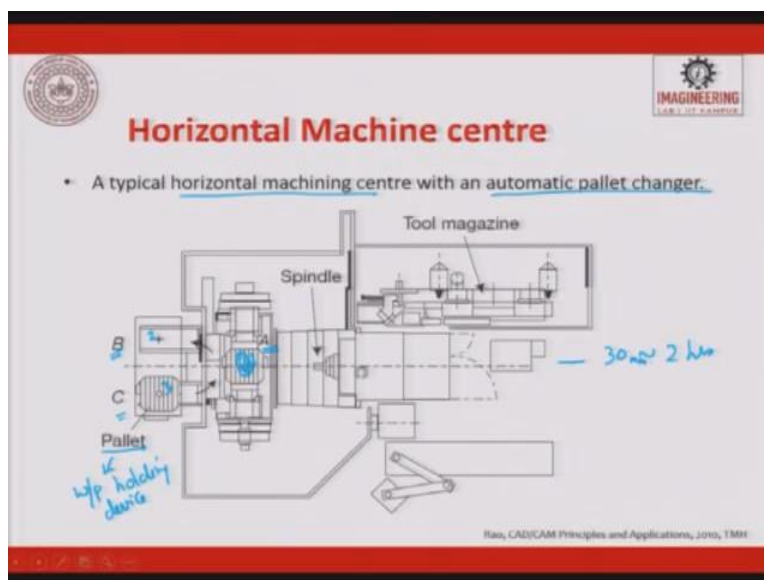


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**Lecture 17**  
**CNC Machining Centre (Part 2 of 2)**

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Okay the next interesting topic in CNC topic is going to be on CNC machines. A typical horizontal machining centre with an automatic pallet changer. What is pallet? This is a

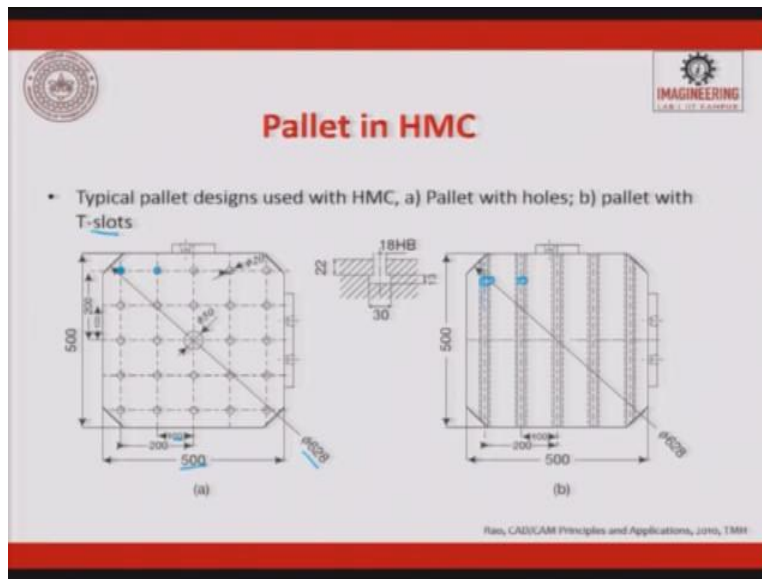
pallet. Pallet is nothing but a work-piece holding device. You put your big component, it is getting rested here. So now you see here, this is a CNC machine, this is horizontal type. There are 3 pallets, 1, 2 and 3, or I would say 3 stations, A, B and C, 3 stations are there.

There are two pallets, so one pallet where the machining goes on. This is a part where the machining is going to go on, when the machining is happening you will have another pallet which is free. So now what we will do is when the machining is on, the next pallet we will place the new part which is to be machined here properly.

Once the machining is over this pallet sweeps out to the position B and C whatever was there, pallet gets into the machining zone. So what is the advantage? The advantage is you are trying to increase the productivity of the machine. So here during the machining time and generally the horizontal machining centres when one job is loaded, typically runs for 30 minutes to even 2 hours, 30 minutes to 2 hours it runs.

So by then this will be there. And here the changing will happen automatically once the machining is over, the door will open, it will come out, this will come in and the next machine starts. So this is only to improve the productivity of a CNC machine. This is the use of a automatic pallet changer.

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So this is how a pallet looks like. So in a pallet you can have pallet with holes, you can have pallet with T-slots, these are all T-slots. So when we have these holes, through these holes you can push in a dowel pin and you can put a part and you can locate a part on it.

