



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
WAKNAGHAT, P.O. – WAKNAGHAT,
TEHSIL – KANDAGHAT, DISTRICT – SOLAN (H.P.)
PIN – 173234 (INDIA) Phone Number- +91-1792-257999
(Established by H.P. State Legislature vide Act No. 14 of 2002)



One Week Online Workshop on “Disaster Risk Assessment”

A One Week Online Workshop on “Disaster Risk Assessment,” was organized by the Centre for Structural Engineering and Disaster Management, Civil Engineering Department, Jaypee University of Information Technology (JUIT), Wagnaghat, in partnership with Indian Institute of Technology, Mandi, and Indian Geotechnical Society, Shimla Chapter, from July 22–26, 2024. The program was successfully completed under the auspices of:

- **Prof. Rajendra Kumar Sharma:** Vice Chancellor, JUIT, Wagnaghat, and Patron of the organized workshop.
- **Prof. Ashok Kumar Gupta:** Dean of Academics & Research, JUIT, Wagnaghat, and Patron of the organized workshop, and President, Indian Geotechnical Society, Shimla Chapter,
- **Prof. Ashish Kumar:** HOD, Civil Engineering Department, and Chairperson, Center for Structural Engineering and Disaster Management, JUIT, Wagnaghat, and Program Chair of the organized workshop.
- **Dr. Sugandha Singh:** Assistant Professor, Civil Engineering Department, and Member, Center for Structural Engineering and Disaster Management, JUIT, Wagnaghat, and Program Convener of organized workshop.
- **Dr. Shivang Shekhar:** Assistant Professor, School for Civil and Environment Engineering, Indian Institute of Technology, Mandi (IIT Mandi) and Co–Convener of organized workshop.

The One Week Online Workshop on ‘**Disaster Risk Assessment**’ comprised mainly of eminent speakers from renowned institutes who discussed various aspects of calculating hazard and risk of different types of hazards. The primary objective of the workshop was to teach the students, academics, and industry professionals, to conduct basic calculations of probability of occurrence of a hazard such as earthquakes, floods, landslide, etc., and further calculating the risk on infrastructure for each hazard. *The workshop was organized to fulfill the capacity building target of the United Nation’s Sustainable Development Goal number 11.* Each day of the workshop covered a different type of hazard and covered a wide range of topics. Through



engaging lectures, interactive discussions, hands-on activities, and insightful guest presentations, participants were exposed to basic concepts required to calculate probabilistic hazard and risk assessment for each hazard. Each lecture was unique as the topics discussed are not taught as part of Civil Engineering or Architecture curriculum at any level. Since the need for conducting such hazards is absolutely necessary for Disaster Resilient Infrastructure, the participants appreciated the workshop to quite an extent.

Table-1 highlights the program schedule of the conducted STC including the names and organizations of the speakers along with the title of lectures (talks) delivered by them.

Table 1: Schedule for One Week Online Workshop on “Disaster Risk Assessment,” July 22–26, 2024

Date	Time	Events
22-07-2024 (Earthquake)	2:15 PM	JUIT Video
	2:17 PM	Welcome of the participants by Dr. Sugandha Singh, Assistant Professor, Civil Engineering Department, JUIT, Wagnaghat
	2:18 PM	Welcome of the participants by Dr. Ashok Gupta, Dean (Academics & Research), JUIT & President, IGS, Shimla; Dr. Ashish Kumar, HOD, Civil Engineering, JUIT.
	2:20 PM	About The Workshop presentation by Dr. Sugandha Singh, Convener of the Workshop
	2:30 PM	Expert Talk by <i>Dr. Sugandha Singh, Assistant Professor</i> , Civil Engineering Department, JUIT, Wagnaghat, on ‘Probabilistic Seismic Hazard Analysis’
	4:00 PM	Expert Talk by <i>Dr. Shivang Shekhar, Assistant Professor</i> , Indian Institute of Technology, Mandi on ‘Probabilistic Seismic Risk Assessment of Infrastructure Systems’
23-07-2024 (Floods)	9:30 AM	Expert Talk by <i>Dr. Saran Srikanth Bodda, Graduate Faculty</i> , North Carolina State University, Raleigh, USA on ‘An Overview of External Probabilistic Risk Assessment’
	11:00 AM	Expert Talk by <i>Dr. Ankit Agarwal, Assistant Professor</i> , Indian Institute of Technology, Roorkee on ‘Probabilistic Flood Hazard Analysis’
24-07-2024 (Landslides)	9:30 AM	Expert Talk by <i>Dr. Maheshreddy Gade, Associate Professor</i> , Indian Institute of Technology, Mandi on ‘Earthquake-Induced Landslide Hazard Assessment’



	11:00 AM	Expert Talk by <i>Dr. Kala Venkata Uday</i> , Associate Professor, Indian Institute of Technology, Mandi on <i>‘Landslide Risk Mitigation and Prediction.’</i>
	12:30 PM	Expert Talk by <i>Dr. Tanmay Gupta</i> , Assistant Professor, JUIT on <i>‘Post Landslide Assessments: Harnessing Innovative Techniques for Future Resilience’</i>
25-07-2024 (Fire and Industries)	9:30 AM	Expert Talk by <i>Dr. P. Ravi Prakash</i> , Assistant Professor, Indian Institute of Technology, Jodhpur on <i>‘Fire Safety in Structures: An Overview’</i>
	11:00 AM	Expert Talk by <i>Dr. Sudheer Dwivedi</i> , Joint Director, Disaster Management Institute, Madhya Pradesh on <i>‘Process Hazard Identification Techniques in Industries’</i>
26-07-2024 (Disaster Economics)	9:30 AM	Expert Talk by <i>Dr. Subir Sen</i> , Associate Professor, Indian Institute of Technology, Roorkee on <i>‘Economic Effects of Disasters: Three Different Cases’</i>
	11:00 AM	Valedictory Session
	11.30 AM	Short Quiz for awarding Certificate of Merit to the participants.

Feedback from participants has been overwhelmingly positive, with many expressing appreciations for the new knowledge gained throughout the workshop, and the expertise of the instructors. As we reflect on the achievements of this course, it is evident that education and training play a crucial role in driving positive advances towards a more disaster resilient future.

Table 2: Summary of participation Details in the Workshop

Total Number of Registered participants	105
Total Number of external participants	88







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Other Salient Features

- Presentation slides of all lectures by the speakers for the workshop were shared beforehand by the organizing committee to the participants.
- Certificates of Merit are issued to all registered participants who scored more than 13 out of 20 on the quiz conducted on the last day of the workshop.
- Certificates of participation are issued to all the remaining registered participants.
- Certificates of Appreciation are issued to all the listed speakers along with an appropriate honorarium.
- Feedback collected from participants on each day of the workshop for further improvement in conducting future workshops.
- Feedback collected from speakers for their input in conducting future workshops.

Event Flyer:

Bank Account Details for Payments <table border="1"> <tr> <td>Account Holder</td> <td>Jaypee University of Information Technology</td> </tr> <tr> <td>Account Number (Current A/C)</td> <td>0427032100000010</td> </tr> <tr> <td>Bank Name & Branch</td> <td>Punjab National Bank, JUIT Waknaghat</td> </tr> <tr> <td>IFSC Code</td> <td>PUNB0637100</td> </tr> </table> <p>For payments through UPI: UPI ID: 9816094184m@pnb Merchant Name: Jaypee University of Information Technology QR Code for Payments:</p> 		Account Holder	Jaypee University of Information Technology	Account Number (Current A/C)	0427032100000010	Bank Name & Branch	Punjab National Bank, JUIT Waknaghat	IFSC Code	PUNB0637100	Registration Fees <table border="1"> <thead> <tr> <th>Designation</th> <th>Participation Fees</th> </tr> </thead> <tbody> <tr> <td>Students (UG, PG, PhD)</td> <td>Rs. 200/-</td> </tr> <tr> <td>Faculty, Research Professionals, Industry Professionals</td> <td>Rs. 400/-</td> </tr> </tbody> </table> <p>The registration fees includes access to all the sessions of the workshop as well as a 'Handbook for Disaster Risk Assessment' which will be compilation of all the lecture notes from the workshop.</p> <p>Registration Process Make the payment as per above table to the account given. Scan the QR Code or go to the link given below to access the Google Form. Fill out all the necessary details along with the payment details. An email will be sent to the participants whose payment details are verified.</p> <p>Registration Starts: July 12, 2024, 10 am Last Day to Register: July 21, 2024, 11.59 pm</p> <p>SCAN ME  Registration Link: https://forms.gle/6LFep55UyhL8Zes9</p>	Designation	Participation Fees	Students (UG, PG, PhD)	Rs. 200/-	Faculty, Research Professionals, Industry Professionals	Rs. 400/-	 One Week Online Workshop on Disaster Risk Assessment July 22-26, 2024 Organized By: Center for Structural Engineering and Disaster Management Civil Engineering, JUIT, Waknaghat in Partnership with: IIT, Mandi and IGS, Shimla Workshop Coordinators Dr. Sugandha Singh, JUIT Dr. Shivang Shekhar, IIT Mandi About The Workshop Indian subcontinent faces multiple natural as well as manmade hazards within a year. From earthquakes to landslides and from fire to industrial disasters, the human lives and infrastructure of the subcontinent. The students, researchers, and professionals working in this area, must understand the basics of conducting hazard and risk assessment to move towards a more robust modelling and design of infrastructure of the Indian subcontinent. 
Account Holder	Jaypee University of Information Technology																
Account Number (Current A/C)	0427032100000010																
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Jaypee University of Information Technology, Wagnaghat, H.P.

The JUIT was conceived by a joint vision of the Govt. of Himachal Pradesh and the Founder Chairman of Jaypee Group Shri Jai Prakash Gaur ji in 2000. JUIT Wagnaghat offers a challenging academic environment to its students. It aims to instill the habit of life-long learning and therefore, provides a learner-centric rather than a teacher-centric educational process. The system has been designed to provide students the freedom to learn what they want to learn at a pace determined by them. Post-graduate students are encouraged to develop independence in thought and action as well as the ability to develop solutions that fit problem requirements. These students are trained to acquire the capability to deploy appropriate technology paradigms for given tasks, explore new technology, and lead teams to solve complex problems.

