International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

# A Study on the Preparation of a Safety Audit

**Sophiya Sunny Pulickal[1], Dhanabal Dhurai[2]**

[1]P.G Student, Department of Civil Engineering, RVS Technical Campus, Coimbatore, India

[2]Associate professor & Head of the Department, Department of Civil Engineering, RVS Technical Campus, Coimbatore, India

**Abstract:** ***Safe jobs are smart constructions since one serious injury can stop the growth of the construction work in its tracks. Safety at the construction site is a very relevant topic that needs to be addressed and given due importance. Everyday construction personnel are exposed to a lot of site perils that could result in injury or even fatality. A complete eradication of these construction site dangers are close to impossibility but, it can be reduced to a considerable extent. A safety audit management system is one step to achieve a better, safe and accident free working environment. An audit is a systematic and wherever possible, independent examination to determine whether activities and related results conform to planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve the organization's policy and objectives. This paper mainly deals with the preparation of a safety audit that could be implemented at a construction site.***

**Keywords:** audit; safety; construction

## 1. Introduction

This paper is intended to provide a summary of the Safety Audit Management process, along with details of the audit specification. The Audit process involves a comprehensive and thorough examination of an organization‟s entire health and safety management system(s) and associated arrangements. It focuses on the key aspects of their approach to managing occupational health and safety in the workplace and offers a structured path for continuous improvement towards best practice. This Audit model has been developed by utilizing extensive worldwide industry experience and acknowledging aspects of internationally recognized occupational health and safety management system frameworks. It objectively evaluates health and safety system(s) and arrangements against current best practice techniques.

## 2. Literature Review

John Smallwood [5] has reviewed the elements of their national H&S Audit System, and the author was approached to assist with respect to the review in terms of research to identify where the focus of such an H&S Audit System should be. Although audits focus on the physical aspects of construction, there was a concern that there was too much focus on administration. Furthermore, anecdotal evidence and the findings of audits indicated that there should be more focus on risk management and hazard identification and risk assessment. Regional H&S competition award winners were surveyed using a self-administered questionnaire delivered per email.

K.Stephens and M.T Roszak [2] has studied the role and benefits of third party auditing in ISO 9001:2008 Quality Management Systems. The review considered the perspective of case studies both from manufacturing and service organizations. The paper firstly explained the key principles relating to auditing quality management systems, the global trends relating to their implementation as well as third party auditing. The paper then presents four short case studies relating to a hospital, ceramic tile manufacturer, a heat distribution organization and a gas equipment installation company – describing the benefits of third party auditing of their Quality Management Systems.

Marcelo Fabiano Costella et al., [6] introduced a method for assessing health and safety management systems (MAHS) that has two innovative characteristics: (a) it brings together the three main auditing approaches to health and safety (HS) – the structural approach (which assesses the system prescribed), the operational approach (which assesses what is really happening on the shop-floor) and the performance approach (which assesses the results of performance indicators); (b) it emphasizes the resilience engineering perspective on HS, which takes into consideration four major principles (flexibility, learning, awareness, and top management commitment). Such principles underlie seven major assessment criteria, which in turn are divided into items (e.g. hazard identification from a resilience perspective is an item that belongs to the criteria of production processes). The items are sub-divided into statements, which are the requirements that should be assessed based on interviews, analysis of documents and direct observations. Within the 112 requirements that were proposed, 38 of them had clear links with at least one out of the four resilience engineering principles adopted. The remaining requirements are based on traditional assumptions underlying the so-called best practices of HS management. The results of the assessment for each item were expressed by a score on a scale of compliance with the established requirements, ranging from 0% to 100%.

D. Sailendra [3] stated safety audit as a vital tool in the hands of top management to ascertain current status of safety scenario, for improving safety performance and for successful implementation of safety programs in construction organizations in India.

## 3. Methodology

The preparation of a safety audit involved the study of various literatures to identify the objectives of the safety audit management system, to learn the relevance of using the safety audit management system on construction worksites,

to familiarize with the various elements used for the audit and to incorporate the most relevant elements into the audit.

### 3.1 Steps involved

- To study the literature available in the form of books, journals and certified audit checklists to get a proper understanding of safety audits.
- To identify the most relevant elements for the safety audit through literatures and certified checklists.
- Preparation of the safety audit on Microsoft Excel.

