NOISE CONTROL IN MECHANICAL SYSTEMS

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**Week: 05**

Lecture: 23

Lecture 23: Noise regulations and guidelines: 2

Hello and welcome to lecture number 23 in the series on noise control in mechanical systems. So, in the previous lecture, we dealt with the noise regulations and guidelines and will continue the same in this lecture as well. So, to sum up, in the previous lecture, we studied about the need for noise control and noise regulation. Why we need, you know, some global standards, policies, etc. for noise pollution.

Summary of previous lecture

Need for Noise Control
& for Noise Regulations
Standards, Policies, etc
Noise Pollution
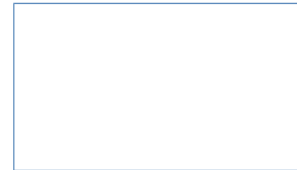
So, here we will continue. So, in the previous lecture, we stopped with the workplace noise regulation and were discussing some of the international standards. So, two things we have to discuss. One was the Occupational Safety and Health Administration guidelines, and today we will discuss the NIOSH guidelines. Then, some of the judicial interventions that have been done, some landmark cases in India with respect to noise regulation, what are the challenges in enforcing these noise regulations, and what are the noise control, a summary of the noise control measures that are being taken, and what is the future of noise regulation. So, this is a summary.

So, we had begun the discussion on the OSHA guidelines. They have recommended what should be the maximum dBA for a particular amount of exposure time for a worker in an occupational environment. Considering the worker is working 8 hours daily for 5 days a week If this is a typical exposure of the worker, in that case, the noise level has to be the upper limit of 90 dBA. Suppose the worker is being exposed not to 8 hours daily but to 6 hours daily. In that case, the sound level exposure maximum limit becomes 92 dBA, and so on. The worker cannot be exposed to a continuous exposure of more than 115 dBA in that occupational environment,

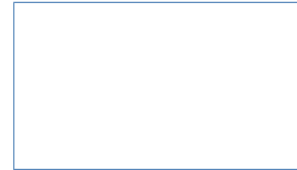## Workplace Noise Regulation: International Standards

- OSHA (Occupational Safety and Health Administration) Standards (U.S)

Sound level dBA slow response	Duration per day, hours
90 ✓	8 ✓
92	6. hr daily
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	0.25

8 hr daily for 5 days a week
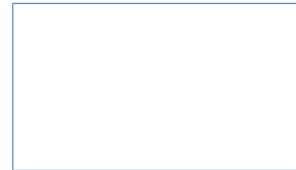
Source:
https://www.osha.gov/noise/standards

and even any instant outburst should not exceed 140 dB. Whenever the noise exposure in any kind of occupational environment, whether industry, factory, office spaces, or anything, exceeds the 85 dBA level, then the employers must implement some hearing conservation programs. So, what do you mean by hearing conservation programs? It means that, within the occupational or working environment, things such as some time off from the machinery, some rotation of jobs, as well as the use of ear mufflers or ear plugs, and the use of sound-controlling devices near the machinery. Such interventions need to be introduced if the noise level exceeds this.