Civil Engineering Department

Undergraduate and Post Graduate Programs in Civil Engineering at JUIT Wagnaghat have been developed to meet the latest requirements of the infrastructural development of our country in areas like Construction, Transportation, Hydropower and Environmental engineering. The curriculum has been developed to keep it more practical and industry oriented without compromising on its academic rigor.

Objectives of the Workshop

The workshop is designed to follow the capacity building target of United Nation's Sustainable Development Goal No. 11 (Sustainable Cities and Communities). To fulfill the same, the familiarity with the concepts of analysis and design to sustain any hazard is very important. Hence, the major objectives of this workshop are as follows:

- To familiarize students, faculty, and industry professionals working in the disaster management to conduct robust risk assessment of various disasters.
- To introduce the basics of deterministic and probabilistic risk assessment for different hazards.
- To enable participants to be able to use similar concepts in various other disasters such as hurricanes, pandemic, economic crisis, etc.

Participants

The workshop is open for all students, faculty members, researchers, and industry professionals working in the field of disaster risk assessment and management.

What Participants will Gain?

Each registered participant will receive an exclusive copy of the 'Handbook on Disaster Risk Assessment' as well as a Certificate of Participation. A Certificate of Merit will be awarded to the participants who perform well in the short quiz at the last day of the workshop.

Workshop Itinerary (Tentative)

Day 1: July 22, 2024 (10 am onwards)
Hazard Type: Earthquakes
Dr. Sugandha Singh, Assistant Professor, JUIT
Probabilistic Seismic Hazard Analysis
Dr. Shivang Shekhar, Assistant Professor, IIT Mandi
Probabilistic Seismic Risk Assessment

Day 2: July 23, 2024 (9:30 am onwards)
Hazard Type: Floods
Dr. Saran Srikanth Boddala, Graduate Faculty, NCSU
Probabilistic Flooding Risk Analysis
Dr. Ashit Agarwal, Assistant Professor, IIT Roorkee
Probabilistic Flooding Hazard Assessment

Day 3: July 24, 2024 (9:30 am onwards)
Hazard Type: Landslides
Dr. Maheshreddy Gade, Associate Professor, IIT Mandi
Landslide Hazard Analysis and Susceptibility Mapping
Dr. Kala Venkata Uday, Associate Professor, IIT Mandi
Landslides Prediction and Mitigation Techniques
Dr. Tanmay Gupta, Assistant Professor, JUIT
Post Landslide Assessments

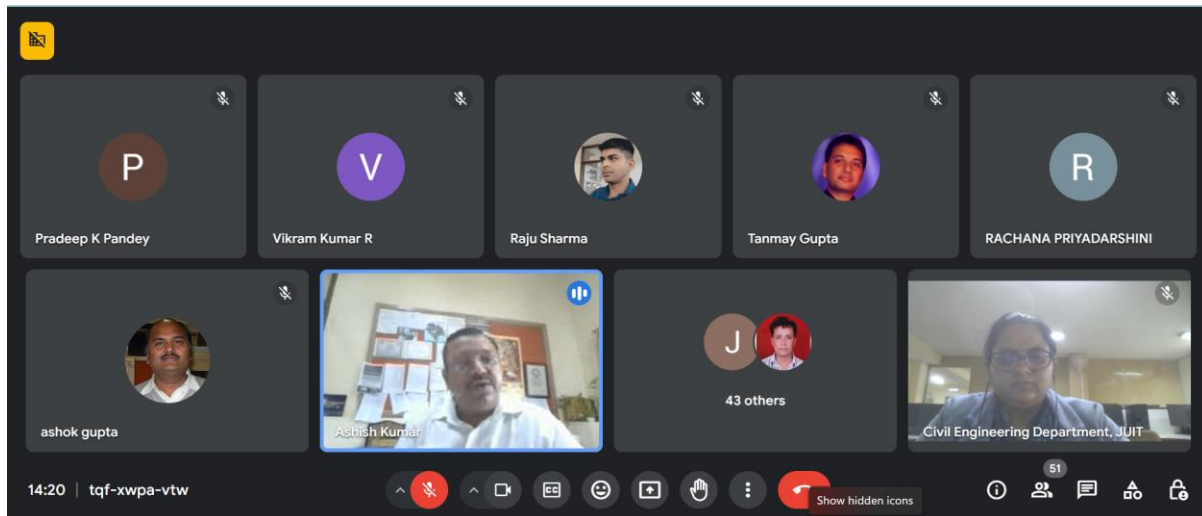
Day 4: July 25, 2024 (9:30 am onwards)
Hazard Type: Fire and Industries
Dr. P. Ravi Prakash, Assistant Professor, IIT Jodhpur
Structural Fire Hazards
Dr. Sudheer Dandevi, Joint Director, Disaster Management Institute, H.P.
Process Hazard Identification Techniques in Industries

Day 5: July 26, 2024 (9:30 am onwards)
Dr. Subir Sen, Associate Professor, IIT Roorkee
Economic Effects of Disasters

Contact Us
Dr. Sugandha Singh
Assistant Professor
Civil Engineering Department
JUIT, Wagnaghat, H.P.
+91-83940 88666
sugandha.singh@juitsolan.in

Event Photos:

Day 1:





Civil Engineering Department, JUIT (You, presenting) Stop presenting

Probabilistic Seismic Hazard Analysis (PSHA)

PRESENTED BY:
 DR. SUGANDHA SINGH, ASSISTANT PROFESSOR,
 CIVIL ENGINEERING DEPARTMENT,
 JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY,
 WAKNAGHAT

14:33 | tqf-xwpa-vtw

Participants: Saurav Kumar, Ashish Kumar, ashok gupta, Pradeep K Pandey, Vikram Kumar R, Tanmay Gupta, Niraj Singh Parihar, 51 others, Civil Engineering...

Civil Engineering Department, JUIT (You, presenting) Stop presenting

Deterministic Seismic Hazard Analysis (DSHA)

Step 3: Select a GMPE and find values of peak horizontal acceleration. Let's select following GMPE defined for data consisting of $M = 3.0$ to 7.7 and distances of 20 to 200 km.

$$\ln PHA = 6.74 + 0.859M - 1.80 \ln(R + 25)$$

The PHA values generated are:

Source	Magnitude, M	Distance, R (km)	PHA
1	7.3	23.7	0.42g
2	7.7	25	0.57g
3	5	60	0.02g

→ Controlling Earthquake

19

15:20 | tqf-xwpa-vtw

Participants: Sanjay Kushwaha, Aaryaman Chande..., Borah Triptimoni, Ashish Verma, CHIRDEEP N R, Dr.J.Prakash Arul J..., RACHANA PRIYAD..., 66 others, Civil Engineering...



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Civil Engineering Department, JUIT (You, presenting) Stop presenting

JAYPEE EDUSPHERE IGNITED MINDS INSPIRED SOULS

PSHA Equation

$$\lambda_{y*} = \sum_{i=1}^{N_s} v_i \sum_{j=1}^{N_m} \sum_{k=1}^{N_g} P[Y > y | m_j, r_k] P[M = m_j] P[R = r_k]$$

16:01 | tqf-xwpa-vtw

Participants: SUVAM DAS, Sanjay Kushwaha, Dr.J.Prakash Arul J..., RACHANA PRIYAD..., Jaswinder Singh, behara subhash, Manojkumar Ghon..., 59 others, Civil Engineering...

Shivang Shekhar (Presenting)

One Week Online Workshop on Disaster Risk Assessment
 July 22nd – 27th, 2024

Probabilistic Seismic Risk Assessment of Infrastructure Systems
 Dr. Shivang Shekhar

16:06 | tqf-xwpa-vtw

Participants: Shivang Shekhar, SUVAM DAS, Sanjay Kushwaha, Dr.J.Prakash Arul J..., RACHANA PRIYAD..., Jaswinder Singh, behara subhash, 53 others, Civil Engineering...



Shivang Shekhar (Presenting)

Seismic Risk

Risk = Hazard × Exposure × Vulnerability

16:24 | tqf-xwpa-vtw

Participants: Shivang Shekhar, Sanjay Kushwaha, Dr.J.Prakash Arul J..., Jaswinder Singh, behara subhash, Rahul Sen, Kayalvizhi Saminat..., 51 others, Civil Engineering ...

Shivang Shekhar (Presenting)

Exposure

16:23 | tqf-xwpa-vtw

Participants: Shivang Shekhar, Sanjay Kushwaha, Dr.J.Prakash Arul J..., Jaswinder Singh, behara subhash, Rahul Sen, Kayalvizhi Saminat..., 51 others, Civil Engineering ...



Shivang Shekhar (Presenting)

Vulnerability

The slide illustrates the concept of vulnerability in structural engineering. It features several diagrams: a bridge structure with vertical supports, a photograph of a collapsed bridge, and various structural models showing different failure modes. A key equation is provided: $Fragility = P[D > C | PGA]$. Below this, a graph plots the cumulative probability of failure (P) against Peak Ground Acceleration (PGA) in g. The curve shows a sharp increase in failure probability as PGA increases, with a dashed line indicating the performance level of an 'As-built bridge'.

16:25 | tqf-xwpa-vtw

Shivang Shekhar (Presenting)

Seismic Fragility Assessment

The flowchart details the process of seismic fragility assessment. It starts with a 'Ground Motion Suite' leading to 'FE Modeling' and 'Structural Response'. From 'Structural Response', the process branches into 'Capacity' (involving Moment and Curvature) and 'Demand Model' (involving ln(D) and ln(M)). Both 'Capacity' and 'Demand Model' feed into 'Seismic Fragility', which is represented by a graph of Probability versus Intensity Measure.

16:33 | tqf-xwpa-vtw



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Shivang Shekhar (Presenting)

Seismic Fragility Assessment

39

- Requirements
- Ground motions
- Structure model
- Assessment

- Selection of ground motions
- Structure numerical modeling
- Seismic vulnerability assessment

Shivang Shekhar

16:46 | tqf-xwpa-vtw

53

Dr.J.Prakash Arul J...
Jaswinder Singh
behara subhash
Rahul Sen
Kayalvizhi Saminat...
cpal3012
44 others
Civil Engineering ...

