

Development and Applications of Special Concretes
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Lecture-32
Closing the Course

Namaskar and welcome back to a series of lectures on development and applications of special concretes which was a course developed under the massive open online course initiative of the government of India that is MOOCS. And today we are closing the course with this very short lecture 32.

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The slide features the IIT Kanpur logo and department name at the top. Below, a blue box highlights 'Eight modules'. A list of eight modules follows. Handwritten red notes are present: 'Special Materials' and 'Process - GMA' are written vertically, and 'App - SCC/RC' is written horizontally. A small number '3' is in the bottom right corner of the slide content area.

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Eight modules

- Modules 1 and 2: Review of normal concrete
- Module 3 : Curing, cold and hot weather concrete, and importance of specifications
- Module 4 : Underwater concrete and roller compacted concrete
- Module 5 : Self compacting concrete
- Module 6 : Rheology and fibre reinforced concrete
- Module 7 : Mixing, shotcrete and high strength concrete
- Module 8 : Polymer concrete, improving cover concrete, compaction, precast concrete

Special Materials
Process - GMA
App - SCC/RC

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We did the material in this course over 8 weeks which was divided into 8 modules. To recapitulate modules 1 and 2 dealt with the review of normal concrete. Module 3, dealt with curing, cold and hot weather concrete and the importance of specifications. Module 4, we went through a discussion on underwater concrete and roller compacted concrete. In 5, we dealt with self compacting concrete, in 6 we learned about fiber reinforced concrete and had a treatment of rheology.

In module 7, we talked about some mixers, the different kinds of mixing processes, shotcrete and high strength concrete. And in this last 8th module we talked about polymer concrete, steps that can be taken to improve the cover concrete, a little bit about compaction and vibration of


concrete and a brief lecture on precast concrete. So, as far as special concrete is concerned, we covered it from the dimension of using special materials or materials which are not normal that is cement, water, sand and coarse aggregate.

We talked about fibres, we talked about polymers and we talked about mineral admixtures, chemical admixtures and so on. Then we talked about processes, and methods that are used, concretes like shotcrete come under that kind of a discussion. We talked about special environment concrete placed under a special environments like underwater, hot weather, cold weather.

Special properties, self compacting concrete for that matter has a special property of self compactability. High strength concrete has the property of strength higher than normal. So, basically, we said throughout that there is a normal range of variables and then there is a special part. And once any one or more of the different processes involved that is mixing, transportation, to placing, to curing any of these things becomes a little special.

All the other processes need to be appropriately redesigned or rethought of. So, that has been the central thought that is run through all these 8 modules. And that is why we spent module 1 and 2 reviewing or understanding of basic concrete or normal concrete where we talked about the properties of fresh concrete, the properties of hardened concrete, basic curing methods and so on and so forth.

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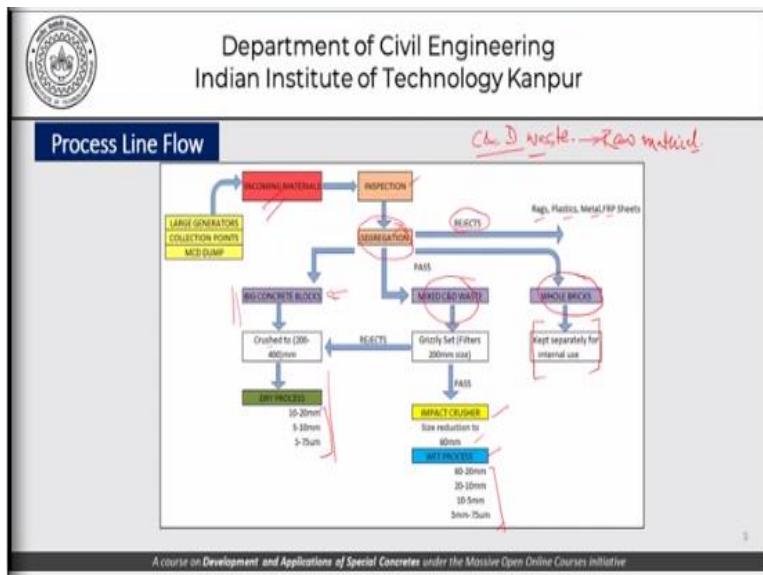

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Could not include a discussion on environmental impact of concrete construction.
 That would include topics such as using construction and demolition debris, assessment of life cycle cost, sustainable construction, green construction, rating systems.....

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One thing which I could not touch upon and I would have loved to do it perhaps but there was not time, was we could not include a discussion on environmental impact of concrete construction. That would have included topics, such as using construction and demolition debris, assessment of the life cycle cost, sustainable construction, green construction, rating systems for buildings, rating systems of construction, rating systems for concretes and so on. That is something which got missed out in this discussion that we had over the last 8 weeks.