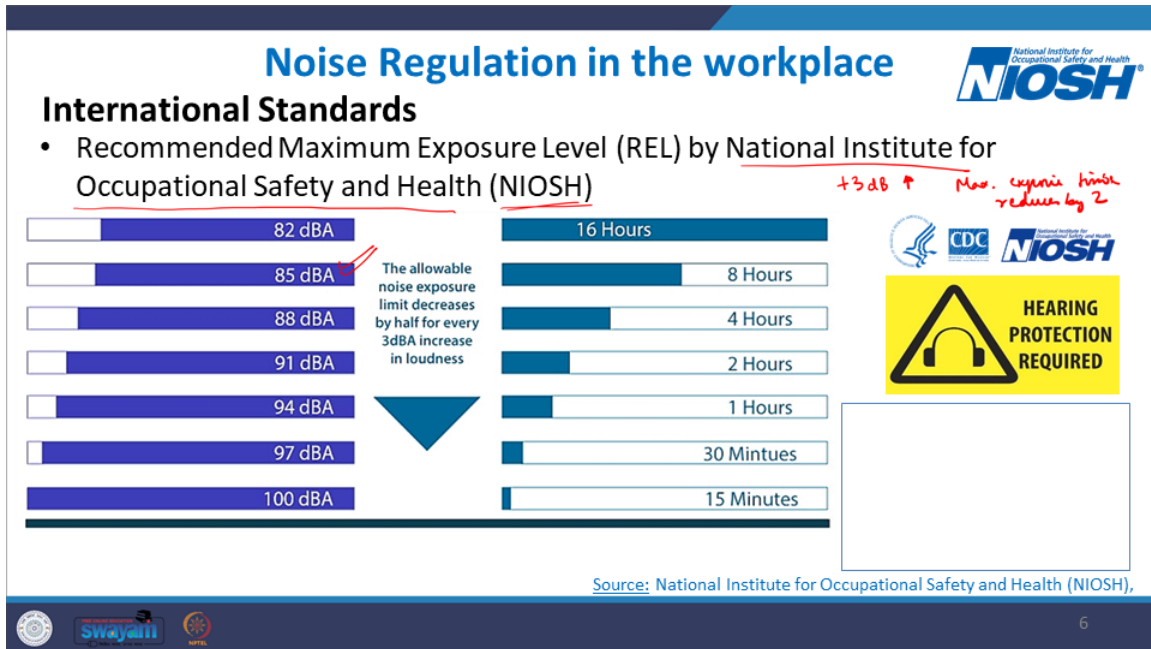**Workplace Noise Regulation**

International Standards

- OSHA (Occupational Safety and Health Administration) Standards (U.S)
  - Exposure to continuous, steady-state noise is limited to a maximum of 115 dBA.
  - Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.
  - When noise exposure is at or above 85 dBA averaged over 8 working hours, employers must implement a hearing conservation program.

Source: https://www.osha.gov/noise/standards

In the same way, we have already studied the sound exposure levels given by the National Institute for Occupational Safety and Health, or NIOSH. This is a slightly stricter guideline where, in this case, it was for 8 hours at 90 dBA. Here, the maximum limit for an 8-hour duration is 85 dBA, and as already discussed with every 3 dB, an increase in the exposure level reduces the maximum exposure time by a factor of 2, and vice versa.

Okay, so let us see again. This was the global perspective. Let us see the noise regulation in India and what are some of the key regulatory bodies which a person can approach with respect to problems related to noise and the regulation of noise. So, we have at the center the Central Pollution Control Board, CPCB, which is the statutory organization under the Ministry of Environment, Forests, and Climate Change. This is the principal body responsible for the enforcement of any kind of noise standards in India, as well as issuing any kind of guidelines, monitoring the noise levels, and advising the government on various policies and regulations related to noise pollution. So, noise being one form of pollution, it comes under the purview of CPCB. In the state, the same, you know, similar role performed at the state level is by the State Pollution Control Board, and here they are also implementing the noise pollution control measures but at the state level, and they coordinate with the local authorities such as the municipal corporations and the panchayats, and they monitor and regulate the noise pollution in their respective states.

Noise regulation in India

Key Regulatory Bodies

• **Central Pollution Control Board (CPCB)**

Statutory organization under the **Ministry of Environment, Forests and Climate Change** (MoEFCC)

Role: principal body responsible for the enforcement of noise standards in India. It issues guidelines, monitors noise levels, and advises the government on policies and regulations related to noise pollution.

• **State Pollution Control Board (SPCB)**

Role: Responsible for implementing noise pollution control measures at the state level. They coordinate with local authorities to monitor and regulate noise pollution in their respective states.

