निर्माण प्रबंधन (Construction Management) के सिद्धांत

[Nirman prabandhan (Construction Management) ke Siddhant]

Prof. Sudhir Misra & Chirag Kothari
Department of Civil Engineering
Indian Institute of Technology – Kanpur

Lecture – 40

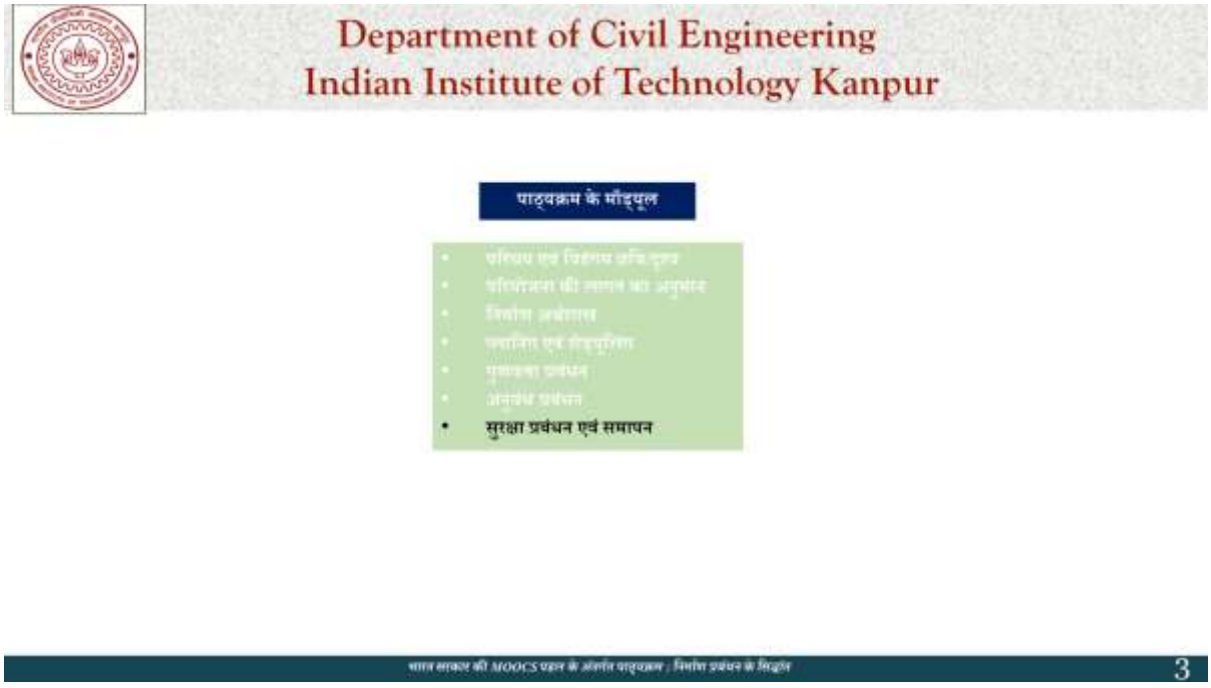
Construction 4.0 se Parichay

Namaskaar, ek baar aapaka phir se svaagat hai Bharat sarakaar kee moocs pahal ke antargat ‘Paathyakram Nirmaan Prabandhan ke Siddhaant’.

(Reference Time 00:22)

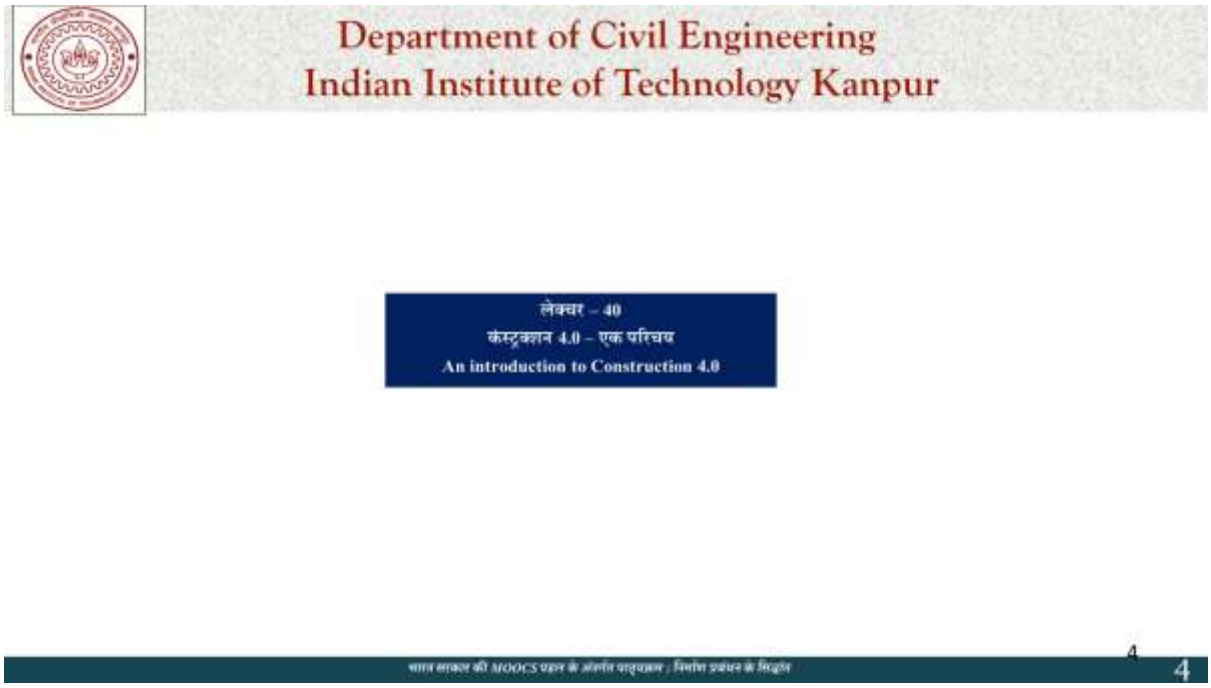
Is paathyakram ke module jin par hamane charcha kee hai - parichay evan vihangam drshy, pariyojana kee laagat ka anumaan, nirmaan arthashaastr, planning evan scheduling, gunavatta prabandhan, anubandh prabandhan, suraksha prabandhan.

(Reference Time 00:35)



Aur ab ham aa gae hain samaapan kee or.

(Reference Time 00:38)



Maine pichhalee baar kaha tha ki nirmaan udyog se jude tamaam log tamaam kshetron mein ho rahe technological development (technology mein vikaas) ko kis prakaar se nirmaan udyog ke vibhinn pahaluon ko sulajhaane ke liye kis prakaar unaka upayog kar sakate hain is baat par vichaar kar rahe hain. To aaie nirmaan udyog ke bhavishy ke baare mein ek chhavi ham dekhenge aaj ke lecture main.

(Reference Time 01:07)

Introduction to Construction 4.0

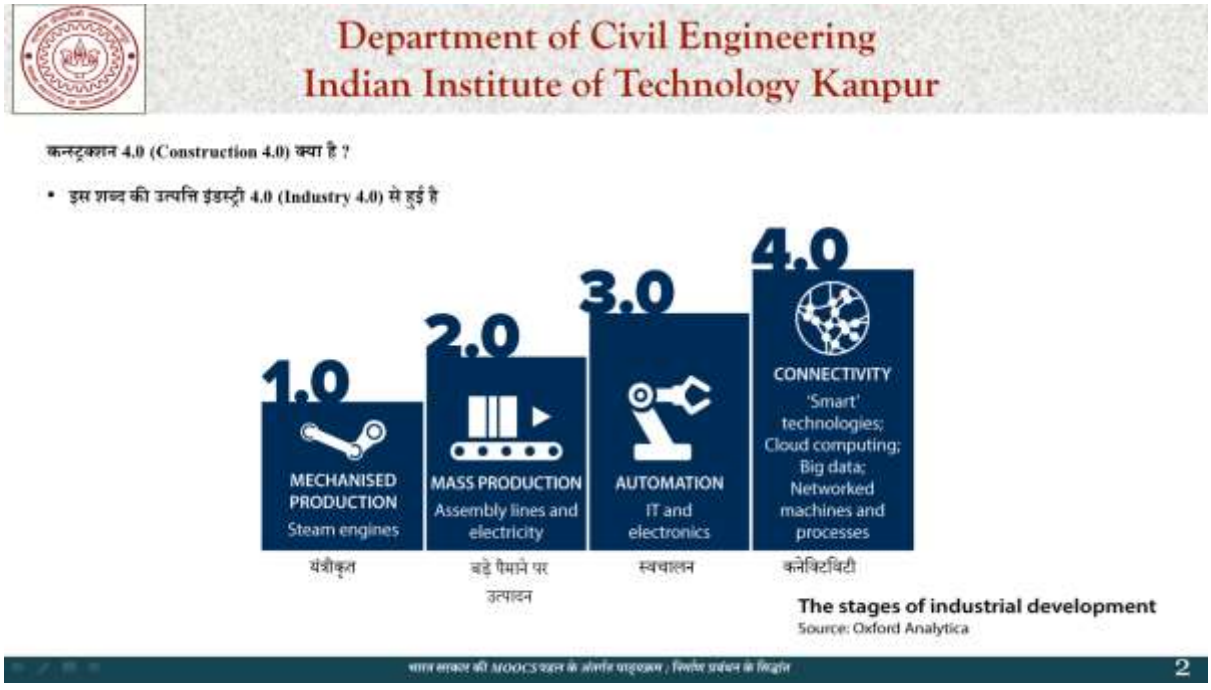
Chirag Kothari

Department of Civil Engineering
Indian Institute of Technology Kanpur
KANPUR 208016

