निर्माण प्रबंधन (Construction Management) के सिद्धांत

[Nirman prabandhan (Construction Management) ke Siddhant]

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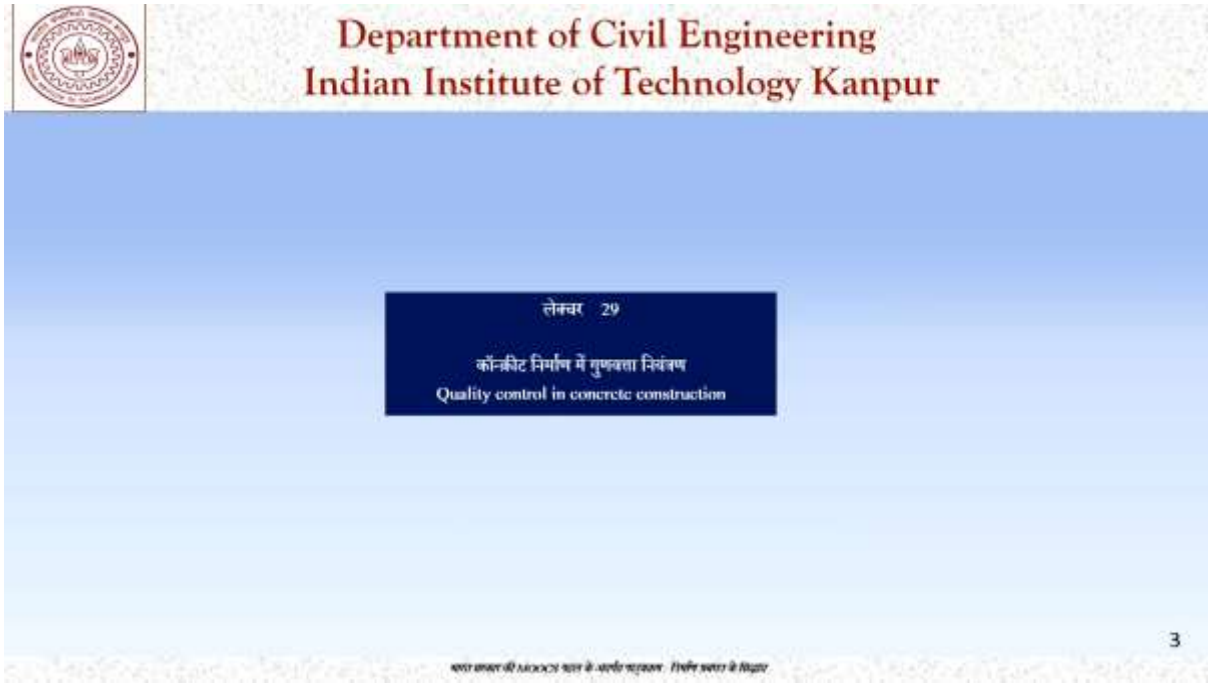
Lecture – 29

Nirmaan mein Gunavatta Niyantran

(Quality Control in Concrete Construction)

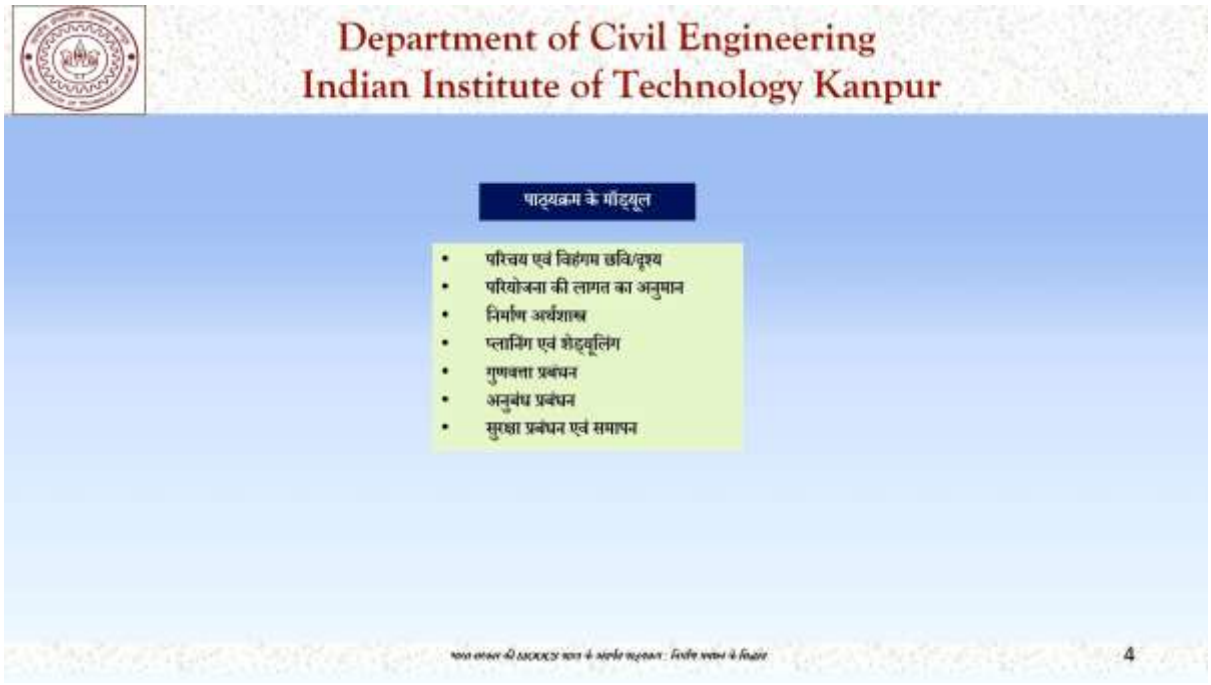
Namaskaar aur ek baar phir se svaagat hai aap sabhee ka Bhaarat sarakaar kee MOOCS pahal ke antargat paathyakram Nirmaan Prabandhan ke Siddhaant (Principal of Construction Management).

(Reference Time 00:24)



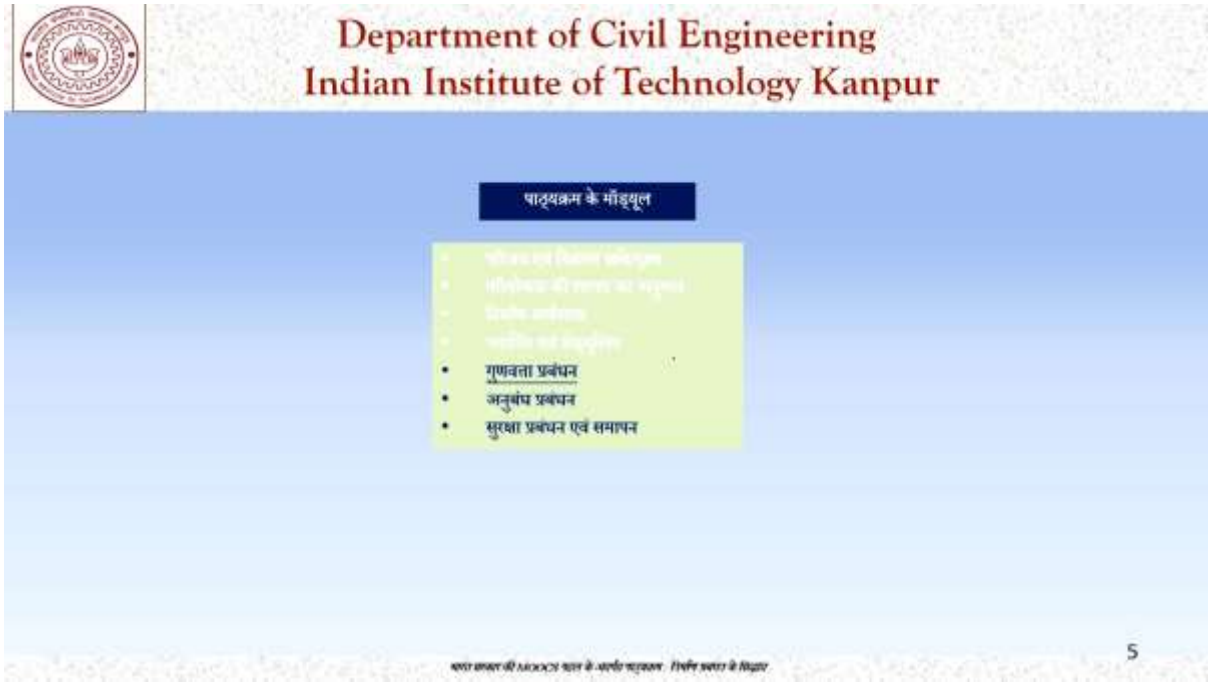
Aur ham log lecture 29 par hain aur hamaaree aaj kee charcha concrete Nirmaan mein Gunavatta Niyantran (Quality Control in Concrete Construction) par kendrit hogee.

(Reference Time 00:36)



Yahaan par paathyakram ke module dikhae gae hain.

(Reference Time 00:39)



Aur hamaaree charcha is module mein gunavatta par kendrit hai.

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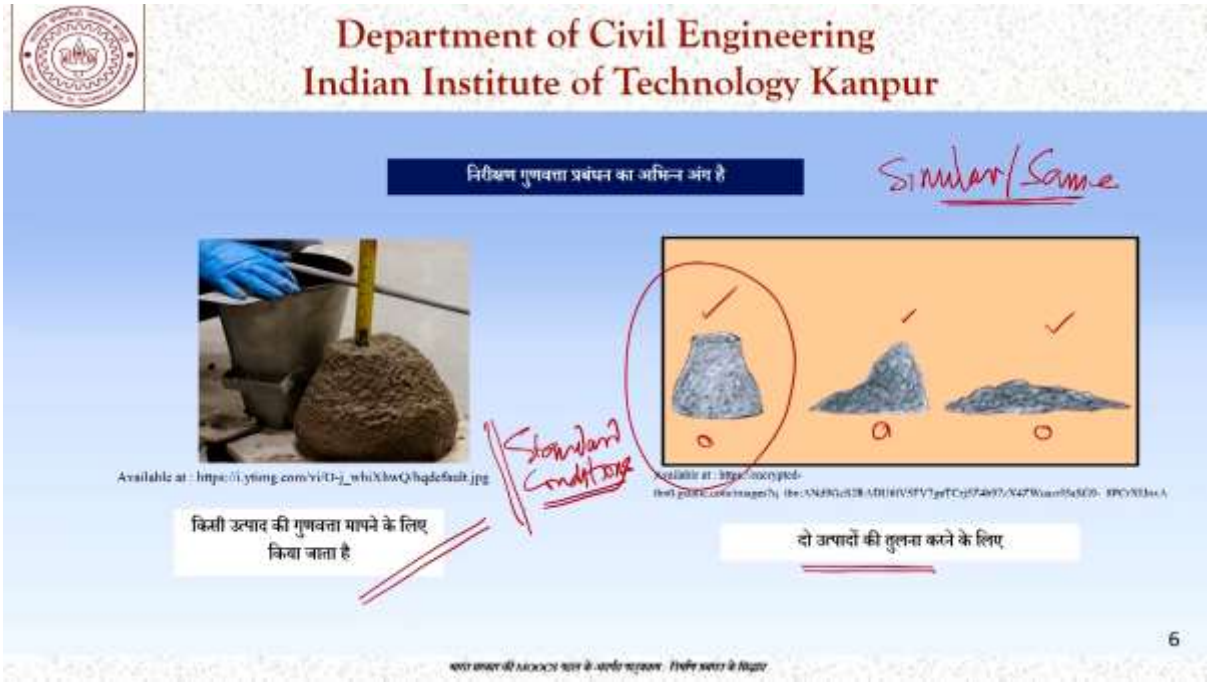
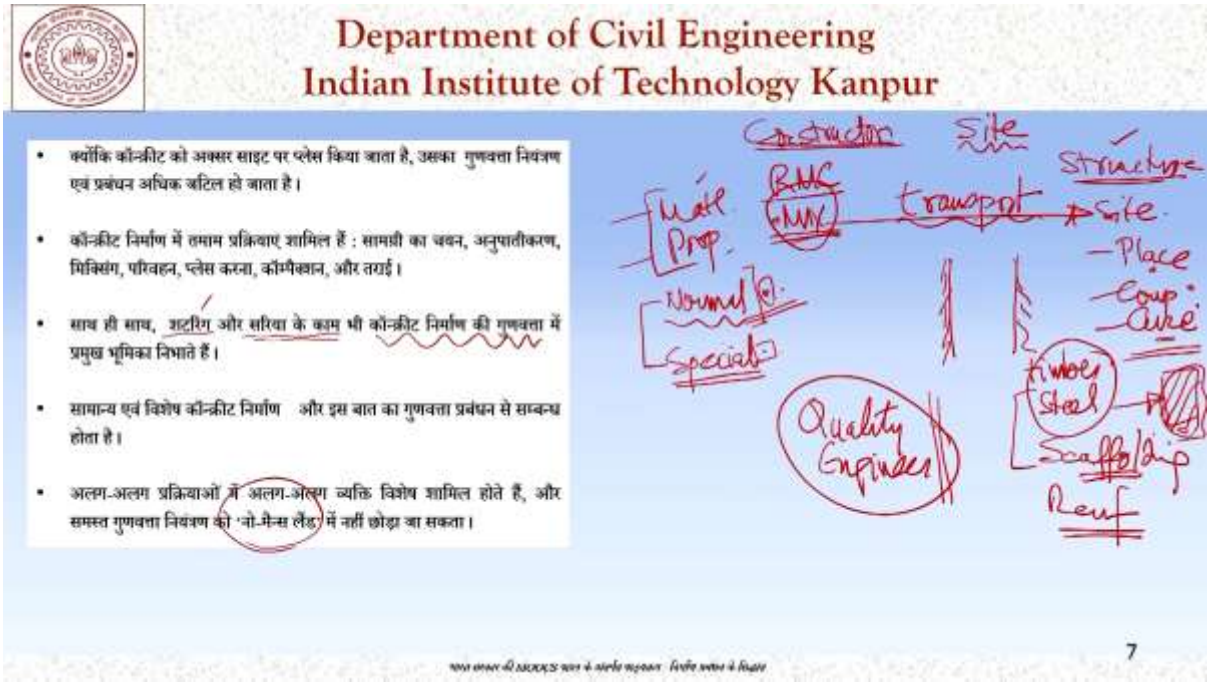


