Fire Protection, Services and Maintenance Management of Building
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Lecture - 39
Periodicity of maintenance management

So, following from what we discussed earlier, we said that we will go to express the, you know standard in some manner.

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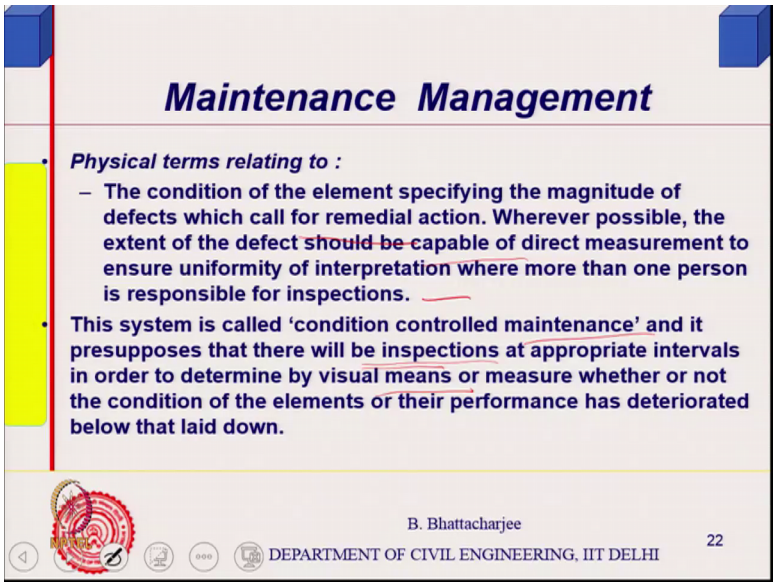

So, one is physical term simply physical term measurable item right: The condition of the element specifying the magnitude of defects, which will require remedial action alright. Wherever possible the extent of the defect should be capable of direct measurement right, to ensure uniformity of interpretation where more than one person is responsible for inspection. As usual say later on a plan maintenance would invariably I mean; it must it is a you know inspection is a must for plan maintenance.

So, you have l inspection every year before you do the budgeting, this inspection is a must. Anyway coming back to so you inspect also what is the state whether next year you got to do the maintenance or not, you go to measure them or check them. So, you take your items and check wherever it is measurable right. Now I just trying to I will let me see where you know where one can measure. Examples I have given you of course, internal painting lux metre into you know thing, but some other cases let me just re

collective there is anything which is measurable and then put into the you know like inspector should measure, which is which require regular maintenance.

Alright even measuring let us say water pressure at certain level in the pipelines. Especially in the later part of the life if there is a you know if there is a leakage or something of that kind or I mean this is not leakage, but gradual life time to see there something, example I can give for the gradual failure gradual failure if there something some example, lighting I have given you external painting I have given you. Some of the other items of course, you know the periodicity from other consideration, but some places because structural system are not supposed to deteriorate.

But supposing the deterioration is occurring you see or for example, visual moisture marks. I can go to a next slightly advance scenario which is normally at the moment not done. Supposing one where is you know important building is there let us say something like a laboratory sort of a production unit of let us say, semiconductor limited. You know which was producing I do not know whether it still produces electronic chips or similar of an you know it is a sophisticated one. Now there the moisture condition the dust condition there very specified. So, they use what is called a clean room.

A clean room the it is filters there for the air conditioning system pressure entrant is very high level filter, do not allow particular system evolve a big size, which is not now related to breathing, but the system. Also the rate of fresh air flows much higher there similarly, relative humidity there cannot be variation. So, and then it is all fall ceiling etcetera etcetera to ensure that there is sufficient, you know sufficient 2 things one is the loop part of it otherwise you want a gap insulation air conditioning temperature is to maintain. Now, suppose he has a moisture you know issue of moisture could be there leakages from tank or something of that kind. Best way to keep a survey every year is to do a infrared thermography right?