Email: ckothari@iitk.ac.in

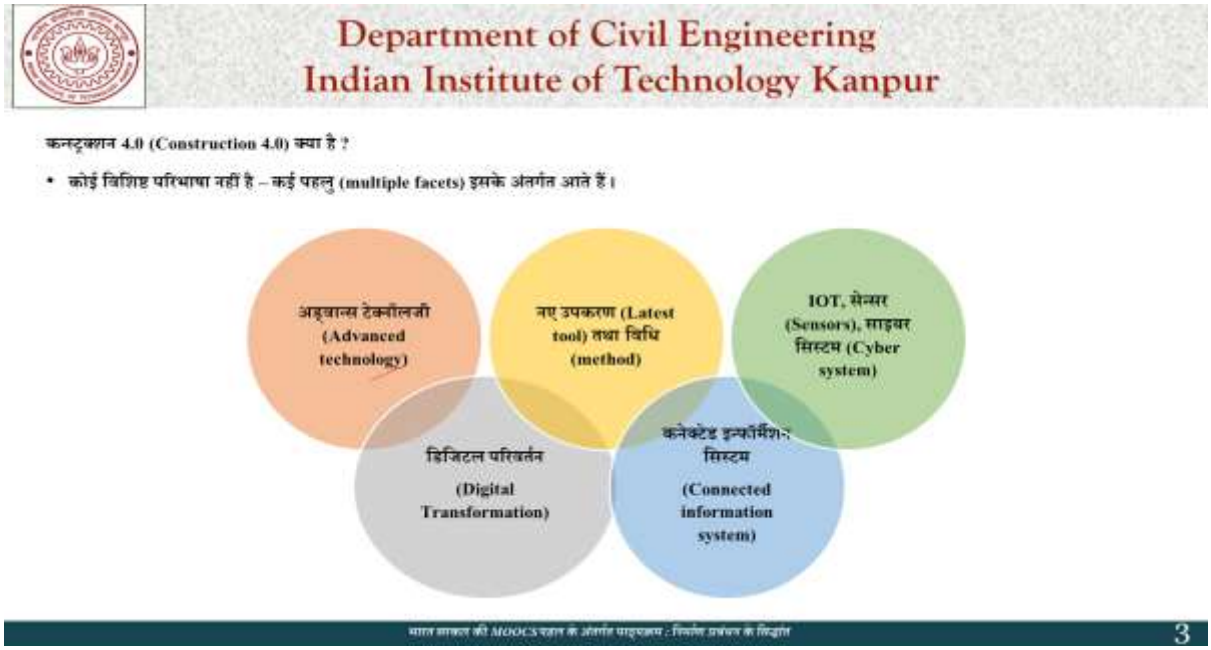
Is lecture ka sheershak construction 4.0 hai aur maine anurodh kiya hai apane sahakarmee evan sahayogee prof Chirag Kothari se. To aaiye ham sunate hain prof Chirag Kothari ko. Namaskaar, aaj kee charcha ham construction 4.0 ke vibhinn pahaloo par karenge.

(Reference Time 01:24)



Aage badhane pahale vaazib hai, prashn uthata hai construction 4.0 kya hai? Construction 4.0 shabd kee utpatti industry 4.0 se huee hai. Aap jaanate honge industry 4.0 kuchh is prakaar aage badha. Sabase pahale aaya mechanized production, phir ham industry 2.0 kee taraph badhe jahaan par hamane mass production ka bade paimaane par utpaadan shuroo kiya. Phir ham badhe 3.0 kee taraph jahaan automation (svachaalan) aaya. Aur abhee ham industry mein 4.0 jahaan par connectivity par focus hai us daayarekshan mein aage badh rahe hain. Industry 4.0 kee tarah construction 4.0 mein bhee smaart technologies, connectivity aur automation par dhyaan diya gaya hai.

(Reference Time 02:17)



Agar ham dekhana chaahe ki construction 4.0 kee paribhaasha kya hai? To koee ek paribhaasha nahee hai. Kaee pahaloo hain (multiple facts) hain jo isake antargat aate hain. Sabase pahala hai advanced technology. Jo bhee naee technology aa rahee hai jisase nirmaan prabandhan mein madad kee ja sakatee hai vah isake antargat aatee hai. Sabhee naye upakaran (latest tools) aur methods (vidhiyaan) isake antargat hain. Saath-hee-saath iot (Internet of Things) jahaan par uddeshy hota hai ki hamaare sabhee devices ek doosare se baat karen, connected rahen aur yah sab ek cyber system se bhee connected ho. Yah sensors kee madad se kiya jaata hai. Usake baad moolat: uddeshy yah hai ki hamen jo nirmaan kee prakriya hai usaka digital transformation karana hai aur yah karane ke liye ham ek connected information system ka prayog karate hain. Connected information system kya hai? Connected information system ko aap is tarah se samajhiye ki ek server hai us server ko jitane bhee hamaare stakeholders hain sab usaka prayog kar rahe hain. Vah sab vibhinn information jo unake paas hain, use ek system par daalate hain. Vah system ek hee jagah hai aur saaree information jo bhee share ho rahee hai vah ek doosare se connected hai. To hamane dekha construction 4.0 evan vibhinn methods and technologies ke combination se banata hai. Ab ham aage badhate hain.

(Reference Time 04:06)

Yah lecture kuchh is tarah organize kiya gaya hai ki jis prakaar ham koee nirmaan karate hain to usakee jo life cycle hotee hain, jo pariyojana ka jeevan chakr hota hai usamen jo vibhinn gatividhiyaan aatee hain un gatividhiyon ka past (history) kya rahee hai tatha vartamaan roop mein ham use kaise prayogakar rahe hain aur bhavishy mein aisee kya technologies aur methods hain jo upayog mein laayee ja sakatee hain unake baare mein charcha kee gayee hai. To maan leejiye agar hamaar project in teen phase mein rahata hai. Pre-project phase, jo project ka construction start hone se pahale kee jaatee hain. Usake baad project phase, aur usake baad project hamaara ban jaata hai, construct ho jaata hai. To post-project phase, kya-kya gatividhiyaan hotee hain, yah teen phase hai aur in teen phase mein ham charcha aage badhaayenge.

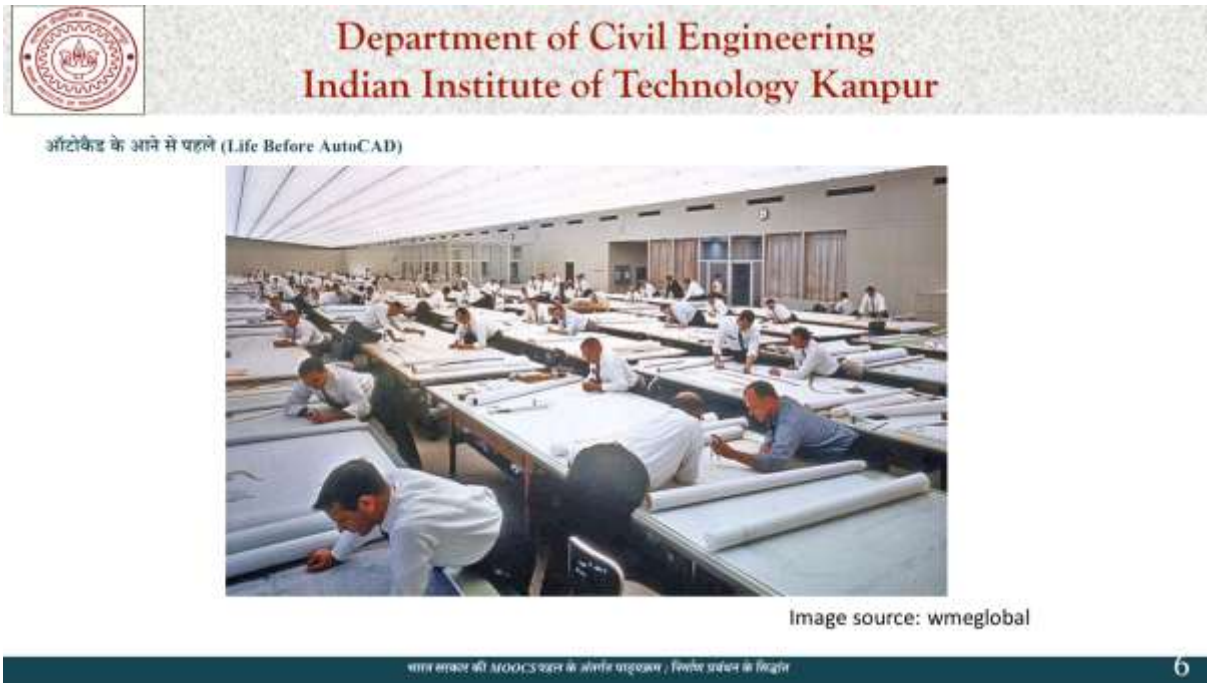
Maan leejiye aapako aapake ghar ka nirmaan kaary karana hai. Sabase pahala phase hota hai project ka idea aap sochate hain ki haan hame ek ghar banaana hai. Aapake paas aapakee kuchh jarooraten hotee hain. Aap sochate hain hamen kitane bedroom ka ghar banaana hai, ek hall hona chaahiye, ek kitchen hona chaahiye, kitane log usamen rahenge aur phir aap feasibility study karate hain. Jahaan par aap dekhate hain ki kya aapake paas jagah hai, kya aapake paas resources hain, kya aapake paas utana paisa hai ki aap use bana paayengen. Yah saare stages poorn ho jaate hain to aap aage badhate hain.

