**Computer Methods of Analysis of Offshore Structures**
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**Module - 01**
**Lecture - 03**
**Matrices (Part - 2)**

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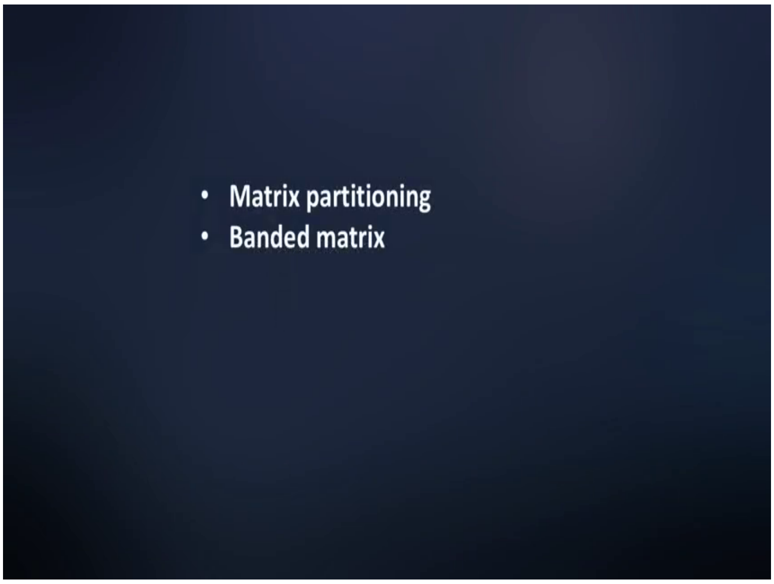


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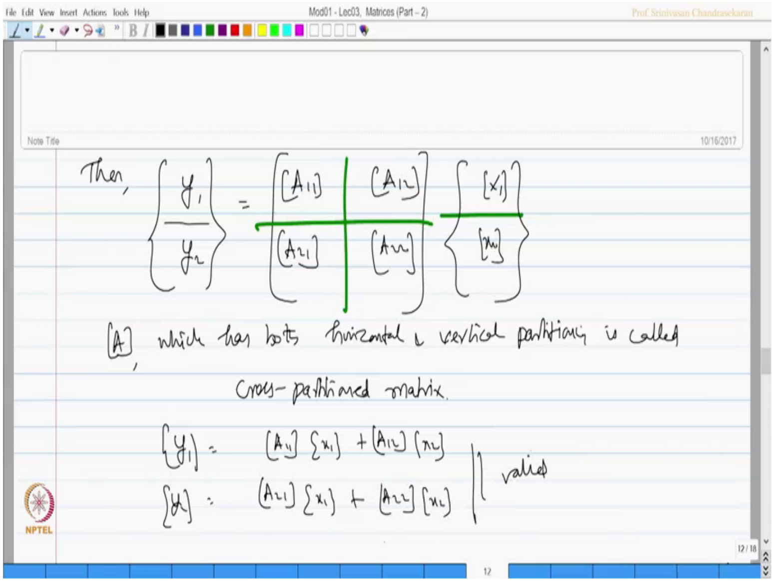


Y 1 y 2 with the horizontal partition will be equal to A 11 A 12 which are all sub matrices A 21 and A 22 which are all partitioned, which can be now multiplied with the vector x 1 and x 2 which are also partitioned horizontally. So, it means that the matrix A which has both horizontal and vertical partitioning is called cross partitioned matrix. This will be very helpful in structural analysis in future problems.

Let us see the advantages of this. Let us demonstrate the advantage of this. So, once we partitioned then from this expression y 1 is also equal to A 11 x 1 plus A 12 x 2. Similarly y 2 will be equal to A 21 x 1 plus A 22 x 2. So, these are all now valid.

Now let us take how this partitioning can be helpful in estimating inverse.

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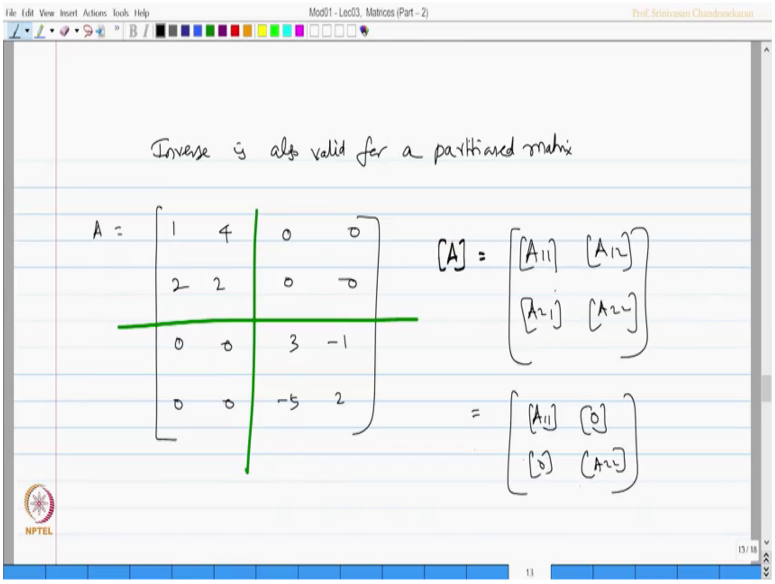


