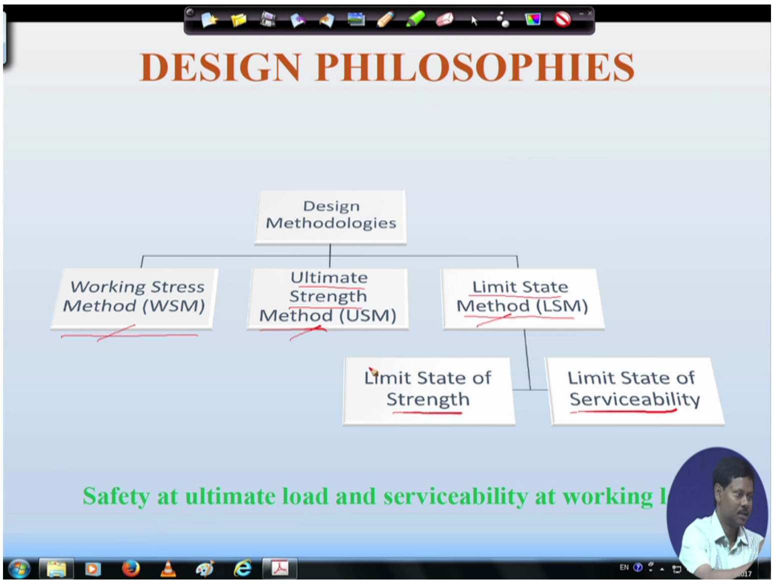
**Course on Design of Steel Structures**
**Professor Damodar Maity**
**Department of Civil Engineering**
**Indian Institute of Technology Kharagpur**
**Lecture 03**
**Module 1**
**Limit State Design**

In today's lecture I am going to discuss about the design philosophy of the steel members and in this course as we have told that we will be designing the members of the limit state method. So the design philosophy of the limit state design would be discussed in todays lecture.

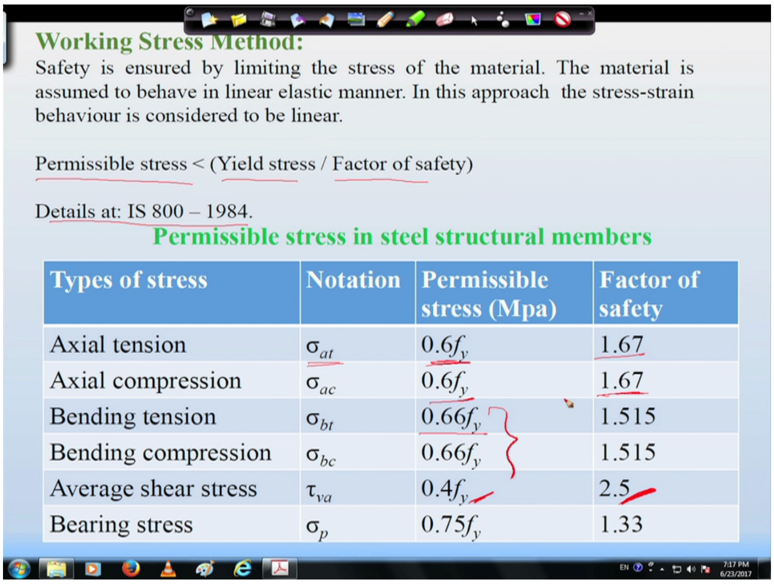
(Refer Slide Time: 0:54)




Now different type of Design Philosophy has been followed in the decade in last few decades and if we see the Design Philosophy we can see that different type of Design Methodologies was used earlier one is called Working Stress Method, this Working Stress Method was used till 2007 in our country, we were using till 2007 the Working Stress Method Design Philosophy.

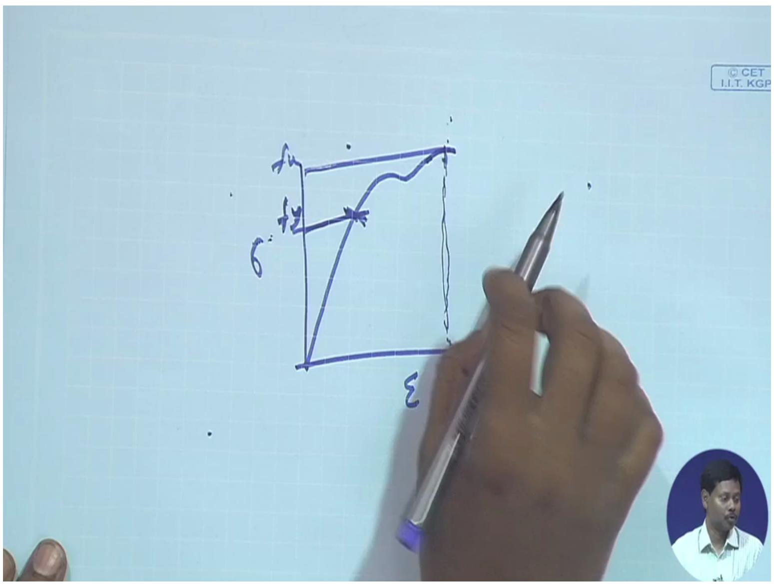
Another Design Philosophy we come across the globe that is Ultimate Strength Method, Ultimate Strength Method and again another Design Philosophy which we will be considering in our course is that Limit State Design Method Limit State Method and Limit State means basically Limit State of Strength and Limit State of Serviceability. So why we are not going for Working Stress Method or Ultimate Strength Method why we are going for this that also will be discussed in todays lecture little bit and what are the Philosophy of Different Methodology that very briefly I will discuss in next few slides.

(Refer Slide Time: 2:09)




First let us discuss about the Working Stress Method as I told that Working Stress Method was used till 2007 in our country and IS 800-1984 was the code through which we used to design in Working Stress Method basically the stress what about stress we consider permissible stress or permissible stress that we divide in some factor of safety to get the allowable stress.

(Refer Slide Time: 2:45)



So if we see in case of Working Stress Method what we do that if we see the stress strength diagram in case of steel that is like this, so up to limited percent is up to Yield strength means if this is fy, so we consider the structure to withstand load up to fy, that means the characteristic strength of the member, that means the Yield strength. So up to Yield strength we consider and then we make some factor of safety and then we get the Permissible stress.

If you see here I have written that Permissible stress is should be less than Yield stress by some factor of safety. So here we assume the material to behave in linear elastic manner and stress-strength diagram stress-strength behavior is also consider linear. That means we are not considering beyond the yield stress though the member can take certain load after reaching the Yield stress.

