SOUND BYTES - 14

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Official Newsletter of ISNT Chennai Chapter

To include the news about ISNT's Mega event as early as possible and for administrative convenience Sound Byte, hence forth will be published on 1st January, 1st April, 1st July and 1st October.

TEAM SPIRIT

Dear Readers,

Success in any organization relies on the collective intelligence and unified vision of its employees working towards a common goal. Collaboration is pivotal for achieving goals, as it harnesses the collective strengths, skills, and perspectives of diverse team members across all levels. The T20 World Cup win reflects the values of collaboration and teamwork in the workplace. India's journey to the World Cup was filled with challenges, but the road to success is paved by failure. With endless hours of practice, learning from past games, and refining their strategies, they achieved this big win after 13 years. It has inspired us to embrace core values both on the field and at work and also highlighted the importance of collaboration to achieve a shared goal.

1. "Talent wins games, but teamwork and intelligence win championships." - Michael Jordan. India's victory exemplified this principle perfectly, as the entire team, led by Rahul Dravid and Rohit Sharma, demonstrated true resilience, teamwork, and preparation. Rohit's strategic captaincy, Virat Kohli's consistency, SKY's unforgettable catch, Arshdeep Singh, Jaspreet Bumrah's, and Hardik Pandya's excellence in bowling all contributed to the team's win.
2. Consistency is Key With millions of fans watching and the weight of expectations on their shoulders, the Indian team was under intense pressure. Despite the gut-wrenching wickets in the first few overs and the creeping pressure in the last couple of overs, the mental toughness throughout the match was significant. The team demonstrated unity and focused on the goal.
3. Pause. Ponder. Play When Heinrich Klaasen and David Miller launched their fierce attack, it was crucial for India to dismiss them. Rishabh Pant's medical time-out gave Rohit Sharma the time to re-think his strategy, soon after which Hardik dismissed Klaasen in the first ball of the 17th over. The team's ability to adjust its strategy in response to its opponents showcased the importance of flexibility.
4. Pushing Boundaries How important is pushing boundaries? It's about challenging your limits while preserving what truly matters. Suryakumar Yadav, aka SKY, demonstrated this perfectly with a heart-stopping catch that showcased his agility and presence of mind, dismissing Miller in the final over.
5. Significance of a Support System Family and friends are a positive force that goes beyond just cheering from the sidelines. An undeniable truth is how they are there through the highs and the lows. While the families of the Indian cricket team celebrated their victory, we witnessed how the families of the South African team provided unwavering support during their loss. The role of support systems is key to every player's journey. The lessons from this win highlight the power of collaboration. Let's translate these lessons into our workplace by embracing change, maintaining consistency, and standing united.

By Ms.Humsini Rajesh

Chief Compiler's note:

I came across this beautiful article in one of the newsletter of an organization. I thought that it will be beneficial for our members also to read it and assimilate the points brought out regarding the value of team spirit.

Ram

Indian Society for Non-Destructive Testing , Chennai Chapter

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Email: isntchennaichapter@gmail.com; Website: www.isnt.in

ISNT Chennai Chapter News

Addition of Members – **Newly Added Members up to September 2024**

Life Corporate Member

1. Maitravaruna Technologies Private Limited, "H.M.Square", No.23, Kamaraj Avenue, 1st Street, Kasturba Nagar Adyar, Chennai-600020. - LCM10016CH
2. RADENT ENGINEERING, No.211, Thirunagar, 87, Veppampattu Post, Thiruvallur Dist, Tamil Nadu, India PIN 602 024 - LCM10030
3. NOVSOL COMCO INDIA PVT LTD - 6th Floor, Guna Complex, Annex- 1, Teynampet, Chennai – 600018 LCM10035
4. METAL NDT AND INSPECTION SERVICES LLP, Hyderabad - LCM10036CH

Life Member

1. Dr.N.VAANI, School of Civil Engineering (SCE), Vellore Institute of Technology (VIT), Vellore-632014
2. Mr.SAPTARSHI SASMAL, Special and Multi-functional Structures Lab, CSIR-SERC, CSIR Road, TTTI Post, Taramani, Chennai-113
3. Mr. Ashwin Kasi Viswanath, No 49 E44 Arihant Amara, PH Road, Kattupakkam, Chennai - 600056
4. Mr. Siddarth Kasi Viswanath, No 49 E44 Arihant Amara, PH Road, Kattupakkam, Chennai - 600056
5. Mr. Joseph J Kakkassery, Veltech, P2- 307 , VGN stafford, Avadi, Chennai -600062
6. Mr.N.Hariharan, VSSC, ISRO, Rajakilpakkam, Chennai
7. S RAMAKRISHNAN, Brakes India Limited, Chennai
8. Mr.R.Shyam Sunder, Chennai
9. Mr.Prem Kumar, NPCIL, Maps. Kalpakkam

MEMBERSHIP STATUS UP TO SEPTEMBER 2024

PARTICULARS	June 2024	Newly added	Sep 2024
LIFE CORPORATE MEMBER	50	4	54
CORPORATE MEMBER	3		3
LIFE FELLOW	14		14
HONORARY FELLOW	9		9
LIFE MEMBER	604	9	613
MEMBER	19		19
ASSOCIATE MEMBER	7		7
STUDENT MEMBER	202		202
TOTAL	908	13	921

Course Conducted from June 2024 to September 2024

Sl.No	Course	From	To	No. of participants	Course Director
1	Ultrasonic Testing -Level II	11.06.2024	22.06.2024	16	Sri S.R.Ravindran
2	Radiography Testing-Level II	10.07.2024	20.07.2024	09	Sri S.Chockalingam
3	Visual Testing-Level II	29.07.2024	03.08.2024	08	Sri Sathya Srinivasan
4	Penetrant Testing-Level II HRDD, SHAR, Sriharikota (In-house Program)	05.08.2024	10.08.2024	24	Sri P.Anandan
5	Surface NDT(PT&MT)-Level II	22.08.2024	31.08.2024	15	Sri M.S.Viswanathan
6	Ultrasonic Testing -Level II	10.09.2024	21.09.2024	19	Sri B.Ram Prakash

Courses Planned for the next 3 months

1. **RT Level-II course from 16th October 2024 to 26th October 2024**
2. **Surface NDT (MT & PT) Level-II from 7th November 2024 to 16th November 2024.**

PT LEVEL - II COURSE AT HRDD, SHAR, SHRIHARIKOTA 10.08.2024

MT & PT LEVEL-II COURSE VALIDECTORY ON 28.08.2024

UT LEVEL-II COURSE VALIDECTORY ON 18.09.2024

THANKS NOTE

Thank you ISNT Chennai chapter for conducting such an enlightening and comprehensive training session. Your thoughtful approach and practical examples helped us to grasp complex concepts with ease. I appreciate your dedication to excellence and the positive impact it's had on our professional development.

I would like to thank all the Faculty members for their valuable knowledge sharing and experiences with us.

I would especially like to thank @velumani sir for helping us throughout the session for getting hand on experience with UT machines and practical approach for performing UT examination.

We had a great time and met with new friends across various department and industries.

Thank You all....

Vikhyat Gautam
Heavy Water Plant,
Tuticorin

EC meeting

1. The 3rd EC Meeting for the financial year 2024-2025 was held on 13th July 2024
2. The 4th EC meeting for the financial year 2024-2025 was held on 11th August 2024.

Guest Lecture

Mr.R.Balakrishnan, Chairman Elect gave a Guest lecture on "Awareness on Non-destructive Testing" on 1st July 2024 (Monday) at 02: 30 PM to Engineering Students of Thiagarajar College of Engineering, Madurai.

AGM

The Annual General Body Meeting (AGM) was held on Saturday 13th July 2024 at 6.30 PM at Hotel Quality inn Sabari, T.Nagar, Chennai. Total number of members attended was 65.

HO news & other chapter news

For ISNT Head office announcements and Webinars of other chapters please refer to the Website of HO of ISNT (www.isnt.in).

Technical Meeting

S.No.	Date	Topic	Speaker	Venue
1.	11.08.2024	"NDT&E Of Concrete Structures Using Active And Passive Wave Propagation Techniques" by	Dr. ING SAPTARSHI SASMAL, FIE, FNAE, Chief Scientist & Head, CSIR - SERC, Chennai and sponosed by M/s.Mabel Engineers Private Limited, Gummidipoondi .	ISNT Head Office Conference Hall , Chennai
2.	15.09.2024	"Automation In X-Ray Testing Of Castings Forautomotive Applications"	Shri. S. Ramakrishnan, Senior General Manager (Retd) Quality, M/s.Brakes India Limited, *Sholingur* and sponosed by M/s.Precision Equipments (Chennai) Private Limited, B-70/1, SIPCOT Industrial Park, Irungattukottai, Sriperumbudur	ISNT Head Office Conference Hall , Chennai

TECHNICAL TALK PHOTOS

AGM PHOTOS



INDIAN SOCIETY FOR
NON - DESTRUCTIVE TESTING
CHENNAI CHAPTER








National NDT Awarded by Head Office during National Conference

NATIONAL NDT AWARDS

Sl. No	Category	Sponsored by
01.	ISNT-EEC Award for Excellence in Contribution in R & D – National NDT Award	M/s. Electronic & Engineering Co. (I) Pvt. Ltd., Mumbai
02.	ISNT-P-MET Award for Excellence in contribution to Industrial Applications National NDT Award	M/s. P-Met High Tech Co. Pvt. Ltd, Vadodara
03.	ISNT-MQS Award for Excellence in contribution to NDT Systems innovation & development – National NDT Award	M/s. MQS Technologies Pvt. Ltd. Hyderabad
04.	ISNT-IXAR Award for Best Paper in JNDE, R&D category	M/s Industrial X-Ray and Allied Radiographers, Mumbai
05.	ISNT-Eastwest Award for Best paper in JNDE, Industrial application category	M/s East West Engineering & Electronics Pvt. Ltd. Mumbai
06.	ISNT-CHOKSI IMAGING Best Chapter Award for the Best Chapter of ISNT	M/s Choksi Imaging Limited, Mumbai
07.	ISNT Lifetime Achievement Award	ISNT
08.	Hon. Fellow Member	ISNT
09	ISNT-CHOKSI Award for Young Scientist.	M/s. Choksi Asia Pvt. Ltd, Mumbai
10.	ISNT National NDT Award for International Recognition	ISNT

Application form (category wise) are available at https://isnt.in/isnt-ndt-awards/ndt-awards-2024.php

Please visit our website at https://isnt.in/home/index.php for more details.

