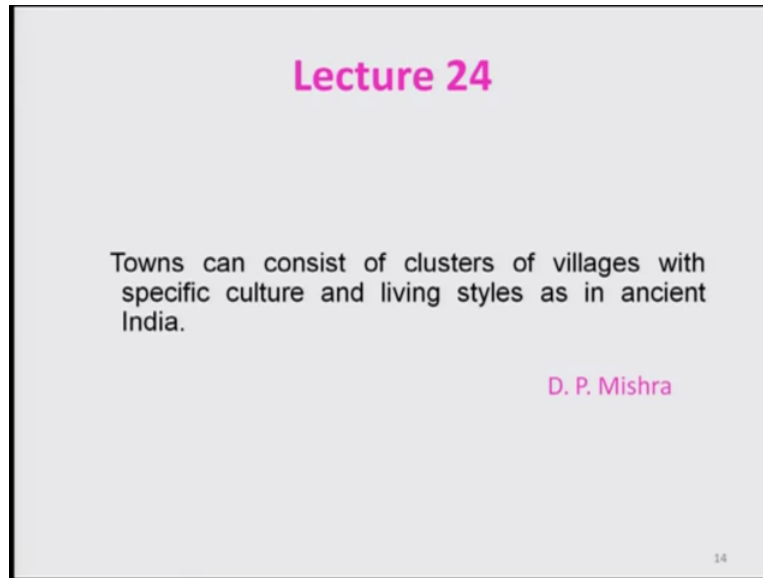


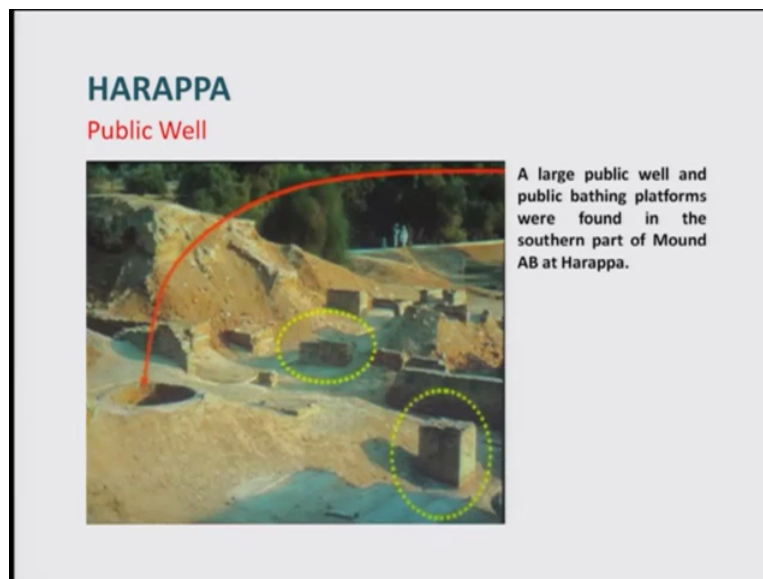
Introduction to Ancient Indian Technology
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Module 5
Lecture No 24

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Let us start this lecture with a thought process that, “Towns can consist of cluster of villages with specific culture and living style as in ancient India”. If we recall that we started discussion in the last lecture about town planning in Ancient India. Of course, various aspect of Harappan u’ civilization and its town planning, we had discussed. If we recall that we were discussing last time about granary which was meant for storing the grains and if we look at the interesting fact was that, it was having some what you call, air gap between the walls and that is a very important aspect which need to be investigated to why it is so but, as I had mentioned in the last lecture, that it is basically to control the temperature and quite interesting that, and there might be some reasons also, we need to explore it.

