Principles of Metal Forming Technology

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Lecture - 27
Equipments used in forging

Welcome to the lecture on equipments used in forging. So, in this lecture we will going to discuss about the different types of equipments which are to be used in the forging. So, as we discussed that normally depending upon the type of you know operations which we apply, in the case of forging you have one is drop forging So, where there we use the hammers.

So, these hammers basically they will be coming and they will be giving the impact force from certain height. And, they will transfer the energy on to the workpiece and then the material gets you know deformed. So, the energy of these ram, which are moving from top to bottom they are utilized to be formed the material.

So, that is how these hammers are used. Now, similarly as we discussed that you have the process, there we use the continuous squeezing action by the machine, and they apply the load on the you know component and that is why depending upon the load how much they apply the deformation will take place. Now, when we talk about the different types of you know hammers.

So, if you talk about hammers, you have the board hammer or power hammer or counter blow hammer.

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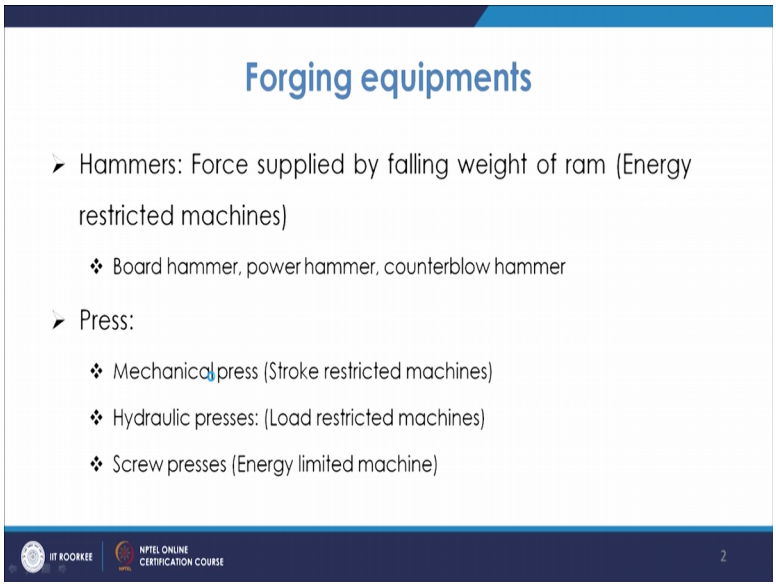

Now, in that board hammer or sometimes we also classify as the gravity drop hammer. And, then you have to drop hammer will be in fact, categorised as again for the gravity drop hammer and then you have the power drop hammer.

So, what happens that in those cases you require so you have; so when we talk about the drop hammers.

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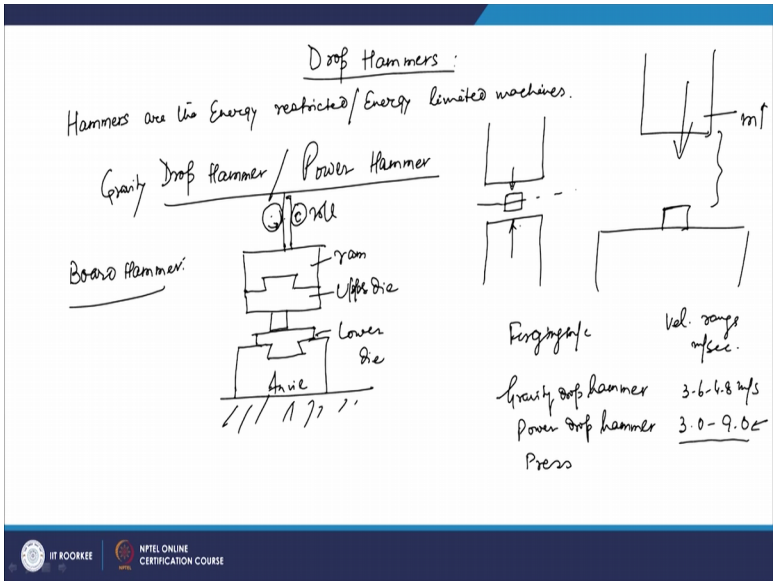

So, as we discussed that we have a (Refer Time: 02:49) and then you had it has to fall with it is weight. And, it has to fall from certain height and then it will come and then, it

will do the impact force, it will be falling with impact on the specimen, which is here and it will transfers whatever energy it has it will transfer that energy due to that energy. So, this energy is utilized in the form in this workpiece.