So, infrared thermography it the colour changes having is basically, you know what it does it measures temperature infrared radiation is heat radiations are all infrared radiation. And the infrared thermography, videography even one can do the very sensitive to very small temperature difference. So, if you do that to the whole building you can find out whether there is any patches were does moisture because where does moisture evaporation occurring temperature will be lower. So, the from the colour

change one can find out. So, indicator of blue colour or x y z colour and if the area is more than so much it confirm.

So, you might quantify this I just given an extreme example there are many other examples of the similar kind, where it is measurable right. So, that is one thing right that is one thing. So, where you can measure the quantity there, you know other examples of course, structural scenario I did not want to go into too much into structural scenario, but then this do happen. Supposing the moisture marks are there in a building you know and there is you find that there possible change of chance of inforcement corrosion. So, whether the inforcement corrosion is actually occurring or not, whether you need the maintenance or not that you can find out one some electrochemical measurement.

Like half-cell potential measurement or something like looking at resistivity. Now bridges also this are very important actually. So, you might do from time to time see if there any sudden changes are occurring in the values of the potential or not. So, just I am just giving a extreme examples for measurable quantities, there are many more right. So, wherever possible physical quantity measurement and it is not it should not be in it should be independent of persons, you me him or somebody you know it should be independent of person so that is what it is.

So, direct measurement and then you specify ok, the voltage you know the half cell potential below minus 350 moon negative then minus 350 actually there is a risk of corrosion is very, very high. So, you specify that if it is minus 350 or more sudden change then that area you should open up and do maintenance or whatever it is. So, that kind of possibility is there. So, these are called condition control maintenance right? This is called condition controlled maintenance and it presupposes you know there will be an inspections. If we supposes there is an inspection; obviously, all planned maintenance system should have an inspection at appropriate intervals in order to determine by visual means or measure whether or not the condition of the element of the performances deteriorated below the laid down level.

It can simply the area affected area quantified, measure the affected area moisture marks measure the affected area if it is more than x percentage maintenance is required. So, that is quantification right. So, this is quantified so condition control. Then there is some which are periodically controlled from your past experience, or the guarantee that has

been given by the manufacturer or the people who have given you. For example, external painting sometime on internal painting sometime the open manufacturer the paint manufacture will tell you 7 years guarantee, she got to be paint it after 7 years. So, this is periodicity sometimes referred to the frequency base maintenance.

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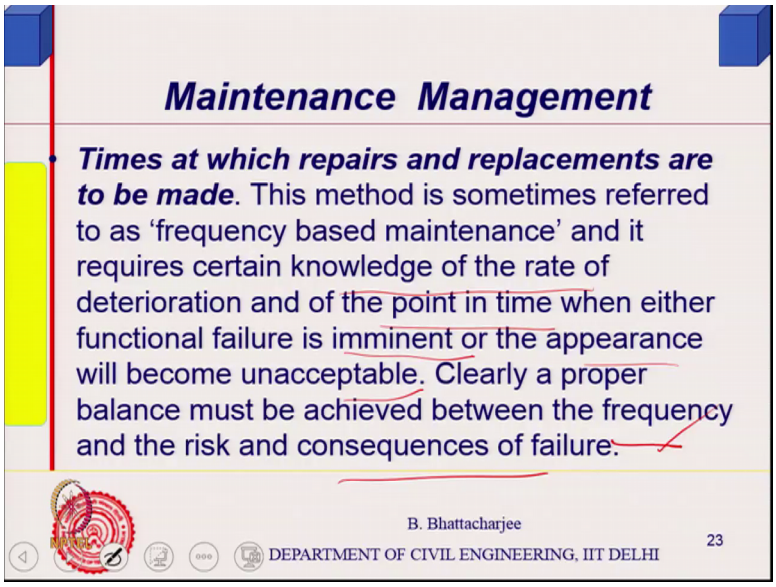

So, this is frequency based maintenance and certain knowledge of the rate of deterioration of the point of time either functional failure. So, after that period there will be functional failure it may not work or the appearance will become unacceptable. Now, paints fits into painting fits into this very well. Functional means what if it is external it is supposed to drain out the water no I will get growth. So, after 7 years it may not be able to after all those polymeric systems silicon or whatever it is. They when they are exposed to where a ultraviolet radiation or solar radiation of the complete thing they you know characteristics starts changing.

