gone where it is structurally stronger then another building structural restoration is made so that they will start functioning structurally as good as it would have before the earthquake strikes structural it could be made again

structure again so this particular process is called Restoration that can be done with multiple ways you know adding columns or riding element adding structural pin multiple ways in order to do restoration so if you can see in this particular picture this Church had fallen off during the earthquake and a restoration work is being carried out which will make the outlook as an architectural a company as well structurally very stable.

Some of the approaches for the restoration removal of portions of crack masonry wall and pipes and rebuilding them in richer motor use of non shrinking motor will be preferable

addition of reinforcing mesh on both faces of the crack wall holding it is a wall through Spikes or Bolt and then covering is suitably.

Several alternatives have been used in epoxy material and integration epoxy like material which is strong intension into the cracks and walls columns beams etc so this kind of restoration works are even carried out in multiple other areas especially by Archaeological Survey of India when there are historical building that are being restore are by other restoration process for any other structural building. Those kind of restoration process are used for the earthquake affected buildings in order to bring it back to structural stability.

Strengthening of Existing Buildings

The seismic behavior of old existing building is affected by the originals structural inadequacy material degradation due to time and alteration carried out during over the years is making new opening addition of new parts including the cemetery in plan elevation etc.

The possibility of substituting them with new earthquake resistant building is generally neglected due to historical and social economic reasons for the complete replacement of the building in a given area will also lead the destroy the number of social and human links, therefore seismic strengthening of existing damage or undamaged buildings can be different requirements of the same area strengthening is an improvement over the originals strength over the evaluation of the building indicates the strength available before the damage was insufficient and restoration alone will not be inadequate in future quits so what happened one is there are some buildings which we repair there are some building restored there are some buildings that be strengthen.

The difference between the three is very important understand repairing we only repair the architecture finishers of the building just to make it more livable we bring back the services in to the functioning we bring back the architect it finishes in the proper that makes it look really stable but structurally it will be even more brittle or even more and less stronger than how even less stronger then how it was before the first earthquake strikes in restoration what do we do is we realize that the first structural stability of the building is good enough before the earth strike it still can be repaired to be a structurally strong building so what we do we add structural stability and structural members to the particular and make it look more make it structurally more strong as strong as it was before earthquake affected it because we're kind of restoring the structural quality that the building process before the earthquake hit it and strengthen of the existing building is when we realize that the amount of strength that the building process before the earthquake hit it is not completely sufficient so is it important to re strengthen it and increase the strength of the particular buildings and make it more suitable for the future quakes if any.

If you can see in this particular you know which you can see that many supplements are added in the structural stability is being in improved in a particular building the extend of modifications can be determined by the general principles and the design methods stated in the other discussion that we had before another lecture and should not be limited to increase in the strength of the members that I have been damage it was should consider the overall behavior of structure, so basically in restoration we consider each and every element of the particular building that was structurally damage than we restore it and here we consider the overall building and the structural performance of the overall building and we work out the structure of the particular building based on the building and we redo The structures so commonly strengthening procedures should aim at one or more of the following object that is increase the lateral strength in one or both directions by reinforcement or by increasing wall areas of the number of walls and columns.

Giving Unity to the structure by providing a proper connection between its resisting elements in such a way that inertia forces generated by the vibration of the building can be transmitted to the members that have the ability to recess them, Typical equally important aspects are the connections between the roof of the floors and walls between intersecting walls and between the walls and foundations Eliminating features that are sources of weakness of the produce concentrations of stresses in some members asymmetrical plan distribution of resisting members abrupt changes of stiffeners from one floor to another floor concentration of large masses large openings in the wall with the proper peripheral reinforce examples of defects of this kind. Avoiding the possibility of brittle modes of failure by proper reinforcement and connections of resisting members since its cost may go as high as 50 to 60 % of the costs of rebuilding the justification of such strengthen must be fully consideration.

So basically then going for a rebuilding of a particular line because there are some human lives and there are some reasons why the buildings can’t be restored we are actually investing 60 percentage of the total money of a restoring of a building actually going the strengthening the building so each that's the reason why each and every element structural element that particular building should be completely analyze completely understood and then building be seen as a hold structural element and then the strengthening of a structure should be done so that it can be stand the quake.

Repair Materials

The most Common repair materials for damage repair works of various types of cement many situations none stinking cement or an admixture like aluminum powder in the ordinary Portland cement will be admissible.