So, normally these hammers are known as the energy restricted machines, energy restricted or energy limited. So, because it is using it is kinetic energy of this ram which is falling from the top. So, that is why it is known as energy restricted to energy limited machines. Now, in this you have drop or drop hammer or the power hammer. Now, in the case of drop hammer basically in both the cases they are dropping, but in the drop hammer gravity drop hammer.

So, is it is also known as gravity drop hammer. Now, in the case of gravity drop hammer, you know the ram falls of it is own weight. And, then that weight basically will be falling under the action of gravity, and that will be falling under the job and this way the material will get default. Whereas, you may have and certainly it will be further you know take a half and then further it is allowed to drop. So, that sequential blows take place in the case of these hammers normally, it is not that it will do the deformation process in one blow, it will be going on continuously.

So, actually it will be going on continuously and you it will be doing the deformation. So, normally the velocity also is there, when we talk about this you know hammers. They have a certain velocity with which they are basically falling over the machine.

Now, if you talk about this so, gravity drop we have talked about now coming to power hammer. So, in those cases you accelerate with certain power source. So, and then that will give extra velocity and it will come and it will be doing that you know it will be doing that operation. So, that will be power hammer; now, this gravity drop hammer of the power drop hammer. So, this is basically your job is there on the anvie and anvie is attached to the foundation.

So, this foundation will be observing that energy impact energy and that is why in these cases your foundation must be strong enough. So, that because it will transmit that energy to the foundation, it will take some energy will be taken by this material and then that will be transmitted towards the E foundation need to be very very strong. In the case of the earth gravity drop hammer or the power drop hammer.

Now the difference between these 2 is also that, as you know that in the gravity drop hammer you have the top ram portion that will be falling over the work piece.

So, depending upon it is weight you know that it will have certain kinetic energy that energy it will be achieving. So, if you have to achieve. So, if your velocity is fixed. In that case and certainly when you are allowing it to free freely fall then you know that depending upon the height it will attain certain velocity from where it is released. So, depending upon the height from here it is released it will attain certain velocity.

So, that way you are going to get some energy that energy will be basically transferred to this material. So, depending upon this height how much it is? You will have the energy which is you know there into this ram and which will be transferred to the. So, that energy will be utilized for the deformation, but and if you have to have the larger value in that case you have nothing but you have only one option, that you increase the mass because velocity for that height will be you know fixed because of the height h. So, what you do is you make this heavier.

So, you have to increase it is m. So, that what we can only do, but once you increase the height it will be more and more bulky and then you have to have some power also while taking lifting it upward. So, what we do is that? Then, we have these machines like power hammer where the velocity is basically increased. So, you can increase the velocity ram being also that top diode maybe of smallest even with the same you know mass if you increase the velocity. In that case the energy which is you know achieved that will be larger. So, that will be for the power hammers.

Now, similarly you have also the presses now if you talk about. So, in the press as we discussed that when the in the press it will come and it will be pressing and squeezing continuous. So, if you talk about the speed ranges; so if you talk about the forging machine and if you talk about the velocity range in meter per second. So, it is seen that if it is a gravity drop hammer.

So, in that case the velocity range is 3.6 to 4.8 meter per second. So, that is the range of the velocity which we achieve and if you talk about the power drop hammer. Now, in these cases your velocity will be ranging from 3 to 9. So, you can see that you can achieve from smaller to the larger, you know this range is quite large and this high velocity you can achieve.

You have certainly some specialized you know machines and you have special methods, where you can achieve very large velocity ranges where we apply this forging pressure in very small area with large, you know velocity and they are used in HERF machines there it is going of the order of 6 to 24 meter per second. Now, if you talk about the mechanical presses.

So, if you talk in the case of press. Now, when we talk about the press so, before that we must know that you have a gravity drop and the power hammer. And, in those cases we use since we use the energy of the you know hammer that is ram which is coming down to deform the workpiece they are known as the you know energy restricted machines, and the power can be by any source you have you know the steam also is used as for increasing the powers then we normally call it as, the you know steam hammer we also call it as or are there are terms like you have board hammer.