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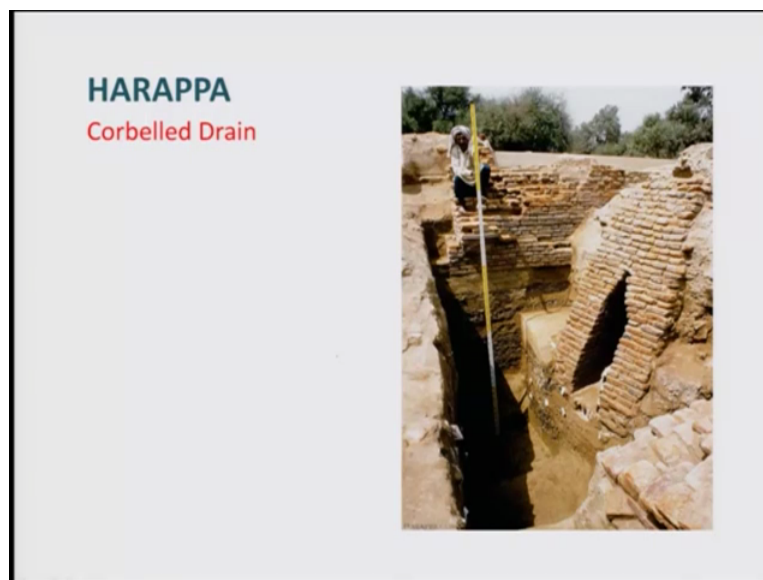
Let us today, let us now discuss about other aspects like well, in the last discussion we discussed about private wells and also there are instances of public wells which are large in size and it will be having also a platforms and which was, were found in the Mound AB at Harappa. If you remember that Mount AB that I had shown you and from here figure you can see that this is a well which is of course the scale is not given but it is quite a large ambit and also beside this there are some pedestal here like, if you look at these are the pedestals, which are there and this might be, there is there is also another pedestal here and this pedestal might be there for taking bath and also the washing clothes as is common in many traditional cities in Pakistan and India even today.

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I remember that, when I was in a college, in a hostel and at that time we used to use similar pedestal for washing clothes, at that time we were not having luxury of using washing machines, of course now a days is very prevalent, very much there even in hostels. So, there is also working platforms found in Harappan, you know excavation site. If you look at this is a one of them, this is another of them, there is also one here somewhere. So, these are quite huge in thing, it is a having a what you call, circular in nature and a vessel which will be steady in nature and these you can call it as a basically a motor and motor means you know, it is can be utilize for pounding the rice husk or the husking the grains and it was might be, these might be there in the courtyards or maybe in a very big room and if these are located in a courtyard, they must be used for public purposes.

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So, these are the kind of things what people found out during excavations and beside this there was a drainage system which was unique and if you at this, I have shown you, the drainage system here, it is having Corbelling also. This is a quite large corbel and what they found out, it was built in middle of an abandoned gateway at Harappa to get rid of the rain water and sewage. In some of the cities, even today we do not have sewage systems. Now, government is trying very hard to garner funds from various sources, even from the world bank to build sewage system and it was there in earlier days and it is a very cost-effective way of doing using the bricks, these are the bricks if you look at but, we are using concrete for that and which is not that cost effective and also the durability is a question for concrete.

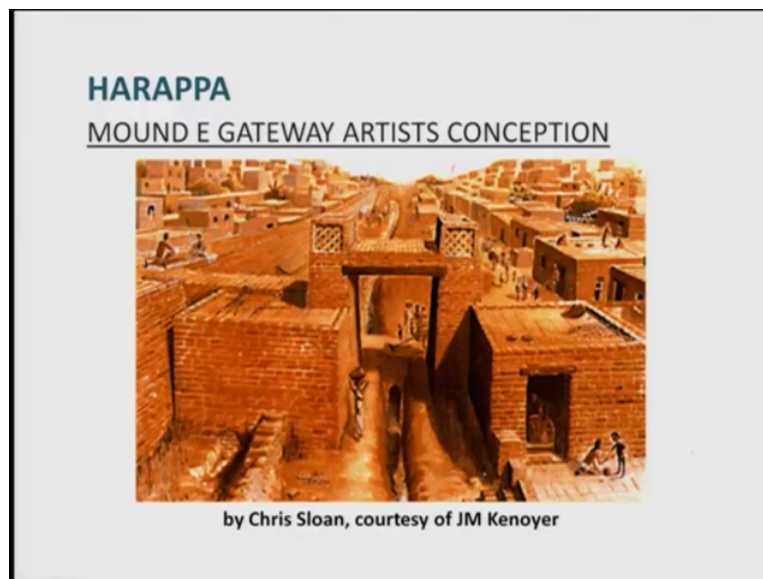
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This Mound E and ET, they could find out you know some places to be craft works for the quarter because they found out lot of debris which might have come from manufacturing certain items in the areas if you look at, I think these are the some of the spots they might have located here, some pedestal here and some places here might be some kind of a furnace, heat furnace they might have anticipated from these identifications or identifiers and then they could have assumed that this might be workshops, where people were doing crafts. As, I had told earlier we are having the cottage industries which is a part of like, not that industry that will be separated out like in modern days.