Shivang Shekhar (Presenting)

FE Modeling of Bridges

41

- Levels of modeling for seismic bridge analysis

LUMPED PARAMETER MODELS (LPM) STRUCTURAL COMPONENT MODELS (SCM) FINITE ELEMENT MODELS (FEM)

Shivang Shekhar

16:49 | tqf-xwpa-vtw

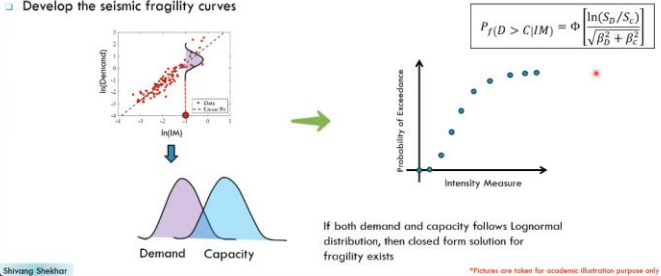
50

Dr.J.Prakash Arul J...
Jaswinder Singh
behara subhash
Ashish Kumar
Kayalvizhi Saminat...
cpal3012
41 others
Civil Engineering ...

Shivang Shekhar (Presenting)

Seismic Vulnerability Assessment - Example

Develop the seismic fragility curves



$$P_r(D > C | IM) = \Phi \left[\frac{\ln(S_D/S_C)}{\sqrt{\beta_D^2 + \beta_C^2}} \right]$$

If both demand and capacity follows Lognormal distribution, then closed form solution for fragility exists

Shivang Shekhar

17:07 | tqf-xwpa-vtw

44

Shivang Shekhar

behara subhash

Kayalvizhi Saminat...

Umesh Kumar

Ashish Kumar

Vivek Singh

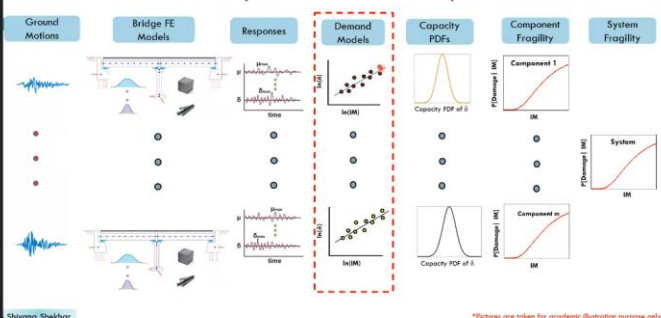
Mayank Gangwar

35 others

Civil Engineering ...

Shivang Shekhar (Presenting)

Seismic Vulnerability Assessment – Example 2



Ground Motions

Bridge FE Models

Responses

Demand Models

Capacity PDFs

Component Fragility

System Fragility

Shivang Shekhar

17:10 | tqf-xwpa-vtw

44

Shivang Shekhar

behara subhash

Kayalvizhi Saminat...

Umesh Kumar

Ashish Kumar

Vivek Singh

Mayank Gangwar

35 others

Civil Engineering ...



Shivang Shekhar (Presenting)

Seismic Risk

The diagram illustrates the process of seismic risk assessment. It starts with a 'Fragility Curve' graph showing 'PFDs-as-IM' on the y-axis and 'Ground Motion Intensity (IM)' on the x-axis. This is multiplied (indicated by a circled X) by a '(Total) Hazard Curve' graph showing 'Annual Frequency of Exceedance' on the y-axis and 'IM' on the x-axis. The result is a 'Repair Cost' graph, which is then used to calculate the 'SLCC' (Seismic Life Cycle Cost) shown in a circular diagram.

Participants: Shivang Shekhar, behara subhash, Kayalvizhi Saminat..., Ashish Kumar, Vivek Singh, Mayank Gangwar, Amit Singh, 36 others, Civil Engineering ...

17:12 | tqf-xwpa-vtw

Shivang Shekhar (Presenting)

Seismic Life Cycle Cost Assessment

The flowchart shows the process of Seismic Life Cycle Cost Assessment. It starts with 'Hazard Curves' and 'Fragility Curves' (both showing Probability vs. Hazard Intensity). These are combined (indicated by a circled X) to form a 'Damage Model + Repair Cost' graph (Probability vs. Damage Level). This leads to a 'Life Cycle Cost Analysis' graph (Expected Cost vs. Lifetime of Structure).

Participants: Shivang Shekhar, behara subhash, Kayalvizhi Saminat..., Ashish Kumar, Vivek Singh, Mahak Swami, Mayank Gangwar, 34 others, Civil Engineering ...

17:16 | tqf-xwpa-vtw



Shivang Shekhar (Presenting)

SUMMARY

HOW CAN WE REDUCE RISK?

$$\text{RISK} = \text{HAZARD} \times \text{EXPOSURE} \times \text{VULNERABILITY}$$

- We can improve our abilities to monitor and forecast hazards
- Increased awareness of the hazards faced by communities and their exposure to them
- The greatest benefits can be achieved by reducing the vulnerability to natural hazards

17:17 | tqf-xwpa-vtw

Shivang Shekhar

behara subhash

Kayalvizhi Saminat...

Ashish Kumar

Vivek Singh

Mahak Swami

Mayank Gangwar

33 others

Civil Engineering ...

Shivang Shekhar (Presenting)

Multi-Hazard RESilient Infrastructure Systems (MH-RESIST) Lab @ IIT Mandi

Dr. Shivang Shekhar
Team Leader

Team Members:
Chirdeep, Vivek, Mayank, Divesh, Vikram

Risk Assessment of Ageing Highway Bridges considering Climate Change and Geohazards

Resilience Enhancement of Ageing Highway Bridges using Optimal Retrofit Measures

17:20 | tqf-xwpa-vtw

Shivang Shekhar

behara subhash

Kayalvizhi Saminat...

Ashish Kumar

Vivek Singh

Mayank Gangwar

chandrashekar k...

32 others

Civil Engineering ...

Day 2:



Saran Srikanth Bodda (Presenting)

Monte Carlo Simulation

- Performance Function is itself an unknown implicit.
- 1. Define the problem in terms of RV's

Grid of participants: Saran Srikanth Bodda, Er. Kumar Lal Babu, DIKSHANT GUPTA, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, 50 others, Civil Engineering Departm...

10:06 | tqf-xwpa-vtw

Saran Srikanth Bodda (Presenting)

Flooding Fragility

- Define Performance Function, $g()$
- Calculate probability of failure
- $P_{fj}(\lambda) = P[g() < 0 | \text{flood intensity} = \lambda]$
- Fragility in terms of Capacity
 - Represents CDF of capacity of an SSC to resist an undesirable limit state.
 - Capacity is measured in terms of IM (λ) at which the SSC exceeds the undesirable limit state.
- 2 Parameters: λ_m, β_C

log-normal fragility model

$$P_{fj}(\lambda) = \Phi \left[\frac{\ln \left(\frac{\lambda}{\lambda_m} \right)}{\beta_C} \right]$$

Grid of participants: Saran Srikanth Bodda, Er. Kumar Lal Babu, DIKSHANT GUPTA, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, 51 others, Civil Engineering Departm...

10:14 | tqf-xwpa-vtw



Saran Srikanth Bodda (Presenting)

Flooding PRA Scenario

10:17 | tqf-xwpa-vtw

Microphone in use by: Google Chrome

Participants: Saran Srikanth Bodda, Er. Kumar Lal Babu, DIKSHANT GUPTA, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, 51 others, Civil Engineering Departm...

Saran Srikanth Bodda (Presenting)

Fault Tree of Protective Floodwall Event

10:21 | tqf-xwpa-vtw

Participants: Saran Srikanth Bodda, Er. Kumar Lal Babu, DIKSHANT GUPTA, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, 52 others, Civil Engineering Departm...



Saran Srikanth Bodda (Presenting)

10:24 | tqf-xwpa-vtw

Fault Tree Diagram

A graphical decomposition of Top event (TE) into intermediate events (IE) and basic events (BE) using Boolean logic gates such as AND/OR gates.

Girder Bridge System

Participants: Saran Srikanth Bodda, Er. Kumar Lal Babu, DIKSHANT GUPTA, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, 54 others, Civil Engineering Departm...

Saran Srikanth Bodda (Presenting)

10:29 | tqf-xwpa-vtw

Cut Sets

Cut Sets – Unique combinations of BE's that can cause TE failure

$TE = IE_1 \cup IE_2$
 $= (X_1 \wedge X_2) \cup (X_3 \vee X_4)$
 $= X_1 X_2 \cup X_3 \cup X_4$

Minimal Cut Sets – Smallest combinations of BE's that can cause TE failure

$X_1 X_2 \cup X_3 \cup X_4 = X_2 \cup X_4$ (Minimal)

Participants: Saran Srikanth Bodda, Sachin Singh, Chandrapal Gautam, Arundhati Balouria, RACHANA PRIYADARSHINI, Saksham Sharma, neelima.ce civil, 50 others, Civil Engineering Departm...



Saran Srikanth Bodda (Presenting)

TE Probability Evaluation

C_1, C_2, C_3
 $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
 $TE = \bigcup_{i=1}^n C_i$

Exact Quantification: Quantifies the TE probability using the exact probability quantification algorithm (Inclusion – Exclusion principle).
 $TE = C_1 + C_2 + C_3 - (C_1C_2 + C_1C_3 + C_2C_3) + C_1C_2C_3$

Rare-Event Approximation: This calculation simply sums each cut set as an approximation to the exact Top Event probability.
 $TE > 1$ $TE = C_1 + C_2 + C_3$

Upper Bound Approximation: This calculation approximates the probability of the union of the minimal cut sets for the fault trees.
 $TE = 1 - (1 - C_1)(1 - C_2)(1 - C_3)$

Participants: Sachin Singh, Chandrapal Gautam, Arundhati Balouria, Mrityunjay Tiwari, Saksham Sharma, Er. Kumar Lal Babu, 48 others, Civil Engineering Departm...

10:36 | tqf-xwpa-vtw

Saran Srikanth Bodda (Presenting)

Example

Basic Event	Count	Prob	FV	RRR	RIR	RII	RII	BI
B1	1	0.01	0.8724	7.8319	86.1111	0.0006	0.0600	0.0606
B2	2	0.02	0.3263	1.4840	16.9603	0.0002	0.0112	0.0115
B3	3	0.03	0.1490	1.1749	5.8008	0.0001	0.0034	0.0035
B4	2	0.04	0.6526	2.8771	16.6377	0.0005	0.0110	0.0115
B5	3	0.05	0.1490	1.1749	3.8269	0.0001	0.0020	0.0021

Participants: Sachin Singh, Chandrapal Gautam, Mrityunjay Tiwari, Arundhati Balouria, Saksham Sharma, Er. Kumar Lal Babu, 50 others, Civil Engineering Departm...