Steel will be required in many forms like balls like roads angles like channel expanded metal welded fabric.

wooden bamboo are the most common material for providing temperature support and scaffoldings extra and will be required in form of round sleeper ,planks etc.

Shotcrete is first prepared material method that we use, shotcrete is the method of applying a combination of sand and Portland cement which Mixed pneumatically and conveyed in dry stable to the nozzle of a pressure gun where water is mix and hydration takes place just try to expansion the material bands perfectly the properly prepared surface of masonry and steel.

In variability of application to cure irregular surface is strength after application and good physical characteristics cables and other elements there are some minor restrictions of clearance thickness direction of application etc.

Next is epoxy resin epoxy resins excellent binding agent with high tensile strength these are chemical preparation compositions of which can be changed as per requirements

Epoxy Communism mix just try to the application the product is low viscosity can be injected in small cracks too.

The higher viscosity epoxy resin can be used as a surface coating of filling logic cracks they epoxy mixture strength depend on temperature of curing. Lower strength of the highest temperature and method of application for large white spaces it's possible to combine epoxy resins of either low viscosity or higher viscosity with sand aggregate to form epoxy mortar the epoxy mortar mixture has higher compressive strength higher tensile strength and a lower modules of elasticity than Portland cement concrete. this the motor is not a stiff material for replacing reinforced concrete is also reported epoxy combustible material that was not used alone so this is the most common repair material that we use epoxy one.

This sand aggregate mixed to form the epoxy motor provides are heat sink for heat generated and it provides increased modulus of elasticity too.

Gypsum cement mortor, it has got rather limited use for structural application it has lowness strength at failure among these three materials

so first one is a Quick setting cement mortar material this material patented and was originally developed for the use as a repair material for reinforced concrete floors adjacent to steal blast furnaces.

It is a non hydrous magnesium phosphate cement with two components a liquid and dry which can be mixed in a manner similar to Portland cement concrete next is a mechanical anchors for

mechanical type of anchors employee using actions to provide Anchorage some of the anchors provider and both shear and tension resistance. Such anchors manufacturer to give sufficient strength alternatively chemical anchors bonded in drilled holes polymer adhesives can be used. so basically we learn about like a four major repair materials for the buildings as I said when we do repair of a building what we basically she is we kind of find out small architectural failures of the particular building and services failures of the particular building and kind of bring that back into working condition so what we do if we don't add new material we just have to add more

Material to the existing failure whether it will actually come back to working conditions of these kind of repair works done only in the buildings where in the damage is very limited so that is why the first material that it is a shotcrete combination of sand and Portland cement and this is converted in dry state and its added to the nozzle of pressure gun and then the water is mixed and that is why the hydration takes place and then we expel it so the best part about this particular method is that band perfectly to properly prepared surfaces and like masonry and steel and then make it look new so basically in applications of curve and irregular surfaces application also

good physical characteristics that is the bases used and in epoxy resins is basically it can be used from small quantity to high quality usually whenever there is a large crack or hole and there were there has to be some filling to make it look normal whenever it has to be a plane surface we use the epoxy resin to fill the crack of fill the hole and make it completely new the basically epoxy resins strength is completely depending on the temperature of curing that we do and the method of application that we do, there are multiple method of application of epoxy resin and when can’t be use the larger

The white spaces we mix this epoxy resins with low viscosity of high viscosity results of low viscosity or high viscosity is of sand aggregate and that particular a mixture of call epoxy mortar.

Basically epoxy resin is used for smaller cracks, smaller hole when the crack for bigger the holes are bigger we mix this particular epoxy resin with sand and then we make that becomes epoxy mortar and that would be feeling bigger areas of water. Epoxy mortar is better for bigger areas because of the high compressive strength find of a hold it together and make sure that it gives the tensile stress and less elasticity modulus .is this particular

The motor is stiff material for using reinforced concrete and that's why we use Gypsum cement Moto so Gypsum cement motor is got very limited useful for structural application because of that this is the no this particular element has the lowest strength among all the other materials that I just discussed with you.

Next is the Quick setting cement mortar so quick settings in Moto is just basically for the blast still blast furnaces so that's also used for this particular use can a mechanical anchor nothing but basically anchors to provide Anchorage on those areas which needs to be given sufficient tensile strength or resistance so this kind of gives more sensing to make it hold it together that's when we use mechanical anchors so these are the repair materials we use.