

# Crisis Management during Emergencies with Reference to Pune Metro

Rama Mogane<sup>1</sup>, G.A.Hinge<sup>2</sup>

P.G. Student, Department of Civil Engineering, TSSM'S B.S.C.O.E.R, Narhe, Pune<sup>1</sup>

Principal of B.S.C.O.E.R, TSSM'S B.S.C.O.E.R, Narhe, Pune, India<sup>2</sup>

**ABSTRACT:** Rail-based 'Mass Rapid Transit System' (MRTS) has been widely accepted as a solution for most of the traffic and environmental pollution related crisis which major cities throughout the world are facing now. In this project focus is on important environmental and other critical crisis have been discussed with activities, crisis and solution with respect to Pune metro also reducing accidents and determining construction risks are extremely important with reference to Pune Metro. Main aim of the projects is to study and analyze one of the essential steps for construction safety management is hazard identification, since the most unmanageable risks are from unidentified hazards and to rank the risk of construction hazards with respect to Pune metro. Project also works on study Vibration analysis of TBM. Metro rail construction activities are being undertaken in a big way in India, existing metro rail network of the city of Kolkata and Delhi are being expanded, while it is under various stages of construction in cities like Bengaluru, Chennai, Mumbai and Hyderabad, Pune. In the present article, important environmental and other critical crises have been discussed in the Indian context which is equally relevant in other developing countries with respect to Pune metro. The construction industry has the largest number of injuries compared to other industries with respect to Pune Metro. Thus, reducing accidents and determining construction risks are extremely important. One of the essential steps for construction safety management is hazard identification, since the most unmanageable risks are from unidentified hazards. This report aims to rank the risk of construction hazards with respect to Pune metro.

**KEYWORDS:** Tunnel Boring Machine, vibration analysis, Risk Management, hazard Identification, Pune Metro.

## I. INTRODUCTION

Negative events in today's globalized world may lead to crisis and thereby affect construction companies in time gradually. These events may occur suddenly or after a long process. Process-based crisis usually send early warning signals, and construction companies that can catch these signals can prepare against the forthcoming crisis. One of the most important processes in crisis management is to establish an early warning system. This provides some time to take the required precautions against potential crisis. After catching early warning signals, construction companies that can successfully manage crises inform their personnel about approaching crisis to prepare, organize a crisis team before the crisis, and perform an effective struggle during the crisis. Construction companies which can survive in a crisis may evaluate opportunities of the crisis and start to make recovery studies after the crisis to turn to their former positions. If a construction company estimates a crisis well and executes crisis management efficiently, they can overcome crises with zero or minimal damage.

### Background

The infrastructure projects are important for development of a nation and are also a mirror of any country's development. However, most of the infrastructure projects on account of their sheer size and nature (namely, type, site/location, urban settling, etc.) are invariably accompanied by significant environmental and social impacts during different phases (namely, pre-construction, construction and operational phase) of the project. The nature of these

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019

impacts could be either positive or negative, depending upon their potential to favorably or adversely affect the surrounding environment and also the resident community.

### Motivation

In order to improve the public transportation system, the Mass Rapid Transit System (MRTS) have been provided or being planned in various parts of the world. Although most of the developed countries have already provided MRTS in their major cities, the same is lacking in most of the cities in the developing countries, including India.

### Problem Statement

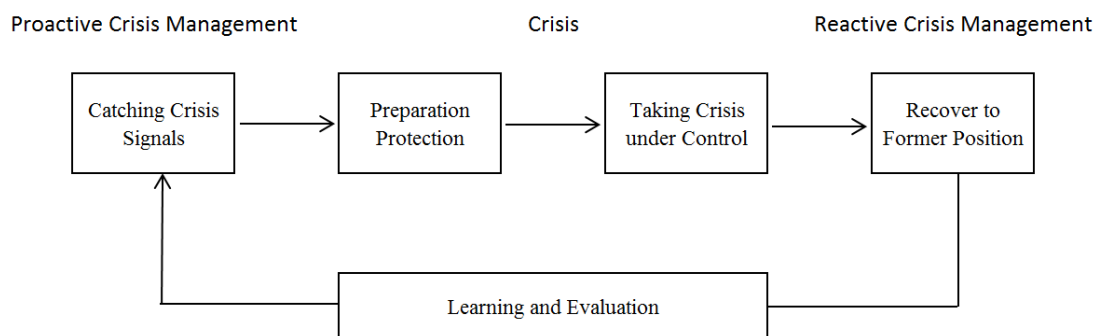
In the present project, important environmental and other critical crisis have been discussed in the Indian context which is equally relevant in other developing countries with respect to Pune metro. The traditional construction industry has the largest number of injuries compared to other industries. Thus, reducing accidents and determining construction risks are extremely important.

