

Experience Summary

- Working in Engineers India Limited, New Delhi from September 2007 to till date.
- 14 years of experience in the fields of stress analysis and has carried out the advanced technology development activities such as transient thermal and creep-fatigue interaction and successfully executed finite element, fatigue, creep and creep-fatigue analysis of pressure vessels & piping components including many high pressure and high temperature reactors, coke drum, dryers, agitator vessels etc in many projects.
- Performed numerical simulations to indentify the root causes of the problem fault sequence and fitness for service assessment of pressure vessels, piping components, heater exchangers and provided recommendations to improve designs.
- Acquired in-depth knowledge of general FEA software like ABAQUS & ANSYS and utilized for solving many first time unconventional, complex and multidisciplinary problems arising out of pre- and post-commissioning activities.

Publications & Achievements

- i. Nominated for **Best Individual Innovation Award** 2017, 2018 and 2019 in EIL.
- ii. Nominated for **Best Executive Award** for the Year 2019.
- iii. Nominated for **National Young Executive Award for the year of 2016** from Engineers India Limited.
- iv. **Co-authored** on the paper titled **“Thermo-Mechanical Fatigue Life of Coke Drum Skirt Attachment Designs”** was presented at 2016 ASME Pressure Vessels & Piping International Conference, July 17-21, 2016, Vancouver, Canada. The time-dependent variable heat transfer coefficients at the inner surface of the coke drum, which change with the operation stages and the levels of oil filling and water quenching, are determined based on the field measured thermocouple temperature data on the outer surface of the coke drum. Sequentially coupled elastic-plastic transient thermo-mechanical stress analyses of coke drum skirt attachments are carried out using both Twice Yield and cycle-by-cycle methods. The effective strain ranges and the fatigue life of three different skirt attachment designs are calculated and compared.
- v. **Co-authored** on the paper titled **“Integrity Assessment of Subsea Pipeline Dent / Buckle - A Case Study”** was presented at 2019 Petrotech, New Delhi, India. Mechanical damage in subsea pipelines in the form of local dents / buckles due to excessive bending deformation may severely threaten their structural integrity. Residual stresses are set up as result of the plastic deformation and stress

concentrations are created due to change in pipe geometry caused by the denting / buckling process. The objective of this paper is to evaluate the severity of dent / buckle in a 48" subsea pipeline and to make the rerate, repair, or replacement decision. This paper presents Level 3 integrity assessment of a typical subsea pipeline dent / buckle with metal loss reported in in-line inspection (ILI) in accordance with Fitness-For-Service Standard API 579-1/ASME FFS-1. In this paper, the deformation process that caused the damage (i.e. dent / buckle) with metal loss is numerically simulated using ILI data in order to determine the magnitude of permanent plastic strain developed and to evaluate the protection against potential failure modes. For numerical simulation, elastic-plastic finite element analyses (FEA) are performed considering the material as well as geometric non-linearity using general purpose finite element software ABAQUS/CAE 2017. Based on the numerical simulation results, the integrity assessment of dented / buckled subsea pipeline segment with metal loss has been performed to assess the fitness-for-service at the operating loads.

- vi. **Co-authored** on the paper Titled "**External Pressure Charts for Carbon and Low Alloy Steels in the Creep Range**"-PVP2015-45023, in the Proceedings of the **ASME 2015** Pressure Vessels & Piping Conference, ASME PVP2015 on July 19-23, 2015, Boston, Massachusetts, USA. External pressure charts of ASME Boiler & Pressure Vessel Code do not account for reduction of buckling strength due to creep under long-term loads at elevated temperatures and are not available in any design codes or literatures. External pressure charts are developed for most commonly used elevated temperature materials (Carbon & 1.25Cr-0.5Mo and 2.25Cr-1Mo low alloy steels) for operating temperature upto 550 degree Celsius. The developed external pressure charts are used in the design of CCR reactor for Dangote Project.
- vii. **Co-authored and presented** a technical paper on "**Creep-Fatigue Design Studies for Process Reactor Components Subjected to Elevated Temperature Service as per ASME-NH**" in ICONS-2014, the first in a series of International Conference on Structural Integrity, held on February 4-7, 2014, jointly organized by the SFA, IIM, IIW and IGCAR at Kalpakkam, which received a **good appreciation from Scientists of Nuclear Fraternity**.
- viii. **Co-authored and presented** a technical paper on "**Creep-Fatigue Analysis of Pressure Vessel Components as per ASME Code Case 2605**" at THIRD ASIAN CONFERENCE ON MECHANICS OF FUNCTIONAL MATERIALS AND STRUCTURES, (ACFMS 2012) held at IIT-Delhi, INDIA during the period December 05-08, 2012. And implemented the same in projects of EIL. **Discrepancies in ASME code case 2605 were identified and emphasized in the paper.**