Gunavatta prabandhan aur concrete mein gunavatta par charcha karane se pahale ek baat main aapase share karana chaahata hoon vo hai ki nireekshan (inspection) gunavatta prabandhan ka ek abhinn ang hota hai. Nireekshan ya testing inspection karate samay do baaton ka dhyaan rakhana chaahie. Ek to yah ki kisee utpaad kee gunavatta ko maapane ke lie kiya jae. Yahaan par slump concrete kee workability ka test hai aur ham test kar rahe hain workability ka. Ek objective to hai slump pata karana ki slump kitana hai aur doosara objective hota hai do utpaadon kee tulana karane ke lie. Jab ham is test ko gunavatta maapane ke lie karate hain to yah dhyaan mein rakhana chaahie ki vah test stunderd conditions mein kiya jae, jo ki maanakon mein dee huee hai. Jab ham do utpaadon kee tulana karana chaahate hain tab vah test ham similer ya same conditions mein kar sakate hain, chaahe vah stunderd ho ya na ho kyonki un conditions ka prabhaav is utpaad par ya is utpaad par ya is utpaad par ek saamaan sa padata hai. To agar hamen is concrete ko aur is concrete ko aur is concrete ko compare hai ki inaka slump kam hai, jyaada hai, slump ka behavior hai to ham kisee bhee condition mein slump test kar sakate hain lekin agar hamen vaastav mein maatr is concrete ka slump pata karana hai tab hamen stunderd conditions mein hee test karana chaahie.

(Reference Time 02:27)

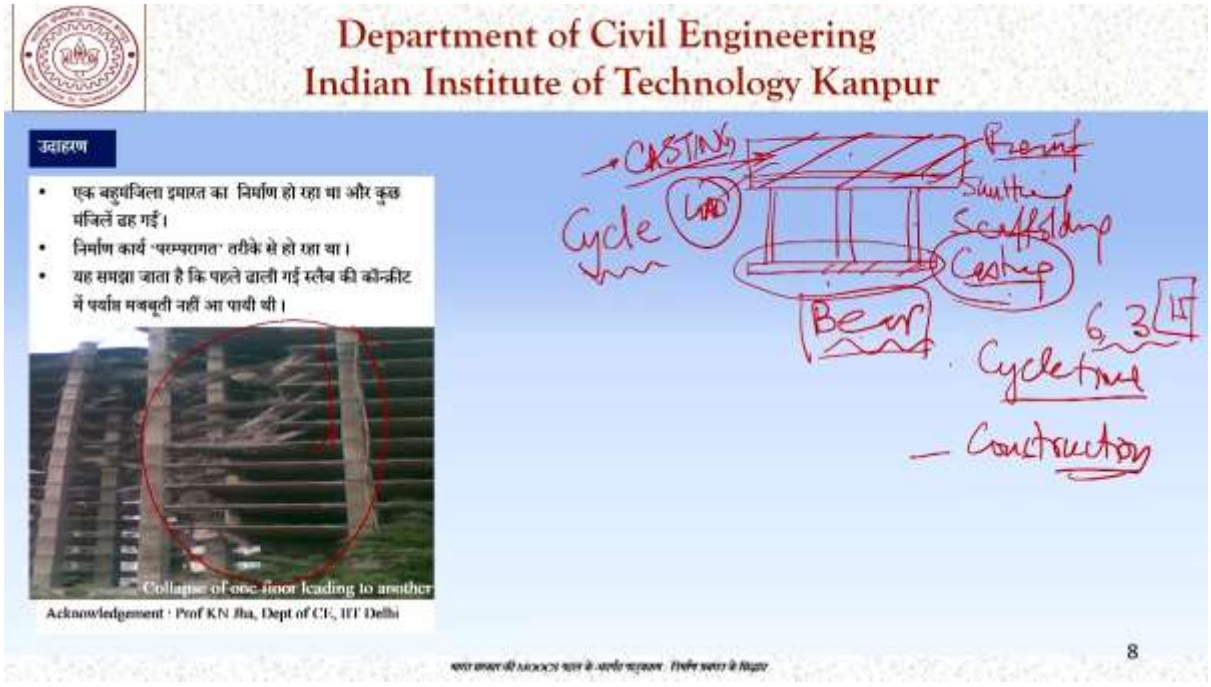


To lie aage badhate hain aur concrete se sambandhit gunavatta niyantran par charcha karate hain. Site par place kiya jaata hai usaka gunavatta niyantran evan prabandhan adhik jatil ho jaata hai. Yah ham lagaataar kahate aae hain ki construction industry (nirmaan udyog) mein bahut saara kaam site par kiya jaata hai aur isalie jo siddhaant factory mein utpaadon par laagoo hote hain vah hamaare lie site par un products ko produce karate samay laagoo nahin ho paate hain. Is baat ko dhyaan mein rakhana hota hai aur concrete mein yah vishesh roop se saty hai kyonki vahaan par gunavatta niyantran kar paana bahut hee jatil hota hai. Concrete nirmaan mein tamaam prakriyaen shaamil hotee hain. Saamagree ka chayan, anupaateekaran, mixing, parivahan, place karana, compaction aur taraee. To jab ham concrete ka koee structure banaate hain to ham concrete ready mix concrete plant mein mix karate hain aur usako site par lekar aate hain. Site par ham usako place karate hain, compact karate hain aur antatah cure karate hain. Mix karane se pahale plant mein ham material selection karate hain aur usako ek nishchit anupaat (proportion) mein mix karate hain aur yahaan se lekar yahaan tak ham usako transport karate hain. To yah vibhinn prakriyaen hain jo ki hamako antatah ek concrete structures banaane ke lie karanee hotee hai.

Ab concrete structure kee jo gunavatta hai vah in sabhee baaton par nirbhar karatee hai hamane kaun sa padaarth liya, kis anupaat mein usako mix kiya, mixing kis prakaar se kee, kis prakaar se ham transport karake le gae aur hamane usakee placing kaise kee, compaction kaise kiya aur cure kaise kiya? In sabhee baaton ka dhyaan hamen rakhana chaahie. Is course mein ham apanee charcha nahin karenge lekin jab ham normal concrete construction ya paramparaagat construction, saamaany construction kee baat karate hain to usake vipareet ham baat karate hain special concrete kee, special construction kee. To special concrete aur special construction mein gunavatta niyantran aur bhee mushkil ho jaata hai usake bhee kuchh udaaharan ham aaj aapase discuss karenge lekin moolat: hamaaree charcha normal concrete normal, construction method ke aadhaar par hogee aur normal conditions mein gunavatta niyantran ko samajhana special conditions mein usako implement karane ke lie bahut hee aavashyak hai. Saath hee saath jab hamaare structure kee baat hotee hai na sirph concrete balki shuttering evan sariya ke kaam ka bhee concrete nirmaan kee gunavatta par bahut adhik asar padata hai. Shuttering kya hotee hai? Concrete ko support karane ke lie

yahaan par jo wooden structure ya timber ka structure ya steel plate ka structure lagaaya jaata hai usako shuttering kahate hain. Shuttering ko support karane ke lie ham scaffolding shabd ka istemaal karate hain aur yah donon bhee concrete ka structure achchha bane isake lie bahut hee anivaary hai. Saath hee saath sariya ka kaam bhee hota hai, reinforced concrete mein bina sariya ke kaam nahin ho sakata hai reinforcement hee sariya hai. To sariya ka kaam agar hamaara theek se nahin hua hai to concrete kee gunavatta par pratikool prabhaav padega. In sabhee baaton par ham aapake saath aaj charcha karenge. Saamaany evan vishesh concrete nirmaan abhee hamane charcha kee is baat ka gunavatta prabandhan se bahut hee ghanisht sambandh hota hai. Alag-alag prakriyaon mein alag-alag vyakti vishesh ya institutions shaamil hote hain aur samast gunavatta niyantran ek samagr tareeke se comprehensive tareeke se overall tareeke se yah hamesha sunishchit kar lena chaahie kee gunavatta ek no-man's-land jaisee jagah par na pahunch jae jahaan par ki yah na samajh mein aae kee gunavatta aakhir kisako sunishchit karanee thee, kya jisane material supply usako gunavatta sunishchit karanee thee, proportion jisane mix kiya usako sunishchit karanee thee, jo transport karake le gaya usako sunishchit karanee thee ya ja isane curing kee kyonki har vyakti alag-alag kaam kar raha hai. Ek quality engineer ka yah daayitv banata hai ki vah in sabhee baaton ko achchhee tarah se samajhe aur antatah ya sunishchit kare ki jo concrete ka structure bana hai vah hamaare maanakon ke anuroop hai. To lie yah baat ham ek udaaharan ke maadhyam se samajhane kee koshish karate hain.

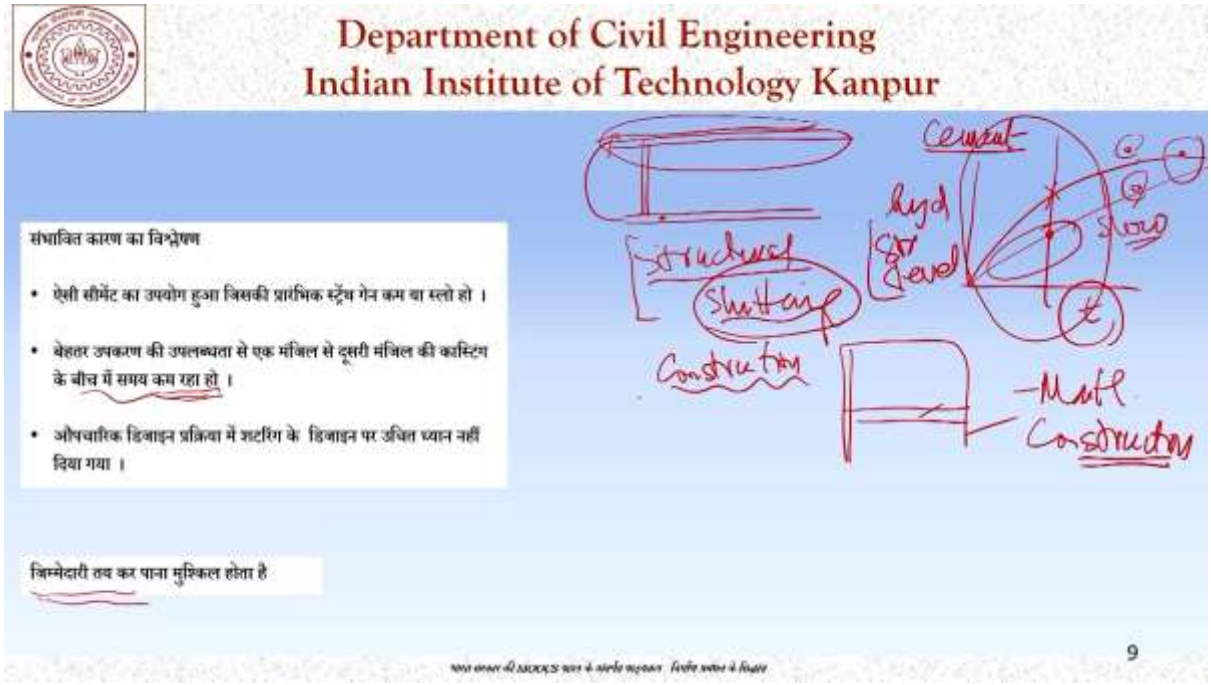
(Reference Time 07:38)



Yah chitr hai ek nirmaanaadheen multi-story building ka. Ek bahumanjalee imaarat ka nirmaan ho raha tha aur kuchh manjilon kee slab dhah gaee. Nirmaan kaary paramparaagat tareeke se traditional tareeke se ho raha tha. Yah traditional tareeka kya hai? Ki ek slab kee dhalaee kee jaatee hai usake kuchh dinon baad is slab ko base maanate hue isake oopar scaffolding khadee kee jaatee hain aur yah shuttering plate lagaee jaatee hai aur phir yahaan par sariya ka kaam hota hai reinforcement. Sambhav hai ki reinforcement ka kuchh kaam baahar kiya jae aur phir vah sariya laakar yahaan rakhee jae aur usake baad ham is slab kee casting karate hain arthaat is slab kee casting se lekar is slab kee casting tak ek cycle time aa jaata hai ek nyoonatam samay sa aa jaata hai ki ham yahaan par casting karane se pahale

hamen 6 din chaahiye ya 3 din chaahiye ya hamen 15 din kee aavashyakata hai yah sab nirbhar karega ham kis prakaar se is nirmaan ko kar rahe hain. Ab is case mein yah samajha jaata hai ki pahalee dhalaee ke baad slab kee concrete mein paryaapt majabootee nahin aaee aur yah slab cast kar dee gaee, isase kya hua? Ki yah jo load tha isaka jo vajan tha vah is slab par to aana hee tha agar isake beech mein ye jo cycle time tha agar yah paryaapt hota to yahaan par itanee strength aa jaatee itanee kshamata hotee ki yahaan se aane vaale construction load ko yah slab vahan kar letee lekin is slab mein vah oopar se aane vaale construction load ko vahan karane kee kshamata nahin thee, ab yah kaee kaaranon se ho sakata hai.