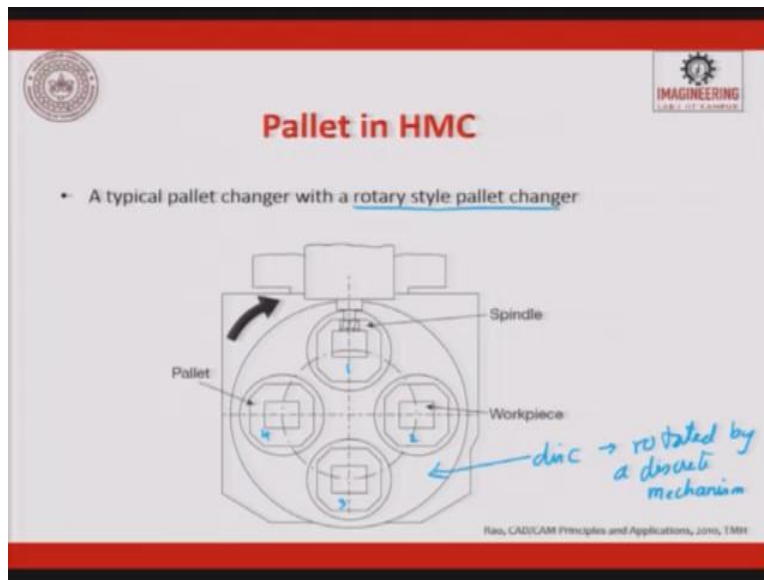
So this is basically helping you to locate a part on a pallet and you know the locations of all the points here. So correspondingly when you write a CNC program, you know the X and Y, Z coordinates of the work-pieces very quickly. So you can see here the diagonal distance is 628, the length is 500 between pin to pin it is 100. So it is like a matrix, several dots equidistance okay. So then you see that.

So this is predominantly used for locating some complex jobs. And here these points are discrete if you want to have infinite points, then we go for a pallet with a T-slot, put the stopper here and locate the component wherever you want and then start machining. So this is also of the same dimension, 500, the diagonal is 826, the distance between the pitch between the two slots is 100 millimeter. So both these pallets are used depending upon the requirements. So you will have either this or that.

So both you will not have a machine where they have both, one which is there for pallet changing, either this you will have a automatic pallet changer or this for a automatic pallet

changes. The normal conventional all the milling machines will have T-slot based table. So that is what it is.

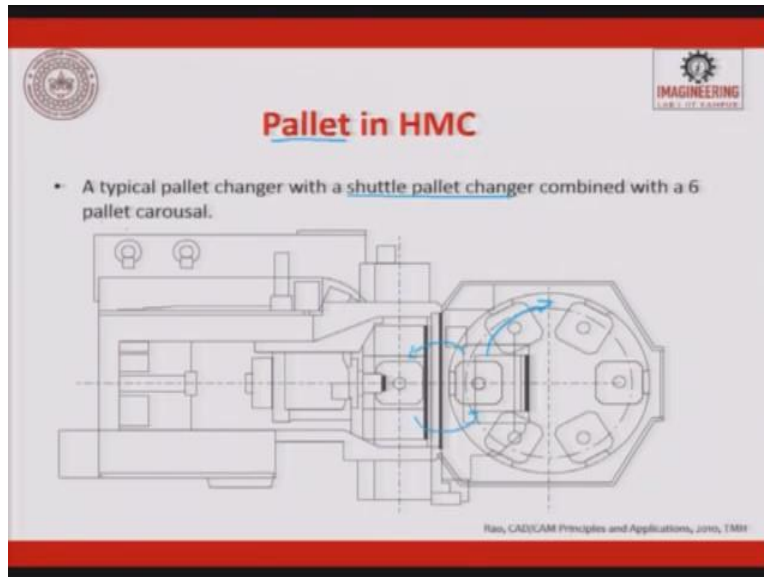
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So a pallet in a HMC, a typical pallet changer, this is a typical pallet changer, so here is a spindle so here there are 4 pallets which are there. Each pallet you can keep start locating it. These pallets will be sitting on top of your disc. This disc will be rotated by a discrete mechanism, which is nothing but a Geneva mechanism is kept at the bottom.

So it indexes and it stops, so because if you use a gear then it will be continuously moving. So you will have a gear at the bottom, but this gear will be discretized at 4 points. So it indexes and stops. So by this what will happen is you can try to increase the productivity of the machine, a typical pallet changer with a rotary style pallet changer.