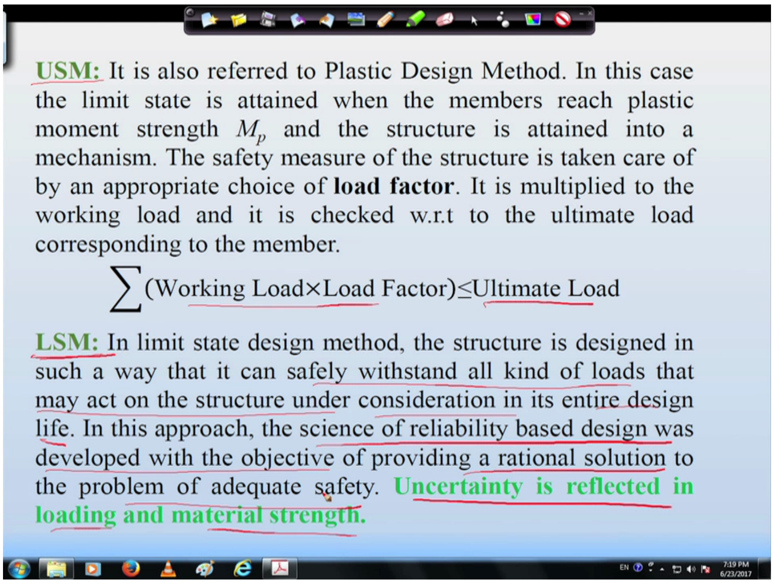
So that we are not going to consider here and the factor of safety in different case has been reputed here this is given details you can find out IS 800-1984 the earlier code where the Axial tension sigma at was consider at 0.6fy the permissible stress that means factor of safety was 1.67. Similarly for compression also 0.6fy and factor of safety was 1.67 but in case of bending we consider 0.66 bending tension and bending compression and for shear stress 0.4fy factor of safety we are taking 2.5.

So this is how the working stress method was used earlier but in this case there are certain disadvantages of certain drawbacks were there like here we do not consider load factor that means the load that we are considering the service load we design on the basis of that service load but from the probabilistic method we have understood that load whatever we are considering sometimes it may excess that load.

So in that case the structure may into fail, so to take care we cannot rely on this Working Stress Method always, this is one thing. Another thing is that sometimes this Working Stress Method become very conservative because we are taking upto the linear behavior of the stress-strength diagram, that means we are considering upto the yield stress though after yield stress the member can take certain amount of load with certain information.

So that part the nonlinear part the (())(5:44) part we are not going to consider which is not correct. So if we consider that then our design in the construction cost or the design member would become less member size will become less and it will be economic and also we have to understand that the structure we means member will design in such a way that it should not be conservative it should be economic and of course 100 percent safety has to be consider we will not compromise with any safety but at the same time we would try to make it economic. So that is possible if we go Limit State Method why I am coming later.

(Refer Slide Time: 6:37)



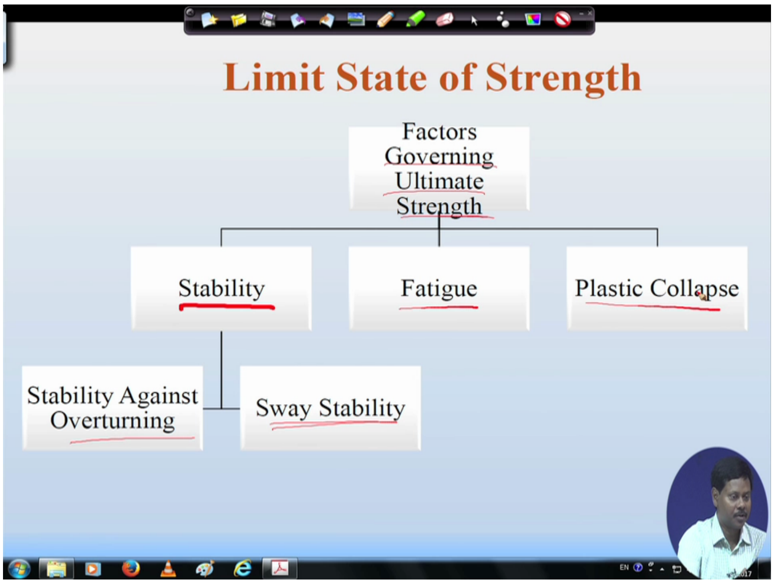

Than another method which we consider earlier was Ultimate Strength Method Ultimate Strength Method it is basically a plastic design method in this case the Limit State is attend by the members reach plastic moment. That means in this case we go up to say fu, up to this we go right. So up to this we consider and then we design and of course we also multiply some load factor we multiply some load factor with the working load to get the Ultimate Load so Ultimate Load can be found by multiplying a load factor with the working load.

So this is done but in this case problem is that serviceability condition we are not going to consider that means whether the occupant feel discomfort or not, whether excessive deflection is coming or not that we do not bother. So from the users point of view it is not it is not advisable so this method also became nowadays absolute.

Nowadays what method we provide is the Limit State Method in this Limit State Method the structure is designed in such a way that it can safely withstand all kind of loads that may act under consideration in its entire design life so that is you have to consider means we have to remember and the science of reliability based design was developed with the objective of providing a rational solution to the problem of adequate safety, that means we are not compromising with the safety and uncertainty is reflected in loading and material strength. So what we do here we consider the up to ultimate strength and we make use of some factor of safety to get the permissible strength or the member.

So there we are giving means some sort of factor safety to ensure the uncertainty factor also we are giving the load factor means from load point of view we are means we are not sure that what will be the actual load in the site at the time so what are the load is coming we try to find out the maximum means worst possible combination and we multiply with some factor which was obtained from (())(9:18) method and then we try to design with that factor load this is Limit State Method but this is Limit State of strength another is Limit State of Serviceability that also we have to consider that I am coming.

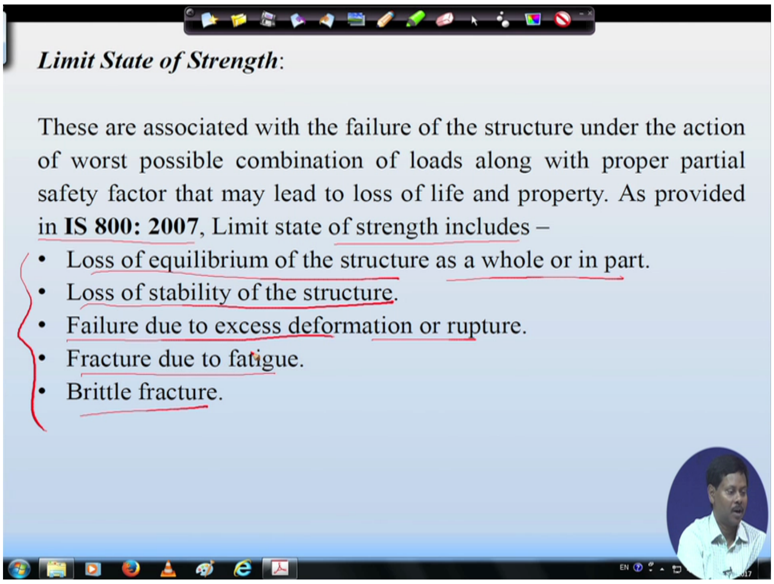
(Refer Slide Time: 9:43)




So Limit State of Strength we can think that factors governing with the Ultimate Strength so one is Limit State of Strength and another is Limit State Serviceability this two point we have to consider Limit State Method means Limit State of Strength and Limit State of Serviceability.