Earlier days, it was quite you know, simple thing to do and then they were doing in home itself and some of the things if you look at the shell ornaments and these are the beads, right; these are the small beads where people were using, stone beads and there is a also like a some more ornaments and this is a of course the stone tools and several other things and people were thinking that there might be gold work as well but, there is a one things I would like to show you Steatite button seals, which you look at these are the a design one and this 1, 2, 3, 4, 5 and the centre is having and there is a 2 holes here; one is here and one is here, broken and these they might have used as a button, what we are using for shirts or may be some kind of ornaments they will be using you know, so which is a very symmetric in nature and very well designed.

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So, from these one can say that they are not having the buildings but also, they are having the other state of the art, design and development and then of course they are making these art works and which we call it, we can call it now in industries you know, at that time. If we look at this figure, being made by basically Chris Sloan and was taken from the JM Kenoyer, who was basically researcher on Harappan civilizations and this site is related to artistic conception of a gateway in Mound E, you can see this is your basically a gate kind of things and these are latish work and this is the middle and the middle of this thing what people are saying, this is the corbel sewerage system, I was wondering how; but if you look at this, it is a very compact like you know they are using the space on the bottom, there is a sewerage system going on and on the top they might be using as a road.

Like, we do that in today also because I remember in Kanpur city, the sewage system was in trouble, they had excavated or the dig it and to repair it and similar things I had seen in Kanpur, may be 1 or 2 years back in the middle of the road they were doing that. That means to repair that sewage system which was made out of what you call, bricks. And these are the houses, if you look at there are the flat roofs and there is also a 2 storey and there is a doors and windows, keep in mind this is not the actual figure I am showing you, it is the basically people have conceived it after looking at the foundations and their remanence, and they could think that okay, the city could have been like this okay, that is the thing.

So, till now we have looked at basically the town planning in the Harappan and similar features are there in what you call other sites like Mohenjo-Daro and then several other sites.

I will be not discussing about it but now, we will be looking at The Literary Evidence of Town Planning in Ancient India. I will be just touching up on because of paucity of time and also it cannot be covered adjutively.

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The literary works do not provide actual picture of town planning in ancient India & its descriptions are generally verbose. However it mentions repetitively high defense walls, deep ditches, wide street, large portals, busy markets, ponds, and gardens, etc which provide overall views about town planning.

Scripture/Text	Details
Rigveda	Houses were built with wood, bamboo, thatch (Sthagati in sanskrit), etc
Asthadyahi by Panini	Two types of towns: <i>Udhicyagrama</i> and <i>Pracyagrama</i> Town contains <i>parikha</i> (moat :trench), <i>prakara</i> (rampart), <i>dvar</i> (gate).
Budhist texts/Jataka Stories	<i>Pattana</i> (port town), <i>niḡamas</i> (market town), <i>durga</i> (fort town)
Anupatika : Jain text	The <i>parikha</i> (moat) must be broad at top and cut deep down. The <i>prakara</i> (rampart) must be built solidly and bent like a bow and provided with buttresses. The <i>attalayas</i> (bastions) must be with <i>torana</i> (gates), <i>gopura</i> (towers). The <i>raja marga</i> (high roads) may have 3-6 junctions of roads.
Arthashastra by Kautalya	Grama (village) : 1 <i>krosa</i> in length (1 <i>krosa</i> = 2 km); <i>Sangrahana</i> (small town) tax collector: 10 villages; <i>Kharavatika</i> (town): 200 villages; <i>Dronomukha</i> (big town) chief administrator :400 villages ; <i>Sthaniya</i> (city) :800 villages;