So, the key regulatory bodies Again, we have the urban local bodies such as the municipal corporation below that hierarchy and other local governing bodies which play a key role at the local level in your area. So, whenever you have got, you know, something which is creating a lot of noise, it becomes a public nuisance. In the last lecture, we studied that the noise is now added as a public nuisance under the Indian legislation, and then nuisance reporting you can do at the municipal corporation or at the nearest police, but the police will not take action. The municipality then you can approach, and they can take steps to ensure that the noise remains at a specified level and does not create any nuisance. Similarly, various NGOs are the informal organizations. They are also playing a key role in terms of various kinds of societal issues, and noise, at a beyond a certain level and with repetitive occurrence, can become a social issue. It is, as I said, a public nuisance. And then, whenever it creates a lot of disturbance, even the NGOs, they play an active role. They advocate for noise pollution control. They create public awareness. They also can enforce legal actions and can file complaints and monitor the noise at the various local levels.

Noise regulation in India

Key Regulatory Bodies

- Urban Local Bodies (ULBs)

  Role: Municipal corporations & other local governing bodies play a crucial role in enforcing noise regulations at the local level. Responsible for ensuring that noise levels in residential and commercial areas adhere to the prescribed limits.

- NGOs

  Key Role:
  - Advocacy for Noise Pollution Control
  - Public Awareness Campaigns
  - Legal Action
  - Noise Monitoring

So, this is just one such example where a campaign was led by the Awas Foundation, which is an NGO in Mumbai, and here they were seriously campaigning against, you know, there should be no honking while people are driving in the streets or on the roads. So, no honking day came into practice, and if you go into the metropolitan areas, you see that on average people blow very few horns while they are driving their cars. So, this was the campaign led by them, which led to a significant amount of change in the metropolitan cities.

Noise regulation in India

Key Regulatory Bodies

Campaign led by Awaaz Foundation (NGO Mumbai led by Sumaira Abdulali)

Image source: https://thebetterindia.com/

Let us see some of the landmark court cases with regard to this. So, some of the judicial interventions. The very first case, which I'll briefly discuss, is, you know, the case of the Church of God or the Full Gospel versus KKR Majestic Colony Welfare Association, which happened in the year 2000. So, the judgment was given in 2000. So, what was it? The Supreme Court held that no religious or cultural practice can infringe upon the health and peace of others through noise pollution. This was a landmark case, and the court had ruled that loudspeakers used in religious practices should comply with the permissible noise limits. So, nothing, be it any reason, be it cultural, religious, or any region, nothing can infringe on the right of individuals to live peacefully. And it became, this was one of the landmark cases that affirmed that no individual or group has the right to create noise that disturbs others' well-being, regardless of the reason, be it cultural or religious.

Judicial Intervention in Noise Regulation

Landmark Court Cases in India

- **Case 1:** Church of God (Full Gospel) v. K.K.R. Majestic Colony Welfare Association **(2000)**

- **Judgement:**
  - Supreme Court held that no religious or cultural practice can infringe upon the health and peace of others through noise pollution.
  - The Court ruled that loudspeakers used in religious practices should comply with the permissible noise limits.

- **Impact:**
  - This judgment affirmed that no individual or group has the right to create noise that disturbs others' well-being, regardless of the reason (cultural / religious).

Source: https://indiankanoon.org/doc/88766/

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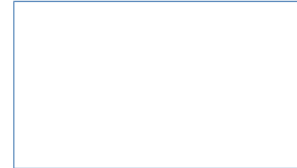
In the same way, there was another case, you know, the Noise Pollution Regulation and Control Rules of 2000, which was included in the Bombay High Court. So, various PILs were filed by the NGO Awas Foundation, and the court imposed restrictions on noise during festivals, processions, and various kinds of public events, particularly in silent zones like hospitals and educational institutes. So, in that case, these interventions have significantly reduced noise during the festival seasons in Mumbai and have raised public awareness about adhering to noise limits.

