Sustainable Transportation Systems
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Lecture No. 28
TOD Case Study - III Naya Raipur

Hello friends, so, you may recall that we were discussing about the case studies related to transit oriented development. And we have already discussed two important case studies, one was related to Delhi Metro that was kind of Brownfield development and then one suburban area related TOD that was a Serbian city. And now, today we will discuss about Naya Raipur's TOD case study, how TOD will shape the Naya Raipur development, which is a new city basically in Chhattisgarh.

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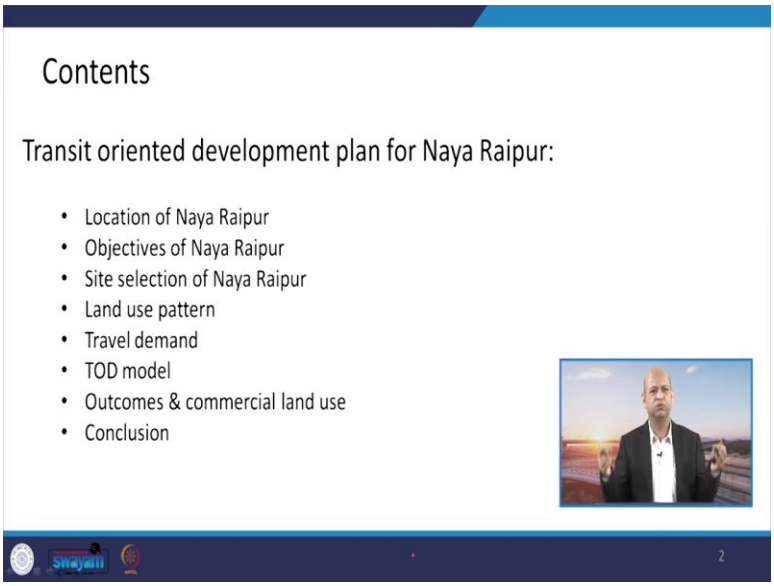

So, the contents of this particular lecture is like first we will discuss about the location of the Naya Raipur and then what are the objectives of this new city which is known Naya Raipur and what were the parameters to help the site selection and land use patterns which are there already existing and the new kinds of things which we are aiming for related to this TOD related development and what are the travel demands which will be fulfilled by TOD and which kind of TOD model we want to develop there. And then the outcomes and commercial land use because of this TOD development and then conclusion that would be today's lecture.

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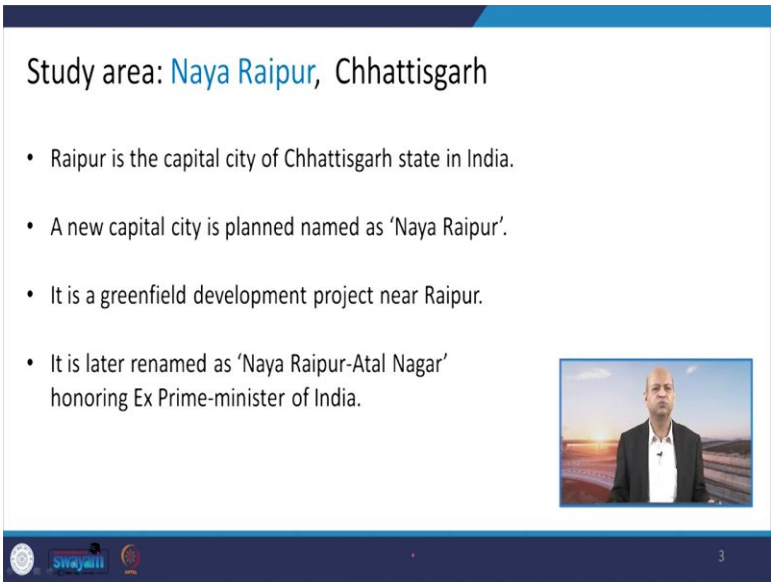

So, the study area basically is focused on Naya Raipur which is the capital city of Raipur is the capital city of Chhattisgarh state in India and Naya Raipur is basically the new capital city which is being planned now to develop as a like Delhi, New Delhi, those kinds of things. So, new city development and new facilities, new parameters, new paradigms, all these things will be included in the development of this new city.

And it is a greenfield development project because where this new city is coming up there was no city kind of development there, it was just barren land and agriculture related activities and little bit habitation but very sparsely. And later this city has been named as like Naya Raipur Atal Nagar to honor the ex-Prime Minister of India Atal Bihari Vajpayee.

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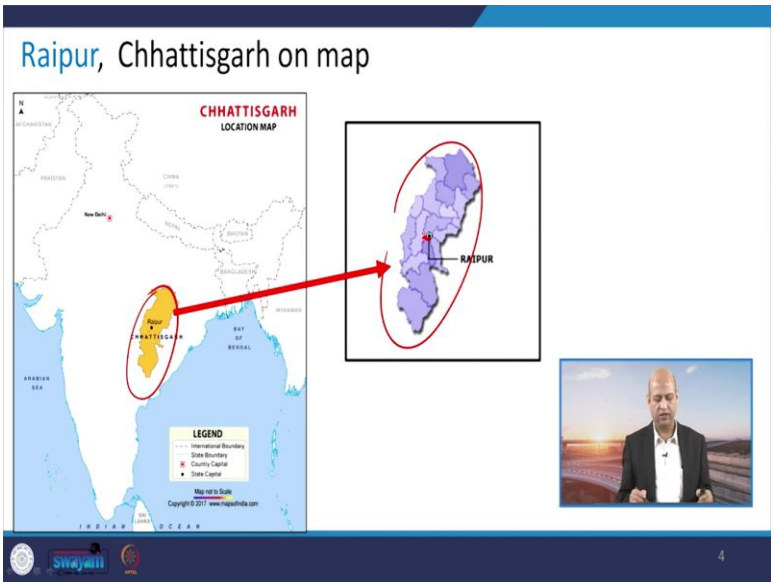

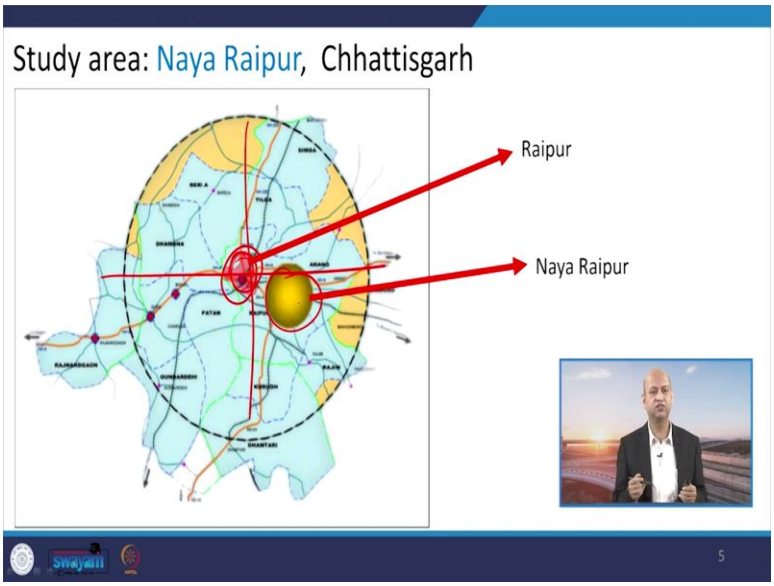

Well this is the location on the map. So, you can see this is the Chhattisgarh state of India and at this location this Raipur is there and the shape of the geographical or topographical shape of the Raipur is will be discussed later on. So, this is the Chhattisgarh and within Chhattisgarh there is the Raipur and they study area of Naya Raipur is here basically this is the Raipur the existing Raipur and the Naya Raipur will come here adjoining to the Raipur city and if you develop four quadrants behind this Raipur at the center, taking the Raipur city existing, then you will see that the southeast quadrant this Naya Raipur will be located and we will see why this quadrant analysis is important to locate a new development.

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Well, the objectives of Naya Raipur is basically like Chhattisgarh is the new state and they want to have kind of vibrant economies. So, the economic change is needed. And the social transformation is also one aspect because when urbanization happens then a lot of things also happen in terms of cultural changes, in terms of life standards, in terms of life patterns, job opportunities, educational institutions, or health sector, all those kind of things, and the growth prosperity and the financial capital or financial center is also one aimed at this city, this new city should be hub of growth and the prosperity means the wealth generation must be there, because a lot of economic activities may center there.

Then it should be a kind of servicing hub for manufacturing and IT and biotechnology related industries. So, that is one pre-decided area because of its own strength. So, the, Chhattisgarh government wants to develop it as a hub for manufacturing center. So, some industries will come which will be supporting manufacturing activities and then the IT related parks and the development and the biotechnology oriented industries which will also be boosted there.