Of course, we cannot rely on the literary work on how much about the getting the integrity about of town planning because, it will not give the actual pictures, as generally the literary works is a little verbose, even today when we are writing we see that it is a little exaggerated but however, one can look at various terms and terminologies which are began used namely like, high defence walls, deep ditches, wide street, large portals, like busy markets, ponds and garden and etc. These are all to be designed properly like, otherwise it will be there, otherwise people will not talk about it and that can provide the overall views about town planning.

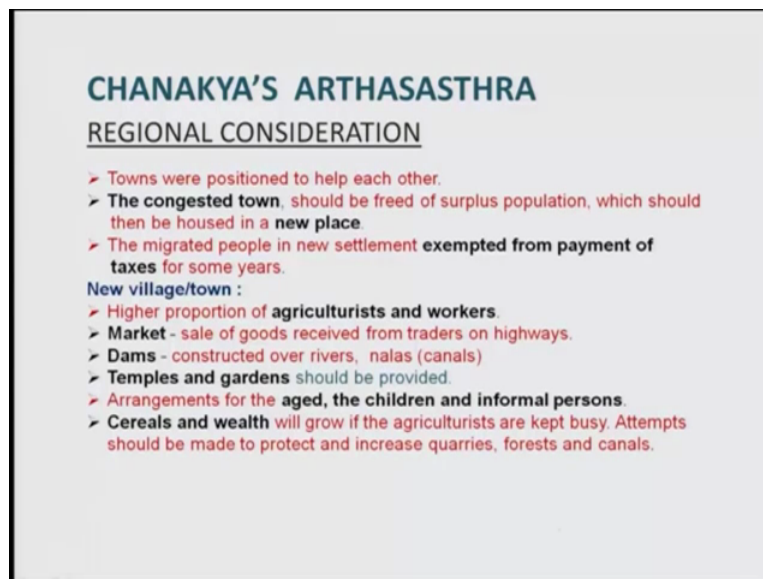
So, from this one can also make out that there was some kind of planning in designing the town and then placing it. If you look at the RigVeda, RigVeda has talked about the houses which were built with wood, bamboo or thatch in Stagati in Sanskrit it is known as thatched and even till today, people are using thatched at house what we had covered in the lecture on rural housing and I wish and hope that even thatched house will be coming up may be after 100 or 200 years, once this petrochemical waste economy will be vanished and there is of course a Asthadyahi, a Grama or book written by Panini, he has talked about 2 types of words for towns, Udhicyagrama and Pracyagrama.

Udgicya means basically North side and Pracya means the eastern side of this thing and one can say that basically town may be consist of gramas or the villages at that time and when he talks about town, he also uses certain words like, Parikha means a moat or a trench and Prakara is basically rampant and Dvara means gate. Like, these are part of the fort areas which will be fortified and these things and beside this there are several Buddhist texts and of course in which Jataka stories will be there, you can find description about various you know terminology related to the towns. For example, like Pattana; Pattana is a port town even in Orissa and Andhra Pradesh there is you will find this word Pattana even today which was a basically Pally word or the word in Pally language, and Nigamas is basically market town and Durga is the fort town.

Even town also being classified depending upon their utility and there is a Jain text; Anupatika which is also mentions certain terminologies like, Parikha, must be a broad at the top and cut deep down, right. That means, if you look at a moat is basically trench and it will be having a broad at the top but bottom it will be little short you know, kind of thing and which is obvious thing and the Prakara, the rampant must be built solidly and bent like a bow provided with buttresses, buttresses means the support systems with the stone and the bricks that it will not be broken easily, it can stand you know certain impact load and Attalayas, the bastions must be with the Torana or the gate, Gopura is basically towers and Raja Marga which we in present term we call, highways may have 3 to 6 junctions of road and there are several other things are there also in this text and several other texts are there which I am just giving some you know representative kind of things.

