Experimental Stress Analysis – An Overview
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Lecture – 4.5
Key technologies that have influenced Experimental Mechanics

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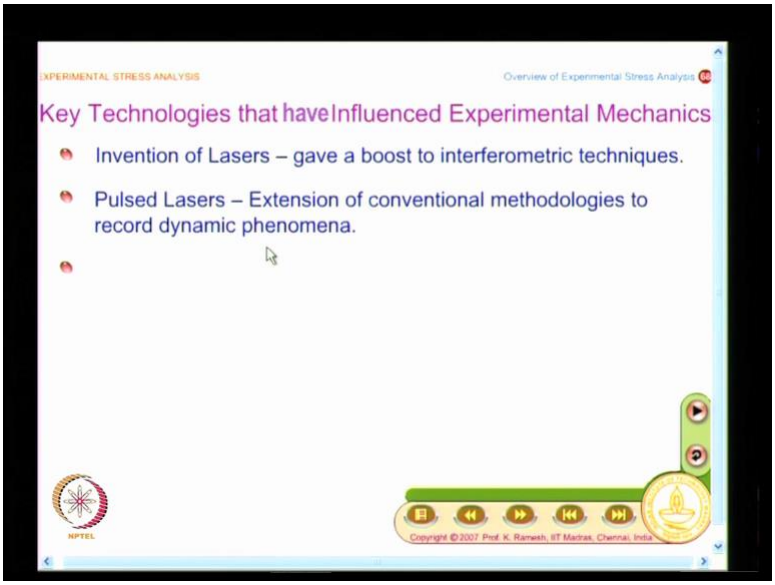

Now, lets us look at Key Technologies that have Influenced Experimental Mechanics. Obviously, invention of lasers gave a boost to interferometric techniques. I said when holography was invented Dennis Gabber had only mercury or clamp. So, he could not take the advantage of technology. The moment lasers came into picture, all our interferometric techniques have become refine we are lot more sensitive and you could go for long phase difference calculation. Once you have lasers you also had development of pulsed lasers.

So, you have intermittent illumination, you could extend conventional methodologies, to record dynamic phenomena, and dynamic phenomena recording, reveals lot of interesting information. See, if you go and have water that is getting boil. It looks as if it is random, it is not really random. You have bubbles formed at periodic intervals and

come out and then they burst and people do research on how this bubble formation so, on and so forth and recording dynamic phenomena like, you have a microscope which optically magnifies. You have a time magnification here. You are able to record at very minute intervals and see it as a slow motion film.

You understand the physics behind it better. You know stress ways in solids, where reveal beautifully by Photoelasticity. Until then people where not understanding what are stress waves. When you see the fringe pattern when you see the fringe patterns move that gives lot of understanding on the phenomena and you need if the process is very fast, then I need ultra fast recording. One of the issues in ultra fast recording is, I should have a light source, which is strong enough to illuminate because when I have a long exposure, I am not worried about the intensity of light.

Even a dim lid condition if I have long exposure I can record. When I want to record a dynamic phenomena, there has to be a perfect match between your amount of light available and the shortest time that you want to record. So, they go together and pulsed lasers are very intense, and you could achieve some of these advantages. So, what do you find here is pulsed lasers have helped in recording dynamic phenomena.

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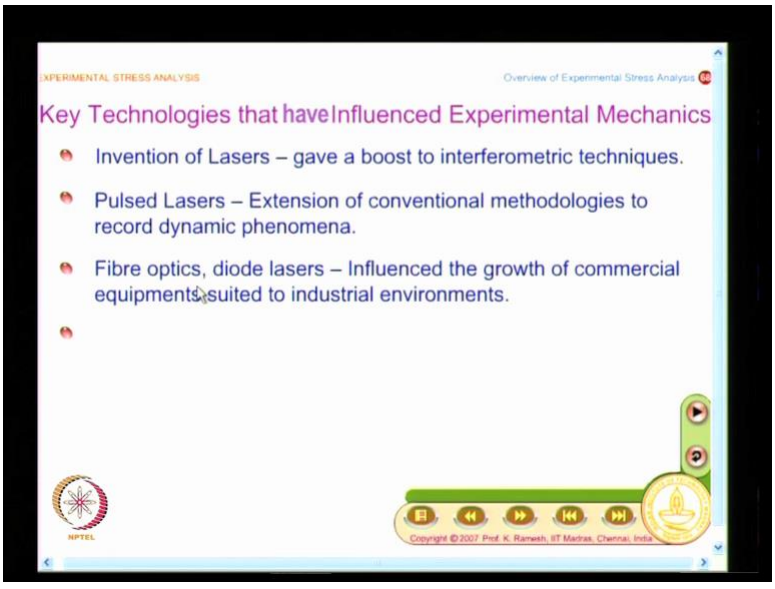

Then what you have? Right now you have very sleek equipment and fibre optics has done the trick. I can have a light source and take the light where you want through a fibre, and then go into your illumination. In hazardous environment, where I want to, where I cannot go near and do it, suppose I want to test a pressure vessel, I can go near the pressure vessel and test it. I have to stay away after barrier, and I want an illumination, I can have fibre optics to do that and you have plenty of laser printers around them all use diode lasers.