There are several things can happen under such situation or moisture and rain, wind etcetera, which time the polymerized given temperature and so on; may be polymers characteristics change some sort of changes. So, may be the water repellent characteristics is lost of sort of in periodic type. And that is known to them known to the manufacture they have told you after 7 months, 7 years the you know it will not be repelling the water one of the function is to keep the water away. So, that water do not enter into the envelope walling system or structural system.

So, that that function it may not be able to perform failure after 7 year, or it might look ugly maybe it will start you know allow dalt accumulation to a such a level, that will does not look anymore nice. So, this is periodic time where it is you has been fixed based on periodicity simply frequency based. So, clearly it has to have you know consequences of failure has to be seen. Now sudden things for example, we will see that lamp replacement in you know lamp replacement in large areas factories very, very important because lighting level is very important for your production system.

So, if you do not maintained if you if the if the you know if the power you know like light is not there, may be the operative the work force is not able to perform the work it my be stopped simply. Extreme case suppose is there factory where very fine items like watch is being produced. So, implication of not doing it might be frequency based on the you know previous study already done on mortality curve of what is called lamp, we will discuss this mortality curve sometime rate at which it fails.

So, based on that you have decided a frequency I will do the maintenance, replacement of all the lamps at a given time, but at how many percentage failure of how many percentage of lamp at which will do actually complete replacement, that it depend upon if you do not do then what is the cost implication indirect cost implication because your production might stop. So, not all situation should be similar situations of different functional buildings different issues will be there. So, it has to have balance between frequency and implication cost implications if it is stops your production, if it stops something then; obviously, will be more bothered.

If you do not do some cases it would be you know for example, the humidity not maintained in a textile factory or garment factory, where fibres change the dimensions somewhere some you know fibre change the dimension with relative humidity, production system might get disturbed so, these are the direct implication. So, some cases you know some cases condition, same might have might be either condition is possibility put in that condition based or frequencies based, but you will have to decide what how you want to want to handle.

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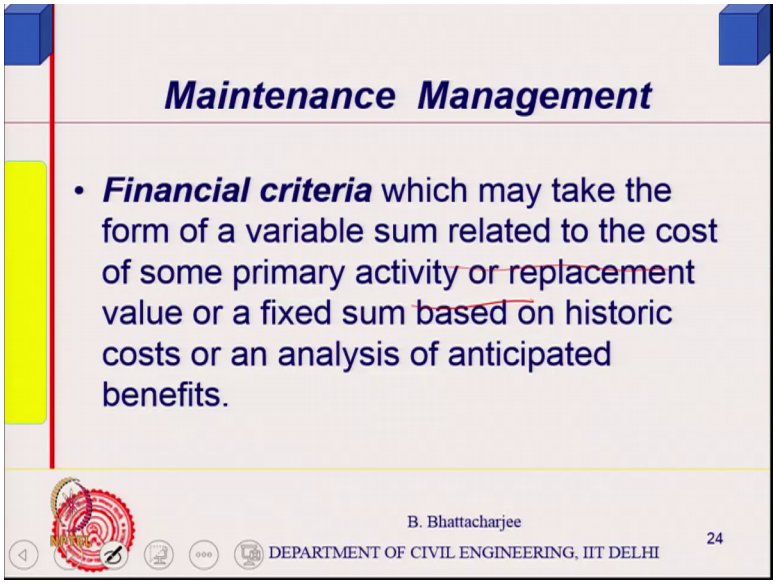

Then there is the third variety finally, the financial criteria which could take indirect cost of not grip maintaining and direct cost of maintenance. More frequently I do my cost of maintenance will increase, but if it has got an very strong you know reapplication on failure of the system then; obviously, I have to take care of that. So, in a hotel well I got to do almost you know in hotel for example, I got to do it as a wall footing basis, because of financial issues involved my return. You know occupancy level the you know it is depending upon that. So, some cases it would depend it is basically, some sort of a sum related to cost of some primary activity.