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But I would like to just share with you a small flow chart here, which is from the processing of C and D waste, construction and demolition waste or debris. So, if you want to reprocess it and use the construction and demolition waste or reuse construction demolition waste as partial

replacement of virgin raw materials in our construction process. Then this flowchart tells us basically the kind of steps that are involved or that will be involved.

Once the raw material comes in, that is once the construction and demolition waste is received at the C and D processing facility, there is an initial inspection followed by segregation. Now the segregation is a very important exercise where some things which become a part of this C and D waste have to be simply rejected, we have to be taken out, that could include rugs, plastics, metals FRP sheets and so on, wood for that matter will be part of this.

That has to be removed whether it is done manually or we have different ways of doing it, if it can be done automatically things have to be rejected, they have to be removed. The second part of this segregation process is taking out big concrete blocks which can then be crushed to 20 centimeters to 40 centimeters kind of blocks and then using a dry process, crushed further to 10 to 20 mm, 5 to 10 mm, 5 mm to 75 micrometers and so on.

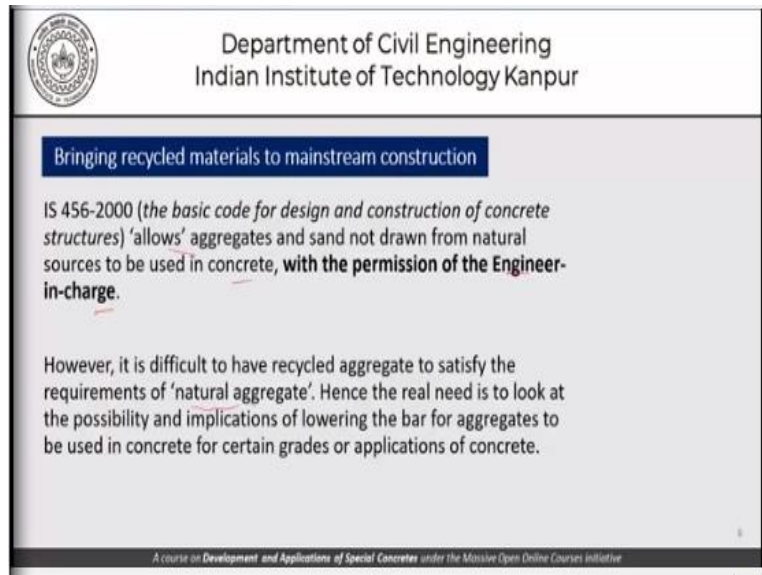
So, this is basically the dry process applied to large chunks of concrete. Now apart from these large chunks of concrete we will have a mixed C and D waste which has to be processed further. And they will be whole bricks which in Indian context is very important, because we use a lot of clay bricks in our construction process, and those clay bricks are definitely a part of the C and D waste.

So, as far as these whole bricks are concerned, they need to be kept separately for internal use that is these bricks can be used as it is in some kind of construction. Now coming to this mixed C and D waste, they pass through a filter and if it is something larger than 200 mm for example it goes back into this side here which is crushed. If it is less than 200 mm then you go to an impact crusher, reduce it to about 60 mm and then use a wet process again to create aggregates and sand kind of material out of the C and D waste that we have.

So, there are different ways of doing it, but this basically outlines the steps that are involved in recycling construction and demolition waste. In an effort to use at least some of that material to

conserve a part of the raw materials or the virgin raw materials, that will otherwise be used as a construction material in our endeavor to keep making or using more and more concrete.

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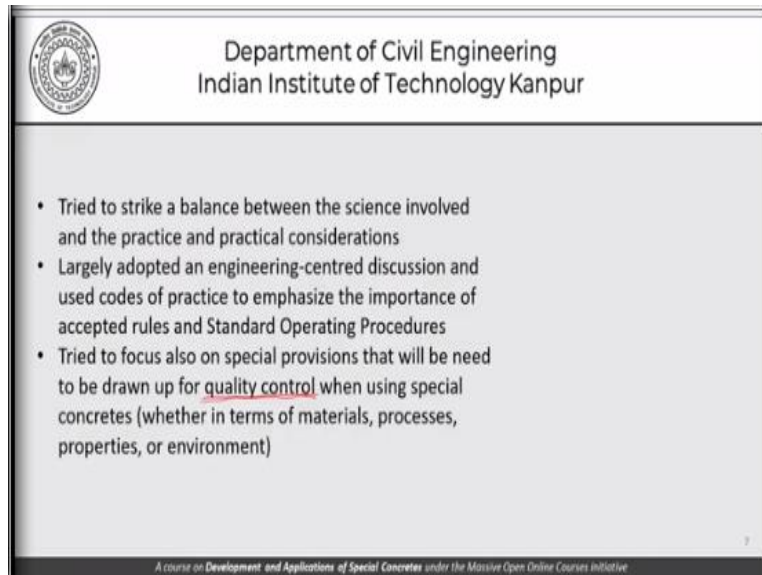
Bringing recycled materials to the mainstream construction that is something which we really need to think about, IS 456-2000 for example which is the basic code for design and construction of concrete structures. It allows us to use aggregates and sand not drawn from natural sources to be used in aggregate, but that is with the permission of the engineer in charge. So, what we really need is a sensitization of engineers in charges, the clients and the professionals.