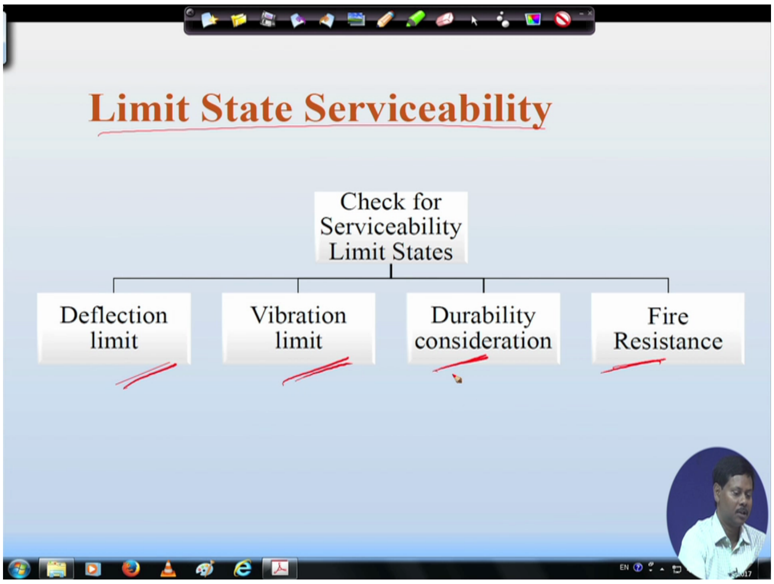
So in case of Limit State of Strength we have to consider this as the Stability with Stability against Overturning and Sway Stability that we have to keep in mind also we have to keep in mind the Fatigue and Plastic Collapse. So Limit State of Strength depends on this few aspects.

(Refer Slide Time: 10:23)



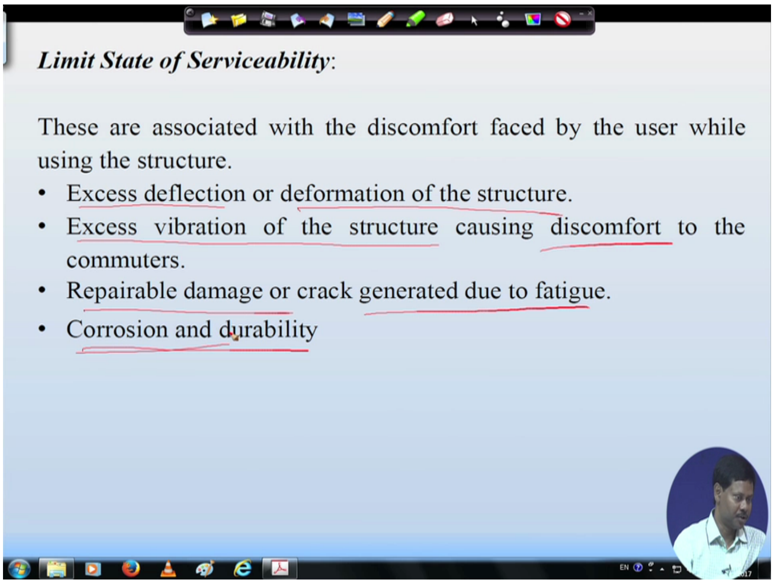

So in (IS 2007) IS 800: 2007 the Limit State of Strength includes this few things which we have to keep in mind like Loss of equilibrium of the structure as a whole or in part, loss of stability of the structure, then failure due to excess deformation or rupture, fracture due to fatigue and brittle fracture. So these are associated with the failure which we have to keep in mind and we have to design another worst possible combination.

(Refer Slide Time: 11:07)




Another thing as I told that one is Limit State of Strength, another is Limit State Serviceability. So Limit State of Serviceability when we consider we check Deflection limit, then Vibration limit, Durability consideration and also Fire resistance. So these are few aspects from Limit State Serviceability point of view, so we have to take care we have to keep in mind this limit and we have to design the structure remember keeping all these limits in our mind.

(Refer Slide Time: 11:42)

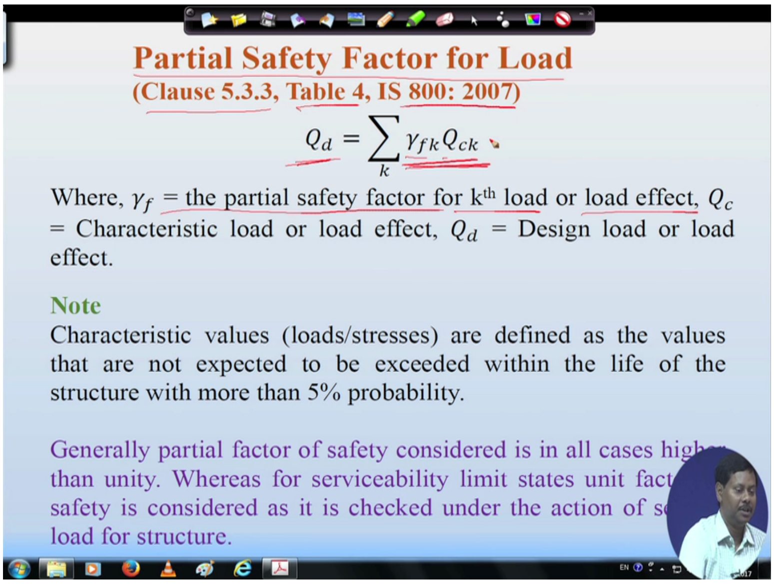



So Limit State Serviceability will be associated with the discomfort faced by the user while using the structure that is one is excess deflection or deformation of the structure. Because suppose in structure we are residing in a tall building towards the top floor then due to vibration means due to cyclone or due to earthquake the building may vibrate considerably but we know from Limit State of Strength we know that design has been in such a way it will not collapse but if you do not consider the Limit State of Serviceability then we are allowing deflection at large, so if deflection is more than the occupant will be afraid of staying there because of this large vibration.

So in such case we have to consider the occupants discomfortability and we have to take certain measure so that vibration can be reduced excessive deflection or deformation of the structure can be reduced. So this has to be take care.

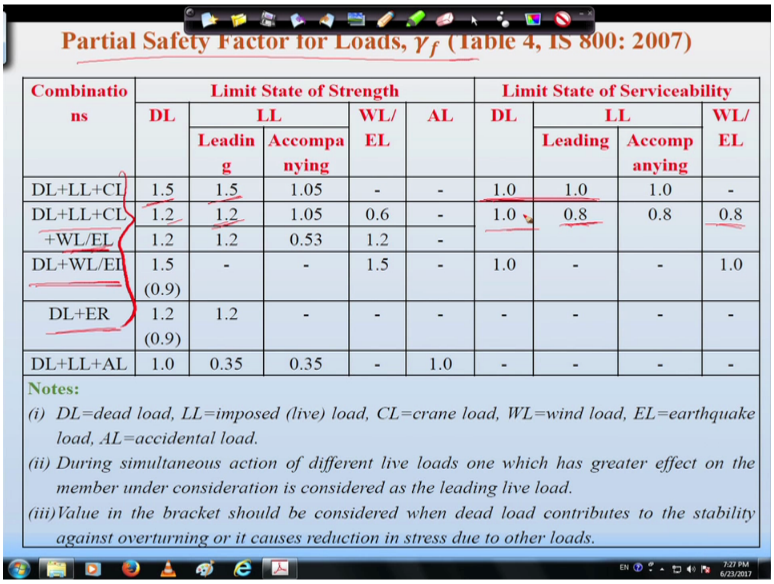
Then excessive vibration of the structure causing discomfort to the commuters, repairable damage or crack generated due to fatigue that also we have to keep in mind that we should take care of damage or crack and of course corrosion and durability that also we have to keep in mind. So these are the some some parameters which are associated with the Limit State Serviceability.

