Engineering Hydrology
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Lecture 82
Summary

Hello all, welcome back. In the previous lecture, we have completed module 7, that was on hydrologic Design.

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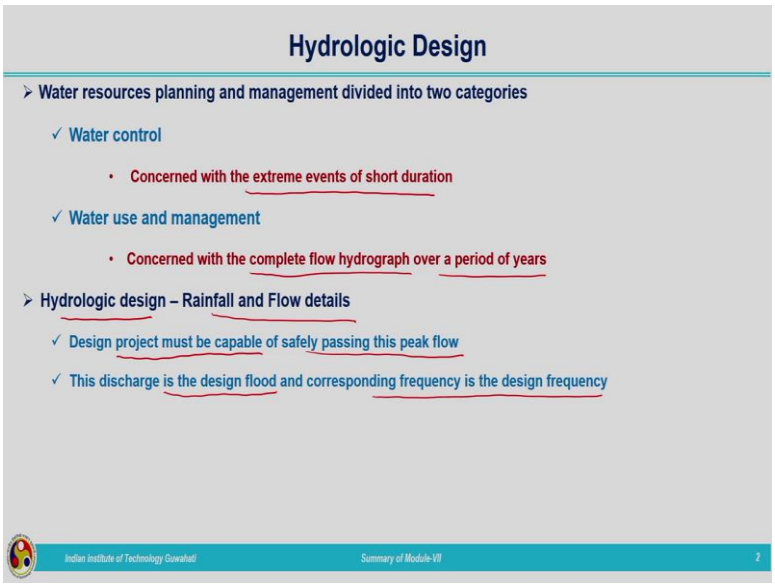

Today, let me summarize that module. When we were discussing about water resources planning and management, it is divided into 2 categories. Our aim was looking into 2 directions related to water control and water use and management. So, water control is concerned with the extreme events of short duration and water use and management is concerned with the complete flow hydrograph over a period of years. For the design related to these 2 categories, we will be making use of 2 different data: one is related to the extreme events and the other one is related to the complete data for so many years.

So, for the hydrologic design, we need to have the rainfall and flow details. If you are going to design a hydraulic structure or if you are carrying out the hydrologic design, that structure should be able to withstand the extreme events or the events which may occur during the lifespan of that particular structure, that is the important point which has to be taken care because we do not know what will be the magnitude of the event which will occur tomorrow, but for a structure, there is a certain lifespan or design life.

So, during this design life, the structure should be stable or there should not be any failure of the structure during this lifespan initially decided. So, it should be able to withstand the extreme event or the event which may occur during the lifespan of the structure. The design project must be capable of safely passing the peak flow that may be extreme flow or that may be a flow related to that particular return period, whatever be we are considering the structure should be able to capable of safely pass that flow. This discharge is termed as the design flood and the corresponding frequency is the design frequency. So, design frequency what is meant by frequency and magnitude of the event corresponding to a particular frequency, all these things we have looked into in this module and in the previous module on hydrologic statistics.

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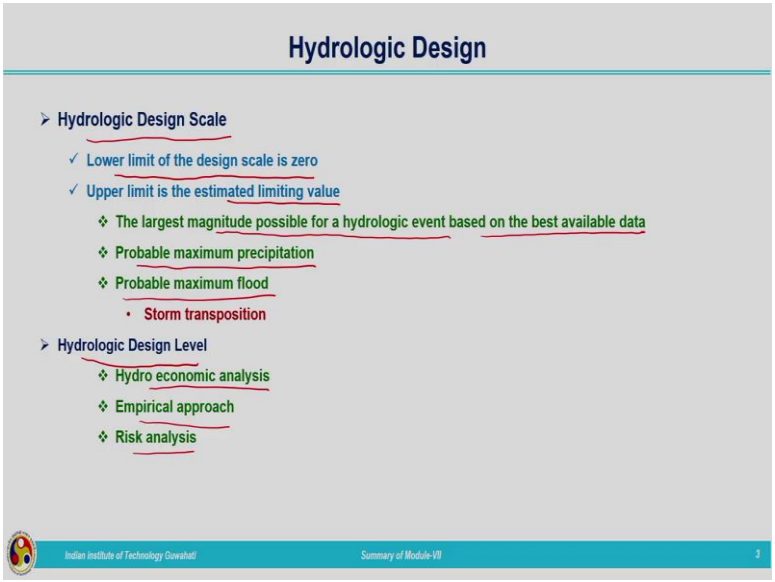