And, if we look at Arthasastra by Kautilya, who is also known as Vishnu Gupta, that he says the grama means basically around a space of 1 Krosa in length and 1 Krosa means 2 kilometres. Even today, it is also may be 2 to 3 kilometre around that place where the people will be living together and we call it village and they were having also the officers for collecting the taxes and managing the towns and other thing and that is being mentioned in the Arthasastra. Sangrahana means a small-town tax collector which is consists of around may be 10 villages and Kharvatika is town which is around 200 villages kind of together they will be taking care and Dronamukha is a big town which is chief administrator; Dronamukha means basically chief administrator of a big town which will be around something 400 villages and Sthaniya, who is a also a administrator kind of things of a big city which is around something 800 villages.

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CHANAKYA'S ARTHASASTHRA
REGIONAL CONSIDERATION

- Towns were positioned to help each other.
- **The congested town, should be freed of surplus population, which should then be housed in a new place.**
- **The migrated people in new settlement exempted from payment of taxes for some years.**

New village/town :

- **Higher proportion of agriculturists and workers.**
- **Market - sale of goods received from traders on highways.**
- **Dams - constructed over rivers, nalas (canals)**
- **Temples and gardens should be provided.**
- **Arrangements for the aged, the children and informal persons.**
- **Cereals and wealth will grow if the agriculturists are kept busy. Attempts should be made to protect and increase quarries, forests and canals.**

So, if you look at earlier days, the villages culture were there in the city and also the city will be having certain fortifications because of getting protected from the enemies and the other things. What we will be discussing now some of the things which mention in the Chanakya's Arthasasthra about town planning and there is a regional consideration like, what he prescribed the towns must be positioned in such a way not only to help people each other but also to protect it from the enemies. There is also a problem of congestion in the town at that time and due to the surplus people and which must be you know decongestant; how it can be done, it can be done by relocating the people and how it can be relocated?

And he has given the idea or the precision and that is the people can be encouraged to migrate to a new place which might be designed properly and people will not go like that way, they must be given some benefit and that benefit is to exempt them from paying the taxes for certain years. So, if you look at, we are also facing the same problem today; most of our cities are populated because of migration of people from village or the rural areas and for better opportunities and better life, they are just coming to the cities and that is being crowded and of course there might be several ideas which might be there in also Arthasasthra or we can generate to solve the problem of over population of the city of the present days.

And when you talk about village and town which will be newly established, he prescribed that it should be of high proportion of agriculturists and workers; that means you know, the new village will be consist of agriculturists means farmers and also the people who will be knowing agriculture so that what will be you will be self-sufficiency in food, unlike the

present day town planners or the town dwellers, they do not have way to what you call farm the land because they do not have land to till it or the produce the crop and it is not sustainable and beside this that is the one way to attract the people to come because food is available and then the other thing is that markets would be there and where the sales of good received from traders and on the highways that means, it would be connected to the roads and there should be also the provision for the water.

Therefore, it should be by the side of the river, or some canals or some water bodies would be around or constructed so that the peoples should have that you know day to day activities with the help of water. Without water it will be difficult, we will be discussing about water and irrigation other things in the next few lectures. The new village would have a temples and garden, it should be planned properly, because these are very much essential for sustaining life. Arrangement for the aged and children informal persons, kind of things they were having also. Aged means, I think it is meant basically may be for Bana prastis, like earlier days people were taking you know, retirement from their household work and they will go and teach and also do some social work as a part of Bana prasta, which I had mentioned earlier.

And they are basically to give back to the society and this the houses or these things should be there. Beside this, the cereals and wealth would grow if the agriculture be kept busy, that means they giving more emphasis on the farming, the attempts also should be made to protect and increase quarries, quarries means basically the mines and forest and canals, water. If we look at these are the glimpse of the town and then also villages where the life can be sustained very peacefully and productively. Unfortunately, today towns are not being planned properly, now we can learn that integrated approach of town planning from them.