## 4. The Audit Process

The Audit is conducted using the following process of gathering information: The auditor will review key areas of the organization‟s health and safety documentation and systems in relation to the requirements of the Client Consultant and will include an inspection of the site(s) and associated buildings. This inspection process is used to determine the effectiveness of the implementation of the organization‟s health and safety arrangements. During the audit process, management, staff, safety engineers, safety officers and others involved in addressing the safety at the construction worksite will be interviewed (as agreed) to confidentially discuss aspects of occupational health and safety relevant to their roles and responsibilities. The audit process is intended to ensure all appropriate aspects of occupational health and safety have been considered within an organization‟s safety management system(s) and how effectively such arrangements are being implemented. A subsequent report is prepared to identify the strengths and areas for improvement within the organization‟s health and safety management systems and also to provide observations and recommendations, together with action planning, for consideration.

## 5. Data Analysis Method

There are nineteen check elements in the audit. The checks are prepared in such a way that each check contains further sub-elements. The overall audit grading is as follows:

Each element is to be rated on 100% as 0%, 50%, 75% and 100% respectively.

**Table 1**

| *Percent* | *Compliance and Implementation* |
|---|---|
| 0% | Evidence of no compliance and/ or no implementation |
| 50% | Evidence of partial compliance and/ or no implementation |
| 75% | Evidence of full compliance with only minor exceptions in implementation |
| 100% | Evidence of full compliance and full implementation |
| NA | If the element is not applicable to the audited organisation, it will be left blank within the relevant table |

Table 1 indicates the guidelines for conducting the audit.

The possible score would be out of 50. The percentage on 100 would then be converted to the actual score. The actual score for each main check (audit element) will then be found by summing up all the actual scores of the sub-checks. In the summary, the actual and possible score for each of the main checks could be found.

Percentage of compliance

$$(\text{Score}) = \frac{\Sigma \text{Actual Score}}{\text{Possible Score}} X100$$

The percentage score for each audit element can be found. These audit elements could then be ranked according to their criticality (least percentage, most critical).

The audit process focuses on nineteen sections as shown below:

**Table 2**

| *Sl. No* | *Safety Audit Elements* |
|---|---|
| 1. | HSE resources of contractor |
| 2. | Personal Protective equipment‟s (PPEs) |
| 3. | Fall protection |
| 4. | Excavations |
| 5. | Scaffolds & Ladders/ Temporary works & platforms |
| 6. | Hoisting and lifting equipment‟s/ MEWP |
| 7. | Vehicles and mobile equipment‟s/ Plants |
| 8. | Tools and equipment |
| 9. | Fire protection and hot works |
| 10. | Permits to work |
| 11. | Confined spaces |
| 12. | Electrical works |
| 13. | Legal requirements/HSE inspections |
| 14. | Environmental |
| 15. | Traffic safety management |
| 16. | First aid |
| 17. | Occupational health |
| 18. | House-keeping site conditions |
| 19. | Amenities/Sanitation |

Table 2 indicates the nineteen major audit elements.

The nineteen sections of the audit are divided into one hundred and sixty (160) elements which attract a maximum numerical value of 7850 points. Several of these elements are considered as “core” to the relevant section, and some of these core elements are also applicable within more than one section. Wherever an element of the audit is not applicable to the organization, it is withdrawn from the audit. The Maximum Accredited Audit Figure (MAAF) is the maximum total score available when non applicable questions have been removed and the Actual Accredited Audit Figure (AAAF) is the score achieved against such applicable questions. The cumulative scoring for these nineteen sections are then converted into a percentage figure. Based on these figures, the ranks for the audit elements could be given based on their criticality (least percentage, most critical). This aspect of the audit process is designed to encourage organizations to focus upon continually developing their safety management systems and culture through demonstration of commitment and robust leadership at all levels.

