Transportation Engineering -II
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Lecture - 37
Terminal Area & Building

Dear students, I welcome you back again to the lecture series of course material of transportation engineering 2. In the previous lectures we have discussed about the 2 operation components of any airports that are runway and taxiways. We have seen the design aspects of those as well as the geometry aspects of provision of a runway or a taxiway or different types of taxiways on any of airport. Along with that we have also seen about, we have discussed about the aprons and different types of aprons. In today's lecture, in continuation of the components of any airport we will be discussing about the terminal area and building which is one of the administrative points of any control over any airport.

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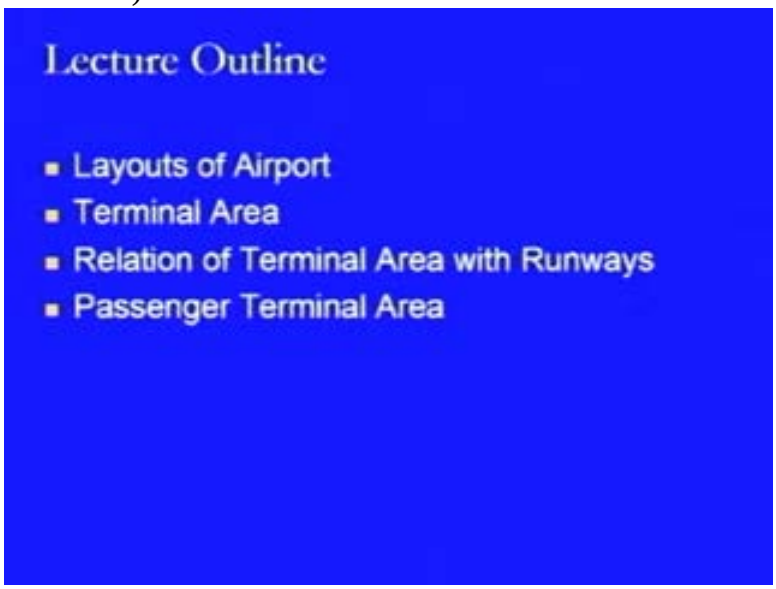

So within this particular lecture what we are going to discuss is the different types of the layouts of airports, the terminal area, the relation of terminal area with runways, the passenger terminal area and the terminal building. Along with that we will also be looking at the space requirements due to provided in any of the terminal building for various activities which takes place within that building. Here we are looking at one of the figures of big airports, this is valley international airport. This is the extent of the airport or the area which is being provided to this airport. This is what we can see by the dotted line as being shown here. This is the way it is being provided and this is the developmental area where we have the technical coly site or we have the marine military academy site on this one and this is the administrative area of this international airport.

Now here, what we can see is that there are certain runways strip being provided; this is one runway strip provided here, there is another runway strip being provided in this direction and then we have the crossing runways strips provided in this form.

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So it means this airport there is a combination of runways strips being provided. At the same time we can also see the taxiways provided here and these taxiways being connected to the runway strip where the provision of this exit taxiway on this side as well as there are perpendicular connectivity's between the parallel taxiway and the runways strips. Similarly there is a connectivity here, there is another connectivity here; the on this side run as well as on this side. So there are all taxiway connectivity's being provided in this diagram or in this airport.

This is another airport which is Provo municipal airport in Utah and here what we can see is that it is a sort of a frontal condition where aircrafts can come on this location. These are the aprons being provided and it is an administrative building of this one and then it it is also having the crossing runways strip being located in this form and these runways strips have been connected to the terminal building by the provision of the taxiway like this and similarly on this side we can see the taxiways going on this form so they are taking the aircrafts to the terminal building. There is another connectivity being provided on the side also.

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This is another figure of the Provo municipal airport which tries to define the feature things which needs to come up in this area and this particular airport and they have been shown in the yellow color and here locations of various important components have been shown along with other strips in terms of runways strips or taxiways.

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Here these are the air cargo commodity center where these can be controlled or these can be processed and then there is a permanent passenger terminal complex to come up in this location and then there is corporate hanger or there is another general aviation hangers being provided at this location. This is the apron area, this is the pury storage facility provided very near to the hangers, there are the hangers. So these are the things

which can be provided in this form in any of the airports and some of these aspects we have already discussed.

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This is another airport Stennis International Airport. We are having the main building in the center and then the runways strips being provided on the 2 of the sides of this building, that is, on this side as well as on this side and then they have multiple connectivity's. We have discussed with regards to the exit taxiways to be provided at the different locations so that this runway can be cleared as soon as possible and this will increase obviously the airport capacity in terms of the number of passengers handled or number of aircrafts handled. Here the aircraft will be coming to these aprons or this apron area and that is what is a terminal apron area being provided in this form. So in that sense if you look at the different components of any airport system then what we found is that within the airport system to there is outside air is placed through which the plane is coming to the airport.

Within the airport system we have 2 sides; one is termed as the air side another is termed as the land side. In the case of airside we have already discussed about the runways, the holding parks, the exit taxiways and taxiway system and the apron and gate area systems. These are already being discussed in the previous lectures. On the lens side we have the terminal buildings and we have the vehicular circulation parking and then there is a ground assesses system being provided so that the airport can be accessed by the CT or by the passengers who are going to come to use this airport. So that is the way how the overall system overall components can be divided.

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So in today's lecture we will be concentrating on this aspect, that is, the land side aspect which is here. Also, again it will be more ampisus given to the terminal building area. So the airports system planning process in that scene if you look at it is defined something like by this type of a flow chart where we have certain policies and with respect to those policies we define the issues goes an object is which are controlled at the same time by certain legislation as we have discussed about zooming and to be fined. Then the access existing system what are the facilities being provided and then we have to make the forecast where they should not be constrained to on this forecasting and it is obviously relating to population and employment and then the deficiency is need to be identified and this deficiency is maybe in terms of the general efficient or it may be in terms of specific career.

