Lighter-Than-Air Systems
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Lecture - 91
Char Dham Yatra – Part I

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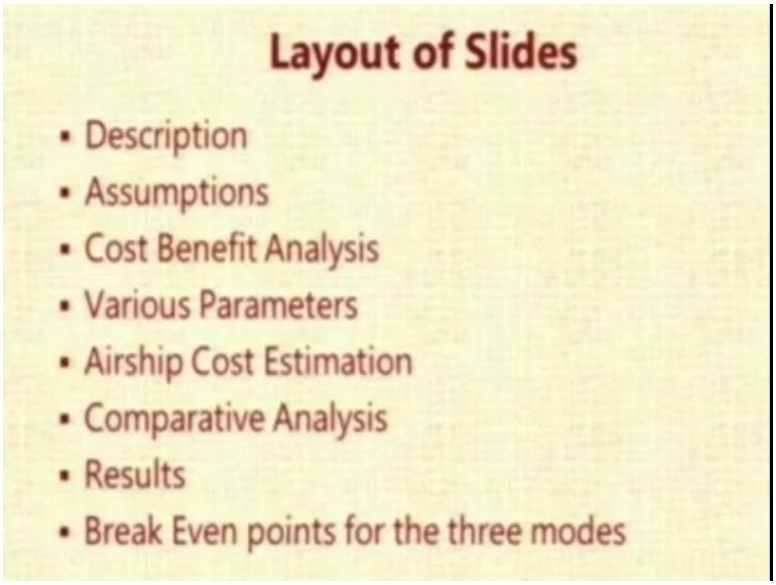

The next case study is about airships versus cars and SUVs, luxury cars and SUVs for one particular application which is the Char Dham Yatra. This is what we will see in the next about 40 minutes or so.

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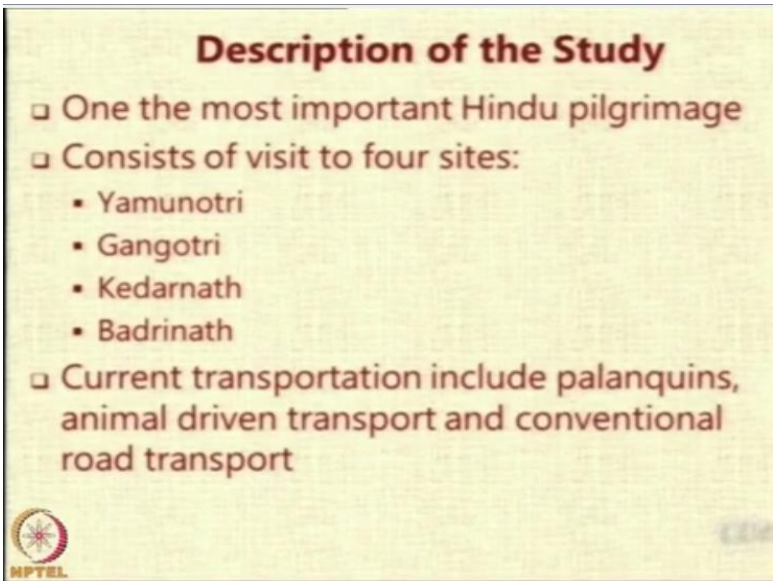

So, basically this is one of the most important Hindu pilgrimage this Char Dham Yatra and there are four sites which have to be visited in a particular order normally. This order is what is recommended for you to travel. And currently how do people travel? They take a road journey. After some point, they either do trekking or they take horseback or muleback or they take palkies and it is a very painful, very tiring journey.

Typically Char Dham Yatra takes around 11 to 12 days time. If you go for a package deal it will take around 11 to 12 days' time. And obviously it is done mostly by aged old people. people beyond 65-70 people who have retired. They are the ones who want to go. Before they die, they want to do this yatra. So, imagine a person who is 65-70, your parents and grandparents maybe in that range, they want to go for this yatra and it is a very tiring journey.