CHAIRMAN'S IMMEDIATE PLAN OF ACTION

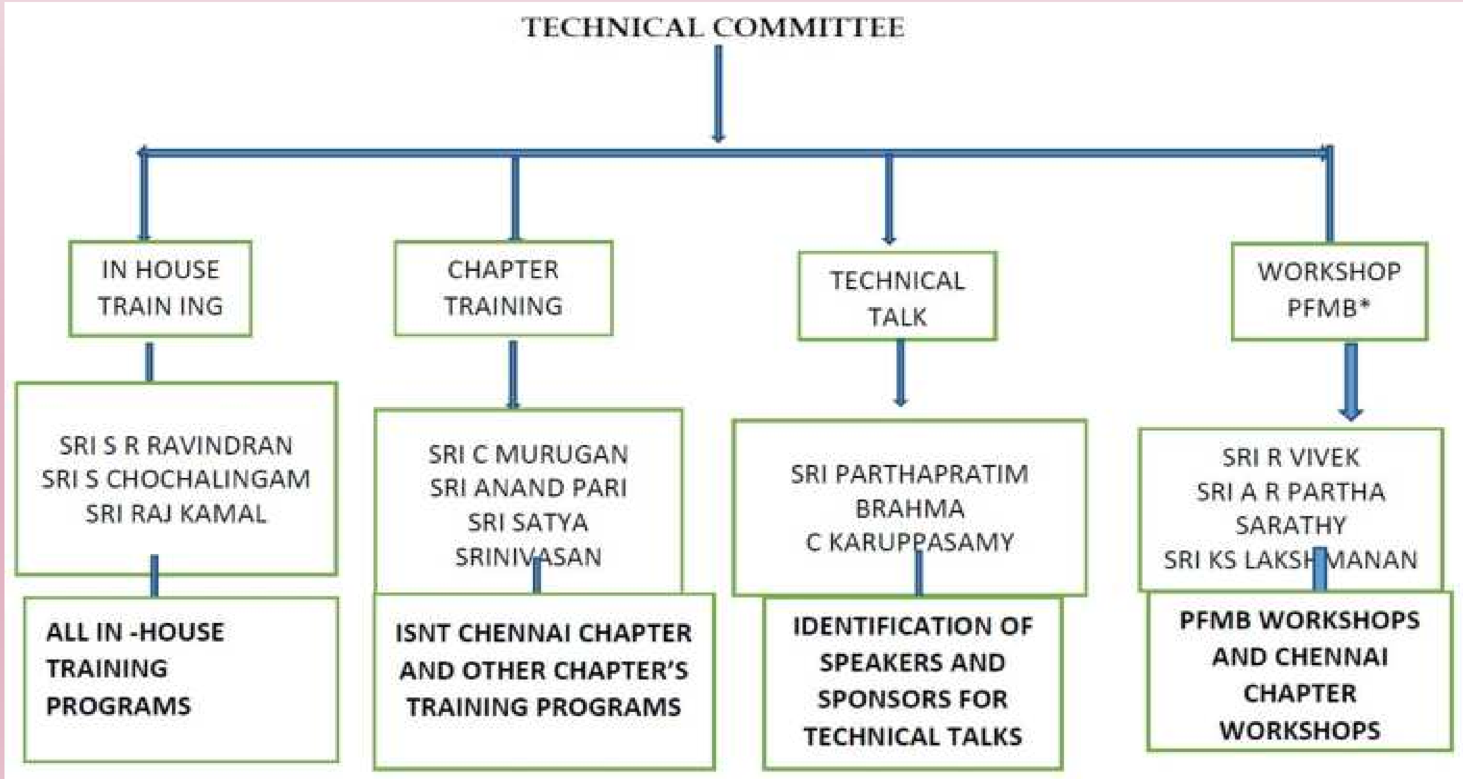
By R.BALAKRISHNAN. CHAIRMAN ISNT CHENNAI CHAPTER

I express my sincere thanks to Chennai chapter members for selecting me as Chairman for the period 2024-26 and I will carry out the duties of the chapter chairman. I hope to measure up to your expectations with your valuable support.

I had been in touch with many of the EC Members and gathered their opinions and interest in promoting chapter activities.
As decided by them the chapter activities were elaborated as detailed below.

TECHNICAL COMMITTEE

Technical committee is the heart of ISNT Chennai Chapter and its growth is mainly dependent on it.



SOUND BYTES –NEWS LETTER

The Editorial News Letter Committee

The response to the newsletter soundbytes is praise worthy. As the chairman of the chapter I hereby promise to extend my full support for its continued publication every quarter. As a chairman I appreciate and congratulate Shri. B.Ram Prakash for his dedicated involvement and his commitment to release it in time.

We, the chairman, and all EC members & Advisers appreciate Sri B Ram Prakash for his monetary Contribution of Rs 2 lakhs to ISNT Chennai chapter with a request to honor the authors of the Newsletter every year.
The committee for sound bytes
S/Sri
B Ramprakash - Chief Compiler
Parthaprathim Brahma
M. Manimohan
C. Karuppasamy
Dr. Prabhu Rajagopal
Dr. Balasivandha Prabhu
Dr. Joseph J Kakkasery

Special NDT Training programs

The Trichy and Sriharikotta chapters of ISNT had invited us to conduct NDT Certification Training Program for their Technicians & executives.

Trichy Chapter- SNT-TC-1A Eddy Current Testing Training –Planned to conduct in the month of October 2024- Course Director Mr KV Siddarth

Sriharikotta Chapter- Leak testing – Course Director- Mr S R Ravindran

Mr. SGN Murthy is designated as convener to conduct workshop on structural Engineering.

NDE 2024 SEMINAR

It is well known that ISNT HO along with Chennai Chapter is organizing NDE -2024 Seminar on the dates 12-14th Dec 2024 at Chennai Trade Centre.

In this connection ISNT CC has nominated the following team members to organize Corporate Meet in the month of October 2024.

Sri C Murugan- Vice Chairman & Mr K Thangamani- Past Secretary –ISNT CC

We request Mr.Jayakandan to use his good office in bringing more delegates/sponsors to NDE 2024 seminar.

PFMB WORKSHOP

The Program Formulation Management Board of ISNT approached Chennai Chapter to conduct Eddy Current Workshop and Chennai chapter welcomed the proposal.

Mr. M Dharmaraj has been nominated to be Convener of the workshop and it would be preferred to conduct the workshop on 4th & 5th October 2024

THE OTHER WORKING COMMITTEE'S FORMED ARE AS GIVEN BELOW

ACADEMIC INSTITUTIONS WELFARE COMMITTEE	FACULTY FELICITY COMMITTEE
1. NDE Awareness 2. Faculty Training 3. Student Chapter Activities – Workshop	1. Organising Faculty Meet 2. Updating course note books 3. Faculty grievances & honorarium 4. Feedback Analysis 5. Assistance to Faculty Inclusion 6. Lab Equipment Requirements & procurements
Committee Members: 1. Dr. Prabhu Rajagopal 2. Dr.Balasivananda Prabu 3. Dr.Rajendra Boopathy 4. Dr. Sathyamoorthy 5. Dr.Joseph J Kakkassery	Committee Members: 1. Mr.P.N.Udayasankar 2. Mr.R.Subburathinam 3. Mr.S.Dwarakanathan 4. Mr.M.Manimohan

IDENTIFICATION OF TRAINERS FOR NDT TRAINING PROGRAMS

It is necessitated to identify suitable trainers to strengthen our Chapter Training activities due to increased demands to conduct training programs from various places

To identify quality NDT trainers it is proposed to conduct a Trainer Program for the qualified certified NDT Technicians. The program will be well framed with the help of our chapter faculty and trainers as given below.

Best UT Trainer Program	Mr.S.R.Ravindran Mr.A.R.Parthasarathy Mr.S.Velumani
Best NDT Trainer	Mr.E.Sathya Srinivasan Mr.S.Chockalingam

NDT EQUIPMENT & ACCESSORIES MAINTENANCE COMMITTEE	OFFICE ADMINISTRATION COMMITTEE
1. Calibration of NDT Equipment & Measuring Instruments 2. Maintenance Of Standards 3. Upkeeping of Course Note books, NDT Books, NDT CDs, Question Bank	1. Old record disposition, 2. Accommodation arrangements 3. MOM with neighbouring Lodges 4. Food arrangements to Participants 5. Office Staff welfare 6. Event Management 7. Infrastructure Development
Committee Members: 1. Sri M S Viswanathan 2. Sri S Velumani	Committee Members 1. Mr.S.Subramanian 2. Mr.N.Karunanidhi 3. Mr.C.Karuppasamy 4. Mr.R.Jayagovindan

Indian culture's foundation is team spirit and bonding. Regarding team spirit an excellent article is appearing in this issue. The second aspect of bonding also plays an important role in any assembly towards achieving common goal. To foster bonding ISNT Chennai Chapter is conducting ISNT Day every year on 21st April along with the family of its members. We initiated this celebration and is followed by many other chapters. To further this movement now I desire to celebrate the birthday of EC members and advisors of EC occurring in that month during the technical talk. The first celebration was on 15th September and the birthday of our Advisor Shri.B.Ram Prakash was celebrated.

Terrace work

We found water seepage on ceiling area of our chapter premises which is due to crack developed in the ceiling. Because of the development of cracks, the false roof was damaged in Chapter hall. Though false roof was replaced it is not effective. It is observed that these ceiling cracks were due to the installation of advertisement boards above the terrace. The cause of crack and further development were due to the static load of the advertisement boards.

A request letter from ISNT CC to remove the advertisement boards were handed over to the owners of the boards and they have removed them.

Now because of the installation of board most of the tiles laid over the terrace were found damaged and needed replacement.