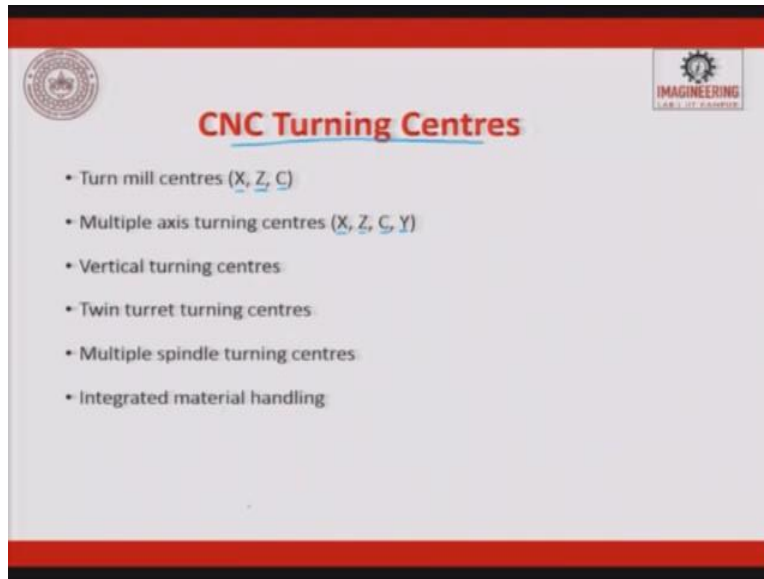
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So a typical pallet changer with a shuttle type pallet changer combined with 6 pallet carousals. So when we talk about this pallets, it is not necessary 2 pallets, you can have a carousel of pallets, carousel of pallets means you can have 6 pallets. So if you wanted to do a mass production, very quick production and all, again you can use this.

So it is a typical pallet changer with a shuttle pallet. So this is a shuttle pallet. So every time it comes here, it gets indexed and this will intern index. So this will go up and down, but and then this will go like this. So you will have a shuttle pallet changer which combined with 6 pallet carousel you can do.

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So when we talk about the CNC turning centres, you can have turn mill centres. This is what I was trying to tell you in the beginning. Today, there is a combination of milling and turning together. So it is called as turnover milling centres or turn mill centres. You can have multiple axis turning centres.

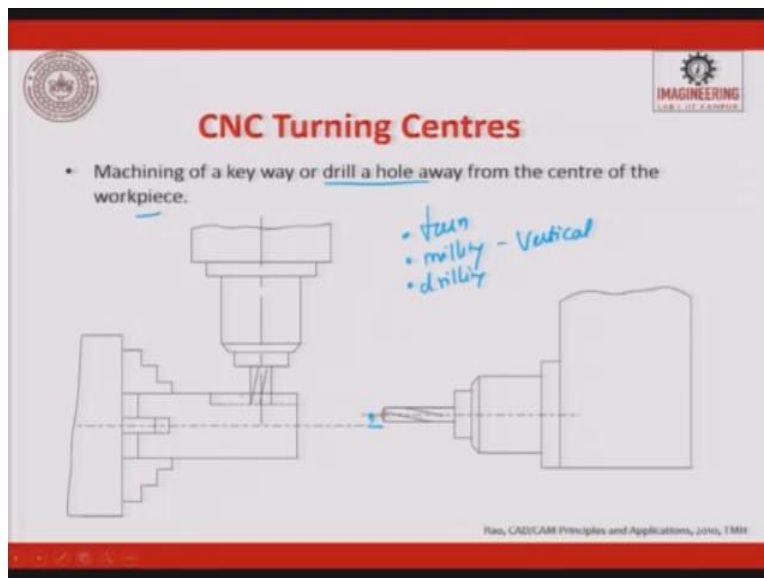
So generally we will have only two, X and Z, now you can have C, you can have X, Z, C and Y. Then you will have vertical turning centres, then twin turret turning centres, multiple spindle turning centres and you can have integrated material handling devices which are attached to the turning centres.

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So this is the slant bed CNC turning centre which I have already discussed. So here you will have the spindle which rotates and here you will have the tool which rests.

