January - March 2021 Vol. 5, No. 1

CSIR–SERC
ENGINEERING SUSTAINABLE STRUCTURES

e-STRUCT

e-Newsletter of CSIR-Structural Engineering Research Centre

In this issue

From the Director's Desk

I am very happy to present Vol. 5, No. 1, 2021 issue of e-STRUCT. This edition of newsletter highlights our R&D pursuits, achievements, new facilities, skill development initiatives and other significant endeavors during January-March 2021.

The spread of COVID-19 pandemic has created a need for rapid deployment of temporary/make-shift hospitals/quarantine facilities across the country including the villages. Utilizing the expertise of CSIR-SERC on analysis and design of light weight structures, CSIR-SERC has come out with optimum designs and faster construction of lightweight transit hospital structures to support the effort of the Government in tackling the emergency condition that has risen due to the spread of COVID-19. The work done by CSIR-SERC is detailed in Research highlights section of this edition of eNewsletter.

During this quarter, an umbrella MoU with East Central Railway, Dhanbad, was signed for the project titled Assessment of Structural adequacy of RDSO's standard composite girders for designed loading standard by instrumentation as per RDSO BS-106R and recommendations for retrofitting of superstructure of bridges (if any) of various spans newly constructed under Chief Administrative Officer/ Construction/South, East Central Railway.

During the period, CSIR-SERC organized four online advanced courses as a part of CSIR Integrated Skill Initiative for the benefit of the student and research community. For the first time in the country, innovative online competitions were organized as part of the JIGYASA events in addition to webinars. In continuation of the previous quarter, four more stakeholder's meets were organized and these meetings were a great success with various experts from the line ministries of Govt. of India, R&D organizations, industry and academia deliberating extensively on the projects and many key recommendations emerged.

The campus celebrated National Science Day 2021 and International Women's Day 2021 with great enthusiasm. This has indeed been a challenging but eventful quarter and as always we look forward to more exciting opportunities in future.

24.8.2021 Dr. (Mrs.) N. Anandavalli

NAFAMMS building at CSIR-SERC

Research highlights

Temporary and Short-Term Hospital Structures for Rapid Construction

Background

The spread of COVID-19 pandemic has created a need for rapid deployment of temporary/make-shift hospitals/ quarantine facilities across the country including the villages. For rapid construction of such facilities, even in villages/remote places, it is required to employ the innovative concepts for prefabricated, lightweight modular or portable structures. Utilizing the expertise of CSIR-SERC on analysis and design of light weight structures, the laboratory has come out with optimum designs for construction of lightweight transit hospital structures to support the effort of the Government in tackling the emergency condition that has risen due to the spread of COVID-19.

Three different schemes were worked out, namely, portable and lightweight transit hospital structure (Poli-Tal and Poli-Tal-M) for immediate requirement and lightweight and prefabricated structure for quarantine hospitals (Pre-Tal) for short-term requirements. The schematic view and typical layout for these structures are shown in Figs. 1-3. The designs utilize optimum material (and are hence light weight), ensure stability and can be executed in fast track construction mode. The structures are modular and scalable due to identical units and are suitable for hospitals/quarantine facilities with 50/100/200/500 beds. Based on the functional requirements and the available area, the units can be arranged. The salient details of the hospital structures are given in Table 1.

Feature	Poli-Tal-1	Poli-Tal-M	Pre-Tal
Type	Modular	Modular	Pre-Engineered Building
Structural Scheme	Steel truss type structure	Foldable steel module	Steel Portal Frame
No. of beds	10-100 beds (4 beds in each modular unit)	10-100 beds (2-3 beds in each modular unit)	50/100/200 beds (40-50 beds in each unit)
Cost* (per sq. ft.)	Rs. 1000	Rs. 1100	Rs. 1450
Implementation period	20 days	7 days	40 days
Suitable for	Immediate	Immediate	Short-term requirements

(Note: * - with minimum facilities)

