



Wind Turbine Blade Fabrication Facility and Wind Turbine Laboratory at NAL

Prof. V.S. Ramamurthy, DAE Homi Bhabha Chair Professor, Inter-University Accelerator Centre, New Delhi and Chairman, Monitoring Committee of the New Millennium Indian Technology Leadership Initiative (NMITLI) Project, unveiled the Wind Turbine Blade Fabrication Facility and Wind Turbine Laboratory at National Aerospace Laboratories (NAL), Bangalore, on 3 February 2007. Dr D. Yogeswara Rao, Head, TNBD, CSIR, was also present on the occasion.

In his welcome address, Dr A. R. Upadhyya, Director, NAL, stressed the relevance of wind as an alternative source of energy in India. Prof Ramamurthy and Dr Yogeswara Rao expressed their happiness over the progress of Wind Energy programme at NAL.

Dr J.J. Issac, Head, Wind Energy Programme, assured that "NAL's blade will be rotating before the wind stops blowing in the coming season."

Dr R.M.V.G.K. Rao, Head, FRP Division, explained the uniqueness and cost effectiveness of the approach contemplated in the indigenous development of these blades.



Prof. V.S. Ramamurthy, DAE Homi Bhabha Chair Professor, Inter University Accelerator Centre, New Delhi and Chairman, Monitoring Committee of NMITLI Project, unveiling the Wind Turbine Laboratory at NAL



Renaming of Regional Research Laboratories (RRLs) of CSIR

Keeping in view the changed profiles of the five Regional Research Laboratories (RRLs) of CSIR located at Bhopal, Bhubneswar, Jammu, Jorhat and Thiruvananthapuram the Governing Body, CSIR in its 168th meeting held on 8 December 2006 has renamed these RRLs, commensurating with their direction, orientation of expertise, excellence developed and reflecting futuristic outlook. The new names are:

1. RRL, Bhopal : Advanced Materials and Processes Research Institute (AMPRI)
2. RRL, Bhubneswar : Institute of Minerals and Materials Technology (IMMT)
3. RRL, Jammu : Indian Institute of Integrative Medicine (IIIM)
4. RRL, Jorhat : North – East Institute of Science and Technology (NEIST)
5. RRL, Thiruvananthapuram : National Institute for Interdisciplinary Science and Technology (NIST)

National Environmental Engineering Research Institute, Nagpur

R & D Highlights

The National Environmental Engineering Research Institute (NEERI), Nagpur, is committed to R & D in environmental science and engineering and related services to government, industry and society. Discernible positive movement towards sustainable development and to derive solutions for the environmental and natural resource problems warrant pursuance of an effective R&D programme in Environmental Science and Engineering. Accordingly, the institute, while fulfilling its commitment towards the national and societal missions, has made significant contributions in its various thrust areas of R&D:

Environmental Monitoring

In the area of environmental monitoring, NEERI has been

operating a nationwide air quality monitoring network for the last 15 years. This programme, sponsored by the Central Pollution Control Board (CPCB), is critical to maintain and update the database on Indian air quality. This enables the studies of the long-term air quality trends for health related critical air pollutants. This database also helps in assessing the maintenance of air quality standards and to form the basis for air pollution management plans. The institute is carrying out ambient air quality monitoring and emission source appointment studies for Delhi. Such studies are being extended to Mumbai and Pune cities.

Stack emission characterization studies, monitoring of gaseous pollutants including VOCs, in indoor and outdoor air, have also been carried out for various industries and locations.

A study related to impact of silt disposal from Beas-Sutlej Link (BSL) project on the aquatic life of the



Air quality monitoring at Delhi



Sutlej was also carried out.

Quality control (QC) has been initiated by the institute to develop a methodology for analyzing polychlorinated dioxins, namely, TCDDs levels in soil and water samples. In an important project related to water quality management for pesticide contamination, the quality assurance (QA) and quality control (QC) of data was formulated for analyzing most commonly present organochlorine and organophosphorous groups of pesticides in water.

Environmental Biotechnology

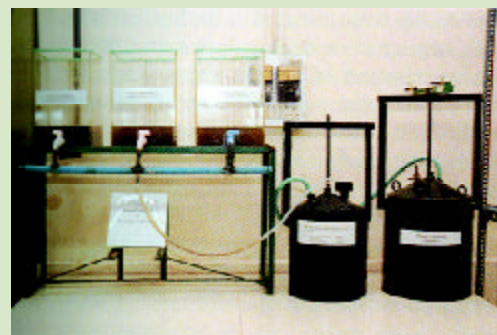
Environmental biotechnology has emerged as a useful tool for sustainable development. The areas of R&D in this field, which remained in focus throughout the year, include the application of biotechnology in environmental monitoring, restoration of environmental quality, resource/residue/waste recovery/utilization/treatment, and substitution of non-renewable resources with renewable sources. R&D studies on environmental genomics have led to the identification of bacteria, which

are renewable sources. R&D studies on environmental genomics have led to the identification of bacteria, which are useful in environmental impact assessment studies. The DNA sequencing studies of these bacteria have been helpful in identifying the pollution source and also to mitigate the adverse impacts on environment.

The institute developed a chemo-biochemical process at laboratory scale for treatment of industrial emissions containing SO_x and NO_x . A pilot plant, with a capacity of 100 m^3/h was designed, fabricated & commissioned at M/s Jubilant Organosys Limited, Bharatiyagram (UP) for the demonstration of deodorisation of industrial emissions containing pyridine and its derivatives. The other significant activities include development of a bench-scale reactor for the biological treatment of waste containing hexachlorocyclohexane (HCH), bioremediation of contaminated sites and development of zeolite materials that are able to sequester metals and oxyanions from contaminated soils.