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So CNC turning centres machining for a key way slot, so you can key way slot or drill a hole away from the centre of the work-piece if you want to do, today there is a provision which it can be done. So you can have this key way slot machining. Otherwise, it is a very difficult job. If you want to do a key way machining in a conventional machine we turn

and then we take it to a milling machine, vertical axis, vertical milling machine and then we relocate it and then get it done.

And the other thing is, if you want to drill a hole also, we will take it out from a lathe machine, take it to a hole. If you want to do off axis, off of the axis if you want to do and then drill, this is possible. So this is offset if you want to do, so you can do and then drill holes or we can do key way holes.

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So the drive for a tooling in a turret of a CNC turning milling centre is this, so you will have this as the turret of a turning milling centre.

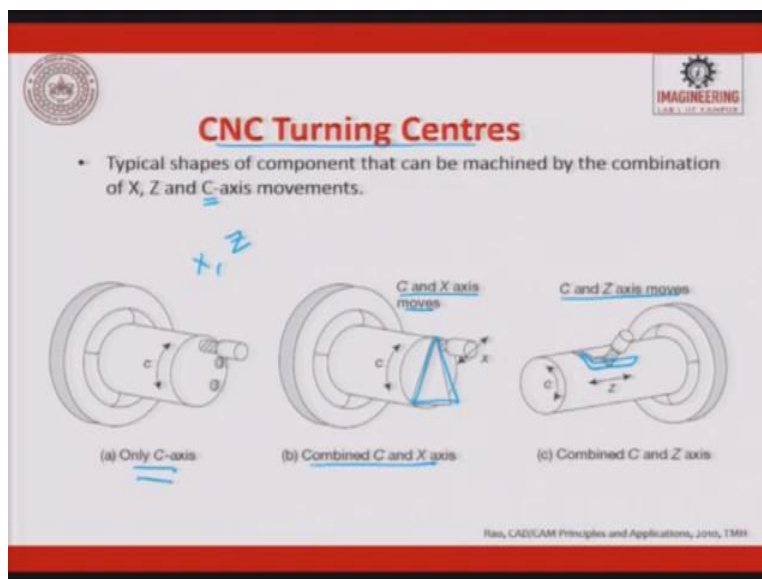


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So where we will have tool turning with driven tools to be used in a turn mill centre. So you can have so many tools which are attached and then this in turn will be doing turning operation as well as a milling operations.

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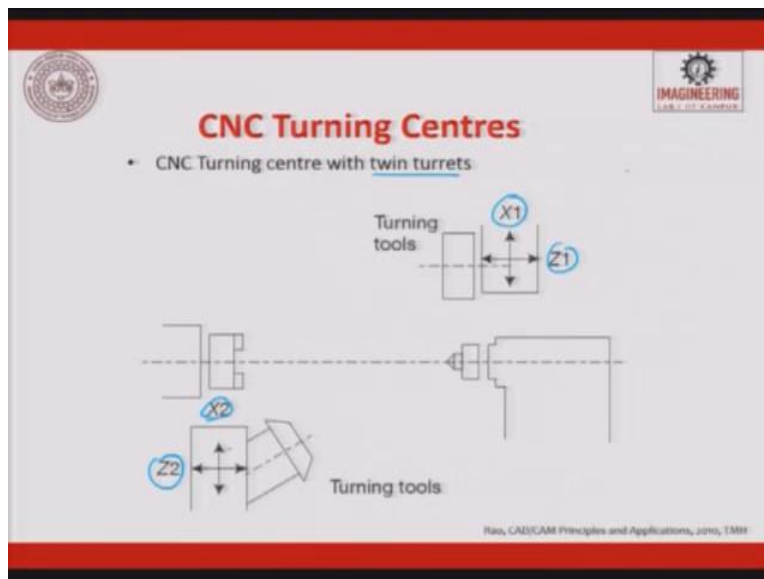
So this is what is a typical thing only C-axis apart from your X and Z which is used in a lathe machine. If you have a C-axis, you can offset and drill a hole and at, you can stop it

at regular indexed position. See, in a lathe machine, the 1 RPM keeps rotating. So now you are discretizing 1 RPM. So that is why you are able to drill this holes.

The other thing is combining of C and X you are able to make a triangle, C and X axis when they are moved, you can try to get a triangle done. If you want to make a slot, wherein which through this slot there is a CAM which moves up and down then we use C and X axis motion, so we will try to get this slot and operate this. So these are all complex jobs which are been made on a CNC machines.