Erection of Advertisement Boards

Damaged Whether proof Tiles on the terrace

Crack formed in the ceiling

Damaged False roof due to water seepage

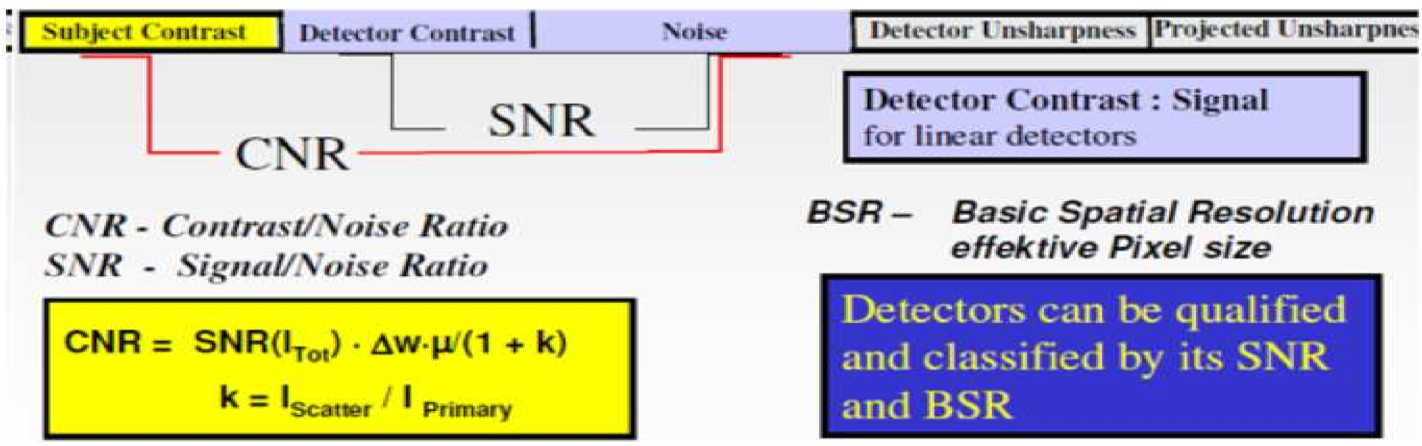
Computed Radiography and Digital Radiography– PART 2

By Dr. R J Pardikar

Quality Aspects of Digital radiography:

The image quality in digital industrial radiography (DIR) depends mainly on the exposure conditions and the properties of the digital detectors. Many parameters influence the result of digital radiographs, but only three parameters are essential for the achievable contrast sensitivity. These essential parameters are the basic spatial resolution of the image (SRb image), the Signal-to-Noise Ratio (SNR) and the specific contrast (μeff) and the perception threshold of the operator at a given viewing condition.
If these parameters of digital image are known, the visibility limits (smallest IQI element of wire or plate hole IQI) can be calculated.

Image Quality parameters- Digital Detectors:

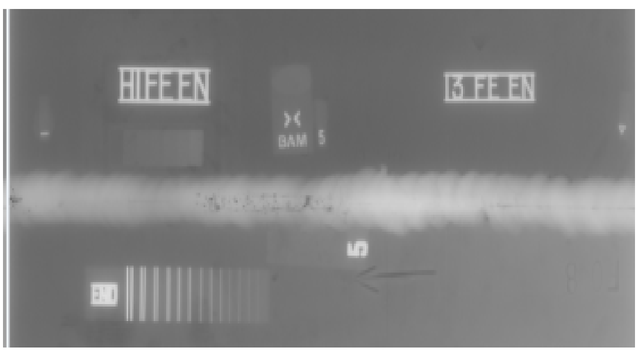


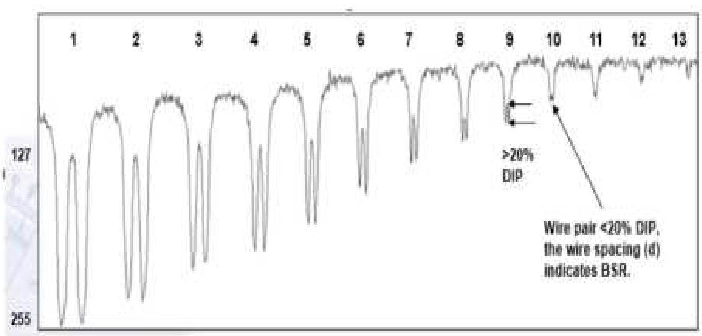
1.**Basic spatial resolution of a digital detector (SRb detector):**

The basic spatial resolution of a detector (SRb detector) is considered as a quantitative value for its effective pixel size. It is the major parameter, which allows the user to decide if a digital system can be applied for a certain inspection task.
(SRbdetector) corresponds to half of the measured detector unsharpness in a digital image and corresponds to the effective pixel size and indicates the smallest geometrical detail, which can be resolved with a digital detector at magnification equal to one.
The basic spatial resolution must be determined from the MTF (Modular transfer function) value at 20%. The corresponding resolution value SRb is calculated by the following equation:

SRb = 1/ (2. MTF20)

SRb: Basic Spatial resolution (mm).
MTF20: Line pairs per mm.
For testing of the basic spatial resolution, the duplex wire can be applied. The first unresolved wire pair shall be taken for determination of the un-sharpness value. This will be the first wire pair that is projected with a less than 20% dip.





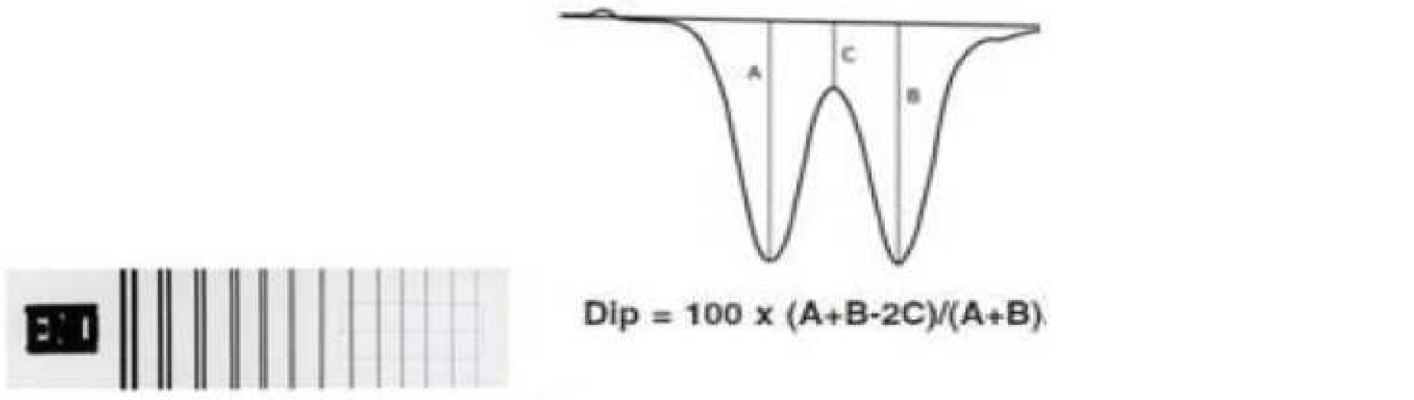


Fig 7. Determination of Unsharpness value using Duplex wire

The measurement with Duplex wire IQI provides a total unshapness value U_T in µm.
Which is equivalent to the special resolution SR_b, which is calculated by:

$$SR_b = \frac{U_T}{2}$$

SR_b detector is directly measured with the Duplex wire detector on the detector.
Duplex wire method has less accuracy than the MTF method but is more user friendly.
Converging Line Pair can also be used for assessing the Basic spatial resolution.

Measurement of Sensitivity with Image Quality Indicators (IQI):

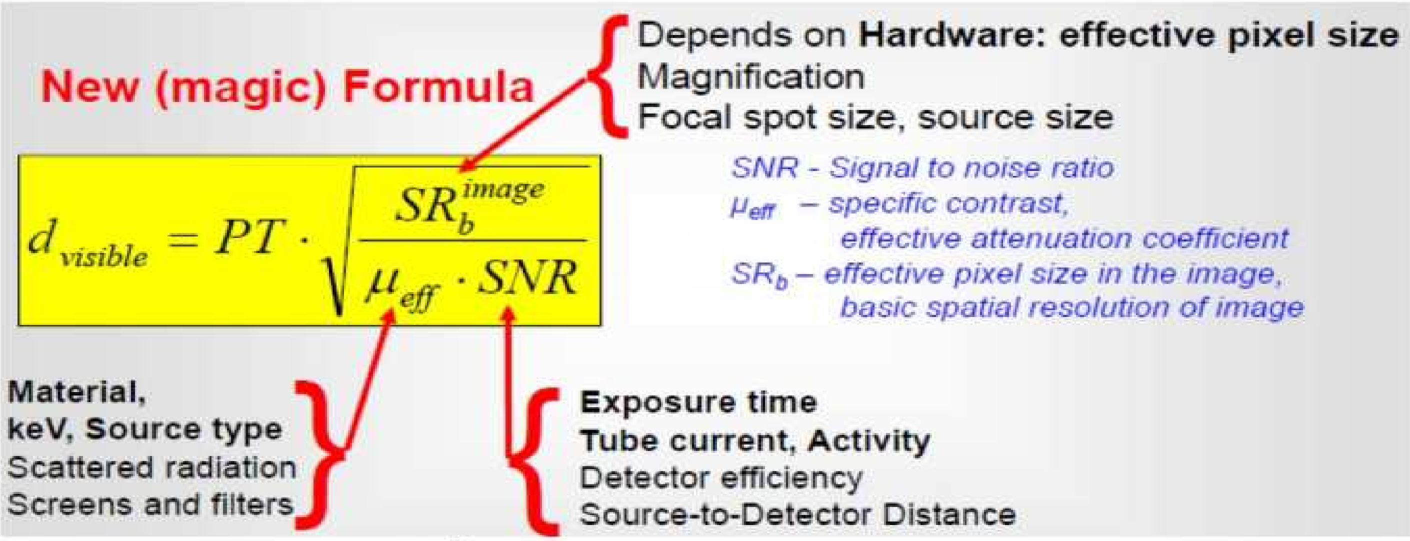
The sensitivity of radiographs is typically evaluated by image quality indicators (IQI). European users apply mostly wire IQIs, or in some areas step hole IQIs (ref ISO 19232) with 1Tholes (1T- hole: diameter corresponds to IQI step thickness). US standards as ASME (BPVC Section V, Article 2) require typically plate hole IQIs, but permit also wire IQIs. In both cases the standards require a material thickness contrast sensitivity (CS) which improves about with 1/square root of the material thickness.
The required thickness sensitivity is similar in the ASME BPVC Section V, Article 2, Table T-276, and ISO 19232-3, testing class A.
ASTM E 1025 (plate hole IQIs) and ASTM E 747 (wires) define the thickness contrast sensitivity quantitatively as EPS (equivalent penetrameter sensitivity). The EPS value is a reference for the 2T hole visibility.
The EPS value is defined for hole type IQIs in ASTM E 1025 by

$$EPS(\%) = \frac{100}{t_{material}} \sqrt{\frac{T_{IQI} \cdot d_{hole}}{2}} \qquad \text{------------------ } 1$$

