Fire Protection, Services and Maintenance Management of Building

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Lecture – 37
Stages of maintenance management

So, let us now define repair rehabilitation retrofit these terminologies are often used these days. This terminologies actually you are not known let us say over 30 40 years back because, you know in our country it was all new construction. But then this became very important, as I am saying maintenance is becoming important and important more you construct infrastructure more maintenance requirement to there more you construct buildings maintenance would be involved.

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So, what is repair? Repair relates to restoring the functional performance to an acceptable level that is what we are saying like patch repair I am saying right. Rehabilitation means complete structure or complete buildings that is the terminology, whenever we say rehabilitation it does not mean one localized repair it means everything. You know whole structure is a whole we will take whole building as a whole and then retrofit is related to currently acceptable standard means nothing might have gone wrong but I decided to retrofit to the.

So, something like your terminal is like energy retrofit, means the currently the building is there. But it is energy consumption is too high and current standard something like ECBC you know energy conservation building code and all that there is a you know you come bring it down do not have per square meter of keep that much energy per year I do not you will not it is not allowed. So, in that case you have to retrofit it to current recovery nothing has gone wrong really.

Similarly, earthquake engineering this is very common as I said perception of seismic risk keeps on changing, not that world universe has change or the tectonic things have change. But our perceptions are changing as the knowledge improves right the places which you are thought that they were not possible is prone to seismic risk now we think that there. So therefore, you are (Refer Time: 02:12) which you are already there we thing the risk is even more because, you have now more knowledgeable more data available more information knowledge both available.

So, codes have change our perception has change so what you are doing since it has change you better make it to currently acceptable standard. So, retrofit is related to that retrofit it to currently acceptable standard could be leaving standard, could be safety standard, could be anything you know energy standard or similar sort of thing that is a terminology you use for retrofit.

So, there is a different people do use quite often synonymously they are not synonymous, you know renovation, rehabilitation, retrofit everything goes as if it is same it is not same every terminology has got different thing right. So, strengthening is different structural scenario again they would you same retrofitting but actually they are do it is strengthening, strengthening is different than repair structural strengthening, strengthening I am saying it is only related to structural strengthening or strengthening related to any other context also could be there, but largely we mean it to the structural strengthening.

So, to you want to increase the size of the column or maybe you know increase the shear capacity of the beam right this is strengthening, shear strengthening the column etcetera including confinement. So, these are strengthening is different it is not same and you have to do you know what are you doing why are you doing that is important and related to that. Then these are the terminologies which are important to talk about that sometime

at the end of our discussion damage and distress damage is essentially occur due to structural.

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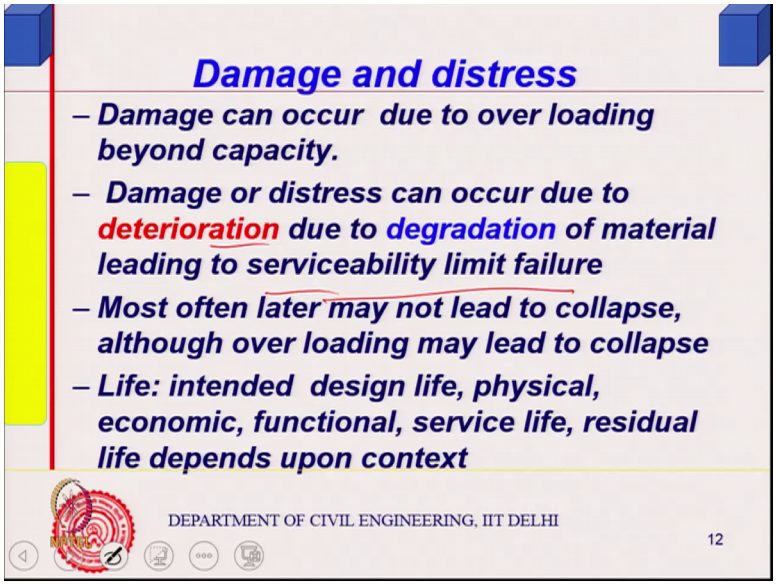

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Right and distress is related to damage or distress can occur because of deterioration 2 things, if I have a you know maintenance also means structural safety part. So, we will look into both safety as well as functional aspect you know structural safety part as well as functional aspect right.