So, they are you have the so, the ram will be there and then along the board the because of with the help of this you know pulleys or rolls. So, by the help of or use of the friction you take the board you know on the board you take the ram up and then further you allow the job to you know, allow this ram to fall down on the workpiece and do the job. So, that is your board hammer.

Now, so, in the board hammer. So, when we talk about this board hammer. So, you have upper die and the ram. So, you have you have a upper die suppose you have a die like this. And, this die will be attached with the ram and then so, this will be the ram. Now, in this case you have the; this is your die upper die and this is your ram. Now in this case they are raised by the friction rolls. So, griping the board. So, you will have a board and on this you have friction rolls.

So, on this they will be moving up and they will be so, this these roles will be moving in you know this direction. So, they will be taking this ram and the upper die together upward and then they will be coming and if suppose this being the job. So, you have a lower die and this basically will be attached to the lower you know die and that will be that will be at the bottom. So, this is your anvie and this is your lower die and this way this is your roll.

So, what happens since this board is used that is known as you know board hammer. Otherwise you know that this is the example of gravity drop hammer. So, while coming

down, they will come and with this all it is weight it will be falling up on it. So, in this case this foundation is to be strong and these hammers are known as a energy restricted machines, one of the other variety of this hammer is the you know counter blow hammer.

So, if you talk about these you know counter blow hammers. Now, we discussed that when in the case of these hammers they are applying this force their energy is transferred that. So, the foundation needs to be stronger. Now, to have you know less requirement of the foundation strength, what we do if we do the hamming operation in between. So, so, what we do is the top as well as the bottom die both are allowed to move in opposite direction, and they will be coming and hitting the specimen at some position which is in between.

So, this way the force or the energy with which they are you know the energy, which is transferred to this workpiece know this die is moving in which direction and die is moving in the direction. So, there this amount of this energy which is transferred otherwise to the foundation and foundation needs to be stronger, that requirement becomes less in the case of these counter blow hammers.

Now so, depending upon you know what type of energy, what amount of you know energy, which is supplied that you can easily find out by finding the mass of this ram and the die it is mass and with what velocity it is falling. So, that will be half mv square. And, then if you are using the power drop hammer and if you are using the presser and you know the area and also you know height.

So, that way you can also find that energy which is coming up and that way you can find the total energy, which you are able to achieve in the case of these hammer operations. Now, coming to the next type of equipment, that is your press.

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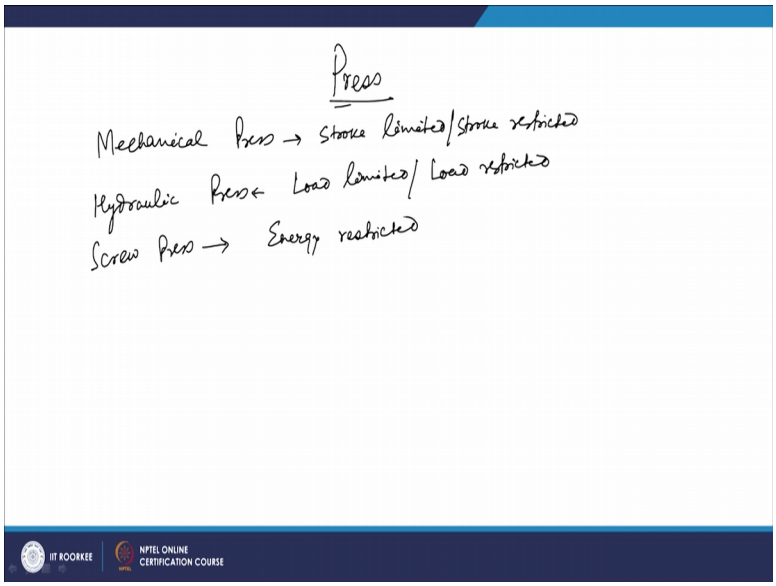

So, as we discussed that this presses also are of different type, you have mechanical press, you have hydraulic press and also you have screw press.

Now, as we discussed that the presses in the press you give a continuous quizzing type of action to deform the material. So, you apply this that load. So, so, hydraulic presses where you apply that load through the hydraulic load so, that is why they are known as the load limited or load restricted machines.