Where,
EPS - Equivalent penetrameter sensitivity in % of material thickness
$t_{material}$ - Thickness of penetrated material
T_{IQI} - Thickness of IQI
d_{hole} - Diameter of IQI hole

The quantitative measurement of the EPS is based on the visibility evaluation of the hole type IQIs at the radiographic image by a human operator, depending on the IQI thickness and hole diameter. The visual evaluation depends on the (subjective) individual operator and the scatter. In digital radiography the viewing of images is performed on a monitor, instead on a light viewing box. This may change the result of visual evaluation of the image quality.
The following essential parameters are controlling the contrast sensitivity and therefore the visibility of IQIs in a digital grey level image:
- Basic spatial resolution (SRb),
- Signal-to-noise ratio (SNR),
- Relative specific contrast (µeff), which is the effective attenuation coefficient (including scatter effects)

Essential Parameters for Calculation of Just Visible IQI - IT Hole diameter:



PT – Perception Threshold; **d**visible - hole diameter of the just visible hole in the image.

The perception threshold (PT) for the visibility of a hole (visibility of small details) by the humanoperator on the image display can be formulated as follows:

PT = dvisible·CNR -- eq. 2

Now it is assumed that the hole diameter d is equal to the IQI thickness T = Δt.

The just visible 1T hole diameter and IQI thickness can be calculated from eq. 2 and 3,

$$d_{visible} = PT^* \cdot \sqrt{\frac{SR_b^{image}}{\mu_{eff} \cdot SNR}} = PT^* \cdot \sqrt{1/CNR_N^{specific}}$$

-------------------------eq. 3

PT depends also on operator and viewing conditions. If the hole diameter is much larger than theunsharpness, the equivalent IQI sensitivity (EPS in %) changes for a given material thickness asfollows.

$$EPS = \frac{PT'}{t_{template}} \sqrt{\frac{SR_b^{image}}{\mu_{eff} \cdot SNR}}$$

Additionally, the number of presented pixel at the monitor has to be considered for correct IQI perception. Since the acquired image size depends on the pixel size and number, the presentation on the image display monitor depends also on the pixel size (one acquired pixel shall be presented atone separate monitor pixel). That means that the real diameter d can be presented with different scaling factors at the monitor. Following the Shannon sampling theorem, the information content of an unsharp image (bandlimited “) is sampled with the size of the unsharpness kernel and therefore, the basic spatial resolution is used instead of the pixel size. In consequence, the effective pixel size SRb for scaling correction is also considered for calculation of the just visible IQI hole diameter:

Dependence of equivalent penetrameter sensitivity on contrast, noise and special resolution:
Human technicians and camera system recognise IQI holes at different **CNRs** as a function of hole diameter. It also has to be taken into account that the brightness should be above perception threshold limit. Human technicians perceives the larger indication at Lower CNR and smaller ones at larger CNR.

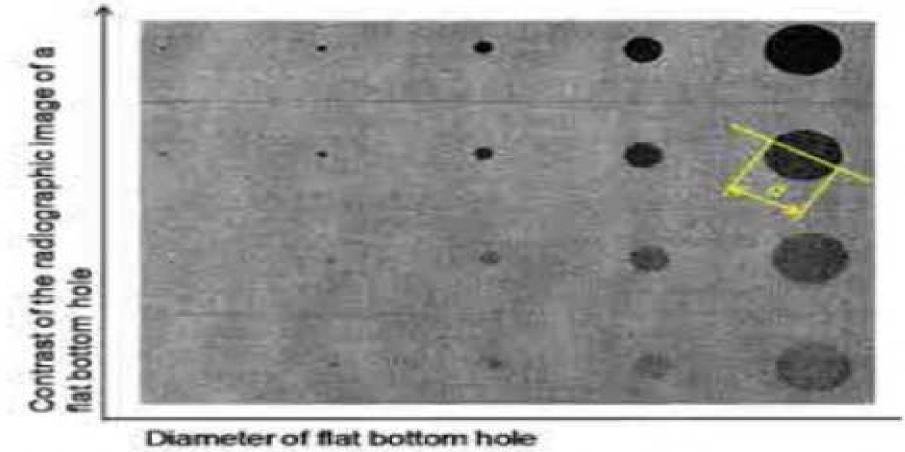


FIG 8 . Grey value image of holes with different contrast, CNR and diameter. The CNR is constant in each line and the diameter is constant in each column. Holes with larger diameter are seen at lower CNR.

contrast sensitivity:

SNR and contrast sensitivity improve with exposure time, but above a detector specific value the contrast sensitivity does not change significantly anymore. Decreasing the radiation energy will improve the contrast sensitivity.

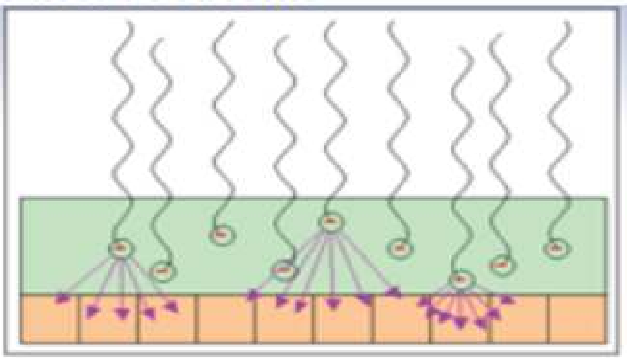
$$CS\% = \frac{PT}{SNR.w.\mu_{eff}}$$

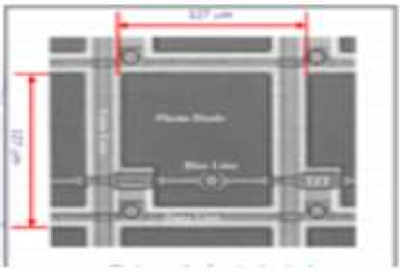
CS:contrast sensitivity

SNR: Signal to noise ratio.
w: Wall thickness or penetrated thickness.
μeff: Effective attenuation coefficient.
PT: Perception threshold typically 1 for linear and2.5 for circular.

3.SNRN or grey value (CR only) are used as equivalent value for film system class selection and opt. density limits.
4.Usage of duplex wire for system qualification and system selection is mandatory.

Pixel Problems





Single pixel Noise

Pixel problems	
No gain pixel	Not responding to signal
Over responding pixel	Over responding to signal (higher grey value in comparison with neighbors)
Under responding pixel	Under responding to signal (lower grey value in comparison with neighbors)
Noisy pixel	Fluctuating high signal response over a number of images
Non uniform pixel	Not uniform with neighbor pixels after calibration
Persistance/lag pixel	Retains signal >1% after x-ray shut down in comparison to neighbors BURN IN!

Noise Sources in Digital Radiography : Different noise sources have to be considered in digital radiography which have its origin in:
1.Photon noise, depending on exposure dose (e.g. mAs or GBqmin)2. Structural noise of DDAs and Imaging Plates also called fixed pattern noise (due to variations in pixel to pixel response and in homogeneities in the phosphor layer) 3.Noise due to Crystalline structure of material and Surface roughness of test object.
The first two noise sources (Photon noise, Structural noise of DDAs and Imaging Plates) can be influenced by the exposure conditions and detector selection. The achieved Signal-to-Noise Ratio (SNR) of images depends on the exposure dose (low dose application). The SNR increases with the square root of mA· minutes or GBq· minutes, due to the improved photon quantum statistics. The structure noise of films and imaging plates depends on its manufacturing process and can be influenced basically by the selection of the specific detector type (e.g. fine or coarse grained film). The structure noise of detectors and all noise sources depending on the object properties determine the maximum achievable SNR and limit, therefore, the image quality independently on the exposure dose (high dose application). Only with DDAs, the structure noise (due to different properties of the detector elements) can be corrected by a calibration procedure, since the characteristic of each element can be measured quite accurately.
Dark noise and structural noise reduced by offset (Detector Signal in the absence of x-ray exposure) and flat field correction.

Signal to Noise Ratio (SNR): It is the Ratio of mean value of the linearized grey values to the standard deviation of the linearized grey values (noise) in a given region of interest in a digital image.
The SNR values of film are measured with a circular diaphragm of 100 µm diameter after exposure to a diffuse optical density of 2 above fog and base. The diaphragm area (aperture) has to be converted into a square shaped area for comparison of film to digital images or detectors. The equivalent square of a picture element (pixel) amounts to 88.6 x 88.6 µm², which corresponds to a resolution of 287 dpi. The pixel size/area is important, because the SNR depends on the detector area. The SNR increases proportional to the square root of the pixel area under same exposure conditions (same radiation quality and exposure time).
Since the gray values of the pixels in the digital images (assuming signal is linear to dose) depend on noise and signal intensity independent of the contrast and brightness processing for image viewing, the SNR has been accepted as an equivalence value to the optical density of a certain film system in film radiography.
Bad pixel(Dead pixels, noisy pixels) correction improves SNR. But correction of bad pixel may affect basic spatial resolution @ corrected location. Increasing the SNR will improve the contrast sensitivity. Higher accumulated radiation intensity (mA x time, number of frames) results in Higher Signal there by Higher SNR.

Normalised Signal to Noise ratio(SNR_N):

Signal-to-noise ratio, SNR, normalized by the basic spatial resolution, SRb, as measured directly in the digital image and/or calculated from the measured SNR

$$SNR_N = SNR_{measured} \frac{88{,}6\ \mu m}{SR_b}$$

The normalized SNR_N is independent on the unsharpness, but depends on theefficiency and plate homogeneity.