And the trade and hospitality sector can also develop there and the quality education has to be ensured. So, new institutions will be developed, new schools, new universities or engineering and medical institutions those things have been planned to aim for this Naya Raipur.

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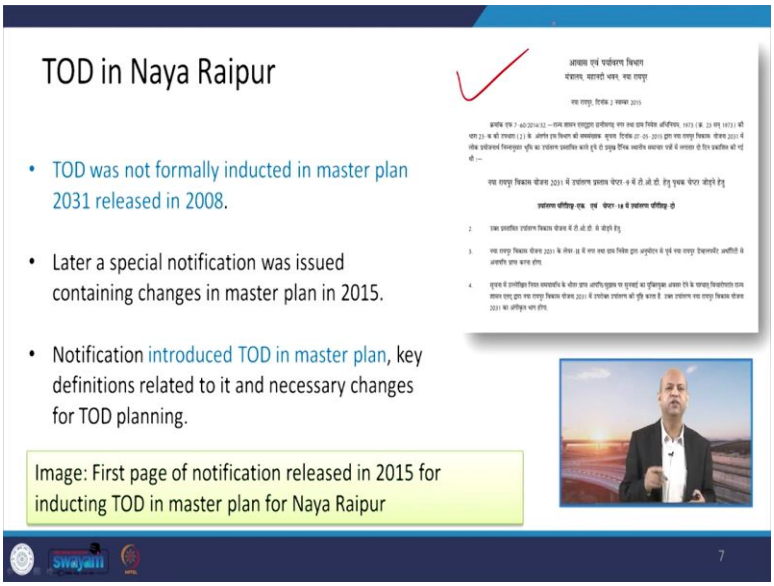

Then the TOD that is the transit oriented development in Naya Raipur basically, it was not formally included or inducted in the original master plan of 2031 which was released in 2008. So, later on it was included in 2015 that we should have a transit oriented development because it really helps put together a lot of population and help them get connected with the transit system and the like mobility, smooth and cost effective and all those development related aspects which will be considered as per the TOD so all those things motivated that we should have that TOD.

So, later on, it was included. And here this is the first phase of that particular notification which included in the original master plan, this TOD Related development.

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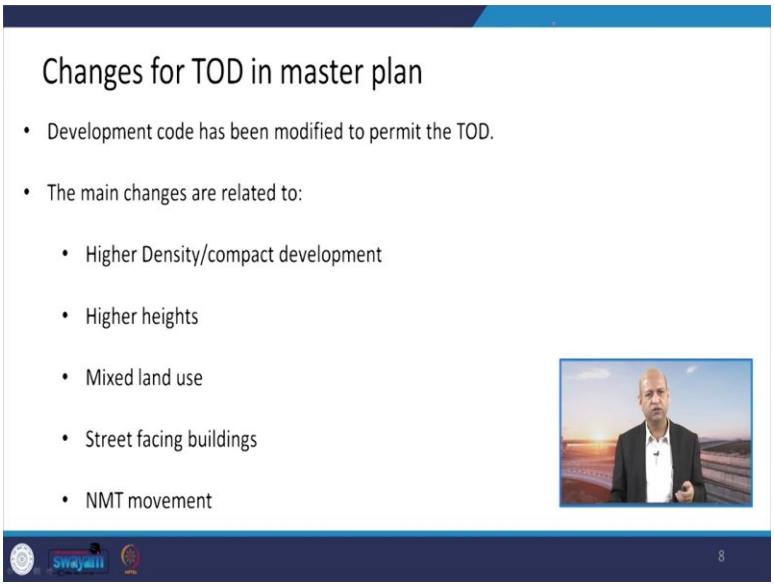

Then changes for TOD in the original master plan were made. So, the development code was defined or modified to permit that TOD so, it is illegal kind of inclusion, and the main changes were like higher density compact development was allowed at certain locations. So, that this transit oriented development helped them to get this mobility and transportation facilities nicely.

And higher heights means multi storey buildings those were allowed, then mixed land use depending upon commercial activities, recreational activities, shopping centers, and various other kinds of things. And then the street facing buildings were planned and the non-motorized related transportation movement to increase that also, that inclusion was made there.

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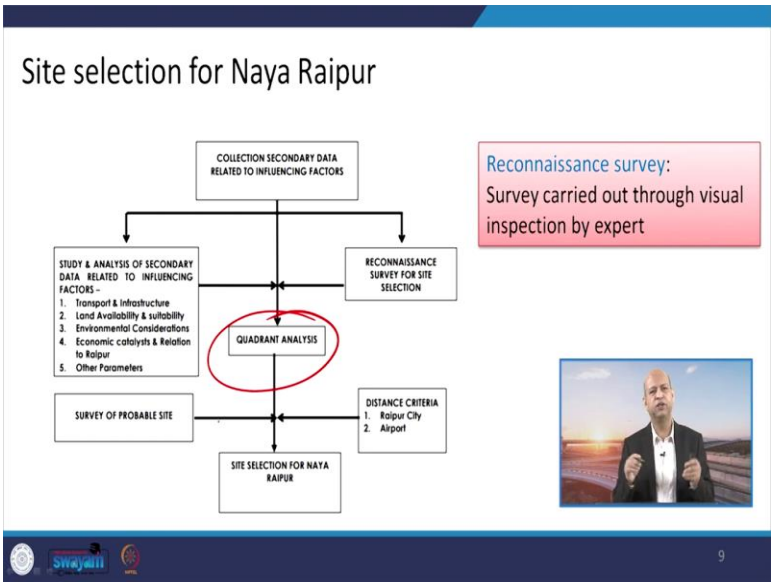

And the site selection for Naya Raipur so, there were, like collection of secondary data, that survey was conducted this reconnaissance survey was conducted by experts, so, visual inspection of the land, land use patterns, what is being there, if the land should be of this kind that very less disturbance should be of the activities which are going on that land. So, this quadrant analysis technique was used for having the new site location.

And after survey, the distance of the airport, existing airport and the existing Raipur city that was also one consideration, it should not be much far away. And then the transport and infrastructure related data collection and all other parameters, which are needed for new development they were collected, and these were combined to make decision where this new site should be located for Naya Raipur.

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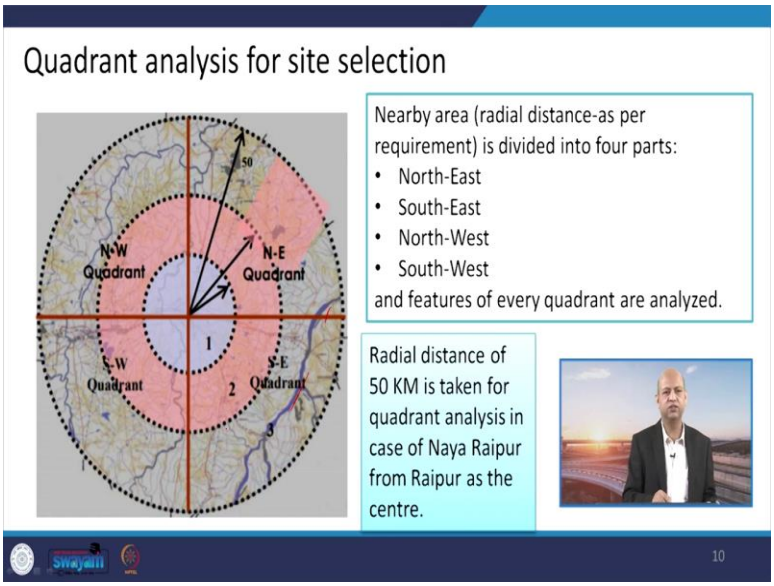

So, this quadrant analysis of the site selection is very popular technique. So, wherever one existing center is there or habitation is there, if you want to have new development than the existing center, existing habitation is to be kept as a center and like a 50 kilometers radius, this area is considered and then it is divided into four quadrants, and then each quadrant it is seen that which is better, kind of location or site location for the new development.

So, it was seen that the like this Mahanadi River and this barren land, all those things, which we will we will discuss soon after this slide. So, all those favorable conditions were in this southeast quadrant. So, this was the quadrant where site was selected and those were the parameters or the features in the southeast quadrant, which favored to decide about this new Raipur site selection.