Table 1: Salient features of the temporary and short-term hospital

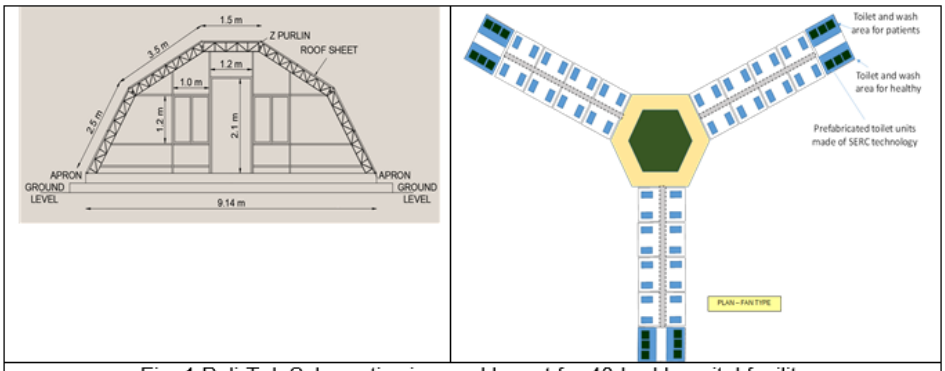


Fig. 1 Poli-Tal: Schematic view and layout for 48-bed hospital facility

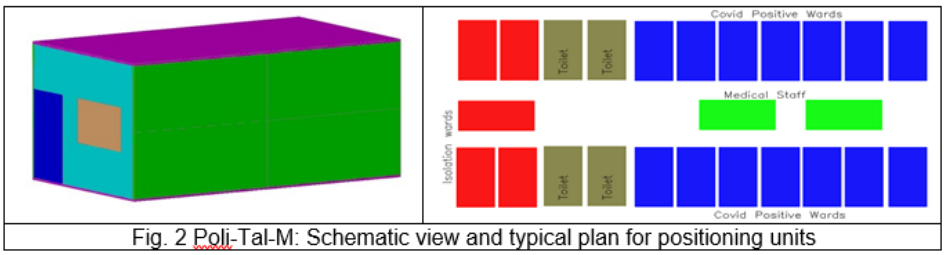


Fig. 2 Poli-Tal-M: Schematic view and typical plan for positioning units

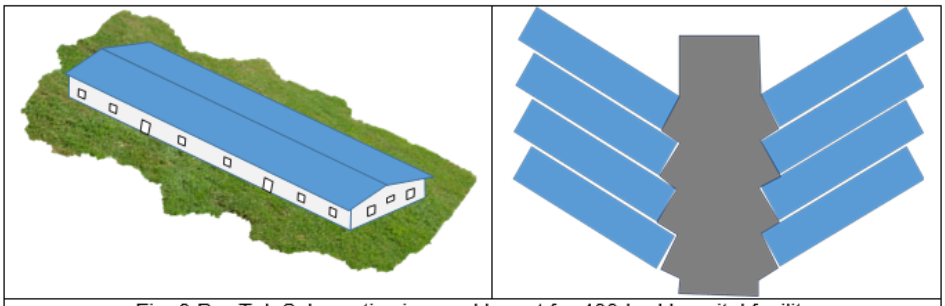


Fig. 3 Pre-Tal: Schematic view and layout for 400-bed hospital facility

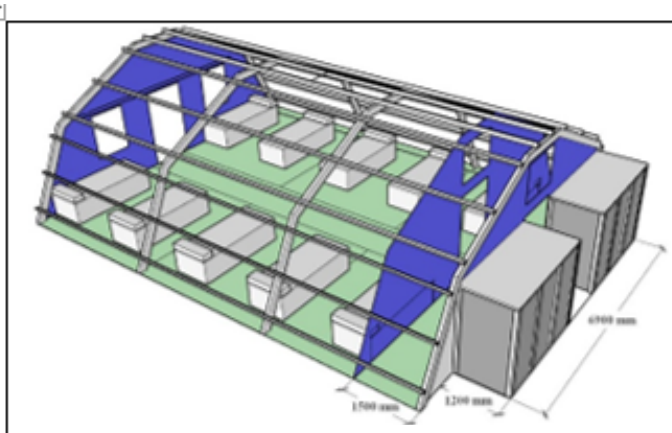
Poli-Tal Makeshift Hospital at NDRF, Arakkonam