My parents have done it, so I know that it is a very tiring journey. So, we thought let us try and use airships for this yatra so that we can relieve the misery of our senior citizens

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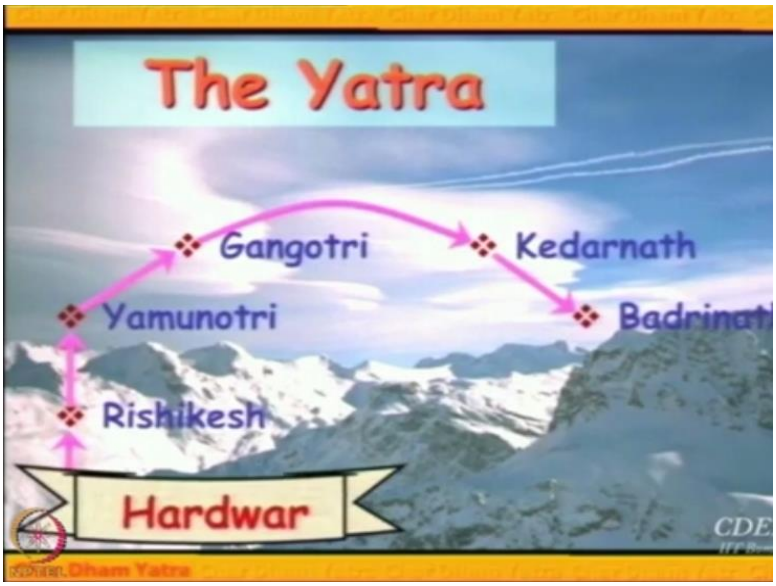

So, now what follows is a presentation made by a student team. So, therefore it is more colorful and more exciting. So, the yatra starts from Yamunotri, it goes to Gangotri, it goes to Kedarnath and Badrinath. Normally people start from Rishikesh or Hardwar the two places which are very popular. And this is the period in which it can be done. In other periods, the routes are inaccessible.

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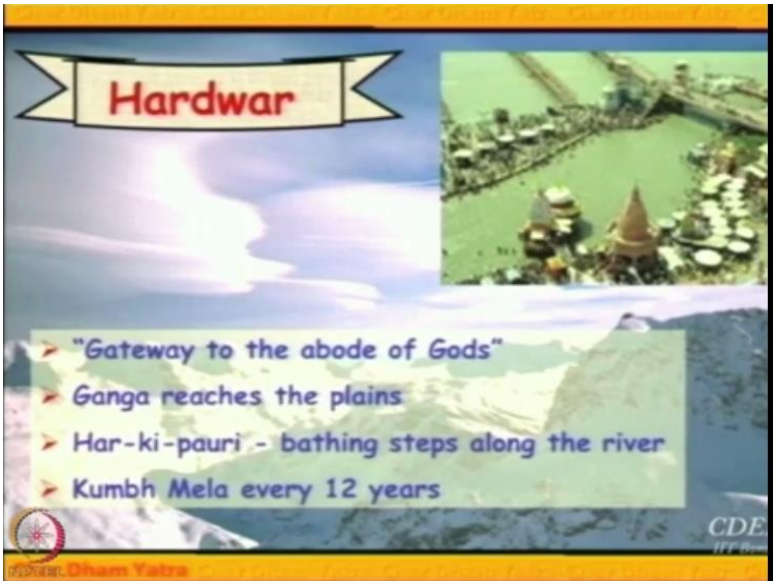

So let us look at this place called Hardwar. This is a very popular place and it is called as the gateway to the abode of the Gods. This is the first place where the river Ganges becomes a wide river and reaches the plains. Before this, the river Ganges is basically a mountain river, very rough, very harsh. Here, it starts becoming almost like a flat river and many people go here for having a holy dip and there is a Kumbh Mela every 12 years.