To permit or encourage or accept the use of material made from C and D waste, which is basically going to come under this category that sand and aggregate not drawn from natural sources to be used in construction of concrete. It is difficult to have recycled aggregate to satisfy the requirements of natural aggregates. Hence the real need is to look for the possibility and implications of lowering the bar for aggregates to be used in concrete for at least certain grades of applications of concrete.

So, that requires a little bit of a mindset change, a thought process has to be initiated, awareness has to be created, I would have probably like to spend a little more time discussing the different issues involved here. And the state of the art as far as India is concerned and as far as Europe or

other parts of the world are concerned. But that is now something which I am leaving to you too, sensitize yourself, try to do some literature survey on your own and move forward.

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Having said that let me try to reiterate what the approach that I have adopted as far as this course is concerned. I have tried to strike a balance between the science involved in the different processes and the practice and practical considerations. To me concrete construction is a very practice-oriented field, but it has a very solid and important foundation in science. And therefore, practitioners need to understand the science and the scientist need to understand the practice of cement, concrete and cement concrete constructions.

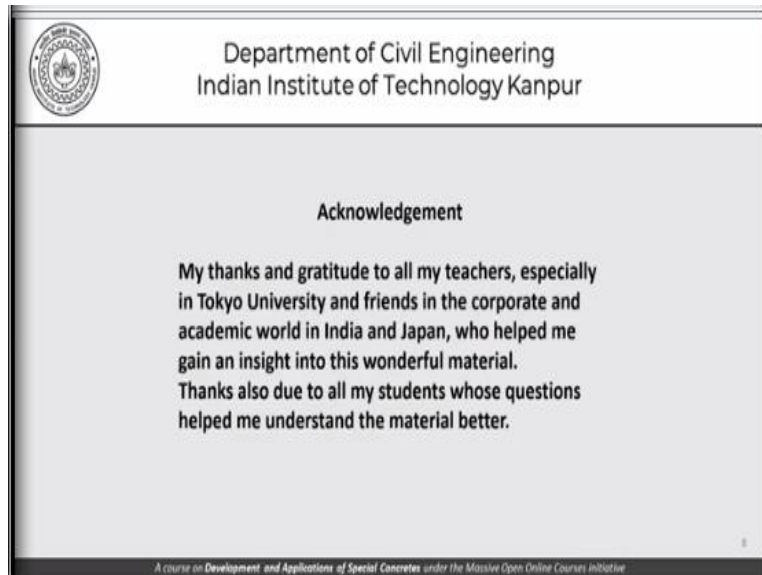
I have largely adopted an engineering centered discussion and not a science centered discussion to have tried to keep the principles of science also in the foreground and used the codes of practice to emphasize the importance of accepted rules and standard operating procedures. I have tried to focus on special provisions that will be needed to be drawn up for quality control when we are using special concretes whether it is in terms of materials, processes, properties or environment.

This has been our central theme, how will we do quality control when we are using fiber reinforced concrete or using shotcrete or underwater concrete or self-compacting concrete, roller compacted concrete? So, the special provisions that will have to be brought in and how the

existing provisions or normal provisions of provisions for normal concretes, how they need to be adapted?

That has something which has tried to emphasize throughout the course, you will recall our discussion that we had in terms of preparing panels for shotcrete in order to get samples which can be used, then for determination of compressive strength or collecting the samples of underwater concrete in a tank of water. So, these are the kind of special conditions that need to be incorporated in our testing mechanisms or testing systems. And one should not be afraid of creating new SOP's if the situation so demands.

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So, with this we come to an end of our discussion in this module and this course, and I would like to once again thank my teachers at Tokyo university and India and Japan, my friends in the corporate world, in the academic world who have helped me understand and gain insight into this wonderful material. And I would like to thank the students at IIT-Kanpur for all their questions which has help me understand the material better, explain it possibly better.

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Acknowledgement

My thanks and gratitude to Dr Prasanna Kumar Behera and Jineesh Shaj, who helped me in so many different ways all through the course. I take this opportunity to wish them well in their endeavours.
Thanks to all the registrants in the course and their support!

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And for this course I would like to thank and express my gratitude to Dr. Prasanna Kumar Behera and Mr. Jineesh Shaj who helped me in so many ways all through the course. I take this opportunity to wish them well in their endeavours and finally I must also thank all of you for having gone through these lectures. I hope that you found them interesting and it has helped you gain some insight into this construction material.

I have enjoyed being with you in this course and I hope you have enjoyed the course too, thank you once again and I look forward to meeting you again in another course sometime and I wish you all the best in your endeavours, thank you.