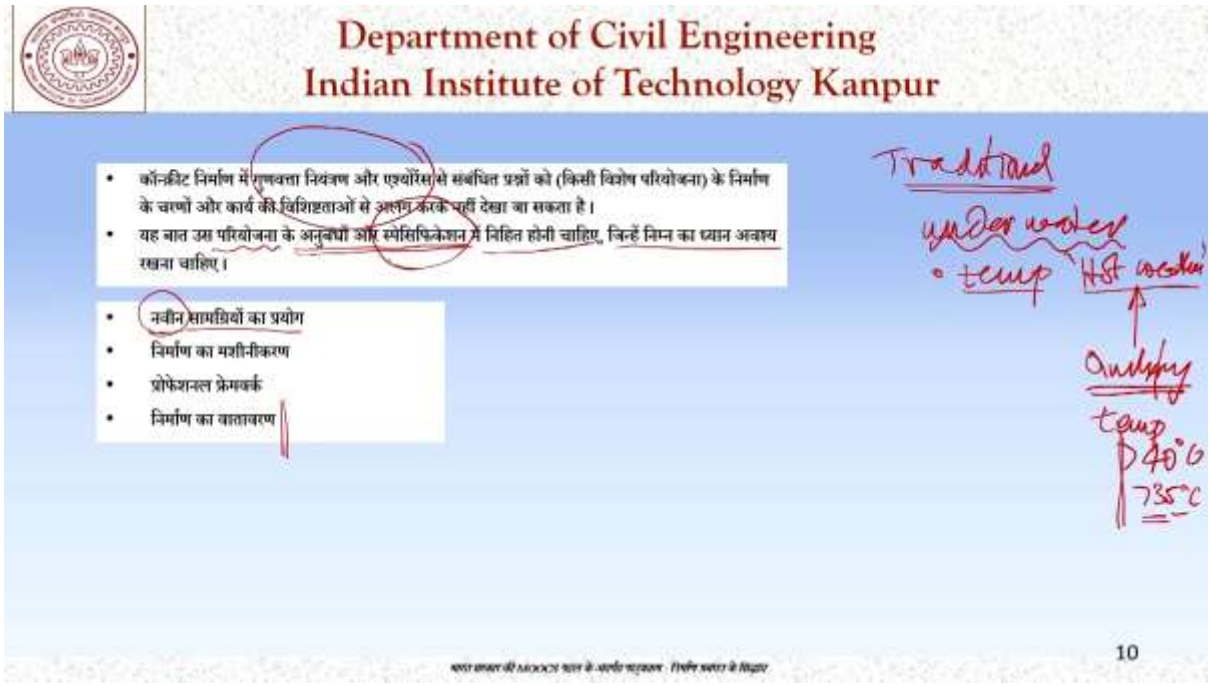
(Reference Time 09:52)



Isaka agar ham vishleshan karate hain to ham kah sakate hain. Yah ho sakata hai ki aisee cement ka upayog hua jisakee praarambhik strength gain kam ho ya slow ho. Cement kaee prakaar kee hotee hai usaka ek chemical composition hota hai aur usake aadhaar par hee cement mein jo hydration hota hai jo ki usake anusaar hee jo hydration ya strength development hota hai is strength ka vikaas hota hai samay ke saath, vah nirbhar karata hai. Kuchh cements mein strength development shuroo mein slow hota hai. Ant mein ho sakata hai ki vah ek hee strength tak pahunch jae. Agar nirmaan kaary mein is tareeke kee cement kee bajaay is tareeke kee cement ka prayog kiya gaya aur cycle time kam ho gaya to agar ham is tareeke kee strength kee apeksha karate hain hamen ho sakata hai itanee hee strength milee isase hamaaree slab kee kshamata kam ho jaegee, yah ek conjecture hai yah ho sakata hai aisa hua ho. Saath hee saath behatar upakaranon kee upalabdhata ke kaaran ek manjil se doosaree manjil kee casting ke beech mein samay kam raha ho jaisa ki bhee hamane baat kee. Yahaan kee casting hone ke baad yahaan kee casting karane ke lie hamen yah scaffolding lagaanee hogee, shuttering lagaanee hogee, sariya ka kaam karana hoga ityaadi. Agar hamaare paas upakaran behatar hai manpower adhik ho gaee to yahaan se yahaan tak jaane ke lie cycle time kam kiya ja sakata hai aur ek constructor ya thekedaar (contractor) is baat ko karane mein nahin hichakichaayega. Agar yah project jaldee khatm kiya ja sake to usake lie phaayada hee hai isalie vo to cycle time kaam karana chaahega lekin cycle time kam karane ke saath yah dhyaan mein rakhana hoga ki hamaara strength development ityaadi sunishchit

kiya gaya ya nahin. Phir kya ho sakata hai? Aupachaarik design prakriya mein shuttering ke design par uchit dhyaan nahin diya gaya, jab ham structural design karate hain tab ham shuttering ka design nahin karate. Ham maatr aarasee frame ka design karate hain ki ye columns hain, ye beem hain isake beech mein kuchh slabs hain un par jo dead load aaega, live load aaega, quick load aaega unako vahan karane kee kshamata in columns mein, slabs mein, beams mein honee chaahie. Banaate samay nirmaanaadheen samay mein jab shuttering lagee ho live load poora na ho ityaadi us samay construction loads ke aadhaar par design aksar nahin kiya jaata hai. To ek overall gunavatta sunishchit karane ke lie yah sabhee baaten hamen dhyaan mein rakhanee hogee chaahe vah material se related ho, chaahe vah construction sequence se related hon to ab yah kahana ki construction sequence site par chhod diya jaega yah baat theek nahin hai yah baat hamane jab welding kee ham charcha kar rahe the tab bhee kee thee ki drawings jo ki ek designer banata hai usamen yathaasambhav guidance honee chaahie taaki ek sabjective decision jo kee ek vyakti ke anusaar badal jaata hai vah usakee gunjaish kam se kam ho. Agar hamaara construction sequence, shuttering ka design yah sab ek central procedure ke antargat ho raha hai tab ham gunavatta sunishchit karane mein adhik saksham honge. Ab yah to aap samajh hee gae honge ki itanee complex situation mein yah tay kar paana kee aakhirakaar jimmedaaree kisakee thee yah bahut mushkil ho jaata hai. Isalie yah bahut hee aavashyak hai ki har prakriya se jude log kam se kam apanee prakriya ko bhalee-bhaanti samajhen aur yadi ho sake to usase judee huee prakriyaon ke baare mein bhee achchha khaasa gyaan ho taaki vo total product ek achchha product ban sake.

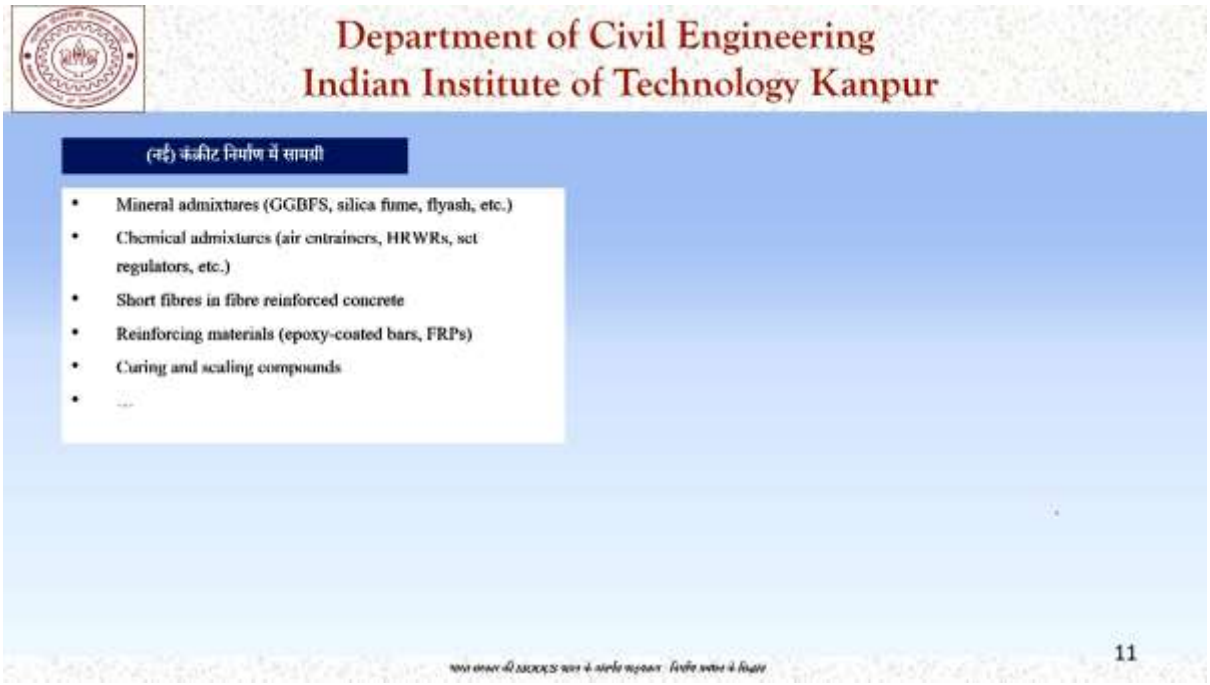
(Reference Time 14:12)



To aaiye aage badhate hain concrete nirmaan mein gunavatta niyantran aur assurance quality control and assurance sambandhit prashnon ko kisee vishesh pariyojana ke nirmaan ke charanon aur kaary kee vishishtataon se alag karake nahin dekha ja sakata hai. Har project kee apanee visheshataen hotee hai chaahe vah soil kee conditions ho, chaahe vah weather kee conditions ho, chaahe vah vahaan ka material ho ityaadi. To in sabhee baaton ko dhyaan mein rakhate hue ya aavashyak hai ki jo anubandh ya specification likhe jaen vah us pariyojana ke lie hee hote hain aur is baat ko dhyaan mein rakhen ki har pariyojana kee quality control aur

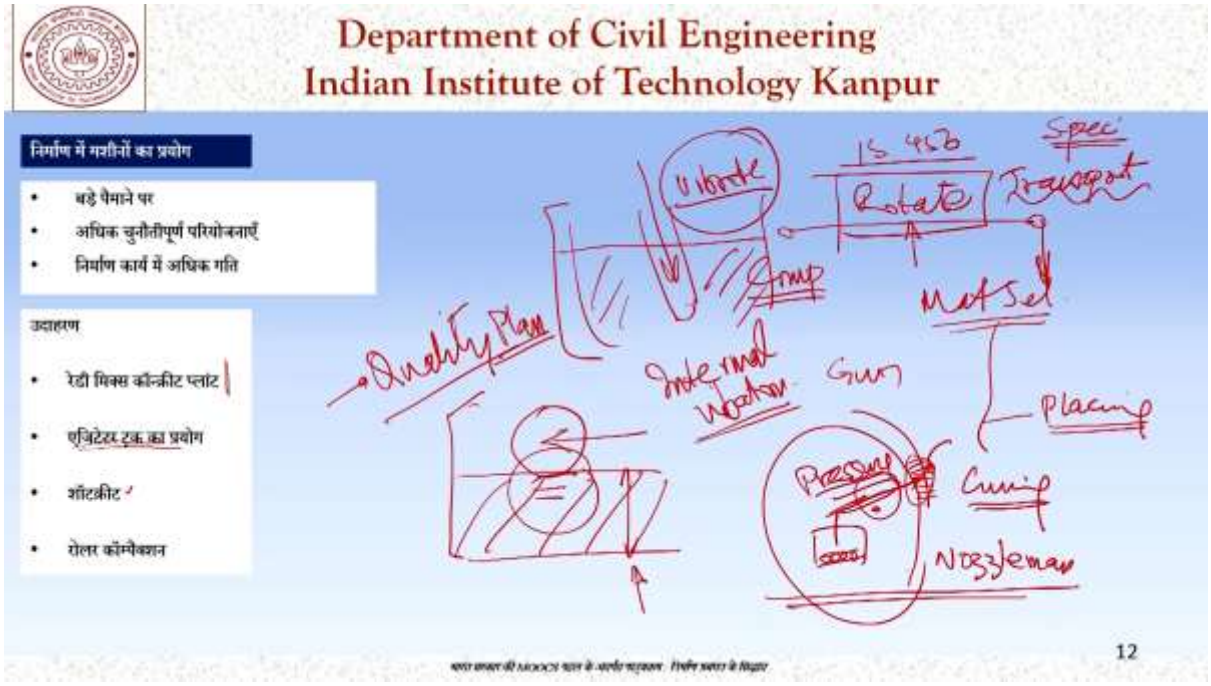
quality assurance plan alag hona chaahie aur usake aadhaar par hee hamen aage badhana chaahie aur isalie specifications aur anubandh ye dhyaan mein rakhen ki kya naveen saamagriyon ka prayog is pariyojana mein kiya jaega? Ab kaun see saamagree naveen hai? Isake lie yah aavashyak hai ki ham samajhen ki hamaaree traditional saamagree kaun see hai, use traditional saamagree ke lie koee vishesh ullekh karane kee aavashyakata nahin hai lekin agar koee alag se saamagree us pariyojana mein use ho rahee hai (prayog mein aa rahee hai) to hamaare specifications ko vah dhyaan mein rakhate hue usakee quality ke baare mein charcha karanee chaahie. Nirmaan ka masheeneekaran kitana ho raha hai, kis prakaar kee masheen prayog mein laee jaegee, professional framework kya hai, thekedaar ya contractor kee kya responsibility hai, design kisane kiya hai ityaadi aur nirmaan ka vaataavaran kya hai, tamaam technological vikaas ke chalate ham bahut hee chunauteepoorn vaataavaran mein concrete nirmaan karane mein saksham hain. Ham underavaatar (paanee) ke neeche bahut saara nirmaan karate hain. Ham kabhee-kabhee bahut hee adhik taapamaan jisako ki ham kahate hain hot weather, garmee ke maahaul mein concrete ka construction hamen karana padata hai us samay hot weather concrete se sambandhit ya usase judee huee jo precautions hain vah hamen lene chaahie isake lie hee aavashyak hai ki ham yah paribhaashit karen ki hot weather kab hoga ya hot weather ham kisako maanenge? Isake lie hamen quantify karana hoga kee hot weather arthaat agar vaataavaran ka temperature 40 degree se jyaada hai ya 35 degree se jyaada hai kyonki in sab baaton ka ek financial implication hoga. Agar temperature hot weather kee range mein aata hai to ham kuchh precautions likhenge un precautions ko observe karane ke lie kuchh cost aaegee jo ki ho sakata hai ki thekedaar bachana chaahe. Ho sakata hai thekedaar yah kahe ki nahin is temperature par to saamaany construction ho sakata hai. Isalie yah aavashyak hai ki specifications jo rules hain vah bahut hee clearly likhen aur is baat se quality control engineer ka jeevan bahut hee saral ho jaata hai vah yah kah sakata hai ki anubandh mein 35 degree se adhik temperature par yah precautions lene ka praavadhaan hai isalie inako to lena hee hoga lekin agar vah guidance vahaan par nahin hai to vah quality control engineer ke vivek par aa jaatee hai aur jaisa ki hamane pahale bhee charcha kee thee vivek par koee cheej chhod dena yathaasambhav avoid karana chaahie usase bachaana chaahie.