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CHANAKYA'S ARTHASASTHRA

- ❖ A city was used to be located **centrally** to facilitate trade and commerce.
- ❖ The site - large in area, and **near a perennial water body**.
- ❖ Its shape - **circular, rectangular or square** as would suit the topography.
- ❖ The separate areas were provided for **marketing different goods**.
- ❖ The protected walls were around the town, - **3-6 dandas high and 1-2 dandas wide**. Beyond the wall, there should be **three moats of 14', 12' and 10' wide** to be constructed four arm-lengths apart; **depth – 3/4th of width**.
- ❖ **Three-east west and three north-south roads**, should divide the town.
- ❖ The main roads should be **8 dandas wide and other roads 4 dandas wide**.
- ❖ **Bridges and forest paths 4 dandas**.
- ❖ **1 well for 10 houses**.

1 danda = 1.8 m (approximately)

The diagram illustrates a city layout with a central grid of roads. The zones are labeled as follows:

- DEPRESSED GLASS (top)
- CEMETRIES (top-left)
- FOREST, FOREST GOODS (top-right)
- PALACE & TEMPLES (center)
- TRADERS / SKILLED WORKERS / SHASTRIYAS (right)
- TREASURY / GOLDSMITHS / INDUSTRIES / DOCTORS / ARTISTS (bottom-left)
- FOREST & MINISTERS (bottom-right)

According to the Chanakya's Arthashastra; city was used to be located central to facilitate trade and commerce, as I had mentioned earlier, not only to trade and commerce but also for the farming's and to protect it from the enemies and site must be large enough and near perennial water body; that means, the water bodies which will be lingering, which will be there for all the time should be there for selecting a site for new town.

And also in old towns you will have to make provisions for that and its shape can be circular, rectangular or square or as to what will be suitable for that kind of topology, where you want to have and separate areas were provided for marketing of different goods, the protected walls were around the town, which is around something 3 to 6 Danda high and 1 Danda is basically around 1.8 metre and there should be 3 moats for to protect the city from the enemies, 14 feet and 12 feet and 10 feet wide to be constructed kind of thing which will be 4 arm apart and depth will be three fourth of the width, they have defined something but there might be some changes here and there.

3 East to West and 3 north to South roads you know, should be dividing each other, roads would be enough. Generally people should have you know, roads from east to west so that it for crossing, like grid kind of structure roads, which are not prevalent today in cities because we do in a very haphazard way now a days and the main road should have 8 dandas wide and other road should have 4 dandas wide, this means you know 8 into if you look at something 1.8, it will be around may be, something 14 metre kind of things. And the bridges and forest part should have 4 dandas, that means forest should be there nearby and bridges also will be

there to connect and 1 well for 10 houses, that is the precision what he has given; that means 10 house should have at least 1 well depending on the people, the wells would be there. And this is the some topology or the layout which is being given but there might be several others also as per the Chanakya's Arthashastra.

If you look at the place, his palace is located here, this is your palace and whenever a palace is there, there will be temple; you know because they are part of the things which will be followed. Beside this there will be treasury kind of things here and some industries in this region and there will be doctors, artists and all those people will be these locations and also the goldsmiths and if you look at the this corner side is the priest and ministers, will be there and there is a cemeteries and also crematories; it will be this side where you can dispose the dead bodies and the forest and areas some person will be there and also the forest goods will be available in some places but, at that time forest is a part of their life because it is not only with the village right, each village will be having their own forest, which is being considered as sacred, so also towns will be having forest area

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Town Planning of 2nd Phase of Indian Civilization

- ❖ 2nd phase of **Indian Civilization** commenced around 600 BCE
- ❖ The capital cities of 16 *Mahajanapadas* (great kingdoms) excavated cities are *Kausambi, Rajgir, Campa, Vaisali, Kasi, Sravasti, Ahicchatra, Hastinapura, Mathura, Ujjain, Taxila, etc.*
- ❖ The general feature of these ancient cities are:
 - Fortification (Moats, wall, gates, bastions, towers, etc)
 - Use of stone, baked bricks, wood, gypsum, natural bitumen
 - Well planned roads and streets
 - Alignment of houses with cardinal points and streets.
 - System of drainage and sanitary provisions
 - System of water supply
 - Kiln burnt Bricks
 - Highways for long distance trade & communication
 - Introduction of coinage
 - Use of Iron along with other metals.