10:42 | tqf-xwpa-vtw



Saran Srikanth Bodda (Presenting)

Uncertainty Analysis

- Calculates variability in TE failure probability resulting from uncertainties in the BE probabilities
- Uncertainty Distributions – Point estimate, Normal, Lognormal, Beta, Gamma, Uniform, Exponential
- Sampling – Simple Monte Carlo, Latin Hypercube Sampling (LHS) $[0, 1]$
- Output Statistics – mean, median, standard deviation σ 5% 95%

Saran Srikanth Bodda

Sachin Singh

Chandrapal Gautam

Mrityunjay Tiwari

Arundhati Balouria

Saksham Sharma

Er. Kumar Lal Babu

49 others

Civil Engineering Departm...

10:45 | tqf-xwpa-vtw

Ankit Agarwal (Presenting)

Terminologies!!

- Hazard - any potential source of harm, or danger that can result in loss of life, or damage to people, or property - can be natural or human-made
- Exposure – extent of people or property affected due to hazard
- Vulnerability – degree to which people or property susceptible to hazard damages
- Risk – potential for adverse consequences - combination of the probability of an event happening and the severity of its outcome

Risk = Hazard x Exposure x Vulnerability

Ankit Agarwal

Niraj Singh Parih...

Amit Singh

DILLIP KUMAR B...

51 others

Civil Engineerin...

11:17 | tqf-xwpa-vtw



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Ankit Agarwal (Presenting)

Interaction of H, E, V/C generate risk

Intense widespread flooding	Moderate flooding	Localized flooding
Planned construction Good Institutional support	Unplanned construction Dense population No institutional support	No construction No people
Risk = Low (Moderate hazard, Moderate exposure, High capacity)	Risk = High (Intense hazard, High exposure, High vulnerability)	Risk = 0 (Low hazard, Zero exposure, zero vulnerability)

11:20 | tqf-xwpa-vtw

53

11:33 | tqf-xwpa-vtw

49

Participants: Ankit Agarwal, Er. Kumar Lal Babu, Niraj Singh Parihar, DILLIP KUMAR BARIK, Sanjay Kushwaha, Er Kapil Ohri, Rajendra Prasath C, 41 others, Civil Engineering Department, JUIT.



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Ankit Agarwal (Presenting)

Probabilistic flood hazard analysis (PFHA)

Why the consideration of probability to flood hazards?

For the future flood risk assessment – essential to quantify the future flood hazard – different sources of uncertainty that affect flood hazard such as:

- changes in the climatic conditions (eg: more frequent extreme rainfalls, sea level rise, glacier melts, etc.,)
- changes in the catchment conditions (eg: urbanization, deforestation, etc.,)

7/23/2024 Probabilistic Flood Hazard Analysis | 19

11:42 | tqf-xwpa-vtw

Participants: Ankit Agarwal, Er. Kumar Lal Ba..., DILLIP KUMAR B..., Niraj Singh Parih..., 47 others, Civil Engineerin...

Ankit Agarwal (Presenting)

NSIH 2024
 Natural-hazard Symposium for the Indian Himalayas
 8th - 10th October 2024
 Website: <https://juit.ac.in/NSIH2024>

Theme: Hydro-climatology of the Natural Hazards in the Mountainous Regions

Plenary Talk, Research Talk, Panel Discussions, Hands-on Training

Organized by: Prof. Ankit Agarwal

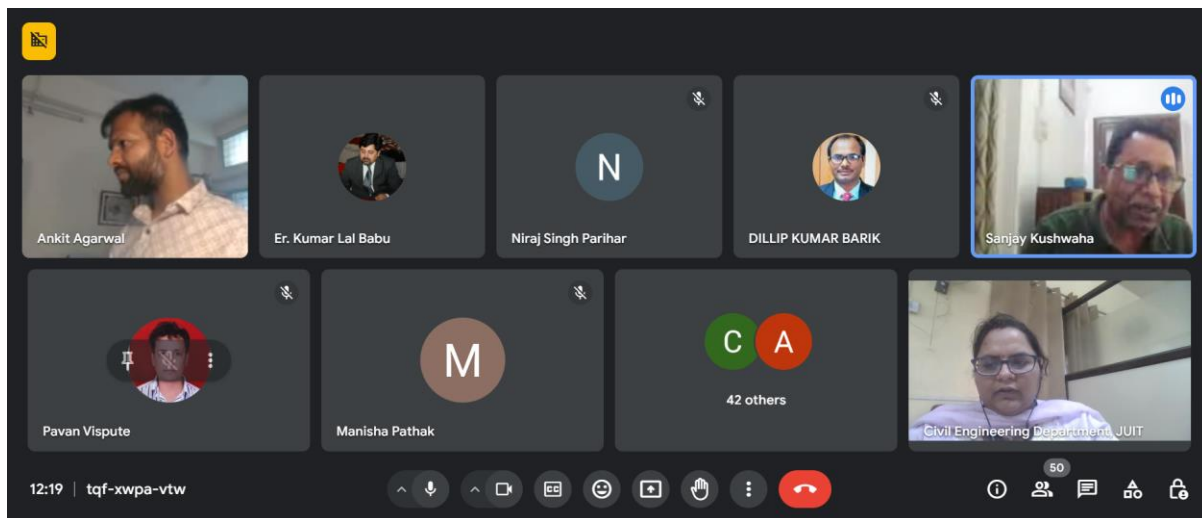
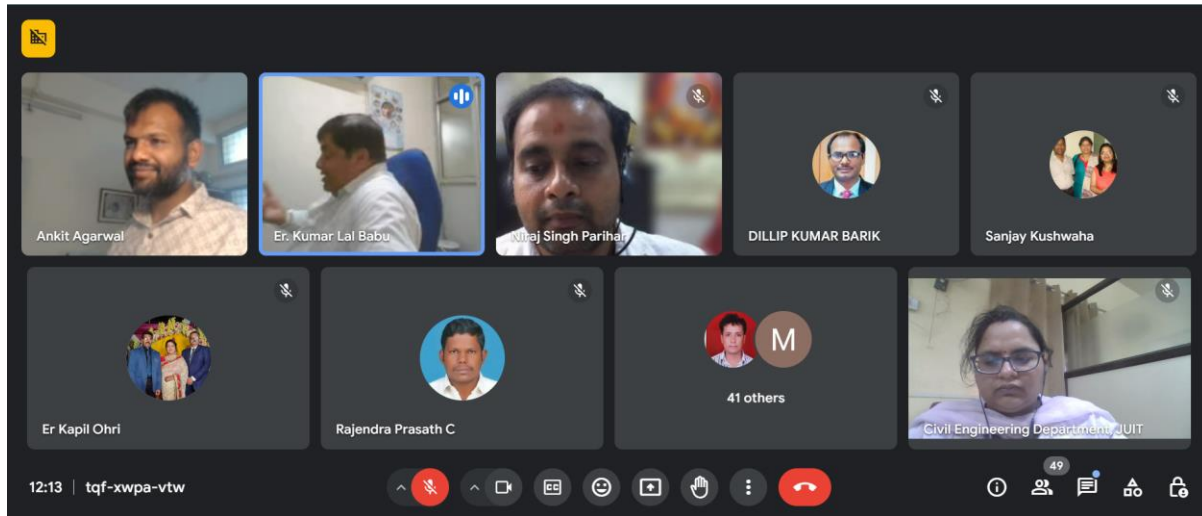
12:11 | tqf-xwpa-vtw

Participants: Ankit Agarwal, Er. Kumar Lal Ba..., Niraj Singh Parihar, DILLIP KUMAR B...

Message from Shanku Ghosh: Sir could you please share the group link in the box



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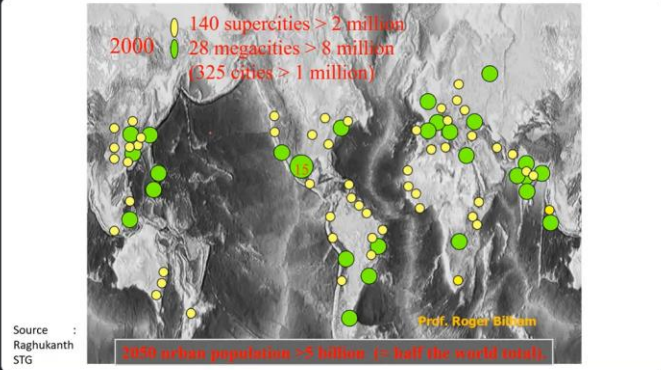
Day 3:



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Maheshreddy Gade (Presenting)



Source : Raghukanth STG
 Prof. Roger Bilstein
 2020 urban population > 5 billion (~ half the world total)

09:42 | tqf-xwpa-vtw

Participants: Maheshreddy Gade, GokulChandra Sha..., Aakash Kumar, Nanditha K, Musab Ahmad, ATHIRA JOSEPH, Umesh Kumar, 31 others, Civil Engineering ...


Kala Venkata Uday (Presenting)

One Week Online Workshop on Disaster Risk Assessment
 July 22-27, 2024

Organized By
 Center for Structural Engineering and Disaster Management
 Civil Engineering, JUIT, Wagnaghat & SCENE, IIT Mandi

Landslide Risk Mitigation and Prediction

Speaker
Dr Kala Venkata Uday
 Associate Professor
 School of Civil and Environmental Engineering
 IIT Mandi
 uday@itmandi.ac.in



10:57 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, Niraj Singh Parihar, Raghvendra Singh, Pavan Vispute, Musab Ahmad, Nanditha K, neelima.ce.civil, 47 others, Civil Engineering Depar...