(Reference Time 05:50)

Isake baad aap jaate hain conceptual drawings kee taraph. Sabase pahale ham dekhenge conceptual drawings pahale ke samay kaise banaee jaatee thee aur vartamaan mein yah kis prakaar isaka prayog kiya ja raha hai? Chaliye aage badhate hain.

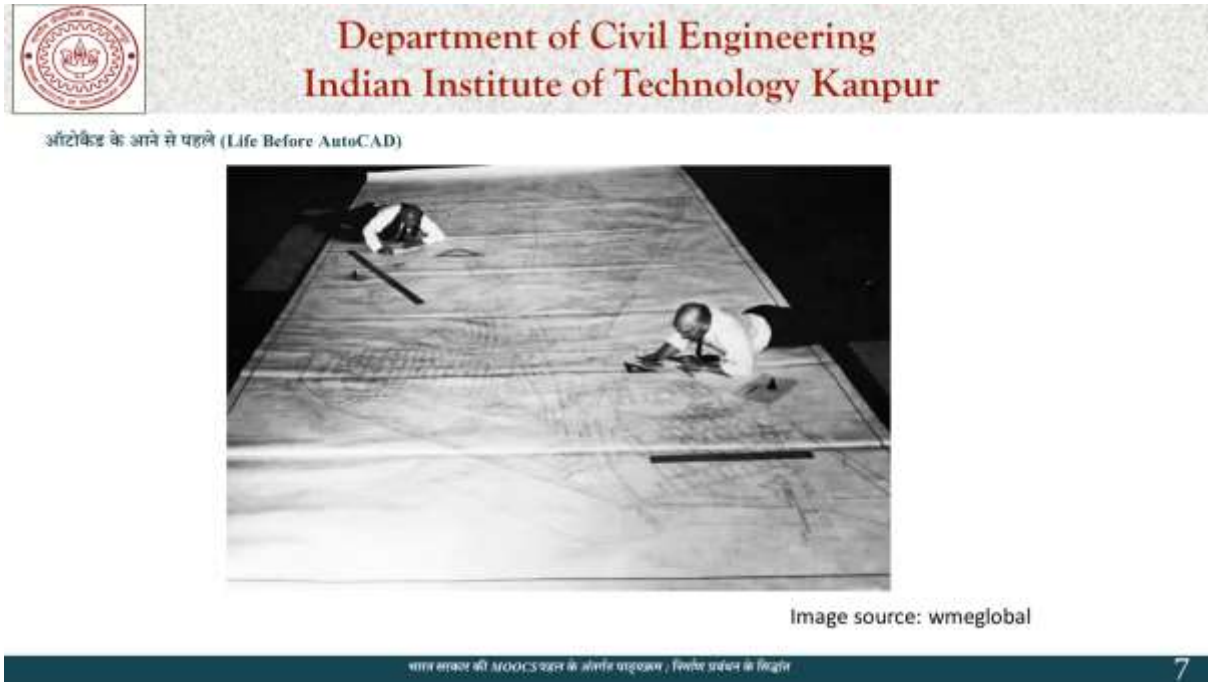
Conceptual drawings, ummeed karate hain aap sab jaanate honge conceptual drawings ya drawings. Yah ek aisee field hai jahaan par software ka prayog moolat: bahut jyaada hone laga hai. Khaasa karake aap sabane naam suna hoga autocad ka. Lekin main aapako dikhaana chaahoonga ki autocad ke aane se pahale drawings kaise banaee jaatee thee. Yah kuchh chitr hain jo mujhe internet ke maadhyam se praapt hue hain.

(Reference Time 06:22)



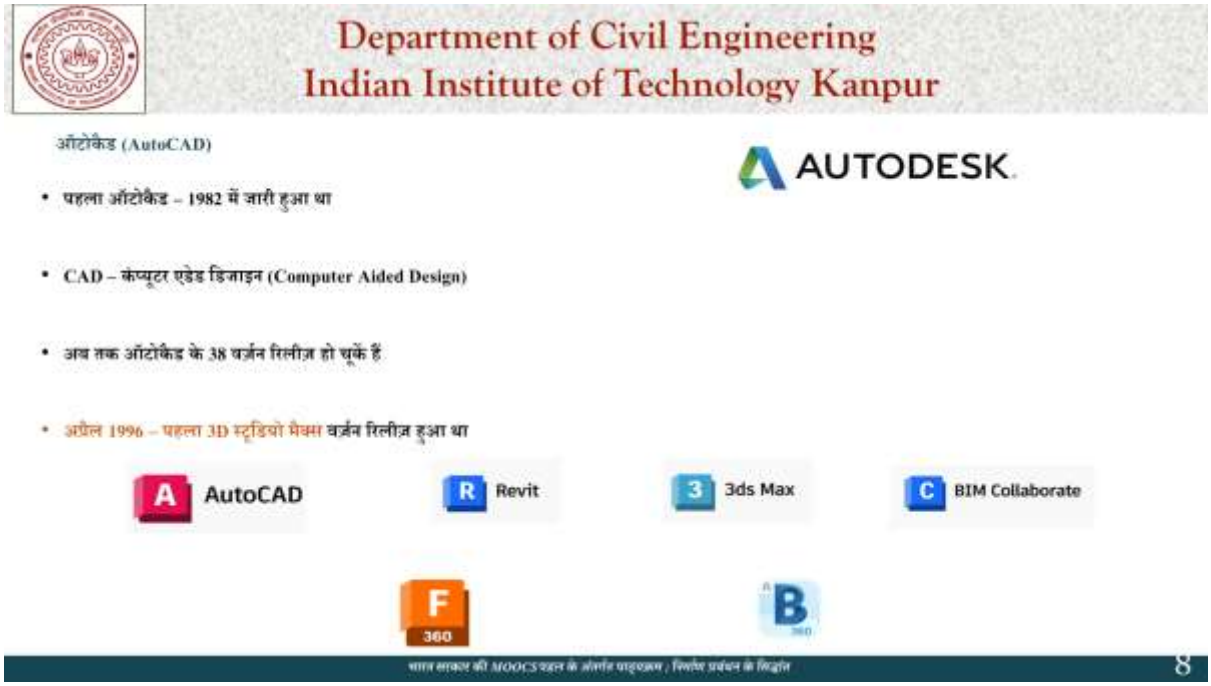
To aap dekhiye jab autocad nahee tha to agar maan leejiye kisee building ka drawings banaana hai, to ek bada sa hall book kiya jaata tha. Us hall mein vibhinn log ek saath aate the. Sab apanee-apanee sheets par drawing banaate the aur vah kuchh is prakaar dikhata tha. Yah hua agar aap kisee project ke liye drawing bana rahe hain. Agar aapake paas multiple floors hain aur bahut saaree drawings banane vaalee hain. Jab main kah raha hoon drawings to sirph civil drawings par focus nahee hai. Civil ke saath electrical drawings hain, HBSE jo hamaara AC units hain, usakee drawings hain. Jo bhee service hamaree buildings mein ja rahee hain un sabhee kee drawings hain. Architectural drawings hain, interior drawings hain, vibhinn tarah kee drawings hain. Un sab drawings ko sheets par banaaya jaata tha aur vah kuchh is prakaar dikhata tha. Yah to phir bhee theek hai. Ab maan leejiye aapako kaha jae ki aapako kisee shahar kee drawing banaanee hai. Maan leejiye aap jis shahar mein rahate hain usakee drawing banaanee hai. To sochiye jab autocad nahee tha to yah kis prakaar hota tha? Vah kuchh is prakaar dikhata tha.

(Reference Time 07:31)



Ek bada sa hall book kiya jaata tha. Ek pepar jo ek room ke baraabar ho, use bichhaaya jaata tha aur jo bhee designers ya architects hote the vah us pe haanth se drawing banaate the. Ab bahut kuchh badal chuka hai aur vah sambhav hua hai autocad ke aane se. Mera uddeshy yah kuchh pictures dikhaane ka yah hai ki main aapako bataana chaahata hoon ki kis prakaar autocad ke aane se pooree industry jo hain vo revolutionized ho gaee hai aur ummeed karana chaahiye ki aage bhee kuchh is prakaar ke softwares aayenge ki ham jo bhee gatividhiyaan kar rahe hain vah karane mein hamen aur saksham banaayega.