(Reference Time 17:55)



Jahaan tak naee saamagree ka savaal hai mineral admixtures, chaahe wha slag, silica fume, fly ash ho in sabako ek tareeke se new material kaha ja sakata hai. Yah material ho sakata hai cement mein milakar aaen to hamaaree cement ek special cement ho jaatee hai. Poslonic Portland cement jisako ki PPC kahate hain yah ek tareeke se naya material hai kintu ab kaee varshon se yah itana adhik upayog mein aaee hai ki shaayad ham isako saamaany padaarth bhee maan sakate hain. Chemical admixture mein bhee vahee baat hai ki ab hamaare paas concrete kee properties ko apanee ichchhaanusaar mode dene ke lie bahut saare chemicals upalabdh hain air entrainers hain, water reducers hain jo ki high range hai, normal range hain, set regulators hain jisase ki ham concrete mein cement kee setting ko regulate kar sakate hain in sab ka upayog karana hota hai jab ek vishesh vaataavaran mein vishesh sthiti mein hamen concreting karanee hai. Udaaharan ke lie yadi bahut garmee mein construction karana hai to normal cement jaldee set kar jaegee usamen agar ham set regulators use karate hain ek retarder use karate hain to ham usamen setting time badha sakate hain to is tareeke kee jo chhotee-chhotee baaten hain usee se ham saamaany construction aur vishesh construction ko alag-alag tareeke se dekh sakate hain. Yah baat samajh hee gae honge ki jab ham saamaany construction se vishesh construction kee or badhate hain to gunavatta aur usako sunishchit karane ke lie pareekshan maanak yah sab bhee thode-thode avashy badal jaenge. Agar ham concrete mein fibers ka prayog karate hain, short fiber reinforced concrete banaate hain, tunnels mein, kabhee-kabhee roads mein, phir hamaare lie in fibers ka upayog bhee gunavatta ke lie ek chunautee pesh karata hai. Reinforcing material jo normal sariya hai vah theek hai lekin kabhee-kabhee hamen epoxy coated bars ka prayog karate hain, fiber reinforce plastic ka prayog karate hain to hamaare lie concrete mein kam balki concrete structure kee gunavatta sunishchit karate samay in baaton ka dhyaan avashy rakhana hoga. Curing and sealing compound yah bhee hamaare lie gunavatta mein chunautee ban jaate hain yah baat nahin ki ham usako handle nahin kar sakate lekin usake lie additional specifications, additional test methods, additional inspection kee aavashyakata hotee hai jisake ki financial implication hote hain isalie unako pahale specification mein likhana chaahie taaki thekedaar yah jo contractor hain vah unako dhyaan mein rakhate hue hee cast quote karen usako set karen.

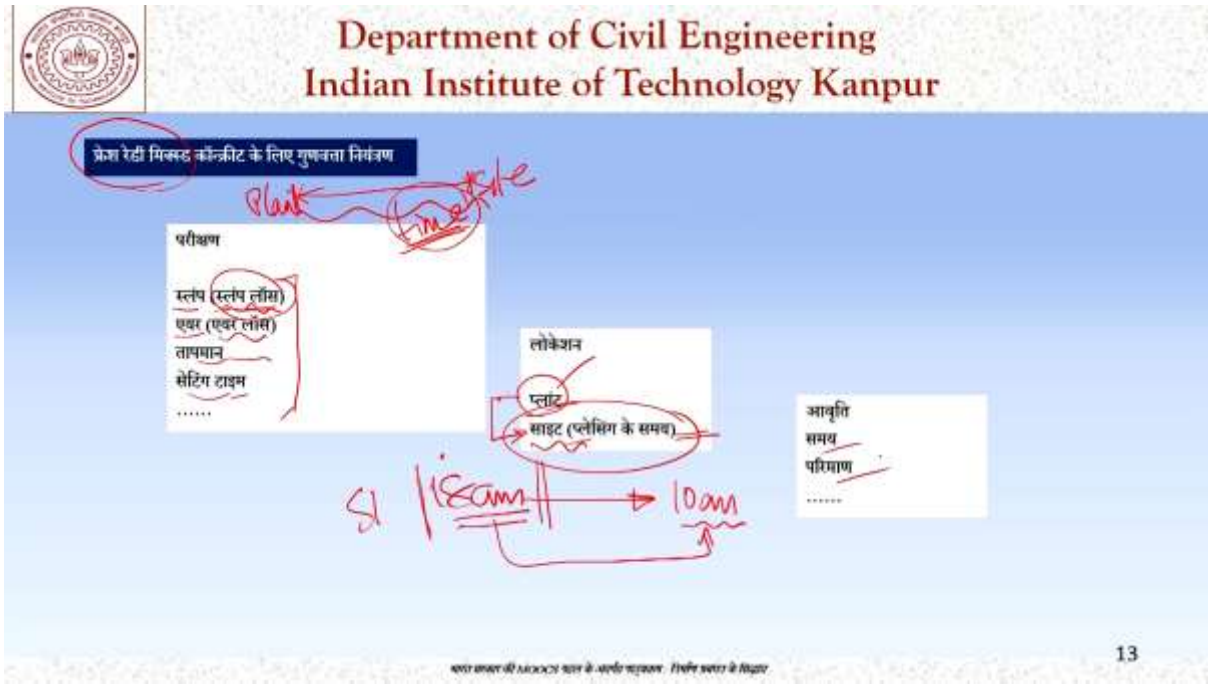
(Reference Time 20:40)



Aage badhate hain concrete mein masheenon ka prayog. Jis prakaar se ek traditional ya paramparaagat construction hota tha usamen aksar ka concrete haanth se milaee jaatee thee ya chhota sa plant lagaakar site par mix kee jaatee thee. Vah concrete kisee bhee maadhyam se site par le jaee jaatee thee place karane ke lie. Ab masheenon kee upalabdhata kee vajah se ham bade paimaane par large projects kar sakate hain. Saath hee saath adhik chunauteepoorn pariyojanaon ko ham sajeev kar sakate hain. Nirmaan kaary mein ham gati pradaan kar sakate hain tejee se kar sakate hain. Kuchh udaaharan dekhate hain jaise ready mix concrete plant, ab IS 456 jo kee concrete kee gunavatta aur usake design ke lie ek mool srot hai ek mool reference hai. Usamen is baat ka explicit mention yah nahin likha gaya hai ki yah concrete kis prakaar se banaee jaegee. Agar ready mix concrete plant mein concrete banaee jaatee hai aur usako sunishchit karane ke lie jo test hain vah sabhee test 456 mein utane clearly nahin likhe gae hain. Isalie hamesha ek quality control engineer ko yah samajhana chaahie ki koee bhee specification hamaare lie kitana relevant hai, kya hamaare lie jo kuchh relevant hai vah sabhee kuchh usamen likha hai ya nahin agar usamen nahin likha hai to kisee any specification se hamen seekh lenee chaahie. Ready mix plant mein banee huee concrete ke baare mein abhee ham agalee slide mein shaayad charcha karenge. Ready mix concrete plant mein banee huee concrete ke saath hee ek aur prashn hota hai agitator trucks ka prayog. Yah agitator trucks aapane dekhe honge ready mix concrete plant se site par le jaane mein prayog kie jaate hain unako ek jagah se doosaree jagah le jaate samay dheere-dheere rotated bhee kiya jaata hai usamen jo rotation hota hai vah dheere-dheere usake drum ke under jo blade hain vah rotate karake rakhe jaate hain taaki concrete under set na ho aur site par concrete ko dump karate samay us concrete ek tejee se rotation karane ke baad hee dump kiya jaata hai. Transportation kee is prakriya ke chalate gunavatta ke tamaam prashn uthate hain yah ham log abhee agalee side mein phir charcha karate hain. Agar ham maan leejie shotcrete ke maadhyam se concrete ko place kar rahe hain, hamane pichhalee ek slide mein kaha tha ki concrete ka ek structure banaane ke lie material selection se lekar curing tak tamaam proseses involved hote hain. Shotcrete ek aisa prakriya hai jo kee placing mein involve hota hai is prakriya mein ham concrete ko ek gun ke maadhyam se is satah par deposit karate hain aur

yah deposition karane ke lie isako under pressure is gun ke through drive karate hain yah poora system automated bhee ho sakata hai aur manual bhee. Agar manual hota hai to yahaan par nozzleman hain is gun ko handles karane vaala usakee skill kaareegaree par bahut kuchh nirbhar karega ki jo ham concrete yahaan par deposit kar rahe hain usakee gunavatta kya hai aur isakee gunavatta aur isakee properties kya is concrete ko jisako ki ham yahaan par deposit kar rahe hain usase kitanee bhinn hogee kitanee bhinn nahin hogee. Isee baat ka dhyaan to gunavatta niyantran mein rakhana hota hai. Ek aur example hai roller compaction ka, jisamen ki ham concrete ko ek jagah par dump kar dete hain aur internal vibration jo ki ham aksar buildings mein dekhate hain jahaan par ki hamaare paas ek needle hotee hai jo ki ham concrete mein under daalate hain aur ye vibrate karate hain isase ham surrounding concrete ko compact karate hain. Lekin roller compaction mein yah needle ka prayog na karake ham yahaan par ek vibratory roller is layer ke oopar chala dete hain aur yah chaahate hain ki yah concrete jis tareeke se compact honee chaahie use prakaar compact ho jae. To yahaan par jo internal vibration ke lie jo maanak ya jo prakriya hai vah yahaan par utana to apply nahin hota hai. To agar ham kisee pariyojana mein roller compacted concrete ke maadhyam se construction karana chaahate hain to hamen is pariyojana ke quality plan mein yah dhyaan mein rakhana hoga ki usamen roller compacted concrete se uthane vaale sabhee prashnon ka uttar ho. Agar ham shotcrete se apanee pariyojana mein concrete ko deposit kar rahe hain. To hamaare quality plan mein vah baat bhee explicitly honee chaahie aur usee ke anusaar quality plan banae jaana chaahie.

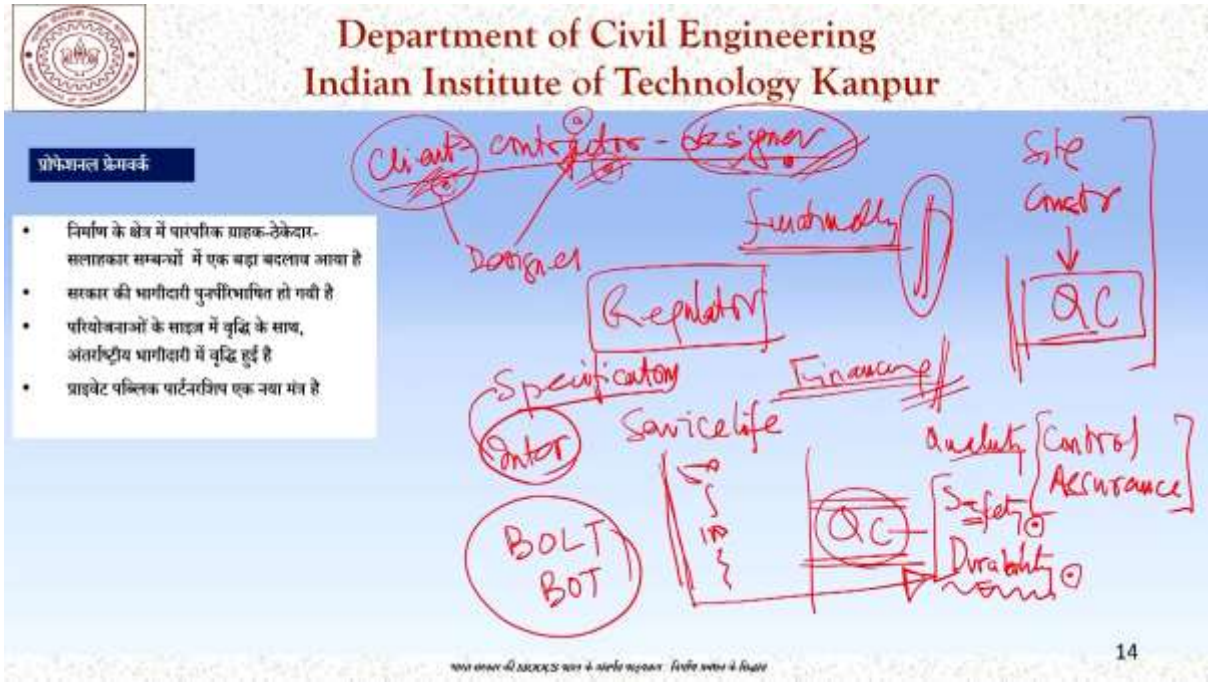
(Reference Time 26:04)