Solid and Hazardous Waste Management

In this field, NEERI has pioneered significant R&D activities for various industries. A process for bio-methanation of municipal solid waste with two-phase approach to generate bio-energy from the municipal solid waste has been developed on bench scale. The institute has



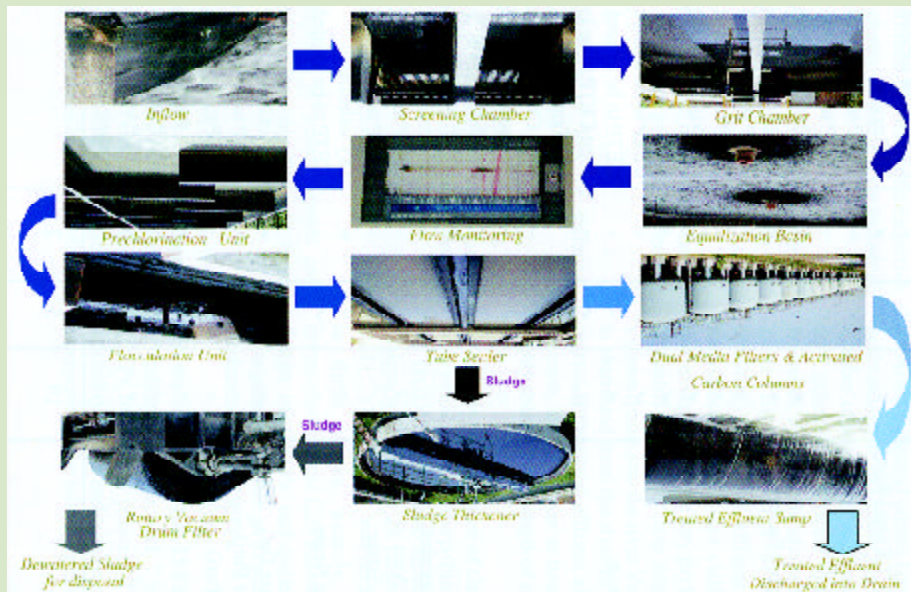
Experimental set-up for biomethanation

initiated activities related to methane emission from wastes, including municipal solid waste dumpsites and sewers as per the revised IPCC guidelines.

The institute is also undertaking studies related to assessment, remediation and management of hazardous wastes for various industries. The technology on "solidification / stabilisation and containment of arsenic bearing hazardous wastes" was transferred to Zuari Industries Ltd (ZIL), Goa. NEERI achieved in immobilizing arsenic bearing hazardous waste at the ZIL. About 50 metric tonnes of solid and 250 m^3 of liquid waste containing around 10 percent of arsenic were disposed after solidification and stabilization in a secured landfill specially designed and constructed at ZIL site. This was a remarkable contribution of the institute in the field of hazardous waste management, as the entire project was handled by NEERI, including development of lab scale protocol for solidification and stabilization, design of the landfill, supervision of the construction of the landfill, implementation of the protocol in the plant and final closure of the landfill.



Aerial view of a pilot plant for bio-deodorization of industrial emissions containing pyridine at M/s Jubilant Organosys Limited, Bharatiyagram (U.P.)



Sequential unit operations and processes at CETP, Delhi

the production processes, waste generation is minimized, residuals are treated cost-effectively and byproducts are recovered and recycled. Carrying capacity study, in addition to assimilative capacity carried out by the institute, takes cognizance of the supportive capacity of the region in terms of material, institutional and human resources, and provides the macro-scale strategy for sustainable socio-economic development in the regional context.

Environmental Risk Assessment

The institute also provided significant suggestions to various industries by carrying out Environmental Risk Assessment (ERA) studies for proposed/existing projects. The ERA studies assist in the identification and evaluation of potential hazards in industries enabling suggestion of remedial measures to reduce or eliminate such hazards.

NEERI also carried out Environmental Audit (EA) studies for various industries so that their developmental activities and products do not adversely affect the environmental quality and material and energy resources are used efficiently. During this period, the institute bagged a prestigious EIA project from Steel Authority of India Ltd for more than Rs one crore. NEERI is also trying to go international by taking international assignments for EIRA studies in the Gulf region. The institute has recommended various mechanisms so as to devise policy, planning, legal and informational measures for sustainable development.

The institute is significantly

Environmental Systems Design Modelling and Optimization

The thrust for R&D in the field of environmental system design and development was mainly on the development of cost-effective and resource recovery based technologies suitable to socio-economic conditions prevailing in the country. Such technologies that have been developed by the institute include: novel functionalised materials for CO₂ capture, advanced materials for various environmental applications, nanostructured zeolitic materials for artificial photosynthesis, catalytic materials for diesel exhaust emission control and catalytic reduction of NO_x from stationary sources. Most significantly, the institute has entered into a very challenging area of CO₂ sequestration through absorption from power plant stacks, through multi-institute project.

The other significant R&D activities involve optimisation of

environmental systems, and development and validation of mathematical models for prediction of dispersion of pollutants in air and water, and their environment-health linkages. GIS based studies are also carried out to predict and assess environmental degradation. The institute is providing basic engineering packages for designing Common Effluent Treatment Plants (CETPs) at various places in the country.

Environmental Impact Assessment

NEERI was called upon by several organizations and industries to carry out Environmental Impact Assessment (EIA) studies to identify and evaluate the impacts of various proposed activities and delineate Environmental Management Plans (EMPs). The EMPs prepared by the institute ensure sustainable development. The measures include the following: the resources are utilized efficiently and optimally in



contributing through various R&D projects on dearsenification of water, water quality management and quality control/quality assurance, sponsored by international organisations like UNICEF, USEPA and WHO.

The activities related to CSIR Network Projects have also been carried out during this period, which involve industrial waste minimization and clean-up, development of enzymatic bioreactor for treatment of industrial wastewater, photocatalytic treatment of wastewater for colour removal, development of appropriate technologies for treatment and recycling of industrial wastes and sludges, etc. Special attention has been paid to sustainable water resource management in Himalayan villages, with special reference to rainwater harvesting and environmental protection of the streams for safe drinking water supply and sanitation in hilly region of Tehri Garhwal, as a societal mission.

MoUs/Agreements

NEERI signed several MoUs/agreements with various agencies/organizations. These include:

- With National Thermal Power Corporation Limited, New Delhi, for sponsored research project “Novel functionalized materials for CO₂ Capture” for two years
- With CPCB for three years NAAQM (2005-2007)
- With IOCL for the Project “Ambient Air Quality

Monitoring and Emission Source Apportionment Studies for Delhi”

- With HLL in the area of water quality to prepare various action plans identified jointly by HLL and NEERI
- With National Thermal Power Corporation Ltd (NTPC) to carry out research activities comprising the development of novel functionalized materials for CO₂ capture
- With Global Tech Safety and Environmental Consultancy, Dubai, for developing business in Gulf countries and technical cooperation in the areas of EIA, HWM, biological impact and marine ecological studies.
- With All India Institute of Local Self Government, for activities related to municipal solid waste management.