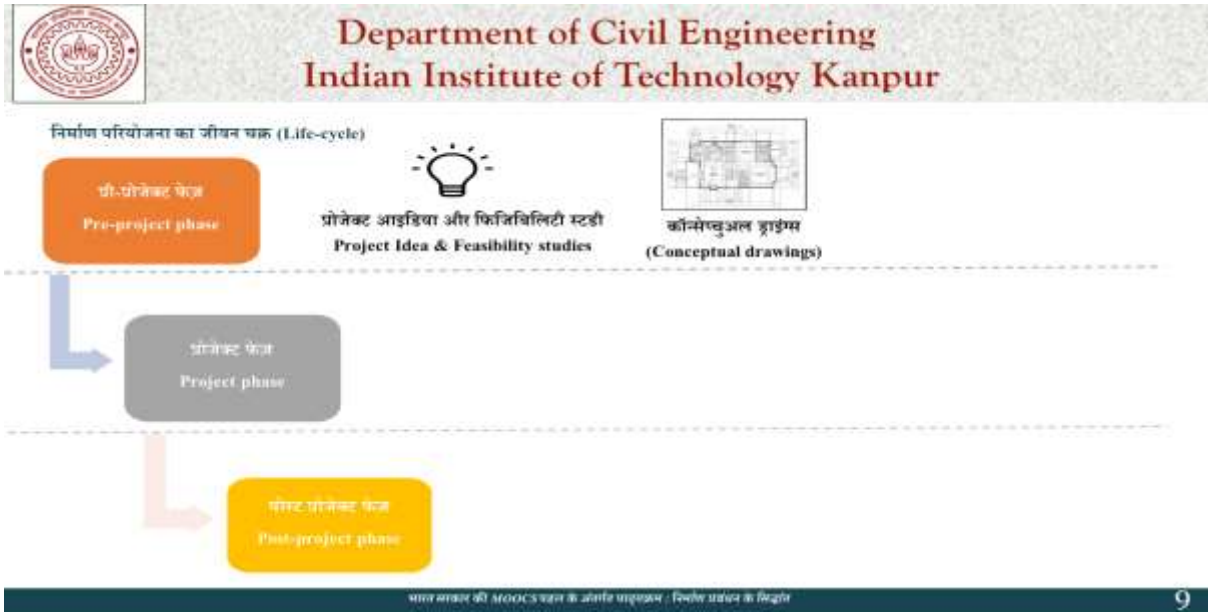
(Reference Time 08:11)



To aaiye sabase pahale ham charcha karate hain autocad kee. Autocad 1982 mein jaaree hua tha. CAD kya hai? CAD hai, Computer Aided Design. Autocad software hai jisakee madad se ham Computer Aided Design kar paate hain. Yah Autodesk company ne banaaya hai lekin aur bhee companiyaan hain jo is prakaar ke software banaatee hain jahaan par CAD drawings

kee ja sake. Autocad ke abhee tak 38 versions release ho chuke hain. Sabase pahale autocad ka prayog too dimensionals drawing (2D) drawings ke liye kiya gaya. Phir 1996 April mein pahala 3D studio max versions release hua, jisakee madad se 3 dimensional drawing banaee ja sakee. 3 dimensional drawing ka matalab hua ki jo x aur y axis hain usake saath hamane gaharaee ya depth ko jod diya. Yah kuchh softwares hain jinaka prayog aaj ke samay mein kiya jaata hai aur Compurter added design drawings ko computer kee madad se banaaya jaata hai.

(Reference Time 09:24)

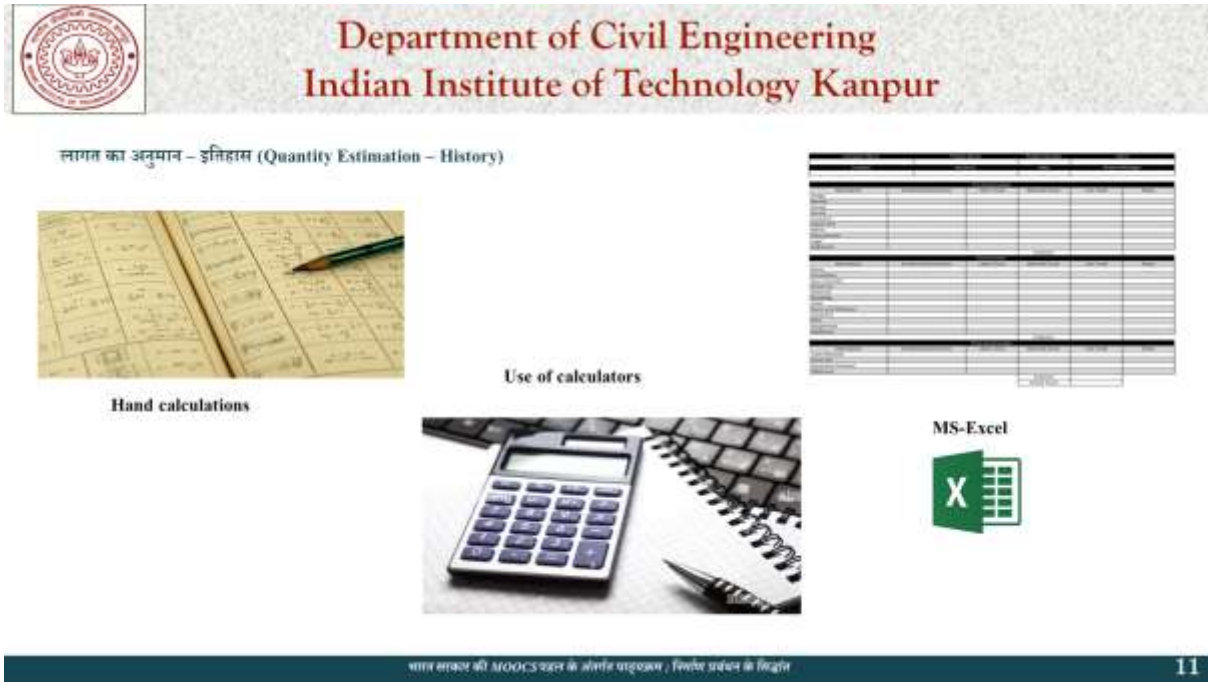


Ab ham aage badhate hain, drawings hamaare paas ban gaee hai usake baad ham karate hain quantity take off (maatra aur laagat ka anumaan).

(Reference Time 09:34)

Yah ek bahut hee mahatvapoorn step hai kyonki hamaare paas ek idea hai jisakee hamane conceptual drawings banaee. Ab ham dekhana chaahate hain ki ham jo total construction karenge usakee laagat kya hogee? Usakee laagat is cheej par nirbhar karegee ki ham jo bana rahe hain usamen kitana building material use hoga, kitana cement use hoga, kitana steel use hoga? Un sabhee gatividhiyon ko karane ke liye ham quantity estimation ka prayog karate hain.

(Reference Time 10:04)



Aaie aage badhate hain quantity estimation moolat: pahale ke samay haath se kee jaatee thee. Bahut badee book hotee thee jisamen likha jaata tha kitana earthwork hoga, kitana construction mein concrete use hoga, kitana cement lagega ityaadi. Sabhee gatividhiyon ko likha jaata tha aur haath se calculate kiya jaata tha. Maan leejie ham hamaare deevaar ke example par jaate hain, to hamen pata hai ki vah kitanee lambee hogee, kitanee chaudee hogee aur kitanee oonchee hogee? Vah teenon ko use karake hai ham usaka volume nikaal sakate hain. Phir calculator aaye. Calculator ke prayog se yah kar paana thoda aasaan hua. Ab ham calculator ka prayog karake nikaal sakate the ki kitanee length aur width rahega aur us hisaab se kitana quantity rahega. Aaj agar ham industry ko dekhen to moolat: Microsoft Excel ka prayog kiya jaata hai. Jahaan par saaree gatividhiyaan darshaee jaatee hain. Unakee lambaee, unakee chaudaee aur unakee gaharaee likhee jaatee hai aur total quantity nikaalee jaatee hai. Yah abhee tak ham kar rahe hain. Isamen hamen dhyaan dena hoga ki jo hamaare designers hain, architects hain vah hamen drawings dete hain ham un drawings ko dekhate hain aur ham pata lagaate hain ki kaun-kaun see gatividhiyaan hongee aur un sabhee gatividhiyon ka ham calculation karate hain. Ab technology kee madad se is poore process ko automate kiya gaya hai.

(Reference Time 11:51)

Main ek video aapako dikhaana chaahata hoon jisamen darshaaya gaya hai ki ek Autodesk ka software hai assemble, main dikhaana chaahata hoon ki usake prayog se kis prakaar yah automatically kiya ja sakata hai. Yahaan par aap dekhiye, jo hamaare designer hain unhone jo design autocad ya revert mein kiya hai use ham directly import kar sakate hain, to vah jo model hai vah model hamaara is software mein aa gaya. Ab jo vibhinn elements hain hamaaree drawings ke jaise maan leejiye ham ek building bana rahe hain to vahaan par walls hain, 4 inch kee concrete kee wall hai, ek 9 inch kee concrete kee wall hai, ek core wall hai is prakaar jo vibhinn elements hain vah yahaan par aa jaate hain. Ab aap kisee bhee element par click karate hain to aap yahaan right side par dekhiega ki information yahaan par dee gaee hai. Hamen pata chalata hai vah kis level par hai usaka total area kitana hai, height kitanee hai, length kitanee hai, area ke prayog se volume nikaala gaya hai. To is prakaar aap chaahe to software kee madad se pooree building kee quantity nikaal sakate hain. Aur hamen yah jaanana hoga ki yah kyon mahatvapoorn hai aur ise automatically karane se kya phaayade hain.