The National Disaster Response Force (NDRF) has requested CSIR-SERC to provide a makeshift hospital with ten bed capacity at Arakkonam. As a part of demonstration project, CSIR-SERC has taken up the construction of the 10-bedded portable and lightweight transit hospital structure (Poli-Tal) at NDRF, Arakkonam (Fig. 4). Salient features of the hospital structure are:

- Light weight with ready to assemble components
- Four beds can be accommodated in every unit at any point of time
- Easily erectable in both rural and semi-urban areas without much requirement of skill, labour and sophisticated/large equipments
- All the joints are detachable and can be fixed within few hours
- The components of the structure will be prefabricated in factory and can be quickly assembled at site
- With the ready to build site and minimum preparation, the erection of one units should not take more than 6 hours
- Owing to the size and shape of the units, any plan area can be adjusted with ease. The system like radial or linear arrangements can be adopted
- Other functional requirements including air conditioning can be accommodated in the proposed scheme

The scheme implemented for construction of ten bedded light weight transit hospital structure (Poli-Tal) for NDRF, Arakkonam, has been conceived taking into account of all the aforementioned requirements. CSIR-SERC was responsible for constructing the structure including the claddings and washrooms, while the construction of foundation and providing the electrical fittings were executed by NDRF, Arakkonam. Three bath and three toilet units, prepared with the textile reinforced concrete (TRC) technology developed at CSIR-SERC, were installed at the back end of the structure. The technology has advantages such as faster in erection, lightweight and cost effective.

The demo construction of portable and lightweight transit hospital structure (Poli-Tal) at NDRF, Arakkonam, has been completed to accommodate ten beds with three repetitive units of size 9.14 x 4.0 m, which are of not only lightweight with fast track construction, but also requires less skill, labour and does not require any sophisticated/large equipment for erection at site. This will pave the way for collaboration between CSIR and NDRF for rapid deployment of such facilities in places of need across the country.


Schematic view


Front view


Back view with attached toilets and bathrooms


Inside view of completed hospital

Fig. 4: Poli-Tal Makeshift Hospital at NDRF, Arakkonam

Industry connect

The portable lightweight foldable module (Poli-Tal-M) for make-shift hospitals and other needs developed at CSIR-SERC is an innovative, prefabricated, lightweight and modular structure for rapid installation (Fig. 5). The design utilizes optimum material, is extremely stable, can be erected very quickly and can be used as make-shift hospitals, emergency/temporary shelters, toilet units, etc. This technology is first of its kind in India, and has a high potential for multi-functional use for different needs such as the fast deployment of shelters for ready to use makeshift hospitals, housing for affected people in case of natural disasters, temporary shelters for migrant workers in construction sites and remote areas, deployment of shelters at remote strategic locations etc. the salient highlights of the technology are:

- Single foldable unit having total weight around one ton
- The module can be fabricated easily, folded flat for easy transportation and can be erected at the site using a crane
- The wall panels consist of four panels with cladding, provided with hinges and can be folded to the floor level
- Standard size of the module is 6.0m x 3.0m x 2.8m height and can be customized based on the requirement
- Provisions for electricity including lighting is provided as a part of the structure even in the folded condition
- The installation takes less than one hour with 2-3 labour
- Using provisions at different parts of the panel, the roof and walls of the module can be lifted and arranged sequentially. On ensuring perfect erection and alignments, the front and back wall panels can be opened up
- Multiples units can be stacked/ arranged together with openings for commuting from one place to another

The Poli-Tal-M technology has been licensed to M/s L&T Ltd. and M/s PressMach Infrastructure (P) Ltd..