So, while discussing about hydrologic design the important terminology which we have come across is hydrologic design scale. There should be a scale or a range of values decided for these events rather than a single value a certain range will be provided. So, that should be very clearly defined before the hydrology design, under the scale lower limit can be 0. Even though it would not be 0, but it can go up to 0, it would not take any negative value, but when we talk about the maximum value, where it should be limited, that we have seen with the help of an estimated limiting value, upper limit is decided based on the estimated limiting value.

So, the largest magnitude possible for a hydrologic event is determined based on the best available data. Different ways are there to determine the upper limit: one can be the way in which we can determine the magnitude of that event by making use of the past data that is by means of frequency analysis and other way is to by making use of the probable maximum

precipitation and probable maximum flood. Probable maximum precipitation, that is the maximum precipitation that can occur during the lifetime. This is decided based on the entire past data and the corresponding flood is termed as the probable maximum flood. But always we would not be going for selecting this probable maximum storm and probable maximum flood for the design of a structure, that will be selected for the structures which need to be designed beyond certain return period.

So, there are certain catchment or watershed which are ungauged in nature, which face the problem of data scarcity, in that case for the determination of this maximum flood or maximum storm, we can make use of this storm transposition principle. In this we will be making use of the data from the gauged catchment which is climatically similar to that of this ungauged catchment. The data from this ungauged catchment and also the data which is available for the gauged catchment, all collected together and the suitable maximum value will be chosen based on certain methodology. That is coming under storm transposition that we have covered. And then coming to the hydrologic design level, how to decide this design level, we have gone through 3 different methods, those are hydro economic analysis, empirical approach and risk analysis. Under risk analysis, we have discussed about the risk and reliability. Risk is representing the probability of the chances of occurrence of a flood equal to or beyond a certain threshold value that is associated with the structure. Risk and reliability are complementary to each other. If one is calculated other can be obtained by subtracting it from 1. That much, we have covered under risk analysis.

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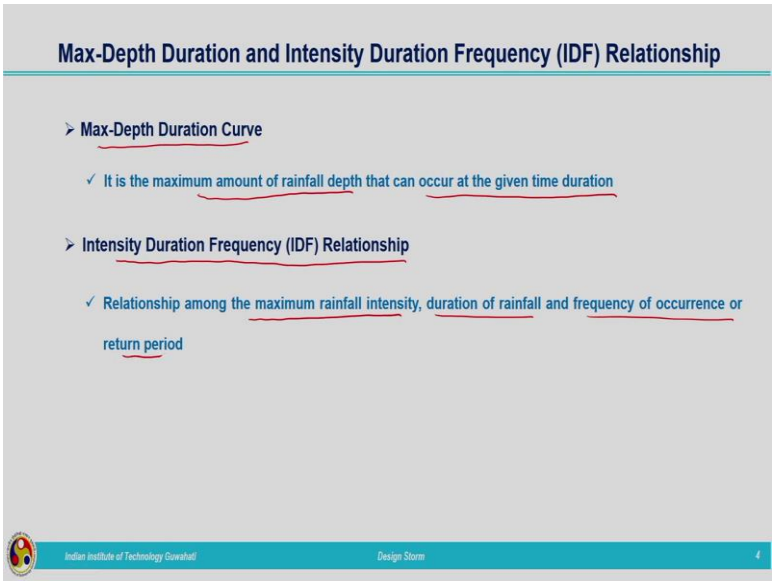