Judicial Intervention in Noise Regulation

Landmark Court Cases in India

- **Case 2:** Noise Pollution (Regulation and Control) Rules, 2000 - Bombay High Court Rulings

- **Judgement:**
  - Following PILs filed by NGOs like Awaaz Foundation, the court-imposed restrictions on noise during festivals, processions, and public events, particularly in silence zones like hospitals and educational institutions.

- **Impact:**
  - These interventions have significantly reduced noise during festive seasons in Mumbai, and have raised public awareness about adhering to noise limits.

Source: https://indiankanoon.org/doc/68805775/

Another case where it is a forum for the prevention of environmental and noise pollution versus the Union of India in the year 2005. So here the case focused on the restrictions for firecrackers during festivals like Diwali, which we all know is a big festival in India, and a lot of firecrackers are usually burnt. The case was filed stating that there should be some restrictions on the noise level of the firecrackers as well as the amount of firecrackers that are burnt because, if done on a large scale, it can lead to both noise pollution and air pollution. And whatever debris comes out after the firecrackers are burned, it leads to land pollution. So a lot of pollution happens. So the Supreme Court placed strict regulations on the timing and the permissible decibel levels of firecrackers to control the noise pollution. So because of this ruling, what happened? The use of firecrackers during the nighttime after 10 p.m. was limited. And it emphasized that only eco-friendly firecrackers should be used. which resulted in a quieter and more eco-friendly Diwali and fewer complaints about noise pollution.

Judicial Intervention in Noise Regulation

Landmark Court Cases in India
- **Case 3:** Forum, Prevention of Environmental and Sound Pollution v. Union of India, 2005

- **Judgement:**
  - This case focused on the restrictions for firecrackers during festivals like Diwali. The Supreme Court placed strict regulations on the timing and permissible decibel levels of firecrackers to control noise pollution.

- **Impact:**
  - The ruling limited the use of firecrackers during night-time (after 10 p.m.) and emphasized that only eco-friendly crackers should be used, resulting in a quieter Diwali and fewer complaints about noise pollution.

Source: https://indiankanoon.org/doc/541057/

So, let us see, you know, a lot of measures are being taken not just in India but worldwide, and policies are in place. You know, there are a lot of provisions and policies in place, but does that mean that we do not have noise pollution or does that mean that we still do not have any complaints with respect to noise? That is not the case. Even though there are so many regulations and policies in place, we still often hear complaints related to noise in our day-to-day lives. So what are the key challenges which are, you know, preventing the enforcement of these noise regulations? The first being, you know, the lack of awareness and public cooperation. So low public awareness, many people are still unaware of the harmful effects of noise pollution or the regulations in place to control it. If you go to some of the suburban areas to various kinds of factory settings and you have migrants from poorer regions who are earning their daily wage by working in such hazardous factory setups and environments, if you go and ask them and if you conduct interviews with them, what you will find is that they are still not aware of how harmful this noise level can be. You know, lately, many of them are still unaware. Suppose somebody is working in some kind of chemical plant or factory, then they would be aware that, okay, the chemicals can be harmful. The fumes, the smoke, and the dust could be harmful to them. But when it comes to noise, that something is making noise, It still becomes an insidious form of pollution. Not many people, especially those from poorer and illiterate regions, are really aware that this noise can also harm. It is also one of the

important forms of pollution. Apart from, you know, the land, the water, and the air pollution. So, land, water, and air pollution are more common, and people are more aware of that, but noise pollution is something which people are still not very aware of at the grassroots level, and this awareness needs to be created. I hope this course can also be one means through which I can spread this message to everybody to, you know, create awareness about the harmful effects of noise and the need for, you know, regulating noise. Then also, cultural resistance, you know, in many regions, noise is culturally accepted or sometimes even encouraged during certain events such as festivals, weddings, and political rallies. Now, I am not against any community or any kind of celebration, but I am saying that You know, sometimes, you know, the louder, for example, the wedding is happening or some kind of, you know, social gathering or event is happening, then people actually rejoice the fact that it was a success if, you know, the loudspeaker was blasting at huge levels and people even three to four blocks away can hear the noise, and that means the event is a success. That's how the tendency becomes. If you do a quieter ceremony or a quieter celebration, then that doesn't give them the feeling that they have celebrated. So that form of cultural tendency is there, which obviously sometimes restricts proper enforcement. As well as political rallies and various other such gatherings, they were making more noise and actually being encouraged.