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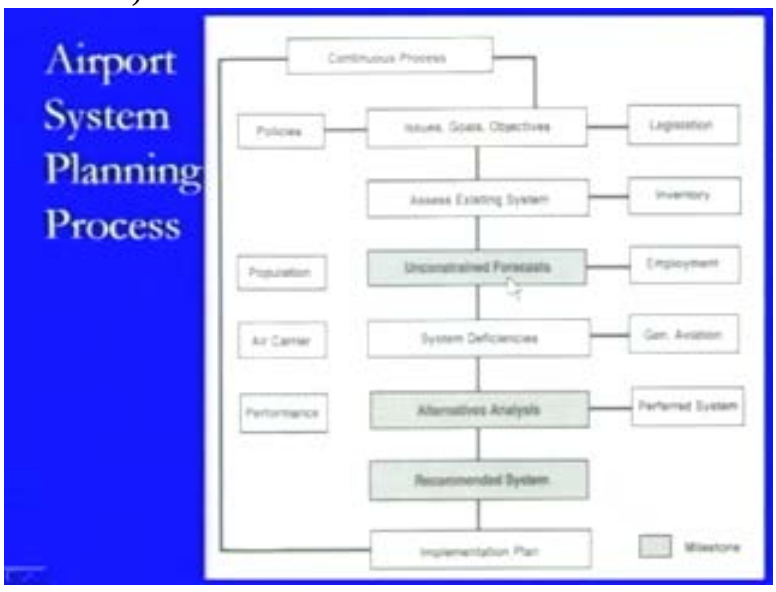

So that looks needs to be looked that and then some analysis is to be done and this analysis will be looking at the alternate policies or the ways by which the deficiency is can be removed, so the preferred system will be looked at and their performance analysis will be done and final events this is being done, then system is recommended and it is implemented. So once it is implemented then in we keep on getting the information on the implementation and the use and appriation of that facility with new system and if again we found at there is a problem then this all of the process starts back and that is why it is a continuous process of planning. Here in these colors with the darkness color something milestone have been shown because they are the important points of any airport system planning, that is, the forecast analysis and the recommendation of any system which will remove efficiencies of the existing airport system.

So in this one we are talking about the airport system planning process. What we are going to look is set the objectives of that planning process and what it needs is that the should in orderly and timely development of a system of airports adequate to meet present and future aviation needs and then there should be a development as a part of a balanced and multimodal transportation system satisfying aviation goals. Further there should be protection and enhancement of the environment and then there should be optimization of land use and airspace plans and recourse optimization. So these are in general the main objective of planning of the planning process.

But then there are some more things which needs to be looked that like the provision of the framework which is consistent with the sort and a long range airport system requirements and that is what we have talking about the deficiencies we have to look at the initiate deficient. There are the deficiencies which maybe there in a long range development and within that range development plans we have to formulate the plans and then fix the priority so that the financing can be decided how the money will be coming so that the development can take this in a faced manner and in that one what is needed is the coordination between the various agencies which are involved and we have to find out the way out or the mechanism which this type of a coordination can be achieved.

Now we come to the type of the layout of an airport. In the case of any layout one thing which we had discussing is terminal area because the rest of the things we have seen in the previous diagrams and then we have also discussed in the previous lectures. So here in the case of terminal area we have the terminal building, we have the traffic control tower, the aprons hangers, the parking area for passenger vehicles. In that case we have already discussed about the aprons and we will be discussing about the terminal building. The traffic control tower will not be taken up as it is a more related towards the electronic side of control but we will be looking at certain control measures in terms of the visualize like marking and lightings in one of our lectures.

So further in this layout of the airport we have also discussed about the runways and we have also discussed about the taxiways. So here in the terminal area how we can define it is that its major interface between the airfield and the rest of the airport or the ground exit to that airport, this is what we have seen when we have looked at the figure where the components of the overall airport system have been defined with airspace system, the

field system the land system and the ground exit system. So that is why this is one of the interface between the 2 of the systems and it includes the facilities for passengers and the baggage processing cargo handling, airport maintenance operations and the administration activities. So the numbers of activities are there which needs to be provided within this area and that is from where the overall full comes in.

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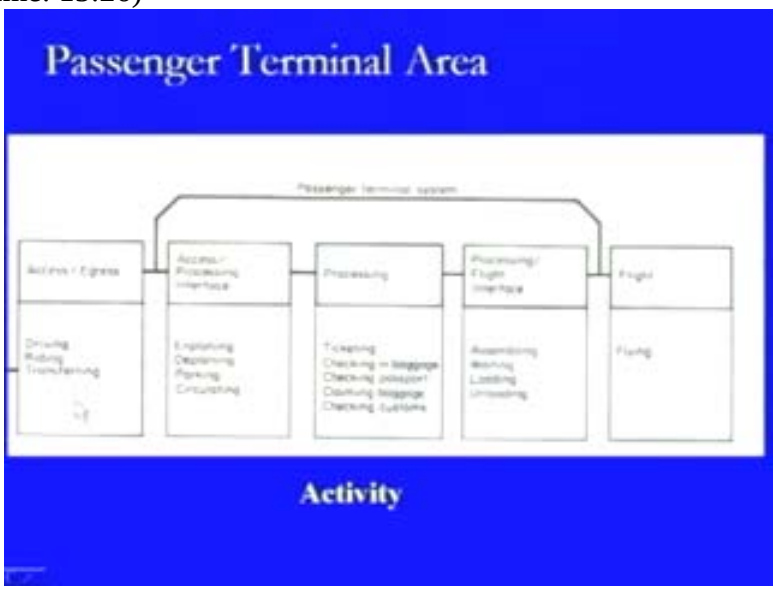

Now in this scene, if we are looking at the very first expect that is related to the passenger than we will be talking about the passenger terminal area and this passenger terminal area is one of the major connectivity which is provided between the ground access system and the aircraft because the persons who are coming from city by using certain access systems in provided on the ground they will be reaching the airport and then before reaching the aircraft directly supported for moving one another city they have to cross certain terminal area and activities placed within that. So that is why this is connectivity being provided between two of the things, it provides interface between the airport access mode and aircraft process the passengers for origination, or termination, or continuation.