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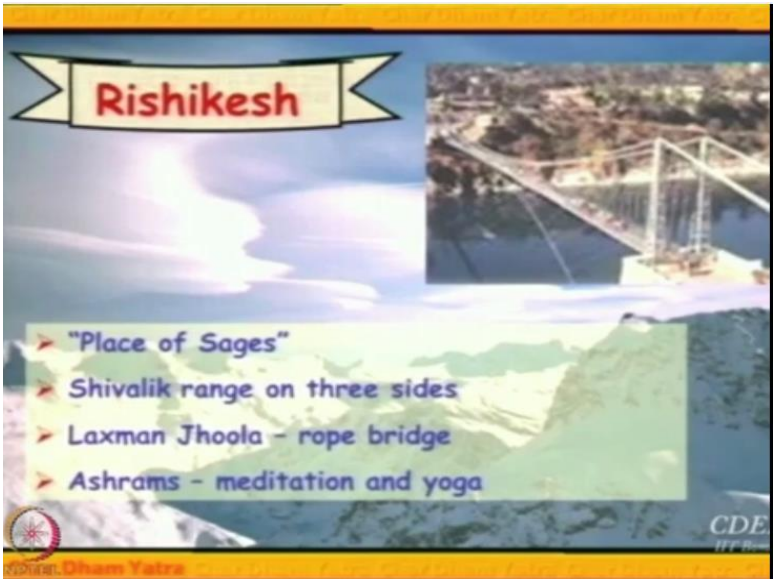

The next point is Rishikesh, which is a place of the sages they say. On three sides of Rishikesh there are Shivalik hill ranges and one of the famous bridges is this Laxman Jhoola, which is basically a very dangerous kind of a bridge for you to cross the river. And there are lots of ashrams there, lots of places where you can do meditation, yoga, etc.

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From there, the first place is Yamunotri. Yamunotri basically is the origin of the river Yamuna that is why the name is Yamanotri. And there is a glacier called the Champasar glacier 1 kilometer away from Yamunotri. So the people who go for pilgrimage, they go to Yamunotri. The people who go for adventure will go to the glacier and have a look at the river. And there is a place called Hanumanchatti from there it is at 13 kilometer trek, so it is a back breaking journey.

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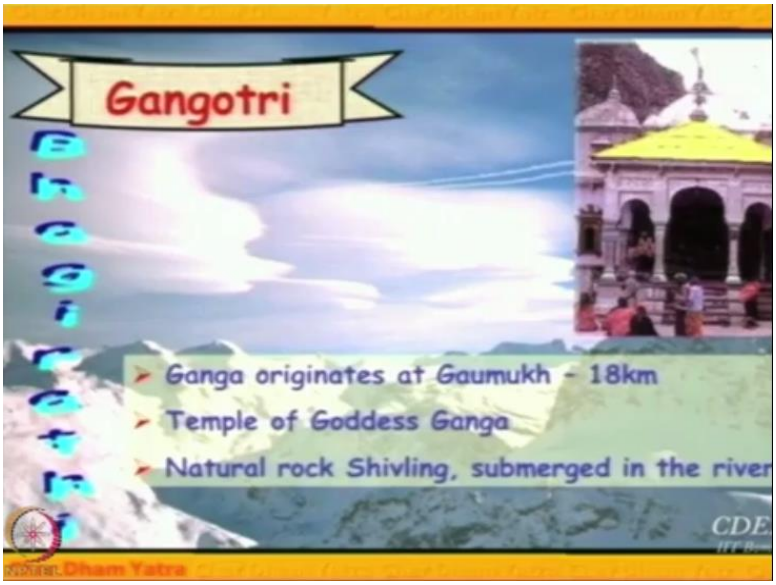

Then, once you go to Yamunotri, the next stop is Gangotri which is basically the origin of the river Ganga, but the actual river which starts in gangotri is Bhagirathi. The Ganga originates at Goumukh which is an 18 kilometer trek from this particular place. But the temple shown there is one of the very religious places.