### Need of the Project

The need of the project is one of the essential steps for construction safety management is hazard identification, since the most unmanageable risks are from unidentified hazards.

### Objective of the project

1. To study important environmental and other critical crisis have been discussed with activities, crises and solution with respect to Pune metro..
2. To study and analyze one of the essential steps for construction safety management is hazard identification, since the most unmanageable risks are from unidentified hazards.
3. To rank the risk of construction hazards with respect to Pune metro.
4. To study Vibration analysis of TBM.



## II. RESEARCH METHODOLOGY

The main motto of hazard identification is to identify & evaluate the hazards & the unintended events, which could cause an accident. In hazard identification & quantification of probability of occurrence it is assumed that they will perform as designed in the absence of unintended events (component & material failure, human errors, external event, process unknown) which may affect the process behaviour.

The steps of hazard identification and risk assessment are:

### Step 1 Hazard Identification

The purpose of hazard identification is to identify and develop a list of hazards for each job in the organization that is reasonably likely to expose people to injury, illness or disease if not effectively controlled. Workers can then be informed of these hazards and controls put in place to protect workers prior to them being exposed to the actual hazard.

### Step 2 Risk Assessment

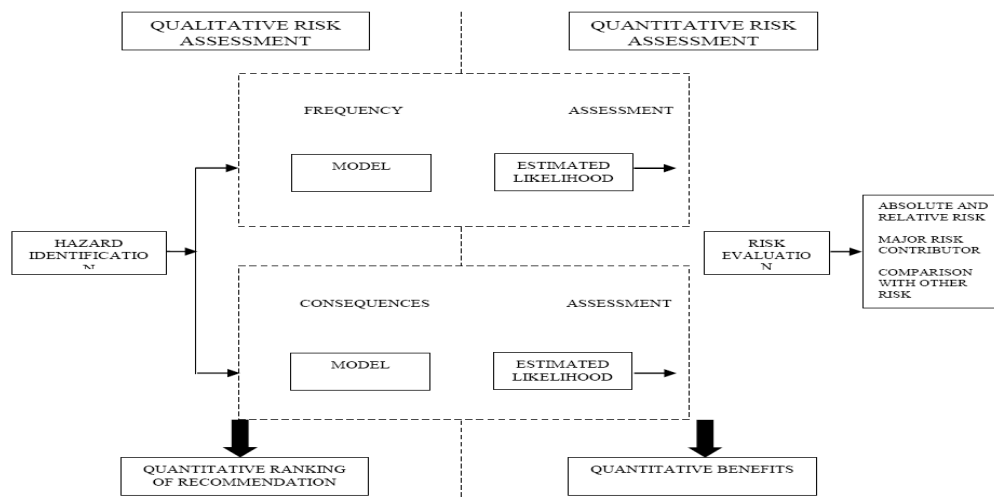
Risk assessment is the process used to determine the likelihood that people exposed to injury, illness or disease in the workplace arising from any situation identified during the hazard identification process prior to consideration or

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019



implementation of control measures. Risk occurs when a person is exposed to a hazard. Risk is the likelihood that exposure to a hazard will lead to injury or health issues. It is a measure of probability and potential severity of harm or loss.

### Step 3 Risk Control

Risk control is the process used to identify, develop, implement and continually review all practicable measures for eliminating or reducing the likelihood of an injury, illness or diseases in the workplace

### Step 4 Implementation of Risk Controls

All hazards that have been assessed should be dealt in order of priority in one or more of the following hierarchy of controls The most effective methods of control are:

1. Elimination of hazards
2. Substitute something safer
3. Use engineering/design controls
4. Use administrative controls such as safe work procedures
5. Protect the workers i.e. by ensuring competence through supervision and training, etc.