These are the 3 things which can happen with respect to any of the passenger; it may happen the passenger is starting this one from that airport and that is way it is an origination condition and aircraft is also starting from that location or it maybe a termination where the aircraft is reached the final destination and therefore the passengers are coming out of the aircraft and coming out of the airport also subsequently whereas the third condition maybe a continuation condition where the aircraft is coming to an intermediate airport and will still continuous flight to some other destination and there are some passengers who are be coming out and some will be boarding and that is why there is a continuation of the air transportation strip and at the same time there maybe in the requirements of the passenger and baggage to and from the aircraft depending and what type of movement in the air taking up. So that is the way how any passenger terminal area can be defined.

Now when we talk about this passenger terminal area then in that passenger terminal area there are 2 things; one is different type of activities which will be taking place in that area and another thing is the physical system which needs to be provided so that those activities can be taken up. So in that sense if you look at there is an access or a egress system wherein the people will be either driving or they will be riding any transport systems so it is to reach the airport or there maybe a transfer from one vehicle to the airport system, that is, the type of the thing which can happen at the same time when those persons have reached the destination will be going out of the airport.

Again they maybe driving a car, they maybe a rental car or their own car which has been parked there or they will be riding any another system like a bus system or there maybe some transfer facilities after that and between the flight, that is, the final thing which can happen and the people will be flying that is the activity which will be taking place in between these 2 things there are certain activities which are taking place and they are the within the passenger terminal system like there is an access in processing interface where there maybe the unplaning or deplaning persons. There maybe the parking of the vehicles or there maybe the circulation of the vehicles and the passengers or the persons to come see or who has gone to receive in the passengers of any flight.

Then there is a processing. Processing will be consisting of number of activities like ticketing, checking in of the baggage, checking passports if its international flight system then claming of the baggage and checking of the customs again required for international flight. Then processing of the flight interface will be there, that is once you have been processed and once you have moving towards the flight that is all customs checks of baggages have been given or the passports have been checked and claimed then and between the taking the flight there will be things like you have to assemble at a certain location which is termed as the passenger lunch and that support of the passenger terminal are where before boarding any flight you will be just standing and looking at your aircraft and means it involves rating and then there can be a loading a aircraft or there maybe an unloading depending if you are reached destination or there is an aircraft which has come on the intermediate airport and therefore there are certain passengers who are unloading where they will be some passengers who will be loading in this system, so these are the different activities which will be there.

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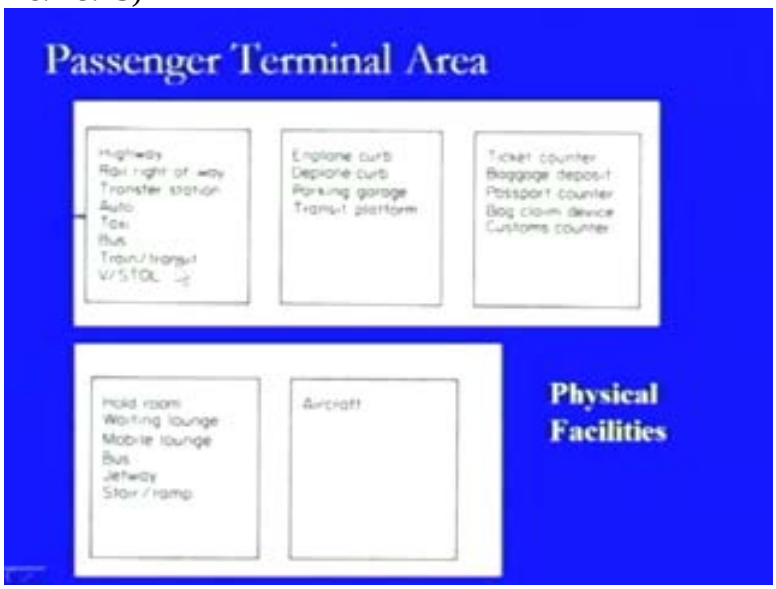

Now, if I look at the physical facilities which can be provided, then, in that sense for the access system or egress system we can have the highways or we can have the real right of re-connectivity or there may be certain transfer stations in terms of the various modes like auto rickshaw, or a taxi, or a bus or at sometimes there can be a type of a facility in terms of the train or the transit, that is, mass transit system being provided like macros or the rail connectivity being at number of airports are there where this type of connectivity has been provided. Then there is a V stol or S stol facility, that is, the vertical takeoff landing or a steep takeoff landing facility is provided at certain airports where a person is coming by some flight and then they have their own personal plane or they are to be lifted by say the helicopter so to reach the destination where the other things cannot go or it is a urgent emergency requirement so that is type of the system which maybe available on the airport itself. So these are all the access or egress facilities which can be provided.

Then when we are talking about the persons processing or the persons initial activities which will be taking place at the interface of coming into the airport, then it maybe enplane curve or deplane curve means the locations or the path is or the sidewalks where the persons can stand and they are the separate areas for those who are enplaning or the separate area for those who are going to deplane. At the same time they are parking the garages, it is a big airport then it is to be provided otherwise there can be a parking lot in which the vehicles can be parked or there is a transit platform.

Then, when we talk about the processing the facilities needs to be provided or in terms of ticket counters from where the ticket can be taken, the baggage deposit system where the baggage are given, the passenger passport counters where the passport can be checked by the officials, then bog claimed device that is if you are reaching an airport then you will be claming your baggage and the customs counter that is again at both the times where you are going out, you are coming in of an international flight then you have to either declare something, then it requires to go to the customs counter.