So, damages related to when I say earthquake damage earthquake does not cause deterioration the earthquake damage, you know damage due to wind or due to overloading. Now, this is very common in transportation usual capacity of the trucks are possibly 25 ton even say. But it will carry 40 ton something like that till than we can move that is what they say in the roads actually this is very common in India overloading. So, such real overloading it takes place and yours you know it goes beyond the safety measures somewhere it can even cause damages locally directly or indirectly you know the fatigue life might get reduced whatever it is.

So, what I am saying is these are damages, while deterioration is a slow process; deteriorations occurs because material degrades with time all the man made material all the material that we produce we produces the expensive energy they are not there in the

nature. So, they will have a tendency to go to a tabular state stable state. So, you know relatively stable state I mean relatively stable state right because all the materials that is available in nature are stable because, they have dissipated all their energy and come to a stable state that is why they are there otherwise they would change.

So, but manmade materials you have change those natural materials to a new material new system with the expense of energy. So, actually you have raise their potential level potential energy you have give some energy, so it is potential level chemical potential level thermodynamic potential level actually you have increase. So, that is will they will have a tendency to go back to their original state, therefore they are not generally stable. So, material tends to degrade materials degradation of material and then this causes deterioration of the element. So, deterioration degradation these are the terminology and this might lead to serviceability limit failure.

So, most often later may not lead to collapse sum sort of one local crack even you know structural element, it will not lead to collapse I am talking about structural system at the moment. But it is giving you an warning that you got to replace it because is not acceptable either for the loop point of view or although it will not lead to collapse, if there is excessive deflection or something like that or vibrates people will not simply go there. So, this is serviceability limit failure and therefore you know even though it does not lead to collapse you go to repair it replace it depending upon the situation.

I have already talked about intended design life physical economic service life at there is one terminology of residual life residual life means at this moment part of the life is over. At the mid of intended design life I want to look into how much is the life in any context could be residual service life, you know you expect this is the period during which it remain in service at this point of time residual life because some damage is occur. So, next repair time for next repair in terms of residual service life of element that you have to see so that is what it is.

So, again I as I said I mean you know I am just like people have all kind of notional things, you know somebody will say life of the enforce concrete buildings are 100 years I mean how we will it say. So, it is very difficult to say or you have design something for 1000 years, well 1000 years it would be notional only. Estimating this is not very easy thing is fairly complex 1000 years is extremely complex, how can you say that

something will last for 1000 you just cannot say with the confidence level will be relatively low. So, there are issues actually so but anyway it is contextual, so intended design life functional life economic life physical life these are all contextual definition there is no single definition of life and we are talking in building maintenance management system we are talking of intended life right.

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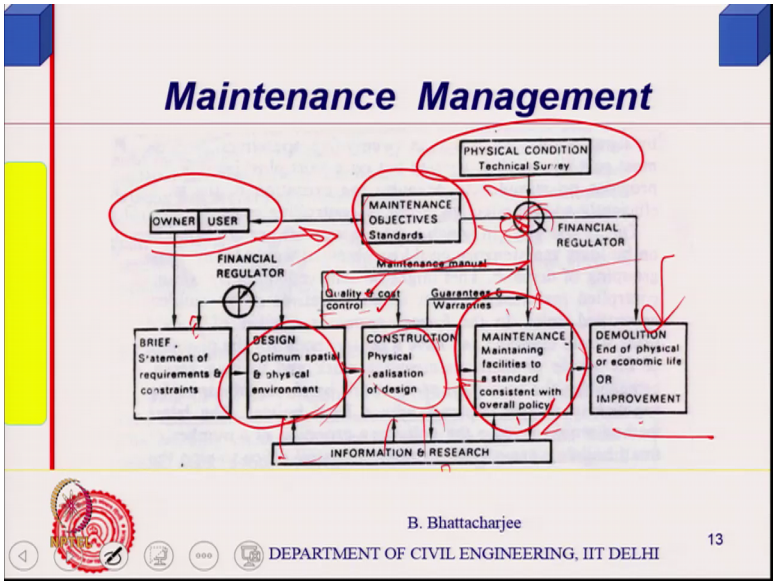

Let us see where does maintenance tends in the overall building schemes, the scheme of buildings if you can see this actually how does it starts building construction it starts with the owner or user owner or user. You know owner can be the user or user could be separate it starts from there, they only think that we should be having a building. Now then they give brief statement why do I need a building.