To ab maaniye ki aapane ek architecture designer se aapake ghar kee design banavaee usaka calculation kiya aur ab aapako pata hai ki total kitana quantity hai, kitana area hai, kitana total volume hai. Lekin ho sakata hai ki thode din baad kuchh parevertan aaye . Maan leejiye aap chaahate hain ki aapaka room thoda sa bada ho aur aap chaahate hain ki aapake room ko thoda sa bada kar diya jae. Jab architect aur designer vah karenge, to vaazib see baat hai ki quantities bhee badalengee. Ab agar ham yah calculation haanth se kar rahe hote to hota kuchh is prakaar ki jahaan-jahaan par change (parevertan) kiya gaya hai vahaan hamen dekhana hota ki hamane kya lambaee, chaudaee likhee thee aur use badalana hota. Lekin ab ise automate kar dene se yah hota hai ki jab bhee designer ya architect koee bhee parevertan karate hain, hamaara model vah parevertan dekh leta hai aur hamen bataata hai ki is parevertan ke kaaran yah-yah maatra badalengee aur us kaaran se kya-kya anumaan badalega. To yah ek phaayada hai software ka upayog karane se.

Aur is video ko main vaapis se play karoonga ham aur kuchh features jo software kee madad se upayogee rahate hain, unhe dekhenge. To yahaan par aap dekhiye ki hamen saaree jaanakaaree right column mein dee gayee hai. Agar main ise thoda sa aage badhaoon to aap dekh sakate hain hamaaree drawings mein jitanee bhee cheejen hain, floors hain, columns

hain, frames hain, walls hain, windows hain vo yahaan par dikh rahee hain. Ab kaee baar aisa hota hai ki drawings bahut badee ho jaatee hain aur doosaree aisee jo gatividhiyaan hotee hain, jo chhipee huee hon, vah dikhatee nahee hain. To software kee madad se ham kuchh is prakaar unhen hide ya unhide kar sakate hain. Taaki ham sirph vahee dekhen jo ham dekhana chaahate hain. Yah bahut upayogee hota hai kyonki kaee baar aisa hota hai ki bahut saaree services ek hee jagah se ja rahee hotee hain to software ka prayog karake ham unhen hide ya unhide kar sakate hain. Ham sirph unhen hide (chhipa) rahe hain, ham unhen model se hata nahee rahe hain. To ham bina model ko bigaade sirph vah features ya elements ko dekh sakate hain jinhen ham dekhana chaahate hain.

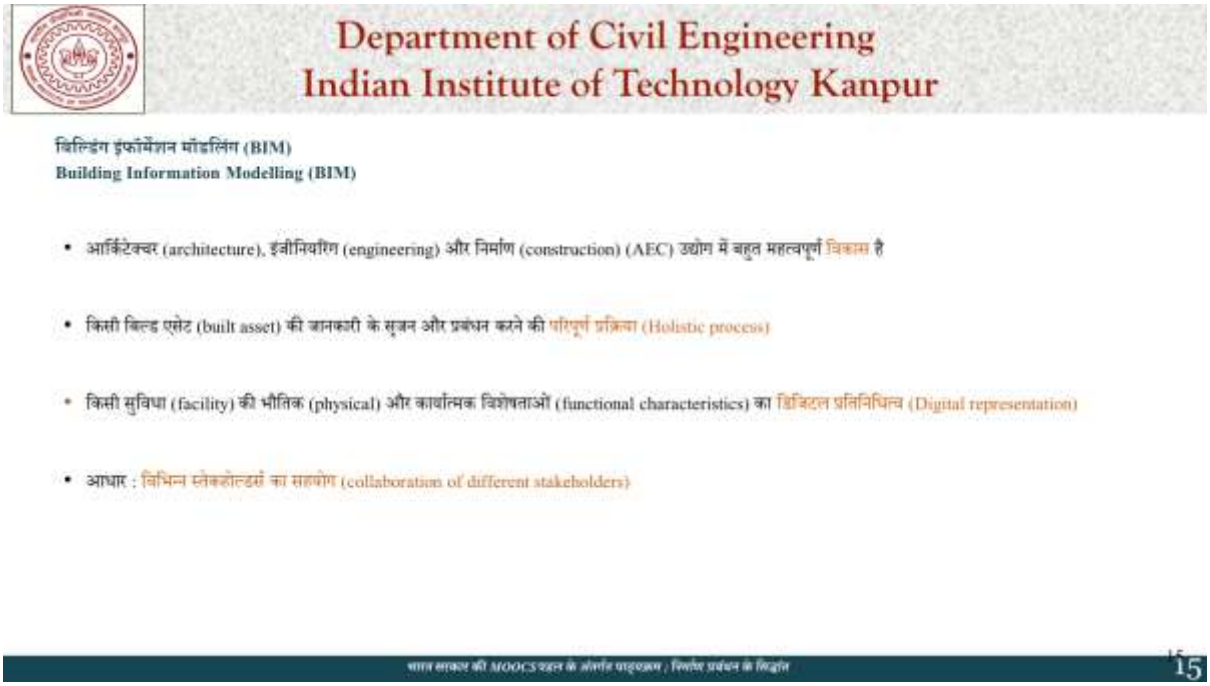
Ab hamane maan leejiye anumaan kiya total kitana length rahega, kitana width rahega aur kya volume rahega saath hee maan leejiye aapane isamen cost bhee daal dee. Agar aapako maaloom hai ki ek square feet construction karane mein maan leejiye 100 rupaye lagenge, to vah bhee aap isamen daal sakate hain aur yah aapako bata dega ki poore project mein total kitanee cost lagegee. To is prakaar se software ka prayog karake quantity take-off kiya ja sakata hai.

(Reference Time 16:07)

To hamane dekha pre-project phase mein sabase pahale ek project ka ek idea hota hai phir ham kuchh conceptual drawings banavaate hain aur phir conceptual drawings ka upayog karake ham maatra aur laagat ka anumaan karate hain. Kaee baar aisa ho sakata hai ki maan leejiye hamaaree laagat jyaada aa rahee hai aur ham chaahate hain ki ham laagat kam karen. Ho sakata hai ham vaapas hamaaree conceptual drawings par jaayen aur ghar ka example len to ham kah sakate hain ki ham shaayad ek room kam karen ya ho sakata hai ham room chhote karen. To is prakaar ham aage-peechhe ja sakate hain lekin moolat: ham us stages par aa jaate hain jab hamen pata hai ki hamen kitana quantity of construction karana hai aur usakee laagat kitanee aane vaalee hai. Ab ham project phase par badhate hain.

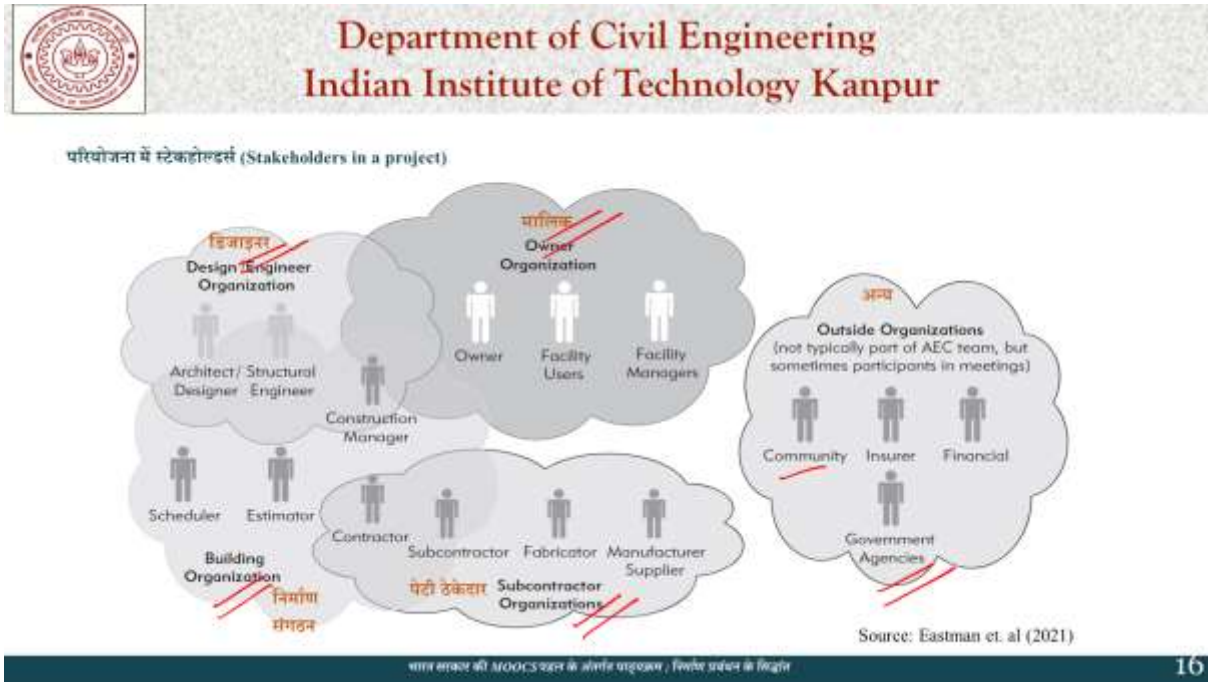
Aage badhate hain isake baad aata hai detailed designing. Abhee tak hamane conceptual drawings banaee thee jo sirph hamen ek idea de rahee thee ki hamaara ghar ya hamaara jo nirmaan hai vo kis prakaar dikhega. Phir ham jaate hain detailed designing stages par jahaan design kiya jaata hai.