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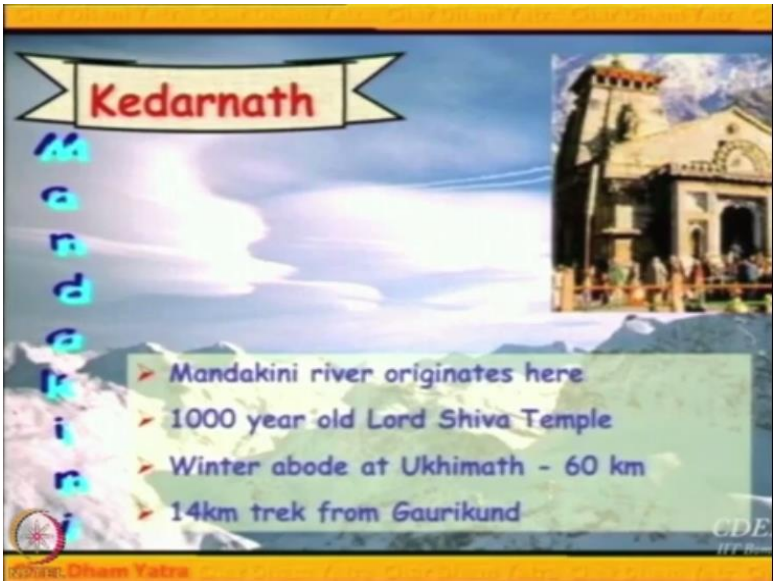

The next place is Kedarnath, which was in news recently because of the massive trouble that was there because of huge floods. So, the river Mandakini originates here and the origin of the river is a 14 kilometer trek again.

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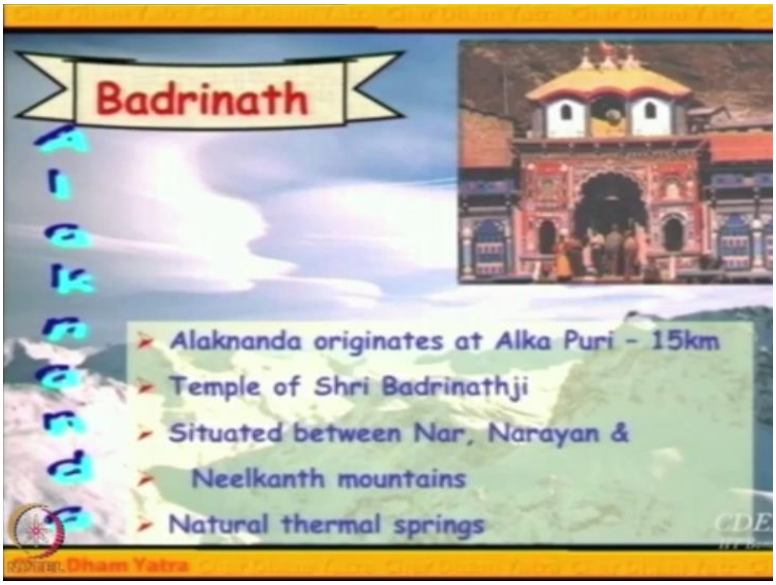

And then the last places Badrinath. Interestingly, Badrinath is connected by road. So among all these four, Badrinath is a place where you can straight away go today by road, no need to do any treking. So this is the easiest of the four dhams to do. And this is the last dham in the order. And it is famous for a temple and there is the river Alaknanda. Its source is nearby so 15 kilometer trek.

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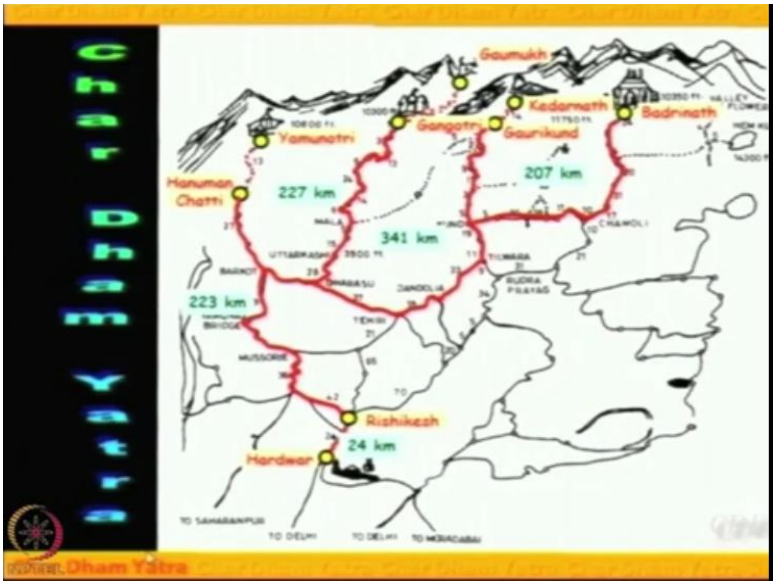

This is interesting. When you travel to these places by road because of the terrain you may start from Hardwar, 24 kilometers you have Rishikesh. And then you can go to this place and then you get Hanumanchatti and then you have to trek 13 kilometers. Then you have to come back, travel all the way down to Barkot, then take a turn, go to this place and again there is going to be a trek.