Opening of front and back door panels


Inside view

Fig. 5 End to end demonstration of Poli-Tal-M at CSIR-SERC

Major Projects Undertaken

- **Studies on Fatigue Life Evaluation of Welded Rail Joints - M/s. Chakradhar Industries, Mumbai**
- **Finite Element Analysis and Checking the Structural Adequacy of Non-standard Twin Steel Box Composite Super - Structural Span for ROB at Mithapur Danapur Division ECR – M/s. IRCON International Ltd., Patna**
- **Assessment of Structural Adequacy of Three Numbers of Composite Bridges (BR78, BR130 and BR134) near Renukut under Dhanbad Division of ECR for 25T Axle Load – The East Central Railway, Renukut**
- **Analysis of Single Lane Steel Modular Bridges (with and without Walkway Attachment) of Varying Spans from 30ft to 230ft to prepare Complete Load Span Charts – M/s. Garden Research Shipbuilders & Engineers Ltd., Kolkata**
- **Structural Healthiness and Adequacy of Juari Bridge and Semra Bridge for the Movement of Loaded Ash Bulkers / Hyewa at NTPC – M/s. NTPC, Vindhyachal**
- **Condition Assessment of TG Columns and Deck of Stage II (2 Units) and Recommendation for Repair Measures – M/s. NTPC, Unchahar**
- **Wind Tunnel Investigation on Aeroelastic Models of 150m and 240m tall RC Chimneys - for 3x200 MW +3X500MW Ramagundam FGD - M/s. BHEL, Noida**

Technology transfer / MoUs

- An umbrella Memorandum of Understanding (MoU) between CSIR-SERC and the East Central Railway, Dhanbad, was entered on 3 February 2021 for the project titled ***Assessment of Structural adequacy of RDSO's standard composite girders for designed loading standard by instrumentation as per RDSO BS-106R and recommendations for retrofitting of superstructure of bridges (if any) of various spans newly constructed under Chief Administrative Officer/ Construction/South, East Central Railway***.

Capacity development

Courses organized as a part of CSIR Integrated Skill Initiative

- An online advanced course on ***Behaviour and Design of Connections in Steel Structures*** was organized during 20-22 January 2021. Around 50 participants from academia, industry and professionals participated in the course
- An online advanced course on ***Geopolymer Concrete*** was organized during 28-29 January 2021. The course attracted huge response with 95 participants including students, researchers, teaching faculty, professionals from government departments, public sector & industry and private consultants attending the course.
- A online advanced course on ***Forensic Analysis of Concrete Structures*** was organized on 11-12 February 2021. Around 34 participants attended the course
- A online advanced course on ***Quality Control and Assessment of Field Concrete*** was organized on 18-19 March 2021. Around 47 participants attended the course

Other Programmes

- An online user awareness training on ***Web of Science*** was organized at CSIR-SERC, on 29 January 2021
- An online user awareness training on ***Endnote*** was organized at CSIR-SERC, on 11 February 2021

Events

JIGYASA

CSIR is organizing JIGYASA events for knowledge sharing between scientists and students since 2017. The primary objective of JIGYASA is to develop and promote scientific temper among students across the country.

This year, in addition to webinar presentations, innovative online competitions named SCIFIC and TECHNOVATION were organized by CSIR-SERC for the first time. The objective of the competitions is to improvise the student's problem solving capabilities and creative thinking skills. SCIFIC was for the students of class 6-8 and TECHNOVATION was for the students of class 9-12. Students in large numbers from across the country enthusiastically praticipated in the competitions.

For the SCIFIC (individuals) competition a total of 106 students from 11 states have registered and thirty final entries were submitted by the students. For the TECHNOVATION (group event) competition a total of 45 groups (consisting of total 157 students) from 12 states have registered and fourteen final entries were submitted by the students. Cash awards were given for the winners of the competition.

Vigyan Manthan Yatra – 2020

In connection with Vigyan Manthan Yatra – 2020, organized by the Madhya Pradesh Council of Science & Technology, 150 students of classes 8-12 connected online with CSIR-SERC on 18 January 2021. CSIR-SERC scientists delivered the following technical presentations and virtual demonstrations to the students:

- Introduction about CSIR in-general and about CSIR-SERC in-particular
- Technical presentation and virtual demonstration about Advanced Seismic Testing & Research Laboratory (ASTaR)
- Technical presentation and virtual demonstration about Tower Testing & Research Station (TTRS)
- Technical presentation and virtual demonstration about Fatigue & Fracture Laboratory (FFL)

Stakeholder's meetings

Four stakeholder's meetings were organized in online mode during January - March 2021 with the following objectives: (i) to present the idea and deliverables of the relevant projects at CSIR-SERC, (ii) to present and disseminate information on relevant technologies already developed by CSIR-SERC, (iii) to involve various stakeholders' view points in the initial stages of the project itself to understand their need and expectations, (iv) to understand the market requirements and to join hands with the industry at the project initiation stage itself to ensure large scale implementation of the technologies in the field, etc.