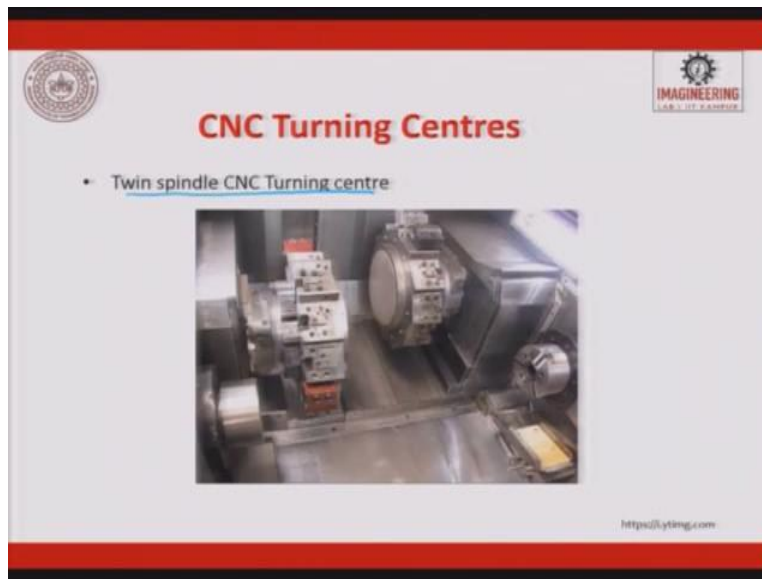
So if you have a CAM follower, this CAM follower following this and then you can try to get locking or unlocking of a system. So it is very typical a job. All these jobs can be done today in a CNC turning centre, provided you have a C axis which is attached to the X and Z axis.

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When I was talking to you about twin turrets, so this is a turning tool, so you will have another turning tool. So you will have X1, X2, Z1, Z2, so you will have to plan this and write so you have 2 twin turrets are used for machining.

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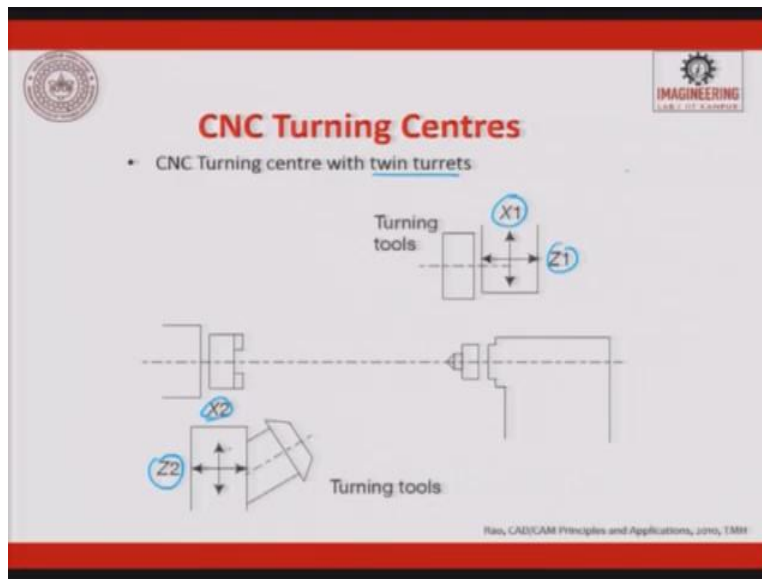
So this is how a twin turret looks like. So this is one turret, two turret and here is the lathe machine, this is a spindle wherein which you will load the work-piece.

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So this is how a twin spindle CNC turning centre looks like, a twin spindle CNC. Two spindles are there. You have multi-spindle automats today. So you will have 6 spindles are there. These are basically an SPM machines. You would have never even thought about 2 spindles.