From here you have to come back down to Dharasu. Then travel along Tehri, Gadolia. Tilwara all these places and then you go to this Kedarnath. Then you come all the way back and then go like this and then to Badrinath. From Badrinath you have to come all the way back like this, like this, like this, like this maybe you can take this route and come down or you can take this way come down.

So, these numbers are the distances in kilometers between the two points and the total distance is 24, from here to here 223 kilometers, 227**,** 341, 207 and then back. So the route is like fingers, you have to go up down, up down, up down and back that is why it takes 11 days approximately to travel.

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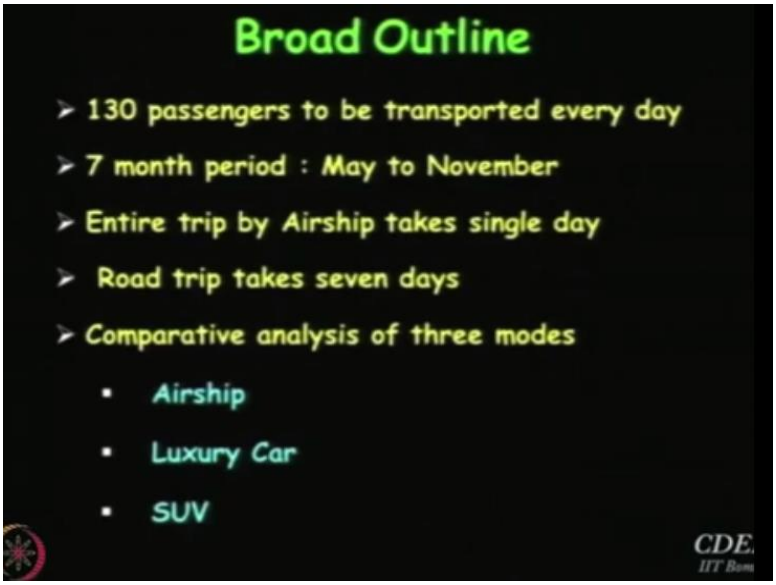

So now let us see if we can do this whole yatra by airships. So, based on certain interviews with travel agents and an assessment of the ground situation, there was an assumption made that let us assume that 130 people have to be transported for this yatra every day. This number can be argued, but let us assume that this is a number. Now, only 7 months the yatra is permissive, in the remaining months the road is closed because of the weather.

Now if you are going to travel the entire distance by an airship, it is technically possible for you to hop from one to the other. We have to find a reasonably clear location, maybe on a slight slope near each dham where the ship can be docked. Now that is a very stupendous task okay. It is a very difficult task but it is a doable task because people who live there they say that what you need is a small ground.

Yeah, there are colleges, there are institutions in all these places or nearby where one can figure out, maybe there will be half a kilometer, 1 kilometer trek, but we can reach these places. In airships, you also have a possibility although it is a little bit difficult of no need to land, you can actually transport people down with cranes, so you can bring the airship to a landing point. You can lower the gondola with ropes, ballast it with more weight, let the people get off.

If there are people who want to come in, they can take their place you can actually raise it up and continue. So this is also possible in the case of airship. So, one innovative solution could be this that we design a new airship or a new kind of airship. This concept was first proposed by a company called Cargo Lifter for transporting huge amount of cargo using airships. As I mentioned to you they have gone bankrupt unfortunately, but the technical concept is feasible.