(Reference Time 17:15)



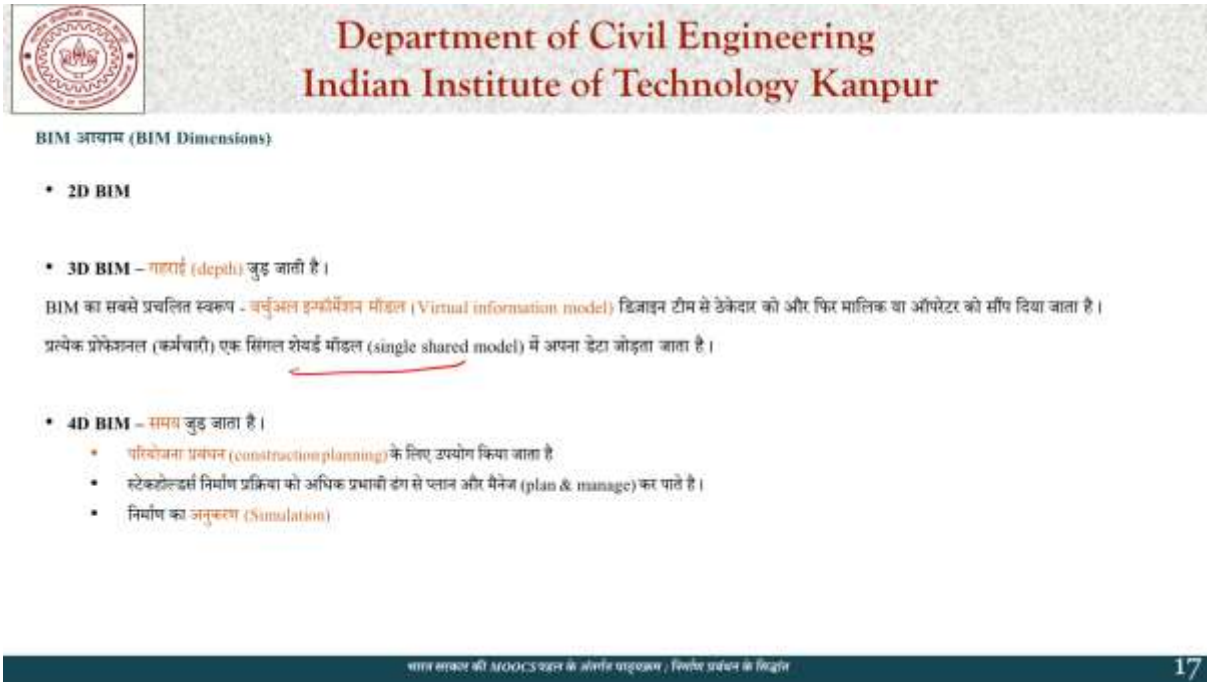
Designing mein ham sabase pahale ek bahut hee mahatvapoorn pahaloo jisaka naame hai building information modeling par charcha karenge. Sabase pahale aaiye jaanate hain building information modeling kya hai? To building information modeling, architecture, engineering aur construction industry mein ek bahut hee mahatvapoorn vikaas hai. BIM mein ek holistic process (paripoorn prakriya) par mahatv rahata hai jo bhee hamaara asset hai usase judee huee sabhee jaanakaaree ka srjan, collection aur prabandhan (management) kiya jaata hai. Jo hamaara physical building hai ya jo facility hain usakee jitanee bhee functional characteristics (kaaryaatmak visheshataayen) hain aur physical dimensions (bhautik dimensions) hain un sabaka ek digital representation banaaya jaata hai. BIM ka aadhaar hai ki jo hamaare stakeholders hain unaka collaboration ya sahayog kis prakaar sunishchit kiya jae. Main yahaan par vishesh taur se bataana chaahoonga BIM koee ek software nahee hai. BIM ke process hai. Holistic process (paripoorn prakriya) hai jisase yah sunishchit kiya jaata hai ki jo vibhinn stakeholders hain jo alag-alag information denge, vah sab information ek hee platform par, ek hee framework mein laee ja sake aur is jaanakaaree ka upayog achchhee tarah se kiya ja sake.

(Reference Time 18:53)



Ab ham yah ek udaaharan se samajhate hain. Mainne starting mein kaha tha ki maan leejiye aap ek ghar bana rahe hain ab aapaka ghar banaane mein vibhinn aise organization honge jo saath mein aayenge. Sabase pahale aayenge maan leejiye designers. Designers jo aapaka ghar design kar rahe hain. Yahaan par design hone ke baad aayenge, nirmaan sangathan (building organization) jinhen aap yah kaary de rahe hain ki vah aapake ghar ka nirmaan kare. Aap maalik hain (owner organization) hain jo us ghar ko use karenge. Ab jo building organization (nirmaan sangathan) hain vah ho sakata hai ki kuchh chhotee-chhotee gatividhiyon ko petee contractors (chhote subcontractors) ko de. Maan leejiye agar waterproofing ka kaary hai vah ho sakata hai vah kisee chhote subcontractors ko de de. Ho sakata hai painting ka kaary hai vah kisee aur subcontractors ko de, to vah yahaan par aate hain. Aur saath hee saath kuchh aise organization hain kuchh aise sangathan hain jo directly ab is kaary se nahee jude hain lekin jarooree hai ki jo bhee kaary ham kar rahe hain vah un maanakon ka paalan kare jo aautasors organization ne banaaye hain. Maan leejiye kuchh government ejensees hain jinake kuchh rules hain jinaka paalan kiya jaana jarooree hai. Maan leejiye kuchh communities hain jo hamaara nirmaan ham kar rahe hain usase impact hone vaalee hai. To BIM jo ek holistic process hai usaka uddeshy yah hai ki yah jitane bhee organization hain. Jab ham koee bada project karate hain kabhee-kabhaar yah bahut jyaada number mein hote hain. Kaee baar possible hai ki 100 se adhik aise vyakti hain jo ek project par saath mein aate hain aur kaam karate hain. Building information modeling yah ensure karata hai ki in sabhee stakeholders ke paas sahee information (jaanakaaree) sahee samay par upalabdh ho aur vah jo bhee jaanakaaree pradaan kare, vah jaanakaaree kuchh is tarah se update kee jae ki jo bhee hamaare doosare organization jo hamaare is project ka bhaag hain unhen bhee yah jaanakaaree samay par mile. Ummeed karate hain ki ab tak aap ye samajh gaye honge ki building information modeling ek software nahee hai aur usaka uddeshy hai ki ek holistic prakriya rahe jahaan par sabhee organization, sabhee stakeholders, designers, architects, construction, subcontractors, government, saaree agencies sab ek saath aakar kaam kar sake aur sabhee ke paas sahee jaanakaaree sahee samay par upalabdh ho.

(Reference Time 21:39)



Ab ham dekhate hain BIM ke kya dimensions hain. Sabase pahale aata hai 2D BIM, 2D matalab jo ham abhee tak drawings dekhate aa rahe hain vah 2 dimensional drawings hotee hain agar ham use BIM model par laate hain to vah bhee 2D BIM kahalaatee hai. Isake baad aata hai 3D BIM jahaan par gaharaee ya depth ko joda jaata hai. Ek virtual information model banata hai jo design team thekedaar ko detee hai aur thekedaar maalik ya operator ko saump deta hai. Aap kuchh is prakaar samajhiye ki ek single shared model hai. Ek model hai jo sabhee designers, maalik, operators se shared hai. Vah sab alag-alag gatividhiyon kee jaanakaaree usee model par daalate hain taaki vah jaanakaaree sabase paas samay se rahe.

Ab ham aage badhate hain 3D dimensions ya third dimension mein hamane dekha depth jud jaatee hai. 4th dimension mein samay jud jaata hai jo hamaaree 3D drawing hain usamen ham samay jod dete hain. To ham bataate hain ki hamaara jo project hai vah kis-kis time par kis-kis stages mein kaise-kaise banega, to samay ke jud jaane se pariyojana ka prabandhan, construction planning mein bahut phaayada hota hai yah bahut prabhaavee rahata hai. Ham sahee tarah se plann aur manage kar paate hain. Ise aap ek prakaar ka 4 dimensional simulation samajhiye jahaan par dikhaaya gaya hai ki maan leejiye zero din par ek khaalee zameen hai. 10 din baad ham khudaee shuru karenge. Usake thode din baad ham foundation daalenge. Foundation daalane ke baad ham vaapas se bharaee karenge. Bharaee karane ke baad ham beems, columns uthaayenge aur is prakaar ham nirmaan karate jaayenge. To jo hamaaree 3 dimensional drawing thee jahaan par sirph 3 depth thee usamen time ko jod dene se yah sunishchit kar liya hai ki jo bhee planning karee jaayegee ki kis prakaar yah nirmaan kaary hoga vah bhee ham BIM ke antargat hee karenge.