Each measure must have a designated person and date assigned for the implementation of controls. This ensures that all required safety measures will be completed.

### Step 5 Monitor and Review

Hazard identification, risk assessment and control are a non-going process. Therefore regularly review the effectiveness of your hazard assessment and control measures. Make sure that you undertake a hazard and risk assessment when there is change to the work place including when work systems, tools, machinery or equipment changes. Provide additional supervision when the new employees with reduced skill levels or knowledge are introduced to the workplace. The phase of risk identification is essential, because it establishes the bases of the risk analysis. Indeed, the data of risk identification will be the input of the evaluation and/or hierarchisation phases. Therefore, it is necessary to make an identification phase in an exhaustive way to get the best results.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019

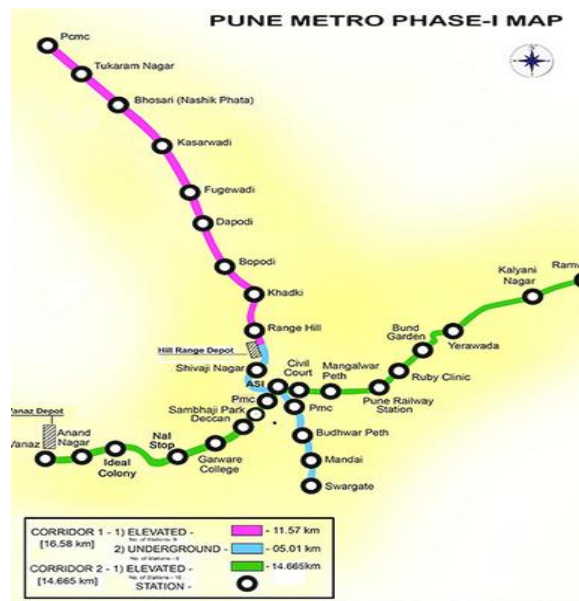


Figure No 4. Pune Metro Project Map

### III. GENERAL DESCRIPTION

Jan 8, 2018 - Hindustan Construction Company Ltd. (HCC) has been awarded a Rs 484-crore contract by the Maharashtra Metro Rail Corporation Ltd. (MMRCL) for the Pune Metro Rail Project. Pune Metro Project was approved by the cabinet on 8 December 2016. The Pune Metro project has been undertaken by MAHA Metro, a SPV (Special Purpose Vehicle) of Government of India and Government of Maharashtra. The project plans to improve the infrastructure of Pune and also intends to develop world class stations and surrounding areas to showcase the rich cultural heritage of Pune..Line 1 (14 Stations) PCMC - Swargate 16.589 KM underground 5 elevated 9

Line 1 consists of the following stations -

- PCMC
- SantTukaram Nagar
- Bhosari (NashikPhata)
- Kasarwadi
- Phugewadi
- Dapodi
- Bopodi
- Khadki
- Range Hill
- Shivaji Nagar
- Civil Court
- BudhwarPeth
- Mandai
- Swargate

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019

## IV. RESULT AND DISCUSSION

In this possible result and discussion, only most hazardous activity is taken from the site to give an example of job safety analysis procedure.

### A. Normal Crisis

Table No 1. Normal Crises

Activity-	Crises	Risk Control Measures
List the task required to perform the activity in the sequence they are carried out	-Against each task list the hazards that could cause injury when the task is performed	-List the control measures required to eliminate or minimize the risk of injury arising from the identified hazard

#### Activity 1- Job Safety Analysis for Excavation

Crises 1- Exposure to or contact with underground utilities (electrical cable, pipeline, etc)

Risk Control Measures1 -

1. First Refer Engg. Drawings as per site excavation Plan
2. Seek information about the underground utilities and check for the same before excavation. Obtain Excavation Permit Engineer/Supervisor shall be responsible for any violation of the requirement
3. Insulated tools, rubber hand gloves, mask, goggles and safety shoes
4. Use hand digging initially till underground facility located if drawings not available

#### Activity 2-

Job Safety Analysis for Concreting during Pune metro Construction

Crises 2-

1. Vibration or toppling of machine.
2. Manual handling of cements bags.
3. Physical contact with cement slurry or wet concrete

Risk Control Measures 2 -

1. Position the machine on a firm level ground with proper anchoring.
2. Helmet/Goggle/Safety shoes/Hand gloves.
3. Use mechanical means to carry cement bags from go down to site.
4. Use safe method of manual handling.