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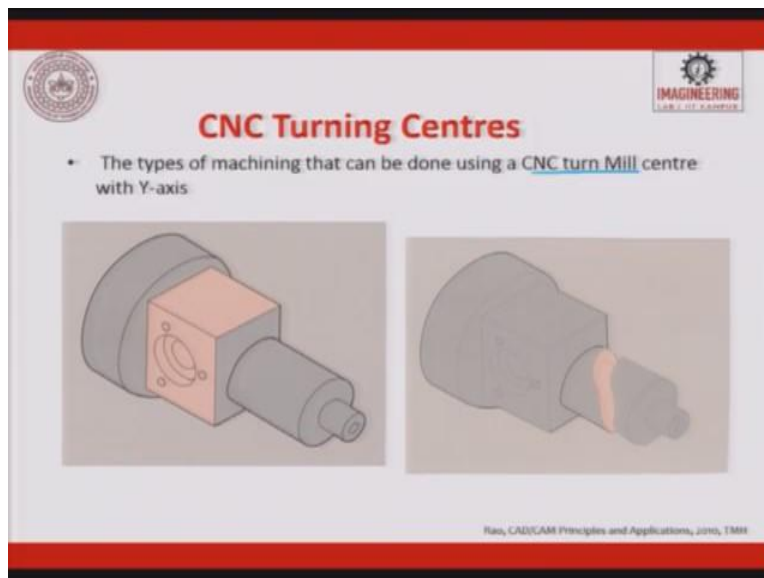
Look at it, two spindles. This is twin turret okay. So this is two spindles.

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So you can have CNC turning milling centre with Y-axis. Y-axis, why is it specified? Because in a lathe machine you will always have X and Z-axis only.

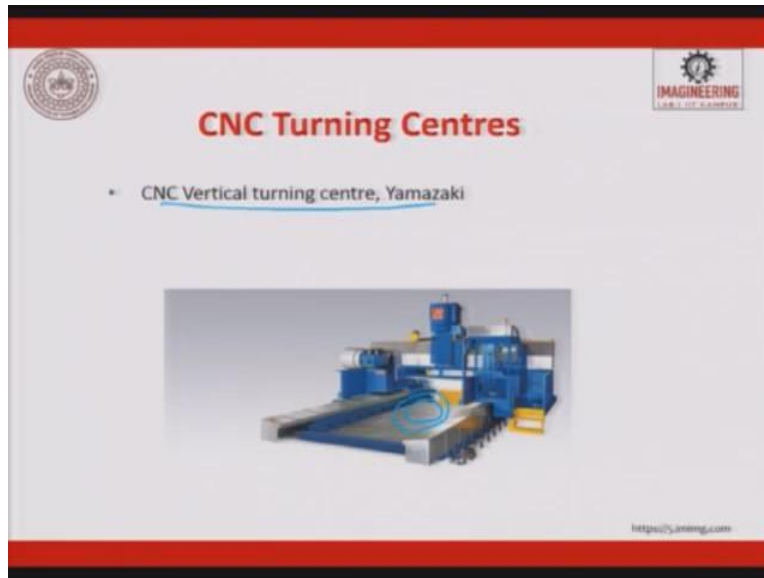
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So if you want to do a typical job like this, a hole to be done and then you will have a cube to be machined and then drill and then along inside you want to have a tab which can be done. So all these things can be done in this turn mill centre with Y-axis this way and then if you want to make a groove, it can also be done.

So these are typical jobs which are done on a turning centre. So I am just bringing it to you because multi-featured cylindrical components are now the talk of the town. So how do you make multi-feature cylindrical components to meet customer requirements? So this is how it is, a camel roll on it for locking and unlocking. These are all for assembly operations we do.

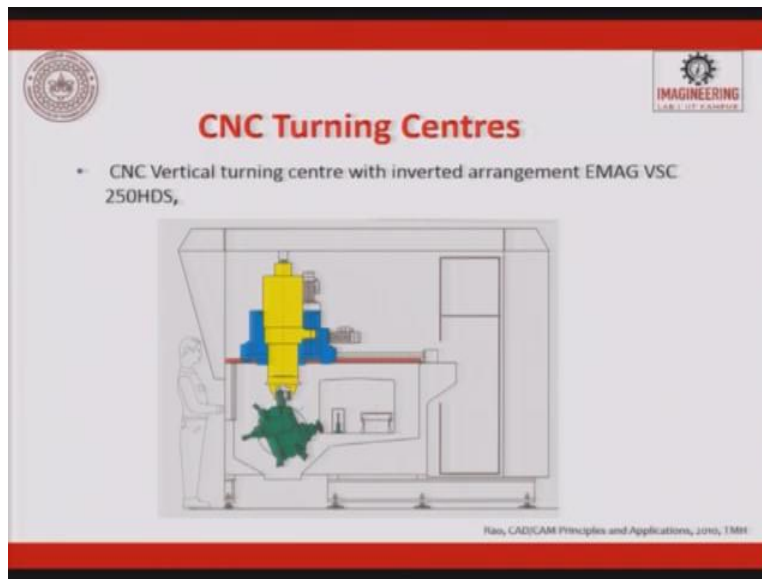
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So when we talk about vertical turning centres, these are also if you have a large dye to be made, for example, a truck tire has to be processed. So generally what they do is, they make a large dye and then in that dye you used to keep several sheets of rubber and then this iron wires at regular enforcements.