## 6. Audit Report and Action Plan

Upon completion of the audit process, a detailed report is prepared by the auditor and will be issued within 28 days. The report content will include:

- Executive Summary (including graphical performance indicators)
- Overall Scoring
- Observations
- Recommendations for Improvement
- Corrective measures

## 7. Preparation of the audit

In order for the audit process to be as effective as possible, it is considered important that pre-audit preparations are agreed and completed as required. Once all logistical arrangements have been confirmed with the relevant managing consultancy, the allocated auditor will contact (no later than 10 days before the audit start date) the appropriate person within the organization to discuss and agree the audit details (timings, interviews, site inspections, induction process, etc.). This specification document will outline the various forms of information and documentation that the auditor is likely to request for review, together with personnel who may be requested for interview. It would be advantageous if documentation is readily available (either electronically or hard-copy format) and that some of this material may be retained by the auditor during the audit process. All auditors are mindful of operational demands and requirements and will apply as much flexibility with the audit schedule as is reasonably practicable to accommodate such matters. Table 3 shows the nineteen major audit elements and their sub-elements required for conducting an audit.

**Table 3**

| | |
|---|---|
| **1** | **HSE resources of contractor** |
| 1.1 | Number of HSE personnel employed by Contractor at site is as per contract requirements. |
| 1.2 | The number of Subcontractors‟ HSE Personnel at site is as per contract requirement and is competent and approved by Contractor |
| 1.3 | The number of fulltime supervisors for main Contractor at site are as per contract requirements |
| 1.4 | Barricades and/or rebar caps installed and maintained |
| **2.** | **Personal Protective equipment's (PPEs)** |
| 2.1 | Hard hats worn and maintained as required |
| 2.2 | Hearing protection worn as required. (>80dBA) |
| 2.3 | Eye protection required and worn in a proper manner. Sunglasses provided were assessed as needed (e.g. while working outdoors for prolonged periods) |
| 2.4 | Correct hand protection worn when required |
| 2.5 | Safety footwear being worn and in good condition |
| 2.6 | Correct Respiratory protection used and worn as assessed |
| 2.7 | Face shield or goggles worn as required |
| 2.8 | Other: High visible vest, chemical resistant garments, welders apron |
| **3** | **Fall protection** |
| 3.1 | Employees using full body harness are trained to use and properly wear it by a competent person |
| 3.2 | Harnesses and lanyards are in good condition, and have been inspected and examined. 2 lanyards are used where identified as a need |
| 3.3 | Lanyards are adequately secured to suitable anchorage |
| 3.4 | Anchorage & static lines capable of supporting 2450kgs (5000lbs) |
| 3.5 | Perimeter guarding/adequate coverage for any open holes. Holes are fully protected, boards are fixed and "hole cover do not remove" painted on boards |
| 3.6 | Tools tied to prevent them falling |
| 3.7 | Tools and material raised and lowered by rope in correct container |
| **4** | **Excavations** |
| 4.1 | Waste earth and Construction materials are not being stored within 2 metres of the edge of any excavation |
| 4.2 | Ladder access available every 12 metres for access and egress |
| 4.3 | Excavations clearly marked and barricaded |
| 4.4 | Documented inspections conducted at least daily, before entry and after poor weather conditions |
| 4.5 | Heavy equipment is kept a minimum of 2m from the edge of excavation dependent on soil type/compaction and angle of repose |
| 4.6 | Permit to dig in place for all breaking of ground |
| **5** | **Scaffolds & ladders / Temporary works & platforms** |
| 5.1 | Scaffold erected, altered and dismantled by competent people. Scaffold is inspected and tagged and are recertified „fit for use‟ every 7 days by a competent person. The results of inspections are documented and maintained as a record |
| 5.2 | Scaffolding over 10 metres in height to be designed and approved by 3rd party and/or as per client procedures and/or contract requirements. |
| 5.3 | Double guard rails and toe boards or other suitable protection is fitted at every edge, to prevent people falling off scaffold and prevent materials falling onto workers below. |
| 5.4 | Working platforms are fully boarded and the boards are clipped/fitted to prevent tipping or tripping |
| 5.5 | Scaffolding is designed suitable for the weight of materials stored on it and are these materials are evenly distributed |
| 5.6 | Effective barriers or warning notices are fitted to incomplete scaffolding/platforms to prevent people accessing the scaffolding/platforms |
| 5.7 | Tower scaffolds have been erected and inspected and are being used in accordance with suppliers‟ instructions |
| 5.8 | The wheels of tower scaffolds have been locked and outriggers deployed when applicable |