(Refer Slide Time: 13:18)




Now coming to Partial Safety Factor, so in case of Limit State of Strength we know that certain safety factor are going to be consider, one is Safety Factor for Load, this is given in clause 5.3.3, table 4 of IS 800: 2007. In table 4 we will get details which I am going to show in next slide where the formula is given that Qd is equal to summation of gamma fk into Qck, where Qc is the characteristic load or load effect and Qd the design load or load effect and gamma is partial safety factor for kth load or load effect. So this gamma f is going to vary from time to time depending on the type of loading gamma f value will be going to be changed, right. So Qd we can find out that is the design load as gamma f into Qc.

(Refer Slide Time: 14:34)




| Combinations | Limit State of Strength | | | | | Limit State of Serviceability | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DL | LL | | WL/EL | AL | DL | LL | | WL/EL |
| | | Leading | Accompanying | | | | Leading | Accompanying | |
| DL+LL+CL | 1.5 | 1.5 | 1.05 | - | - | 1.0 | 1.0 | 1.0 | - |
| DL+LL+CL +WL/EL | 1.2 | 1.2 | 1.05 | 0.6 | - | 1.0 | 0.8 | 0.8 | 0.8 |
| | 1.2 | 1.2 | 0.53 | 1.2 | - | | | | |
| DL+WL/EL | 1.5 (0.9) | - | - | 1.5 | - | 1.0 | - | - | 1.0 |
| DL+ER | 1.2 (0.9) | 1.2 | - | - | - | - | - | - | - |
| DL+LL+AL | 1.0 | 0.35 | 0.35 | - | 1.0 | - | - | - | - |

Notes:

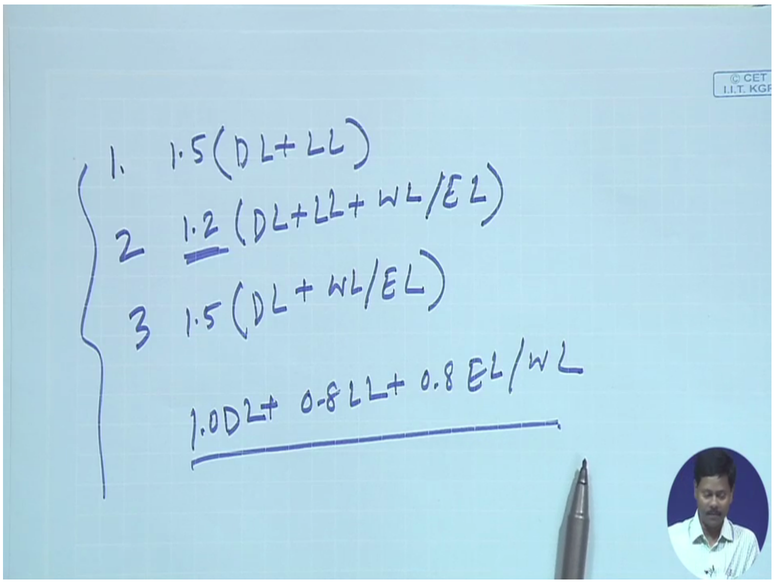
(i) DL=dead load, LL=imposed (live) load, CL=crane load, WL=wind load, EL=earthquake load, AL=accidental load.

(ii) During simultaneous action of different live loads one which has greater effect on the member under consideration is considered as the leading live load.

(iii) Value in the bracket should be considered when dead load contributes to the stability against overturning or it causes reduction in stress due to other loads.

So in table 4 of IS 800: 2007 this partial safety factors are given. Now if you look into this table so then table 4 we will see the different combination set given like dead load, live load, crane load, like dead load, live load, crane load plus wind load or earthquake load, dead load plus wind load or earthquake load, dead load plus erection load like this and different type of load combinations are there.

(Refer Slide Time: 15:23)

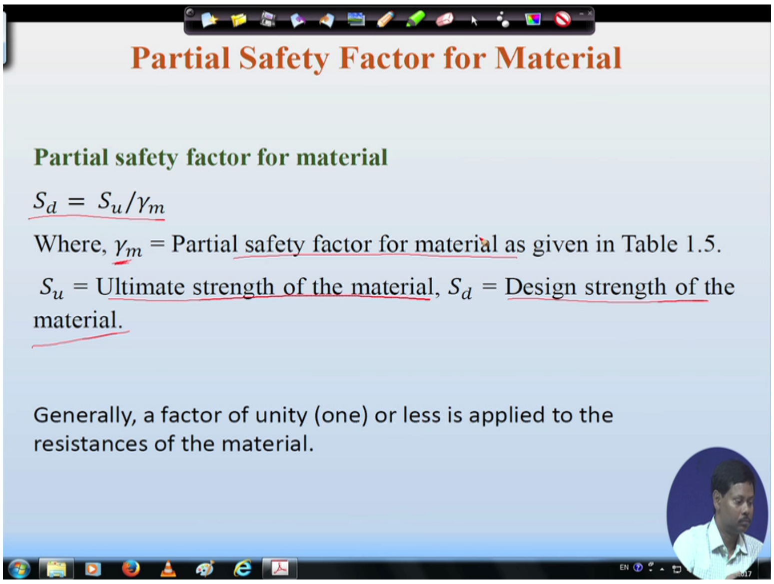



Next is what will be the partial safety factor, suppose if we have dead load, live load and crane load combination what we can do for dead load we can multiply 1.5 and for live load also we can find out we can multiply 1.5, so this will become like this one load combination will be 1.5 into dead load plus live load, this is one load combination we can make. Another load combination we can make that is that dead load plus live load plus wind load or earthquake load there we are making multiplication of 1.2, so there we can make like this 1.2 into dead load plus live load plus wind load or earthquake load, either wind load or earthquake load we are providing, so this is one sort of load combination.

Another load combination is say 1.5 times dead load plus wind load or earthquake load, so this is different type of load combinations reported in the code which we have to consider and we have to find out the worst combination that means which one will be worst and we have to design the member from that worst combination and also we can see that Limit State of Serviceability under dead load and live load we can multiply just (())(16:22) 1, but when we are going to consider Limit State of Service under dead load live load and wind load or earthquake load, we will multiply 0.8 and 0.8 that means for that serviceability load condition we can consider that dead load plus 0.8 live load plus 0.8 earthquake load or wind load, here it is 1.0, so this is one combination against which we have to check the deflection that means the Limit State Serviceability, we have to check the Limit State Serviceability by using this type of load combination.

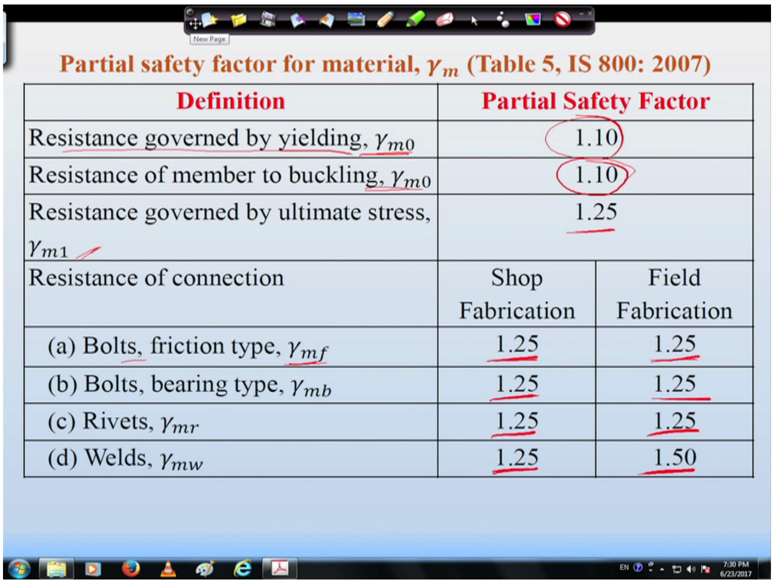
So several load combinations will come into picture one is due to load will be consider due to strength point of view we have to consider another is due to serviceability point of view we have to consider. So for each case we will consider and we will see whether it is exceeding the limiting value or not, limiting value may be strength, stress, limiting value may be deflection. And when we are going to check the deflection criteria we will multiply either 1 or 0.8 as per the codal provisions given and in case of strength calculation we will multiply either 1.5 or 1.2 as per the type of loading, right.