So, what will happen with this is the need for ground infrastructures will be further reduced. But the thing is that you cannot always assume that these things are possible, so you need to have a backup. In case of any adverse situation, you cannot say we are coming here now we will not land, it is a little bit difficult to justify. So the need for creating flat piece of land can be obviated by creating areas or places where airships can be temporarily located.

People can be transported up and down. So we assume that that much of R&D we assume can be possible. And we also assume that the people who are doing this trip, they do not have any other sightseeing interest. They want to do this Char Dham Yatra only and they want come back as soon as possible. These are basically old people, people who are coming from abroad, they do not want to spend 11 days just doing it.

The road trip unfortunately takes 7 days just to cover the route and you need at least 1 day at each place, so that is why it becomes 11 days. Now, what we have done in this study is we have done a comparative analysis of airships with luxury cars and with a SUVs, the SUV is Tata Sumo car. A luxury car is a car which can take only 3 passengers or which will take only the driver, 1 passenger and 2 passengers.

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So, this is the airship that we chose. Unfortunately, there is no existing airship in the world which can straightaway start operating for Char Dham Yatra with passengers because the terrains are so high. So, we had another assumption that an airship like Skyship 600 can be

modified, updated and by making improvements or modifications by using better material because Skyship 600 also was designed in mid 80s or 90s and now we are in 2015.

So, there is a great improvement in technology of materials, therefore it would be not be very imprudent to assume that by this time some amount of R&D will be done to ensure that airships can operate with a reasonable payload at these altitudes.

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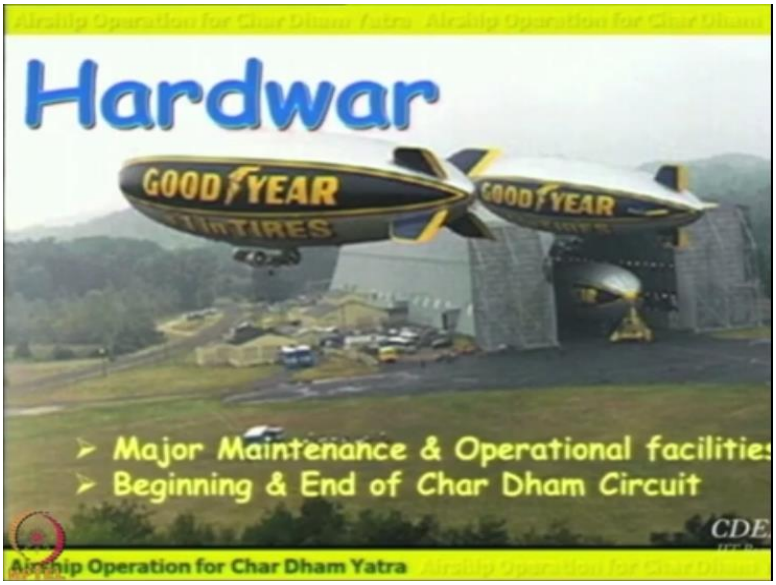

So, for storing the airships we need hangars. So we assumed that Hardwar will be the place where hangars will be built. There is ample land available there. It is a flat area and you can build a hangar where you can have the maintenance and operation facilities plus it will be also the starting and the ending of the circuit. So it is a logical place to build a hangar for storing the airship.

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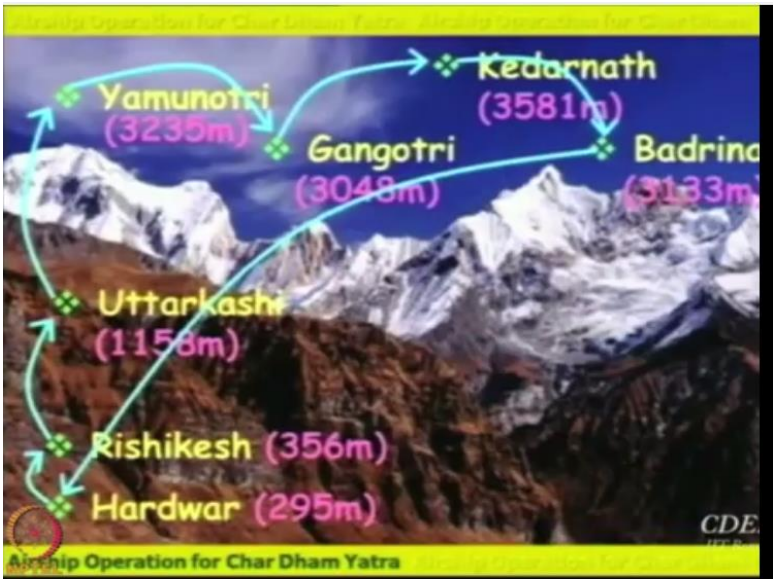