Abhee hamane ready mix concrete plant mein banaee jaane vaalee concrete se sambandhit gunavatta niyantran ke baare mein thodee see charcha kee thee. To pareekshan ke lie ham slump ya air ya taapamaan ya setting time unakee charcha karate hain. Jab ham ready mix concrete kee baat karate hain aur plant se site tak kee dooree kee baat karate hain aur yahaan elapse hone vaale samay kee baat karate hain tab hamen slump loss, air loss, taapamaan mein vrddhi in sab baaton ka dhyaan avashy rakhana chaahie. Setting time ka bhee hamen dhyaan rakhana hoga ki jitana time jo samay plant se site par laane mein lagega us dauraan concrete set nahin honee chaahie taaki ham site par usako place kar sake compact kar sake. Location

arthaat plant ya site isaka taatpary yah hai ki jo hamaare quality control ke parameter hain ham kahen ki slump 18 cm hona chaahie, to yah kah dena ki 18 cm hona chaahie yah kaaphee nahin hai hamen yah kahana hoga ki slump 18 cm hamako chaahie plant mein ya site par. Jab ham plant mein 18 cm kee baat karate hain to ham slump loss maan ke chalate hain ki agar ham 18 cm kee concrete lekar chalenge yahaan par kuchh samay lagega to ho sakata hai site par pahunchate samay isaka slump 10 cm hee rah jae yah. Agar hamen maany nahin hai to hamen kuchh aur kadam uthaane honge aur yah kadam bhee gunavatta ko affect karenge usako impact karenge. Isee prakaar agar ham site par 18 cm slump chaahate hain to ham yah kyon chaahate hain? Kyonki hamaaree jo placing condition hai, hamaaree jo reinforcement hai vah aisee hai ki ham isase kam slump vaalee concrete ko place nahin kar sakate. Isake lie hamen plant par kitana slump chaahie yah hamen alag se likhana hoga aur nahin to yah ensure karana hoga ki plant se site tak aate samay slump loss na ho. Isakee jo aavrtti hai, frequency of testing hai vah samay parimaan aadi par nirbhar karatee hai aur yah baat bhee hamen dhyaan mein avashy rakhanee chaahie.

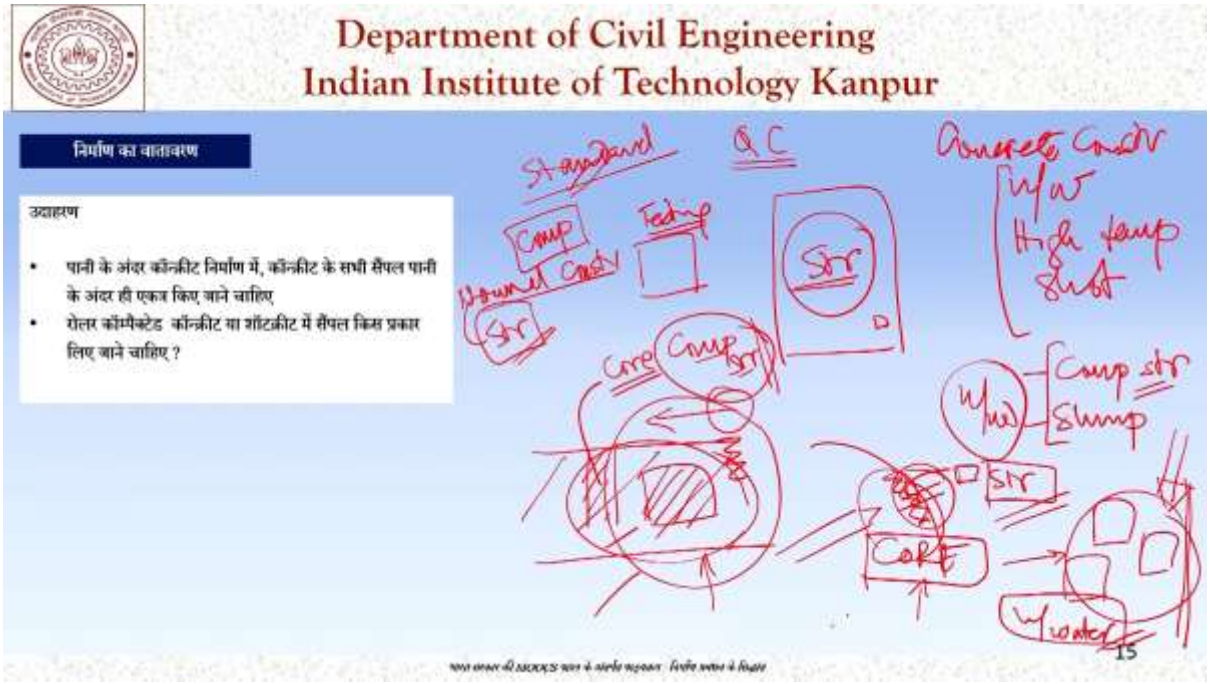
(Reference Time 28:36)



To aage badhate hain aur professional framework aur usaka gunavatta par kya prabhaav padata hai us par ek sankshipt charcha karate hain. Nirmaan ke kshetr mein paaramparik graahak, thekedaar, salaahakaar sambandhon mein bada badalaav hota ja raha hai. Client, thekedaar, designer yah jo ek paaramparik relationship thee ki structure client ka hai ek designer ne usakee design kiya aksar client ke office mein hee design kee capability thee to client hee design bhee kar leta tha aur phir vah thekedaar se kahata tha ki is drawing ke anusaar yah structure bana deejie. Ab kya hua hai? Designer alag ho gaya hai, client designer se kahata hai aur vah design aur drawing client approve karake thekedaar ko deta hai ab kuchh is prakaar ke contract bhee aane lage hain jisamen ki client design ka kaam bhee thekedaar par chhod deta hai arthaat vah aisa kahata hai ki functionally hamako is prakaar ka ek structure chaahie. Usaka structural design aur construction yah donon hee ham outsource kar dete hain chaahe vo ek agency ko karen ya alag-alag agencies ko karen in sab baaton ka finally site par construction ke samay quality control par bahut phark padata hai kyonki designer to site par nahin rahata, site par client ke log honge aur thekedaar ke log honge. To

antatah ek prakaar se quality control ka kaam ya to client ko karana hoga ya thekedaar ko karana hoga. Donon ko karana ho sakata hai yah kahana ki yah kaam hamaara nahin hai yaheen par gunavatta compromise ho jaatee hai. Is baat ko avashy dhyaan mein rakhana chaahie specially aap logon ko jinako ki abhee tamaam varshon tak construction industry se jude rahana hai. Sarakaar kee bhaageedaaree punarparibhaashit ho rahee hai, redefined ho rahee hai. Sarakaar ek regulator hai. Pahale sarakaar hee bahut bada client thee sarakaaree vibhaag chaahe vah railway ho, chaahe vah MES ho, chaahe vah sadak parivahan ho yah sabhee sarakaar ke vibhaag the lekin ab dheere-dheere yah sabhee vibhaag sarakaar se kisee na kisee roop mein alag hote ja rahe hain aur sarakaar maatr ek regulator ke roop mein kaam kar rahee hai. Saath hee saath infrastructure aur large project kee jo financing hai vah bhee pahale sarakaar hee karatee thee aur financing bhee kaee project mein sarakaar ke baahar chalee gaee hai. To thekedaar ya usake saath mein jude hue financier yah donon milakar hee finance bhee karate hain. In cases mein quality control, assurance in sabhee kee paribhaasha thodee-thodee alag hotee ja rahee hai. Is baat ko dhyaan mein avashy rakhana chaahie antatah site par quality control karate samay. Isake implication kee charcha hamane is module ke pahale lecture mein kee thee aur main aapako phir se yaad dila doon ki quality control ka safety aur durability in donon par bahut hee close effect hota hai. To agar ham quality control theek prakaar se nahin karate hain to ham structure mein jo expected safety hai vah nahin la paate hain aur na hee jo expected durability la paate hain. Jaisa ki hamane us samay kaha tha unakee service life 50 saal, 100 saal ya usase bhee adhik maanakar chalate hain. Itane lambe samay mein yah sunishchit karana ki yah structure durable hai isakee neenv construction ke dauraan hee jo quality control ho raha hai us par hotee hai yah baat ham pahale bhee kar chuke hain aur isaka mahatv itana adhik hai ki hamane socha ki aapako ek baar is baat ko dohara den. Pariyojanaon ke size mein vrddhi ke saath antarraashtreey bhaageedaaree bhee badh rahee hai aur antarraashtreey bhaageedaaree apane-apane desh kee quality control paddhatiyaan, thekedaar, designers sabhee log lekar bhaarat aa rahe hain aur bhaarat ke log baahar jaakar construction kar rahe hain. To dheere-dheere hamen ek doosare se seekhane kee aavashyakata bhee aavashyak hai hamane kaha ki hamaare jo specifications hain vah ho sakata hai ki utane relevant na ho ek project ke lie, to hamen international specification se seekh lene mein koee hichak nahin honee chaahie. Private pablik Public Partnership (PPP), isaka zikr abhee hamane kiya jabaki hamane kaha ki financing construction ka ek hissa ho gaee hai aur sarakaar ya client se door chalee gaee hai. Contracting models jaise ki build operate, lease and transfer, build operate and transfer ityaadi isee prakriya ka ek ang hai.

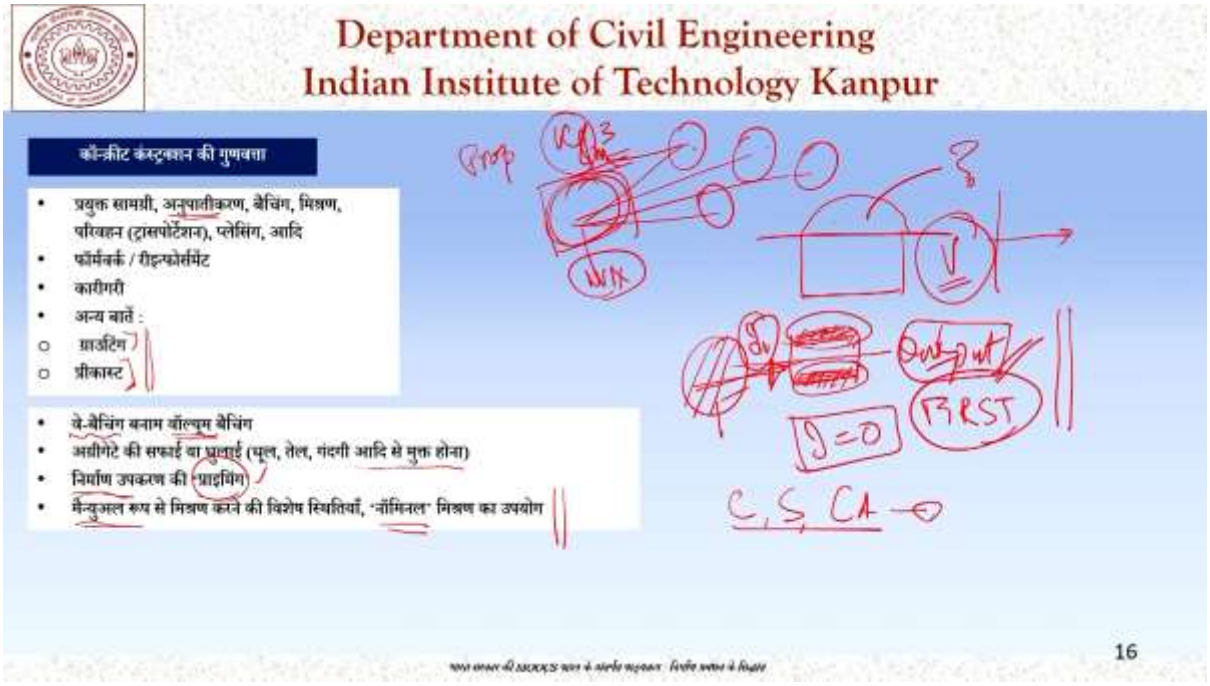
(Reference Time 33:54)



To aaiye aage badhate hain aur ham baat karate hain nirmaan ke vaataavaran kee. Ham charcha kar chuke hain ki concrete construction under water ho sakata hai, high temperature ho sakata hai ya shotcrete jaise maadhyam se ho sakata hai. To in sab ka quality control par kya phark padega usake kuchh prashn hain jo main aapake saamane rakhana chaahata hoon us par charcha karana chaahata hoon aur usase aapakee gunavatta ke prati soch ko mold karana chaahata hoon. To aaiye dekhen pahala prashn, paanee ke under concrete nirmaan mein concrete ke sabhee sample paanee ke ander hee ekatrit kie jaane chaahie ham chaahe vo compressive strength ke sample ho ya slump ho yah sabhee test under water hee kie jaane chaahie. Hamen yah baat hamesha dhyaan mein rakhanee chaahie ki jab ham quality control kar rahe hain to nirmit structure is structure ke vaataavaran se milate julate vaataavaran mein hee testing ho agar yah structure under water ban raha hai to isakee sampling bhee under water hee honee chaahie. Haan majabooree hai ki ham under water shaayad isakee strength test na kar saken kyonki hamaaree masheene usake lie design nahin hai. To jahaan tak ho sake apanee baat dhyaan mein rakhate hue un procedures ko minimum modification karana chaahie. Ek aur prashn dekhate hain ki roller compacted concrete ya shotcrete mein sample kis prakaar lie jaane chaahie . Pichhalee baar hamane charcha kee thee ki roller compacted agar is prakaar se concrete kee layer hai jis par kee ek vibratory roller chala karake hamane isako compact kiya ab ham dekhana chaahate hain ki yahaan par concrete kee compressive strength kya hai usee prakaar shotcrete karate samay hamane gan se concrete ko yahaan par deposit kiya aur ham concrete kee gunavatta ke lie yahaan par jo strength hain vah jaanana chaahate hain to isake lie kya paramparaagat tareeke se jo lab mein cubes lie jaate hain vah tareeka sahee hai? Nahin vah tareeka sahee nahin hai. Isake lie hamen yahaan se hee core lene ka praavadhaan karana hoga chaahe vah shotcrete ho chaahe vah roller compacted concrete ho aur hamen core nikaalanee hogee aur use core se hee hamen compressive strength jaanane ka prayaas karana chaahie. Yah baat dekhee jaanee chaahie use paripekakshy mein ki ham compressive strength ko standard conditions mein test kar rahe hain, standard condition se determine kar rahe hain ya ek comparison ke lie kar rahe hain. Jab ham is concrete ka ya is concrete ka mix design rahe hain aur do concrete mix kee tulana kar rahe hain vahaan par to ham shaayad standard conditions mein test karake aage badh saken lekin site par hone vaale quality control ke lie site mein bane structure ko hamesha dhyaan

mein rakhana chaahie. Main aapako ek homework dena chaahata hoon ki jo hamaara normal construction hota hai usamen jo hamaara normal tareeka hai cube lene ka aur underawater unako cure karane ka kya yah tareeka hamaare structures ka jo vaataavaran hai usako represent karata hai. To agar nahin karata, to hamen kya karana chaahie? Itane dinon se ham yah test is tarah hee kyon karate aa rahe hain. Isaka uttar aapako kaee kitaabon mein bahut hee spasht roop se mil jaega. Usee uttar ke aadhaar par aap in baaton ka bhee uttar dhoondh sakate hain.