Now, again if you go to the mechanical type of press, now in this case you have the stroke. So, that stroke will be dependent, you have crank arrangement. And, depending upon the stroke position it will have you know the different we that you know load will be transmitted. So, depending upon the stroke position, that is why since that the deformation is limited upon the stroke positions. So, we call it as the stroke limited or stroke restituted stroke restricted machines. And, this hydraulic press will be load limited or load restricted machines. Similarly you have the screw press.

Now in the screw press what happens you have a flywheel attached and what it does is normally it will be taking the extra energy absorbed, and that energy extra energy will be used for doing the deformation so basically this screw press is the energy restricted machine.

So, normally you have these are the 3 different types of the presses, which are used in the case of the presses and one being that load limited hydraulic press, mechanical press, is said to be the you know a stroke limited and the screw press is said to be the energy restricted.

So, now when we talked about the hammers now, we discussed that in the case of hammers, if we talk about the total energy which is supplied you know to the blow in a power drop hammer.

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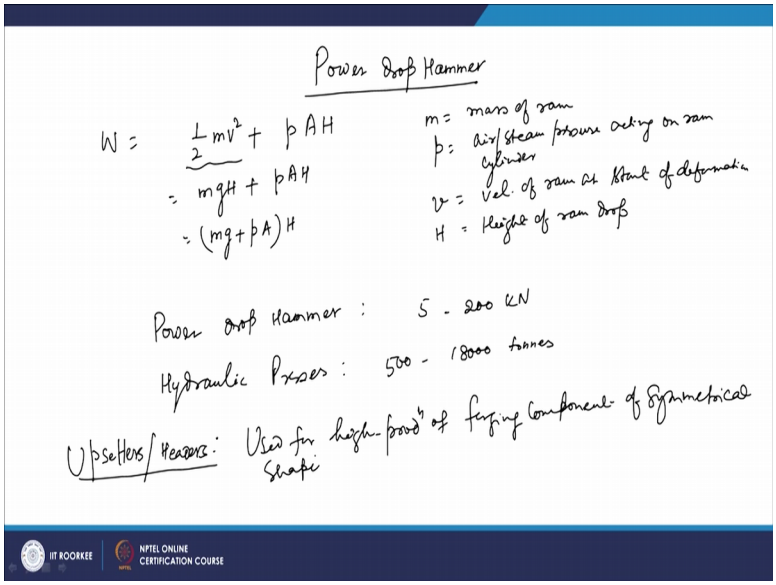

So, if you talk about a power drop hammer. So, in that case to the total energy supplied as we discussed that you have the mass of the ram, which is die also there and then that will be moving with certain velocity v.

So, you will have to (Refer Time: 19:48) so, that will be half mv square and then also you are you know using certain other source for increasing that you know energy. So, you have this p that is whichever pressure you are acting you are trying to act on the ram cylinder. So, that is your p and then you have the area over which this pressure will act and then you have the height of the ram drop.

So, based on that the total energy will be you know depending upon. So, you have m as the mass of ram. Similarly, you know you have p as the you know pressure or air or steam compressor acting on ram cylinder. So, during the (Refer Time: 20:54) stroke that

pressure which is acting on the ram that is your p, similarly v is the velocity of the ram at the start of deformation. So, at start of deformation then you have next remaining is H.

So, you will have this will be basically height of the ram drop. So, the ram is getting dropped from a certain height. And, it will be nothing but it will be mg. So, it will be falling over there. So, that will be nothing but the mg. So, it will be mg and then H and then you will have the p A H. So, that is your potential energy is that just says that, it is a kinetic energy and it is equivalent protons potential energy so, m g H and if you mg plus p A into H. So, depending upon the pressure you apply, you can find it is you know, you know total energy which is supplied on the workpiece.

Similarly, you can also calculate you know the total energy which is applied during the stroke of a press. And, that will be depending upon the moment of inertia of a flywheel and also the angular velocity. So, that that also has certain you know expressions by which you can calculate that energy which you apply. Now, talking about the you know machines configurations, when we talk about these forging hammers or the forging presses. So, normally these power drop hammers. So, they are they are ranging from 5 to 200 kilo newton.

So, that is the range for these power you know drop hammers and here their size is from 5 to 200 kilo newton. And, you know like a 13 kilo newton something like in this power hammer. It can produce a forging road in the axis of 600 tons. So, that is how the normally you calculate that what is the amount of energy, which is to be transferred so that they will give you certain idea about those things.