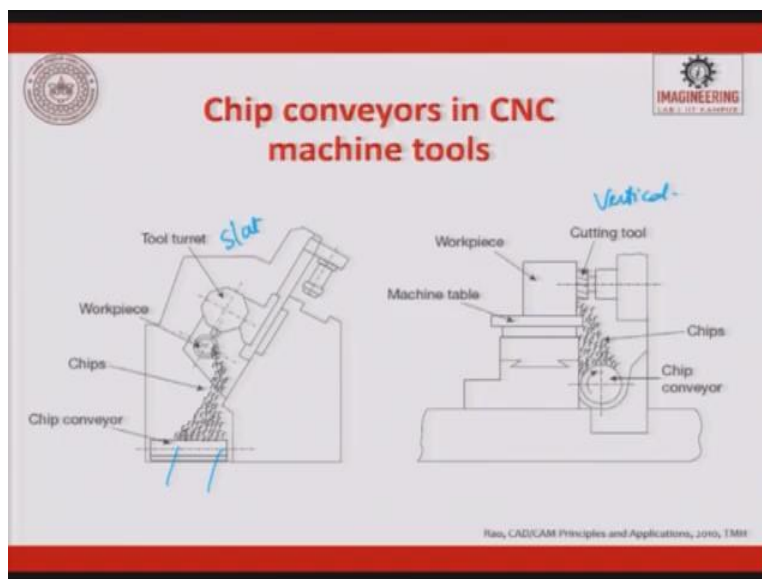
And then what they do is they try to process the dye and here it is done on a CNC vertical turning centre. The dye is machined using a CNC vertical centre.

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So CNC vertical centre with inverted arrangement you can see, which is inverted arrangement, this is that. You will have a inverted arrangement. So all options of CNC machines I am talking about.

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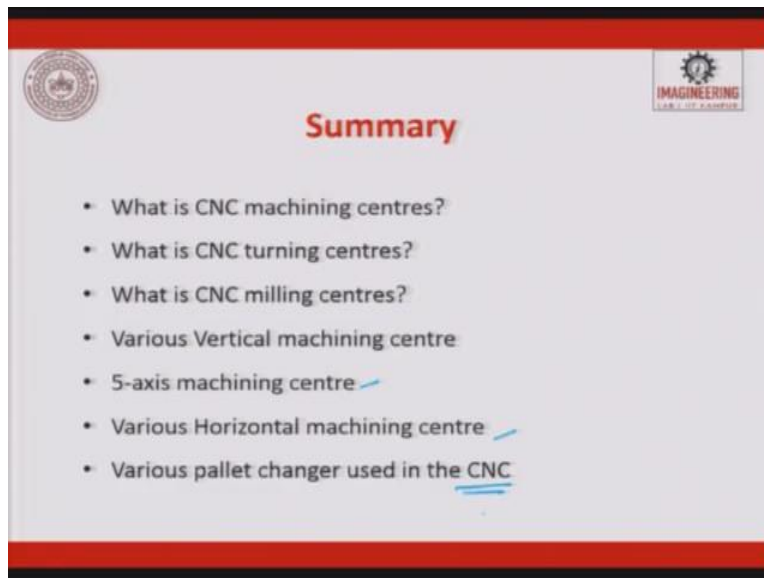


Then as I told you chip, when we try to talk about machining. So we will try to, the chips are formed, if the chips gets accumulated on the table it is going to be difficult. You have

to frequently clean the table so rather than that we always use a slant bed, so the chip falls on a conveyor. So this conveyor can be a bucket or it can be a moving conveyor.

The chips are thrown out into another conveyor so it is always kept clean. So it can either be like this, or it can be like this. So this is slant and this is vertical okay. So the conveyor can be moving like this or the conveyor, there can be a drum which rotates and this drum keeps throwing down and then the chips can be accumulated into a bin.

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To summarize, in this chapter, we saw what is a CNC machining centre? We saw CNC turning centre, then we saw CNC milling centre, then various vertical machining centres we saw. 5-axis machine, various horizontal milling machines and then we saw about various pallet changers which are used in a CNC machine to improve the productivity. Thank you.