Then for that again at the interface of the flight and we are processing you have the whole rooms where you will be waiting that is the lounge; the waiting lounge or the mobile lounge means you have moving within through that carry doors as to reach it or sometimes the facilities are provided in terms of the busses or gateways or a steers ramp so that you can you are taken to the aircraft by these facilities and you will be loading the aircraft so the aircraft will be there on some aprons and you will reach that aircraft by these facilities and loaded. So it means what we look at is that it is various components of that interface we will transfer of passenger from the access mode travel to the passenger processing component is there and it involves activities like circulation parking curbside loading and unloading of passengers and this what we have already seen and we will be just looking at all those things one by one.

Another thing is that processing and processing of passengers is the preparation for starting, ending or starting that is starting, ending or continuation of an air transportation trip. The activities in this case are ticketing, baggage check, baggage claim seat assignment, that is, once we have ticket you take the seat at counter itself and inspection and security. So these are the things which will be processed on then. The next is the flight interface and that interface the passengers transfers from the processing component to the aircraft and therefore the activities here are assembly conveyance to and from the aircraft and aircraft loading and unloading.

Now we look at the access interface and the various facilities which will be included in this interface or enplaning or deplaning curb frontage which providing the loading or unloading with vehicular access to and from terminal building. So you are at the terminal building and you are trying to go to the aircraft or if you are come from by the aircraft and you have to reach the terminal building so some facilities are to be provided for that so that type of curb frontage is there; the automobile parking facilities for passengers, visitors employees as well as the facilities for rental cars public transit taxis etcetera. So these are the things needs to be provided outside the airport in front of that and the vehicular roadway which provides the access to the terminal curbs, parking spaces, public street highway system etcetera. So these are the various facilities in the access interface.

Further there are pedestrian walkways for crossing roads automated systems which provide access between the parking facilities and terminal buildings. Then there is a service road which provides the access to various facilities in the terminal area or to some other airport facilities. In the case of the processing system various facilities included will be the airline ticket counters and offices which are used for ticket transfer, baggage check-in, flight information, administrative personal etcetera. Then there are the terminal service space which consists of public and non-public areas like amenities, food storage etcetera. Then there is lobby for circulation and visitor waiting, then the public circulation is space such as stairways, escalators, elevators, corridors etcetera. So these are all parts of the processing system.

We also look at the some more systems like the outbound baggage space for sorting and processing baggage for departing flights, that is two conditions, one is for departing flights so we have to sort out the baggages on the basis of the various intermediate or the

final destination which will be taken up by that flight. Then intraline and interline baggage space for processing the baggage transferred from one flight to another that is condition where passenger maybe taking a connecting flight and therefore there is a transfer of baggage from one airline to the another airline or within the same airline system. Then the inbound baggage space for receiving baggage from arriving flight and for delivering it to the arriving passenger so that is another facility which are processing which will be there or any processing system or the passenger terminal area.

Further certain administrative things needs to be provided in terms of airport or the service area which will be used again for administrative reasons by the airport management operations maintenance facilities. Then inspection service facility for processing passenger arrival on an international flights means it is related to securities, it is related to the customs and passport facilities immigrations or all such type of obtains. Now looking at the flight interface what we found at the facilities being provided or like concourse which provide circulation to the departure and other terminal areas so that is the sort of the connectivity being provided between the different facilities.

Then departure lounge for assembling passengers for a flight departure, that is, you are just in front of your aircraft looking at that from the windows and you are assembled in a lounge from where you will be allowed to move to the aircraft once the aircraft is ready for flight. Then there are passenger boarding devices needs to be provided so that the passengers can move into the aircraft and there maybe different type of things like this stairways or the departure lounge or concourse which curbs connected from departure lounge to the plain, so such type of devices will be there to needs to be provided. Then there will be airline operations space for airline personnel equipment and activities related to arrival and departure of aircraft. Then the security facilities are used for the inspection of passengers and baggage.

Now we come to the main terminal area and we look at what is the functional role of any such terminal area or terminal building as such. In that case there is one functional role which is termed as originating terminating role. In the case of this originating terminating role there is a beginning or ending of trip and there is a high level of passenger flow because the aircraft is starting from there. It is then all the passengers will be moving towards the aircraft or if it is a terminating role then all the passengers will be coming out of the aircraft and will be moving towards the various facilities. Another one is through role where is in this case the aircraft is moving to another destination but on the way it is going to stop at one of the airports which comes on the way. So here there maybe the low percentage of originating flights and high percentage of through passengers means those passengers who will remain within the flight and there we very less number of person who will be coming out of the flight or will be boarding that flights. So that is the difference between the originating and terminating role and the through role apart from these two.

Then there is another role which is known as transfer role. Now here it is happening in terms of the connectivity to be taken up between the origin and destination which is not being provided by one type of flight, so in that sense person will be taking two flights

being provided with connectivity at a certain intermediate airport or maybe some times the terminal airport and then it takes percentage another flight from that terminal airport to the destination. So therefore there can be a high percentage of passengers who are connecting between the arriving and departing flights and that happens in the case of big airports or hubs which provides the connectivity from one point to the other destination, another point in the world with connecting flights. So at that location you will find that large numbers of people are transferring from one such area to the other area so as to take those flights. Here we are looking at again on an airport layout.

This is the Pittsburgh international layout where what we can see is that there is a centralized terminal area being shown here in the form of circle and then there are some arms which are coming out of this circle that these are the arms which are there.

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Here this is a single arm this is also single arm and but this is L shape arm here and this is another L shape arm here, these are the locations along which the aircrafts have been parked. All these hesi area which we can see here, this hesi area around all these locations and they are the aircraft stands or the gate locations from where the passenger will be boarding these aircrafts. So this is the type of connectivity being provided here and what we can see further is that there number of there is a chain of runways strips being provided. We can see the runways strips here, we can see the runways strips here or moving in this direction and then these a wing connected by the use of the exit taxiways provided at different locations or the simple taxiway being provided this overall void area being located like this.