### B. Critical Issues

#### 1. Underground versus Elevated Corridor

While the requirement for an efficient public transportation system like a metro rail system in Indian cities is no longer a matter of dispute, the question about whether these should be elevated or underground has attracted a lot of attention and has generated spirited debate among various stakeholders, with some even taking this issue to the courts of law. A few organisations representing the Resident Welfare Associations (RWAs) of residential colonies where these metro rail corridors are expected to cross or will be passing, opposed the elevated corridor because of their perceived concerns related to an increase in noise pollution (including vibration) and privacy-related issues affecting their houses which are very close to the proposed/existing metro rail alignment. Further, the elevated corridors are also opposed by a few town planners and others on plea that these elevated corridors will not only adversely affect the aesthetics of the city, but will also reduce the visibility of various historical monuments by obstructing the line of sight and will further increase concretization of the whole city which might led to irreversible micro-climatic changes including increased heat-island effects.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019

## 2. Land/Property Acquisition and Resettlement and Rehabilitation (R&R) Related Issues

Metro cities of developing countries throughout the world are densely populated with little availability of land for such mega infrastructure project. Land/property acquisition has always been an integral part of any mega infrastructure developmental project. Efforts are always made to minimise the land/property acquisition as to minimize its socio-economic impacts. The land/property acquisition in some areas along the metro corridors sometimes becomes inevitable no other option related to alternate alignment requiring less R&R impacts is feasible due to technical reasons (including those related to ridership), environmental considerations and financial constraints. The issue of land/property acquisition is a pre-construction phase activity, for which proper socio-economic and R&R surveys need to be carried out to determine the project affected persons/families.

## 3. Noise Pollution and Vibration Issues during Pune Metro Construction

Noise and vibration-related issues along the corridor(s) are one of the major issues which may be significant during both the construction as well as the operational phase of the project. During the construction phase, the use of heavy machinery and construction equipment may cause vibrations and also increase the ambient noise levels. Vibrations generated during the construction phase may have several adverse impacts, including cracks developed on the surrounding buildings which can have serious implications on the structural safety.

During the operation of the metro rail, rail-wheel contacts with tracks generate noise and vibration. Engine, cooling fans and generators further increase ambient noise and vibration levels inside the coaches and also outside the metro rail corridor.

## 4. Accidents during Construction Phase

Ideally, no accidents during construction should take place. However, during the construction of complex structures such as metro rail corridors, which involve the use of huge machinery and equipment, some freak fatal accidents are always a possibility. The accidents may occur due to human errors/negligence, mechanical failure of machinery, design faults, use of low-quality construction materials and also due to man-made and natural disasters like earthquakes, flooding, fire and deliberate sabotage and terrorist activities.

## C. Mathematical model of vibration analysis for TBM

Vibrations occurred before the machine begin tunneling and during operation are due to impacts of cobble and boulder along the alignment. The directions concerning the analysis will have the following co-ordinates : radial (R - towards the TBM axis), tangential (T - perpendicular to the radial direction), longitudinal (L - along the TBM axis). Impact and ambient vibration testing of the TBM before drilling (outside the tunnel in open air) are integral to understanding its behavior, where outputs can be measured to known inputs. Analysis is limited by the open-air nature of testing as the cutter head cannot be conventionally accessed to perform test impacts under pressurized conditions, so some differences are expected. Stationary impact testing gives the best opportunity to understand the response of different sensors to different impact locations and directions, as the impacts can be tightly controlled and repeated with a stationary cutter head. Impacts to a stationary cutter head provide the chance to understand the response of different sensors to different impact locations and directions. The transfer function is calculated in equation below as a function of frequency ( $\omega$ ), accelerometer location ( $\omega_{dir}$ ) and response direction ( $\omega_{dir}$ ); response at the impact location is indicated by  $\omega_{dir}$ . While some redundancy is valuable in case a sensor is damaged while tunneling, the overarching goal is to gain as much information as possible. Therefore, sensors were placed in different locations throughout the TBM interior to gather possibilities for different responses.