Noise Problems:

$$SNR_{detector} = \frac{S_{quantum} + S_{dark}}{\sqrt{N_{basic}^2 + N_{quantum}^2 + N_{structure}^2}}$$

Squantum : Acquisition with radiation dose.
Sdark : Acquisition without radiation dose.
Nbasic : Noise due to electronic and read out noise.
Nquantum : Noise due to radiation (internal and external scattering).
Nstructure : Noise due to the structure of the imaging plates or DDA (digital detector array) in thecase of flat bed panels.
8.The only material independent values are the effective attenuation coefficient and SNR that we can influence.

Contrast to Noise ratio (CNR): It is the ratio of the difference of the mean signal levels between two image areas to the averaged standard deviation of the signal levels.CNR describes how easily a defect can be detected. Higher the CNR, better the detectability.

Normalized contrast-to-noise ratio(CNR_N): It is the contrast-to-noise ratio normalized by the basic spatial resolution, SRb, as measured directly in the digital image and/or calculated from the measured CNR, by

$$CNR_N = CNR \cdot \frac{88{,}6\mu m}{SR_b}$$

CNR and SNR increase with increasing exposure time due to improved photon statistics.

Specific Material Thickness Range:
It specifies the recommended material thickness range for application of the qualified detector. The thinner wall thickness is limited by 80 % of the maximum grey value of the DDA and the thicker wall thickness by a SNR of 130 for 2 % contrast sensitivity and SNR of250 for 1 % contrast sensitivity

Compensation principles:

Compensation Principle**I: Compensation for reduced contrast (μeff) by increased SNR**
In film radiography, it is well understood that the image quality increases if the tube voltage is reduced. In DIR, it can also be observed that the image quality increases in a certain range if the tube voltage is increased. The higher photon flow (X-ray intensity behind object) increases the SNR in the detected image faster than the reduction of the contrast by the decreased transmission contrast (also known as specific contrast or effective attenuation coefficient μeff). This effect depends on the ratio of attenuation decrease to SNR increase since the product of SNR and μeff controls the contrast sensitivity in the digital radiograph. Well calibrated DDAs can be exposed typically at higher tube voltages than films.

The compensation by increase of the tube voltage is restricted depending on the detector and material-properties and especially on the maximum achievable SNR in the radiograph.

Compensation Principle II. Compensation for insufficient detector sharpness by increased SNR .
In a high contrast sensitivity mode the DDAs achieve better IQI reading than film exposures. This effect is observed when subpixel contrast resolution is achieved. This is the case, if the SNR at the detector is increased considerably. If a wire or crack is smaller than a pixel, it still influences the contrast and can be seen in the image if the contrast is sufficiently higher than the noise. Therefore,systems with insufficient spatial resolution can be applied if their higher unsharpness is compensated by increased SNR.

Compensation Principle III. Compensation for increased local interpolation unsharpness, due to bad pixel correction for DDAs, by increased SNR.

Comparison of Image Quality for Film and Digital Detection Systems:

NDT films yield an excellent image quality but need 10 to 100 times higher dose for sufficient exposure. Therefore, NDT films are exposed to an optical density (D) between 2 and 4. Critical NDT objects, as e.g. castings and weldments, require the visualisation of fine cracks and fine wall thickness changes. This leads to higher demands for the image contrast and sharpness.
Film systems are characterised by the gradient GD (at D = 2 and D = 4 above fog and base) and the granularity δD at D = 2 above fog and base. The most important parameter for the perception of fine flaws is the gradient over granularity ratio G2/δD, which can be used to calculate the corresponding SNR.
The conversion of G2 /δD into SNR values is based on the assumption that both systems, NDT film system and digital detector array systems, provide signals (opt. Density, photo stimulated luminescence, or digital grey values), which are approximately proportional to the exposure dose. Non-linear signals have to be linearised before SNR and spatial resolution can be determined.

The SNR values of film are measured with a circular diaphragm of 100 µm diameter.
after exposure to a diffuse optical density of 2 above fog and base. The diaphragm area (aperture) has to be converted into a square shaped area for comparison of film to digital images or detectors. The equivalent square of a picture element (pixel) amounts to 88.6 x 88.6 µm², which corresponds to a resolution of 287 dpi. The pixel size/area is important because the SNR depends on the detector area. The SNR increases proportional to the square root of the pixel area under same exposure conditions (same radiation quality and exposure time).

In film radiography the film unsharpness depends more on the lead screen thickness and on the used radiation energy (keV) than on the AgBr grain size in the emulsion . The unsharpness value amounts to about 10 – 30 µm between 100 and 300 keV. Typically, the geometric unsharpness resulting from the focal spot size and distance to the object is larger than these values of the NDT film systems and determines the total unsharpness UT = 2. SRb image.

The inherent unsharpness of digital detectors is typically higher than the one of NDT film
systems. Computed radiography systems, which are currently used in NDT were classified with a SRb detector of 40 – 160 µm. Digital detector arrays (DDA) are currently available for NDT applications with SRb detector of 80 – 400 µm.

All international radiographic standards regulate basically 4 major conditions to achieve
a sufficient quality in radiographic testing:

Requirement	Film	Digital	
	ISO, CEN, ASTM, ASME	ISO, CEN	ASTM, ASME, MAI
Exposure	Exceed minimum **optical density**	Exceed minimum required **SNR_N**	Exceed minimum required **CNR** for DDAs CR systems shall be exposed to **EPS plateau** values (under discussion and published in MAI [2])
Detector requirements	Use required **film system class** or better	Use detectors, which achieve the required **SNR_N** and do not exceed **detector unsharpness** limits	Use detectors, which do not exceed **image unsharpness** limits
Maximum image unsharpness	Do not exceed the **geometrical unsharpness** limits	Do not exceed the **image unsharpness** limits	Do not exceed the **image unsharpness** limits
Image quality	Achieve the required **IQI contrast sensitivity**	Achieve the required **IQI contrast sensitivity and duplex wire resolution**	Achieve the required **IQI contrast sensitivity**

The application of digital detectors is mainly limited by the requirements on the maximum unsharpness. Digital detectors can be applied only in contact with the object, if the inherent detector unsharpness is smaller than the permitted geometric unsharpness.

ISO 17636-2 permits the application of digital detectors which have an inherent unsharpness close to the permitted geometric unsharpness values of film radiography (ISO 17636-1). The user may choose a high-resolution detector and use a larger spot size and a short SDD or a detector with less resolution and may need a mini or micro focus tube for the same inspection task. Magnification technique may be used to optimize the application.

Summary:

Digital Radiography (DR) is the State of art technology based on Digital Detector Array systems. and Computed Radiography (CR) is the first step towards adopting digital imaging technology. They substitute film radiography and radioscopy systems. They can also be used in real-time.
DR systems provide high-speed workflow. The fast data acquisition and the ability to allow testing with a high dose (mA) permits very short inspection cycles.
Image quality in digital industrial radiography depends on the essential parameters: (specific) contrast µeff, achieved SNR and basic spatial resolution SRb.
For practical application further parameters have been included for DDAs, as contrast sensitivity, efficiency, image lag and material thickness range.
SNR and EPS improve with exposure time, but they are limited by a maximum achievable SNRmax value which is limited by the design of the imaging plate (fixed pattern noise) or DDA calibration.
The operator increases the contrast sensitivity by the exposure time and tube current up to a certain EPS plateau, which defines the recommended grey value working range for CR.

ECHO BITES

Dear Sir,

To express my sincere appreciation for the latest issue of Sound Bytes, Decibel 24, Frequency 2, which I thoroughly enjoyed reading.

I would like to commend the initiative of ISNT Chennai Chapter Awards highlighted in the newsletter, especially the format provided for the application for the Best Graduate Program Students Award.

My suggestion pertains to introducing a "Student Corner" section in the newsletter. This section could provide a dedicated space for students to express their views, share experiences, and showcase their achievements. It would not only encourage student engagement but also enrich the diversity of perspectives within the newsletter.

I must also acknowledge that all the presentations by the authors were exceptionally educational and informative.
My heartfelt congratulations to the entire editorial board for consistently producing such a high-quality newsletter. Your dedication and efforts are truly commendable.

I eagerly look forward to future issues.

Best regards,

Dr. Joseph J Kakkassery
Lead- Vel Tech - Dr.Baldev Raj Non Destructive Testing Lab
Vel Tech TBI - Technology Business Incubator
Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology

TITBITS

By Mr.M.Manimohan, Manager (Retired), NDTL, BHEL, Trichy

Henri Becquerel discovered radioactivity by exposing a photographic plate to uranium in 1896. Henri Becquerel discovered radioactivity by using uranium in 1896.
What was radiation first called?
Although it was Henri Becquerel that discovered the phenomenon, it was his doctoral student, Marie Curie, who named it: radioactivity.
The most well known examples of naturally-occurring radionuclides in foods are bananas and Brazil nuts. Bananas have naturally high-levels of potassium and a small fraction of all potassium is radioactive. Consuming one banana would deliver a total dose of 0.01 millirem (0.1 microsieverts) of radiation.

Surgical lights are engineered to provide a shadow-free environment, which is crucial for the success of delicate surgical procedures.

Surgical lights have multiple high intensity light bulbs that light is emitted from various angles, reducing the formation of shadows.

Also, surgical lights use diffusers to scatter the light evenly to soften the light and prevent sharp shadows from forming.

NONLIEAR ULTRASONICS AND ACOUSTIC EMISSION BASED TECHNIQUES FOR INTEGRITY ASSESSMENT OF CONCRETE STRUCTURES

By Saptarshi Sasmal, Chief Scientist & Head, Special and Multi-functional Structures Laboratory, CSIR-Structural Engineering Research Centre, Taramani, Chennai 600113, INDIA. Email: saptarshi@serc.res.in, Phone +91 44 2254 9210

Background

SAE standard ARP6461 has defined Structural Health Monitoring as "*the process of acquiring and analysing data from on-board sensors to evaluate the health of structure*". SHM is an emerging technique which performs diagnosis and prognosis of structural health condition by combining advanced sensor technology with intelligent algorithms. From the aspect of total investment and preservation of constructional heritage, the non-destructive evaluation (NDE) techniques gained attention over past few decades in academia and industries. Eddy current, liquid penetrant, radiography, acoustic emission, ultrasonic testing are some of the well-known techniques, which come under non-destructive evaluation (NDE). Ultrasonic methods are the most active field of research in NDE because it has a great potential to detect very small sized damages (barely visible) caused by several factors like, fatigue, corrosion, porosity, creep, static/cyclic loading and unloading.

