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Structural Dynamics
Week 11: Module 02

Non Structural Elements
Example

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Welcome to structural dynamics class so in this class we will study how nonstructural elements behave under the earthquake excitation so in the previous class we have studied the behavior however in this class what we do is we will solve one example problem by taking a real near real conditions of putting non structural elements in say four or five story building and different levels and then give earthquake excitation at the base and check the performance of this nonstructural elements whether they are safe in the respect to floors or they are unsafe. So that we will discuss in this class.

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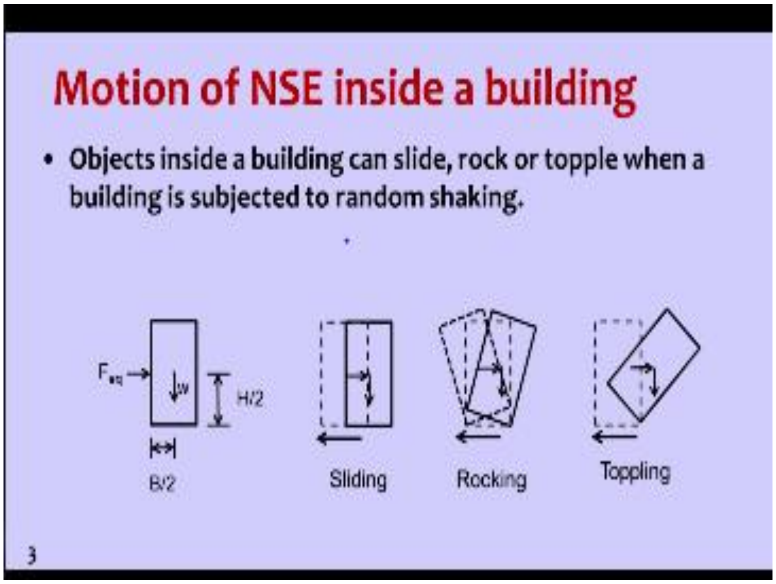

So let us summarize about nonstructural elements in the building objects inside building can slide rock or topple when building is subjected to random shaking so as you can see this non structural element so it can algebra store well table or any other furniture okay so wait is acting downwards earthquake excitation is acting up putting a force at the center of mass so the center of mass is it H by 2 from base and B by 2 from left and so it can slide depending on some conditions it can rock depending on some conditions it can topple depending on some conditions so what are these conditions.

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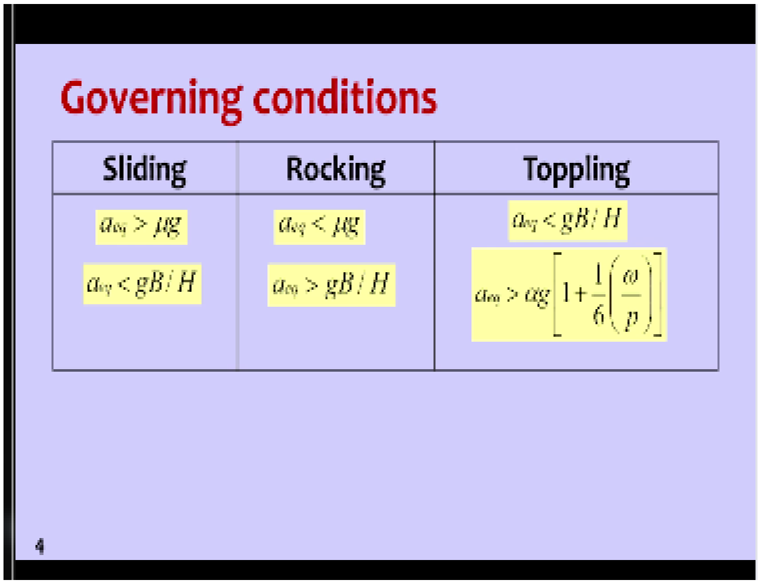

Let us look at it so for sliding there are two necessary conditions one is peak acceleration should be greater than frictional resistance times gravity acceleration due to gravity and then at the same time this acceleration should be less than gravity times aspect ratio be by H is aspect ratio so then sliding takes place now for rocking this acceleration peak acceleration should be less than a frictional resistance time co-efficient of friction assistance times gravity and then acceleration should be greater than gravity times acceleration.