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Kala Venkata Uday (Presenting)

The most common types of landslides. Source: USGS

11:08 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, Niraj Singh Parihar, Raghendra Singh, Pavan Vispute, Musaib Ahmad, chandrashekhar kurhe, neelima.ce civil, 50 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Water triggered Kotrupi landslide in 2017 in Himachal Pradesh due to intense and persistent rainfall. The failed slope was approximately 250 m high and 150 m in width. Approximately 300,000 m³ debris was displaced for approximately 950 meters resulting taking 46 lives. (Courtesy: Himachal Pradesh State Disaster Management Authority)

11:16 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, Niraj Singh Parihar, Raghendra Singh, Pavan Vispute, Musaib Ahmad, neelima.ce civil, SUVAM DAS, 45 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Landslide risk = Hazards x consequences

Risk matrix and required actions

	Consequence Low	Consequence Medium	Consequence High
Low hazard (probability)	Low risk	Low risk	Medium risk
Medium hazard (probability)	Low risk	Medium risk	High risk
High hazard (probability)	Medium risk	High risk	High risk

Require new site investigations
Require mitigation measures
Require new stability calculations after mitigation

16

11:20 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, SUVAM DAS, Niraj Singh Parihar, Raghvendra Singh, neelima.ce civil, Pavan Vispute, Musaib Ahmad, 46 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Risk Mitigation

Landslide risk mitigation

- Structural measures
 - Regional
 - Rainfall thresholds
 - Zonal
 - Data-Driven models
 - Local
 - Field scale monitoring
- Non-Structural measures

22


11:39 | tqf-xwpa-vtw

Participants: Niraj Singh Parihar, Kala Venkata Uday, Musaib Ahmad, SUVAM DAS, Raghvendra Singh, Manish Sharma, Pavan Vispute, 48 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Structural Mitigation measures

- Active measures:
 - Engineered cutting of slopes
 - Retaining walls
- Passive measures
- Remedial measures



21


11:36 | tqf-xwpa-vtw

Participants: Niraj Singh Parihar, Kala Venkata Uday, Musaib Ahmad, SUVAM DAS, Raghvendra Singh, Manish Sharma, Pavan Vispute, 46 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Structural Mitigation measures

- Active measures:
 - Engineered cutting of slopes
 - Retaining walls
 - Nailing
- Passive measures
 - Nets
- Remedial measures



21

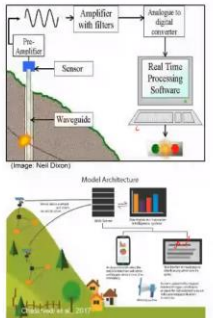
11:37 | tqf-xwpa-vtw

Participants: Niraj Singh Parihar, Kala Venkata Uday, Musaib Ahmad, SUVAM DAS, Raghvendra Singh, Manish Sharma, Pavan Vispute, 46 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Structural Mitigation measures

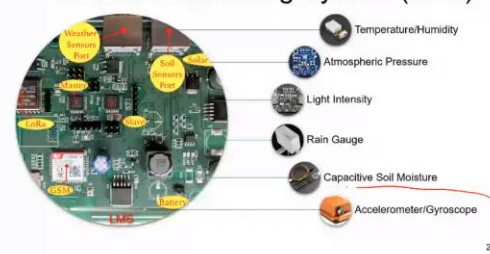
- Active measures:
 - Engineered cutting of slopes
 - Retaining walls
 - Nailing
- Passive measures
 - Nets
 - Barriers
 - Meshing/Shotcreting
 - Early warning system
- Remedial measures



11:37 | tqf-xwpa-vtw

Kala Venkata Uday (Presenting)

Landslide Monitoring System (LMS)



- Temperature/Humidity
- Atmospheric Pressure
- Light Intensity
- Rain Gauge
- Capacitive Soil Moisture
- Accelerometer/Gyroscope

11:43 | tqf-xwpa-vtw



Kala Venkata Uday (Presenting)

Displacement Profile from Accelerometer and Camera

Fig. Showing Displacement calculated from the values of accelerations and from frames captured by the camera.

Fig. The best performing BS-LSTM model showing the soil movement (in meters) over the Kumarhatti's training and testing dataset (Froeven et al. 2021) 27

Kala Venkata Uday

SUVAM DAS

Niraj Singh Parihar

Albankhrawbok Syiem

Manish Sharma

Pavan Vispute

Musaib Ahmad

52 others

Civil Engineering Depar...

11:48 | tqf-xwpa-vtw

Kala Venkata Uday (Presenting)

Alert Generation

Fig. A framework of alert generation in real-world environment

Fig. Map view of the landslide monitoring system location

Kala Venkata Uday

SUVAM DAS

Niraj Singh Parihar

Albankhrawbok Syiem

Manish Sharma

Pavan Vispute

Musaib Ahmad

52 others

Civil Engineering Depar...

11:49 | tqf-xwpa-vtw



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Kala Venkata Uday (Presenting)

Working of the LMS in Real World

31

11:52 | tqf-xwpa-vtw

59

Participants: Kala Venkata Uday, SUVAM DAS, Niraj Singh Parihar, Manish Sharma, Pavan Vispute, Musaab Ahmad, Nanditha K, 50 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Landslide Alert App

Landslide Alert App is developed for users to ensure their safety and convince. The Android application predicts landslide based using their current location's latitude and longitude.

33

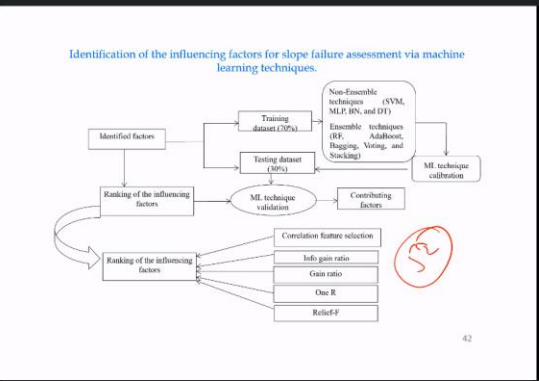
11:53 | tqf-xwpa-vtw

58

Participants: Kala Venkata Uday, SUVAM DAS, Niraj Singh Parihar, Manish Sharma, Pavan Vispute, Musaab Ahmad, cpal3012, 49 others, Civil Engineering Depar...

Kala Venkata Uday (Presenting)

Identification of the influencing factors for slope failure assessment via machine learning techniques.



The flowchart illustrates the process of identifying influencing factors for slope failure assessment using machine learning. It starts with 'Identified factors' which are used for 'Ranking of the influencing factors'. This leads to 'Training dataset (70%)' and 'Testing dataset (30%)'. The training dataset is used for 'Non-Ensemble techniques (SVM, MLP, BN, and DT)' and 'Ensemble techniques (RF, AdaBoost, Bagging, Voting, and Stacking)'. The testing dataset is used for 'ML technique validation' and 'Contributing factors'. The 'Ranking of the influencing factors' is further refined by 'Correlation feature selection' (Info gain ratio, Gain ratio, One R, ReliefF) and 'ML technique calibration'. A handwritten red circle highlights the 'Ranking of the influencing factors' box.

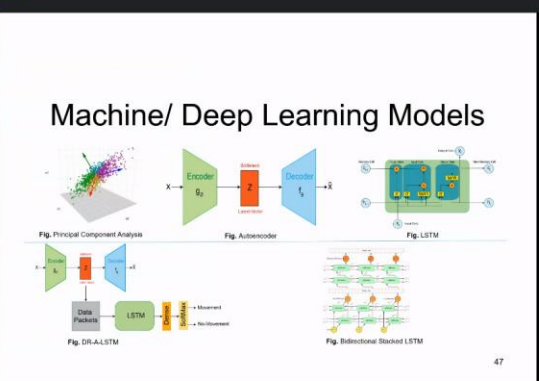
42

11:58 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, Astha Verma, Niraj Singh Parihar, Manish Sharma, Pavan Vispute, Musaab Ahmad, cpal3012, 48 others, Civil Engineering Department, JUIT.

Kala Venkata Uday (Presenting)

Machine/ Deep Learning Models



The diagram shows various machine and deep learning models. It includes 'Principal Component Analysis' (PCA), 'Autoencoder' (Encoder E_p , Latent Space Z , Decoder D), 'LSTM', 'DR-LSTM', and 'Bidirectional Stacked LSTM'. The DR-LSTM model is shown with 'Data Package' and 'LSTM' components, and the Bidirectional Stacked LSTM model is shown with 'Forward' and 'Reverse' paths.

47

12:00 | tqf-xwpa-vtw

Participants: Kala Venkata Uday, Astha Verma, Niraj Singh Parihar, Manish Sharma, Pavan Vispute, Musaab Ahmad, cpal3012, 48 others, Civil Engineering Department, JUIT.



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Tanmay Gupta (Presenting)

JAYPEE EDUSPHERE
IGNITED MINDS INSPIRED SOULS

One Week Online Workshop on Disaster Risk Assessment

POST-LANDSLIDE ASSESSMENTS: HARNESSING INNOVATIVE TECHNIQUES FOR FUTURE RESILIENCE

Participants: Tanmay Gupta, AJAY GARG, Dr. Nitish Kumar S..., PRATIKSHA, Komathi Murugan, Nanditha K, Nadhen Dolma, 15 others, Civil Engineering ...

13:35 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

Understanding Landslides

- Definition and Types:** Landslides are the downward movement of rock, soil, and debris under the influence of gravity. They include rockfalls, slides, and flows.
- Causes:** Triggered by natural events like heavy rainfall, earthquakes, volcanic eruptions, and human activities such as deforestation and construction.
- Impact:** Can cause significant loss of life, destruction of infrastructure, and alteration of landscapes.
- Vulnerable Areas:** Mountainous regions, steep slopes, riverbanks, and areas with loose or unstable soil.
- Importance of Assessment:** Critical for developing effective mitigation strategies and enhancing community preparedness and resilience.

Participants: Tanmay Gupta, AJAY GARG, Dr. Nitish Kumar S..., PRATIKSHA, Komathi Murugan, Nanditha K, Ashish Verma, 17 others, Civil Engineering ...