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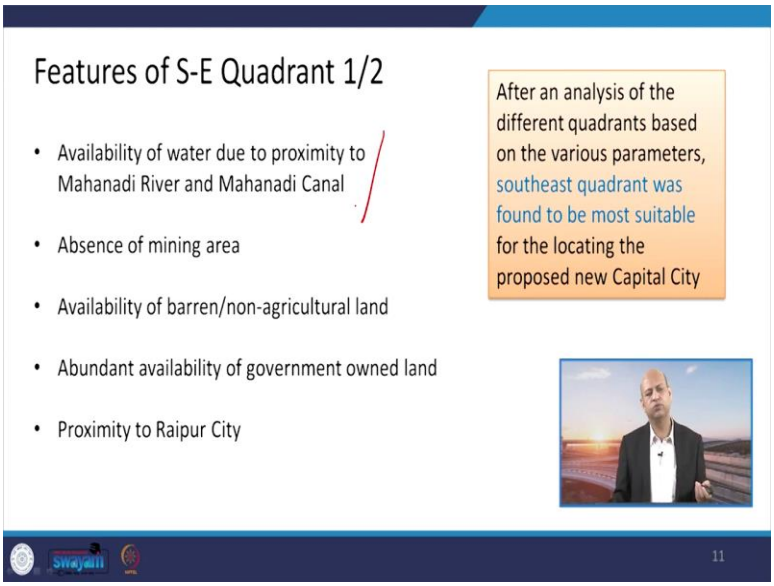

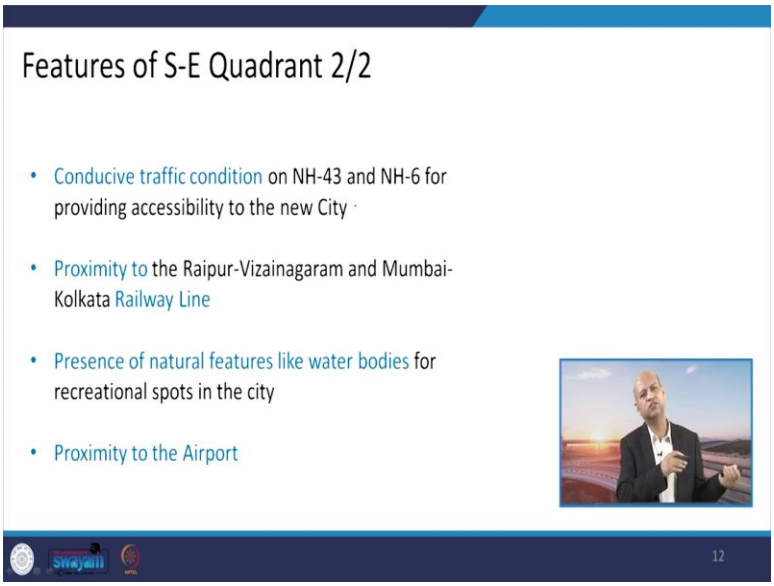

So, like availability of the water, because of this Mahanadi the river and Mahanadi canal, so, that was nearer to this particular location. And there were no mining related activities, that no minerals presents kind of thing. So, that way also this was kind of one favorable site, and then a lot of barren land very less agricultural activities or non agricultural land were abundant in that particular site and the government owned land was also in a large quantity, large area, so that there is no problem of like buying land or occupying that land from other stakeholders.

So, that is also one issue when you go for change of the land use for city planning. So, if it is government control, then it is very easy to acquire, proximity to the Raipur city is also one

consideration that was also fulfilled there. And then, like traffic conditions near NH 43 this national highway 43 and national highway 6, so, those were also nearer to this new site location. So, the connectivity issue was also addressed that way and it was nearer to this Raipur and Mumbai Kolkata railway and those kind of railway tracks. So, those railway lines were also nearer.

And then presence of natural features like water bodies for recreational activities or sports and proximity to the airport was also one aspect which is, so, proximity to the existing city as well as to the airport was also one parameter. So, that was fulfilled by this new site selection.

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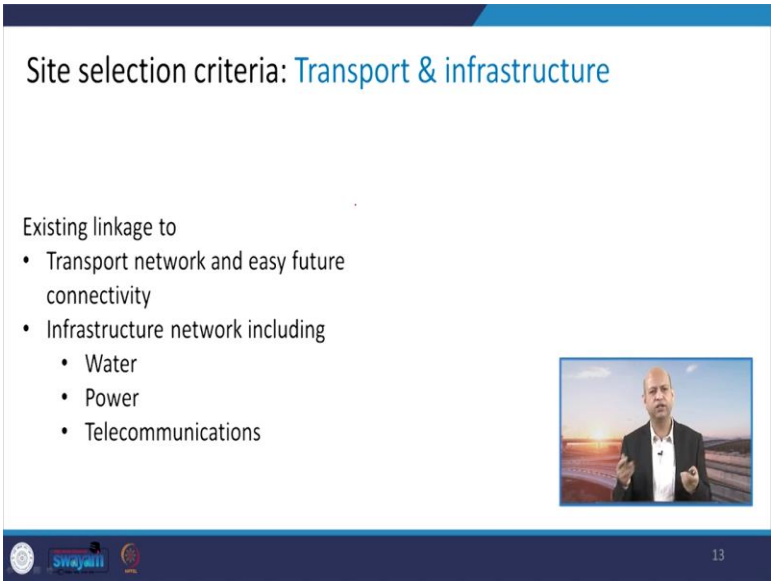

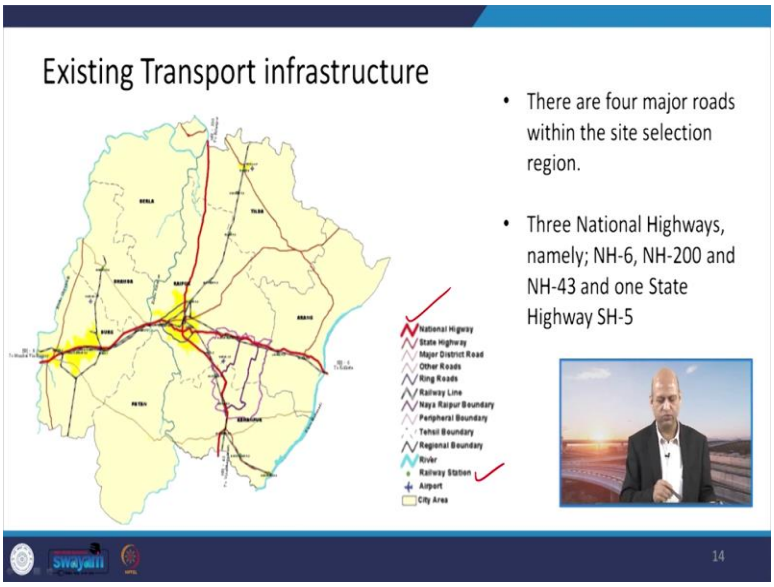

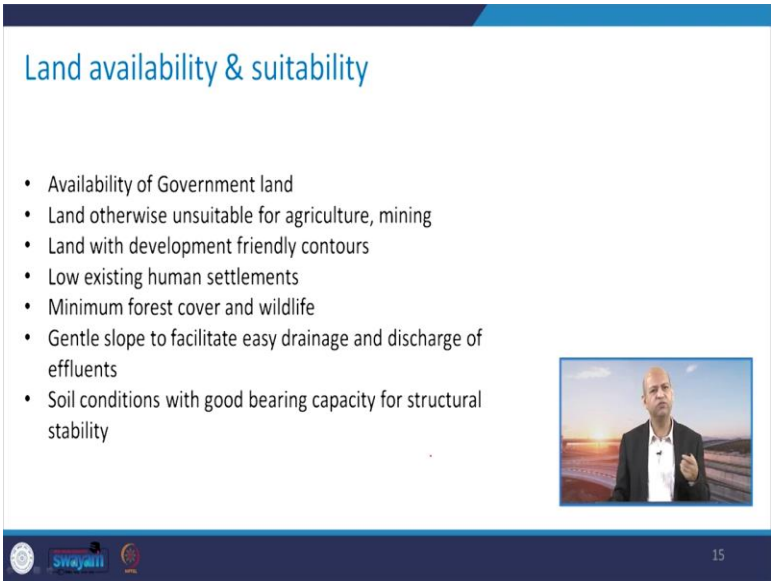

And then there were existing linkages like transport network easy future connectivity because of national highway location and infrastructure network, including water, power telecommunications, so, those features were very helpful in that way, you can see existing transport infrastructure, so, like this national highway is there, this red color, and then there are railway tracks also. So, those were quite easy to connect with the new Raipur development.

And the availability of land as I just said that the suitability of land was also good because government owned land was in abundance plus very less agricultural activity kind of land is there, no mining activity and the land which was barren, it was not much suitable agriculture, for agriculture, though people were doing agriculture but it was not very fertile land.