So, now inverse is also valid for a partitioned matrix which is very advantageous. Let us say for example, A matrix is 1 4, 2 2; 0 0, 0 0; 0 0, 0 0; 3 minus 1 minus, 5 2. Let us say I have a matrix like this.

Let us say I have partitioned horizontal and vertical both. Now I can write A as A 11 A 12, A 21 A 22 which are all sub matrices of a you also further write this as A 11 0, 0 and A 22.

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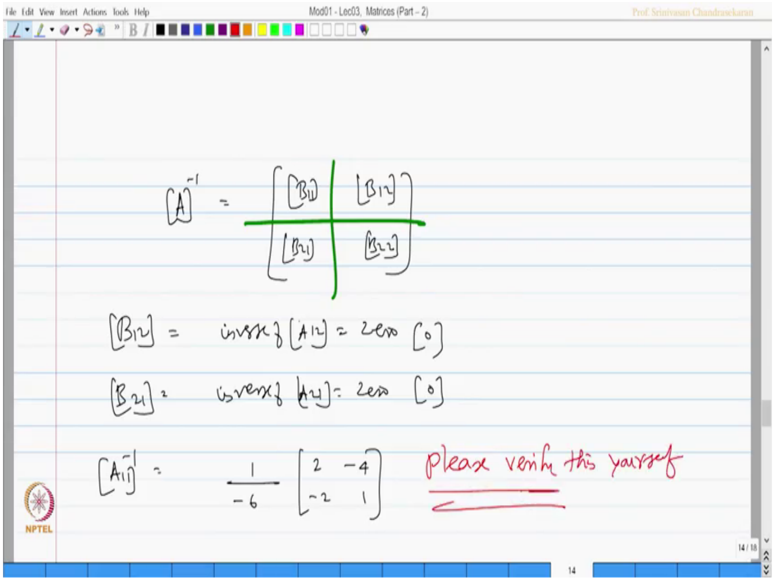


Now, if you want to find A inverse which can also be said as B 11 B 12, B 21 B 22 which are again sub matrices, because algorithm is also valid for this.

We also know that B 12 which is actually inverse of A 12 will be 0, similarly B 21 is actually inverse of A 21 will also be 0; is going to be a null matrix. So, I want to find A 11 inverse I can easily say that as 1 by minus 6 of 2 minus 4, minus 2 1. Please verify this yourself. This is small exercise given to you please verify.

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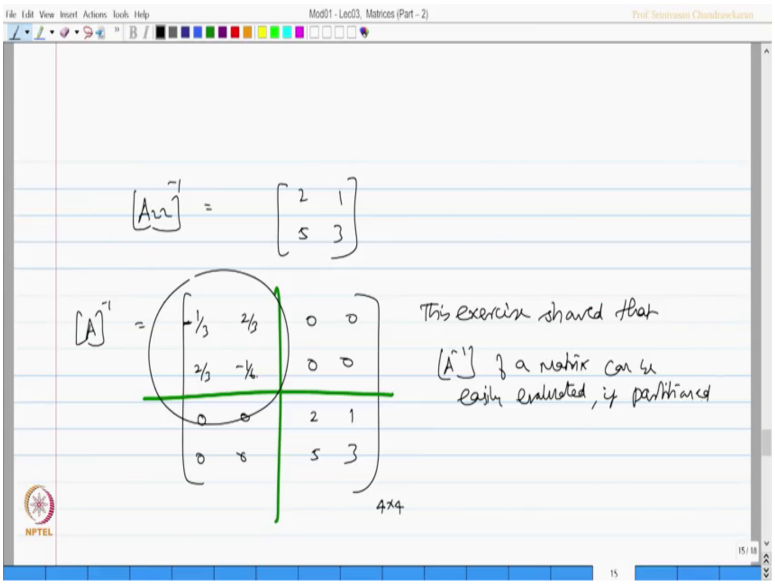


Similarly, I can find A 22 inverse as 2 1 5 3.

Now, the advantage is I can find A inverse simply as 1 over 3 2 over 3, 2 over 3 minus 1 over 6; 0 0, 0 0; 0 0, 0 0; 2 1, 5 3 which is now partitioned like this. Now interestingly finding inverse of 4 by 4 would I have been difficult, but finding inverse of 2 by 2 was relatively simple. So, this exercise show that inverse of a matrix can be easily evaluated if partitioned.