Then we also have inadequate monitoring and enforcement infrastructure. So, once again, I would like to emphasize here that Air pollution, land and water pollution have been there, and you have more stringent and stricter policies as well as stricter monitoring of air, water, and land pollution. But noise pollution is still considered secondary, you know, it is sort of considered as it is not given the same level of priority as air pollution or land pollution. So noise pollution becomes an insidious form, and hence we still, compared to other forms, have inadequate monitoring and inadequate enforcement. So, the lack of noise monitoring systems in various places, especially in developing and underdeveloped nations. And then insufficient personnel, where even if we have the infrastructure available, the regulatory bodies available, and the policies available, everything is there, but due to the lack of people working in this area, it cannot be enforced. Even if you have the framework ready, you have all the laws and rules, you have got the agencies that can monitor the noise and report, but still, due to the lack of people working in this area and insufficient staff and resources, the monitoring cannot be done on a large scale and enforced in every aspect of life. Similarly, we have very complex urban environments, and again, noise monitoring in such a complex environment becomes an issue.

Image Source: https://www.sigicom.com/noise-monitoring/

Then, as a developing country or underdeveloped country, they have their own challenges because it's like a trade-off. The developing countries are at the cusp of development. A lot of factories are coming up, and a lot of urbanization is happening, whereas in the developed nations, this has already happened. And now the developed nations are more keen on focusing on the quality of life. So things such as curbing noise pollution, improving sound quality, and all of that, having better emotional health, psychology, and all these things. They are more part of the developed nations because they have already solved their grassroots problems with respect to poverty and modernization. Whereas in the developing countries, they still prioritize, and they have to. So they are prioritizing their economic development and economic development is definitely necessary to make a nation strong, but sometimes it comes at a cost of degrading the environment, which includes increasing noise pollution. Then, in the developed countries, we have so many informal and unregulated sectors; not everything is properly monitored and managed. So, a significant portion of noise in India comes from these informal or unregulated activities, such as street vendors, various unregistered small businesses, unregulated transportation, etc. So when they are not registered, monitoring and regulating them becomes obviously challenging. We also have limited institutional capacity. So, once again, the focus here and the prioritization is given to economic development, reducing poverty, increasing the economy of the country, and hence the majority of the resources, both human and monetary, go into these areas which are given priority, and hence, There is less priority given to the quality of life, such as reducing noise pollution, and therefore we have limited institutional capacity. The developing countries lack such strong institutions that can manage environmental issues, and these things face challenges, and enforcing noise regulation definitely becomes a challenge. So I would say that most of the time in such nations or in such regions, reducing noise levels or improving sound quality becomes more of a luxury to them. It is not taken as a necessity in life; it is rather taken as a luxury. But I would like to say that this is not a luxury; this is actually a necessity of life.

Challenges in Enforcing Noise Regulation

- **Challenges in Developing Countries**
  - Prioritization of Economic Development
    In developing countries, economic growth and infrastructure development often take precedence over environmental concerns, including noise control.
  - Informal and Unregulated Sectors
    A significant portion of noise in developing countries comes from informal or unregulated activities, such as street vendors, unregister--ed small businesses, unregulated transportation, etc.
  - Limited Institutional Capacity
    Developing countries lack strong institutions for Environmental management and face challenges in enforcing noise regulation.