And then minimum forest covers or minimum wildlife. So, that way also, it is good thing that you do not need to disturb them in an intense manner and then the gentle slope of the contours were good. So, drainage was also expected nicely and the soil conditions and the bearing capacity of the soil to support the structural stability of the new buildings was also good. So that way, it was not favorable in that also, in that pattern also.

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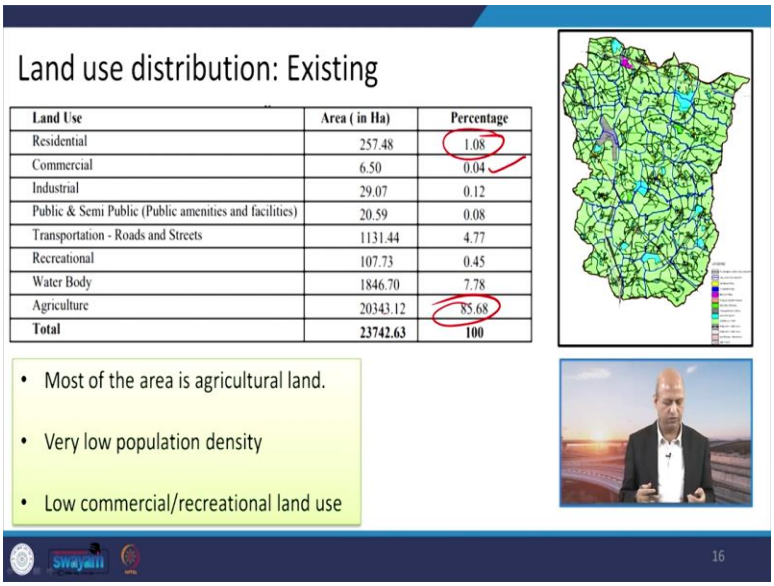

So, this was the land use distribution you can see like residential only 1 %. So, very sparse population was there thin population here and there, very less population, commercial activity was also very less, this was open kind of land, agriculture land here shown 85 % but basically, this was not very fertile, though categorized like agriculture, but it was not much suitable. So, that way, you can say it was a barren kind of land available for the new development.

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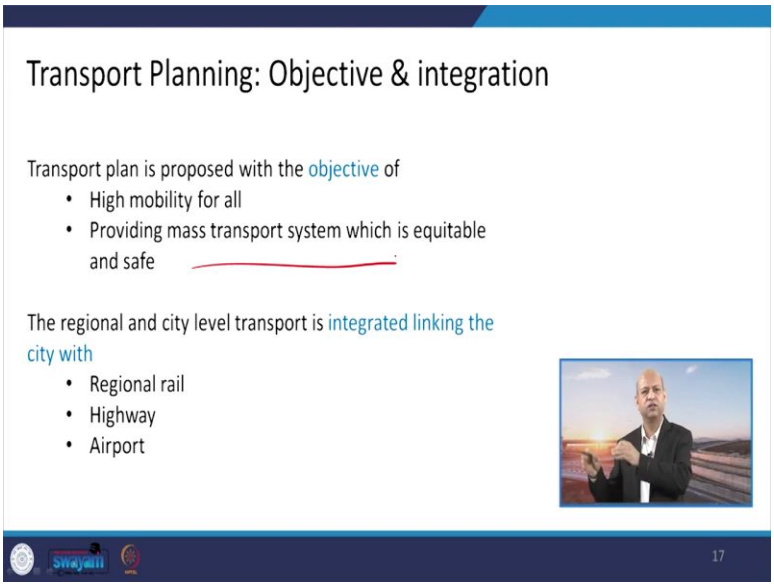

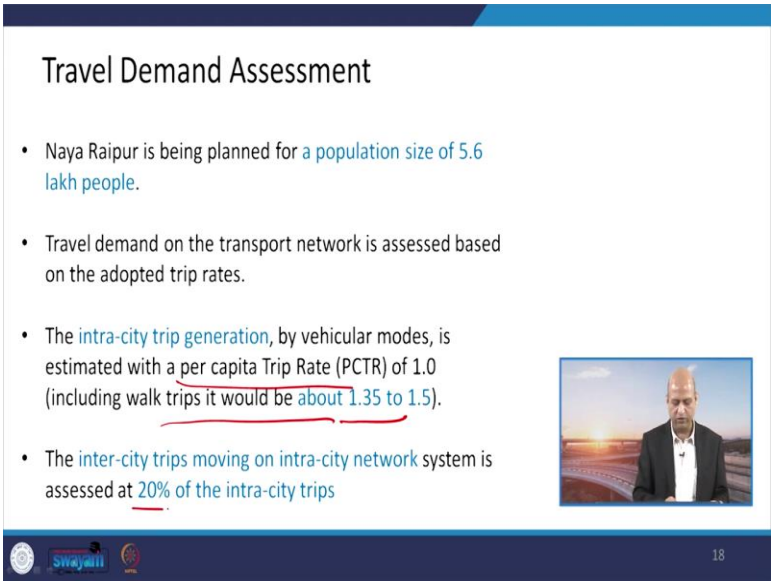

And then this high mobility all those were objectives and integration for the transportation planning with the TOD orientation. So, transit oriented development, were those features were taken into account. So, mass transportation was the objective that we should provide such a transportation system which can cater much lacks of the people. And then it should be integrated with available transportation systems like highways, airports, regional rails, so that we also the new site was giving a good connectivity.

Travel demand assessment was done. So, it was decided that TOD related development we have to do so, what kind of TOD should be there like Metro or BRTS, which systems should be taken into account. So, for that, this travel demand assessment was done properly and trips calculations were done. So, it was this per capita trip rate around one and including this walk, walking trip 1.35 to 1.5 those kinds of calculations were there, intercity trips out of those intracity only 20 % were estimated.

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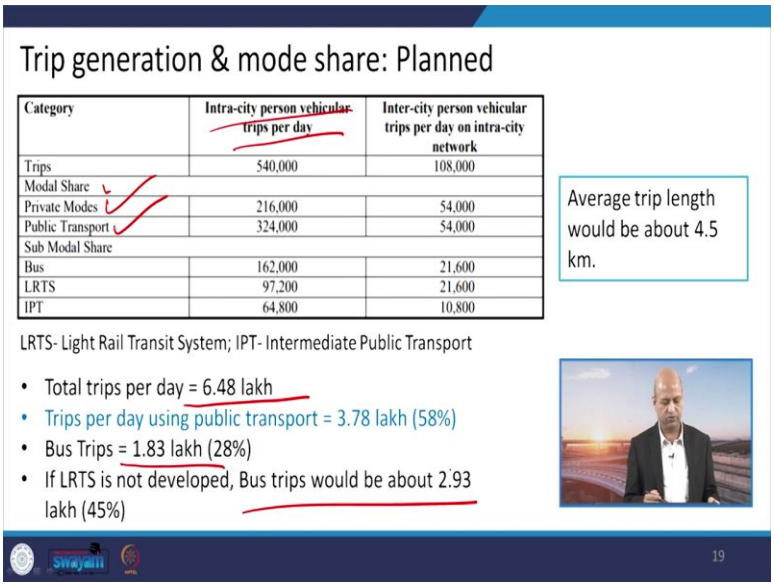

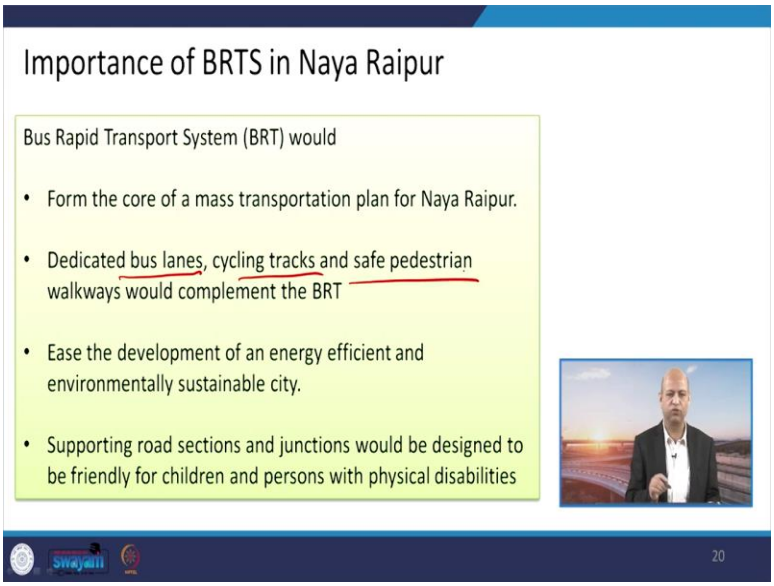

So, that way you can see trip generation and the modes here. You see this, like light rail transit system around intercity persons 20 percent and then the models here, private modes and the public transportation system. So those values are given which are available intra city person vehicular trips per day. So, those were estimated and the total trips per day were around 6.48 lakhs okay and bus trips around 1.83 lakhs 28 percent and if LRTS is not developed then bus trips would be enhanced further, that will go around 3 or 2.93, 45 percent of those. So, all these possibilities were discussed and estimated for decision making.