Agreements

- With CPCB, New Delhi, for conducting the training programme on “Municipal Solid Wastes Management”
- Research alliance agreement with Jeedimetla Effluent Treatment Ltd, for assessment of Microbial Diversity: Culturable and Un-culturable
- With UNICEF, the United Nations Children’s Fund, for the project “Technical strengthening of PHEF-MP/CH-UNICEF Bhopal/NEERI collaboration for effective delivery of TSC/SD”
- With CPCB, New Delhi, on training programme on sampling analysis and characterization of

hazardous wastes and their management

- With IOCL for environmental audit studies of Gujarat Refinery
- Cooperative agreement with United States Environmental Protection Agency (USEPA) in support of environment protection activities in India
- Cooperation agreement with UNICEF for effective delivery of total sanitary campaign (TSC) and Swajaldhara (SD) in Madhya Pradesh and Chattisgarh

Technology Transfer

- Solidification/stabilization and containment of arsenic bearing hazardous wastes to Zuari Industries Ltd, Goa.

Publications/Patents

During 2005, NEERI published 95 papers including 71 in peer reviewed SCI journals with an average impact factor of 1.18 and cumulative impact factor of 83.62. The institute filed 17 Indian patents and eight PCT applications during 2005-06. Two patents, one US and one European were granted.

NEERI has strengthened its financial base through external earnings to an extent of 40% of the total budget. It earned Rs 11.08 crore whereas the CSIR grant for the year was Rs 11.90 crore. The institute’s External Cash Flow (ECF) has shown consistent improvement in the recent years, from Rs 8.50129 crore in 2003-04, Rs 9.16999 crore in 2004-05 to Rs 11.07973 crore in 2005-06.



Advanced Analysis of Steel Frames and Beam Column Connection Behaviour

A review of codes of practice of many advanced countries reveals that all of them prescribe second order analysis methods for steel frames. Another important aspect of frame analysis is the consideration of connection flexibility. The semi rigid behaviour concept has been introduced in many of the codes of practice. In India, the current code of practice for structural steel – IS:800 – is based on the Working Stress Design Method. The Load and Resistance Factor Method or the Limit State Method is based on the concepts of probability, and is followed by most of the foreign codes. It has been found that in many situations the probability-based design methods result in more rational and economical designs.

The Structural Engineering Research Centre (SERC), Chennai, took up a study of 'Advanced Analysis and Design Methods for Steel Frames and Experimental investigation of Steel Frame Connections'. Based on the study, computer software have been developed for the advanced analysis of frames and design of members and structures based on the limit state design method. A knowledge base has been created for the behaviour of simple bolted beam column connections.

Advanced Analysis (AA) represents any method that can approximately predict the limit state strength and stability of a structural system and its individual members without resorting to independent

member capacity calculations using the specified equations: The advances in computer technology have now made it feasible to use advanced analysis techniques for direct design of frames. Advanced analysis method considers both material and geomaterial nonlinearities directly.

The Centre developed an efficient formulation called SERC (Shear deformable, Exact, Reissner's Curved) beam element and implemented in a computer program. The developed computer program has capabilities for the kinematically exact and second order analysis of steel frames. The performance of the SERC beam element was compared with the performance of beam elements available in five general purpose FE codes, namely, STAAD Pro 2003, NISA II, SAP 2000, ANSYS and NASTRAN. Six bench mark problems involving beams and columns suggested by the Australian Institute of Steel Construction (AISC) were chosen. From a comparative study it was seen that almost all the FE codes do not handle the 'one element per member' concept in frames while the SERC beam element with 'one element per member' produced excellent comparison with the results of AISC.

The software for the second order analysis of frames was further refined to include connection nonlinearities. The connections are assumed to behave as nonlinearly

elastic and the special formulation has been embedded in the SERC beam element. This has been done by the spring augmentation approach and the static condensation of the superfluous rotational degrees of freedom of the connection spring. From the studies it has been found that the present software is capable of producing results that are comparable to the results published in literature. A one by two storey frame with connection characteristics taken from an experimental work was studied for a top-seat angle with double web angle connection. The same problem was solved with moment rotation characteristics from another experimental work.

SERC developed a new beam element based on Euler-Bernoulli (EBER) hypothesis. The kinematically Exact formulations for EBER beams (KEEBER element) involves kinematically exact strains, which are functions of displacement gradients, expressed in terms of double binomial series. This leads to formulations which are series within a series. The challenging task of computer implementation of this aspect using Taylor series was completed. The new beam element has three nodes with three degrees of freedom (dof) u , w and θ in each node. The Kirchoff condition of zero shear strain ($dw/dx - \theta = 0$) is applied at the Gauss points and then the w , θ dofs at the mid-node are eliminated. The resulting element is found to be very efficient for



problems of large deformation and post buckling analysis of thin beams and frames. It passed the fourteen Australian Institute of Steel Construction benchmark problems published in literature.

For the advanced analysis of steel frames, to enable easy implementation of material nonlinearity, a new beam element formulation has been developed based on finite Green's strain. The strain-displacement relations have been obtained by truncation of the binomial expansion of the finite strain. Using these strain terms, total Lagrangian finite element formulations have been developed using the secant matrix technique. The order of matrices is three. These formulations were implemented in a computer program and calibration studies have been conducted at SERC.

An existing computer program was modified to study the inelastic behaviour of frames by plastic zone

analysis using the conventional beam column theory. Parametric studies were carried out using the advanced analysis program by the plastic zone approach. For the case of the portal frame considered in the study, when the columns are subjected to larger axial loads, the strength of the frame is decreased by 4% due to initial imperfection. The behaviour of the frame is also affected due to initial imperfection. Residual stresses cause behavioural variations in the initial nonlinear region, but the ultimate strength is affected only minimally (0.04%).