(Reference Time 38:05)

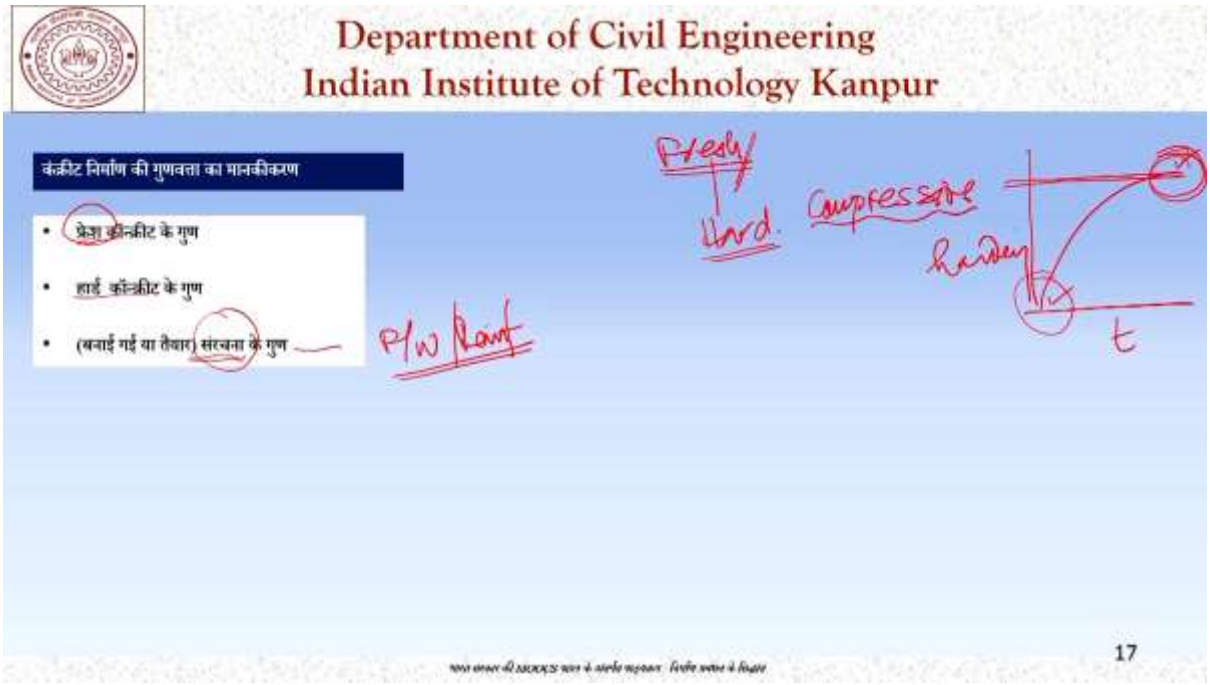


To concrete construction kee gunavatta se sambandhit tamaam baaton ko ek baar phir se doharaate hue hamane dekha ki prayog saamagree anupaateekaran arthaat proportioning, batching, mixing, transportation, placing aadi ka bahut mahatv hota hai aur ek quality plan banaate samay unaka paryaapt dhyaan rakha jaana chaahie. Formwork aur reinforcement inaka bhee mahatv hota hai aur abhee ham ek chitr mein dekhenge ki agar hamaara formwork ya reinforcement work theek se nahee kiya gaya hai ya compatible nahee hai hamaare concrete ke saath to concrete construction kee quality pratikool roop se prabhaavit hotee hai. Kaareegaree (workmanship) chaahe vah mason kee ho, chaahe vah concrete place karane vaale kee ho, curing karane vaale kee ho, compaction karane vaale kee ho, nozzleman kee ho, roller compactor use karane vaale us driver kee ho, in sab ka bhee bahut mahatv hota hai. In kaareegaron ka theek prakaar se tren hona, prashikshit hona aur unaka certified hona bahut hee aavashyak hai.

Kuchh any baaten, concrete ke baare mein ham bahut saaree baaten kar sakate hain lekin tamaam operations hote hain jaise grouting or precast, concrete ke koee number jo ki factory mein banata hai aur site par laakar place kiya jaata hai isase sambandhit gunavatta se jude prashn usake liye unakee apanee alag conditions hotee hain aur unako ek alag se apane quality plan mein samaaveshit karane kee aavashyakata hogee. Weigh-batching banaam volume batching. Jab ham kuchh anupaat tay karate hain to hamaaree jo proportion hotee hain vo hotee hai kilograms per cubic meters ke aadhaar par. To ham do material ya chaar material jitane bhee hain unako ve karake mix karate hain ki yahaan se itane kilo yahaan se

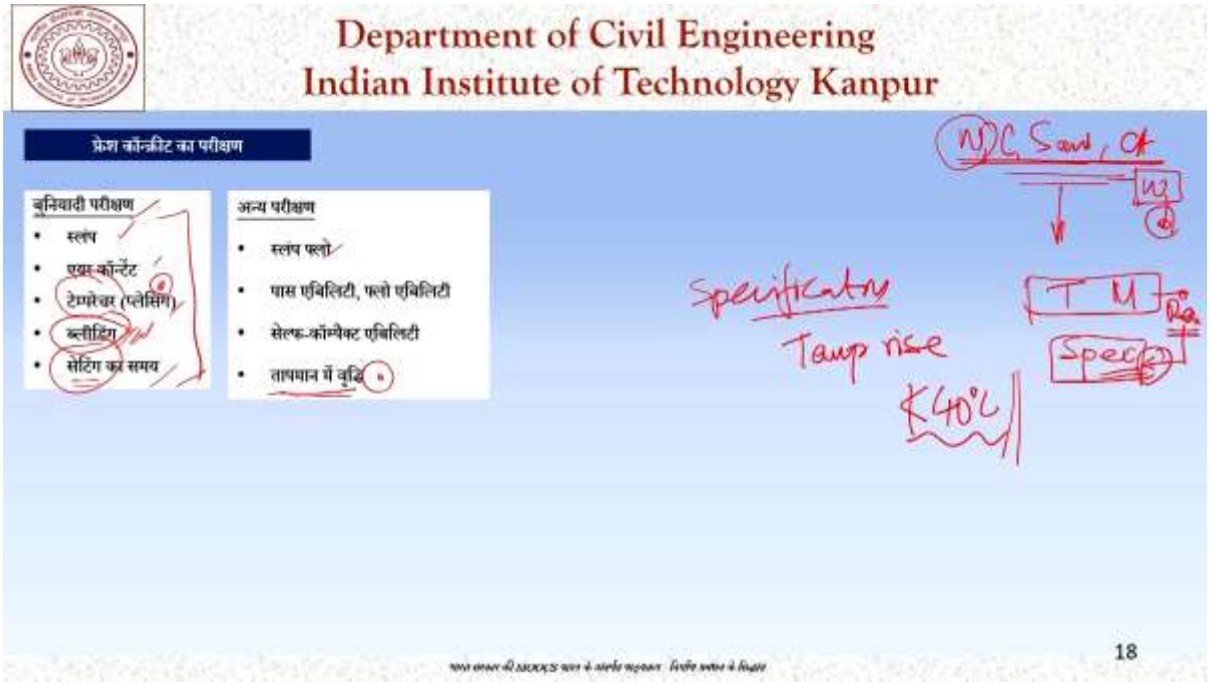
itane kilo, yahaan se itane kilo, yahaan se itane kilo aur yahaan par unako mix karana ye to hai weight-batching jahaan par ki yah batching vajan ke aadhaar par ho rahee hai. Kabhee-kabhee ham site par volume ke aadhaar par proportion karane ke lie majaboor ho jaate hain to hamen kya karana hota hai ki hamen yahee chaaron material ek volume se measure karane hote hain, tab ham kya karate hain? Ek dabba rakhate hain jisaka kee fixed volume hota hai lekin tab hamen yah sunishchit karana chaahie ki material is prakaar se leveled ho usamen is prakaar se heap na kiya jae kyonki agar ham heap kar denge to yah volume batching upayukt nahin hogee. Yah volume batching accurate nahin hogee aur hamaaree concrete par jo ki ham yahaan mix karenge usakee properties ko pratikool roop se prabhaavit karegee. Aggregate kee saphaee ya dhulaee dhool., tel, gandagee aaj se mukt hona yah kitaabon mein likha hota hai specifications mein likha hota hai aur usako implement karana ek quality engineer ka bahut hee mahatvapoorn job hai. Nirmaan se jude upakaranon kee Priming karana. Jab ham kisee bhee upakaran ko use karate hain to usamen kuchh na kuchh material rah jaata hai agar ham concrete ko pipe ke maadhyam se pump kar rahe hain to kuchh na kuchh material us pipe mein chhoot jaata hai, to usase hota kya hai? Ki jo concrete ham yahaan input karate hain usamen kuchh yahaan deposition hone ke baad output mein jo concrete hamako milatee hai vah thodee bhinn ho jaatee hai. To priming ek aisee prakriya hai jisamen ki ham first mix jab karate hain to usako yahaan par apane output mein nahin lete, usako ham waste kar dete hain usako ham kisee any les important jagah par use karate hain. Vaastavik construction hamaara tab shuroo hota hai jabaki yah chhootane vaala jo padaarth hai yahaan par yah ek baar ho chuka hai. Jo agale mix aaenge usamen yah inaput output baraabar hoga arthaat jo concrete hamako yahaan mil rahee hai vahee concrete hamako yahaan mil rahee hai is cheej ko ensure karane ke lie ham nirmaan upakaranon kee priming karate hain. Isaka praavadhaan bhee hamako quality control kee apane plan mein rakhana chaahie. Manual roop se mishran karane kee jo sthitiyaan agar aatee hain ya nominal mix hamen upayog karane kee sthiti aatee hai usamen hamen vishesh roop se satark rahana chaahie. Nominal mix arthaat ham design mix na karen, ham ek rule of thumb ya andaaj ke aadhaar par ek mix karate ha ain. Theek hai hamako agar yah concrete chaahie to ek andaaj se ham itanee sand, itanee cement aur itanee cores aggregate le len isako ham kahate hain. Nominal mix. To nominal mix lekar ke bade structures ka nirmaan to kabhee nahin karana chaahie aur yah baat code mein likhee huee bhee hai ki bahut hee aavashyak hone par hee nominal mix ka prayog hona chaahie. Isee prakaar manual mixing (haanth se mix karane) ka praavadhaan bhee bahut hee rare conditions mein use karana chaahie.

(Reference Time 43:33)



To ye the kuchh siddhaant jinako ki hamako dhyaan mein rakhana chaahie concrete ka ek quality plan ya gunavatta plan banaate samay. Normal conditions main ham concrete ke gunavatta plan mein kin baaton ka dhyaan rakhate hain. Hamen yah dhyaan mein rakhana chaahie ki concrete ke do bahut hee alag-alag roop hote hain, ek hota hai fresh concrete jahaan par ki ham chaahate hain ki concrete more or less jahaan tak ho sake ek fluid ke tareeke se behave karen to formwork ke kisee bhee kone mein pahunchaane mein adhik shram na karana pade lekin ek baar place hone aur compact hone ke baad ham chaahate hain ki yah concrete hard ho jae aur ek compressive strength jo hamane usake lie deign kee hai, sunishchit kee hai vahaan tak hardening ho to agar ham ek chitr mein dekhen to samay ke saath ham hardening chaahate hain aur chaahate hain ki aakhirakaar ek strength yahaan par pahunch jae to hamen fresh concrete ke gun arthaat properties of concrete in the fresh state isakee charcha karanee hogee aur phir hamen charcha karanee hogee hard concrete ke gun arthaat jo hamaaree concrete yahaan thee usase hamen kya apeksha hai us par ham ek sankshipt charcha karenge. Aisa bhee ho sakata hai ki fresh concrete bhee theek ho, hardened concrete bhee theek ho lekin banaaya gaya structure hamen acceptable na ho, aisa kab ho sakata hai? Aisa ho sakata hai hamaaree formwork ya reinforcement work. Isamen agar kuchh truti ho jaatee hai to structure maany nahin hoga, isake kuchh udaaharan abhee ham dekhate hain.