So, whatever the technological development, that influences the way that you do the experiments. So, what you find is, the availability of fibre optics and diode lasers has influence the growth of commercial equipments, suited to industrial environments. You want some kind of robustness and you would like to have and this is possible with such developments.

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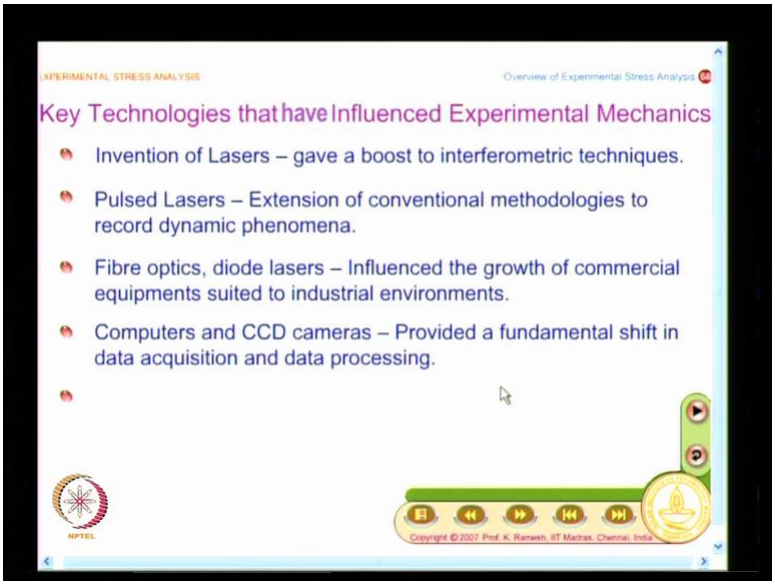

All the optical techniques, if you really look at the development of image processing. Earlier they had used a lathe bed on which they will put a photograph, and then you will on the tool post they will have optical sensor which will pick out the information and the whole thing will traverse and that is how they digitize. Digitization itself may take

several hours. Then you go to the computer, and do extraction of features, other things people have done.

Now, you have charge coupled device cameras, you instantly get the digitized information. So, all optical techniques now replace human eye. No one does in the field inspect in the component with the human eye, you have a electronic eye which records this information, then you process it. So, it has provided a fundamental shift because I can record intensity data. So, I can have new ways of data processing possible. This is the particular influence of technology, but for the technology you could not think in this direction at all and for all optical techniques people use phase shifting methods.

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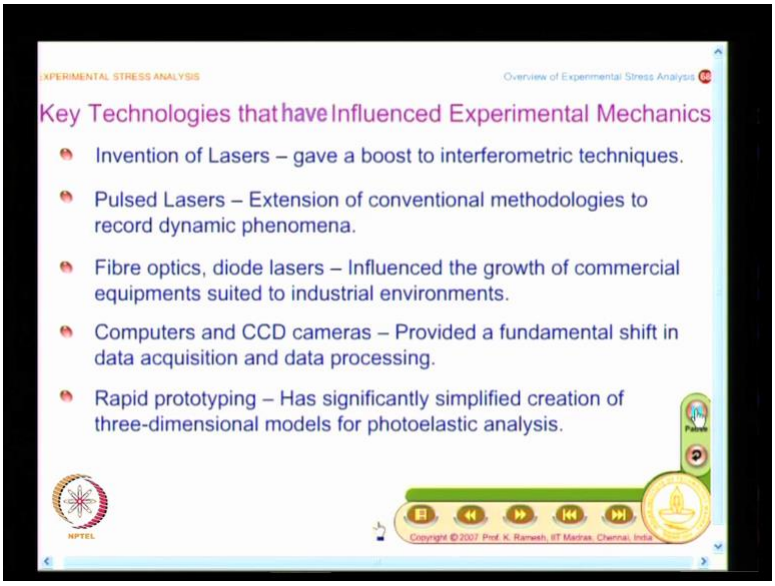

Parallelly, you also had development in manufacturing. You have what is known as rapid prototyping and this as significantly reduce the lead time in fabricating a prototype. And fortunately one or the rapid prototyping technology known as, stereolithography uses certain kind of resin, which are also photoelasticly sensitive.

And I had told you earlier in 1930's when people where devising, different components they were all gone through mandatory three dimensional photoelastic analysis. So, one of the challenge in photoelastic analysis was, fabricate a three dimensional model and now

with rapid prototyping, fabrication has become lot more simpler. Not only it is lot more simpler, I have a cad model to fabricate the prototype. The same cad model can be used for finite element analysis. The same cad model could also be used for photoelastic analysis because I fabricate the model, I do the slicing and then I am able to bridge numerical analysis and experimental analysis. That way I will have more confidence in solving complex problems.

What you find here is technology has a very important role to play and you have to absorb technology in that, experimental techniques will survive only when it is open to development of technology and observes those aspects. If you stay away from computer processing, no experimental technique is going to be useful.

So, in this class we looked at technologies have played a significant role and we are looked at how interferometric techniques got a boost from lasers.