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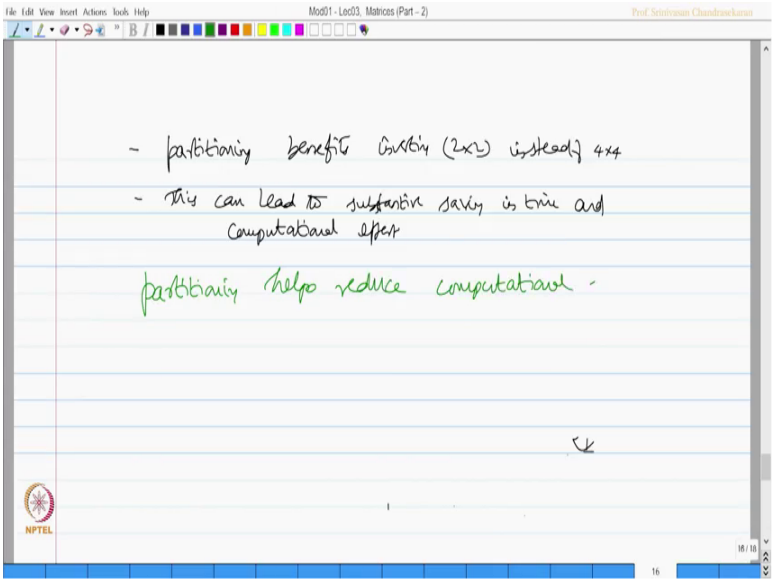


So, partitioning benefits inverting only a 2 by 2 matrix instead of 4 by 4, so this can have or this can lead to substantial saving in time and computational effort. Therefore, we can say partitioning helps reduce computational effort.

Having said this let us talk about some advantage of banded matrix.

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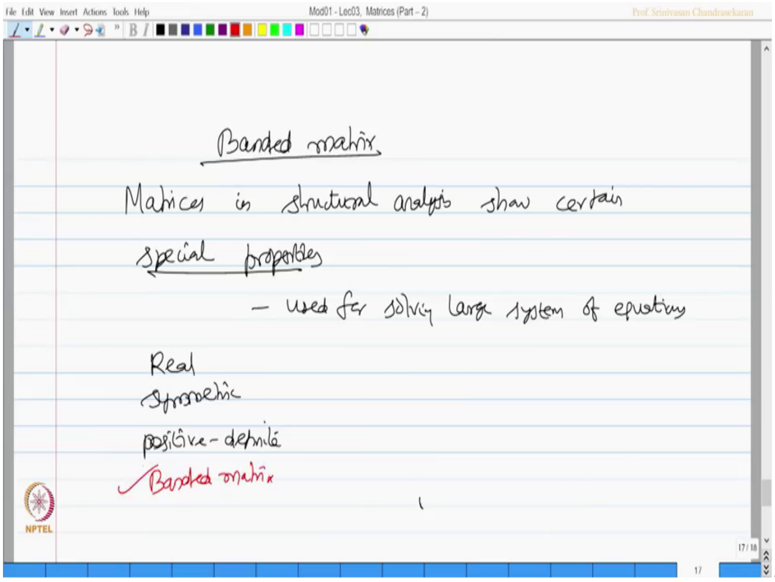


Sometime in structural analysis banded matrix can also be of a great help. Now, matrices in structural analysis show certain special properties, they can be utilized for solving large system of equations; what are the special properties? Real, symmetric, positive definite, and most importantly banded matrix. Let us quickly see; what is a banded matrix.

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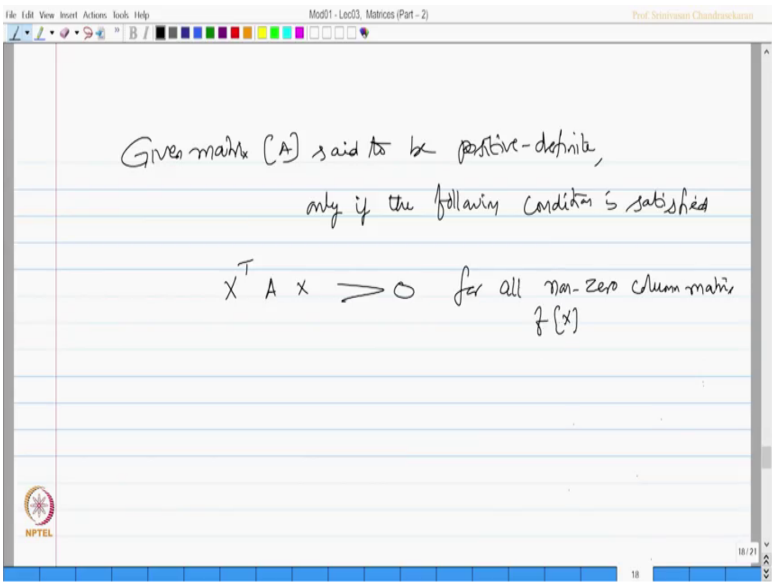