Concrete is a well pervasive building material that has a world-wide utility in civil infrastructures. During the service life, especially the in-situ concrete structures undergo several critical damage scenarios due to excessive traffic load, fatigue cycling, extreme environmental variation, ageing and most importantly, poor design and low maintenances etc. Therefore, the condition and stress state monitoring of such kind of structures are imperative for the structural integrity assessment. The study becomes more challenging for concrete like highly heterogeneous medium, where the complexity starts to appear from very beginning, i.e. from the material microstructure. The soft phase, interfacial transition zones (ITZ) get primarily affected and most of the damages (micro cracks, alkali-silicate reaction induced damage etc.) start to originate here. Hence, pristine concrete structures may possess inherent micro defects (that are distributed in nature) before application of any mechanical loading, which imparts material nonlinearity in the medium. In the presence of loading, these barely visible damages/ crack surfaces (or the crack tips) come in contact repeatedly, slide/ rub against each other and imparts contact nonlinearities (CAN) and other damage induced nonlinearities in the material. In such challenging cases, the use of robust and effective nonlinear ultrasonic methods carry a high importance to study the early damages phenomenon and the stress behaviour in the concrete structures.

Nonlinear ultrasonics-– A passive wave propagation technique

From past few decades, ultrasonic wave propagation methods (specially nonlinear ultrasonic methods- NLU) are found to be very promising in detecting wide range of damages. As, the pulses are of higher frequency (low wavelength), they can interact several times with the microcracks within the structure and bring out the maximum signature of the damage induced nonlinearities While interaction, the incident wave undergoes reflection, refraction, wave modulation, attenuation, phase transformation, wave diffusion, scattering and so on. Researchers perform several linear and nonlinear ultrasonic methods, such as, pulse velocity, attenuation, wavelet packet decomposition, Hilbert phase, diffusion, coda wave interferometry, nonlinear attenuation, scaling subtraction method, higher harmonic methods, sideband peak count, sideband energy ratio, energy based nonlinear acoustic parameter,

pattern recognition methods to detect damage characteristics and the stress changes within the structure. The present study mainly focuses on three critical and unique aspects, 1) in depth microstructural study to address the wave-matter interaction phenomenon within the cementitious material and to find out the influence of nonlinear mechanism during different phases of hydration using experimental and numerical approaches, 2) critical damage condition monitoring and stress state evaluation in concrete structures in laboratory scale specimens that can help to carry out structural health monitoring for in-situ structures, 3) the need of improvisation of existing ultrasonic methods, as well as, the establishment of advanced nonlinear ultrasonic methods to successfully monitor various critical damages and stress scenario.

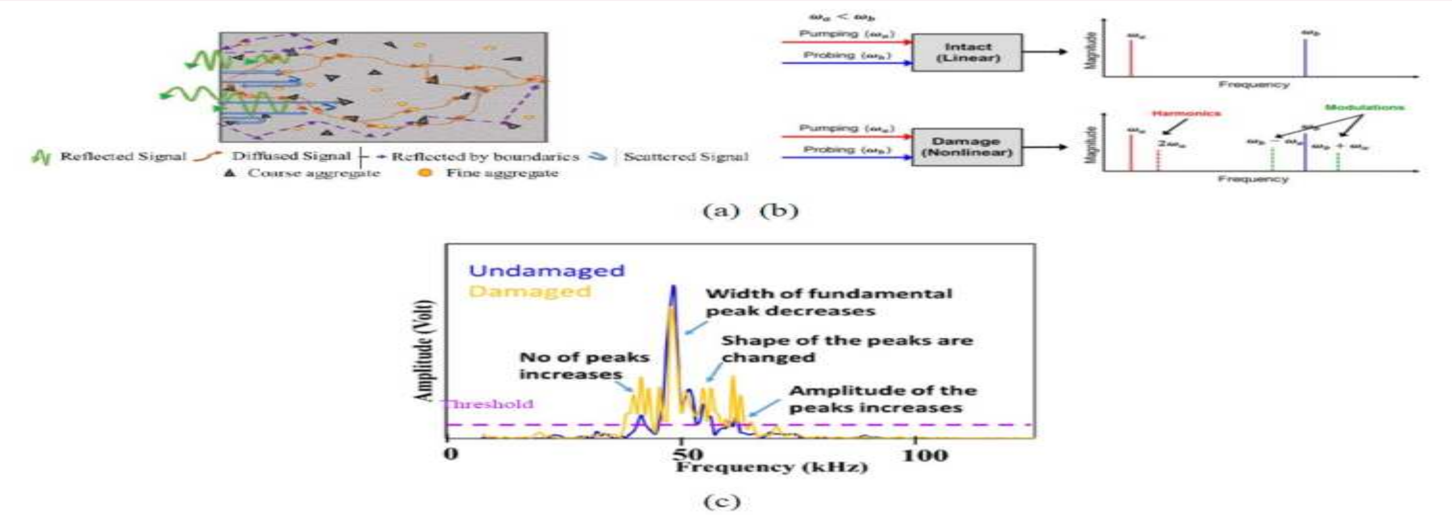


Fig. 1. Causes and features of nonlinear ultrasonics; (a) interaction of high frequency ultrasonic wave within the multi-phase concrete material, (b) generation of sub- and super- harmonics, (c) side-band peaks generation due to wave interactions

Acoustic Emission (AE) – A passive wave propagation technique

The basis of the AE technique is the rapid release of energy from various internal sources that results in elastic waves. Appropriate AE sensors capture the emitted acoustic waves and convert them into an electric waveform that can be processed and stored. Different AE parameters can be defined from a typical presentation of acoustic waveform, as illustrated in Fig. 2. The AE waveform's maximum voltage is called amplitude (dB), threshold is the amplitude that the user defines based on the noise level of the surrounding environment, rise time is the period of time between the initial threshold crossing and the maximum amplitude, counts are how many times an AE hit goes over the threshold, the interval between the first and last threshold crossings is known as duration, absolute energy is the integration of the squared voltage signal (V_s) over the duration divided by a reference resistance as expressed below.

$$Absolute\ energy = \frac{\sum V_s^2}{reference\ resistance\ (10k\Omega)} \quad (1)$$

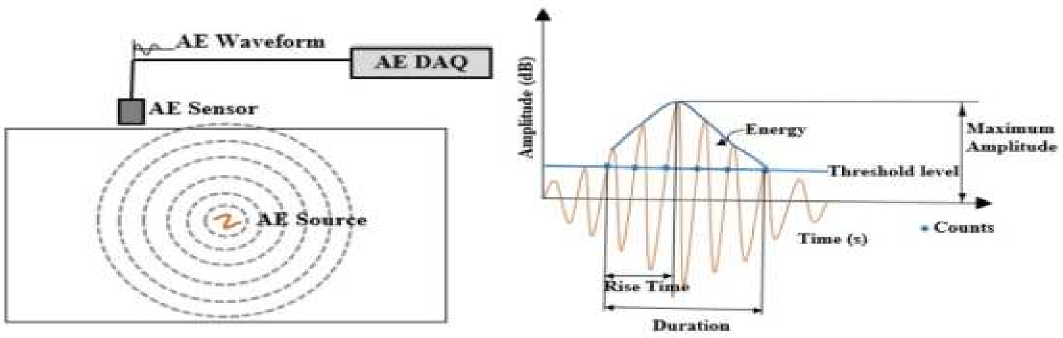


Fig. 2. Acoustic wave formation and a typical waveform

Work carried out at CSIR-SERC

Extensive investigations have been carried out at CSIR-SERC, Chennai. Several linear (LU) and nonlinear ultrasonic methods (NLU) and AE based methods are employed to carry out a sensitive investigation in the particular field.

Micro structural study during the days of hydration

The study encompasses micro structural characteristic behavior in cement and concrete material during hydration using LU and NLU based methods under different transmission modes and different frequencies. For that purpose, six prismatic specimens (200 mm x 150 mm x 150 mm) - 3 nos. of cement material and 3 nos. of concrete (M40) material are cast and gone through ultrasonic investigation at different days of hydration-1,3,7,28,60 days. Ultrasonic diffusion study has distinctly explained the wave diffusivity and dissipation mechanism inside both the material- cement and concrete. NLU methods have also shown efficient performance for identifying the nonlinear activities with progressive level of hydration using experimental and numerical approach.

Fig. 3. Ultrasonic set-up to perform micro structural study in cementitious specimen and the wave-matter interaction using numerical model

Early damage detection in RC bridge girder under four-point loading

An experimental study has been carried out to detect early stage cracks in a 4.5 m long RC girder under four-point loading. Ultrasonic measurements have been taken at undamaged stage and four incremental load steps: 2.6 kN (L1), 5 kN (L2), 8 kN (L3), 10.6 kN (L4). It is found that, the frequency domain based nonlinear methods (namely, Sideband Energy ratio, Sideband Peak Count Index) can sensitively monitor the load induced cracks from very early stage to severe damage scenario.

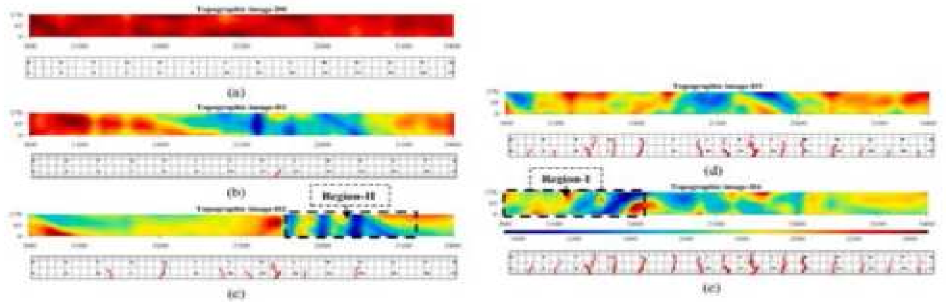


Fig. 4. Ultrasonic tomography for detection of on-set of damage in RC structure using NLU

3. Interfacial flaw detection in CFRP-retrofitted structure

An experimental study has been conducted to find out critical interfacial flaws of different sizes (10 mm- LD10, 25 mm- LD25, 50 mm-LD50)in CFRP-concrete composite structure (150 mm X 200 mm X 1300 mm). The experimental observations are validated with numerical simulation that demonstrates the wave propagation characteristics in multi-layered composites in presence of interfacial flaw between the laminate and beam surface.