Experimental Investigations on Beam-column Semi-Rigid Connections in Steel Frames

Single Web Angle (SWA) connection was designed at SERC using the limit state design concept. Both the column and the beam sections were ISMB 300. The clip angle or the web angle was ISA

65×65×6. The web angle was connected to the beams by 16 mm diameter black bolts. The test specimens were fabricated with two beams of each 1 m in length connected to the column on either side. Two pilot tests on SWA connection with the above details were carried out to check the loading and instrumentation arrangement. The loading was applied through the column and the entire system acted like a simply supported beam. From the experiments the relationship between moment and relative rotations were obtained.

Tests on Double Web Angle (DWA) connection were carried out and M-0, curves for these connections were plotted. In these series of tests, the web angles were connected to the column flanges using HSFG bolts. The dimensions of the beams, column and connection angles were the same as for the SWA tests. The failure of the connection was due to tearing of the connection angle between the web and flange legs of the connection angle. This was in contrast to the black bolted single web angle connections, where the failure of the connection was due to the shearing of the web leg bolts. The two stage load carrying mechanism of the connection was witnessed in these series of tests also; the first stage being bending and torsion of the connection angle and the second stage tension – compression mechanism after the closure of the air gap. Parametric studies were carried out by varying the thickness and depth of cleat angles. It is found that the stiffness increases with the

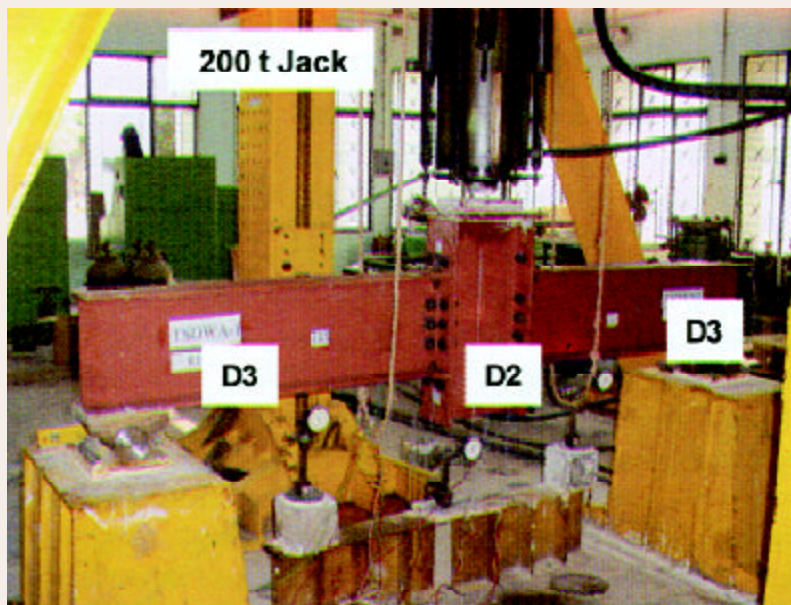


Fig. 1 : Typical test set-up for connection experiment



increase in cleat angle thickness. The load carrying capacity is reduced as the depth of the angle increases. In specimens with web thickness lesser than the cleat angle thickness, the failure mode is by end tearing of the beam web. But for the higher depth of cleat angle specimens, the failure mode was by tearing of the angle. Based on the results arrived, a modified Frye Morris moment rotation model has been developed.

Two Single Web Angle specimens (SWA), four Top-Seat-Double Web Angle (TSDWA) specimens and one top and Seat Angle (TSA) specimen were tested with the same test configurations as mentioned above. Fig. 1 shows the

typical experimental set-up for the connection. The behaviour of the connections was basically a two stage mechanism. In the first stage, the connection components, the web angle in the SWA case and the top angle in the TSDWA case, deform and dry to close the air gap between the column and the framing beam. Once the air gap is closed, the load carrying mechanism is by compression of the top flange on to the stub column, tension by the bottom flange and web connection components. Fig. 2 shows a view of a failed specimen. Based on the experimental studies, linear models have been developed for the connections studied.

Experimental studies were conducted on beam-column joint test specimens with end plate connections. The end plate connections in beam-column joint test specimens were designed based on the yield the method and limit state approach as per IS:800 draft. All specimens consisted of two ISMB 300 beam sections of length 1000 mm connected to a 650 mm high stub column. The stub column is stiffened (at the beam column flange junction) using 8 mm thick plate to prevent premature buckling of the web. The end plate is welded to one end of the beam and the beam-plate assembly is connected to the stub column by high strength friction grip (HSFG) bolts. The bolts are

pretensioned with a torque of 214 Nm. Eight specimens have been fabricated by varying the important parameters, i.e. Endplate thickness (8 mm, 10 mm and 12 mm) and lever arm distances. For the 8 mm thick plate case, two cases of lever arm, i.e. 342 mm and 362 mm and for the 10 mm and 12 mm thick plates, three cases of lever arm, 342 mm and 382 mm were considered.

All the specimens exhibited very stiff linear behaviour in the early stages of loading. Five types of yield line patterns that were observed in all the tests are: (1) along the bottom row of tension bolts, (2) along the tension flange web between the beam and the end plate, (3) Adjacent