And then for toppling acceleration should be less than first gravity times aspect ratio and it should be greater than alpha G times this bracket value so before going to example problem let us look at the behavior of the furniture in various floors so let us see is a small numerical simulation.

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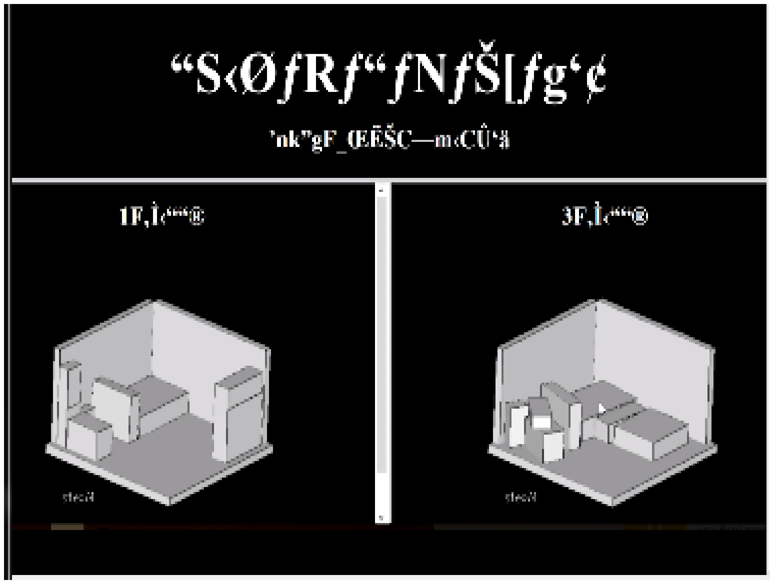

So let us watch this numerical simulation so here you can see so many rigid blocks are kept in a typical floor so in first floor and also in third floor as you can see in this one same type of equipment is behaving differently in different floors this is first floor and this is third floor.

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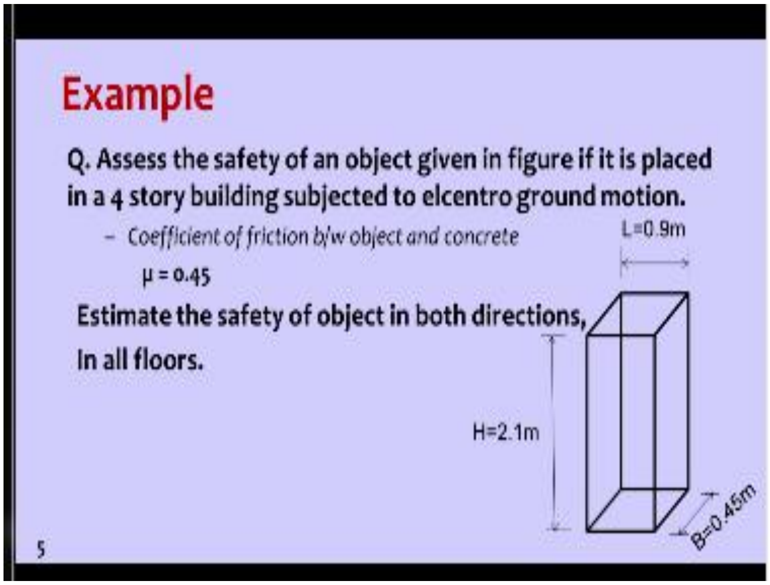

So now we have watched how these launch structure elements behave in different, different floors on the building so we have taken an example of first floor and third floor now let us solve the value numerically.