So, primary activity in hotel is actually renting it out right. So, if it effects that replacement effects that or some fixed sum based on historic costs if I do not do, what will happen? So, basically economic analyze will retain some items will be simply based on economic I said that carpet change in hotel nothing goes wrong, but then they do not want the same look because people who come in they have you know better feeling. So, just change nothing has really gone wrong, no frequency based just financial implications they say and finally, make it of course, frequency based. So, this is how it will be done. So, this is the same diagram that we are talking about.

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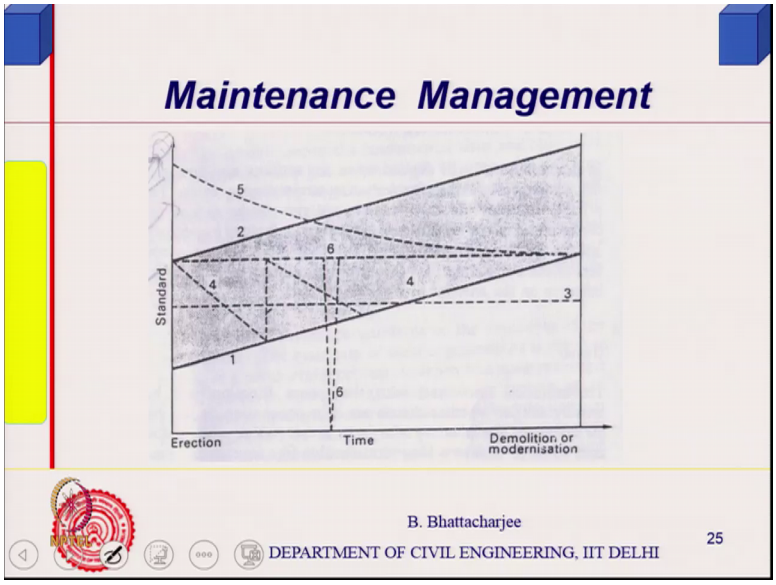

Now, let us see out of this same diagram from that we followed out of these let us see, which one you know how do you go about it, but before doing that we must also understand one thing as I said that financial criteria frequency based or condition based. All of them particularly they related to depends upon at what level I want to provide; you know it is basic maintenance objective related to basic maintenance objective. For example, if there is no financial implication I do not need a good level say, some factory or somebody is providing housing.

Say realistic business or whatever it is providing housing for a group which cannot afford very high price. For them they will keep the standard also at the low level therefore, your frequencies etcetera all will get related to that right, is the maintenance objective will be different. So, maintenance objective or your periodicity etcetera everything depends upon the level. So, we must classify the level, so classify the level in 3 different.

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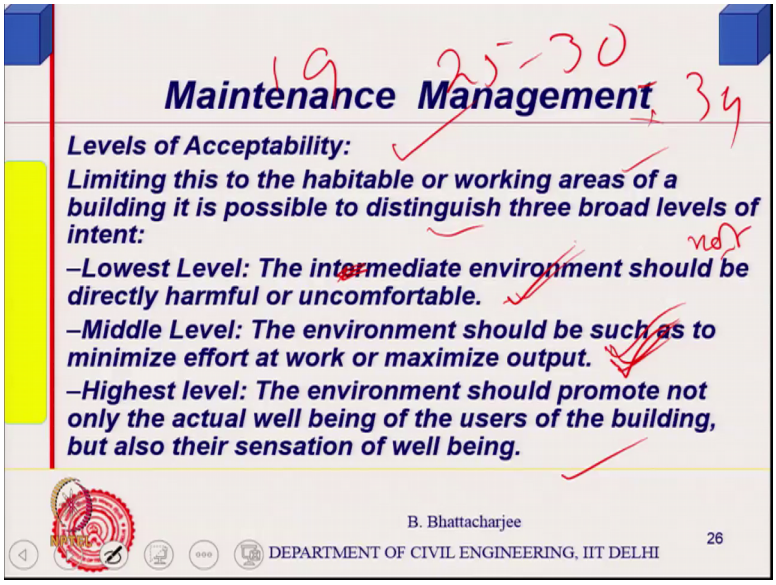

Levels of acceptability you know; limiting these 2 habitable of working areas of a building it is possible to distinguish 3 broad levels. This is qualitative level for example, a lowest level. Last level is that level where immediate inter it is not it is not intermediate it is actually immediate environment should not be directly harmful or uncomfortable.