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This is the terminal aprons in the sense. So after looking at this aerial photograph of the Pittsburgh international airport, that is, look at a closer look of some of the facilities being provided that one. Here, this is a parking facility provided at the international airport. We can see the ground parking facilities being provided and the big parking garage provided in the center. Then there are the landside terminal activities that is how we are reaching towards the final flight, this is how all the stabs have been shown here. So this is the landslide terminal, so from this parking area we are coming to this one or from the roads which are coming here, which are bringing the traffic we are coming to this terminal area and from this terminal area then we are moving to different locations after using the terminal area.

So from here we will be coming by some sort of movement being provided between this terminal area and these final arrivals or departures locations. So here once we come then we will be going to all these arms where these dots being shown they are basically the gate locations where the aircrafts will be standing like this and so once we reach power that gate location which is defined for each and every flight, then we will be able to this aircraft. So, here there will be a departure lounge where the passengers have to wait before taking this flight. So these are the various terminal activities being shown in this diagram or figure. Now we look at this landside terminal which is provided on the same airport. Here what we can see is that there are the arrivals curves and they are the departure curves being located separately.

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So that the persons who are coming to the airport for going out of the airport can use all different planes and can move. Now here when there are arrival curves then there is a baggage plane so they are directly connected to the baggage plane where the departure curves are directly connected to the ticketing system and then they go to the ticket counter or some commercial curve are there. In between here when they are moving towards the connectivity to flight side then there is a security checkup and there can be an information desk before so that if you require some information you can take it. This is the close-up condition of the air site terminal where we have the immigration checks, we have the custom check, then there are international arrivals and this is the people mover which is providing connectivity to this mall with the main terminal building. So this is how it is being provided on the side and then they are the different gate locations being provided in this form and the various facilities will be available in this area which is the central area, it maybe in terms of all the passengers utilities being provided here.

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This is another photograph of the airside terminal of the same international airport where this is one of such arms which is coming out and we can see how the aircrafts have been landed and this is the concords which provides the connectivity between this terminal area, so this is the departure lounge which we can see. These are all departure lounges and for this departure lounge is connected by this concords being provided in this form to the aircraft.

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Here also we can see these are all departure on just being provided and they are flexible departure on just they can become a small like this or they can become long like this. This is the parking area, this is the hotel being provided, then big parking for long stress or short stress, then moving walkways, average segregated conditions have been shown

in this figure, in this diagram being provided later on the Pittsburg international airport. So these are all parts of the terminal system.

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Now apart from these parts of the terminal system what needs to be looked at is the relationship of the terminal area with respect to these and in this case the key to a desirable airport layout is to provide the shortest taxiing distances from the terminal area to the take-off ends of the runway and to shorten the taxiing distances for loading aircraft as much as is practicable and the reason behind is that we want to make the total time taken in different processing as small, as less as possible. Then if there is a single runway then in that case it is better that we locate the terminal building centrally and in this case the taxiing distances will remain equal regardless of which particular end of the runway strip is being used for take-off or landing. So the assumption here will be that we have equal number of arrivals and departures.

Further, if there are parallel runways being provided and many of the airport then the terminal building can be located between those 2 runways and we have seen in one of the airports this type of a condition where the terminal building was provided between the parallel runways and here the assumption will be that the wind conditions are such that landings and take-offs can be made in either of the direction. Then if one runway is exclusively used for landing, another is used for take-off, then it is platted to go for the staggered parallel runways and it can be used with terminal building which is placed near the take-off ends. So if it is placed near the take-off ends it means it will take lesser of times so its reach the take-off position and therefore it is optimizing on the operation because this is the lower speed movement and this will reduce the taxiing distance both for landing and taking off aircraft but the exclusive use will affect the capacity and more land will be required due to staggering of the runways strips.

Then there is a another type of runway configuration which we have previously discussed when we talked about, when discussed about the runways is the open way runways and in

this case the terminal building is generally located centrally within the this V area. So if this is the V area then it can be located centrally somewhere like this. Now when the winds are light the air traffic controller is able to use both runways for landing or takeoff. In case of high traffic volume and the wind is blowing fairly regularly in the same general direction throughout the year then 3 runways maybe provided and one set of parallel staggered runways with one more runway. So that is the way we can handle the type of the conditions which are arising at any of the airport out of the varying traffic volumes or the metrological conditions especially in terms of the wind durations, in terms these are directions.

Now here in this figure we are looking at single runways strip and therefore in this runways strip one end is being used for take off and another is being used for landing or we can use for landing or take off for both the ends. So either way it can be done. Now here the terminal area is being located centrally with respect to this runways strip with multiple connectivity being provided from this terminal area to the runways strip in terms of the exit taxiways as well as the parallel taxiway as shown by the dotted line.

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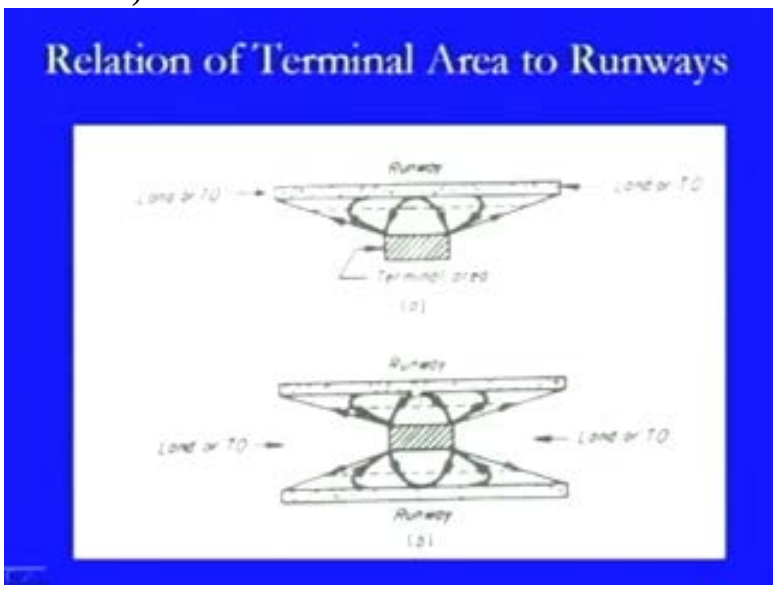