So, then it was decided that BRTS is the right way, bus rapid transit system would be good for Naya Raipur because, metro needs a lot of investment and it was not such a big city where metro could be supported or it could be viable. So, with the help of those data, which were collected by virtue of survey conducted by experts, and other policymakers, so, it was decided that we should go for BRTS and, when we go for BRTS, then we have dedicated bus lanes, cycling tracks, safe pedestrian walkways, so, all these were included in the plan.

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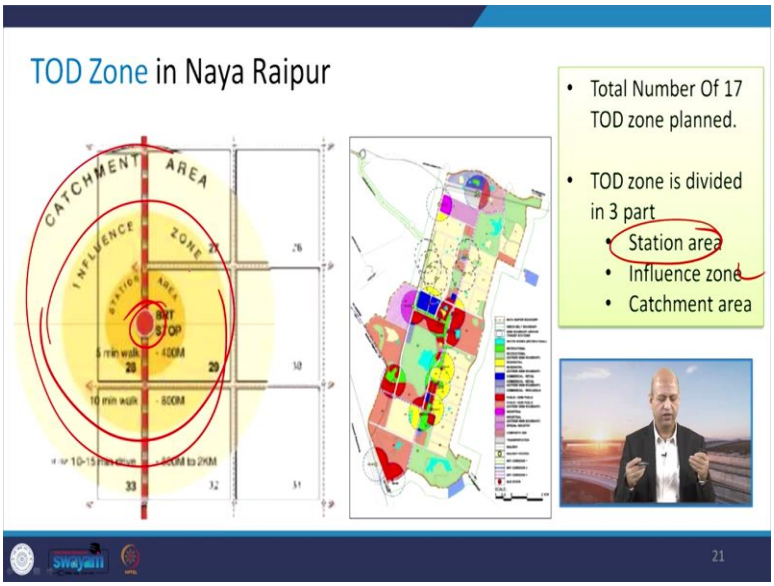

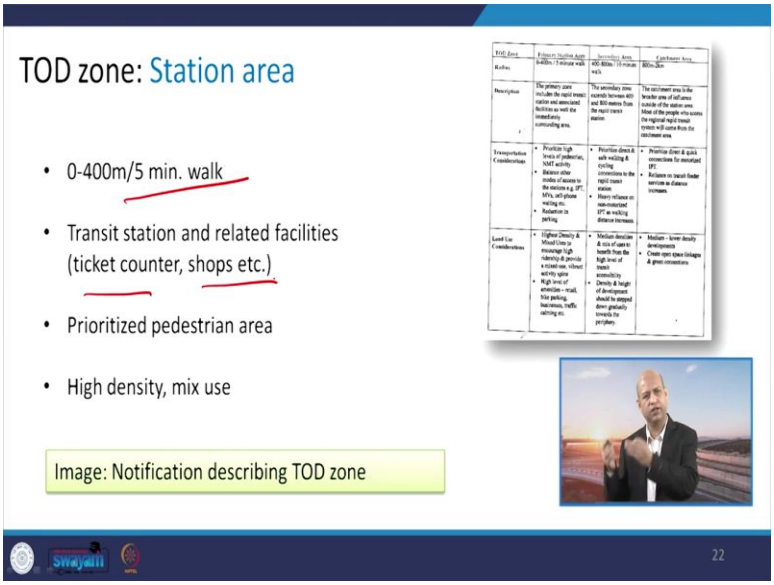

And this TOD Zone like one example is there. So, for example, one BRT, this stop is there, bus rapid transit, then there is this area, which is the station area, and that is one central area station

area and after that influence zone is known, like this catchment area is also there. So, as we go away from the station or the stop, there are different kinds of zoning you can say, so, around 400 meter, up to 400 meter from the station and you can say around 5 minutes walk that is the station area basically.

So, all those activities are planned within the station area, ticket counters, shops, etcetera and pedestrian area is also well defined and then it is high density and mixed use area because, if there are like shopping centers very near to that then it can be high rise building also.

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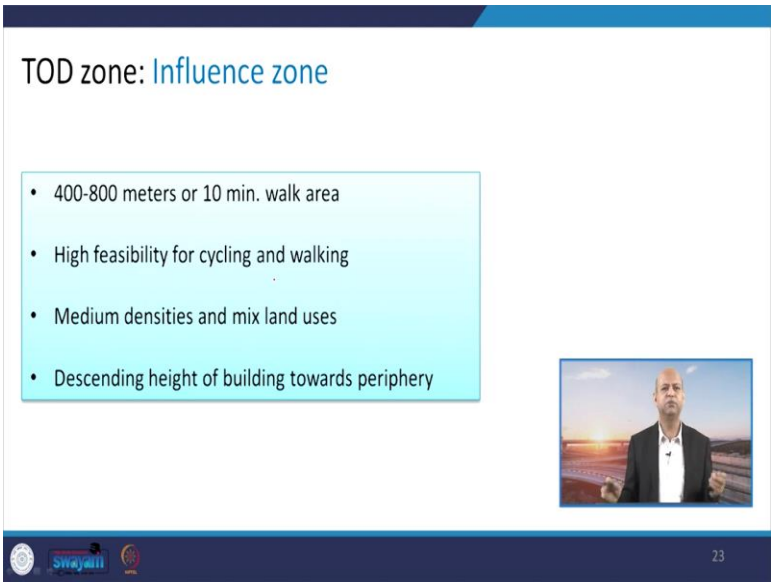

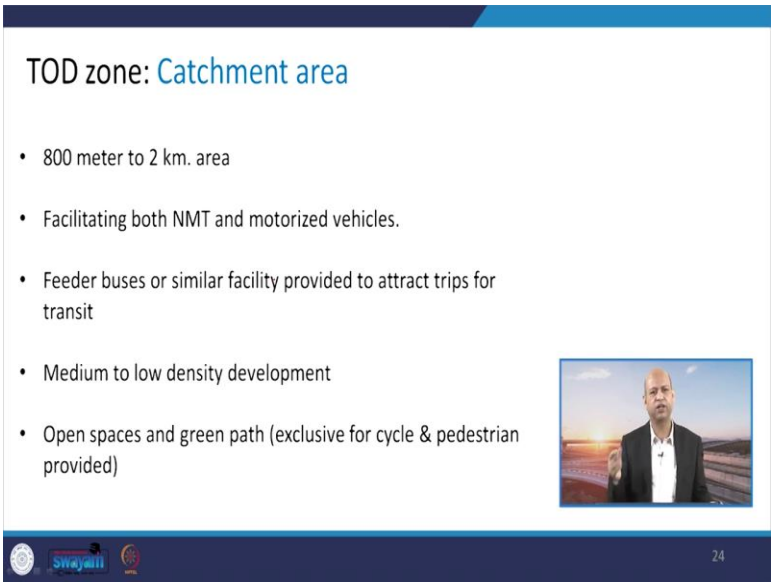

When we talk about influence zone then it is around 400 to 800 meters from the station and walking time could be like 10 minutes okay. And high feasibility for cycling and walking can be ensured there and medium density mixed land uses can be encouraged and the descending height means more height near each station then as you go away less rise buildings. Then the next one is catchment area which is beyond 800 meter and up to two kilometers.

And this can be connected with the NMT that is non motorized transportation modes or some motorized vehicles like three wheelers etc., feeder buses can also be used for that, because they, ultimately they will connect with other places which are farther away. And similar facilities can be developed and then this medium to low density development can be encouraged, because it is beyond 800 meter and up to that 2 kilometer.

So, further less rise buildings, then open spaces and green parks or paths that can be developed for cycling pedestrian people. So, means aesthetically also good development can be ensured.