You are just merely managing hygienic condition and just comfortable condition. At the example that I was giving for I have said you know. If you look at the something called tropical summer index which is which is used for thermal comfort in Indian context, which is the function of relative humidity temperature I think I might have mentioned one-day temperature relative humidity and velocity etcetera etcetera. Now it is comfortable range is 25 to 30 degree, right? 30 is equivalent temperature you need it is the same, but a tolerable range is 19 to 34. So, just comfortable range I might like to an extent it to a little bit at lowest level ok.

Because they are unlikely to use air conditioner and it may be almost impossible to provide in naturally condition building not you know actively condition building. Naturally condition building to maintain a temperature between 25 to 30 in a climate of let us say something like, Delhi or even many other places Chennai etcetera etcetera. While it is the temperature is very high relative humidity is also very high in Chennai, where Delhi some season it may not possible. So, you say that will at least maintain up to 4-degree lowest level.

So this is the lowest level it should barely comfortable, no not harmful hygienic conditions to be maintained and it should be so this is the lowest level. Now you come to middle level here you should be comfortable. Now couple of days back if you remember in this classroom the air conditioning system was not there. And in fact, the class that we were taking, almost everyone felt that when we are should be going out including myself right. So, actually concentrating also becomes difficult because otherwise is meant for air conditioning system. So, therefore, there no natural ventilation in that

And if it if supposing because of the season change there they were not started the operation the very first day we felt that which means that our efficiency would go down. You know you might stop the class earlier go of, everybody would you know everybody was feeling uncomfortable. So, this is this is your performance level so minimise the effort and maximize the output. So, let maintaining the level so therefore, if this classrooms is there therefore, you would like to say that since you know especially in modern kind of multi-storey academic buildings, class you know lecture theatre and such so on. Because they are they are now close from all sides that you maintain the condition where people are not uncomfortable.

This is a middle level scenario you have to have active system, here you cannot do without the active system and it has to maintain it. While you know as I said residential economically weaker section. You might not think in terms of that level you might say up to 34 because I am naturally conditioning it is fine right. Similarly, lighting level right, it has to be appropriate if it is that then you may not be able to you know teaching of reading would be difficult. So, this middle level would ensure that output is maximum. Even if the residential scenario you know generally that would depend upon the economic level of the people actually, but otherwise functional issues, functional building of course, the output has to be maximized and that is the middle level.

Highest level is 1 where you should promote not only actual well being; that means, it should not only maintain the comfort level, but you should also feel that it is actually very comfortable. You know feeling you know pride right you take a pride into it. So, that is will be a scenario of hotel you know 5-star hotel. Where the pride is very important so somebody says is so no. Lonely is comfortable I also feel that it is very comfortable you know that kind of thing. So, psychological well being or psychological

feeling that it is better simply not comfortable. So, this kind of levels of acceptability has to be decided, then you can plan your periodicity then you can plan your periodicity.

So, that is how it will execrate, now let us say how it will some periodicity how you find out, how do you find out periodicity for some of the items at least right. These are the levels, but some examples I will take is of course, there is not distinguish the level there general, some way how you find out now, how can you find out ? One were I know the deterioration process like I said you know the slow deterioration process I bring it back roof covering is one such example. If you were roof covering it is not you are of it is not a question of 2 years, 3 years, 5 years all I am talking of in a time span of 60 years. So, 25 years might require for roof covering to shoppys problem right.

So, roof covering after how many years I should actually change the roof covering. Quite often we think that ones you start construct a building, everything a particularly systems like roof covering, envelope, structural system you know you do day to day maintenance of what? Ok there is suddenly the power has gone off because there is a circuit breaker which is not working replace as MCB. This is the kind of maintenance one do, but similar maintenance if you look at it they do not show up so easily. So, first possibly roof covering leakage you would start. Couple of years later one would see a patch of moisture somewhere in the ceiling. And then few years later you might see chunk of concrete coming down because (Refer Time: 22:48) has started rusting reinforcement bar has started rusting.