(Reference Time 45:18)



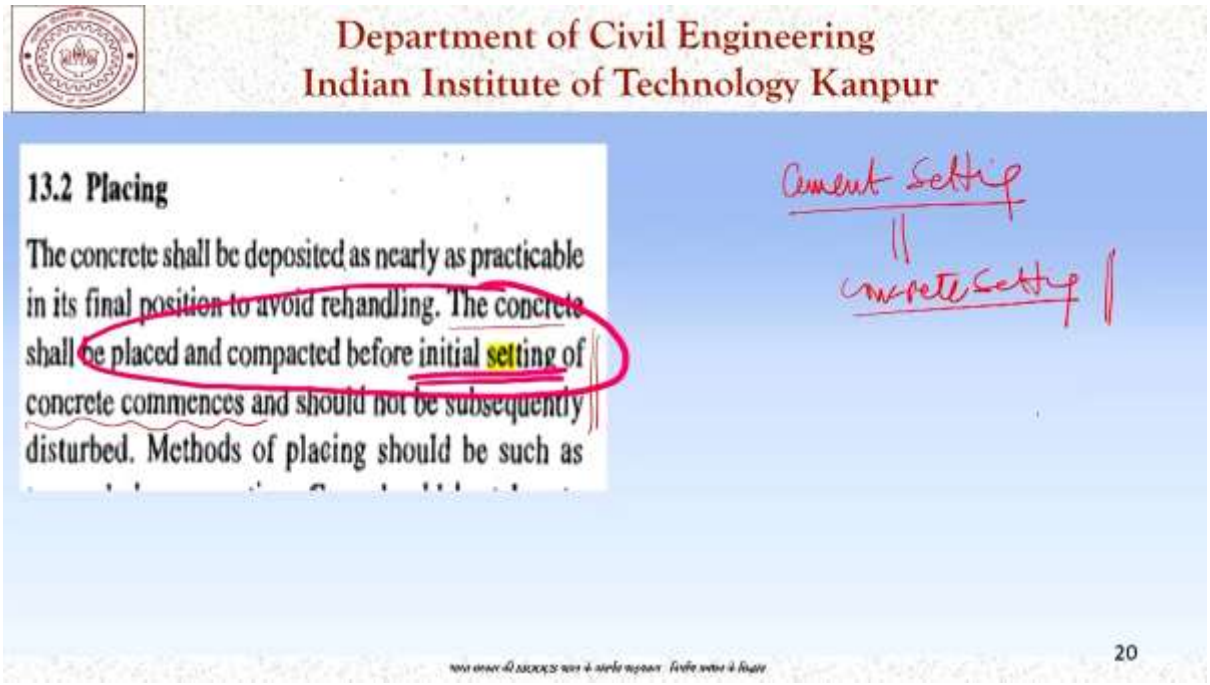
To aaiye aage badhate hain hamesha kee tarah ham test methods kee details par charcha nahin karenge ham maatr un test ke baare mein baat karenge aur unakee details aapake oopar chhod denge ki usake jo test method hain vah aap svayan apane aap padh len. Jahaan tak fresh concrete ke pareekshan ka savaal hai ek jo normal discussion hai vah slump, air content, temperature of placing, bleeding aur setting ka samay yah chaar-paanch test hain jo ki avashy kie jaane chaahie. Yadyapi hamane kaha ki ham test ke details kee charcha yahaan par nahin karenge completeness ke lie aapako thoda help karane ke lie bleeding, setting time aur temperature in teen test par ham thodee see charcha avashy karana chaahate hain. Yah dhyaan mein rakhie kee water, cement, sand aur cores aggregate yah jo mool ingredients hai hamaaree concrete ke vah sabhee paanee se bhaaree hai arthaat agar inaka concrete ka agar mixer banaenge to yah sab settle kar jaenge aur oopar paanee nikal aaega. Is prakriya ko ham kahate hain bleeding. Hamen ek aisee concrete banaanee hotee hai jisamen kee bleeding kam se kam ho, yah kam se kam hona hamaare maanakeekaran ke lie mushkil hai hamane hamesha kaha hai ki quantification of a parameter kisee bhee parameter ka quantification bahut hee aavashyak hai aur iseelie bleeding ka test kaise kiya jaata hai isaka maanak aap avashy dekhakar apane aap se samajh len ki ham concrete mein bleeding kis prakaar se maapate hain aur usaka acceptable standard kya hai. Hamane hamesha kaha hai ki test method aur specification yah do alag-alag baaten hain. Koee bhee test method aapako ek result dega vah result aapako many hai ya nahin yah specification tay karega. To aap pahale bleeding test karie yah dekhie ki hamaaree bleeding ek percent hai, dedh percent hai, dedh percent bleeding aapako us particular structure ke lie maany hai ya nahin maany hai. Usee prakaar concrete ka setting time bhee bahut aavashyak hai aur ham isako alag se determine karate hain. Cement ka setting time concrete ka setting time nahin maana ja sakata hai yah bhee ek mahatvapoorn indicator hota hai hamaaree concrete kee properties ka. To fresh concrete ka kitana temperature hota hai yah aap svayan jaanane kee koshish keejie. Kuchh any test jo ki ek vishesh concrete construction mein use hote hain vah slump flow, possibility flow ability, self compatibility aur taapamaan mein vrddhi. Taapamaan mein vrddhi ka jo prashn hai vah us samay bahut mahatvapoorn ho jaata hai jabaki concrete mass concrete vaale phase mein hotee hai. Tamaam structure normal concrete hote hain lekin kuchh structures mein mass concrete construction aa jaata hai. To vahaan par hamaare

specifications mein likha jaata hai ki jo temperature rise hai vah 40 degree se kam ho isake lie hamaare quality control engineer ko yah samajhana hoga ki ham concrete mein temperature rise kaise measure karen aur kis prakaar yah sunishchit karen ki ki yah temperature rise 40 degree se kam hee rahe.

(Reference Time 48:53)

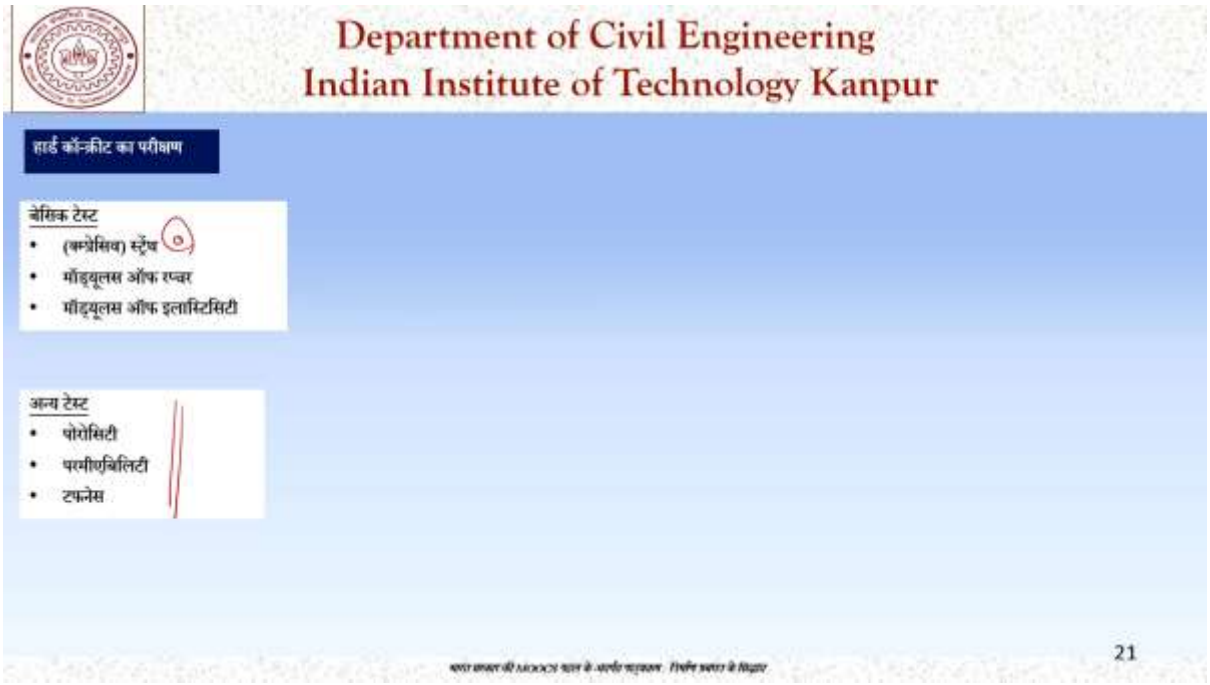
Ab do udaaharan main aapake saath aise share karana chaahata hoon jahaan par ki specifications mein kuchh baat to kahee gaee hai lekin kuchh baat nahin kahee gaee hai jo ki shaayad kahee jaanee chaahie thee completeness ke lie. Yahaan par air entered kee baat kee gaee hai lekin yah nahin dikhaaya gaya hai ki air content kis prakaar measure kiya jae. Aap mein se kaee log jo ki collage mein hai shaayad aapane ek air meter dekha bhee nahin hoga yah ek air meter hai jisake ki maadhyam se ham fresh concrete kee aur air content naap sakate hain. Agar aap site par kaam karate hain to main nahin samajhata ki aap mein se bahut se logon kee sites par air meters upalabdh honge kyonki air ko naapana usaka record rakhana hamaare specifications ka amooman ek part nahin hota hai.

(Reference Time 49:13)



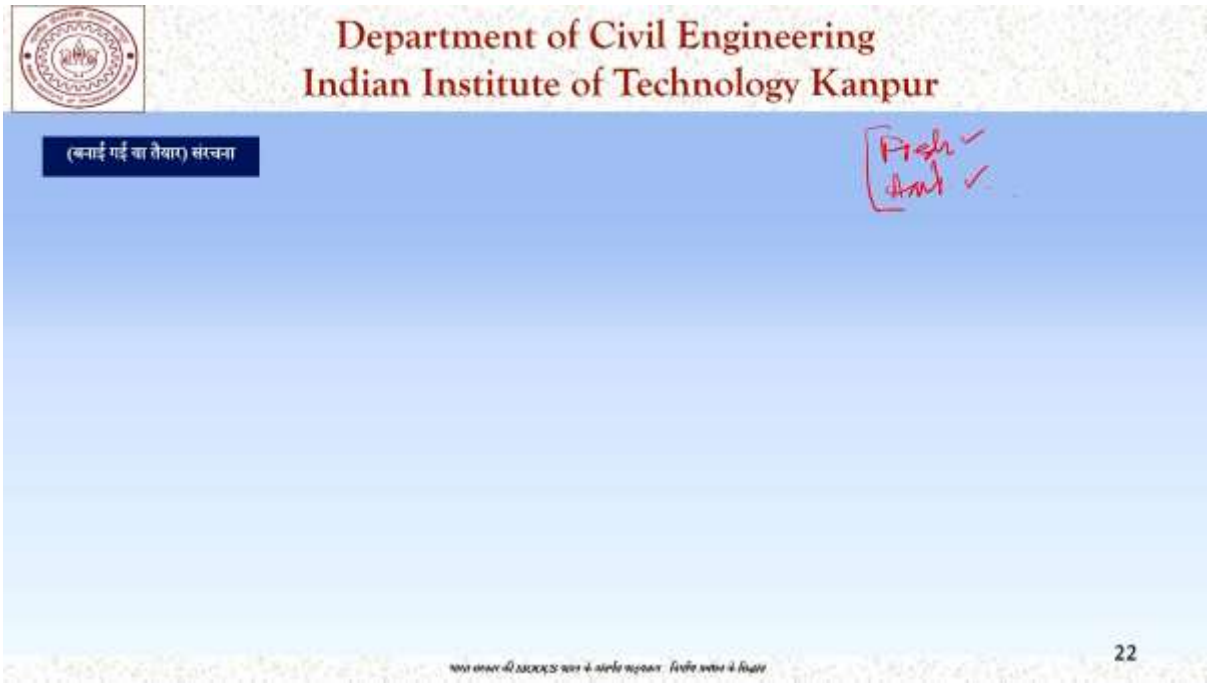
Doosara example hai setting time yahaan par likha hai. The concrete shall be placed and compacted before initial setting of concrete commences lekin yah nahin likha hai ki concrete ka setting time kis prakaar maapa jae, to jab tak hamaare engineer yah nahin jaanenge ki concrete ka setting time kis prakaar naapana hai to ham is provision ko kis prakaar enforce karenge yah main aapake lie homework ke roop mein chhod raha hoon ki concrete ka setting time kis prakaar maapa jaat aa hai. Chetaavanee main aapako yah de raha hoon ki cement ka setting time concrete ke setting time ke baraabar nahin liya ja sakata, ab ye kyon nahin liya ja sakata isaka uttar bhee aapako hee socha hoga. Yahaan par uddeshy yah hai ki maanakon par excessive reliance bhee nahin ho sakatee hai. Ek quality control engineer ko maanak padhate samay unako interpreting karate samay yah dekhana chaahie ki kya yah complete hai agar is maanak mein concrete ke setting time ka ullekh nahin hai usakee vidhi ka ullekh nahin hai, to kya kisee any maanak mein hai? To kya ham use maanak ka prayog ham is pariyojana mein kar sakate hain yah nirnay client ko karana hoga, thekedaar ko karana hoga ya deigner ko karana hoga. Is prakaar kee baaten bhee hamen quality plan tay karate samay sunishchit karanee chaahie.