For example an academic institution like IIT it wants to construct a lecture theatre complex right or it wants to construct a hostel. So, that is the brief that is basically the brief statement of purpose requirement right and what are my constraints the constraints is that first constraints should be the space. The floor area ratio is restricted so you cannot you know you something or a height restrictions, I mean particularly in IIT Delhi campus you have a height restriction because you have the aviation route.

Floor area ration will be dictated by the Delhi urban earths commissions requirement whatever they say because, you will have separate floor area ratios for residential areas on for the academic areas you know. So, that kind of thing so they will have this is

another restriction space restriction, this is this is the spaces may be out of all those you want to optimize it best. Supposing you know want wants to built up I mean you know now not now but earlier, they wanted to build up sometime a lecture theory of complex.

So, you see what are your options available which of the space you can utilize, can you demolish something and make it or the empty spaces where you would like to make it. Now demolish something means you have to that people were occupying those space they have to put in some other place temporarily. The other thing is that travel distance is must be minimum which I told you sometime earlier, people should travel list so it must be at the centre for electrical substation I said it should be at the electrical loads centre.

Similarly for people traffic flow is very very important in fact you can see that the lecture theory of complex we have from the departments travelling time. If you have some class in some you know in this side if all classes are there may be students are students will have to walk a little bit less, but the teachers would actually travel quite a bit. So, in hospitals it is become very important because, doctors by lose their time in travelling, the nurses might lose their time in travelling and it has been seen in 1960 you know survey in UK that is quite often you know bad design they might spent even 60 percent of the time moving from operation theatre to his office, to chamber out to OPD to the you know like to the what you call wards.

So, if they are design in probable because there a lot of functional spaces there OT is one kind of functional space, the wards are another kind of functional spaces. So, you know this one of the papers by whitehead and elders they actually they gave that result of the survey. So, so the optimizers see out single storey layout planning. So, this should the constant should be stated in this manner you have this space and try to optimize with those constraints, so that is the first thing.

Now, then what does what one does the you know the plan is made generally architects take up this kind of work, they would do the planning of difference spaces right. So, then design optimal special designs space related and the considering the physical environment, which means the thermal environment temperature relative humidity, the requirement for no yes lighting and day lighting and all those issues. So, functional planning and special optimization that is what is done.

But simultaneously you have to see you know quite often somebody's we the one provides this kind of design and you find that the it is too costly. So, there is a financial regulator of the time goes back because budget constraint must have been also given by the owner. So, you cannot you know so the you might so and might change this you know as much as possible, then at this point of time obviously the construction will go structural design will also occur, structural design will also take place and one complete design would be there and then this information will go to the follow to construction and physical realisation of the design physical realisation of the design right.

Now, when you want to design you know you want to physically want to realise the design that means the construction there is a quality issues are also involved right. The variability you know from the desired level you want some equality some level of the construction and you find there is there is a deviation from this the quality is not as good. So, you also specify what should be the quality recruitment what should be the quality requirement and of course quality control and cost control comes here. Actually estimated cost and actual executed cost there should not vary too much definitely not beyond 10 percent.

You know 10 percent is allowed because something many things you might not have seen but actually is happening, but not should not very very large it should be as estimated you know errors in estimation is usually there, so you can accept around some amount of error. So, variation deviation should not be there it can be less nobody bothers, but still it should be as accurate as possible. So, quality and cost control is done cost should not go high up, so therefore you realise physically what is it and at this stage itself you must talk in terms of maintenance manual.

During the design stage physical before physical realisation even you know before the structure is or facilities physically realised you prepare the maintenance manual because, in design itself you have decided xyz type of materials and system I will use and you know how much after how many years it will require very simple example is a paint external painting depending upon the area. Now you have decided this paint has to be replaced or repainted in every 5 years you might put it in maintenance manual. If you have a good maintenance manual later on poor decisions will not be taken poor decisions will not be you know otherwise arbitrary decisions maybe taken. So, at the a

maintenance manual should come exactly simultaneously it should be prepared quite off sometime it is done also.