So slow process we are talking in 25-year early time or something of that kind. So, then there is a need to look into that when replace or maintain maintenance. This is this is generally which is has very slow process many of the civil war it will (Refer Time: 23:09) something else we quickly repair is possibly washer tap washer. Tap suddenly go and open the tap when you find water is coming out like a like a you know waterfall. And you try to close the tap it does not work because the water washer has given away. Such as the examples this is this you know this would be possible then immediate replacement.

So, this is this is done but then there can be a policy decision to change them in such a we will see that how it will. So, similarly there can be different types of item how do we decide the periodicity, that is what we will look into next right. How do you decide first

we take the case example of a roof covering alright. So, roof covering you can see recycling or recycling of roof covering. So, we have something called first we define something called you know let me see it is there here not ready something we call it we call it anticipated state matrix right.

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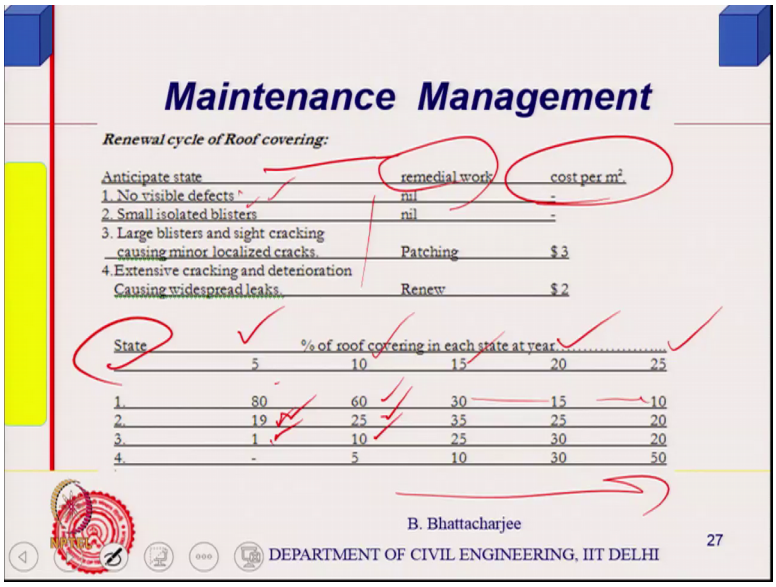

Let me just first in such situation what you do is we define something called anticipated state matrix.

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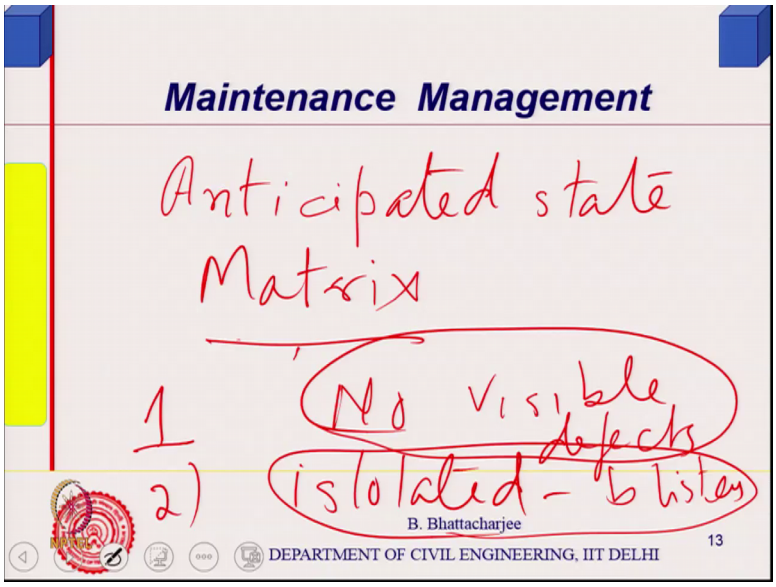

Certain items we do like this, where deterioration process is relatively slow. And when deterioration is there is a such a level it is not economic to maintain do the maintenance. So, we call it anticipated state matrix ok. Now what is anticipated state matrix? Which is a define states state number one no visible defect, then 2 something like isolated. Now, in case of roof covering roof tiles are there, if you see a roof typical roof depends upon which part of the country you are. In northern part you have a structural element, then you will have an insulation element, then you will have some tiles you know waterproofing layer.