And there is a depressed class of people who are residing this side, kind of things and it may be amounts to be some kind of a system which was there at that time. If you look at the, this is the you know we had seen the first phase of town planning in case of Harappan and then Mohenjo-Daro and Lothal and other areas but the second phase of Indian town planning was basically again, commence around 600 BC kind of thing and there are several capital cities, what we call Mahajanapadas, were being excavated in recent times, some of them are Kausambi, Rajgir, Campa, Vaisali, Kasi, Sravasti, Ahicchatra and Hastinapura, Mathura,

Ujjain, Taxila and others, several of them. What will be doing basically, we will be looking some of these things, selected one only but, let us look at general feature of these ancient cities, there will be fortifications.

Fortification means, like you know moats, walls, gates, bastions and towers, these are the things required for fortifications and they use stone, baked bricks, wood, gypsum and natural bitumen, kind of thing and not the what we are using today, these are from the trees and other forest we do get it and which is eco-friendly unlike the present one, well planned road and streets. Alignment of the houses with cardinal points and streets, that is a very important point what being observed in the excavation sites and what we are highlighting now a days, you know; we can put a house anywhere we like, that is, that was not the case in earlier days from the excavation site, what we could learn.



And system of drainage and sanitary provision was very much there at that time and of course, the system of water supply in terms of wells and other kind of this thing and people will using kiln burnt bricks and highways were for long distance trade and communications and what we call it a GT road, people say that it is from the 2nd phase civilization, which is goes from what you call, earlier days from Dhaka to the Afghanistan, that road, which is the main points and similar also southern side there is a road which was meeting this one, earlier days and these quite old roads; right. And introduction of course, coinage was there, which we will not be discussing but a lot of coinage, you can see also in internet and other places and use of iron along with other metals, were a part of this town planning and kind of things.

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Town Planning of 2nd Phase of Indian Civilization

❖ **Kausambi (Near Allahabad, UP) from 400 BCE to 400 AD:**

- It has 6.5 km long fortification wall.
- The excavated main road demarks the plan of this city.
- Every house had access to this road directly or indirectly (by lanes)
- Asokan Pillar was placed at the center of this city.
- Number of cross walls with door provided for security.
- It has well developed sanitation systems with disposal of sewage.
- Drain devices : Soakage pits, terracotta pipes, open brick drains, brick tanks





Let us look at the first city, that is the Kausambi, which is near Allahabad in UP, which was flourishing around, from something 400 BC to 400 AD and people found out a very long fortification wall around 6.5 kilometre which was a quite a big, you know. During the excavation, they could find out the main roads that demarks the plan of the city and every house had access to the road directly or indirectly by lanes. This is the thing they got from the excavation.

And Ashoka Pillar was there at the centre of the city, right. If you look at, this is the Ashoka Pillar, which was there of course, now a days it is a kind of a park, kind of things here. Number of cross walls with door provided for the security and if you look at that, this is the remanence of some of the building areas and which is used to be well planned, you know. If you can look at here, see it is a quite a well-planned kind of thing, that might be some kind of a door kind of a things here and there is the stairs and other things is quite well planned and it was having a developed sanitation system with disposal of sewage and because they could find out like, soakage pits and terracotta pipes, right; open brick drains and brick tanks.

If you look at today, people are using other pipelines, even some kind of cast irons and then iron pipelines and now a days, people are using concrete and some people are using plastic but, terracotta is a very easy, cheaper one and we are not using today. We should use that, so that it will be cheaper and durable, so that we can learn a lot of things from this ancient technology.