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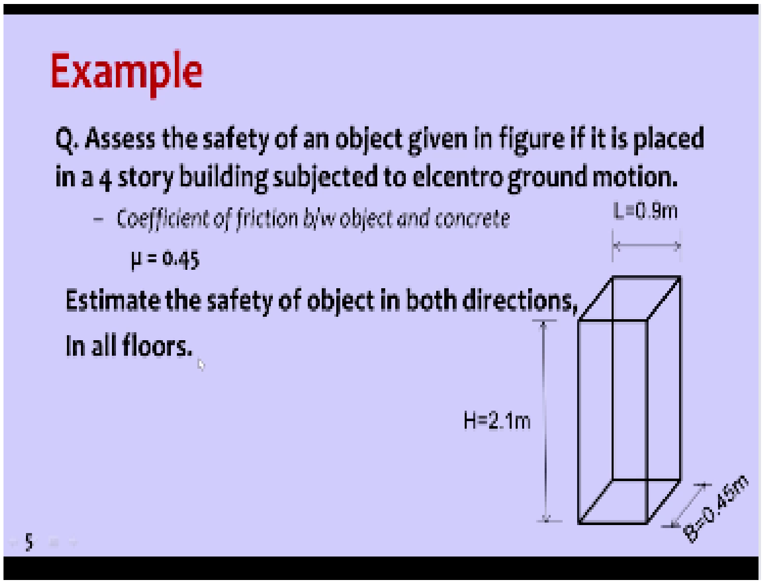

So assess the safety of an object given in figure so this is the object if it is placed in a four-story building subjected to El Centro ground motion so coefficient of friction between object and concrete that concrete floor is a m is equal to 0 .45 dimensions of object are so 2 .1 meter height so point 4 5 meter width and then length is say point 9 meters length so this object is placed in all floors.

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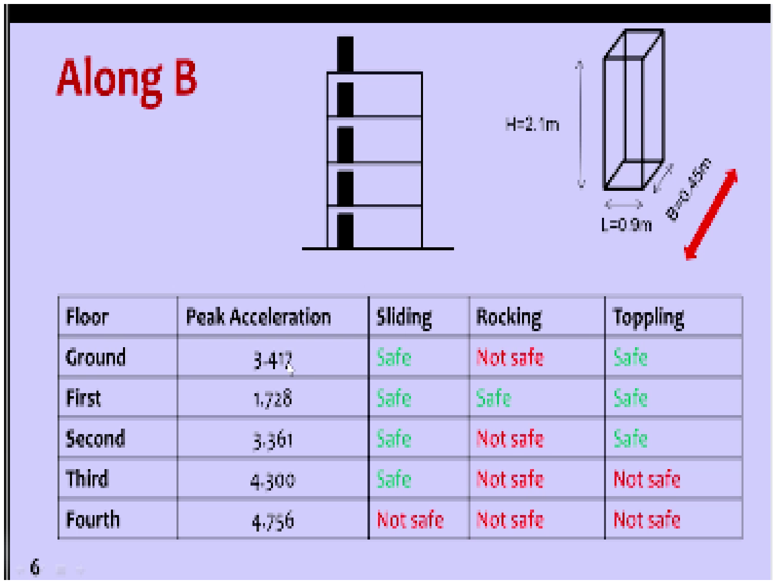

So now you can see this one this we have solved so what we did was so we have modeled this ground building as a framed structure and give L Centre ground motion to this one and obtained acceleration response at say floor one floor to floor three and floor four so for this we have employed numerical technique so Newmark's method of numerical techniques and found out so at ground peak ground acceleration is 3.417 meters per second square.

And at first floor 1.728 is reduced at second floor 3.3 61 meters per second square and third floor 4.3 and fourth floor 4.7 now when we employ sliding condition so it is coming to me this acceleration value.

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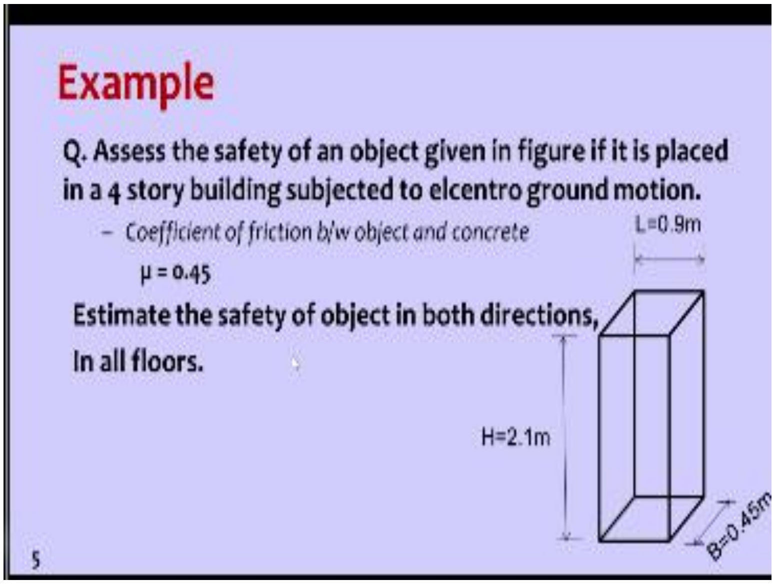