| | |
|---|---|
| 5.9 | Correct ladder is provided for the job performed, secured at proper angle of 1:4 ratio and extending 1 metre above landing |
| 5.10 | Ladder access is provided to all scaffolding and mobile scaffolding platforms |
| **6** | **Hoisting and Lifting Equipment/MEWP** |
| 6.1 | All plants used for lifting are designed and manufactured for lifting |
| 6.2 | Slings, chain falls, shackles, hooks in good condition with current 3rd party certification |
| 6.3 | All hooks have working safety catches |
| 6.4 | Softeners used as required to protect lifting equipment |
| 6.5 | Lift plan in place for all major lifting |
| 6.6 | Banks-man/Riggers are trained and certified |
| 6.7 | Effective communication in place between banks-man and drivers |
| 6.8 | Work & swinging area of the crane properly barricaded & non-essential personnel evacuated |
| 6.9 | Tag lines fitted to loads |
| 6.10 | All Concrete buckets and skips have SWL and 3rd party certification |
| 6.11 | Operators are trained in use of equipment |
| 6.12 | Mobile crane Outriggers are fully extended, footpads are placed on hard stable ground/pads |
| 6.13 | Crane alarm warning devices installed and working (e.g. Safe Working Load bell, anti-two-blocking device) |
| 6.14 | Safe Working Load (SWL) marked on all lifting equipment |
| **7.** | **Vehicles and Mobile Equipment/Plant** |
| 7.1 | Machinery and mechanized equipment shall be inspected by the Contractor and inspected for compliance with safety requirements and free of oil/fuel leaks and proper reports, certifications, are maintained |
| 7.2 | Seat belts fitted, in good order and are being worn |
| 7.3 | All Windows on mobile plant and vehicles are clean and free of damage, and operators to have 360 degree vision at all times |
| 7.4 | Firefighting equipment is in place and inspected and functional |
| 7.5 | No visible fuel/oil leaks on vehicles |
| 7.6 | Maintenance regime in place for all vehicles and records kept |
| 7.7 | Flag person/Banks-man assigned to congested areas |
| 7.8 | Licenses or certifications of operator & equipment |
| 7.9 | Loads are secured properly, and follow legal requirement for load transportation |
| 7.10 | Drivers have been instructed not to use cell phones or radios while driving or operating equipment |
| 7.11 | Speed limits as per the contractors HSE Plan are followed by all drivers |
| 7.12 | Site vehicles are equipped with reversing warning alarms/flashing rotating orange light |
| **8** | **Tools and Equipment** |
| 8.1 | Broken handles on hammers, axes and similar equipment are replaced immediately |
| 8.2 | Suitable and sufficient tools being used for the task being performed |
| 8.3 | Pneumatic/hydraulic hose are properly secured with chains/cables to the compressor to reduce whipping if hoses burst |
| 8.4 | Appropriate safety glasses, face shields, etc. are used while using hand tools or equipment, which might produce flying materials or be subject to breakage |
| 8.5 | Drip trays provided for portable/transportable machines |
| 8.6 | Bench saws are clear of debris, guard fitted and push stick provided and used |
| 8.7 | Explosive actuated tools must have prior written approval of the Contractor"s Safety Manager before delivery. Only trained operatives shall be operating such tools to ensure safe and proper usage. |
| **9** | **Fire Protection and Hot Works** |
| 9.1 | Flammable materials and chemicals stored according to the manufacturer"s instructions/MSDS data and the work environment |
| 9.2 | Oxygen and combustibles separated |
| 9.3 | Fire extinguishers located in accordance with the emergency plan, inspected and tagged for the current month |
| 9.4 | Means of raising the alarm in case of a fire are in place and regularly tested - check |
| 9.5 | Flashback arrestors installed on cylinders and/or triggers |
| 9.6 | Sparks and slag contained, welding screens used as necessary |
| 9.7 | Compressed gas cylinders stored, transported and maintained in accordance with manufacturers recommendations |
| 9.8 | Regulators in place and not damaged |
| 9.9 | There is no evidence of smoking on site other than in designated areas |
| 9.10 | Hot work permit in place and recorded |
| 9.11 | Emergency evacuation plans are posted at strategic areas around site |
| 9.12 | All Workforce are trained for Onsite Emergency Response and Damage Control Action |
| 9.13 | All workforce are familiar with the use of Fire Extinguishers used at a construction site |
| 9.14 | Fire extinguishers properly located, visually inspected monthly and tagged as to their serviceability |
| 9.15 | Assembly point is identified for emergency evacuation |
| 9.16 | Emergency evacuation drills are carried out at regular intervals and recorded |
| 9.17 | Fire/emergency exit signs are posted and indicate the correct means of escape |
| **10** | **Permits to Work** |
| 10.1 | Applicable permits posted |
| 10.2 | All permits are recorded in Logbook before permit issued, or as per client and contract requirements |
| 10.3 | Precautionary measures and controls stated in the permit are implemented |
| 10.4 | All permits closed out as required (daily/weekly etc.) |
| **11** | **Confined spaces** |
| 11.1 | Risk assessment, Method Statement (MS), Emergency Response Plan has been developed , communicated and submitted to SSH for approval |