So, maintenance manual and it should be added to yes you know it should be added to right. So, this is prepared because you might have by deliberately decided to have more periodic maintenance, spending less cost now or maybe high cost in the beginning but less periodic course maintenance cost. So, maintenance manual is prepared at this point of time then actual construction is occurred.

So, S built drawings we call it S built situation that should be recorded and today if you know implementing such a thing is not very difficult, it is a question of culture and intension with the advent of information technology you can have database programs right. You can even we actually did it for IIT main building some time give an identity number for the space numerical identity right, codify it every space and what is they are existing at the time of construction you can actually do that or at anytime you can do it and create a virtual you know virtual situation for total building. It can be done through building information modelling this is because, this information modelling can do lot of you know it gives you what is there or other you can maybe some modules might be added of course.

I do not know exactly whether beam provides this kind of facility, but perhaps it can you know some modules may be added if is not there. So, it is possible to possible to keep this information somewhere the data of what is exactly happened what is existing finally, what has been realised all right and then simultaneously guarantees and warranties are also given after construction, particularly a waterproofing system provided they will say that we 7 years it will be no problem 10 years it will I have no problem.

So, those records will should be there and this information goes to the information and research which can be pass down later on to next building there can be 2 way traffic and then this guarantees and warrantees and then comes a maintenance. So, here is the maintenance maintaining the facility according to a currently acceptable standard that is what comes now we will be maintaining and then information is there.

So, you also have user also defines what is maintenance objective right in the beginning itself this users role also. For example this is not really as at common India, but it is started in some places not in a global scale. But many of those builders actually what

they do they do the maintenance activity also sometime the handover to other maintenance agencies. Now if it is there can be different tires for example, now it is compulsory for most of the builder to a some sort of LIG buildings you know economically weaker section buildings for economy.

Now the maintenance level there will be totally different, then maintenance for luxury houses right the levels will be totally different. So, objective of maintenance also could be different in a hotel maintenance level be totally different because, there the it is it fetches you money. So the return if it is poorly maintained you will not get the return, so objective maintenance objectives are stated also by owner or the user in hospital of course hygienic condition maintenance and also again you know there should be cross contamination and such things. So, this maintenance objectives are write in the beginning it is mentioned.

Then maintenance comes from the as existing the facility status of the facility state of the facility, then these 2 together controlled by a financial regulator because how much money you can spent on maintenance that is to be seen. So, physical condition survey is done for maintenance, so maintenance is finally done based on what is existing and physical survey done periodically and maintenance objective. There is a financial regulator I miss I do not have money to maintain this here we will do it later on 5 years later or something like that. But some sort of financial regulator that would see whether it is financially viable to maintain this facility, I am talking a both structural as well as functional aspects all maintenance right. Is it possible to maintain this and if it says that look it is not worthwhile really maintaining it rather I will sell it off right then demolish I knows not sell it off demolish.

Sell off of course should be something different the may be the functional you know functional changes because, sell it or what change it something else can happen I mean no longer continue it. So, financial regulator governs this issues and then either demolition and the physical or economic life physical life is usually rare, but it can happen if it is not maintained properly or you might improve it functional changes might occur. So, this financial regulator tells me what to do it is not worthwhile keeping this building this property in this shape, actually this is very something is happening very interestingly in Delhi actually must have happened in Mumbai to.

Because the affair changes occurred so it is seen nothing has gone wrong with the building financially it is viable. So, you what you do you either demolition and construct instead of one storey building 3 storey building what is now permitted right or some cases they add up more. Of course but that is kind of improvement, if I may say so you see financial issues dictates whether economic life is over because, the maintenance cost is too high that is one thing other there are other issues comes in building system it may. So, happen that you find it worthwhile to demolish it and construct something new because of rent you will get is higher 3 you know make it from one. So, it is though there maybe more complex issues than simple issue the physical and structural issues. So, that is the role of maintenance management in the overall construction activity right over all construction all right.