If I tell you so these are the sliding conditions so AQ greater than G AQ less than G into aspect ratio.

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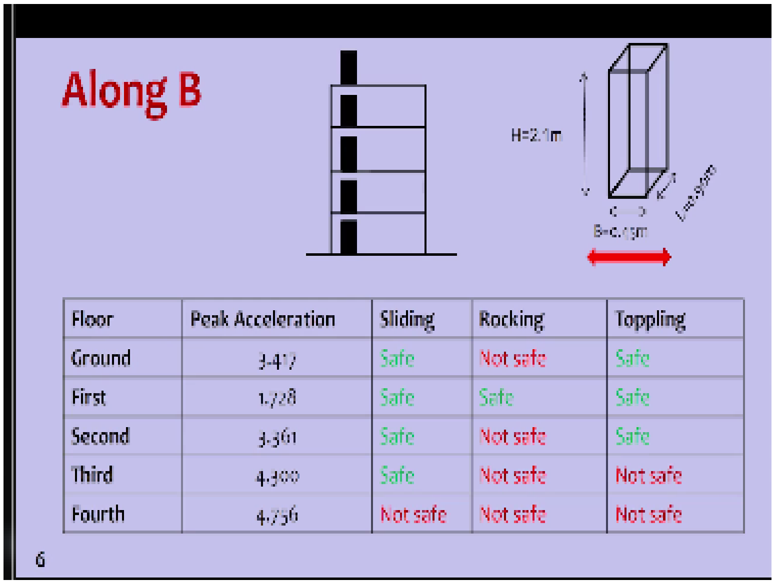

Floor	Peak Acceleration	Sliding	Rocking	Toppling
Ground	3.417	Safe	Not safe	Safe
First	1.728	Safe	Safe	Safe
Second	3.361	Safe	Not safe	Safe
Third	4.300	Safe	Not safe	Not safe
Fourth	4.756	Not safe	Not safe	Not safe

So when we put that sliding condition at this floor it is becoming safe and then rocking condition it is unsafe toppling condition it is safe now at first floor sliding condition safe rocking conditions safe toppling condition again safe and in second floor sliding condition is safe rocking condition not safe toppling condition is safe third floor sliding is safe rocking is not safe toppling is not safe so in fourth floor not safe sliding not safe rocking and not safe in toppling.

So that means what so these objects are not safe in these regions so where it is written in red and is safe in this one so what is needed is so we need to give the solution of tying these nonstructural elements in that floor so this is along one direction a so as shown in the figure.

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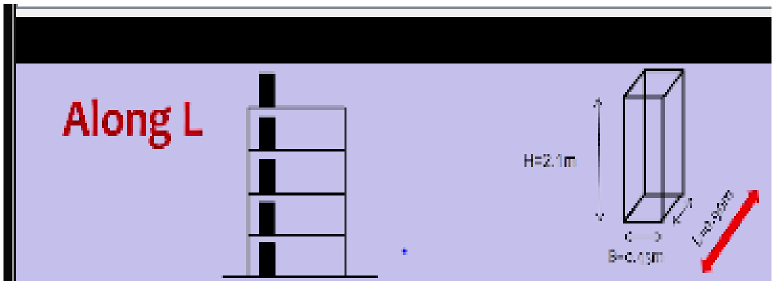

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And in the other direction we can look at the safety because the dimension has changed so that people meter will change so in this one it is more safe in many cases except in third floor in rocking condition and fourth floor sliding and rocking condition.

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So in summary we have solved done example problem to show how a nonstructural element which is placed indifferent floors will behave under the earthquake excitation so we will have one numerical calculation in the tutorial

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