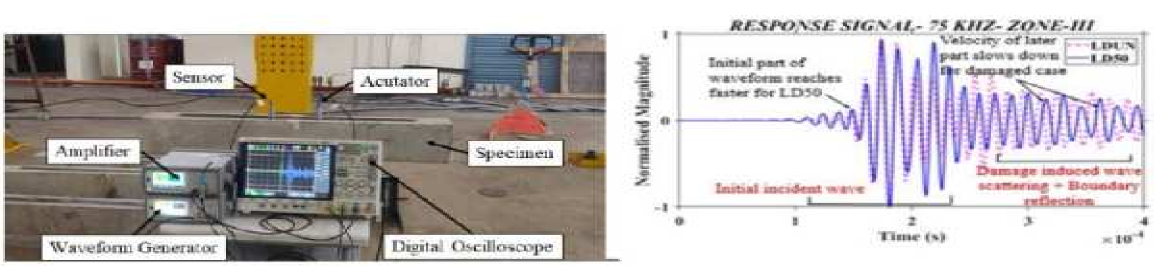


Fig.5. Experimental set-up to detect interfacial flaws in CFRP composite structure

4. Stress monitoring in different scale of structural members under uniaxial compressive loading

Few experimental studies have been organised to monitor axial stress in two different scale of structural components- in concrete prism (150mm x 150mm x 200mm) and a concrete vertical compressive member (200m x 300mm x 1500mm). The study helps to deduce material properties based on third-order elastic constants and performs stress-state monitoring using efficient NLU

Fig.6. Experimental set-up for stress state monitoring in prism specimen and axial concrete member.

5. Stress monitoring in laboratory scale Prestressed Concrete (PSC) girder

Monitoring the stress-state and stress loss has been experimentally conducted in a laboratory scaled (5m long) prestress concrete structures using the ultrasonic based wave propagation methods. Advanced nonlinear ultrasonic methods based on frequency domain and time-frequency domain have been shown commendable efficiency towards stress evaluation of the structure.

Fig.7. Experimental set-up for stress state monitoring in laboratory scaled PSC girder.

6. Crack propagation studies in strain hardened concrete using acoustic emission and digital image correlation investigations

The crack formation, propagation and failure mechanism of concrete are very complex. Incorporation of fibers complicates it further, alters the damage characteristics of concrete. There is a consistent effort to impart the strain hardening properties, for which the special type of chemical fibers (Polyvinyl alcohol, PVA) is found to be very promising. Presently, an attempt has been made to understand the damage mechanisms of PVA fibers incorporated concrete (with three fiber dosages (0%, 1%, 2%) subjected to flexural loading using both contact (Acoustic Emission, AE) and noncontact (Digital Image Correlation, DIC) techniques. The advantages of AE which provides information on internal cracking and DIC which provides surface crack characteristics information are suitably exploited in this study. It was found that the combined use of both techniques has the potential to investigate the crack bridging phenomenon, to analyse the damage progression during loading, and to identify the critical failure mechanism and damage classification.

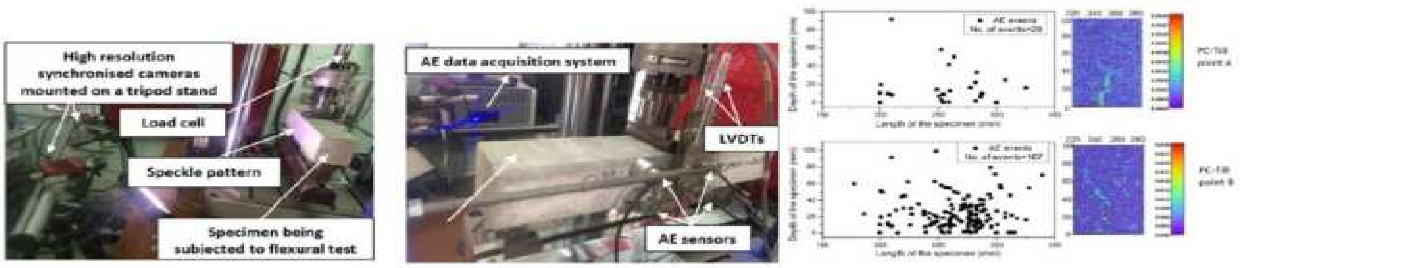


Fig.8.AE events along with DIC strain profile during different stages for PVA fiber incorporated concrete for determining fracture process zone (FPZ)

7. Acoustic emission technique for corrosion-induced damage monitoring in reinforced concrete structures

Early-stage detection of corrosion in reinforcement embedded inside concrete, generally considered as the major problem in structures under extreme marine environments, can help to schedule timely maintenance/repair and to avoid any catastrophic failure. However, quantitative evaluation of the degree of deterioration, especially at a very early stage, i.e., before its appearance on the surface, is extremely difficult due to the complex process in heterogeneous material. This study aims to characterize the critical damage stages in reinforced concrete specimens under accelerated conditions using the Acoustic emission (AE) damage quantification methods supported by machine learning (ML) techniques. Characterized damage stages are validated based on mass loss, current flow and crack width measurements. The results show that the corrosion initiation and crack formation (localization) can be determined from the sudden change in acoustic parameters. The findings indicate that the proposed approach that combines corrosion detection by analysing AE signals recorded during testing of accelerated corrosion with ML technique can accurately and robustly predict corrosion severity.

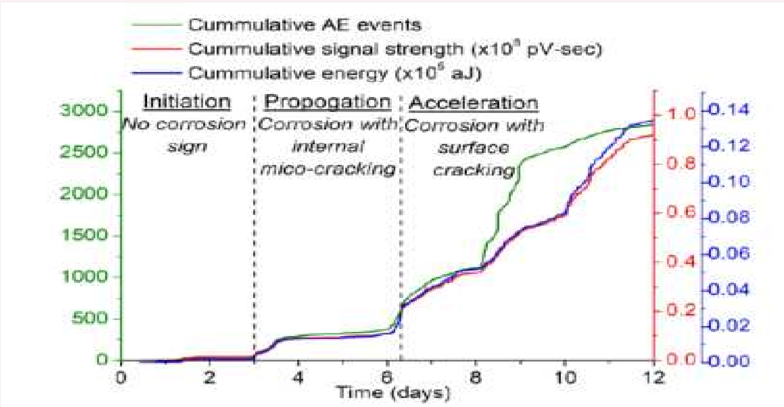


Fig. 9. Cumulative AE activity recorded from a specimen under accelerated corrosion

8. Machine learning supported acoustic emission technique for leakage detection in pipelines

Acoustic emission (AE) based method is a very promising passive measurement technique for detection of faults and incipient damage in in-service structures. Considering the advantage of detecting even the weak acoustic signals emitting from in-service critical infra-systems for characterizing the fault/damages/leakage in the structures, AE technique is considered to be one of the efficient NDT techniques. In the present work, acoustic emission technique has been utilised to detect leakage in the pipelines by systematically analysing the signal parameters. AE signals are measured from the sensors attached to the pipeline and the measured signals are analysed to extract the leakage sensitive acoustic wave features. The AE features evaluated from the acoustic signals are further processed to identify- and localize-the leakage (varying flow rates) in the pipe. Out of all the AE features, AE counts, cumulative AE energy, and signal strength are found to be very sensitive parameters to indicate the leakage in the pipelines.

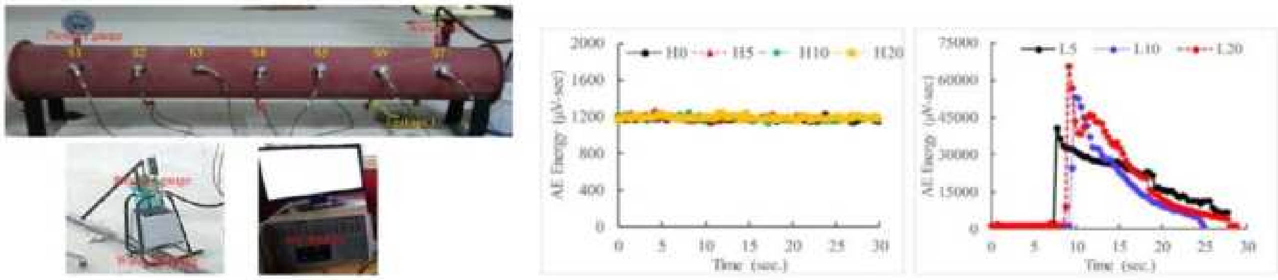


Fig. 10. AE energy response for healthy and leakage pipe under different pressures

9. Acoustic emission-based non-destructive technique for integrity assessmentof heavily reinforced typical Trunnion beam of spillway structure

Owing to the large mass of concrete with heavy reinforcement in dam spillways and the long-expected life of these structures, they are susceptible to degradation mechanisms that can start as minor problems and be present for years. The presence of initial degradation tends to accelerate future problems. For example, the presence of voids/flaws in the trunnion beams lead to greater damage if unattended. However, it is highly impossible to identify the internal voids through visual means. Further, the Ultrasonic Pulse Velocity (UPV) method, which is widely used for condition assessment of concrete structures, may not be effective (sometimes misleading) here due to the presence of heavily dense reinforcement and prestressing strands in large concrete trunnions.In view of this, attempts were made to assess the health of a typical trunnion beam of the spillway structure employing the Acoustic Emission (AE) technique. During the investigations, ambient conditions (excitation due to water thrust on the dam), as well as the slow movement of the radial gates, were used. A three-dimensional sensor arrangement was used so that the acoustic source localization inside the massive concrete turions could be carried out. High-speed acquisition of data through multichannel was performed using an integrated and synchronized AE system (with an in-built amplifier). Due to the ambient condition and during gate operation, the noise-generated acoustic signals were carefully discarded. Through intensive signal processing, the AE parameters, such as the number of AE hits, signal amplitude, and signal strength, were considered to assess the existing health of the trunnions. The present study discusses on typical signals, acoustic characteristics and inference from the AE-based NDT, along with the method used for acoustic source localization. The present study, the procedure and the inferences are helpful to the practising NDT engineers to perform the health assessment of concrete structures with a high amount of reinforcement.