(Refer Slide Time: 17:56)




Now Partial Safety Factor for Material as we told that material we behave up to Ultimate Strength means we will consider up to ultimate strength. So the Partial Safety Factor we can consider Sd as Su by gamma m, where Su is the ultimate strength of the material and Sd is the design strength of the material. So that we use and gamma m is the Partial Safety Factor for material as given in table 5, in table 5 it is given.

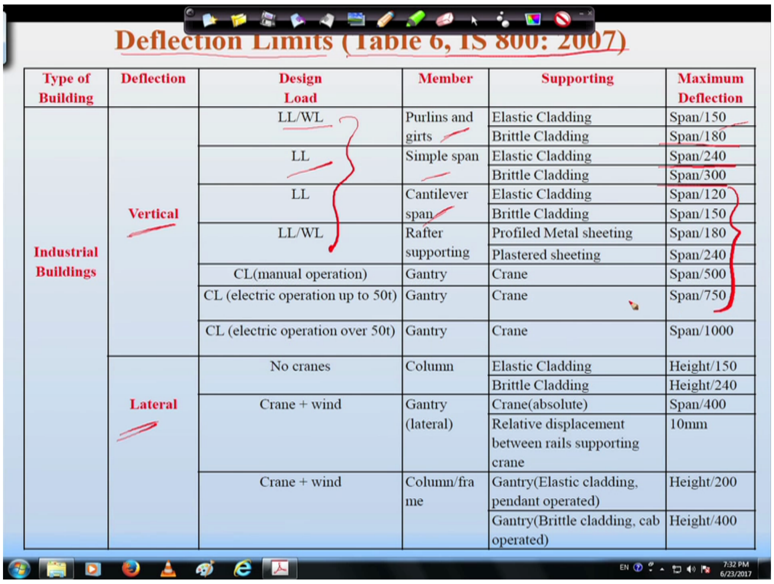
(Refer Slide Time: 18:37)




So if you see the table 5, we can see the different Partial Safety Factor has been consider for different type of material condition, like in case of yielding resistance governed by yielding so gamma m0 is one safety factor which is considered as 1.10, whereas resistance of member to buckling that also as 1.10 that also gamma m0 and resistance governed by ultimate stress that we are making 1.25 partial safety factor that means we are dividing the partial safety factor with the ultimate strength to get the design strength.

And for connection for bolt, friction type bolt gamma mf we use 1.25 for shop fabrication also 1.25 for field fabrication, whereas for bearing type also this is 1.25, 1.25, in case of rivet also we provide 1.25 and in case of weld we provide in shop fabrication 1.25 and for field fabrication we increase that the factor of safety upto 1.5, so this is how the factor safety has been decided and reported in the code which we have to consider and we have to divide with these factor safety with the ultimate strength of the material to get the design strength of the material.

(Refer Slide Time: 20:09)



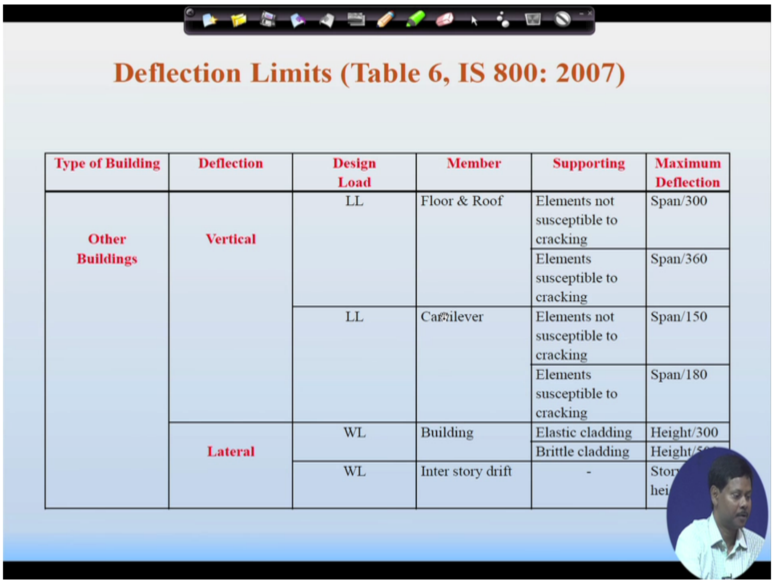
Deflection Limits (Table 6, IS 800: 2007)

| Type of Building | Deflection | Design Load | Member | Supporting | Maximum Deflection |
|---|---|---|---|---|---|
| Industrial Buildings | Vertical | LL/WL | Purlins and girts | Elastic Cladding | Span/150 |
| | | | | Brittle Cladding | Span/180 |
| | | LL | Simple span | Elastic Cladding | Span/240 |
| | | | | Brittle Cladding | Span/300 |
| | | LL | Cantilever span | Elastic Cladding | Span/120 |
| | | | | Brittle Cladding | Span/150 |
| | | LL/WL | Rafter supporting | Profiled Metal sheeting | Span/180 |
| | | | | Plastered sheeting | Span/240 |
| | | CL(manual operation) | Gantry | Crane | Span/500 |
| | | CL (electric operation up to 50t) | Gantry | Crane | Span/750 |
| | | CL (electric operation over 50t) | Gantry | Crane | Span/1000 |
| | Lateral | No cranes | Column | Elastic Cladding | Height/150 |
| | | | | Brittle Cladding | Height/240 |
| | | Crane + wind | Gantry (lateral) | Crane(absolute) | Span/400 |
| | | | | Relative displacement between rails supporting crane | 10mm |
| | | Crane + wind | Column/frame | Gantry(Elastic cladding, pendant operated) | Height/200 |
| | | | | Gantry(Brittle cladding, cab operated) | Height/400 |

Another is the serviceability criteria for serviceability criteria if you see the deflection limits has been defined that is defined in table 6, in table 6 of IS 800: 2007 different limits have been provided, say for in case of industrial building I am just showing few of them one is vertical deflection another is lateral deflection, again design load will be due to live load, wind load, due to live load only. So different type of design load will be consider and members also different type of members have different limiting condition limiting condition mean that span by 150 sometimes, sometimes span by 180, sometimes span by 240, span by 300 like this.