Then there is the technological and urbanization trend. So globally, we have the boost in technology and the boost in urbanization. So this is a trend throughout the world, and with this trend, there is a rise in traffic, a rise in industrial noise, rapid urbanization, growing vehicle numbers, an increase in cities, more people concentrated in small regions, creating more noise. A lot of traffic and transportation noise and industrial noise is happening. Various construction and urban development activities keep happening. If you go to, for example, Gurgaon, that is a very fast-developing city, and at every block, you will see some construction activity happening. And it's not just the case with that city, but in fact, most cities are now expanding and developing, and you can see construction activity going on literally at every block of the city. And that is really an annoying noise source; it is very annoying and can really be irritating at times. Then the noise also comes from various sources because, with the rising cities, you have more people in densely populated areas, and you need public transportation, which has its own noise problem and creates more and more noise.

Challenges in Enforcing Noise Regulation

- **Technological and Urbanization Trends**
  - Rise in Traffic and Industrial Noise
    Rapid urbanization and growing vehicle numbers, particularly in developing and densely populated cities, contribute to increasing road traffic noise.
  - Construction and Urban Development
    With cities expanding, construction activities are major noise pollution source.
  - Noise from Public Transport Systems
    Urban areas with large public transport systems like trains, buses, and metro services can have difficulty mitigating transport related noise.

So obviously, these are some of the challenges, and people are working towards them. Slowly and steadily, we are getting to create awareness, and various noise control measures are now being undertaken. So most of these noise control measures will be discussed in detail in the next module of this course. In the next module, we will learn about the principles of noise control. So, we will first finish the module, then we will explore the instrumentation used in noise control engineering, and then we will examine the principles of noise control and the various techniques, studying each of these techniques in detail. But to sum up, various technological interventions in noise control can be classified as active noise control technology. Here, noise is essentially a wave or a signal. It is a kind of pressure disturbance, and suppose you create an antiphase sound which is just the opposite of it. So, suppose you have some pressure

$$P = A \cos (\omega t + kx)$$

then you create another P dash which is just the negative of this quantity. Then, by the principle of superposition, the two pressures will cancel each other out, and the noise will diminish. That is the principle behind active noise control, which we will discuss in detail in the upcoming lectures. Then we have passive noise control, where various materials are used in the pathway of noise to block it. So, you have barriers and panels. They block the propagation of sound in the pathways. You can especially see these in places like

highways, railways, and industrial facilities, where you have these big barriers. One of their primary functions is to stop or block the propagation of sound from these noisy areas to nearby quiet neighborhoods. Then, various sound-absorbing panels can be installed, which are made of porous materials, and they control the reflection within a room, reducing the reverberation.

Then, soundproofing technologies are being developed. Then we have, you know, various kinds of materials and technologies that are coming up. Double-glazed windows, soundproofing walls and floors, door seals. Then there is a movement in research. So, if you go into the field of noise control, we have a movement where, you know, we are getting towards quiet machinery design and quiet equipment. So, you will see that in the principle of noise control, if you can change the source, that is the most effective form of noise control. So, if, for example, from a conventional engine vehicle, you are shifting to an electric vehicle which runs on a motor, not an engine, and so essentially it is much quieter. So, automatically, the noise is cut down. So, quieter machines, you know, More machines where the mechanism of power generation itself is not noisy—that movement is taking place in the field of research. Then we have various noise mapping and

monitoring systems like sensors and computer algorithms that are creating the 3D visuals of noise levels that can be used for monitoring the overall noise level in urban areas, industrial sites, and we can see what are high-intensity zones, what are low-intensity zones. And we can map just like we create the maps or the political maps and the various kinds of maps of various regions. We can create sound maps of the various regions and come to know how the sound level is distributed in a particular big area, and accordingly, the solution can be put in place.