Similarly, when we talk about the presses so, the hydraulic presses when we talk about the hydraulic presses. Now, they are available in the ranges of suppose 500 to 18, 000 tons. So, even larger more than fifty thousand tons hydraulic presses are also built and they are used the hummer normally are cheaper than the presses, because in the hammer basically a hammer you know we prefer these press machines, because here there is squeezing and continuous type of force being applied.

So, we prefer normally this presses is normally for extrusion type of forging operation where you continuously squeeze and do the operations. So, there you go for this press machines, then you also have you know the forging machines that is known as upsetters or headers. So, among the other varieties of the machines you have upsetters or headers.

Now, these are basically the kind of mechanical you know presses, which are horizontal acting and they will come and they will do that upsetting operations.

So, they will be decreasing it is length and increasing it is diameter. So, that way they do the job. So, in such cases you have these machines are known as the upsetters or headers and you have they are used for the high production is used for high production forging. So, mass production of forging component of symmetrical shape are basically you know produced using this upsetters or headers. And, normally you have rivets or you know gear blanks they are made using this process. So, that is you use of these upsetters or headers another which we discussed earlier.

So, we have discussed about different types of forging machines and different types of press machines. Then another classification of machines is HERF machines; that is high energy rate forming machines.

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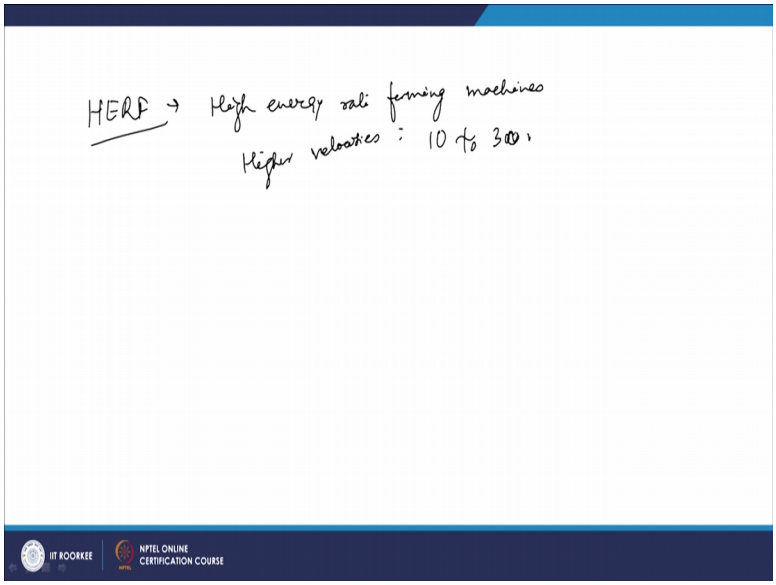

So, these HERF; HERF is high energy rate forming machines. Now, this is normally done in the case of incremental forging of such cases, where you have the velocity range quite high as compared to the normal velocity range, which is achieved in the case of either gravity drop hammer or the power drop hammer. So, in these cases the higher velocities are you know achieved and they are from 10 to 10 to 300 something like 30 10 to 30 meter per second, about 10 to 30 meter per second of the velocity is achieved and,

normally the processes that when you have to do the formation you know the formation in a localized position.

So, you will have you know sometimes example of orbital forging or incremental forging in that, the rate by which or velocity at which day the forming takes place at the localization is quite fast and that way the formation takes place. So, such are the examples of so, that are done by these machines known as high energy rate forming machines. So, depending upon the application, you go for the type of machines. So, they are certainly vast kinds of machines.

So, normally in a nutshell we need to know the different kinds of machines, where they are to be used depending upon the type of application or depending upon the type of geometry, which are we are going to produce, you have different types of machines, you have the use of either you know hammers or you have use of presses, you have the use of counterblow hammers, you have the use of different types of process like mechanical or you hydraulic or the screw presses, you may have the use of the counterblow hammers, whenever you have to reduce that vibration transmission to the you know foundation.

So, that way we have these different types of forgeable equipments which we must have the idea. So, that you whenever required you can design depending upon the load requirement or energy requirement you can design you can be quite versed with the specification of the machine, which has to be used for these typical applications.

Thank you very much.