- ix. Secured **First Prize** in EIL **Technical paper Writing competition 2014** - Authored the technical paper on implementation of new advanced technology in the field of fracture mechanics i.e. XFEM titled "**Extended-FEM (XFEM) in Investigation & Simulation of Real Crack Failure in Petrochemical & Refinery Component**".
- x. One of the **AIMA Certified** Trainer and **Faculty** of EIL domain training on "Introduction to Finite Element Methods" for the years 2012 to 2015, provides training to SED, Piping, PED, Structure department etc.
- xi. Representing EIL Tennis and Badminton Team in PSPB Tournaments for the last 9 years.

Project Applications

Actively involved in resolving the multidisciplinary design related issues like fluid-structure interaction, thermo-mechanical interaction, etc. where the brainstorming with peers of Computational fluid dynamics expertise and Heat & mass transfer expertise are essential. Acquires knowledge and understanding of a problem and resolved it to the perfection with various disciplinary inputs. Has involved in creating awareness to other department peers, like SED, Process & R&D department peers, about the significance and precision of the critical inputs required for performing advanced analysis.

Some Case Studies:

- 1) In analyzing INDAdeptG Reactor (IOCL Barauni), the skin temperature considered as per Process design/operating temperature induced high level of stresses which made it impossible to decide reactor thickness. Further the issue has been solved with involving R&D and Process department including SED and the actual metal skin temperature has been obtained and used in designing of Reactor.
- 2) Piping Elbow analysis of VGO Hydrotreater Unit, HMEL A632 busted out abruptly, which has been solved for design condition using inputs CFD technology of R&D and performed Fluid structure Interaction analysis to demonstrate integrity of pipe elbow for design and operating condition.
- 3) Finite element analysis (FEA) of exchanger to achieve qualitative/quantitative assessment of cause of failure of the tubes Heat Exchangers of Secondary TLX in Gas Cracker Plant, Reliance Petrochemicals, Nagothane (A296). And FE Analysis for Intermediate Tubesheet of CCR Heater, BPCL, Kochi Refinery, which has been found to be failing during operation has been performed in interaction with HMTD and R&D. The thermal-mechanical transient analysis has been performed to figure out the causes of failure and rectifications of design has been issued.

- 4) The Coke drum experiences severe operating thermal cycles. The transient thermal analysis and fatigue analysis of coke drum considering elastic-plastic material properties of material construction is performed to estimate the fatigue life of the Coke drum for IOCL Barauni.

- 5) INDAdaptG Reactors are under cyclic service and also the operating temperature is MOC's creep range. At elevated temperatures, creep damage adversely affects the fatigue damage and can no longer be ignored or treated separately. Hence interaction of creep-fatigue has been considered in accordance with the elevated temperature service design code such as ASME-NH to estimate the creep-fatigue life of IndadepG Reactor for A457-IOCL Guwahati.

- 6) For fatigue evaluation of pressure parts constructed with vanadium modified or 2.25Cr-1Mo-0.25V materials for operating temperatures greater than 371⁰C (700⁰F) and less than or equal to 454⁰C (850⁰F), ASME Code Case 2605 has been used. The creep model given in Code Case 2605 is not available at present in any commercial finite element software. Therefore, the creep-damage model is incorporated into the ABAQUS finite element software by writing a user-defined CREEP subroutine. Discrepancies in code case was identified while implementation. With the acquired knowledge, creep-fatigue analysis reports of CHT & DHT Reactors of MRPL and DHT Reactor of IREP, Kochi has been reviewed.

- 7) As a part of Process Licensor requirement, the internals of Polymerization Reactor are exposed to dynamic loads and bubble impacts. Dynamic Analysis of Polymerization reactor BPCL has been performed and bubble impacts were simulated successfully.

- 8) In Secondary Transfer line Exchanger at Reliance Industries Limited (RIL), Nagothane (A296), they have observed repeated failures in the Secondary Transfer line Exchanger (S-TLX - cracked gas cooled by high pressure Boiler Feed Water) at the gas cracker since June 2010. These exchangers have been in operation since more than 20 years. Upon inspection, RIL has observed a regular pattern of failure location in all these exchangers. The rigorous root cause analysis of Exchanger is performed and causes of failure has been identified and recommendations were made to avoid such failures in future.