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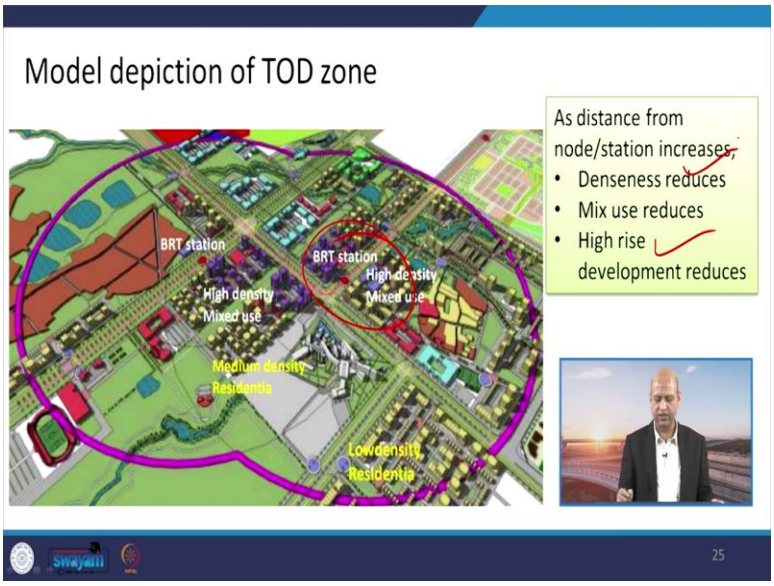
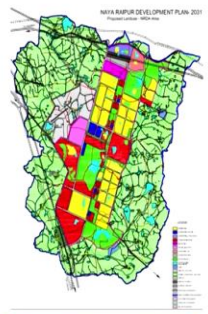


Land use distribution: Planned

S.No.	Land Use	Area (ha)	Percentage
1	Residential	2113.39	26.37
2	Commercial - Retail	146.67	1.81
3	Commercial - Wholesale	130.67	1.63
4	Industrial	196.13	2.42
5	Special Industry	263.05	3.28
6	Public & Semi Public	1846.38	23.04
7	Recreational	2137.44	26.67
8	Transport	1005.77	12.55
9	Composite Use	177.6	2.22
	Total	**8013.1**	**100**

- High population density.
- Land use for offices, transport and recreation increased drastically.



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And this is one model depiction of that TOD zone you can see, so, the BRT station is here. So, high density mixed population use could be there in this inside zone and then the influence zone can be there. So, less rise buildings and then there can be other facilities. So, high rise buildings can be there and denseness reduces as you go away from the station.

So, land use distribution the plan one you can see the residential area was planned around 26 % public and semi public offices etcetera 23 %, then recreational activities 26 percent transportation like bus routes etc. stations 12 % and the composite use 2.2 %. So that way and then industrial and commercial all these inner land use patterns were marked.

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Division of Site: as per land use

- NRDA (New Raipur Development Authority) area is divided into 3 layers.
- Delineating the Naya Raipur, the peripheral and the airport zone.

Layer	Area Included
Layer-I	The Proposed Naya Raipur (Area-80.13 sq.km.) Including 500 – meter wide green belt (Area-95.22 sq. km.)
Layer-II	Naya Raipur Peripheral Region (NRPR) (Area-130.28 sq.km.)
Layer-III	Airport Zone (Area-11.92 sq.km.)

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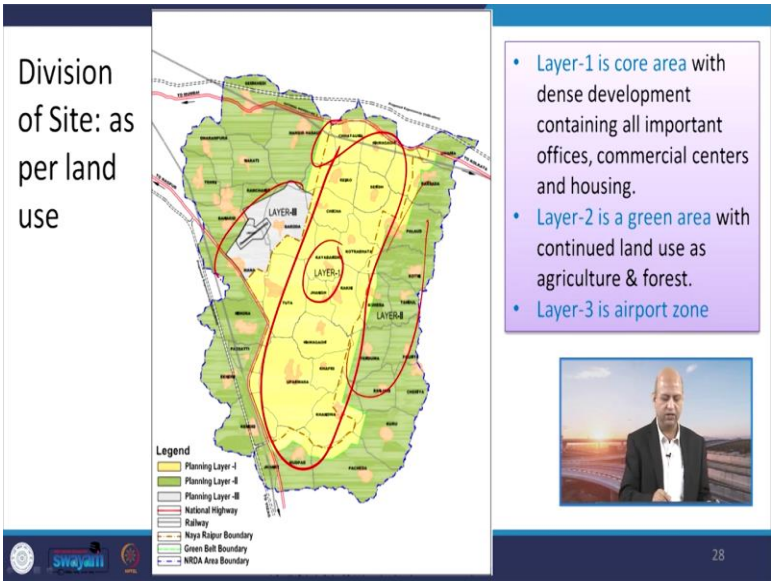

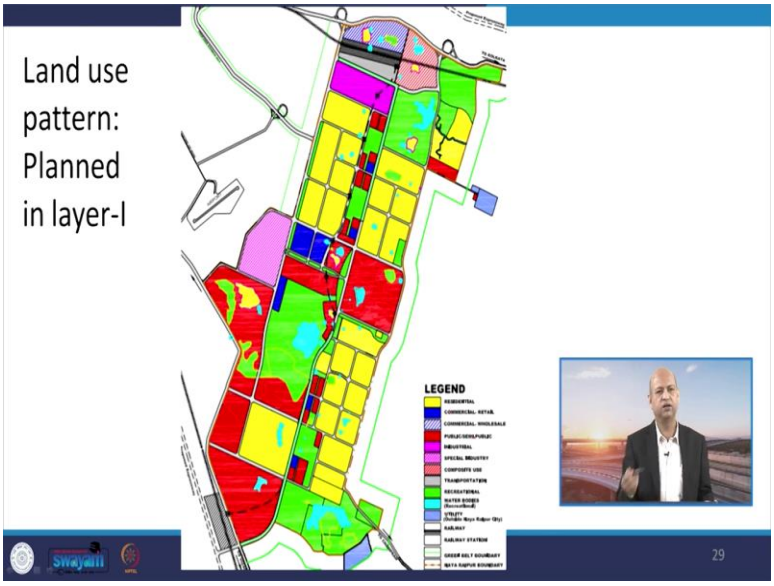

So, the division of the site as per the land use, you can say there were three layers like layer one that was the proposed Naya Raipur that is around 80 square kilometer, this includes 500 meter wide greenbelt around this, layer two Naya Raipur peripheral region and that is around 130 square kilometer okay and the layer third is the airport zone. So, three layer phase based development were ensured.

So, this is the layer one that is the complete Naya Raipur you can see and this is the layer two which is the green area basically, and the layer three is the airport related area. So, in these three layers the land use plan was developed and this layer one you can see the residential buildings or different kind of color coding is there to depict the usage of the area.

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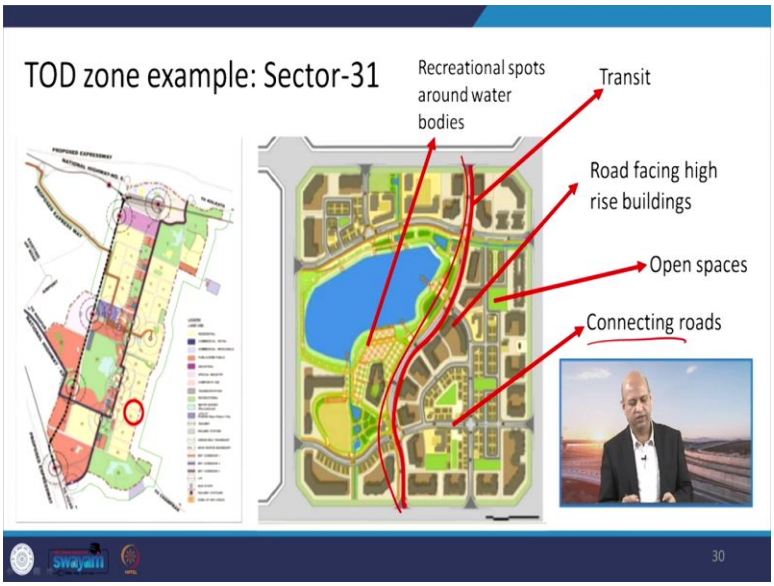

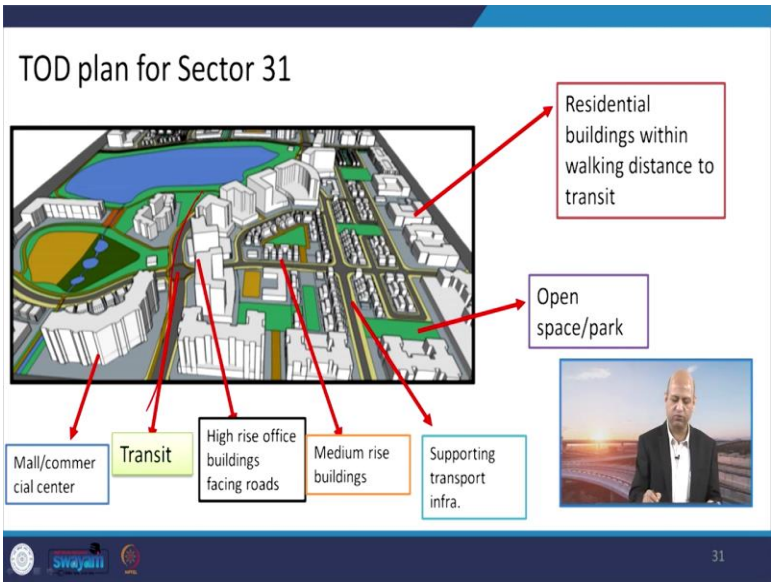

Similarly, the TOD zone example can be seen that for example, when a station is there then different kinds of uses, recreational sports can be there where people can go walking and the open spaces then connecting road must be there and the transit is this one, this is the route so, it is basically connecting every kind of activity whether open space you want to use for cycling and pedestrian uses and the road facing buildings were also planned. So, that way this is one sector which was planned and made use for TOD.