While discussing about the maximum intensity, we have discussed about 2 curves: one was maximum depth duration curve, other one was intensity duration frequency curve. Maximum depth duration curve was the maximum amount of rainfall depth that can occur at any given time duration. Because, whenever we are going for hydrologic design, we need to choose the return period and also the duration of the event. Return period is representing the frequency of occurrence of an event and at the same time duration for which the hydrologic design has to be carried out. For that particular design, what can be the possible value corresponding to intensity of rainfall that can be obtained based on the maximum rainfall depth. For a particular duration, this is the maximum rainfall depth, from that we can calculate the intensity of rainfall corresponding to that duration. That can be obtained from maximum depth duration curve and any other way is to get the intensity is by using intensity duration frequency relationship. This is the relationship among the maximum rainfall intensity, duration of rainfall and frequency of occurrence or return period. So, for different return periods, different number of curves will be there which is representing the intensity versus duration. So, for a specific return period for which the structure is going to design, we can choose the required duration and also corresponding intensity from IDF curves.

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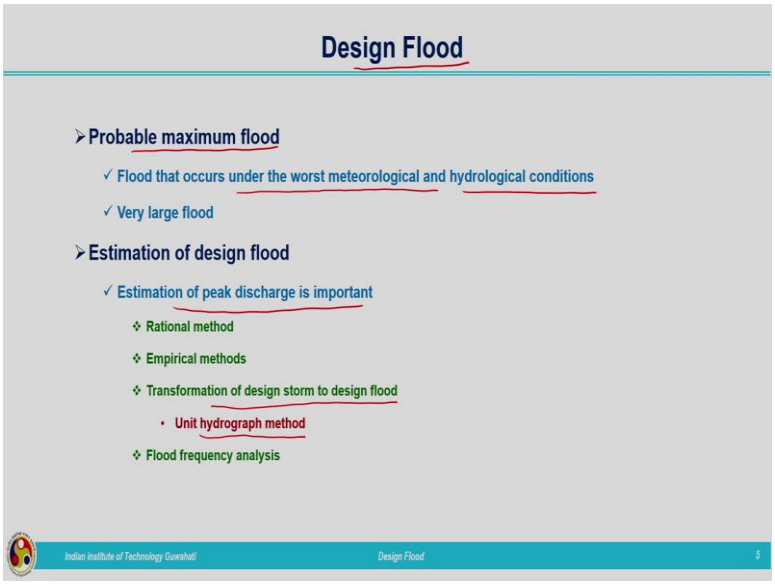

After that we have moved on to the topic of design flood. Under design flood we were discussing about probable maximum flood that is the flood that occurs under the worst meteorological and hydrological conditions. This will be very large, it is very important to determine this value for the design of certain important structures. Estimation of the design flood we have seen different approaches, it is very important for the hydrologic design.

Peak discharge estimation we have seen with the help of rational method, different empirical methods and transformation of design storm to design flood by making use of unit hydrograph method and flood frequency analysis. This transformation of design storm to design flood by using unit hydrograph method, we have not solved any example in this module, but we know by making use of unit hydrograph how to determine the flow hydrograph that we have discussed and solved some of the examples during hydrograph analysis. The same technique we need to make use here for finding out the design storm based on unit hydrograph approach.

And flood frequency analysis, in this probability plotting method can be utilized and Gumbel's method can be utilized that is for a particular return period, what will be the possible maximum value which can be taken up by the event which we are considering, mainly the streamflow or flood value for the hydrologic design we will be looking into design storm and design flood. So, that can be obtained by means of probability plotting or by means of making use of different distributions. Here we have looked into Gumbel's distribution for the determination of the magnitude of the event, which may occur during the particular return

period considered or we can find out the return period corresponding to a particular magnitude of the event.

So, this much we have covered under the topic of hydrologic design. I am repeating again that within this module, we have not gone deep into the topic, the minimal requirement related to the basic engineering hydrology course is covered. So, for better understanding, you have to go through the textbooks which are discussing the topic in an advanced way. So, here I am winding up the summary of the module on hydrologic design. Thank you.