So, what we have seen we have define maintenance we have define various terminologies we have define life and we have also said that you know define maintenance mention and then role of maintenance where does it is tend to the overall construction activities right. In the overall construction activities where does it lie and n then we would looked into you know we also highlighted that that maintenance is an important issue in the overall life cycle cost of the building. So, now, let us look at what causes maintenance in buildings what causes maintenance in building maintenance generators right.

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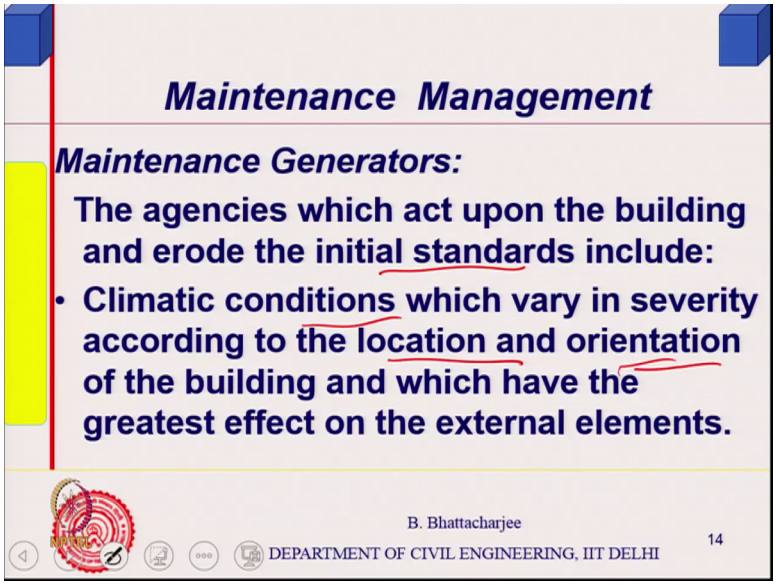

What causes maintenance in building one is mainly you see the maintenance will be related to, as I said maintenance not necessarily related to damages. Damages come once in a while this is not really maintenance if it was damage then you have to restore it state away damaged one. So, damage comes because of accidental I mean overloading or disaster or similar thing, but otherwise largely it is because of the deterioration because of the deterioration because of the deterioration right.

So, first of all deterioration occurs because exposure to the climate first is the agencies is climatic condition. So, for example a facade let me talk of functional first a facade, where rainfall is high the algae growth could be higher say north eastern region of the country right you might find lot of algae growth. So, you will have period we know black and black and concrete surfaces, it will be more say Kerala in northeast it would be actually you might find more related to that. While in Jodhpur or Jaisalmer or those area result areas this aspect would be less here the dust storm it becoming dust storm creating problem would be more.

So, the climatic situation influences basically it can cause deterioration in some manner, where there is high rainfall there could be tendency of steel members rusting steel component rusting and maybe even leaching of chemicals from the you know construction systems or elements. So, this is what it is so this depends upon location orientation now other example is location for example, seashore Mumbai or Goa or anyone of those places.

The kind of amount of river corrosion you will see in buildings I do not think you will see it elsewhere. Here also you see in some in Delhi that is because of poor practice of construction, but naturally considered in seashore you will have salt concentration higher within 5 10 kilometres. Even on the seashore wind blows up the salt sodium chloride etcetera and that can result in deterioration in terms of river corrosion and so on. So, location and also orientation the one phasing twice sea phases shows more, while one on the other side of the sea you do not see it more orientation place you know location orientation of the building which of the greatest effect on external elements internal elements are now mush not so much affected by this all right.