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Town Planning of 2nd Phase of Indian Civilization



❖ **Sisupalgarh (Near Bhubaneswar, Odisha) from 300 BCE-400 AD:**

- Its defensive wall was constructed in first quarter of 200 BC.
- It has a square plan, each side around 1.4 km with a tower on each corner and two gates each side. Hence regular disposition of the eight gates.
- A rampart of clay with basal width of 110 ft and 25 ft height was erected around 300 BC. Later on laterite gravel was added over the clay base and then bake brick rivetment was provided on either side of rampart.
- Large scale use of massive laterite blocks for gateways which were reinforced by brick boxes filled with earth in next century.
- Grid pattern layout for roads.
- The entire area was surrounded by natural streams.

Let us look at another city which was there in Bhubaneswar in Orissa, that was known as Sisupalgarh and which was flourishing around 300 BC to 400 AD. This is the estimation what they have made, it was having defensive wall, constructed around first quarter of 200 BC and it has a square plan, each side around 1.4 kilometres with a tower on each corners. This is the picture of some of the remanence, because now a days, this historical site is being taken by the others to have building new buildings; may be in future, whether people could; government could protect this important excavation site or not, that is a 1 question.

And, these are the some of the pillars, which are you can see and a rampart of clay with basal width of 110 feet; that means you know the ramparts width was very very big, of course the height is 25 feet, which was a quite high was erected around 300 BC, later on what you call laterite gravels were added over the lay base, base was the clay, the base was the clay and then laterite gravels were being added and of course, later on some people add the baked bricks revetments and with the both the sides of the rampart and of course, as the people were using then they will be improving it further, depending upon the available materials and large scale use of massive laterite blocks for the gateway, which were reinforced by the bricks , boxes filled with earth in the next century.

And the grid patterns layout for the roads, road were having a very grid pattern what is expected, what is you know, ideal it should be entire area was surrounded by natural streams and the streams means basically the water will be there and water is very important for life, we do not really plan for that and that should be and we will be discussing about water in the next lecture.

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Town Planning of 2nd Phase of Indian Civilization

❖ **Taxila/Sirkap (Pakistan) 400 BCE:**

- It has extended fortified masonry wall.
- The spinal streets runs from north gate throughout the length of the city. Smaller lanes meeting the main street at right angles.
- The houses were defined and had access to the road.
- It has drainage system.



❖ **Indraprasta (Delhi) 1000 BCE:**

- The old city of Indraprasta of Mahabharata time was excavated in Delhi.
- This excavation revealed continuous occupation from pre-Mauryan, Mauryan, Sunga-saka, Kusan, Gupta, post-Gupta, Rajput, Delhi-sultane, Mughal periods
- The houses were defined and had access to the road.



And Taxila which is now known as Sirkap in Pakistan, around 400 BC this city had actually extended fortified masonry wall, the spinal streets run from North gate throughout the length of the city. Of course the smaller lanes will be meeting the main street at right angles and if you recall that this Taxila, where the Chandra Gupta was a teacher because, there was a university where he was a professor in that place at that time, when the Alexander the Great invaded that place. The the houses were defined and had access to the road and it was having a very good drainage system as well.

So, this some of the layouts, I have shown here, this is about the Taxila city at the time what people have got and if you can look at, these are all well planned you know, layout of the houses and buildings, if you look at these are the houses kind of things, these are and this is the road you are having main roads, right. These are the road kind of things and these are the side roads and these are the may be some common places and it was quite beautifully designed, you know town and Indraprastha, of course you will be knowing well, that is a very historian city, now is known as old Delhi and which is something 1000 BC and always whenever Indraprastha we talk about, it is comes to our mind Mahabharata because, Pandavas which had built that Indraprastha, according to our scripture.

And this excavation, revealed that this Indraprastha which is now in Delhi, occupied it by several people like, Pre Mauryan, Mauryan dynasty, Sunga- Saka dynasty, Kusan, Gupta, Post Gupta, Rajput even of course, the Delhi Sultan and Mughal periods and these I have shown you the Purana Qila, which was the place being you know, capture by all the dynasty

people or the kings, whoever you know tried to capture the power and they will be using that again renovating it also and the houses were well defined and had access to the road. We will now stop over here and then we will discuss more about in the next lecture and I will be continuing this town planning of the second Civilization, Thank you very much.