| | |
|---|---|
| 11.2 | Contractor have developed and implemented a specific permit for confined space |
| 11.3 | Confined space rescue teams are properly trained by a competent person and exercises (drills) conducted and recorded, including as per client and/or contract requirements |
| 11.4 | Atmospheric monitoring are conducted prior to entry, and at hourly intervals |
| 11.5 | Supervisor is located at entrance of confined space at all times whilst permit is in place |
| 11.6 | Confined spaces are thoroughly emptied of any corrosive or hazardous substances, such as acids, flammable, before entry |
| 11.7 | Contractor has installed adequate ventilation system prior to performing any work in confined areas |
| **12** | **Electrical works** |
| 12.1 | Electric extension cables and sockets are in good condition as per approved Standards. 3pin plugs are not allowed, construction sockets only |
| 12.2 | Electrical circuits are protected with Earth Leakage Circuit Breaker (ELCB) and/or residual current devices (RCDs) |
| 12.3 | Electric distribution boxes are weather proof, locked and circuits properly identified |
| 12.4 | Trained and competent persons undertake electrical work and records are maintained. |
| 12.5 | Electrical isolations are not to be made without the involvement of „authorised" maintenance persons and signage of isolation is attached |
| 12.6 | Process is maintained to ensure „working with Live cables" is strictly forbidden (i.e. tagin and tag out system to be utilised) |
| 12.7 | Electrical tools and equipment checked by users, is visually examined on site and regularly inspected and tested by a competent person at monthly intervals |
| **13** | **Legal requirements/HSE Inspections** |
| 13.1 | Safety Meetings held in which SSH attend and minutes of the meeting are recorded |
| 13.2 | MSDS available for all hazardous materials. |
| 13.3 | HSE inspection have been carried out by Municipality Inspector, Contractor and Subcontractor HSE Supervisor and documented. |
| 13.4 | toolbox talks are recorded by contractor |
| 13.5 | Action items resulting from HSE inspections are followed up and closed within assigned time limit |
| 13.6 | Risk assessments, including environment, identified and record kept. |
| 13.7 | Procedures/method statements/risk assessments are written to address hazards |
| 13.8 | Action items resulting from HSE inspection are categorized as per criticality |
| 13.9 | Contractor and Subcontractors are complying with Client applicable procedures, standards and regulations |
| 13.10 | Project Safety Statistics to be displayed and shall be updated weekly |
| **14** | **Environmental** |
| 14.1 | Environmental Risk Assessment performed on overall activities |
| 14.2 | Environmental impact plan in place |
| 14.3 | Aspects register kept, reviewed and updated regularly |
| 14.4 | All substances used, transported & stored in accordance with requirements |
| 14.5 | All waste collected in separate material specific bins |
| 14.6 | All waste disposed in approved dump site with record of disposal |
| 14.7 | Noise generation minimised, noise assessments in place |
| 14.8 | Dust & grit suppression/containment plan in place and maintained |
| 14.9 | Site establishment caters for ground and water pollution prevention |
| 14.10 | There is no evidence of pollution (oil, fuel spillages and chemicals) |
| 14.11 | Emergency spill response kits in place |
| 14.12 | Defined hazardous waste materials' are disposed correctly according to the Municipality regulation and a disposal records are documented |
| 14.13 | Generators / Fuel tanks and Hazardous liquids are contained within catchment area, bunded and/or drip trays as applicable |
| **15** | **Traffic Safety Management** |
| 15.1 | Segregation of vehicles and pedestrians is effective and clearly designated |
| 15.2 | Vehicle access and egress points are clearly designated and routes clearly defined |
| 15.3 | Reversing of vehicles is kept to a minimum, banks-men provided where necessary to reverse, reverse audible warnings are fitted and working on designated plant |
| 15.4 | All loads arriving at site checked before being offloaded that they are secure, and loads will not move when securing straps are removed |
| 15.5 | Pedestrian crossing points are safe and clearly designated. There are sufficient crossing pints available |
| 15.6 | Traffic management is as the plan describes, signs are in the correct places and are clean and readable, cones and markers are spaced correctly and are clean, jersey barriers are in place and will be effective in the event of an accident |
| 15.7 | Traffic management is being maintained as per the plan, is checked regularly and any problems are dealt with in a timely manner |
| 15.8 | Lighting is adequate for site activity and road users during night works, road traffic is not adversely affected by glare from lighting |
| **16** | **First Aid** |
| 16.1 | 3rd Party Certified First Aiders provided on site |
| 16.2 | First Aid facility provided, clearly visible and accessible |
| 16.3 | First Aid equipment stocked in accordance with local regulations |
| 16.4 | Emergency procedures and contact details updated and posted in visible locations on construction site offices |
| 16.5 | 24 hours Emergency vehicle is available on site |
| **17** | **Occupational health** |
| 17.1 | All workforce are instructed and trained in manual handling |