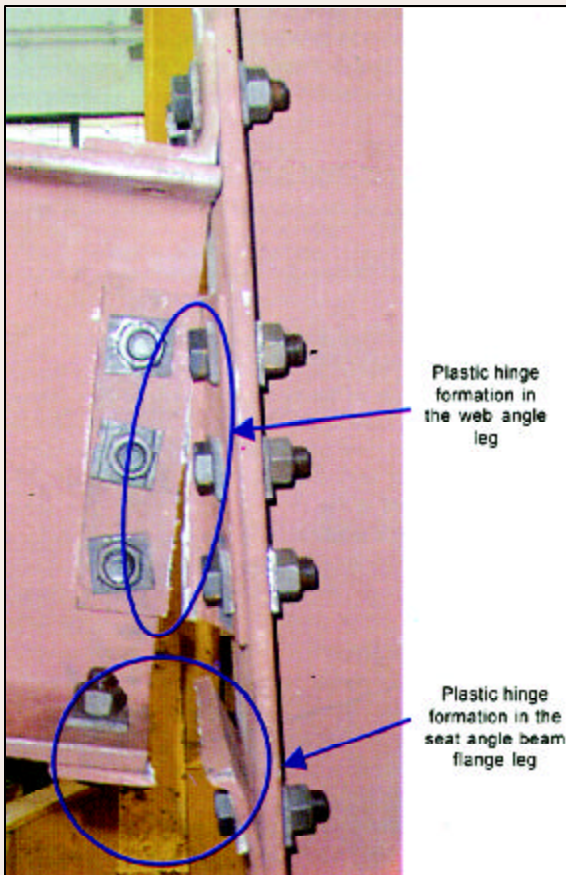


Fig. 2 : View of the failed specimen

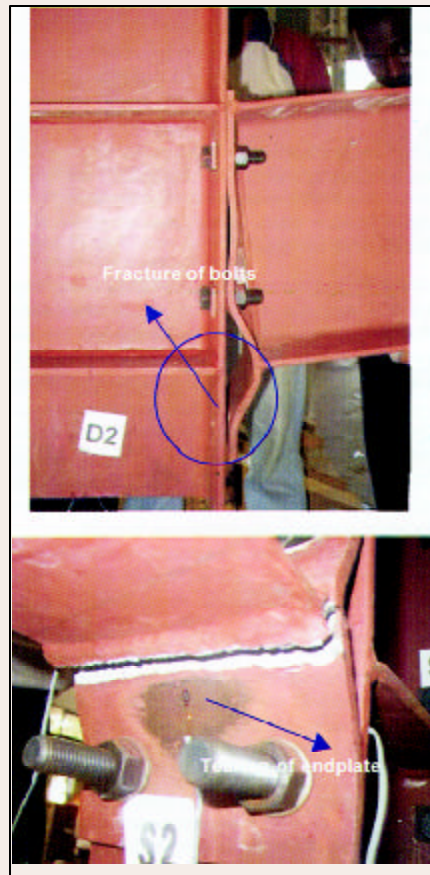


Fig. 3 : Typical failures in end plate connections



to the web weld and the plate, (4) Inclined line from the centre of the bolts in the mid region bolt row to the centre of the upper side weld of tension flange, and (5) Inclined line from the centre of the bolts of the mid region bolt row to the centre of the compression flange of the beam. One general observation of the failure mode in all the specimens was that the middle row bolts undergo bending along with tension. As the lever arm increases, the failure mode of the specimens is by fracture of the bottom row of tension bolts. Fig. 3 shows the typical failures of the specimens. The moment rotation behaviour obtained from the experimental results was compared with the Frye and Morris (1975) model which has been suggested in the IS:800 draft. The non-dimensional parameters of the Frye and Morris model have been reworked based on the present experimental study. New equations have been proposed and compared with the experimental work and the original Frye and Morris model. Load-deflection curves have also been drawn for all the cases.

To evaluate the provisions of the IS: 800 draft for the design of steel tension members, experimental studies have been carried out on thirteen specimens. The tension test specimens, each of length 1000 mm, were obtained from hot rolled steel angle and channel sections. The angle specimens had equal and unequal angles connected to the gusset through long and short legs. The channel specimens were web-connected. All the specimens were connected to the gusset plate using HSFG bolts with 214 Nm

torque applied to all the bolts. The specimens were bolted to the gusset plate by normal bolting, positive staggering and negative staggering in such a way that different failure mechanisms such as net section failure, gross section yielding and block shear failure were obtained. The connection length was varied with different pitch distance of bolts in order to evaluate the strength as proposed in the IS:800 draft. The 250 tonne UTM was used to apply the tensile load gradually. The specimens failed either by block shear or net section rupture. One of the angle specimens with minimum end distance failed by end tearing. The channel specimens failed by splitting of the web along the bolt line. The results of member tensile capacity and the mode of failure were compared with the results obtained from ABAQUS software. While IS: 800-draft predicted strength conservatively for all angle specimens used in the experiment, the prediction for all channel specimens used in the experiments was unconservative.

Parametrics Studies and Limit State Design of Structural Steel Components and Frames

Four independent computer programs have been developed:

(1) TRMADLW (TRuss Member Analysis and Design-Limit and Working states)

Using the IS:800 draft code, a computer program TRMADLW has been developed to determine the compressive strength of "1" sections, channel sections. T-sections, equal angle sections, unequal angles,

rectangular or square hollow box sections, hollow circular tubular sections, square solid rods and circular solid rods. The program can consider any axis of buckling depending on the designer's choice with corresponding imperfection factor. This program has the facility to determine the strength of design a member for a given capacity. For designing the members, to get the lowest weight for the chosen shapes, the database of the sections has been prepared in the ascending order of their weights.

(2) BMADLW (BeaM Analysis and Design-Limit and Working states)

A computer program has been developed to determine the ultimate moment and shear carrying capacity of beam members by the proposed Limit State Method in revised IS: 800, BMADLW (Beam Analysis and Design-Limit and Working states). The program can also design a member for a given factored moment and shear. Depending on the limit for non-dimensional slenderness ratio for lateral torsional buckling. The program can consider the effect of lateral torsional buckling of the beam member. The program has been validated using example problems to determine the capacity as well as the design of beam members.

(3) TRUDES LW (TRUss DESign-Limit and Working states)

An integrated truss analysis and design program has been developed, namely, (TRUss DESign-Limit and Working states). The analysis approach is by the matrix methods



and the design is based on the limit state approach as recommended in the IS:800 draft for Structural Steel design. The database for the design consists of all the various types of structural steel sections mentioned in the IS:800 draft code. The above mentioned database would contain the basic cross sectional dimensions of the sections arranged in an ascending order of the values of their cross sectional areas. Initially, the program assumes member cross sectional area based on the maximum slenderness ratio limit of 180.

(4) FRDESLW (Frame DESign Limit and Working states).

An integrated frame analysis and design program has been developed, namely, FRDESW (Frame DESign-Limit and Working states). The matrix analysis of structures and limit state design are followed. The design is based on the linear interaction equation between axial force and moment. Shear buckling of the web has been considered. Grouping of members is possible.