Then, this is another model like malls and the commercial center and the transit you can see here so, it is connecting means, on both sides and then open spaces is here, high rise buildings are

they are nearer to the transit so that easily people can access the residential building within the walking distance just away from the transit, so, people can just walk and take those buses which are on the transit.

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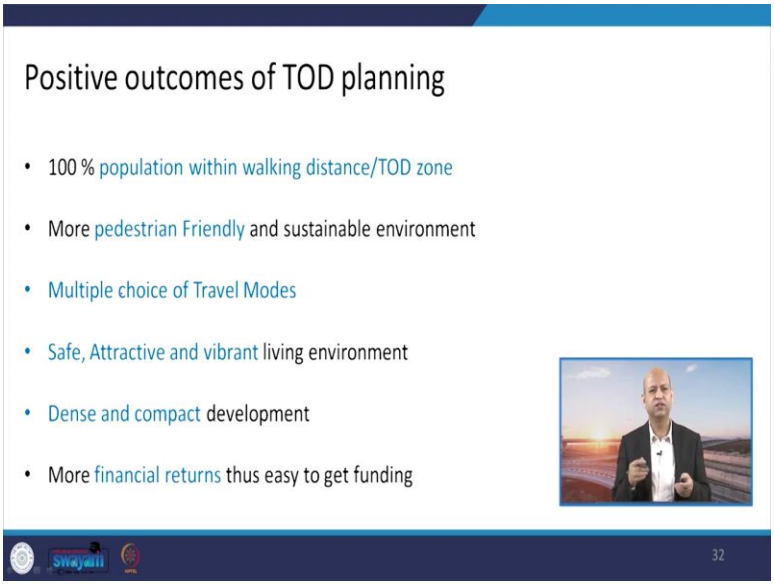

Positive outcomes of this to the planning was that 100 % population within walking distance or TOD zone. So, it was because new city planning and it was a freedom to lay the roads in such a way that the whole population can be connected with the BRT system. So, that was a big achievement and the more pedestrian friendly development and sustainable environment.

So, healthy environment you can say and the multiple choice for travel modes because NMTs or cycling related those kinds of examples then feeder bus etc. Safe and attractive, vibrant living environment was planned for like recreational activities, greenery or dense and compact development, just nearer to the transit that bus lane and more financial returns because of it is easily get funded, the cost is also not very high.

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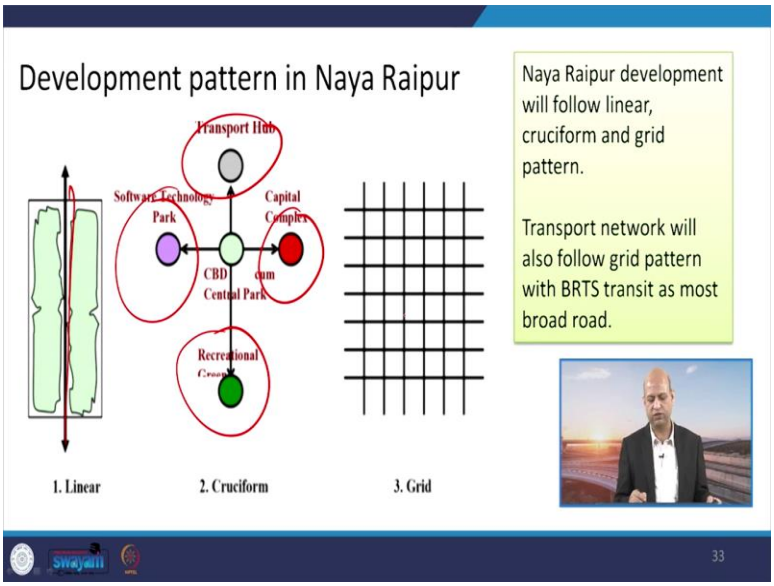

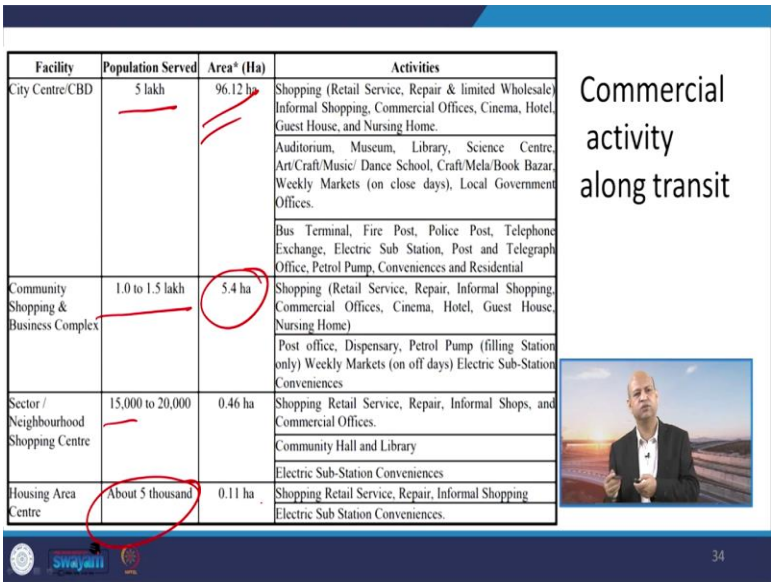

Facility	Population Served	Area* (Ha)	Activities
City Centre/CBD	5 lakh	96.12 ha	Shopping (Retail Service, Repair & limited Wholesale) Informal Shopping, Commercial Offices, Cinema, Hotel, Guest House, and Nursing Home.
			Auditorium, Museum, Library, Science Centre, Art/Craft/Music/ Dance School, Craft/Mela/Book Bazar, Weekly Markets (on close days), Local Government Offices.
			Bus Terminal, Fire Post, Police Post, Telephone Exchange, Electric Sub Station, Post and Telegraph Office, Petrol Pump, Conveniences and Residential
Community Shopping & Business Complex	1.0 to 1.5 lakh	5.4 ha	Shopping (Retail Service, Repair, Informal Shopping, Commercial Offices, Cinema, Hotel, Guest House, Nursing Home)
			Post office, Dispensary, Petrol Pump (filling Station only) Weekly Markets (on off days) Electric Sub-Station Conveniences
Sector / Neighbourhood Shopping Centre	15,000 to 20,000	0.46 ha	Shopping Retail Service, Repair, Informal Shops, and Commercial Offices.
			Community Hall and Library
			Electric Sub-Station Conveniences
Housing Area Centre	About 5 thousand	0.11 ha	Shopping Retail Service, Repair, Informal Shopping
			Electric Sub Station Conveniences.

If you see this development pattern, so, this is the linear pattern, you can see one transit then both sides, some development is there, then this is known as the cruciform. So, like software IT parks related capital complex was also planned, then there is transport hub, this is central business district and residence recreational activities are there then grid patterns are also there for residential kinds of activities.

So, all these patterns were used for the development, when we see the commercial activity along the transit, so, like shopping centers, and the bus terminals, community shopping, then sector neighborhood all those things depending upon the population like city center, it has the 5 lakhs

population 96 hectare and the for communities are paying around 5.4 hectare space was located so this will serve around 1 to 1.8 lakh population.

Sector neighborhood shopping centers will be like 15,000 to 20,000 they can serve so small community related, housing area about 5000 okay 0.11 hectare. So that way different kinds of nature or different kinds of activities related development was planned.