| | |
|---|---|
| 17.2 | Contractor"s health surveillance programme has identified employees exposed to high levels of noise? |
| 17.3 | Hearing protection zones been identified/utilised and signage posted |
| 17.4 | Suitable hearing protection are provided and worn in high noise areas and employees have undergone training in its use |
| 17.5 | Hearing protection equipment are correctly fitted and maintained in a clean and sanitary condition |
| 17.6 | Have workers had information and training on the health risks from hand-arm vibration (HAV) on site, and what they need to do to avoid those risks? |
| 17.7 | Contractors to assure that employees are not exposed to substances which may affect their health |
| 17.8 | Confirm Contractor has carried out Health assessments on all chemicals on site |
| **18** | **House-keeping site conditions** |
| 18.1 | General housekeeping is conducted at the end of each shift |
| 18.2 | Emergency Exits, Assembly Points and Staircases are marked and free from obstacles |
| 18.3 | Walkways and passageways are clear and free of tripping hazard |
| 18.4 | Exposed Rebar is capped and clearly marked/roped off to prevent penetration injury and tripping |
| 18.5 | Constructions Materials are managed and stored to prevent toppling over, and/or prevent injury to passers-by |
| **19** | **Amenities/Sanitation** |
| 19.1 | Cool and Clean drinking water provided to all workers on site. Filters are frequently cleaned. |
| 19.2 | Suitable washing facilities provided and maintained. Provision of soap, towels, basin, Hot and Cold water capable of accommodating entire workforce. |
| 19.3 | Sanitary facility capable to accommodate entire workforce. The washbasins large enough to wash up to the elbow and are they kept clean. The number of toilets and washbasins per area per group of floors need to be complied with. |
| 19.4 | Shaded rest/eating area provided and maintained. Including tables, chairs, rest/eating area capable to accommodate entire workforce |
| 19.5 | Is there any evidence of rodents or animals living on the construction site? Designated food waste bins provided and regularly disposed |

## 8. Conclusions and Suggestions

The study on the preparation of a safety audit was to determine the elements of a safety audit that could affect the health and safety of the construction personnel, and to prepare a safety audit with all the elements in it. Nineteen major audit elements that could cause accidents at the construction work site were selected for study. A comprehensive and thorough study was done on each element, and further sub- elements were prepared. A safety audit is the most effective method by which the factors that could affect the health and safety at the construction worksite could be addressed. The actual worksite conditions should be taken into account and based on the happenings at the worksite, the suggestive measures could be given.