(Reference Time 23:58)

Ab ham agale dimension kee or badhate hain fifth dimension jo hai laagat ka. Abhee tak hamane dekha samay ke jud jaane se ham construction planning better kar pa rahe the. Construction planning achchhe se kar pa rahe the. Ab maan leejiye fifth dimension mein laagat bhee usamen jud jaatee hai, to yah bataatee hai ki maan leejiye BIM model mein aapane kisee tarah kee flooring chose karee. Aapake ghar ke example mein aapane kaha ki hamen Italian marble use karana hai. Aapane us model mein us Italian marble ko daala jaise hee aap vah daalenge usakee ek laagat hai. Hamaare paas already quantity thee. Hamen pata tha ki kitana Italian marble use hoga. Italian marble kee ek cost hogee. Vah cost ko agar ham dhyaan rakhenge to model hamen batadega hamen agar Italian marble use karana hai to hamaaree laagat kitanee aane vaalee hai. Yah bahut jyaada upayogee hota hai bajat mein rahane ke liye . Maan leejiye kisee kaaran se aapako lagata hai ki Italian marble bahut mahanga pad raha hai. Aap kah sakate hain ki nahin ham Italian marbles nahee ham tiles use karenge. Tiles ka cost kuchh aur hoga aap usee model mein vah information daal sakate hain. Aur dekh sakate hain ki agar main tiles use karoonga marble kee jagah to total mere project mein kitana cost hoga, yah ek pahaloo hua. Doosara pahaloo hota hai ki yah hamen madad karata hai ki kis prakaar hamen ghar ka nirmaan karane mein kitanee laagat aane vaalee hai. Maan leejiye ek project hai aapaka ghar hee hai vah do saal lene vaala hai construction main. Starting mein kuchh gatividhiyaan hongee un gatividhiyon mein kuchh cost aayegee. Usaka total aap is model ke upayog se bata sakate hain ki pahale teen maheene mein maan leejiye mujhe itane laakh rupaye chaahiye. Agale 6 maheene mein jab civil structure banega to mujhe itana rupaye chaahiye. Jab main finishing kee or aaoonga ya final stages kee or aaoonga to itanee laagat lagane vaalee hai. Fifth dimension cost ke add ho jaane se hamen bajat mein rahane mein sahayog hota hai aur financial planning kis stages par kis phase mein hamen kitana paisa chaahiye vah jaanakaaree bhee mil jaatee hai.

Ab ham agala dimension dekhate hain. 6 dimension hota hai sustainability ka. Sustainability ka aakalan kiya ja sakata hai. Ham dekh sakate hain ki jo bhee nirmaan kaary ham kar rahe hain usake antargat jo vibhinn environmental factors hain vah kis prakaar sunishchit kiye ja rahe hain aur saath-hee-saath ham dekh sakate hain ki jo bhee ham nirmaan kar rahe hain usaka pradarshan (building kee performance) kis prakaar rahegee. Yah samajhane ke liye ham ek example lete hain. Maan leejiye aapake ghar mein yah decide karana hai ki aap kis

tarah kee lights ka upayog karen. Aapake paas maan leejiye vibhinn option hain. Aap balb use kar sakate hain. LED lights use kar sakate hain. Ab aap jab yah karenge to ho sakata hai maan leejiye balb jo hai vo LED lights se saste hon. To initially ho sakata hai ki balb lagaane mein aapako sasta pad raha ho. LED lights mahange pad rahe hon. Lekin jab aap use bims ke model ke prayog se dekhenge to aapako yah jaanakaaree milegee ki ho sakata hai ki balb aapako har 2 saal mein badalana pade lekin LED lights 4 saal mein badalanee padegee ya yah bhee ho sakata hai ki jo balb aap upayog kar rahe hain vah de too de electricity ka jo consumption hai (bijalee jo hai use jyaada use) kar raha hai lekin agar aap LED lights use kar rahe hain to bijalee ka jo consumption hai vah kam ho raha hai. Aap dekh sakate hain ki jo bhee aap decision (nirnay) aaj aap le rahe hain usaka environmental factors aur building performance par kya impact rahega. Yah bahut hee jarooree dimension hai kyonki kaee baar ham sirph sastee cheez laga rahe hain, kee koshish mein yah ensure nahee kar paata hai ki environmental factors aur long term performance sunishchit ho gayee hai.

Ab aage badhate hain, 7 dimension kya hai? Jo saatavaan dimension hai vah facility management (suvidha prabandhan) par hai. Jahaan par jo bhee hamane nirmaan kiya hai usaka jeevan chakr (life cycle) management par dhyaan de rahe hain. Ham yah sunishchit kar rahe hain jo bhee hamen sanchaalan ya rakharakhaav (operation aur maintenance) karana hai, kab karana hai, kis prakaar karana hai usakee bhee jaanakaaree usee ke andar rahe taaki ek baar construction khatm hone ke baad yah BIM model hamen bataata rahe ki kaun-kaun sa operation aur maintenance hamen de too de karana jarooree hai, vah kis prakaar karen aur kisakee madad se karen. Jo hamaare nirmaata hain maan leejiye aapane aapake ghar me AC lagaaya hai. Koee ek company hai unhonne aapako warranty aur guarantee dee hogee is prakaar kee jo jaanakaaree hai vah bhee BIM model mein add kee ja sakatee hai. To hamane dekha ki ek building information modeling jo 2D drawing se shuroo hota hai usamen kis prakaar depth, time, cost, sastenabilitee aur facility management ko joda jaata hai aur ek 7 dimensional BIM model banaaya jaata hai.

(Reference Time 29:31)

Yah kuchh softwares hain jinakee madad se BIM ko implement kiya ja sakata hai.

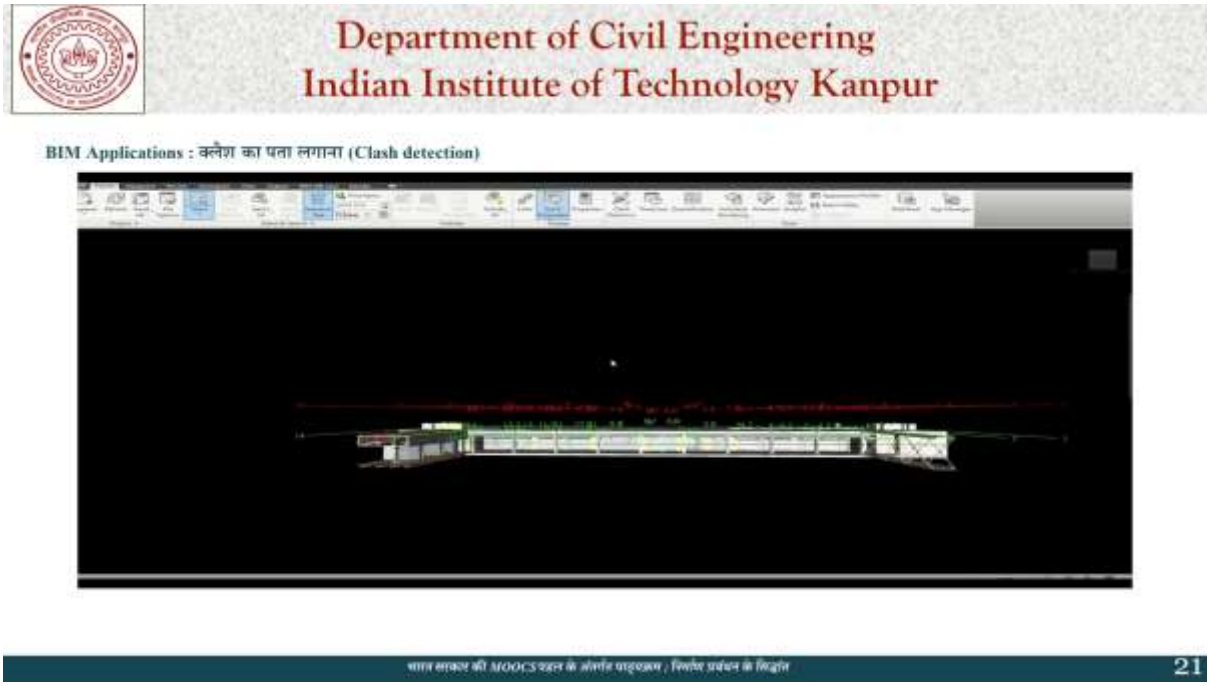
(Reference Time 29:39)

Model based estimation. Hamane dekha kis prakaar designers ya architects jo model hamen de rahe hain usamen agar multiple stakeholders apanee-apanee jaanakaaree jodate jaayen to usaka prayog karake ham yah anumaan laga sakate hain ki hamen kitana cost lagega. Agala sabase mahatvapoorn advantage ya phaayada jo building information modeling ka hai, vah hai clash detection isape charcha karana thoda anivaary hai. Clash detection kya hai? Aap agar kisee construction site par kabhee gaye hain to aapane yah dekha hoga clash detection nirmaan kaary ke dauraan bahut hee aam baat hai. Yahaan par main ise ek example kee madad se bataana chaahata hoon. Maan leejiye ki aapakee ek deevaar hai. Vibhinn services jo electrical ke conduits hain jo maan leejiye ach ke lines hain, paipalines hain, services hain, vah sab usake andar se jaayengee. Ab aam taur par yah hota hai ki hamaara jo architect hai jo yah dekhata hai ki yah deevaar baahar se kaise dikhegee. Jo hamaara interior designer hai vah bataata hai ki yah deevaar itanee chaudee honee chaahiye ya is prakaar dikhegee. Phir hamaaree drawings structural engineer ke paas jaatee hain, jo bataata hai ki is deevaar ko banaane ke liye itana sariye kee jaroorat hogee. Yah sariya itanee dooree par hona chaahiye. Yah sariya is tarah se arranged hona chaahiye.