This is the case of a parallel runways system where this terminal building is being located in the center of these two runway strip, as we can see here. Again we can provide, we can use the runway hence both for landing or takeoff and there maybe landing or takeoff in this direction or landing or take off in this direction, again the multiple connectivity's have been shown as we have shown here.

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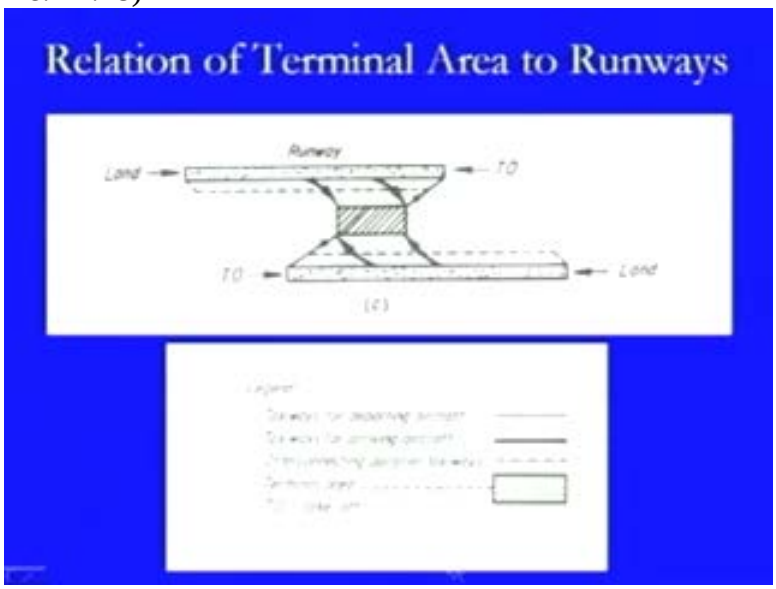

It is just the same sort of a condition being created on the other side so that is the way it comes us to symmetrical condition. This is per stapled condition where what we are trying to do is this, that is, a heavy traffic is there so the takeoff ends have been provided very near to this terminal building which is otherwise not possible in the case of a the parallel runways where this terminal building is centrally located. So this is the take off end and both the ends are very near to the terminal building whereas the landing ends are of the runway strip are at the farthest point and then we are providing the connectivity's in this sense there is an exit taxiways being located like this or this, and this is the unidirectional condition because this taxiway will be used for the take off aircrafts whereas this taxiways will be used for the landing aircrafts which will be moving towards the terminal building.

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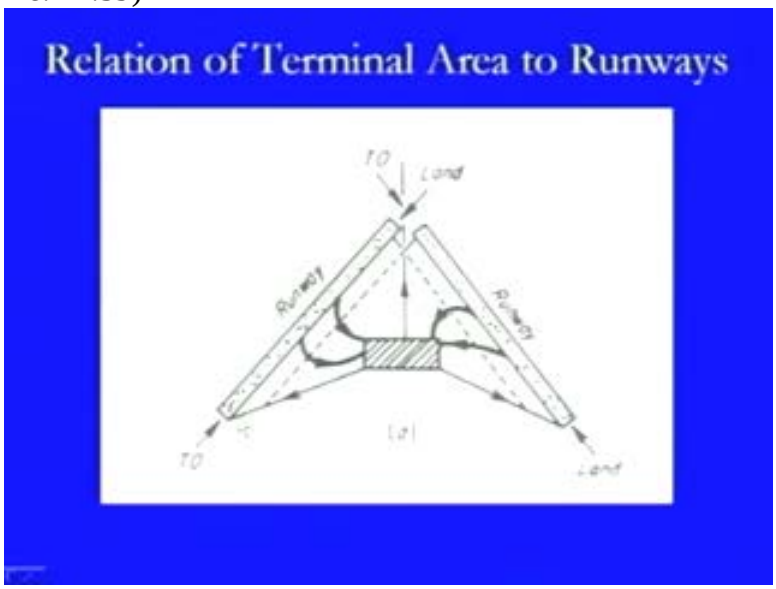

The various reasons have been defined here; we have the line which defines the taxiways for departing aircraft or the taxiways for arriving aircrafts, the interconnecting parallel taxiways, terminal area and then TO is an abbreviation like we have use for takeoff. This is the case of open be condition, we are the terminal area is to be located centrally so this is the central line, so with respect to that terminal area has been located. Here again what we consists that runways strips are in use with there land is specifically being used for specific location operation like maybe takeoff or landing in this case or take off or landing in this case. So it is a opposite condition for both because of the take off on this runways strip is in this direction and again there is a take off in this direction then the both the runways strip cannot be used simultaneously because they are all chances at this flight and path in the air space there can be a collision. So that is the reason why we are having the movements in opposite forms and again that we can see is that there is a uni directional movements being shown along the exit taxiways or the parallel taxiways have been shown by the dotted lines.