Atmospheric Response to Anthropogenic Emissions of Green House Gases

Shanti Swarup Bhatnagar Prize-winner Dr Gufran-ullah Beig's Work



Dr Gufran-ullah Beig receiving the S S Bhatnagar Prize from Prime Minister Dr Manmohan Singh

Dr Gufran-ullah Beig of the Indian Institute of Tropical Meteorology, Pune, has been awarded along with Dr Pulak Sengupta, Jadavpur University, Kolkata, the Shanti Swarup Bhatnagar Prize in Earth, Atmosphere, Ocean and Planetary Sciences for the year 2006 for his research contributions related to middle and upper atmospheric response to anthropogenic emissions of green house gases. His prediction of mesospheric cooling by 2 to 4K/decade

has serious future implications [*CSIR News*, 56 (2006) 296-297].

Dr Beig's work deals with a specific theme 'Global change in the atmosphere' (surface to 100 km). In particular, there are two specific research areas where his work has made a significant impact at global as well as in Indian context, namely: Atmospheric chemistry-transport modeling and Influence of anthropogenic emissions on lower and



middle atmospheric chemical species and thermal structure, in particular over Indian tropical region and transport of pollutants; he led an international scientific assessment work on atmospheric temperature trends which firmly resolved significant global change signals in the middle atmosphere. These findings have been reported to influence the radio communications, climate and weather pattern of the Earth system. Interpretation and explanations of the findings are given below:

Chemical-Transport Modeling and Impact Assessment: Several atmospheric models exist but with very little chemistry. Dr Beig has incorporated detailed chemical schemes in the climate models and carried out coupled 3-D chemistry-transport model simulations to study the lower and middle atmospheric chemical climate, focusing on the Indian subcontinent. He has simulated for the first time the scenario of topospheric changes in ozone and several other pollutants that occurred during the 1990s in the complete geographical region of India in response to enhanced human activities and explained the trends. He has calculated a maximum variation in ozone concentration near the surface to be around 5-10 ppbv for India. He has also developed a methodology using the GIS technique to grid the emission inventory of ozone precursors developed for India, which is used as input to above model for impact study. He also reported model results for the impact of continental

pollution on the marine environment and evaluated the measurements. Assessment of the impact of the release of emissions of pollutants from the Indian subcontinent to the surrounding south Asian region and vice-versa on the topospheric minor constituents led to new findings. He is also responsible for bringing the concept of possible greenhouse effect in ionization components and proposing new ion chemical schemes in the topospheric and stratospheric models.

Global Temperature Trend Assessment: Dr Beig has made significant contribution (3 review articles) and accomplished an assessment of the global mesospheric temperature trends. This work led to the first ever comprehensive review paper recognized as base line paper in this subject area. It has been awarded by World Meteorological Organization. This research has established the impact of anthropogenic forcing of the ground to the upper atmosphere and reported global cooling trends in the mesosphere with an amplitude of 2-4K per decade which becomes negligible in the mesospheric region (80-100 km) and starts further down. If sustained, the observed apparent changes in temperature, and the resulting hydrostatic shrinking could have future consequences for the ionosphere, for example radio and TV communications, and possibly affect the lower atmospheric climate and weather patterns. Scientific results have already started coming in support of Dr Beig's findings, reporting that

Earth's upper atmosphere has contracted and dropped by nearly five miles in the past four decades. Scientific interpretations of several unresolved observational findings have been given in his recent publications.

Dr Gufran Beig obtained his graduate degree from the University of Rajasthan in science (Maths) and master's degree in Physics from M.L. Sukhadia University, Udaipur, as Gold Medallist. He did his Ph.D. in Atmospheric Sciences from Physical Research Laboratory (ISRO), Ahmedabad, in 1990. Thereafter, he was selected for the visiting scientist fellowship to work at National Center for Atmospheric Research (NCAR), Boulder, Co, USA. He has worked at National Physical Laboratory, New Delhi, as CSIR Research Associate and scientist during 1992-94 and in 1996. In between he also worked as Assistant Professor in the Department of Physics, M.L. Sukhadia University, Udaipur, during 1994-95. He joined Indian Institute of Tropical Meteorology (IITM), Pune, in July 1996 and since then has been working at IITM. At present he is working in IITM as Deputy Director/Scientist-E. He has to his credit about 39 scientific papers in highly reputed refereed international journals including four review articles and edited six scientific books so far. In addition, he has more than 100 papers in conference proceedings. He has also served as editor of three scientific international journals.



NAL's ISO 9001:2000 QMS Re-certified

After successfully going through the crucial re-certification exercise, National Aerospace Laboratories (NAL), Bangalore's ISO 9001:2000 Quality Management System (QMS) has been recommended for continuation.

The certificate renewal audit was carried out on 8-9 January 2007 by a team of five auditors from Lloyd's Register Quality Assurance (LRQA). All the 26 Divisions / Sections / Units, including the office of the Management Representative (MR), went through the re-certification audit. LRQA's audit report, received on 15 January 2007, commends the maturity of NAL's QMS and its understanding at various levels within the Divisions / Sections / Units. There is also appreciation for meeting system effectiveness and continual improvement requirements through internal audits and periodical in-depth reviews at Management Review Committee (MRC) meetings.

National Conference on Failure Analysis – NCFA 2006

The First National Conference on Failure Analysis was held in Hyderabad during 22-23 December 2006. The conference was jointly organized by Defence Metallurgical Laboratory (DMRL), National Aerospace Laboratories (NAL), Indira Gandhi Centre for Atomic Research (IGCAR), Centre for Military Airworthiness and Certification (CEMILAC) in association with the Indian Institute of Metals, Hyderabad Chapter. Air Chief Marshal S. P. Tyagi inaugurated the conference. Dr D. Banerjee (CCR&D, DRDO), Dr A. M. Srirama-murty (Director, DMRL), Dr A. R. Upadhyaya (Director, NAL), Shri J. K. Sharma (Chief, CEMILAC) and Dr A. Venugopal Reddy (Regional Director, RCMA, Hyderabad) were the other eminent scientists present to grace the occasion.