(Reference Time 51:09)



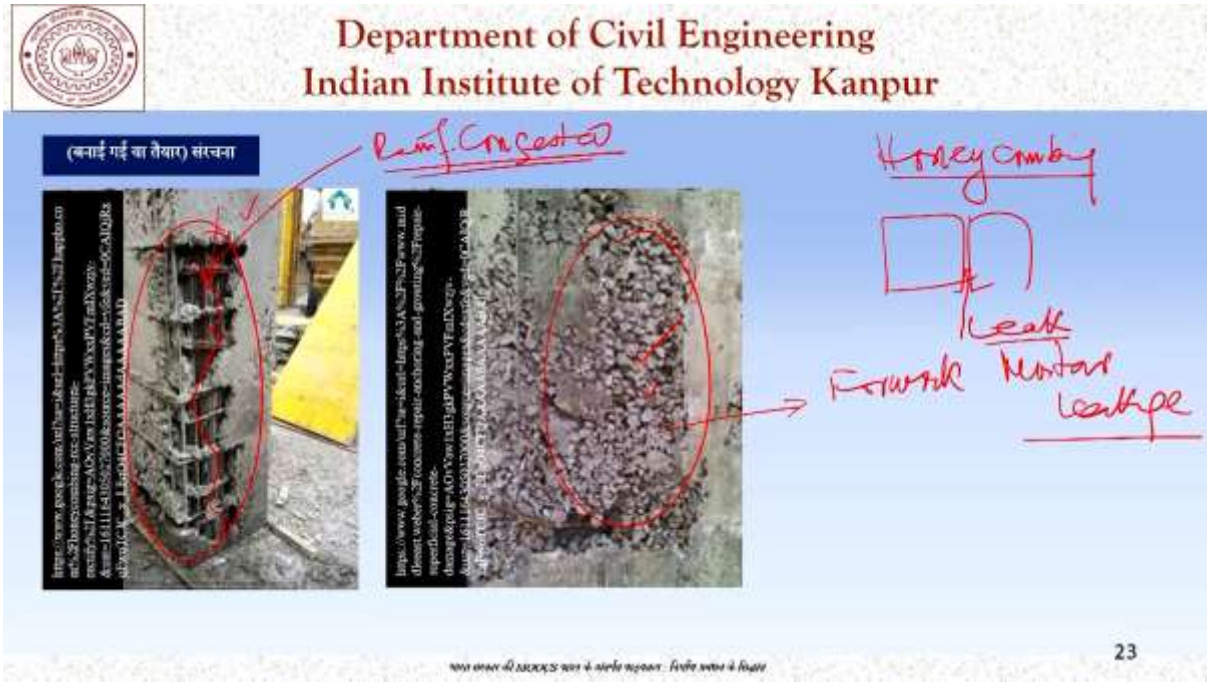
To aaiye aage badhate hain hard concrete ke pareekshan kee or badhate hain aur hard concrete mein jo basic test hai vah compressive strength ka hai. Modules of ya modules aaph elasticity ka hai. To in test ke aadhaar par ham jyaadaatar hard and concrete ka pareekshan aur inspection karate hain. Saath hee any test bhee hain. Jaise porosity, permeability aur toughness. Deigner kabhee-kabhee in test ko bhee prescrib karane lage hain, ab jaise-jaise concrete aur chunauteepoorn vaataavaran mein use hogee aur complicated deigns honge to concrete kee compressive strength jo ki abhee tak ek bahut hee fundamental aur perhaps aur shaayad mool property maanee jaatee thee hard end concrete kee vah nahin rahega aur kaee any properties bhee hamaare engineers ko jaanee hogee.

(Reference Time 52:07)



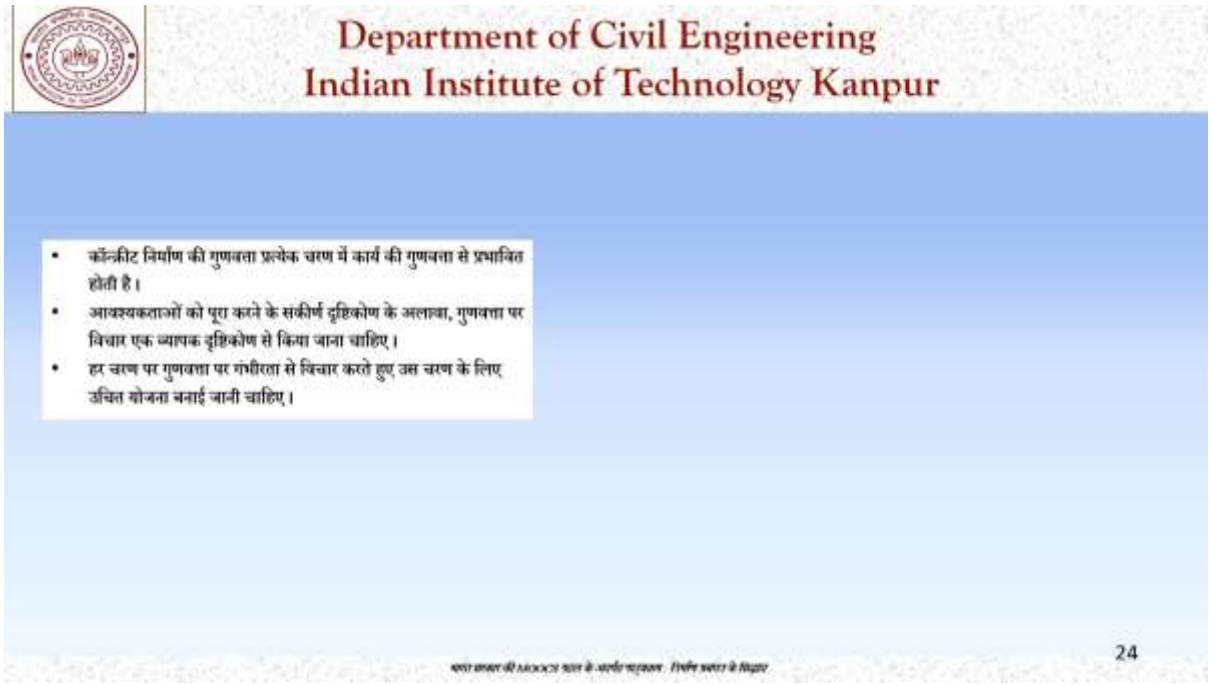
To hamane baat kee thee concrete ke fresh state ke properties, hard end state kee properties aur phir kaha tha yah ho sakata hai ki yah donon properties to theek hai lekin jo ham structure banaenge ho sakata hai maanakon par khara na utare.

(Reference Time 52:23)



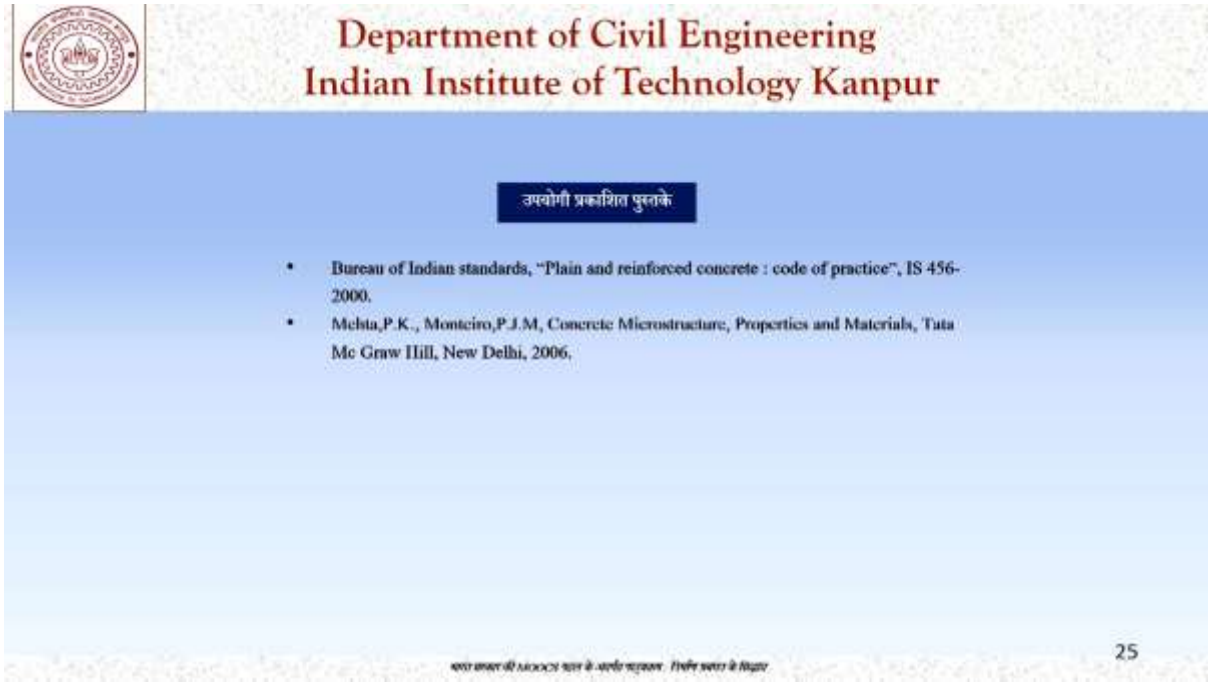
Yah do chitr is baat ke pratyaksh udaaharan hai. Yahaan par aur yahaan par in donon jagah par Honey combing huee hai. Yah kahana mushkil hai ki Honey combing kyon huee lekin dekhane se jo lagata hai vah yahaan par formwork se mortar leakage hua ki mortar part tha concrete mein vah formworks kee plates isake beech se leek kar gaya aur coarse aggregate yahaan par chhoot gaya to jo hanee combing huee vah is chitr mein dikh rahee hai. Is chitr mein formwork se adhik lag ye raha hai ki reinforcement bahut hee congested hai aur isake aasapaas concrete pahunch hee nahin paee to isake lie concrete ka dosh nahin hai reinforcement ke congested hone aur jab yah placement ho raha tha us samay is baat ka dhyaan na rakhane ka nateeja hai ki concrete har jagah pahunch jae.

(Reference Time 53:45)

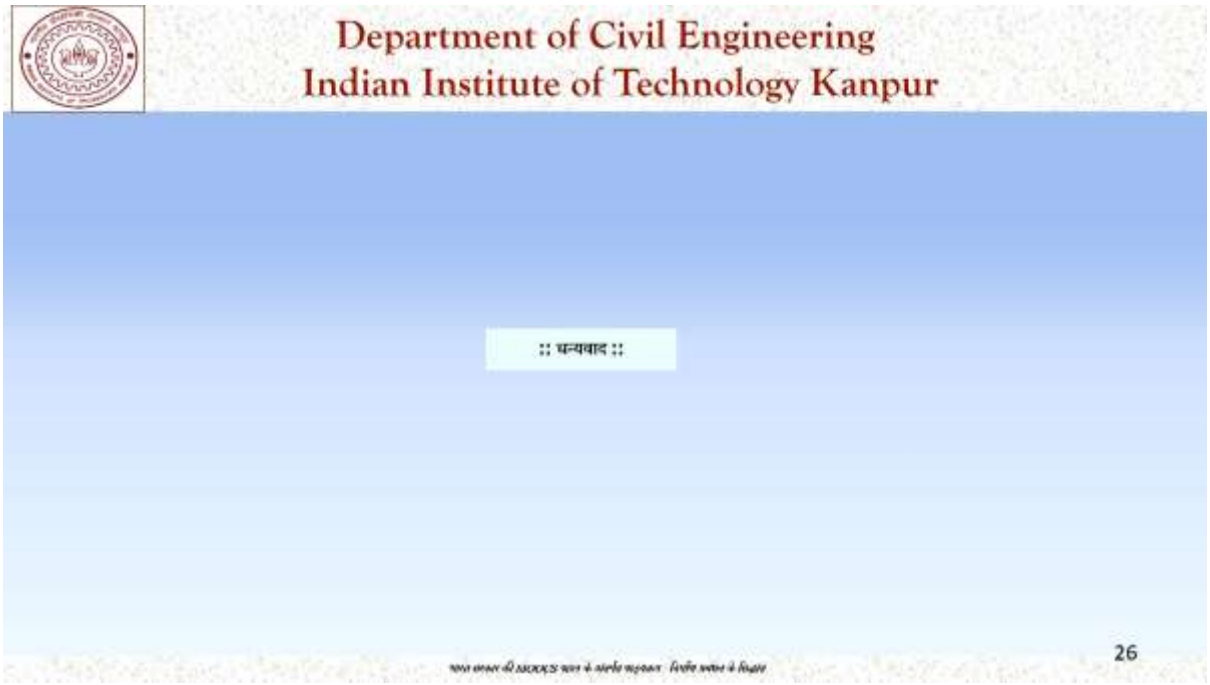


To aaj hamane dekha ki concrete nirmaan kee gunavatta pratyek charan mein kaary kee gunavatta se prabhaavit hotee hai. Kisee bhee charan kee aavashyakataon ya usake requirements ko poora karane ke ek sankeern drshtikon ke alaava gunavatta par vichaar ek vyaapak drshtikon se kiya jaana bahut hee aavashyak hai jo quality plan bane usamen har charan kee chhotee-chhotee baat ka bhee dhyaan rakha jae. Har charan par gunavatta par gambheerata se vichaar karate hue us charan ke lie uchit yojana banaee jae, yah soch quality plan ka ek abhinn ang hona chaahie. Aur isake saath concrete construction mein quality is baat par ham apanee charcha ko samaapt karate hain.

(Reference Time 54:30)



Aur yahaan par hamesha kee tarah kuchh upayogee prakaashan kee list dee huee hai jo ki aapako yah material samajhane mein sahaayak honge.



Dhanyavaad, namaskaar.