Then, obviously, you know, only technologies can be developed, policies can be developed, but until people don't implement it at their individual level, it cannot become effective. So, public awareness and community involvement are very important. You know Otherwise, anything you invent, if it's not being used, what's the point? So, public awareness is very necessary. They have to understand noise pollution and its harmful effects. And also, they need to know what the regulations are in place so that if they think something is creating a lot of noise, then they can approach a proper regulatory body, file complaints at the right place, and bring the noise level down. Awareness at the individual level is required. Then, the role of community noise reduction and community-based

noise monitoring can be done. Public reporting systems can be in place, and community campaigns and initiatives can be taken at the local level. As well as educational programs and outreach. So, for example, over here, this lecture series is supposedly being taken by undergraduates, postgraduates, and industry personnel. So, this is a series on noise control. But if you think about it at the very school level, at the primary and secondary education levels, you hardly have, subjects related to noise control. So, I say, why start this at the undergraduate level once the student is big enough? Why not have something at the very school level as well? So, even at the primary education level, we can at least educate and inculcate some good civic sense into our kids. That you know, noise-making and excessive noise are bad, and what are the harmful effects of noise? So, these kinds of, you know, just the basic information with respect to noise pollution can also be incorporated in the primary and secondary school education system. Other than that, you know, in various universities, we can have courses and public outreach. Even in social media and local media, these can play a big role in elaborating about noise pollution and noise regulations. Workshops and events can also be conducted from time to time. So, more activities need to be there so that people are aware and they cautiously make a choice to lead a quieter and better way of life.

Noise Control Measures

Public Awareness and Community Involvement

- Importance of Public Awareness
    - Understanding Noise Pollution
    - Knowledge of Regulations
    - Awareness of Individual Responsibility
- Role of Community in Noise Reduction
    - Community-Based Noise Monitoring
    - Public Reporting Systems
    - Community Campaigns and Initiatives
- Educational Programs and Outreach
    - Public Outreach, Social Media, Local Media, Workshops and Events

Image source : google images

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Similarly, noise-free zones and public campaigns. So, in many of these, you know, many of the developed nations and in some of the regions in India as well, there are some residential zones as well as hospital zones that have been made as quiet zones. And we need to have such noise-free zones, and the public should know why because, obviously, you know, the residents or the people residing there, they need critical care, and noise can be very harmful for them. Then, public campaigns for noise-free hours can be in place, cultural sensitivity, and respect for traditions. So, over here, obviously, we need, at the end of the day, balancing of the tradition and the noise control. So, and encouraging more noise-friendly celebrations all throughout India, and with this, you know. So, these are some of the ways in which noise can be controlled.

So, how do I see the future of noise regulation, you know? So, in the future, you know, technological innovations are being put in place for noise monitoring and control. So, nowadays, you know, smart noise monitoring systems or the use of artificial intelligence in noise control and noise monitoring is taking, you know, a boost, and various AI techniques can be used for noise monitoring and noise control. Then policy evolution and

stricter regulations are definitely required. You know, we can have more global standards. The regulations in India could be aligned with the global standards, and more comprehensive regulations could be implemented. You know, right now, some of the regulations are very vague or objective and may not be applicable in every scenario. So, more comprehensive guidelines can be put in place, and more enhanced enforcement mechanisms are required.

And obviously, public participation and crowdsourced data are required. And we need some sustainable noise control solutions as well, you know, such as, we will discuss acoustic metamaterials. They are one of the recent techniques for low-frequency noise control. And then there are various green acoustic materials which are being used, for example. The materials from plant fibers, animal skins, and various kinds of plant fibers like jute, cotton, coir, and so many things. So, these are the green materials which are available in abundance, but they are all good absorbers of sound and can be used and incorporated because they are obviously more environmentally friendly and have a lesser carbon footprint. Then noise-reducing urban design is required. So whenever a new city is being planned, the city planning committee and the city planning commission should

incorporate Noise should also be a part of the city design, not just how to manage the traffic or the aesthetics, but also the noise levels in the cities. So in the urban design itself, noise can be a significant factor that has to be considered. Quieter power sources need to be invented and utilized.
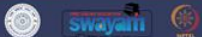

So, with this, I would like to conclude this lecture. So, it is time to educate those around us about the impact of noise pollution, and I hope you take this responsibility and act on it as well. Thank you.

It Is Time To Educate Those Around Us on The Impact of Noise Pollution