Fig.11.Integrity assessment of biaxially prestressed trunnion beams of dam structure

Future scope

1. NLU and AE based techniques to find the influence of high strength matrix, micro structural distribution, early age hydrating microstructure, influence of ITZs, frequency dependant wave characteristics, wave-particle interaction in the highly heterogeneous medium on the subject of diffusivity and dissipation in concrete
2. Coupled AE-NLU techniques for early warning of deterioration in structures exposed to various types of loading would be of requirement
3. Advancement in signal processing and AI/ML augmented techniques is essential to enhance the sensitivity in monitoring stress-based and damage induced phenomenon in concrete structures.

Pipe schedule chart embedded with suitable RT Technique and the Penetrameter by Shri.Chittathur Srinivasan

Technique	Penetrameter	Nom. Pipe Size (in)	Pipe size (mm)	OD (mm)	SS-Sch 5S	SS-Sch 10S	SS-Sch 40S	SS-Sch 80S	CS-Sch 10	CS-Sch 20	CS-Sch 30
Double wall Double image	Source side Penetrameter	1/8	3	10.3		1.24	1.73	2.41			
		1/4	6	13.7		1.65	2.24	3.02			
		3/8	10	17.1		1.65	2.31	3.20			
		1/2	15	21.3	1.65	2.11	2.77	3.73			
		3/4	20	26.7	1.65	2.11	2.87	3.91			
		1	25	33.4	1.65	2.77	3.38	4.55			
		1-1/4	32	42.2	1.65	2.77	3.56	4.85			
		1-1/2	40	48.3	1.65	2.77	3.68	5.08			
		2	50	60.3	1.65	2.77	3.91	5.54			
		2-1/2	65	73.0	2.11	3.05	5.16	7.01			
		3	80	88.9	2.11	3.05	5.49	7.62			
Double wall single Image	Film Side Penetramter	3-1/2	90	101.6	2.11	3.05	5.74	8.08			
		4	100	114.3	2.11	3.05	6.02	8.56			
		5	125	141.3	2.77	3.40	6.55	9.53			
		6	150	168.3	2.77	3.40	7.11	10.97			
		8	200	219.1	2.77	3.76	8.18	12.70		6.35	7.04
		10	250	273.1	3.40	4.19	9.27	12.70		6.35	7.80
		12	300	323.9	3.96	4.57	9.53	12.70		6.35	8.38
		14	350	355.6	3.96	4.78			6.35	7.92	9.53
		16	400	406.4	4.19	4.78			6.35	7.92	9.53
		18	450	457.0	4.19	4.78			6.35	7.92	11.13
		20	500	508.0	4.78	5.54			6.35	9.53	12.70
		22	550	559.0	4.78	5.54			6.35	9.53	12.70
		24	600	610.0	5.54	6.35			6.35	9.53	14.27
DWSI or SWSI (Panoramic) Subject to access and IQI Placement based on Technique	Film side Penetrameter	26	650	660.0					7.92	12.70	
		28	700	711.0					7.92	12.70	15.88
		30	750	762.0	6.35	7.92			7.92	12.70	15.88
		32	800	813.0					7.92	12.70	15.88
		34	850	864.0					7.92	12.70	15.88
		36	900	914.0					7.92	12.70	15.88
		38	950	965.0							
		40	1000	1016.0							
		42	1050	1067.0							
		44	1100	1118.0							
		46	1150	1168.0							
		48	1200	1219.2							

Nom. Pipe Size (in)	CS-Sch Std	CS-Sch 40	CS-Sch 60	CS-Sch XS	CS-Sch 80	CS-Sch 100	CS-Sch 120	CS-Sch 140	CS-Sch 160	CS-Sch XXS
1/8	1.73	1.73		2.41	2.41					
1/4	2.24	2.24		3.02	3.02					
3/8	2.31	2.31		3.20	3.20					
1/2	2.77	2.77		3.73	3.73				4.78	7.47
3/4	2.87	2.87		3.91	3.91				5.56	7.82
1	3.38	3.38		4.55	4.55				6.35	9.09
1-1/4	3.56	3.56		4.85	4.85				6.35	9.70
1-1/2	3.68	3.68		5.08	5.08				7.14	10.15
2	3.91	3.91		5.54	5.54				8.74	11.07
2-1/2	5.16	5.16		7.01	7.01				9.53	14.02
3	5.49	5.49		7.62	7.62				11.13	15.24
3-1/2	5.74	5.74		8.08	8.08					
4	6.02	6.02		8.56	8.56		11.13		13.49	17.12
5	6.55	6.55		9.53	9.53		12.70		15.88	19.05
6	7.11	7.11		10.97	10.97		14.27		18.26	21.95
8	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.23
10	9.27	9.27	12.70	12.70	15.09	18.26	21.44	25.40	28.58	25.40
12	9.53	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40
14	9.53	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71	
16	9.53	12.70	16.66	12.70	21.44	26.18	30.96	36.53	40.49	
18	9.53	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24	
20	9.53	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01	
22	9.53		22.23	12.70	28.58	34.93	41.28	47.63	53.98	
24	9.53	17.48	24.61	12.70	30.96	38.89	46.20	52.37	59.54	
26	9.53			12.70						
28	9.53			12.70						
30	9.53			12.70						
32	9.53	17.48		12.70						
34	9.53	17.48		12.70						
36	9.53	19.05		12.70						
38	9.53			12.70						
40	9.53			12.70						
42	9.53			12.70						
44	9.53			12.70						
46	9.53			12.70						
48	9.53			12.70						

Penetrameter Details

Thickness Range (in mm)	Source Side Wire No.	Source Side Wire φ	Film Side Wire No.	Film Side Wire φ
inclusive of 6.4	A5 / D13	0.20	A4 / D14	0.16
6.4 thro 9.5	A6 / D12	0.25	A5 / D13	0.20
9.5 thro 12.7	A7 / D11	0.33	A6 / D12	0.25
12.7 thro 19.0	A8 / D10	0.41	A7 / D11	0.33
19.0 thro 25.4	A9 / D9	0.51	A8 / D10	0.41
25.4 thro 38.1	A10 / D8	0.63	A9 / D9	0.51
38.1 thro 50.8	A11 / D7	0.81	A10 / D8	0.63
50.8 thro 63.5	A12 / D7	1.02	A11 / D7	0.81

A- ASTM wire No. D - DIN Wire No.

Snippets

NDE ON COMPOSITE MATERIALS

R Balakrishnan, Manager-CQ-BHEL (retd)

What is the difference between a Pipe and a Tube?

People use the words pipe and tube interchangeably, and they think that both are the same. However, there are significant differences between pipe and tube.

The short answer is.. A PIPE is a round tubular to distribute fluids and gases, designated by a nominal pipe size (NPS or DN) that represents a rough indication of the pipe conveying capacity;

A TUBE is a round, rectangular, squared or oval hollow section measured by outside diameter (OD) and wall thickness (WT), expressed in inches or millimeters.

Vigyan Yuva awardee Prabhu Rajagopal: Robotic inspectors of infrastructure

Rajagopal, a professor of mechanical engineering at IIT Madras, and our Chairman Elect has won the award for his work with technologies for remote assessment of condition of infra assets.

Prabhu Rajagopal, a professor of mechanical engineering at IIT Madras, is the winner of this year's Vigyan Yuva Shanti Swarup Bhatnagar award in the newly introduced category of Technology and Innovation. He talks about his work with technologies for the assessment of the condition of infrastructure assets remotely.

अजय के. सूद
भारत सरकार के प्रमुख वैज्ञानिक सलाहकार
Ajay K. Sood
Principal Scientific Adviser to the Govt. of India

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office-psa@nic.in
Website : www.psa.gov.in

F.No.Prn.SA/PSA/O-40/2024
Dated: 5th August, 2024

Dear Prof. Prabhu Rajagopal,

I am happy to inform that you have been selected for the award of **"Rashtriya Vigyan Puraskar: Vigyan Yuva - Shanti Swarup Bhatnagar"** for the year 2024 in Technology and Innovation.

2. Please accept my heartiest Congratulations. It is a significant distinction conferred upon young scientists who have demonstrated exceptional potential in Science and Technology. I am certain that this well-deserved and prestigious recognition would inspire you to scale even greater heights in the years to come and fulfill the vast expectations the country has from you through your work.

3. The Rashtriya Vigyan Puraskar: Vigyan Yuva - Shanti Swarup Bhatnagar Award comprising a Medallion and Sanad would be presented to you on ***August 23, 2024 in a function at Rashtrapati Bhavan Cultural Centre, Rashtrapati Bhavan, New Delhi starting at 4:15 PM.*** The details of the event will be communicated later.

4. On behalf of Govt. of India and on my own behalf, I congratulate you once again and wish you continued success in your endeavours.

With warmest regards,

Yours sincerely,

(Ajay K. Sood)

Prof. Prabhu Rajagopal
410 Machine Design Section
IIT Madras

Raising the Bar

By Mr.S.Subramanian, Co-Convener NDE 2024 Seminar.

The following steps were completed till date in conducting the NDE 2024 Seminar.

S.No.	Particulars	Remarks
1.	Venue	Finalized
2.	Stall Layout	Finalized
3.	Principal Sponsor	1 Confirmed
4.	Platinum Sponsor	1 Confirmed
5.	Platinum Sponsor – Non Exhibition	1 Confirmed
6.	Diamond Sponsor	2 Confirmed
7.	Gold Sponsor	Out of 6 – 5 Confirmed
8.	Gold Sponsor – Non Exhibition	3 confirmed
9.	Silver Sponsor	Out of 21 – 19 Confirmed
10.	Silver Sponsor – Non Exhibition	6 confirmed
11.	Bronze Sponsor	24 Confirmed
12.	Premium Stall (EP)	Out of 26 – 14 confirmed
13.	Stalls (E)	Out of 40 – 8 Confirmed
14.	Souvenir Advertisement	1 Confirmed
15.	Delegates	24 Registered
16.	Abstracts	14 Received
17.	First Announcement	Released
18.	Website launched	www.isntnde.in

NGC meeting held at Mumbai on 21st September 2024

34th Annual Conference & Exhibition on
NON DESTRUCTIVE EVALUATION & ENABLING TECHNOLOGIES
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December 12-14, 2024

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December 12-14, 2024

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