Addressing the conference, Air Chief Marshal Tyagi pointed out that the accident rate of aircraft in the Indian Air Force (IAF) has dropped drastically over the years. The accident graph has come down constantly for the last 30 years from 0.88 per 10,000 hours to 0.22 per 10,000 hours at present. He said the flying environment was becoming safer due to collective efforts of various agencies, including those involved in designing, production, failure analysts and IAF. Shri Tyagi said that not a single MiG-21 was lost in the year 2006. Fuel pump failure was identified as one of the reasons for the crash of a large number of MiG-21 aircraft in the previous years. He highlighted the role of failure analysis in achieving this. He reminded the experts in failure analysis that speed is of utmost importance stressing that the military people are in a hurry because it is a matter of life and death.

Dr D. Banerjee, Chief Controller, R&D, DRDO, underlined the importance of failure analysis to meet future challenges in aerospace organizations with the introduction of new and advanced materials.

More than 200 participants representing aerospace organizations, engineering industries and academic institutions attended the conference. The technical programme, split in three parallel sessions, consisted of a mix of invited and contributed papers. The papers covered all aspects of failure analysis of engineering components and systems. Also featured were panel discussions on pitfalls, future strategies and interaction among the engineering industries, R&D organizations and academic institutions. It was opined that present practice of failure analysis is mainly concerned with the aerospace sector and hence, there is a need to set up a National Facility for Failure Analysis & Accident Investigation with the guidance of the expertise from NAL, DMRL, IGCAR, NML, etc. so that all sections of engineering industries in the country can get benefit from this profession. The conference offered a good platform for interaction and exchanging views among the failure analysis experts, users, manufacturers, and maintenance personnel from all sectors of engineering industries and R&D institutions.

The conference was preceded by a two-day workshop. The workshop featured the basic aspects of failure analysis and about 80 participants attended it. The conference was a great success and it was proposed to conduct the conference once in every two or three years.



CSIO holds Industry - R&D Meet at Ambala

The Central Scientific Instruments Organisation (CSIO), Chandigarh, has played a stellar role in establishing Ambala as the hub of Scientific Instruments Manufacturers in the country. In order to re-establish the faith between CSIO and the Industry, an R&D - Industry Meet was organized by Ambala Scientific Instruments Manufacturers Association (ASIMA) on 11 February 2007 in Ambala. Twenty-two scientists from CSIO and representatives of the local industry including Vaiseshika Electron Devices, Jainsons (India), Popular Traders, Kumar Instruments, Labkron Instruments, The Popular Science Apparatus Workshops, Shan Thermometers & Glass Works, Indian Scientific Instruments Factory, Rolex Scientific Engineers, Alco, Tiode Electronics, Om Motors, etc. participated in the meet.

The event started with the SWOT Analysis of Scientific Instruments Manufacturers of Ambala by Shri Ashwani Goel, President, ASIMA. He highlighted the potential as well as the problems being faced by the local industry. This was followed by a talk by Dr Anil Jain, M.D., Vaiseshika Electron Devices, Ambala and immediate Vice-President, ASIMA. He discussed the role of CSIO in establishing Ambala as the hub of scientific instruments manufacturers. He expressed his gratitude towards CSIO in providing the timely technical help to them, which had significant socio-economic impact on the region. He thanked CSIO Scientists for their participation.

Dr Pawan Kapur, Director, CSIO in his speech on the occasion, extended all help CSIO could provide in re-establishing Ambala as the manufacturing hub of scientific instruments and also called for discussing their problems with the CSIO scientists. He encouraged the industrialists to search for the newer markets for the latest technical inventions which have huge business potential. During the second half, one-to-one interaction between the scientists and representatives from the industry was held.

Prof. Whitesides delivers NCL Foundation Day Lecture



Prof Whitesides delivering the lecture

Professor George M. Whitesides, Department of Chemistry and Chemical Biology, Harvard University, Cambridge, USA, delivered the NCL Foundation Day lecture on "Reinventing chemistry" at National Chemical Laboratory (NCL), Pune, on 29 December 2006. It was NCL's 57th Foundation Day. The lecture was organized under the auspices of NCL Research Foundation (NCL RF).

Prof. George Whitesides gave an empathetic talk about the future prospects of chemistry as a field for itself and for the society in next 50 years. He expressed his thoughts on the end of solving puzzles



Foundation Day Celebrations



Dr Sivaram welcoming the Chief Guest and the audience

of chemistry era and the beginning of an era of solving real problem of society through chemistry. He narrated the brief history of other subjects like physics and biology and compared with chemistry. The growth of physics and its revolution can be classified into different periods such as special theory of relativity (1905), quantum mechanics (1924) and national defense and IT (post World War II). Similarly, biology has also grown with different period of revolutions like finding DNA structure, electrophoresis, sequencing, recombinant protein etc. In the case of chemistry, it started from the revolution of research in the area of fuels (1920), polymers (1930), drugs, regulatory process such as FDA during 1950s, and the development of various instruments such as NMR, GC, MS, HPLC etc during 1970s. As to how these fields will grow in the future, he pointed out that the future revolution would be

based on the science enabled by the advancement of tools. For example, the development of STM/AFM has led to the birth of Nano science, photolithography, gave a new field of microelectronics, and X-ray diffraction has opened a new way of understanding protein chemistry.

He went on to state how chemistry can contribute to solving several problems of society in future. He put forth many such areas in chemistry where break-through can come in the future. Although chemistry has done a lot to understand molecular problems and discovered molecules in the past, it may be important to look into areas such as 'molecular recognition in water', 'single-molecule studies', 'solutions', 'complex system of cell', 'origin of life' and 'entropy and second law'. He also pointed out some fundamental problems that have potential for revolution in chemistry. These areas are energy production/conservation, fascinating materials such as materials with negative index of refraction, high T_c , self-healing materials, etc. Understanding chemical basis of thought and self-awareness and applied problems such as protein-ligand interaction, protein-plasticity, hydrophobic interactions etc are also very important for chemistry. He cited some examples of how one can

reinvent chemical economics by replacing crude oil/petroleum with nuclear energy based resources. In conclusion, he stressed that the answer to these issues in chemical research must come from academics rather than industry. He emphatically stated that "*Universities and government funded National Laboratories must lead the change*". One of the changes that should be embraced by scientists working in University and National Laboratories is to follow an entrepreneur model as being done by MIT and Stanford. The strategy for change should be the use of a set of unique skills of chemistry to connect with big and recognizable problems, which can be used to provide opportunity to do curiosity-driven research.