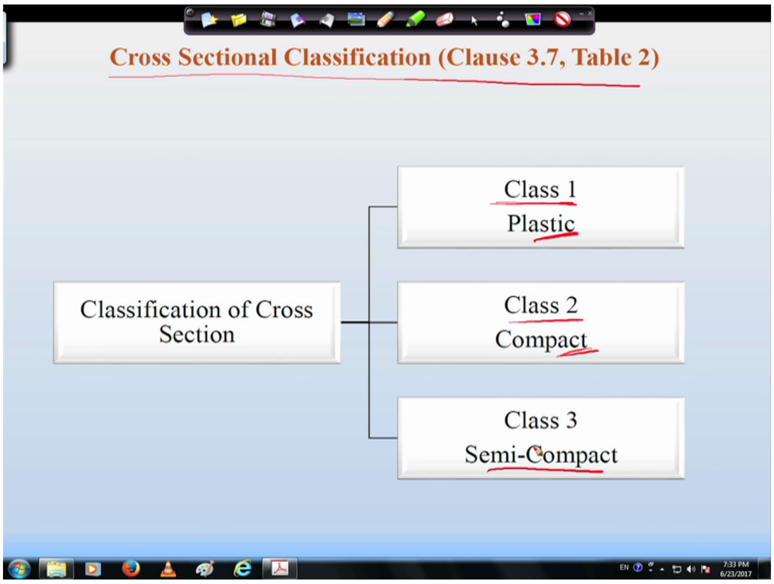
So for different type of supporting condition and different type of members the limiting deflection of the members will be has been given in the table 6, due to different type of load and deflection means this is horizontal deflection as well as vertical deflection. So limiting condition has been defined in the code which we have to maintain, that means when we will be going to design a particular member we have to see under which load we are going to design and whether we are checking for vertical deflection or horizontal deflection, what is the type of (())(21:41) or support condition then what are the type of member, what is the member depending on that we can find out the maximum deflection limit and which we have to follow.

(Refer Slide Time: 22:02)



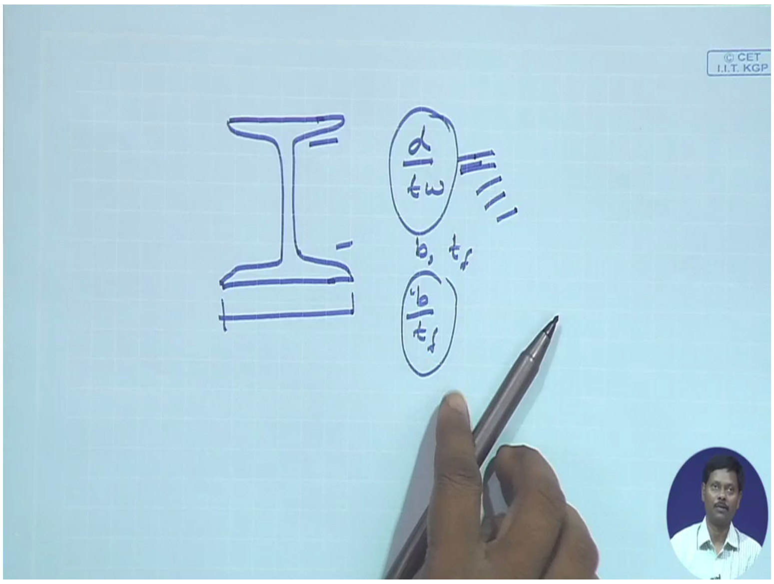

So this is the continuation of the table 6 for other buildings, one was industrial building and another was other buildings we have given.

(Refer Slide Time: 22:10)




Now another thing is the Cross Sectional Classification, this is given in clause 3.7 of table 2, the Cross Section Classification has been made, one is class 1 which is plastic, class 2 classification is compact and class 3 semi-compact, we know in IS code different type of steel rolled sections are given.

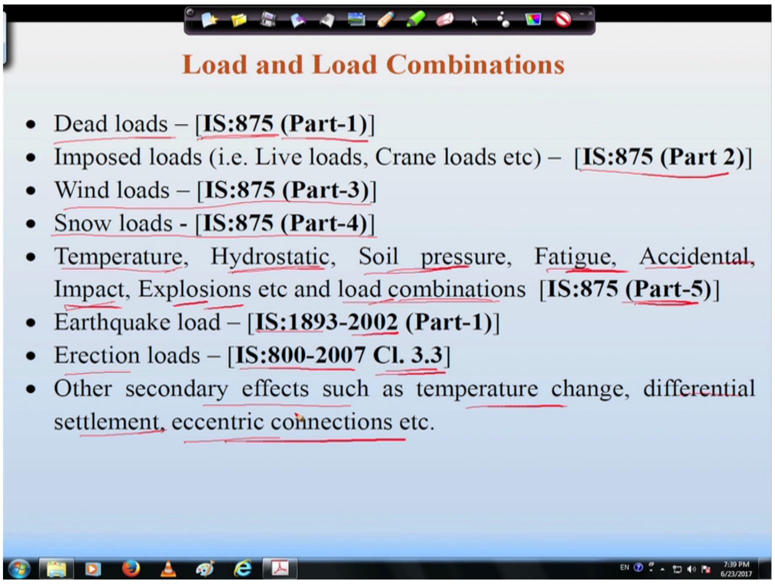
(Refer Slide Time: 22:46)



So say for I section we have ISMB, we have ISJB, we have ISLB, ISHB, ISWB like this we have different type of I sections. Now for different type of I sections, this d the depth of the width and tw, d by tw which is different. Similarly this flange width and flange thickness this is different, so its ratio is also different b by tf, d by tw. So we have to see what is the ratio and this different type of structures has been classified according to the cross section as plastic, compact or semi-compact.

So for a particular type of member, we have to decide means particular type of cross section we have to decide means we have to see whether this cross section is under plastic, semi-compact or compact and accordingly design criteria will be follow. So these things we have to keep in mind.

(Refer Slide Time: 24:00)




Then coming to Load and Load Combinations, load is important because under the particular load we have to design the member and that load may be due to dead load means self-weight, may be due to live load, may be wind load or systemic load or may be other type of load like accidental load or snow load, hydrostatic load different type of loads are there. So then we have to know what are the codal provisions how to calculate the load on a particular member, what will be the amount or quantity of load we will come to that particular member that we have to know.

Then we have to go for the load combination with certain factor of safety that we have seen. So here if we see, the different type of loads are given (IS 18) IS:875 in part 1 to part 5, IS:875 part 1 to part 5, various load and load combinations have been given and now in part 1 the dead loads of the structures have been given like for different type of material, for different type of member what will be the mass density of that like for brick, for plaster, for concrete what will be the mass density which will be calculated for self-weight of the structure that has been given in details in IS:875 part 1.

So the dead load calculation or the self-weight of the structure if we want to calculate then we have to go through the IS:875 part 1 and then we have to see that whether the what is the dead load or self-weight coming into this structure that we have to consider.