Given matrix A said to be positive definite only if the following condition is satisfied: X transpose A X should be greater than 0 for all non-zero column matrix of X. Let us elaborate this slightly with an example

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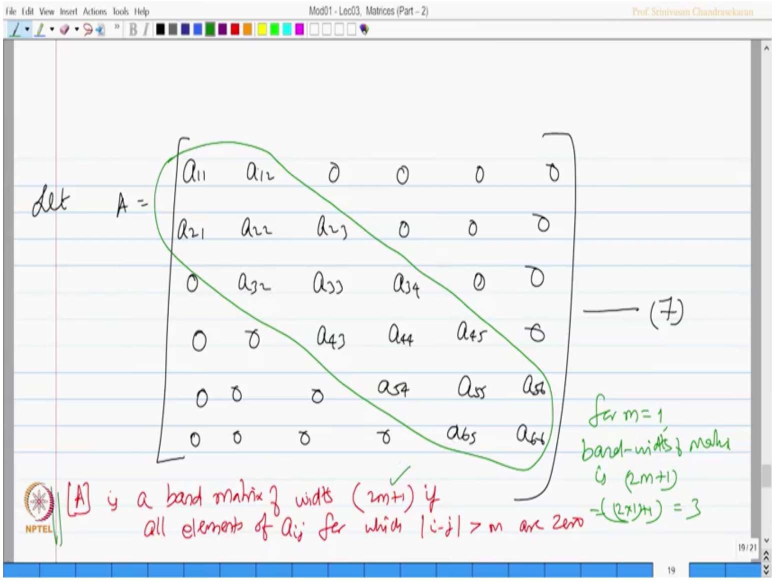

Let A matrix b represented as A 11 A 12 0 0 0 0. Similarly, A 21 A 22 A 23 then remaining elements as 0; A 32 A33 A 34 0 0; A 43 A 44 A 45 0; A 54 A 55 A 56; A 65 A 66. So, the non-zero elements I indicated as a suffix ij, whereas 0 elements I indicated as 0 in a given a matrix. Now let us call equation number 7.

A is set to be a banded matrix with width equals 2m plus 1, if all elements of a ij for which i minus j is greater than m or 0. For m equals 1 band of this matrix it is a band width of this matrix A is 2m plus 1 which is 2 into 1 plus 1 which is 3. So, the bandwidth of this matrix is actually 3; starts from here. So, one can check that this condition is true for the band width of this matrix to be 3 where m seems to be 1 in this example.

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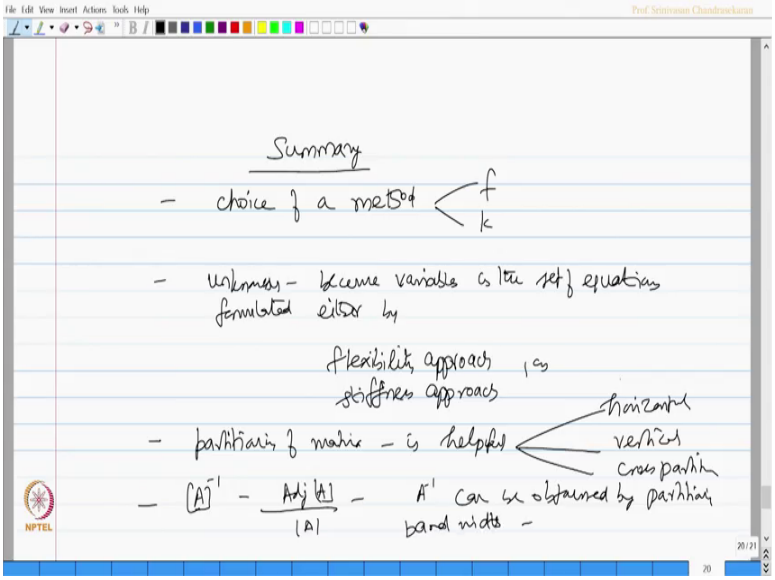


So, friends in this lecture we discussed about the limitations and choice of a method whether it is flexibility method or stiffness method. We understood that the unknowns become variable in the set of equations formulated either by flexibility approach or stiffness approach. We have understood how partitioning of a matrix is helpful. We have seen horizontal partitioning, vertical partitioning, cross partitioning.

We have also enjoyed the convenience I mean understanding A inverse from ad-joint of A by determinant of A. And, A inverse can be obtain easily and conveniently by partitioning. We have also seen how a bandwidth of a matrix can be determined which can be a useful handy solution for problems in structural analysis.

Thank you.