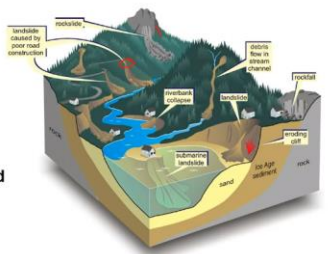
13:37 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

TRIGGERING EFFECTS

Triggering effects:

- Steep Slopes
- Water influence (Heavy rain, snowmelt, long term infiltration)
- Weak or loose rock and soil
- Weathering / erosion
- **Wildfire**
- Changes in surface or sub-surface runoff patterns
- Geometry changes construction and grading and drainage
- Seismic events
- Dam bursts



13:37 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

Importance of Post-Landslide Assessments

- 1** Understanding the Impact: Analyze the extent of damage to infrastructure, ecosystems, and communities.
- 2** Identifying Causes: Investigate geological and environmental triggers to prevent future occurrences.
- 3** Informing Mitigation Strategies: Use data to enhance and develop targeted landslide mitigation measures.
- 4** Enhancing Community Resilience: Educate and engage local populations to better prepare for future events.
- 5** Guiding Policy and Planning: Provide insights for policymakers to improve land-use planning and emergency response frameworks.

13:40 | tqf-xwpa-vtw



Tanmay Gupta (Presenting)

Unprecedented Rains 2023

State witnessed three different spells of very high precipitation during 7-11 July 2023 (Ist spell), 11-14 August 2023 (IInd spell) and 21-23 August 2023 (IIIrd spell) causing widespread damage across the State. From July 7th to 11th, 2023, Himachal Pradesh experienced intense monsoon activity, resulting in widespread, heavy to extremely heavy rainfall across most of the state.

Historically, during the monsoon season (June-September) from 1971-2020, the state averaged a rainfall of 734.4 mm, remarkably, in just four days, from July 7th to 11th, 2023, the state recorded 223 mm of rainfall, a staggering 436% above the typical amount of 41.6 mm for such a period

Tanmay Gupta	AJAY GARG	Ashish Verma
Dr. Nitish Kumar S...	Komathi Murugan	PRATIKSHA
IQBAL HAFEEZ KH...	23 others	Civil Engineering ...

13:41 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

S.No	Proposed Interventions	Proposed Amount (In Crore)
1	State-wide landslide risk mitigation program to include studies, non-structural and structural mitigation measures	10
2	Strengthen Community-based Disaster Risk Reduction measures in each Gram Panchayat with an approximate budget of 5 lakh per Gram Panchayat	200
3	Joint initiatives of State PWD, with NHAI, BRO, along with research institutions to optimize road design (MDR, ODR, and VR) as per Himalayan geology, including studies on road impact	10
4	Strengthening the early warning system by providing local weather monitoring systems in each Gram Panchayat, setting up a centralized data center at the state level, and integrating with SEOC for forecasting and dissemination of early warnings	50
5	Conduct studies and establish floodplain management guidelines and define setback distances based on scientific assessments	10
6	State-wide risk transfer program to develop insurance models , establish support systems for accessing insurance claims, and outreach for penetration of insurance schemes with insurance companies and IRDA	30
7	Strengthening and enhancing Town and Country Planning Act with appropriate policy instruments	10
8	Establish local hill area development authority to regulate construction in rural areas by providing legal support, technical capacities, and human resources on a pilot basis	10
9	Forecast-based dam management system	20
10	Establish Himalayan Centre for Disaster Risk Reduction to conduct scientific assessments, studies, and guide disaster risk reduction measures across all hill states in India	25
Total		375 Crore

PRATIKSHA	Sanjay Kushwaha	Ashish Verma
Saksham Sharma	Dr. Nitish Kumar S...	Aakash Kumar
Tanmay Gupta	27 others	Civil Engineering ...

13:53 | tqf-xwpa-vtw



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Tanmay Gupta (Presenting)

OVERALL VULNERABILITY MAP-HIMACHAL PRADESH

Legend
■ Very High
■ High
■ Moderate

HAZARD VULNERABILITY OF HIMACHAL PRADESH

DISTRICTS	E.O	LANDSLIDE	FLOODS	ANALANCHE	INDUSTRY	CONST. TYPE & DENSITY	OVERALL VULNERABILITY
Kangra	VII	M	L	---	M	VII	II
Chamba	II	II	II	M	M	II	VII
Hamirpur	VII	L	L	---	---	II	M
Mandi	VII	M	M	---	M	II	II
Kullu	II	II	II	M	II	II	VII
Bilaspur	II	M	L	---	M	VII	M
Una	M	L	II	---	II	M	II
Sirmour	M	M	L	---	II	M	M
Solan	L	L	L	---	II	M	M
Kinnaur	II	II	II	VII	II	M	VII
L&Spiti	L	M	L	VII	---	M	II
Shimla	L	M	L	---	II	M	II

PRATIKSHA

Sanjay Kushwaha

Ashish Verma

Saksham Sharma

Dr. Nitish Kumar S...

SANJEEV GARG

Tanmay Gupta

24 others

Civil Engineering ...

13:57 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

Shanti Landslide Drone View

Tanmay Gupta

PRATIKSHA

Ashish Verma

Saksham Sharma

Sanjay Kushwaha

Dr. Nitish Kumar S...

IOBAL HAFEEZ KH...

29 others

Civil Engineering ...

14:06 | tqf-xwpa-vtw



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Tanmay Gupta (Presenting)

Shanti Landslide Drone View

14:07 | tqf-xwpa-vtw

38

Tanmay Gupta, PRATIKSHA, Ashish Verma, Saksham Sharma, Sanjay Kushwaha, Dr. Nitish Kumar S..., IQBAL HAFEEZ KH..., 29 others, Civil Engineering ...

Tanmay Gupta (Presenting)

Shanti Landslide Drone View

14:08 | tqf-xwpa-vtw

40

Tanmay Gupta, PRATIKSHA, Ashish Verma, Saksham Sharma, Sanjay Kushwaha, Dr. Nitish Kumar S..., IQBAL HAFEEZ KH..., 31 others, Civil Engineering ...



Tanmay Gupta (Presenting)

Large-scale flume experiments

- (a) Cross section of **28 m long flume** and instrumentation layout (U refers to ultrasonic sensors; E refers to erosion column; cell 1 measures simultaneously normal and shear stress; and cell 2 measures normal stress and pore pressure; L1 and L2 refer to the locations 3.4 and 12.5 m from gate, respectively; b) cross-section of cell 1 (triaxial cell), σ_{base} : basal normal stress; τ_{base} : basal shear stress

14:28 | tqf-xwpa-vtw

Tanmay Gupta (Presenting)

Risk Communication by Gamification

01 WP1: Creating realistic data

02 WP2: Creating realistic Flood simulations

03 WP3: Creating realistic Landslide simulations

04 WP4: Creating VR user experience

05 WP5: Creating Human Behavior

14:31 | tqf-xwpa-vtw



Tanmay Gupta (Presenting)

Non-structural countermeasures – Gamification

14:32 | tqf-xwpa-vtw

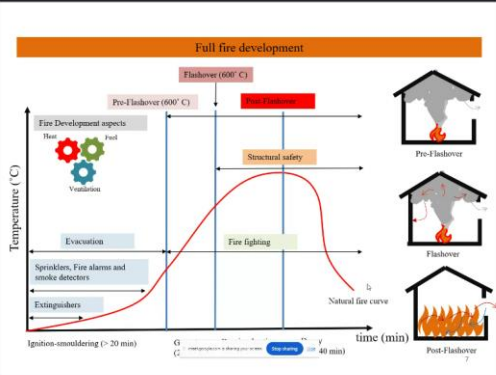
Day 4:

Patnayakuni Ravi Prakash (Presenting)

Fire hazard

09:36 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)



Full fire development

Temperature (°C) vs time (min)

Stages: Ignites-smouldering (> 20 min), Pre-Flashover (600° C), Flashover (600° C), Post-Flashover, Natural fire curve.

Fire Development aspects: Heat, Fuel, Ventilation.

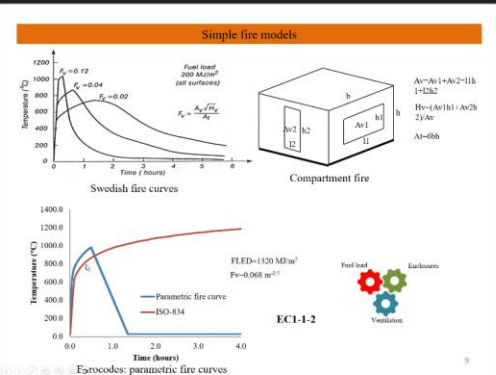
Evacuation, Fire fighting, Structural safety.

Extinguishers, Sprinklers, Fire alarms and smoke detectors.

Participants: Patnayakuni Ravi P..., Athul Nath M K, Ashish Verma, Rajendra Prasath C, Kausar Ali, Rishi Rana, Dr. Sudheer Kumar J, 26 others, Civil Engineering ...

09:45 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)



Simple fire models

Temperature (°C) vs Time (hours)

Swedish fire curves: Parametric fire curve, ISO-434.

Compartment fire: Fuel load, Enclosures, Ventilation.

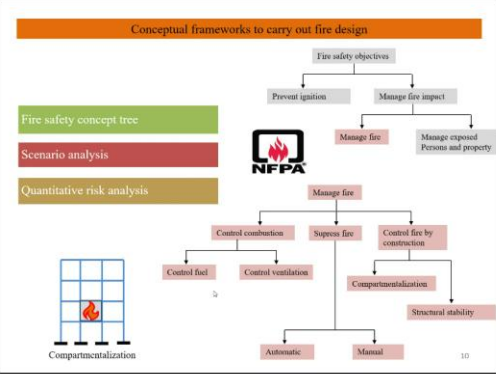
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Participants: Patnayakuni Ravi P..., Athul Nath M K, Rishi Rana, Rajendra Prasath C, Sanjay Kushwaha, Kausar Ali, Dr. Sudheer Kumar J, 31 others, Civil Engineering ...