Each meet had (i) a presentation by the project's principal investigator at CSIR-SERC, (ii) presentations by the perspective stakeholders, (iii) panel discussions and (iv) closing remarks by the Director, CSIR-SERC. The meetings were a great success wih various experts from the line ministries of Govt. of India, R&D organizations, industry and academia deliberating extensively on the projects and many key recommendations emerged.

- A stakeholders' meet for the CSIR-SERC's project on ***Development of electrically conductive concrete utilizing high carbon content industrial solid wastes*** was organized on 9 February 2021
- A stakeholders' meet for the CSIR-SERC's project on ***Prediction of crack initiation and remaining life of structural components*** was organized on 10 February 2021

- A stakeholders' meet for the CSIR-SERC's project on ***Fatigue damage and remaining life assessment of Latticed Transmission line towers due to wind loads (Fadam Trans)*** was organized on 12 February 2021

- A stakeholders' meet for the CSIR-SERC's project on ***PA novel heating module for fire resistance rating of steel structural components*** was organized on 18 February 2021

National Science Day

National Science Day is celebrated in India every year on 28 February to mark the discovery of Raman Effect by Indian physicist Sir C.V. Raman. The Science Day was celebrated with great enthusiasm on 26 February 2021, at CSIR-Structural Engineering Research Centre (CSIR-SERC) and CSIR Madras Complex (CMC) on MS Teams Platform.

The function was presided over by Dr. K. Ramanjaneyulu, Director, CSIR-SERC and Coordinating Director, CMC. Prof. Siva Umapathy, Director, Indian Institute of Science Education and Research (IISER), Bhopal, was the Chief Guest of the function. In his welcome address, Dr. Ramanjaneyulu, talked about the genesis of National Science Day and briefed on the discovery and significance of Raman Effect. Talking about the theme of National Science Day 2021 – Future of STI: Impacts on Education, Skills and Work, Dr. Ramanjaneyulu said that CSIR-SERC and CMC are celebrating this year's National Science Day to promote the spirit of creativity, innovation and scientific temper. Dr. J. Rajasankar, Chief Scientist, introduced the chief guest to the audience.

The chief guest Prof. Umapathy, delivered the National Science Day lecture on Challenges to innovation for the young minds in India. In his lecture, Prof. Umapathy, emphasized that future of India depends on innovation, technology and knowledge. He said that to empower the country, innovation is important and young population can contribute greatly towards it. He talked about the challenges one can face as an inventor; explained the seven habits of an innovator; need for communication methodologies to disseminate the knowledge; examples of innovations that changed our lives for good; etc. He talked on the societal and cultural problems/interferences in our system and emphasized that everybody especially the elders have the responsibility to promote young minds towards innovation and knowledge. He also emphasized on the importance of teamwork, tolerance, ability to interact, respect for colleagues, significance of analysis in experiments, quality publishing, industry/market interactions, etc.

International Women's Day

International Women's Day was celebrated at CSIR-Structural Engineering Research Centre (CSIR-SERC) and CSIR Madras Complex (CMC), Chennai, on 8 March 2021. Dr. Sudha Seshayyan, Vice-Chancellor, The Tamil Nadu Dr. MGR Medical University, Chennai & Member – National Medical Commission, was the chief guest of the function.