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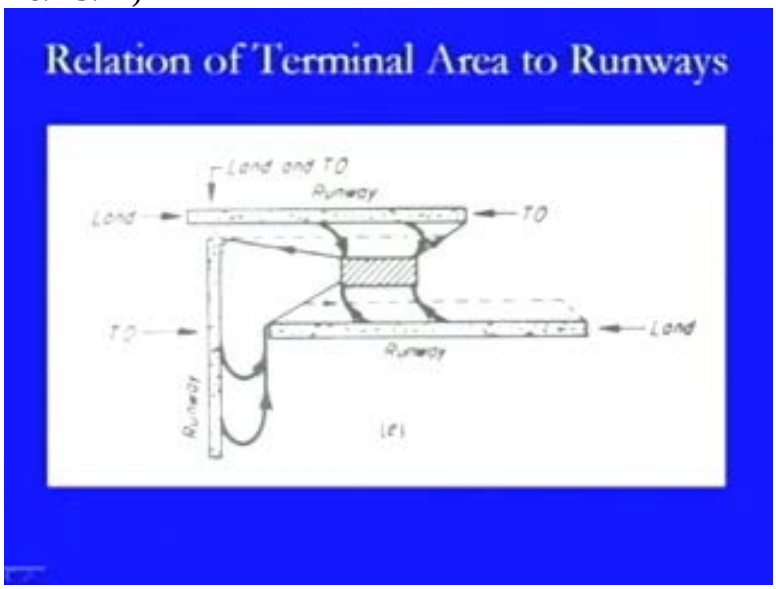

This is the another case where we have discussed about the staggered runway strip along with the third runway strip being provided because of the wind conditions prevailing on that airport and here what we can see is it is a sort of combination, this is already being seen so where we are looking at this take off on this side is, this side only thing being connected here is this runway strip and this is connected again from this side where this runway strip can be used for both these hands either for landing or take off. This is a double parallel runway condition where what we can see is that there are these perpendicular exit taxiways being provided and then these runway strips are used specifically for the specific operations in one direction and then there are multiple exit taxiways located like this where they are crossing the another runway strip and then they are reaching the terminal area.

So, now when we look at the design objectives of providing any terminal building in any of the airport then these can be classified in terms of airline objectives, the airport management objectives and community objectives, passengers objectives. So these are the 4 categorization which can be there as far as the different types of objectives are concerned for designing and terminal building. Now, if we look at the airline objectives then in that case the accommodation is required for the existing and future aircraft fleets with maximum operational efficiency, so that is the one objective of any of the airline which is using that airport. Another thing is the provision of direct and efficient means of passengers and baggage flows for all passengers including domestic and international originating, terminating and transfer passengers. So whatever the different type of operations related to passengers can be there which are in the direct control of the airline then the space is required for all those type of activities. So, that is why they have to do all these things in a more efficient condition.

Then there should be a provision of economic efficient effective securities system so that the overall security of the flights can be maintained. The provision of facilities which will embrace the latest energy, conservation measures needs to be provided and that is the one

of the way of energy conservation implementation programs generally used at any of the places where there as a high or heavy density of loads taking place. Then we can look at objectives from the perspective of airport management, people and in that case they require the systems for maintenance of existing terminal operations, the access systems, the runways systems and the ancillary facilities during all stages of constructions. So that is one thing which is related to airport management. Then there is a provision of facilities which generates maximum revenues they all come under the control of airport management and that is how the management can be managed, so that is why the look at the revenues and that is why we founded at there are due to free shops etcetera have been provided on the airports in the case of international flights or other type of shops being provided on the domestic airports. The provision of facilities which maximizes maintenance and operational expenses, that is another thing.

Then from the community side which is residing in that area where the airport is being provided we have to look at the things like there should be a unique and appropriate expression and impression of the community, that what type of community remains, lives here. So that is the one thing which any communities will always like that should get projected and the provision of harmony with existing architectural elements of the total terminal complex is another important thing. Whatever is being constructed if we look at that thing from aerial point of view or we look at the thing from the elevation point of view then there should be a harmony between the existing facilities of the development and the new development, they should not look different. Then the coordination with the existing and planned off airport highway systems is another thing, that is, it is a thing which is related to the access system to any of the airport in terms of the passengers. In terms of the passengers then the objective remains that the responsiveness to the needs of the people relative to convenience, comfort and personal requirements that is the one thing. Another thing is the provision of effective passenger and access orientation through concise comprehensive and directional graphics.

Then the separation of enplaning and deplaning roadways and curb fronts to ensure maximum operational efficiency. This should not be mixing of the people moving in different directions; provision of convenient access to public and employee parking facilities, rental car areas, ancillary facilities and on-site non-aviation facilities. So whatever different facilities on the ground level and exit system being provided not only for passengers but also for employees, we need to have coordination between all those facilities. Now let us look at the flow of the passengers and the very sequential way in which these flow takes place. There will be arrival of the passengers on an airport, then they will be checking in for boarding pass, emigration and customs if they are going for an international flight otherwise boarding passport remains whether it is a domestic flight or international flight means you have the ticket and you go to the checking counter where sheet will be issued and the pass will be issued to you which is termed as boarding pass.

Then you will be waiting in some area, then after waiting and the aircrafts have come at the locations then you will be allowed to move towards the departure lounge.

So it means you will be screen at the security for your personal belongings and the baggage. The baggages will be given and they will move by itself to the aircraft and then you will be moving to the departure lounge and then finally there will be deplaning, that is, at the deplaning time there maybe the immigrations conditions have the some of the baggages being checked for their weights etcetera and the customs checking. In that sense looking at the various types of the flow the area can be demarcated in different forms like the arrival or departure areas, the baggage acceptance or delivery area, the information and the movements.

Now we look at the space requirement in the terminal building, so because we have already seen in the various type of activities. So on basis of that what we found is that the spaces required for access interface system, the terminal curbs, roadway elements, parking and the passenger processing system, the entryways and foyers, the terminal lobby area, the airline ticket counter and ticket offices. So further, there are security and checking, immigration checking, the customs check, the baggage handling and claim facilities the space for enplaning and deplaning passengers or the departure lounges, the corridors, the intra airport transportation systems that is with in the airport whatever transportation systems needs to be provided. So looking at these types of the activities which we have just seen we will try to look at what type of spaces needs to be provided. If it is related to any airline then we are required to provide a space for cabin service and the aircraft management.