- 9) In CCR Heaters at BPCL Kochi refinery, there was a continuous failures of Intermediate Tubesheet (ITS) [MOC 50Cr- 50Ni-Cb] in the bottom convection section of heaters are reported in the recent past from the site. Vendor has claimed that failure was due to the EIL's design fault. Advanced Finite Element Analysis (FEA) of ITS has been carried out to investigate the root cause of failure and found that source of failure was due to construction and operating issues. Hence, validated EIL's design and reinstated the trustworthiness of EIL's design.

- 10) Due to drastic thermal fluctuations the piping near 90 degree elbow of HDT line of VGO unit got busted and induced fire at GGSR Bathinda (HMEL -A632). Post fire incidence in VGO HDT, EIL has been assisting HMEL in restoration works. From the Fluid structure Interaction analysis, causes of failures were identified and supporting analysis was has been carried out for showcasing the trustworthiness of EIL design.
- 11) During erection of VGO reactor misalignment of Bolt-Chair arrangement was found at VGO-GGSRL-6922. The immediate design rectifications to support the misaligned chair has been issued for incorporation using FE Analysis of different possible configurations.

Fields of Experience

- Refineries, Oil and Gas Processing, Petrochemicals.

Technology

Software	Experience
ABAQUS CAE	11YR WORKING EXPERIENCE
ANSYS-V10	Certified
ANSYS-V19	ON JOB EXPERIENCE
PRO/E	Certified
CATIA	Certified
Solidworks	B.E PROJECT
Cosmos	B.E PROJECT

Career Profile

Dates	Organization	Designation
Sep-2007 to Till date	Engineers India Limited, New Delhi	Deputy Manager

Qualifications

Degree and Date	Institute	Major and Specialization
M.E (June 2007)	GCT-Coimbatore, Anna University	Engineering Design, Mechanical (Distinction)
B.E (June 2005)	SMIT-Chennai, Anna University	Mechanical (Distinction)

ACADEMIC MERIT AWARDS

Secured **85.68** percentile in **Gate 2004**

Secured **96.8** percentile in **Gate 2007**

ACADEMIC PROJECT 1 (2004-2005)

Project on 'STRESS ANALYSIS ON ROLLED STEEL WHEEL RIM & EXPERIMENTAL VALIDATION'

DESCRIPTION

The project was dealing with the stresses acting on different locations in rolled steel wheel rim of Ashok Leyland bus 9"-20" wheel rim which was found by pasting strain gage (350 ohm, 2.7 Gage factor) at various locations in a straight line. And rim is modeled in SOLIDWORKS and analyzed in COSMOS.

ACADEMIC PROJECT 2 (2005-2006)

Project on 'MODELING AND CRASH SIMULATION OF HOOD OF A CAR USING ANSYS LSDYNA'

DESCRIPTION

The project was dealing with modeling of complex profile of hood of a car using ProE Wildfire 2.0 Sheet metal and its IGES form is imported to ANSYS LSDYNA and analysis was done under Head On collision of vehicle with rigid wall. The results obtained were validated with formulas and nature of its crush behavior with real case.

ACADEMIC PROJECT 3 (2006-2007)

Project on 'STRUCTURE ANALYSIS AND CRASH SIMULATION OF A FORMULA RACE CAR CHASSIS'

DESCRIPTION

The project deals with FEA modeling of the chassis of Sports car and its behavior to statistic and dynamic loading conditions are studied and compared with the real data and by which the actual high fidelity model for the sports car is achieved and then the car is to be studied for the various impact and collisions. ANSYS and Solidworks were used for this project and simulation of crashworthiness is performed using ANSYS LSDYNA.

ACADEMIC TRAINING

Underwent Inplant training at

- INTEGRAL COACH FACTORY Perumbur.
- MADRAS ATOMIC POWER STATION, Kalpakkam.
- NEYVELI LIGNITE CORPORATION, Neyveli.
- SALEM CO-OP. SUGAR MILLS, Mohanur.

Visited industries like

KCP, ASHOK LEYLAND, LMW, TNPL etc.,

STUDENT MEMBERSHIP

- ASME-American Society of Mechanical Engineers
- SAE-Society of Automobile Engineers
- ISNT-Indian Society for Non Destructive Testing

EXTRA CURRICULAR ACTIVITY

- Representing Badminton team of the company in PSB level of competition.
- Represented college and school Volley ball team
- Represented zonal level badminton competition
- Secured State First in CLAY MODELLING conducted by TNPL School, Karur.
- Secured Second Prize in 3rd ALL INDIA PAINTING COMPETITION 1997, Hyderabad.

Personal Details

Date of Birth	23-Jul-1983
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Passport Details

Name as on passport	Relationship	Passport Number	Date of Issue	Expiry Date	Place of Issue
Balaji Srinivasan	Self	N8111963	09-05-2016	08-05-2026	Delhi