So from Hardwar you can go to Rishikesh by airship and the numbers in the brackets are the altitude above mean sea level. So this is the route that was suggested to be taken. Unfortunately, from a height of 356 meters if you want to go to Yamunotri which is 3235 meters, here ΔH is very large and we studied in the last class that ΔH decides the inflation fraction.

So if I want to maintain reasonably low inflation fraction let us say 20-25%, it is better to cut this into two parts. You go from Rishkesh to Uttarkashi the ΔH is around 900 meters. From Uttarkashi to Yamunotri is another jump. So instead of having a direct flight, we thought we will have an intermediate halt so that we can take advantage of the inflation fraction being reasonable.

No, it would not be in fact change of airship, it will basically yeah you can say that. You could say that from Hardwar to Rishikesh and Rishikesh to Uttarkashi there will be one airship which will have that inflation fraction and from Uttarkashi to Yamunotri to Kedarnath, Badrinath there will be another one. Then the problem is from Badrinath 3133 you cannot come to Rishikesh straight.

You have to either go to Uttarkashi, change and come down. So yes in reality, you will have to have 2 airships or 2 types of airships. One for the first leg and second design for the second leg or by careful design, you can actually have variable inflation fraction. We could have ballonet change. This is a matter of detail and these are the two places where we thought we will think of some kind of a landing site for some maintenance or some other issues.

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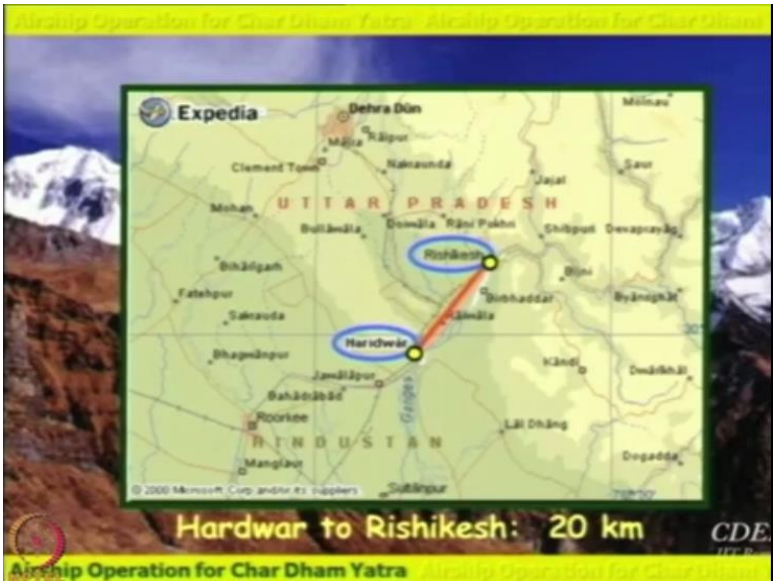

So then we look at the maps, altitude maps and we already charted out the route which can be followed keeping in mind that the maximum altitude should not exceed the altitude which the airship can travel with sufficient payload. So, Hardwar to Rishikesh there is no problem, it is a very flattish terrain, so you can go straight.