09:55 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Conceptual frameworks to carry out fire design



Fire safety objectives

- Prevent ignition
- Manage fire impact
 - Manage fire
 - Control combustion
 - Control fuel
 - Control ventilation
 - Suppress fire
 - Control fire by construction
 - Compartmentalization
 - Structural stability
 - Automatic
 - Manual
 - Manage fire impact
 - Manage fire
 - Manage exposed Persons and property

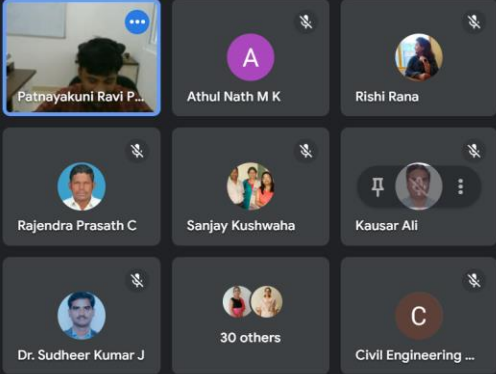
Fire safety concept tree

Scenario analysis

Quantitative risk analysis

Compartmentalization

10



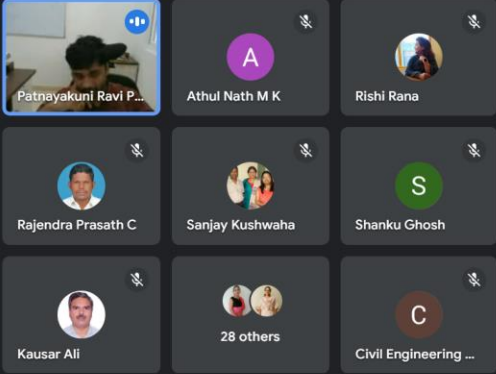
09:56 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Fire resistance rating evaluation methods

Experimental methods	Fire resistance by Building codes	Fire resistance by numerical models
Evaluates fire ratings experimentally for a given fire exposure.	Current fire design codes are prescriptive in nature and provide only minimum requirements relevant to specific buildings/materials	Yields fire ratings by performing structural fire analysis.
These tests are conducted at isolated member level and full-scale level.	Provisions based on 60% and 70% research of Europe, Japan and North American practices build-ups and less relevance to current construction materials and fuels	Simulates real fire scenarios.
Extremely costly and time consuming and cannot capture real scenarios	Indian building code prescribes fire resistance as function of clear cover.	Considers geometric effects, and interaction effects which are critical in Structural response during fire.
	Euro codes are bit advanced in terms of fire design and provides 500 Isotherm method considering standard fire scenario.	VULCAN, SAFIR, ANSYS, ABAQUS, etc.
	ACI 318/216, Eurocodes, IS1641/42	

13




10:04 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Structures under 'Fire'

Steel structures




Instability effects

- Large deformations
- Permanent plastic deformations
- Temperature dependent material degradation

Full scale fire test by Lucy et al.

Concrete structures



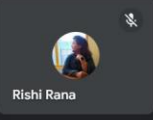

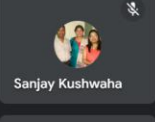
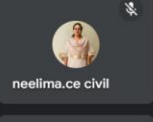
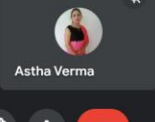
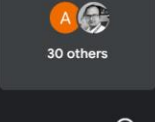
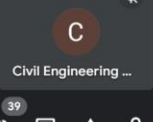


Instability effects

- Large deformations
- Permanent damage
- Fire induced spalling
- Temperature dependent material degradation

Full scale fire test Abbasi and Hogg

Spalling of concrete beam-columns caused by fire












10:09 | tqf-xwpa-vtw


Patnayakuni Ravi Prakash (Presenting)

'Multi-physics' in structures subjected to fire

Phase diagram of concrete at elevated temperatures



Concrete mechanics



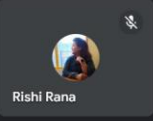



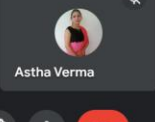
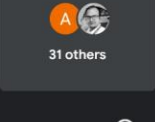
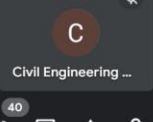


Scales of modelling

Fire induced 'spalling' in concrete

'Multi-physics' in Structures under fire

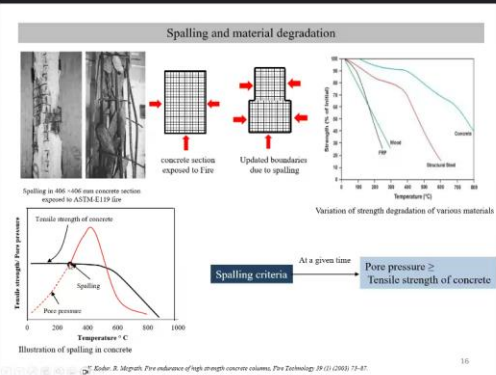
Structural systems under fire

10:10 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Spalling and material degradation



Spalling in 100 - 150 mm concrete section exposed to ASTM E119 fire

Concrete section exposed to Fire → Spalling → Upheaval boundaries due to spalling

Variation of strength degradation of various materials

Tensile strength of concrete vs Temperature (°C)

Illustration of spalling in concrete

Spalling criteria: At a given time, Pore pressure \geq Tensile strength of concrete

Patnayakuni Ravi P...

Athul Nath M K

Rajendra Prasath C

Sanjay Kushwaha

Rishi Rana

Astha Verma

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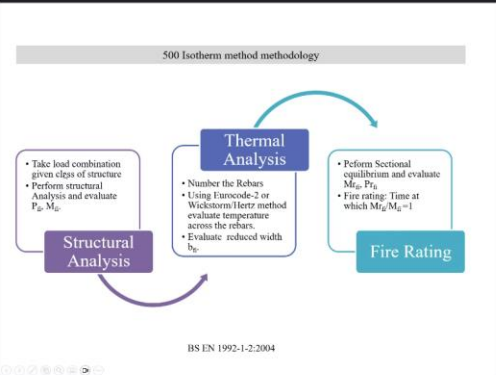
32 others

Civil Engineering ...

10:14 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

500 Isotherm method methodology



Structural Analysis

- Take load combination given class of structure
- Perform structural Analysis and evaluate P_d, M_d

Thermal Analysis

- Number the Rebars
- Using Eurocode-2 or Wickstrom/Hertz method evaluate temperature across the rebars.
- Evaluate reduced width b_{re}

Fire Rating

- Perform Sectional equilibrium and evaluate M_d, P_d
- Fire rating: Time at which $M_d/M_u = 1$

BS EN 1992-1-2:2004

Patnayakuni Ravi P...

Athul Nath M K

Rajendra Prasath C

Sanjay Kushwaha

Rishi Rana

Astha Verma

ABHISHEK THAKU...

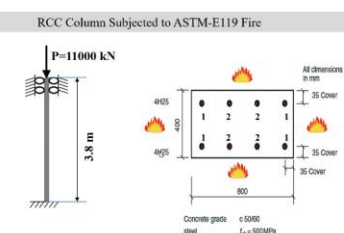
33 others

Civil Engineering ...

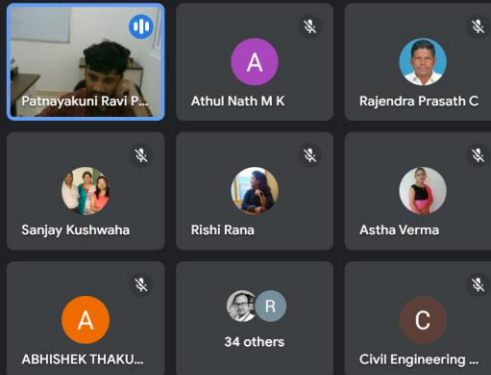
10:20 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

RCC Column Subjected to ASTM-EI19 Fire



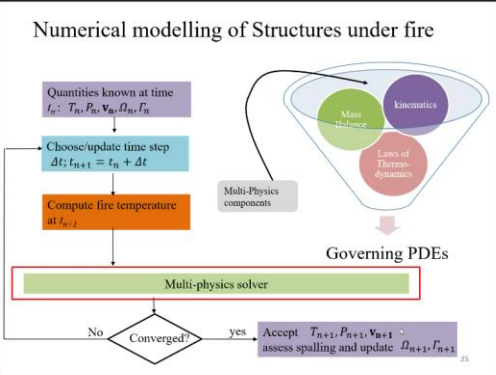
Input Properties
Grade of Concrete: c 50/60
Density of Concrete: 2400 kg/m³
Type of Structure: Office building

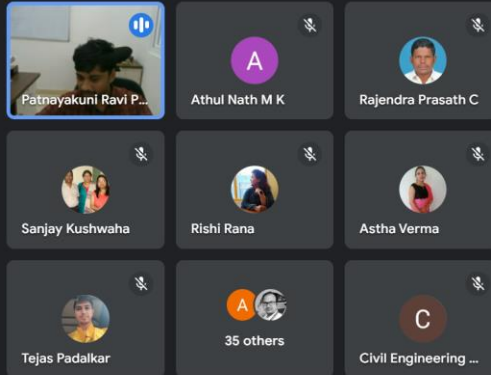


10:21 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Numerical modelling of Structures under fire





10:23 | tqf-xwpa-vtw



Patnayakuni Ravi Prakash (Presenting)

The flowchart illustrates a multi-physics solver process. It starts with 'Compute fire temperature at $t_{e,i}$ ', which feeds into a 'Multi-physics solver' box. Inside this box, 'Thermal Analysis' is connected to 'Mechanical Analysis' and 'Pore-pressure Analysis'. 'Temperature-dependent Material properties' are also input to the solver. The 'Structural model' is shown as a grid with fire at the bottom. The final outputs are 'Temperatures', 'Pore-pressures', 'Stability', 'Deflection', and 'Post-fire capacity'.

10:26 | tqf-xwpa-vtw

Participants: Patnayakuni Ravi P..., Athul Nath M K, Rajendra Prasath C, Sanjay Kushwaha, Rishi Rana, Astha Verma, Tejas Padalkar, 37 others, Civil Engineering ...

Patnayakuni Ravi Prakash (Presenting)

The diagram shows a 'One-way coupling demonstration example'. It features a beam under 'Uniform heating' with parameters $A, L, \delta_1, P, \delta_2$. 'Thermal Analysis' shows temperature profiles T_1, T_2, T_3 and thermal expansion $\alpha \Delta T_1$. 'Stress-Strain behaviour' shows stress σ vs. strain ϵ_m for temperatures T_1, T_2, T_3 with the equation $\epsilon = \epsilon_0 + \alpha \Delta T$. 'Load vs. Displacement' shows load P vs. displacement δ for temperatures T_1, T_2, T_3 . A second beam diagram shows 'Uniform heating' with parameters $A, L, \delta_1, P, \delta_2$ and temperatures T_1, T_2 .

10:30 | tqf-xwpa-vtw

Participants: Patnayakuni Ravi P..., Athul Nath M K, Rajendra Prasath C, Sanjay Kushwaha, Shivang Shekhar, Astha Verma, Tejas Padalkar, 31 others, Civil Engineering ...