Ab yahee jaanakaaree aage badhatee hai. Ham jaate hain electrical engineer ke paas jise ham bataate hain ki hame electrical ke kya-kya equipments lagaane hain aur vah bataata hai ki electrical kee wiring karane ke liye kis prakaar electrical conduits ya pipes jo hain vah deevaar mein jaayenge. Maan leejiye ab ham jaate hain AC ya HBSE vaalon ke paas, jo yah bataayenge air conditioning karane ke liye ya heating karane ke liye kis prakaar kee pipelines ya services hain jo deevaar ke andar se jaayegee. Is prakaar vibhinn log bataate hain ki kya-kya us deevaar ke andar jaane vaala hai lekin yah jaanakaaree multiple sources se aa rahee hai. Anek vyakti hamen yah jaanakaaree de rahe hain. Usamen yah hota hai jab ham nirmaan kaary ke liye actually jaate hain. Jab ham use execute karane ke liye jaate hain to ham dekhate hain ki kaee cheezen conflict ho rahee hain ya clash ho rahee hain. Maan leejiye hamaare structural engineer ne kaha hai ki yahaan se sariya jaana chaahiye. Yah bahut jyaada possible hai ki electrical engineer kah raha ho ki nahee yahaan se conduits jaana chaahiye ya koee aur service vaala kah raha ho ki yahaan se koee aur service kee line jaana chaahiye. Is kaaran yah hota tha ki jab ham execution karate hain to hamen yah problem dikhatee hai kyonki aap samajhiye jagah to ek hee hai, physical vaheen se saaree cheezon ko jaana hai. Ab

jab ham execute karane jaate hain to ham yah nahee kar paate hain phir hamaara daayitv banata hai ki ham pahale designer ko bataayen, phir ham saaree services vaalon ko bataayen ki yah problem aa rahee hai. Phir vah sab ek doosare se charcha karate hain aur isaka nivaaran karate hain. Building information modeling ke upayog se ab ham yah sab construction shuroo hone ke pahale hee kar sakate hain. Yah jo building information modeling ka model hai, is model mein sabhee jaanakaaree ek saath available hai. Ab ham chaahen to directly clash detection naamak ek feature hai, jisaka upayog kar sakate hain.

(Reference Time 33:16)



Yah udaaharan aap dekhiye, yahaan par maan leejiye hamen hamaare alag-alag stakeholders jo hain jo hamaaree drawings bana rahe hain unhonne hamen drawing dee hai. Maan leejiye yahaan par ham test kar rahe hain, us test ko karane ke liye ham sabase pahale maan leejiye plumbing kee drawing select kar rahe hain. Saath-hee-saath ham mechanical kee drawing select kar rahe hain aur ham running test kar rahe hain. Ab yah software kya kar raha hai. Yah dekh raha hai aisee kaun-kaun see jagah hain jahaan par mechanical ke elements aa ra he hain saath-hee-saath plumbing ke elements aa rahe hain aur aise jo bhee elements hain jo ek doosare se clash karenge ya conflict karenge, use yah laal mein darsha deta hai. To building banane ke pahale hee ham yah dekh pa rahe hain ki yah kuchh places hain (yah kuchh jagah hain) jahaan par kuchh clash ho sakata hai. Ab is software kee madad se is clash ko ham asain kar sakate hain. Asain matalab ham dekh pa rahe hain ki yah clash mechanical aur plumbing ke kaaran ho raha hai. Ham chaahen to mechanical aur plumbing kee jo hamaaree teem hai jinhonne yah design kiya hai unhen asain kar den. Unhen bataayen ki yah clash ho rahe hain, aap ise dekhiye. Ab yahaan par aap dekhiye asain clash yahaan par asain tool mein maine naam likha hai ki maan leejiye aap inhen asain kar deejiye usake baare mein kuchh jaanakaaree de dee aur ise submit kar diya. Is prakaar saare clashis poore project pe jo ho rahe hain. Maan leejiye ek bahut badee building ban rahee hai jahaan par vibhinn aisee services hain to yah aam baat hai ki 100 se 150 clash aam taur par aate hain jinhen sunishchit kiya ja sakata hai early stage mein (sahee samay par) ki yah clash jab ham construction karane jaayen to nahee aayen. To BIM ke upayog se jo sabase mahatvapoorn phaayada hai vah yah ho jaata hai ki jab ham construction kar rahe hain to is tarah ke clash ko hamane

pahale hee direct kar liya hai aur usake detection se hamane use sahee samay par resolve kar diya hai aur phir ham agale stage par badh rahe hain.

(Reference Time 35:27)

Ab ham aage badhate hain ek aur upayog jo BIM ka hai vah hai 3D modeling aur virtual reality. Yahaan par ham yah kar rahe hain ki kisee bhee project jo abhee bana nahee hai vah kis prakaar banega usaka ek virtual model bana rahe hain virtual reality bana rahe hain. Yah ek udaaharan hai ki aap ek kaar racing game khel rahe hain. Aap ek car par baithe hain vah kaar aap chala rahe hain lekin vah car aap jis map par chala rahe hain vah map ek actually jo project banane vaala hai vah hai. To yah kis prakaar kiya jaata hai? To hamaare paas starting mein kuchh drawings hotee hain. Too dimensional drawings hotee hain. Kuchh softwares ka prayog karake ham unase ek 3D engineering model banaate hain. Ab ham 3D max studio ka use karake modeling aur rendering karate hain ham design banaate hain ki vah road kis prakaar dikhega aur phir ek gaming engine yahaan par hamane unreal engine use kiya hai par aise kaee engine hain jisaka upayog karate hain aur dekhate hain ki virtual reality mein agar main is road par drive kar raha hoon to yah kis prakaar dikhega. Yah bahut hee upayogee hota hai. Maan leejiye ki aap ek road bana rahe hain jahaan par 6 len hain. Maan leejiye aap kisee ek len mein hain aur aapakee gaadee 100 kee speed se chal rahee hai, ab aapako maan leejiye right turn lena hai abhee aap left mein us lane mein hain. To is model mein aap dekh sakate hain ki agar mujhe maan leejiye ek len 5 len changes karake 6 len mein jaana hai, 100 kee speed par yah kaary karana hai jab doosaree gaadiyaan bhee chal rahee hain. To usake liye mujhe kitane time kee jaroorat padegee vah saaree planning main kar sakata hoon aur sunishchit kar sakata hoon ki jo main construction kar raha hoon vah real world mein kaisa dikhega aur usamen koee problem to nahee aayegee. Yahaan par ek example diya gaya hai jisakee link aapake saath share kee jaayegee. Vah aap dekh sakate hain ki 3D modeling aur virtual reality kee madad se kis prakaar ek project ko visualized kiya ja sakata hai. BIM indiya mein kuchh projects par abhee use kiya gaya hai.

(Reference Time 37:52)

Yahaan par mainne do examples diye hain Chennai Metro and Bangalore Airport ka. In dono projects par yah dekha gaya ki building information modeling kee madad se time efficiency jo nirmaan kaary kiya gaya hai vah paaramparik nirmaan kaary karane kee tulana mein 25 se 30% tej hua. Saath-hee-saath jo cost hai vah bhee 15% kam lagee. Bangalore Airport par BIM ke prayog se jo Operational efficiency hai jo yaatrion mein bheed ya unhen waiting time jo lagata tha use kam kiya gaya hai. BIM kee madad se 20% kamee aayee hai waiting time mein, aur cost mein bhee 15% kamee aayee hai. Yah kuchh udaaharan hain Delhi metro bhee information modeling ka upayog unake projects par kar raha hai. To hamane dekha kis prakaar construction 4.0 khaas taur par building information modeling designing mein bahut jyaada upayogee rahatee hai.

(Reference Time 38:49)

Ab maan leejiye hamaaree designs ban gayee hain isake aage ke jo pahaloo hain tendering, nirmaan, construction, handover, sanchaalan evan rakharakhaav (operation and maintenance) aur demolition isake aage ke sabhee pahaluon par ham aage lecture mein charcha karenge.

Yah lecture ham yaheen samaapt karenge. Bahut-bahut dhanyavaad!