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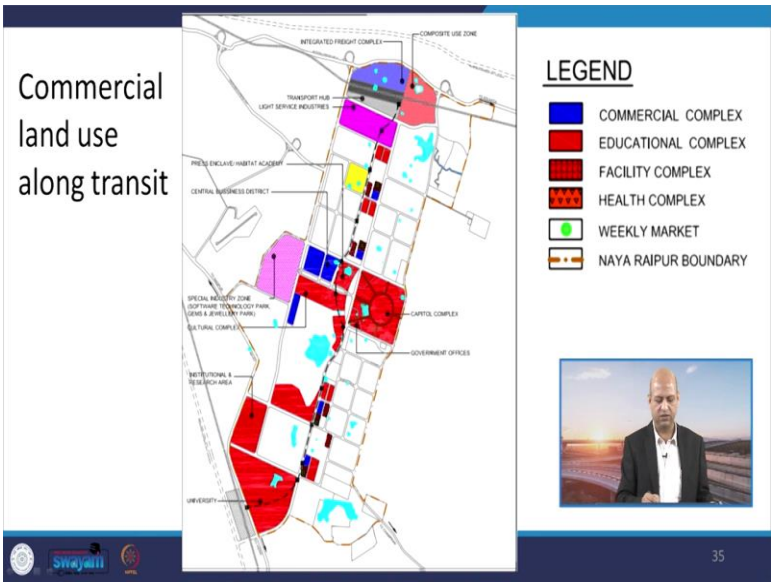

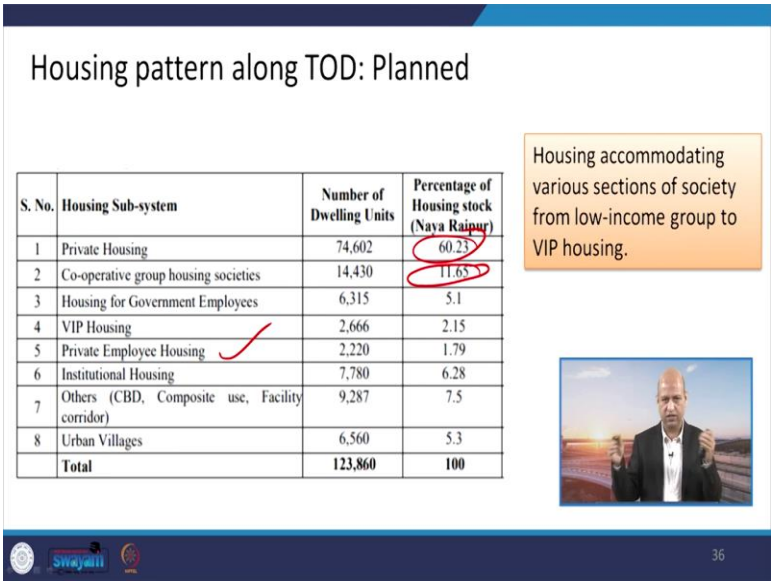

S. No.	Housing Sub-system	Number of Dwelling Units	Percentage of Housing stock (Naya Raipur)
1	Private Housing	74,602	60.23
2	Co-operative group housing societies	14,430	11.65
3	Housing for Government Employees	6,315	5.1
4	VIP Housing	2,666	2.15
5	Private Employee Housing	2,220	1.79
6	Institutional Housing	7,780	6.28
7	Others (CBD, Composite use, Facility corridor)	9,287	7.5
8	Urban Villages	6,560	5.3
	Total	**123,860**	**100**

Commercial land use along the transit, this is the one example you can see different color schemes gives this location along the transit development. Housing patterns if we see so private housing is there, plus some cooperative group housing were also planned. So, you can see private

housing was around 60 %. This cooperative and group housing were around 11.65 % and that for government employees around 5 % space was used within that housing schemes, for VIP housing, like if we have in each city where ministers will live or those bureaucrats will live so those kinds of housing were also planned. Then private employee housing, institutional housing, urban villages near to the city all those were properly planned.

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This is one example of roundabouts where heavy traffic is expected. So they can go from one direction to another without crossing each other so that less possibility is there for traffic jam etc. So, this is beautifully planned, round about you can see. So, all those roads are basically like if you are coming from this side, you can just directly go to this side or those coming from this side they can go like this, if you are coming this way and then you can go like that. So, that way you can easily commute.

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Housing units, these are the examples like high rise buildings along the corridor of the BRTS and then as you go away then less rising, low rising, middle class. So, mixed population were also planned. So, high rise buildings these developments are given and then low rise development is also according to the space or land use planning.

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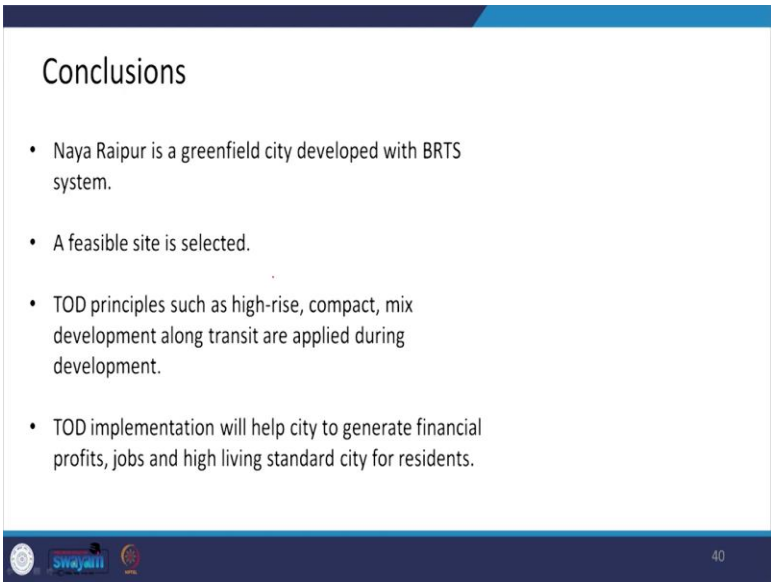

So, in conclusion, we can say that this Naya Raipur is the greenfield city development project, which was integrated with the BRTS system as in this TOD, bus rapid transit system. And the feasible site was selected with the quadrant analysis technique and survey conducted by experts

as well as other feedback according to the uses of the land and other parameters. Then high rise and compact buildings along the transit, that is the roads and then as you go away, so, low rise buildings were planned, and the implementation of the TOD was for like financial profits and the high living standards.

So, all those integrations were there for commercial activity as well as the educational institutions and the industries and as we have seen that, like biotechnology related industries, or IT related parks, and manufacturing activities, so, to serve all kinds of population, and also the administration because this is the new capital, those developments were planned and the BRTS was planned in such a nice way that it could cater all the population.

Because the development of residential areas as well as commercial activities, were in such a way that they could walk and take the bus as well as if they want to go for feeder system, if they are living in some suburban area, then they can take some minibus and they can come to the point where they can have the BRTS related system. So, this is all for this case study, the third case study related to the greenfield development of the TOD that is transit oriented development.

So, three case studies we have discussed. So, I am sure this might have given you a good picture, how transit oriented developments occurs in cities which are already existing or suburban areas or completely new city which is being planned.

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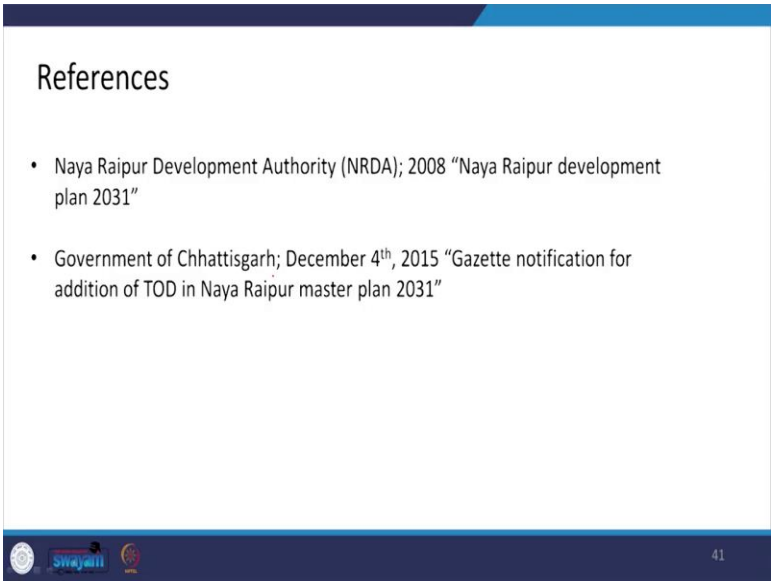

So, this is the reference where we have taken information for this particular lecture which you can refer for additional information. Thank you for your kind attention and we will continue for other kind of topics. Thanks again.