And then some tiles waterproofing at different level and then you will have some roof covering tiles right at the top some tiles would be there. And this tiles supposing the moisture in gases occur the tiles will start coming up what we call blistering so as if blisters were appear right, so isolated blisters. Then the next stage so states actually define next stage the extent also you might talk about the tiles you know as gone away from the area totals tiles are you know disappeared or something like that. So, these are anticipated states these are anticipated states right. Some cases visible the state could be that visible internal insulation something of that kind. So, you define anticipated states as you are likely to see as you know once the roof has been constructed for there for many years.

Now, this caste must come from past experience, this must come from past experience. So, you define anticipated state matrix we call it, anticipated state we define then we talk in terms of after 5 years how much area will you have no visible defect, or you know it will be possibly 100 percent after 5 years. So, in each state after 5 years how much percentage will be in isolated blister after 5 years? So, you are know you are one of the column would be or row would be 5 years or actually column would be 5 years then next is 10 years.

Then in each stage how much area you will see area in each of the state after every year which I will show you in the table, how much is there you can that is the anticipated state matrix. So, that is called anticipated state matrix will give you how much is a yeah so this is basically anticipated state and this is anticipated state matrix. So, 5 years, 10 years, 15 years, 20 years, 25 years so first state it was no visible defects say small isolated blisters, large blisters slight cracking at the top you will see.

And then localised cracks, then extensive cracking and deterioration of causing widespread leaks that is another state so, these are the states that you talk about. And if there is no visible effect remedial measures will be need cost involve will be need. So, in a first table you decide what are the states and then; what is this implication in terms of repair what actually got to take and how much is the cost per unit area. Then you make the anticipated state matrix in which 1 2 3 4 now you classify simply as 1 2 3 4 states. So, you write states here 1 2 3 4 after 5 years generally you will find at least you know 80 percent in state one; that means, no visible defect.

When we are talking of some 10 20 buildings constructed together which is the case or larger area of a single building. So, you will find that 80 85 percent no defects may be 5 percent shows up, you know 5 percent shows up or 1 percent shows up some blistering. It can happen and 19 percent shows I mean small blisters so 1 percent shows up. If you go to 10 years no visible defect might be in 60 percent of the area, and 25 percent might shows isolated blisters, 10 percent might show large end so and so forth. And this you will find that no visible defect goes on reducing which time, and you know this part which is extensive cracking etcetera etecetra this will go on increasing.

Now, since you know the cost of now visible defecting you do not have to do anything. After 5 years after at you know after 5 years some, you will do a little bit of patch repair you know 19 percent you will do a little bit of patch repair. And after 10 years also you might patch repair, now point is that I will just you know discuss and as again I will talk about in the next class. If you do patch repair it is usually costly per unit area it will be costly why because patch repair means the people will do repair the setup, setup cost is high. Every time you do a patch repair there is a set up involved. You will call the people then setup possibly you know learn go there reach there, setup some produce material producing unity which is a cast in C 2 or whatever it is and then they go and do a small area and go away.

On the other hand, if you replace the whole thing it turns out to be cheaper because setup cost per unit area is not is only once, while in each patch repair you will require a setup cost every time right. So, the cost 2 involve in a complete replacement to the whole area in one go, cost is usually less because setup cost is only once where set up cost is there every.

So, what happens is if you calculate out the patch repair that you are doing and you know if you do replacement this comparison you can do. And where in the patch repair cost supposing you have got 50 percent area which is to be done patch repair it will; obviously, cost you more than I am talking every 5 early not one day it will be of 5 yearly. So, patch repair coast will be higher so what you say forget it you just replace the whole thing. So, you periodic now periodicity is defined that; that is the time I will do the complete replacement complete replacement, you have to know the details and pattern and you have to have the data available.