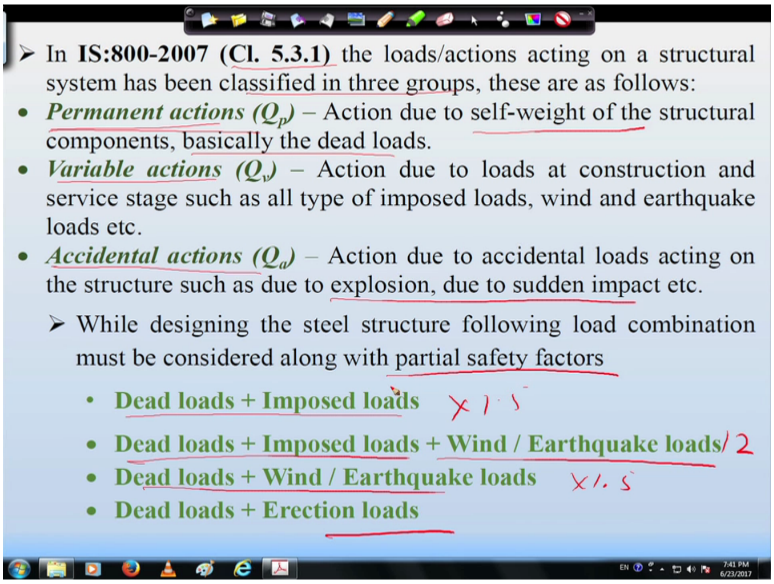
Next is the live load or imposed load. Live load or imposed load will be means is given in IS:875 part 2, in part 2 different type of live loads are given like in case of residential building what will be the live load, in case of industrial building what will be the live load, in case of office building what will be the live load that has been specified, again in case of residential building in balcony, in kitchen, in bedroom what will be the live load, the different live loads are specified, so that has to be taken care from that code.

Another is the crane load crane load also can be found from this part 2, then coming to wind load wind load is given in part 3, IS:875 (Part-3), so wind load I will be coming details after this slide. Then snow load in the area where snow is a factor there we have to consider the snow load and that has been given in part-4, right and in part-5 the temperature load, hydrostatic load, soil pressure, fatigue, accidental impact, explosions etc and different type of load combinations are given in part-5. So part-5 consist of temperature load, hydrostatic load, soil pressure, fatigue, accidental load, impact, explosions etc and different type of load combinations means dead load plus live load, dead load plus wind load, dead load plus live load plus wind load, like this different load combinations are recommended in part-5.

And earthquake load you can find out in IS:1893-2002, in case of earthquake load we know in our country we have 5 zone now it is zone means 4 number of zone, zone 1 and zone 2 is clubbed to zone 2, so zone 2, zone 3, zone 4 and zone 5 and zone 5 is the most systematically active zone. So for different zone what is the systemic coefficient for calculating the load that has been given in the code in IS:1893-2002, so detail calculation of load due to earthquake can be found in this code and according to that we have to calculate the load coming to the particular structure and then we have to apply that load to the structure to find out the structure to make the structural design properly.

Then erection load erection load is given in IS: 800-2007 in Clause 3.3 the details are there and also other secondary effects such as temperature change, differential settlement, eccentric connections those things also has to be taken care in the load and load combinations because due to settlement differential settlement extra load will come into picture, due to temperature extra load will come into picture, so that has to be also taken care in the design calculation.

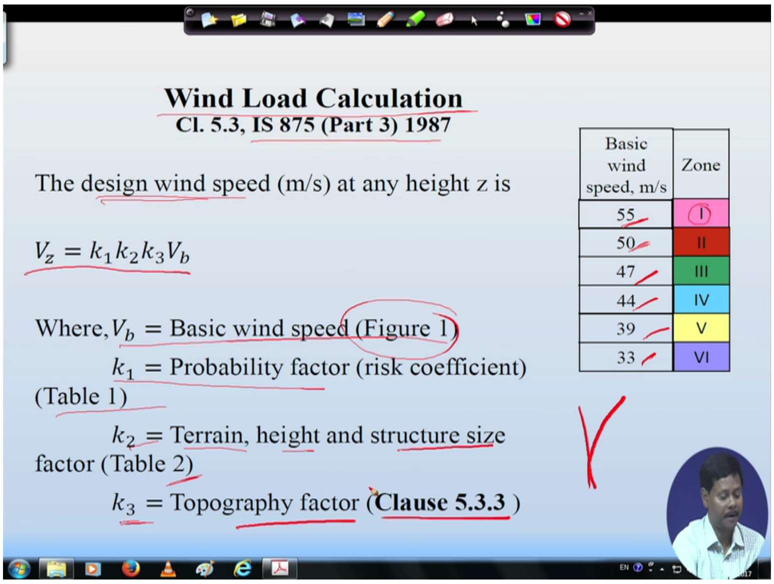
(Refer Slide Time: 29:21)




Now in clause 5.3.1 if we see the the structure system has been classified in three groups, one is the permanent action, permanent action means the load which are permanent in nature these are basically self-weight of the structure which we call generally dead load, so these are permanent action. Another is variable action, variable action means basically imposed load and wind or earthquake load are not permanent these are temporary and variable so these are under variable actions. Another is accidental actions, action due to accidental load like explosion or due to sudden impact such type of accidental accidents happen, so that has to also be taken care.

And we have told that while designing the steel structure following load combination have to be consider with partial safety factor, partial safety factor I have already discussed that is dead load plus imposed load, here we will multiply with 1.5 and dead load plus imposed load plus wind or systemic load that is 1.2, we will multiply dead load plus wind load here also we multiply 1.5, like this dead load plus erections load, so these are some load combinations which we have to take into consideration for the design of the member.

(Refer Slide Time: 30:51)



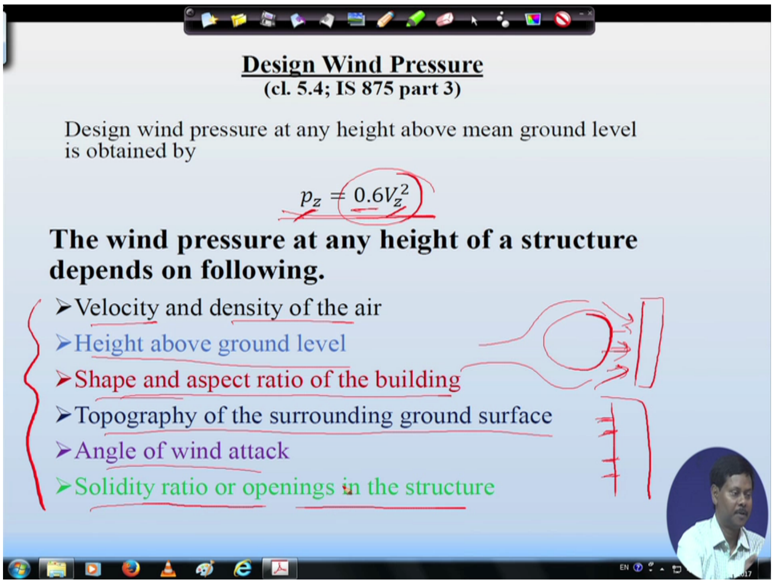

Now very briefly I will go through the wind load calculation because in case of steel structure wind load is a factor for designing the steel members because the steel structures are lite in weight so it is vulnerable to cyclone and wind therefore we need to do what are the wind load coming in to the steel structure and accordingly we have to find out the design criteria means we have to find out the load coming on the on a particular member and then accordingly we have to design not only we will design we will check the limiting deflection because serviceability criteria has to be also maintained.

So what is the deflection coming due to wind because steel are ductile in nature so lot of deflection will come in compile into concrete structure therefore we have to check the serviceability criteria as well, right. So thinking that I am going to give a brief review on the wind calculation and I told that wind calculation was given means is given in the code IS 875 (Part 3) in Part 3 you will get the detail of wind calculation and here the design wind speed Vz are calculated from this formula, that is Vz is equal to k1 k2 k3 into Vb k1 k2 k3 into Vb, where Vb is a basic wind speed and these basic wind speed are divided in divided in our country in six zone, ok in six different zone it has been given like if zone one the basic wind is 55 meter per second this is the highest speed, then in zone two it is 50, zone three it is 47, zone four 44, zone five 39 and zone six is 33 meter per second.