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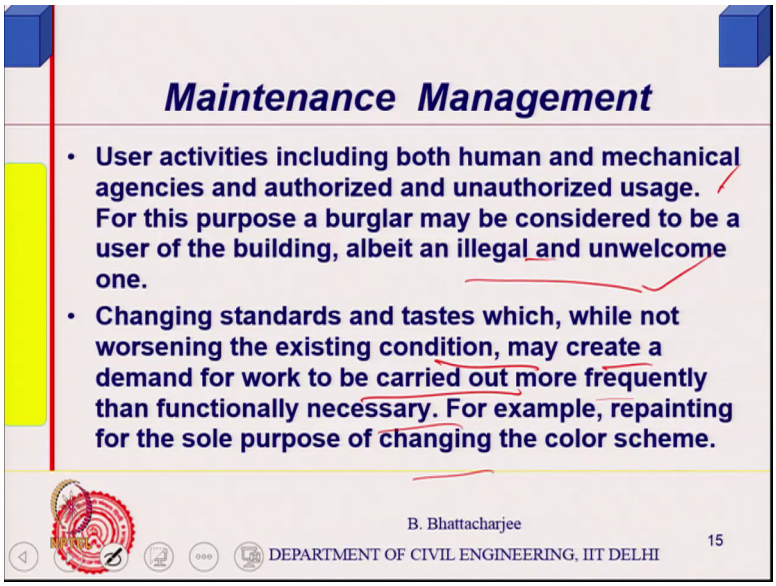

Users activity users activity now this the extreme example again I am showing, so I showed the extreme example related to related to deterioration, extreme example related to you see the also the pains etc. External elements will be damage more in those places where you have got lot of rainfall lot of salt (Refer Time: 26:04) they can make dirty very first look wise it can become aesthetically un present.

Now, coming to user's activity industrial situation if you consider industrial flooring, so it will deteriorated the much faster way because you know crane should move or some other movement of abreaction should be there. So, basically users activity mechanical agencies sometime unauthorised or authorized does not matter. So, all these you know all these could be like burglar can be also an user for that purpose damages. But then that is not very usual we cannot look at the periodicity of burgling, but just is an example anything users activity authorised or un authorised can lead to deterioration right um.

Where you know like this might be plumbing system for example, now a tap washer in the tap which controls the you know water flow there is a washer which will sill it up. So, when you lock it when it close it bulb no water will come through, but if the water gives up that water will drip through it continuously it will you know. So, this is because you have done it for a number of period of time, the washer got it is has got it is life it lost it is life it is goes away.

So, many of those things would actually because or for example old days incantation lambs they will fuse after certain period of time right. Because you will they have a life how many hours of life it will lost, other lambs have longer life's modern lamps have longer life but that is that is what it is. So, if you have used it would you know you did maintenance. So, user's activity actually is the other one which generates maintenance.

Third one is standard changes this is standard of living changes or standard changes, you know here code we are not talking about as we said building maintenance is related to both functional and structural aspects and therefore it is also related to standard of living. So, when it is standard of living they may create a demand for work right more frequently than functionally necessary. So, say as I said the tiles changing you know around nineteen ninety late 1990 all the office tiling or floor tiling you will see in civil engineering department or any department in IIT there are earlier simply concrete plane concrete flooring they have all change to tiles.

You are going to any office today they are all tiles because people fair that you should get a corporate look I mean everybody all offices in the you know everywhere it is old Kazaria tiles why not put Kazaria tiles. So, this is nothing was as gone wrong actually it is a change of standard change of change of standard right. This also happens to furniture curtains and similar sort of thing and hotels that do it very regularly because hotels they have some important you know hotels they have some you know is after all it pays them back. So, hotel they do it very often very regularly change of carpets in the floor, just it has it has nothing has gone wrong periodically just change it. Because the function or functional situation is such the build you know functional situation the building is such standard route keep on changing and is an extreme case.

So, standard change is causes also you know so even if the costs condition is not worse may create a demand for work carried out and more frequently than functionally necessary repainting a sole purpose of changing the colour scheme, somebody might feel you know even colour scheme is inertial colour schemes. Earlier you would have you act all whitewash you know or simple you have today the any Berger Company or Asian Paints they have all combinations you have this side one colour the matching colour is of that side.

I like that this a you know this is simply change of living standards so there is no this much good aesthetically designers colour choice and all that. So, that is a kind of situation and this is what it is and maintenance may have to be done in certain type of luxury houses or certain kind of even high income moderate your high income group also it is like that. Just it is file colour changes you know hotels this is of course very very common, so these are the maintenance generator. So, just let us look at one more think.