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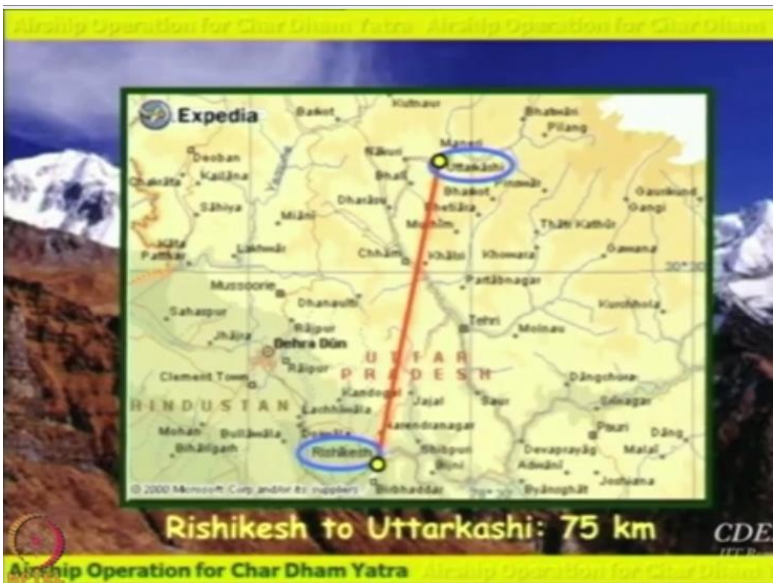

Then Rishikesh to Uttarkashi also there is not much problem.

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Up to Yamunotri no issue. After Yamunotri when you go to Gangotri the terrain is such that you cannot fly straight. You have to do a little bit of circuit. And from Gangotri to Kedarnath which is you can see somewhere here, you just cannot fly straight. You have to avoid these white areas which are beyond the limit of our capacity.

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So, from Gangotri you actually have to fly like this and from Kedarnath you have to also fly like this. So, you cannot take a straight routing, you have to go for a circuitous route even with the airship because the white areas are no go areas. These are high mountains where airship will not be able to operate.

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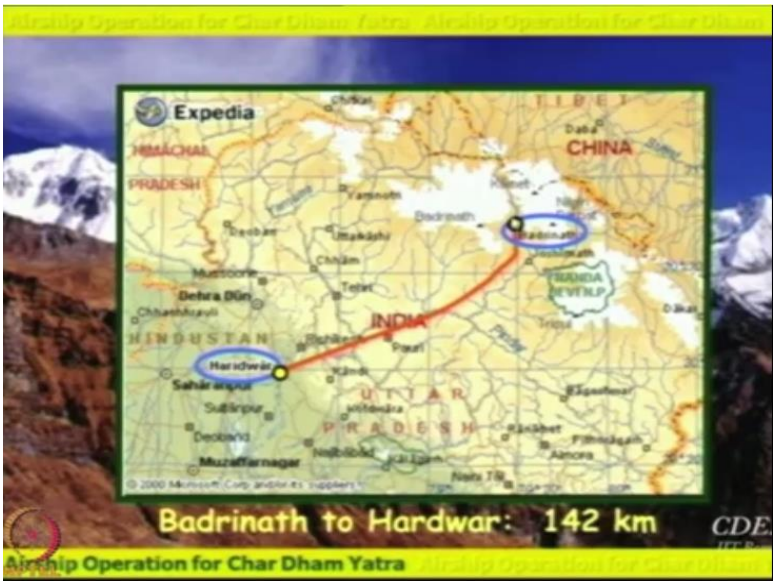

Badrinath to Hardwar or via Tehri is possible without any issue about the constraints. A I said Badrinath is a place where even the roads are already there. Even cars can go to Badrinath, so therefore there should not be much problem.

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So, we did a comparison of what is the kilometers to be traveled by airship and by road for various legs. So, you will notice that the initial leg is not a problem, but as you go to the other legs you find there is a substantial saving. So, it so happens that the entire journey is around 453 kilometers if you do it by airship, but it comes to 1350 kilometers if you do it by road and after this road you have those treking areas 13 kilometers for Yamunotri, 15 kilometers at Kedarnath.

So, that is additional cost and additional inconvenience. We are hoping that either we will be able to bypass that by finding a landing site near, if not we will say okay fine if the car can go to a place we assume that somewhere near the car end we can somehow manage to land our airship. So the journey after that is going to be by the same mode of transport for both the tourists. So at least the road journey of 1350 you can knock off around 900 kilometers from that, that itself is a very big saving in effort and time.