Then there is an outbound baggage makeup and inbound baggage transfer and conveyance system, that is, whatever baggage is coming which is to be taken with the flight is to be placed at one location and then they make a big containers and they are placed in the containers and will be going towards the flight whereas if it is coming with the flight then it will come to the transfer point and from that transfer point it will be taken to the conveyance system by which it reaches the passengers who are waiting in a waiting area for the baggage. Then the space for flight operations and crew ready rooms, that is related for the crew only which will be taking the flight storage area for valuables or outsized baggage which needs to be charged because there of bigger size or some ensurence must be there for valuable things. Then there is an air freight and mail pickup and delivery system, so that is specific type of the freight which has come with the any aircrafts so that is to be taken separately other than the various baggages has been taken related to passengers. Passenger reservation and VIP waiting areas is another space requirement and administrative offices the ramp vehicle and cart parking and maintenance so as to take the baggages and the other materials towards the flight or from the flight to the terminal areas.

In the case of passenger amenities we require space for food and beverages services, newsstands, tobacco stands, the drug stores, gift, clothing, florist shops, the barber shops and the shoe shine stands, the staffed or the automated post offices, the counters for car rental and flight insurance companies, the public lockers and public and courtesy telephones, then the amusement arcades and vending machines, public rest rooms and nursery duty free shops, foreign exchange facilities provided on international gateways, sanitary facilities everywhere, tourist and help desks. In the case of airport operations and

services, we have the offices for airport management and staff functions including police, medical first aid, and building maintenance, then building mechanical systems like heating ventilation and air conditioning. Communication facilities provided on the airports electrical equipments is another things which comes and operation and services, then the government offices for air traffic control, weather reporting, public health and immigration and customs. There all taking the spaces conferences and press facilities, the emergency equipment like health fire etcetera, so the space needs to be provided for all these.

Now if you look at these space requirements, then what we look at is that the terminal building usable space comprises of about 95 percent of its gross area. So that means uptown 95 percent we are going to utilize the overall space. In usable space about 50 percent space is allocated to rentable space and the remainder is non rentable space that is what is the distribution of this percent. As a rough estimate about 25 square meter of gross terminal area is provided per design peak hour domestic passengers and 30 square meters per design hour international for international passenger volumes. So depending on the domestic hour international passenger volume it is 25 square meter or 30 square meter of the gross terminal area respectively. Then the most widely used design parameters for terminal space requirements is the typical peak hour passenger which is abbreviated TPHP, typical peak hour passengers. So within a typical peak hour number of passengers are coming, that is, what we are talking here it is defined as the peak hour of average day of the peak month in terms of this TPHP. The space requirements are total annual passengers or the TPHT as a percentage of annual flows; this is how it is defined.

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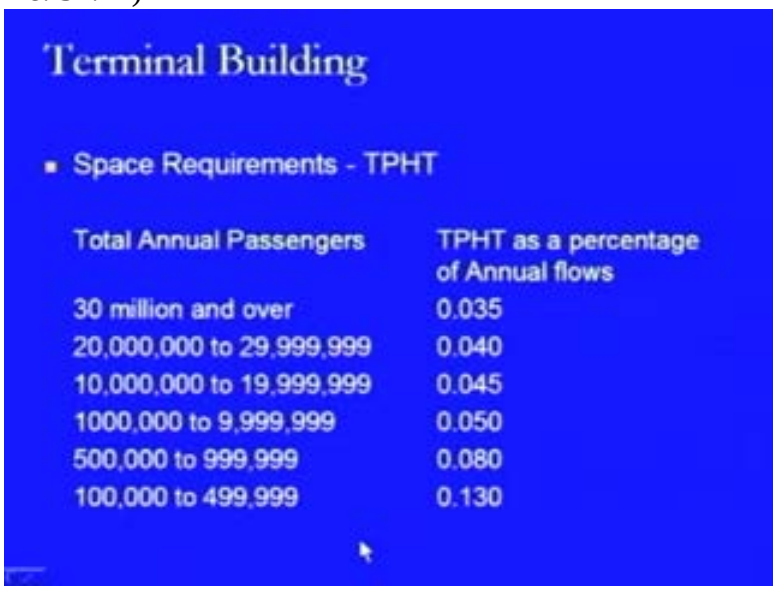

So if there are 30 million and over annual passengers then it is taken as 0.035 whereas if it is 20 million to less than 30 million then it is 0.040 then 10 to less than 20 million, 0.045. Then one two less than 10 million then it is 0.50 and 0.5 to less than 10 million is 0.080 and if it is 0.1 to 0.5 then it is 0.13 and under point 1 it is 0.020, that is how we generally take the values and calculate the flows. Then for different components we take

the space required in 100 square meters per 100 TPHT and in the case of ticket lobby it is taken is 1.0, for baggage claim it is 1.0 means 1.0 is a multiplicative factor, so it is 100 square meter per 100 TPHT. Then it is departure lounge it is 2.0, waiting rooms 1.5, immigrations 1.0, customs 3.0. Further, we have some more components like for amenities it is 2.0 for airline operations it is 5.0 and if you look at the gross total gross area then in the case of domestic airport systems it comes out to be 25.0 whereas in the case of international it comes out to be 30.0 and that is what we have seen in the very starting.

So this is what is all about the terminal areas and terminal buildings and various facilities which are provided in any of the terminal area or the building. So in today's lecture we have tried to look at the various types of layouts and the significance of those layouts and then finally the space requirements for different activities which takes place in any of the terminal building. With this we will be stopping here and will be meeting in another lecture related to the airport engineering. Further, till then good bye and thanks to you.