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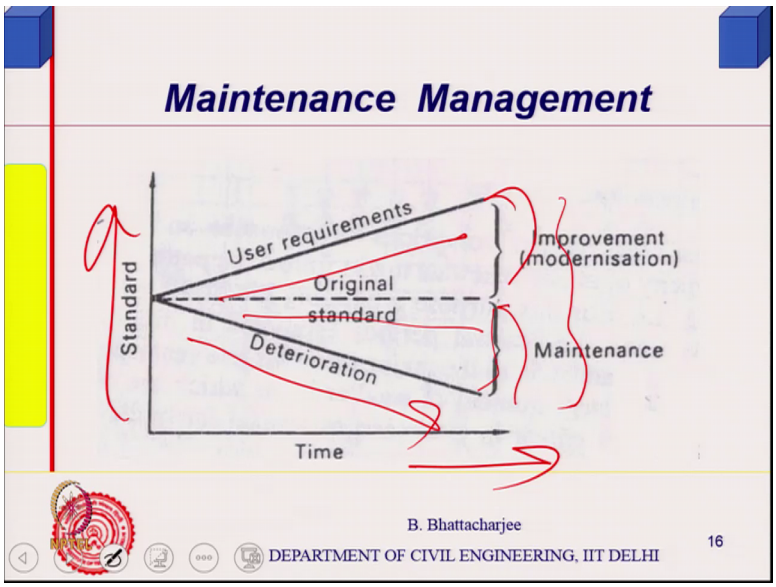

So, if you see with time standard changes like this the last one, deterioration might some cases not always deterioration, deterioration cause it is standard going down level going down right. An original standard where somewhere here, but some cases users requirement now new standard all the time user will require new standard. So, actual maintenance will be this much plus improvement part moderation modernization. So, both can occur simultaneously both can occur simultaneously, so which time this will go on increasing and even this deterioration increases therefore it was some bearing with the timely maintenance also right.

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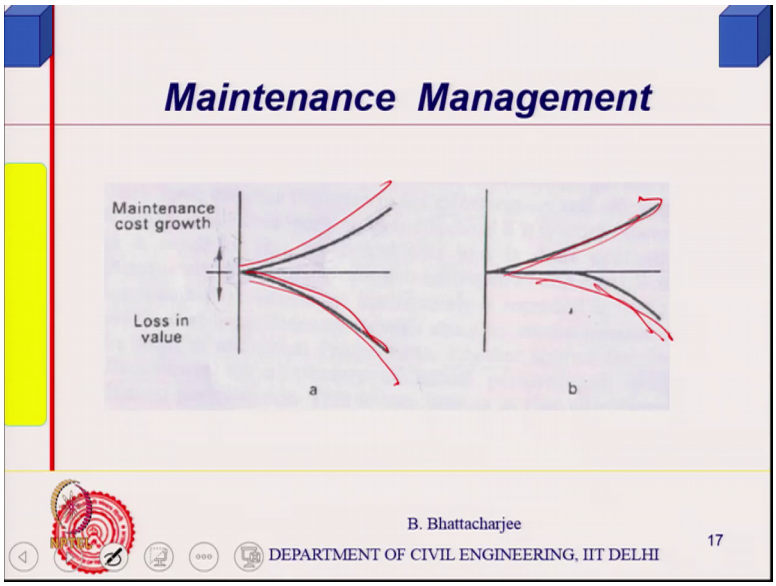

So therefore, in some cases you might find deterioration occurring right in the beginning, some cases deterioration do not occurred but since the standard increase the cost do not increase like this, but cost might increase later on. So, maintenance cost there for loss in value also because, if you do not change the standard value is lost right value is lost. You know if you make it that colour scheme interior colour scheme is better maybe in a hotel room we will get you know you can you can the price of the room will increase right. If you have to give an house in rent maybe it is rent price will increase.

So, this is maintenance cost growth 2 things happen, one there is a deterioration therefore maintenance cost will increase with time no linearly deterioration. So, value when you look and value loss in value would be there because of both the reasons, value is slightly different then the cost value is worth really slightly you different than the cost, cost all price is one thing one value is something slightly more than that this is the worth of the whole thing.

So, maintenance cost will grow in this manner and more the with time value will be lost really. So, you will not be able to sell it to that, you know the popularity of your the rent you will get is less popularity of total might be less etcetera. So, value vary in this manner so this is what it is. So, I thing we will stop it this point and try to take some questions from you right.