Patnayakuni Ravi Prakash (Presenting)

Potential applications of Numerical Modelling

Two storey two bay concrete space frame subjected to local fire

Physical properties	Value
Class and fire resistance (min)	300 for columns and 300/180 for beams
f_c (MPa)	40 (IS:456 and IS:10262)
f_y (MPa)	415
Clear cover	25 mm at bottom, 30 mm at other
Concrete grade	M30 (IS:456) IS:10262
Type of aggregate	Standard
Relative humidity	95%
ϵ_{cu}	2.0
Loading	IS 8750 on all beams, 800 kN on nodes C.B.I.P. Ch. 3.5.2.

Physical properties

10:36 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash (Presenting)

Deformed configuration of twenty-storey space frame (scaling 10x)

10:40 | tqf-xwpa-vtw



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Patnayakuni Ravi Prakash (Presenting)

Conclusions

Framework for Improving Fire Safety in Buildings

- Fire Protection Features**
 - Exit paths
 - Active FP systems
 - Type of occupancy
 - Fire design
- Regulation & Enforcement**
 - Enforce regulations
 - Codes & standards
 - Annual inspection
- Technology & Resources**
 - Response time
 - Voluntary firefighters
 - Emergency preparedness
- Common/Civic Sense**
 - Fire safety awareness
 - Evacuation drills
 - Right of way to firefighters

41

Patnayakuni Ravi P...

Athul Nath M K

Tejas Padalkar

Rajendra Prasath C

Sanjay Kushwaha

Chandrankantham...

JAIN NITPY

31 others

Civil Engineering ...

10:45 | tqf-xwpa-vtw

Patnayakuni Ravi Prakash

Athul Nath M K

Tejas Padalkar

Rajendra Prasath C

Sanjay Kushwaha

Chandrankanthamma L

Manish Sharma

31 others

Civil Engineering Department, JUIT

10:51 | tqf-xwpa-vtw

Show hidden icons



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HAZARDS

A BIOLOGICAL, CHEMICAL OR PHYSICAL AGENT/ACTIVITY THAT IS REASONABLY LIKELY TO CAUSE ILLNESS OR INJURY IN THE ABSENCE OF ITS CONTROL. THE MOST COMMON HAZARDS IN THE INDUSTRIES ARE :

- FIRE :**
 - FLASH FIRE,
 - JET FIRE ETC.,
 - POOL FIRE
- EXPLOSION**

11:07 | tqf-xwpa-vtw

STEPS IN PHA & RISK ANALYSIS

- HAZARD IDENTIFICATION**
 - CHEMICAL IDENTITY
 - LOCATION
 - QUANTITY
 - NATURE OF THE HAZARD
- VULNERABILITY ANALYSIS :**
 - VULNERABLE ZONES
 - HUMAN POPULATION
 - CRITICAL FACILITIES
 - ENVIRONMENT
- RISK ANALYSIS**
 - LIKELIHOOD OF THE HAZARDOUS EVENT OCCURRING
 - SEVERITY OF THE CONSEQUENCES

11:11 | tqf-xwpa-vtw



SUDHEER DWIVEDI (Presenting)

WHAT IF ANALYSIS

- THE WHAT IF ANALYSIS IS AN UNCOMPLICATED HAZARD EVALUATION PROCESS.
- IT REVIEWS THE COMPLETE PROCESS FROM RAW MATERIAL TO FINISHED PRODUCT.
- IN THIS ANALYSIS THE QUESTIONS COVERING EVERY MODE, COMPONENT OF THE PROCESS ARE ANSWERED TO EVALUATE THE EFFECTS OF COMPONENT FAILURE OR PROCEDURAL ERRORS.
- FOR MORE COMPLEX PROCESS THE WHAT IF ANALYSIS CAN BE BEST ORGANISED THROUGH USE OF CHECKLISTS.
- THIS METHOD IS VERY USEFULL IN TRAINING OPERATING PERSONAL ON THE HAZARDS OF PERTICULAR OPERATION.

11:16 | tqf-xwpa-vtw

SUDHEER DWIVEDI (Presenting)

11:22 | tqf-xwpa-vtw

SUDHEER DWIVEDI (Presenting)

Process HAZOP Guide-words

Guide-word	Meaning	Example
NONOT	The complete negation of the intentions	No flow when production is expected
MORE	Quantitative increase	Higher temperature than designed
LESS	Quantitative decrease	Lower pressure than normal
AS WELL AS	Qualitative increase	Other valves closed at the same time (logic fault or human error)
PART OF	Qualitative decrease	Only part of the system is shut down
REVERSE	The logical opposite of the intention	Back-flow when the system shuts down
OTHER THAN	Complete substitution	Liquids in the gas piping

11:27 | tqf-xwpa-vtw

SUDHEER DWIVEDI (Presenting)

Applications of Procedure HAZOP

All operations that are potentially hazardous and that are not identical to operations analyzed before should be subject to a HAZOP

Examples of subsea related operations that should be HAZOPed:

- Drilling and well operations
- Installation of subsea equipment
- Maintenance of subsea installations (wells, templates, pipelines, etc.)
- Complex lifting operations
- Diving operations

11:36 | tqf-xwpa-vtw



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THE FMEA PROCESS

- Identify Elements of System
- Identify Functions
- Identify Failure Modes
- Identify Possible Causes
- Identify Effects on the System
- Identify Effects on other System
- Final Risk Assessment
- Take Action to Reduce the Risk

Participants: SUDHEER DWIVEDI, Hemantkumar Ron..., Tejas Padalkar, Rajendra Prasath C, Sanjay Kushwaha, Chandrakantham..., chandrashekhar k..., 25 others, Civil Engineering ...

11:52 | tqf-xwpa-vtw

Day 5:

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Economic Effects of Disasters: Three different Cases

Subir Sen, PhD.
Associate Professor, Department of Humanities and Social Sciences
Joint Faculty, Centre of Excellence in Disaster Management and Mitigation
subirsen@hs.iitr.ac.in

Presentation One Week Online Workshop on Disaster Risk Assessment,
22-27 July 2024
Organised by: Jaypee University of Information Technology & IIT Mandi

Participants: Subir Sen, Aaryaman Chande..., S M Tahmidur Rah..., Umesh Kumar, Aibankhrawbok Sy..., Rajendra Prasath C, Ashish Verma, 21 others, Civil Engineering ...

09:37 | tqf-xwpa-vtw



Subir Sen (Presenting)

Disasters: Facts and Figures

Figure 2: Number of Victims, 1970–2023
 Swiss Re (2024) Natural catastrophes in 2023: gearing up for today's and tomorrow's weather risks, Sigma No 1/2024

09:42 | tqf-xwpa-vtw

Participants: Subir Sen, Aaryaman Chande..., S M Tahmidur Rah..., Umesh Kumar, Aibankhrawbok Sy..., Rajendra Prasath C, Dr. Rajeev Bhatia, 27 others, Civil Engineering ...

Subir Sen (Presenting)

Climate Change & Predictions

- IPCC (2012, 2007) *prediction* on intensity and frequency of natural disasters... loss of livelihood (Paul 2013, etc.)... meteorological & clima

09:47 | tqf-xwpa-vtw

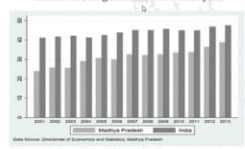
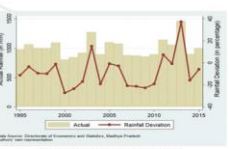
Participants: Subir Sen, Aaryaman Chande..., S M Tahmidur Rah..., Umesh Kumar, Aibankhrawbok Sy..., Rajendra Prasath C, Dr. Rajeev Bhatia, 28 others, Civil Engineering ...

Subir Sen (Presenting)

Impact of drought on economy: A district level analysis of Madhya Pradesh, India

- Impact of droughts and on aggregate economy, agriculture, secondary and tertiary sectors at the district level considering 45 selected district over the time period 2005 to 2012.
- Why Madhya Pradesh?**
 - Rain-fed agriculture (72%) is higher than the country average (49%), and the net irrigated area (38.8%) is significantly lower than the country average for year 2012-13
 - Increase in Drought incidences in recent years

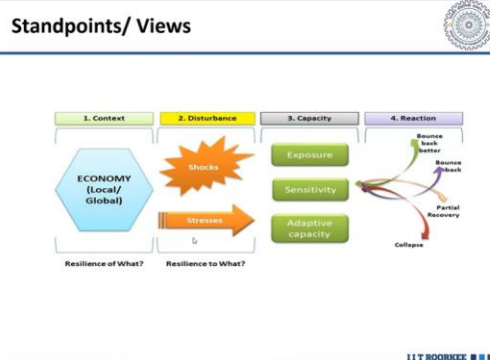
Sector	2005-06	2012-13	% Change
Agriculture	23%	24%	4.34
Manufacturing	25%	25%	0
Service	46%	44%	-4.54

10:09 | tqf-xwpa-vtw

Subir Sen (Presenting)

Standpoints/ Views



10:25 | tqf-xwpa-vtw



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Subir Sen (Presenting)

Sample Size & Data

Panel Dimensions

- 24 States over the period 1990-2015 (26 years), which includes 14 'Less Developed' and 10 'More Developed' states
- Classification is done following Kundu (2015), based on the respective scores of states in the HDI

Data Sources

- Data on Floods are obtained from the Central Water Commission, Govt. of India.
- Data on all other variables are obtained from the Database on

Variable Name	Description
Economic Growth	Growth rate of State GDP per capita
Agricultural Growth	Growth rate of State Agricultural GDP
Manufacturing Growth	Growth rate of State Manufacturing GDP
Services Growth	Growth rate of State Services GDP
Government/ Financial Burden	Govt. Final Consumption Expenditure/GDP
Inflation	100 + CPI annual growth rate
Capital Formation	Fixed Capital Formation/GDP
Financial Depth	Credit (Banks and NBFCs) to private sector/GDP
Education	Gross Enrollment Rate in Secondary Education
Aid	Financial assistance released by the central government
Intensity	Population Affected + Killed per thousand of total population (t-1)

Sanjay Kushwaha can now join this meeting

10:30 | tqf-xwpa-vtw

10:46 | tqf-xwpa-vtw

52