Women in leadership: Achieving an equal future in a COVID-19 world was the theme for International Women's Day 2021. The programme started with an introduction on women's day function at CSIR campus by Dr. C. Bharathi Priya, Senior Scientist, CSIR-SERC. Dr. K. Ramanjaneyulu, Director, CSIR-SERC and Coordinating Director, CMC, in his welcome address spoke briefly on the genesis of women's day, this year's women's day theme, and said that CSIR-SERC and CMC are committed towards equality. He pointed out that women are still underrepresented in many important fields and encouraged women to achieve equality. Dr. N. Anandavalli, Senior Principal Scientist, CSIR-SERC, introduced the chief guest to the audience.

The chief guest, in her special talk titled Women and Science, spoke on the UN report on equality, multiple challenges faced by women especially during COVID-19 pandemic period and lockdowns, renowned women scientists of India who have made a mark, challenges faced by women scientists and how to face them, facts that women scientists should accept and adapt to at work place, etc. She also called upon the women not to assign any predefined narratives on themselves and not to give up only because they are women.

Demonstration and installation of toilet units using Thin Precast Concrete Segmental Panels at CSIR-CLRI

The staff quarters of CSIR-Central Leather Research Institute (CLRI) provides common pool accommodation for the staff members of CSIR-CLRI, CSIR-Structural Engineering Research Centre (CSIR-SERC) and CSIR-CMC. The residential complex also houses a Kindergarten school, Kendirya Vidyalaya, playground and a grocery store to cater to the needs of families residing there. As the complex is frequented by visitors, there was a long-felt need for common rest rooms in the complex. CSIR-CLRI requested CSIR-SERC to provide 4 single toilet units and one cluster type (2 units combined), as demonstration of technology in the complex as a part of Swachh Bharat mission to cater to the needs of the visitors. Based on this request, the toilet units using thin precast concrete segmental panels were demonstrated and installed at the residential complex on 17 March 2021 by CSIR-SERC. Dr. K. Ramanjaneyulu, Director, CSIR-SERC and Dr. K.J. Sreeram, Director, CSIR-CLRI were present during the demonstration. Dr. Sreeram appreciated the work carried out by the scientists of CSIR-SERC.

This technology (toilet units using thin precast concrete segmental panels) was developed at CSIR-SERC to provide strong, cost-effective and durable toilet units using small segmental components – that are easily transportable and can be assembled in two hours' time. The components of the toilet unit are precast, light weight, highly ductile and have

good corrosion resistance. The total cost of a single toilet unit is around INR 12500. The developed technology is modular and hence can be simply combined together for developing clusters or can be constructed as toilet with service core units. This novel technology is readily available for technology transfer to the industries.

Honours, awards & recognitions

• Shri R.P. Rokade, Senior Principal Scientist was awarded Doctor of Philosophy for the thesis titled, ***Probabilistic risk assessment of transmission line towers under high wind conditions*** by the Annamalai University

• Shri M. Surendran, Senior Scientist was awarded Doctor of Philosophy for the thesis titled, ***Linear smoothed extended finite element method for fracture analysis*** by the Academy of Scientific and Industrial Research

• Smt. K. Sasikala, Principal Technical Officer was awarded Doctor of Philosophy for the thesis titled, ***Decision support system framework for cyclone disaster mitigation on cloud environment – an applied research*** by the Anna University

Invited Lectures

• Dr. T. Hemalatha, Senior Scientist, delivered an invited lecture titled ***Supplementary Cementitious Materials-A Boon to Cement/ Concrete Industry*** at the online advanced course on Geopolymer Concrete organized by CSIR-SERC, on 29 January 2021

• Dr. G.V. Rama Rao, Senior Scientist, delivered an invited lecture titled ***Experimental Methods in Structural Dynamics and Earthquake Engineering Engineering*** at the Short Term Training Programme (STTP) on Advanced Vibrations – Various Engineering Applications, organized by the Jawaharlal Nehru Technological University, Kakinada, on 8 February 2021

• Dr. P. Kamatchi, Sr. Principal Scientist, delivered an invited lecture on ***Seismic Resilience and Risk Evaluation of buildings*** at the online short-term course titled Advances in Structural Engineering and Materials, organized by National Institute of Technology Srinagar, on 18 February 2021

Paper Publications

- **SCI Journals - 23**
- **Reputed Indian Journals - 2**

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