Prof Whitesides presented several awards instituted by NCL RF, including NCL RF Technology Award (Sponsored by ICICI Ltd), NCL RF-Cipla Hamied Award for the Best Process/ Product Development (Sponsored by Cipla Ltd), Highest Industrial Earning Award, Award for "New Initiative taken by the R&D Support System", Director's Commendation Award, Individual Merit Award, etc.

Earlier, Dr S. Sivaram, Director, NCL in his welcome address briefly traced the history and developments at NCL over the period of time since its inception. He also introduced Prof Whitesides to the audience.



CFRI celebrates Diamond Jubilee

Established on 17 November 1946, Central Fuel Research Institute (CFRI), Dhanbad, has completed 60 years of its service to the nation. The institute's Diamond Jubilee Celebration Programme included a workshop on "Atmamanthan" held on 16 November 2006 to look back, assess and plan for the future. Achievements of the institute of last 60 years were discussed in nine broad areas covering (1) Coal Chemicals, Products & Uses; (2) New Techniques for Coal Preparation; (3) Environmental Management for Societal benefits; (4) Coal Carbonization and Industry;

(5) New Dimension in Fuel Science; (6) Coal Resource Quality; (7) Coal Gasification: India and Abroad; (8) Coal Combustion, Coal Grading and (9) Coal Liquefaction.

Prof Vimal Kumar, Advisor, TIFAC, New Delhi, was the Chief Guest and inaugurated the workshop. Dr Rajendra Prasad, Head, ISTAD, CSIR, was the Guest of Honour. A compact disk covering the achievements of CFRI during the 60 years that have gone by was released by the Chief Guest.

An exhibition on "Sixty Glorious Years' Journey of CFRI" was also organized on the occasion, in which

products/ technologies/process/ know-how developed by the institute were displayed. Publications during the last sixty years were also displayed.

A press conference was also organized, where the CFRI Director briefed the media about the present activities and future R&D planning of the institute.

A Diamond Jubilee souvenir and a bound volume of list of Patents & Publication were being also brought out. With the above workshop and exhibition, the year-long programme of CFRI Diamond Jubilee, which began on 17 November 2005 came to an end.

Team from ONERA visits NAL

A delegation from ONERA visited NAL on 12 February 2007. ONERA (Office National d'Etudes et Recherches Aérospatiales) is a French national aerospace research center. ONERA is both an active participant in aerospace research and a coordinator of this research.

Dr A.R. Upadhyya, NAL Director warmly welcomed the delegation. The officials from ONERA made a brief presentation. The team of Directors from ONERA had a lively interaction with NAL team regarding collaborative research projects under Indo-French relationship programmes.



The officials from ONERA interacting with the NAL team

Air Commodore M. Matheswaran visits NAL

Air Commodore M. Matheswaran, Commandant, Aircraft Systems Testing Establishment (ASTE), Indian Air Force, Bangalore, visited the National Aerospace Laboratories (NAL), Bangalore on 11 January 2007. Dr A. R. Upadhyya, Director, NAL, welcomed the Air Commodore and made a brief presentation on NAL activities. Air Commodore Matheswaran in his speech stressed that development of core technologies in proper time is essential in the field of aerospace in this country.

He also reiterated ASTE's co-operation to NAL's programmes and said that "we are looking forward to working together".



Air Commodore M. Matheswaran being greeted by Dr A. R. Upadhyya



Dr K. Thangaraj and Dr D. Kar Chowdhuri bag UKIERI Major Research Award

Dr K. Thangaraj, Scientist, Centre for Cellular and Molecular Biology (CCMB), Hyderabad, and Dr D. Kar Chowdhuri, Scientist, Industrial Toxicology Research Centre (ITRC), Lucknow, have been awarded the Major UK-India Education and Research Initiative (UKIERI) Awards. These awards were launched by the UK Prime Minister, Tony Blair, to promote the innovative research and academic excellence between the UK and India, during his last visit to India.

Dr Thangaraj and his collaborators Dr Mart Mirazon Lahr and Dr Toomas Kivisild of Cambridge University received this award for a four-year collaborative project, which involves genetic analysis of the various populations in India. It also involves mutual exchange visits of scientists between

CCMB, India and Cambridge University, UK. The award carries a research grant of Rs 2.5 crore to understand “Was the first out of Africa settlement of *Homo sapiens* in India?”

Dr Chowdhuri was awarded this award for the project entitled ‘Mathematical and experimental modeling of the animal stress-response network’. Dr Chowdhuri is the Principal Investigator and his colleague Dr D.K. Saxena, Scientist, is the Co-investigator. Other collaborators of this project are Nottingham University, UK and IIT Kanpur.

This award carries a plaque and



Dr D. Kar Chowdhuri, Scientist, receiving UKIERI Major Research Award from Mr Gordon Brown, Chancellor Exchequer, Government of UK, at British Council Office, New Delhi

a research grant of £ 500,000.

The awards were bestowed upon Dr Thangaraj and Dr Chowdhuri by Mr Gordon Brown, Chancellor Exchequer, UK Government on 18 January 2007, at a glittering award ceremony held at British Council Office, New Delhi.

Dr M. R. Nayak invited to be Associate Editor of IJSS

Dr M. R. Nayak of the National Aerospace Laboratories (NAL), Bangalooru, Adviser (M&A) and Head, ALSD, has been invited to serve as an Associate Editor of the *International Journal of Systems Science* (IJSS) for a period of two years from 1 January 2007.



Shri S. A. Narasimha gets the Best Poster Presentation Award

The International Symposium for Research Scholars on Metallurgy, Materials Science and Engineering was held at Chennai on 18-20 December 2006. Shri S. A. Narasimha, Senior Research Fellow of the Materials Science Division, of the National Aerospace Laboratories (NAL), Bangalooru, received the Best Poster Presentation Award for the paper “Electronic and Thermal Properties of b-Zn Sb” co-authored by Dr V. Shubha and Dr T. G. Ramesh³.

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