## References

[1] Alexia Nalewaik, „Construction Audit- an essential audit control function", „International Journal of Engineering Trends and Applications (IJETA)" – Volume 4, Issue 3, May-June 2014
[2] K.Stephens, M.T. Roszak (2010), „A study of the role and benefits of third party auditing in quality Management System", „Journal of Achievements in Materials and Manufacturing Engineering", Volume 43, Issue 2, Dec2010
[3] D.Sailendra, Awadhesh Shah, „Study of Internal and External Safety Audit by Gap Analysis approach in Indian Construction Organisations" , „International Journal of Engineering Trends and Applications (IJETA)", – Volume 2, Issue 3, May-June 2015
[4] M.N. Vinodkumar, M. Bhasi, „A study on the impact of management system certification on safety management", Elsevier: Nov2010
[5] John Smallwood, „Optimizing the elements of a construction health and safety (H&S) program and audit system", Elsevier- Creative Construction Conference-2015
[6] Marcelo Fabiano Costella, Tarcisio Abreu Saurin, LiaBuarque de MacedoGuimarães, „A method for assessing health and safety management systems from the resilience engineering perspective", Elsevier- Safety Science 47, PP- 1056-1067
[7] G.Grole, C. KuÈnzler, „Diagnosis of safety culture in safety management audits", Safety Science 34, PP- 131-150
[8] Wil van der Aalst , Kees van Hee , Jan Martijn van der Werf , Akhil Kumar, „Conceptual Model for online auditing", Decision Support Systems 50, PP- 636–647
[9] Zubaidah Ismail, SamadDoostdar, ZakariaHarun, „Factors influencing the implementation of a safety management system for construction sites", Safety Science 50, PP-418–423
[10] Rebecca Mitchell, Rena Friswell, Lori Mooren, „ Initial development of a practical safety audit tool to assess fleet safety management practices", Accident Analysis and Prevention 47, PP-102– 118
[11] Dr.P.Sivaprakash, Dr.R. K. Elangovan, L.M.Karthikeyan , Sebastian joseph, „A Study on Safety Audit System in Indian Engineering Industries", Life Science Journal 2013;10(9s)
[12] John Smallwood, „Optimising the elements of a construction health and safety (H&S) programme and audit system", Procedia Engineering 123, PP-528 – 537- Creative Construction Conference 2015 (CCC2015)
[13] YumeiWanga, Man Lib, „The Role of Internal Audit in Engineering Project Risk Management", Procedia Engineering 24, PP- 689 – 694- 2011 International Conference on Advances in Engineering
[14] Dr. Alexia Nalewaik, Professor Anthony Mills, „Project Performance Audit: Enhanced Protocols for Triple Bottom Line Results", Procedia - Social and Behavioral Sciences 194 (2015) 134 – 145- 28th IPMA World Congress, IPMA 2014, 29 September – 1 October 2014, Rotterdam, The Netherlands
[15] Safety Management System Audit (OTN management system audit)

[16] Veritas Consulting- construction site health and safety audit
[17] Environmental and Occupational Health and Safety Unit
[18] ISO14001 Environmental system
[19] Checklist for an Audit of Safety Management System- OGP Publications

## Author Profile

**Er. Sophiya Sunny Pulickal** received her B"tech degree in Civil Engineering from (Mar Athanasius College of Engineering, Kothamangalam) M.G.University (2014). At present pursuing her Masters in Engineering in RVS, Technical Campus, Coimbatore affiliated to Anna University(2016). Her specialisation area is Construction Engineering and Management. She published papers on "Study of Fibre reinforced bituminous concrete" in the International Journal of Environmental Research and Development (IJERD) in June 2014 and "Study on Safety Audit Management System in Kuwait" in the International Journal of Science and Research (IJSR) in 2016.

**Er. Dhanabal Dhurai** holds a Master degree in Structural Engineering from Bharathiar University, Coimbatore (1997), Bachelor degree in Civil Engineering from Bharathiar University, Coimbatore (1995). Apart from teaching in various Engineering colleges, he has served in various senior positions in industry for 19 years.