So according to this IS code in the figure figure 1 of the IS code IS code means IS 875 in figure 1, the basic wind speed for different zone has been given also at the end of the IS code in a tabular form it is given for different city what will be the basic wind speed for different city like Kolkata, Delhi, Madras means Chennai, Mumbai, Bangalore in different city you will get the what is the basic wind speed of that city, that also we can find out from the code.

Next is the probability factor k1, k2, k3, k1 is the probability factor or risk coefficient this is given in table 1, I am not going into details if you look through the code you will be able to understand all the details have been given. Then k2 k2 depends on the terrain, height and structure size, so that factor is given as k2 and in table 2 that is given, you will see that according to height the k2 factor is going to increase like this it is going to increase that means the wind speed will go on increasing with the increase of height so, k2 takes care that that effect, right another is k3, k3 is the topography factor means what type of topography is it in the where the structure is going to be constructed whether it is valley or anything else or plane land depending on that what is the slope depending on that the k3 factor will be calculated these details you can find out in Clause 5.3.3.

(Refer Slide Time: 34:51)

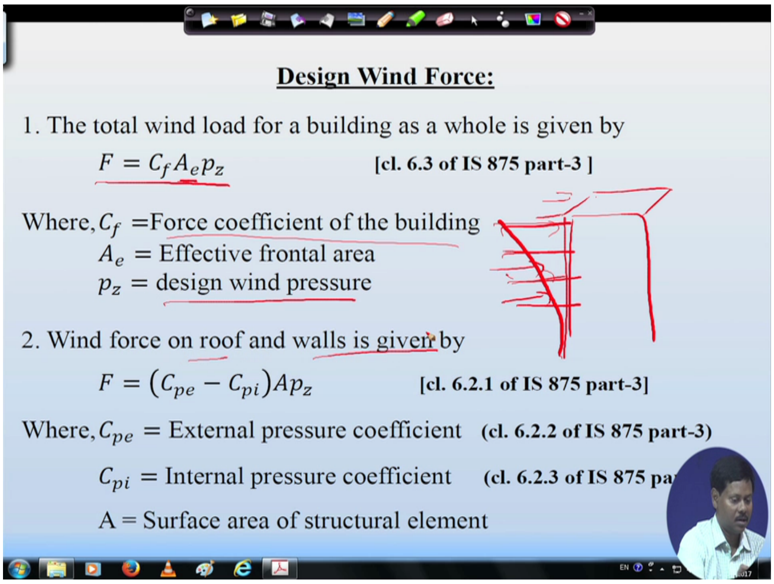



Now Wind Pressure, Wind Pressure we can find out from this formula pz is equal to 0.6vz square, actually 1200 kg per meter cube is the mass density of the air so if we use that formula then we half (())(35:07) v square so pz we can find out 0.6 vz square and this wind pressure at any height of structure depending depends on this type of criteria, like wind pressure depends on velocity and density of the air because density we consider 1200 but depending on the density also this wind pressure varies and of course with the velocity velocity Vb will be different at different zone at different city so according to that Vz will be changed so that also we have to consider.

Then height above ground level, the building or the structure is situated at what height above the ground level that also have to be keep in mind for which the wind pressure depends. Then shape and aspect ratio of the building suppose if building is circular, then the wind pressure will not be much but if building is like this then wind pressure will be much means wind pressure will develop in this area will be much. So it depends on the shape and aspect ratio of the building.

Also topography of the surrounding ground surface, angle of wind attack whether it is this angle, this angle or 90 degree angle that depends on that the wind pressure will depend also solidity ratio or opening in the structure means on the structure whether if we have open openings or not depending on that also the wind pressure will be govern. So depending on the solidity ratio the wind pressure can be calculated. So these are some factors which are which depends on the calculation of the pressure.

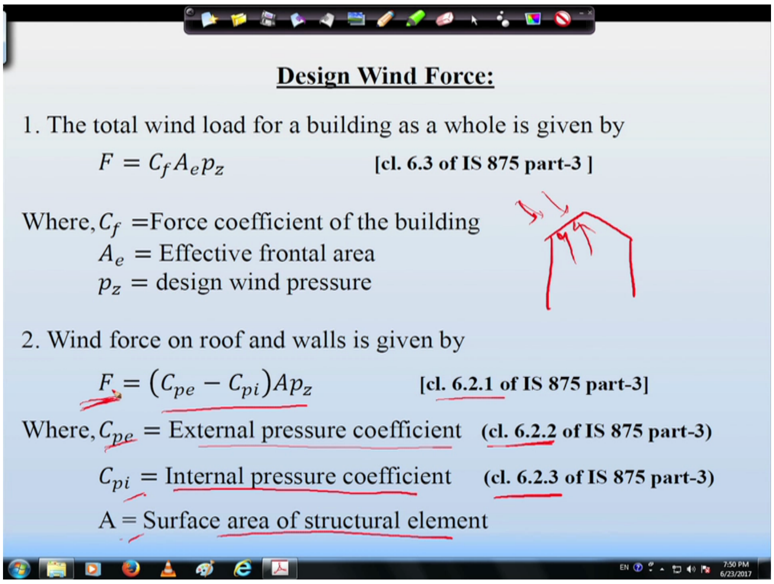
(Refer Slide Time: 37:02)




Then Design Wind Force once we get the design wind pressure we can find out the wind force that is F is equal to Cf into Ae into pz, pz is the design wind pressure at different height we can find out the wind pressure different way and Ae is the effective frontal area effective frontal area means if we have a building like this and if we have wind from this direction then the area will be area will be in this direction means area will be this height into the width of that direction.

Then pz is the design wind pressure and this pz will vary with the height so at floor to floor or at a different height we have to calculate the wind pressure and then we have to find out the force on that particular floor or particular height. And Cf is the force coefficient of the building so this is how we can find out the total wind load of a building as a whole and after getting wind load we can divide into different floor, right.

(Refer Slide Time: 38:23)




Another thing is we have to consider that wind force on roof and walls as an individual means if if there is a roof suppose we have a building like this and it has a roof so there we can find out what is the wind pressure is coming from externally and what is the internal wind pressure is coming depending on that we have to find out the force and this force can be calculated from this formula that is (Cpe minus Cpi) into A into pz, this is given in Clause 6.2.1, where Cpe is the external pressure how to calculate this is given in clause 6.2.2 and Cpi is the internal pressure coefficient Cpe and Cpi so internal pressure coefficient also can be calculated from clause 6.2.3 and A is the surface area of the structural element.

So if we can find out this value the coefficient external pressure coefficient and internal pressure coefficient and the surface area then we can find out the wind force on roof or wall as an individual, right so this is how we can calculate the wind force.

So this is all about todays lecture and we have seen in todays lecture that why Limit State Method is important and why why it is more accurate, more practical compare to other two methods that is Ultimate Strength Method and Working Stress Method, why we have move to Limit State Method that is understandable now and tomorrow onwards when we will be going for design of members or connections individual members or connections will follow this criteria that means Limit State Method design criteria where the load factor and the partial safety factor for the material will be consider and what will be the load combination for which we have to design that will be consider and we have seen the what is the ultimate strength of the member, what is the yield strength of the member for the steel that according to the different weight we can find out and we can use make use of those parameters for design of the elemental means element or member, ok. So with this I will have to conclude todays lecture, thank you.