$$f, A_{bulk}(n), dir = \frac{FFT(A_{bulk}(n, dir))}{FFT(A_{impact}(dir))} (1)$$

TransferFunction

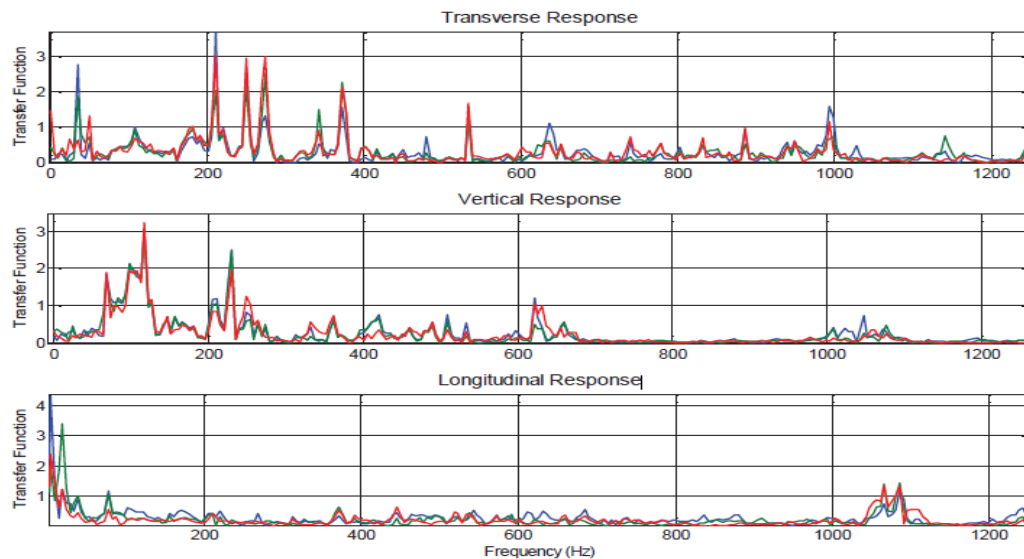


Figure No 5 . The transfer function is calculating by dividing the FFTs of sensors in the bulkhead by the FFT of the impact location sensor. The responses of 3 different sensors placed on the bulkhead are indicated by differently colored lines. The directional similarity for each sensor indicates redundancy. This analysis was obtained from (1).

## V. CONCLUSION

Construction of the metro rail system in Pune and other cities of India (as well as other parts of the world) have brought out several important environmental, social and other related critical issues which need to be studied and addressed carefully to make these mega infrastructure projects not only environmentally and socially acceptable but also technically and financially viable. These metro rail projects are capital intensive projects and mostly implemented in large cities where the high cost of construction can be justified, direct and indirect benefits. Moreover, metro rail networks have to be constructed/built in very difficult urban settings so that there is the least inconvenience to the general public. Various structures to be built should be aesthetic and merge with the surroundings. There is always a debate regarding the justification of introducing a metro rail system vis-à-vis other public transportation system(s) in an urban area. Various critics argue that these metro rail projects are very costly, subsidized, require excessive land use densities, are generally ineffective in solving most of the transportation problems and favor rich people. However, a study carried out by Litman (2010) has concluded that most of these arguments/criticism of rail projects are not based on the actual facts rather based on omissions, errors misrepresentations and intentional bias of data/figure. It was argued that if various benefits (namely, congestion reduction, pollution reduction, vehicle kilometer travelled (VKT), etc.) are considered individually then the cost of the metro rail projects will definitely be higher as compared to other public transportation system but if these benefits are combined together then metro rail projects are least costly vis-à-vis other public transportation project (Litman 2010). Metro rail projects take many years to get operational. During initial years, ridership is small as people take some time to change their transportation preference, thus accrued benefits are generally very small during initial years and as the time passes and various teething problems associated with the operation of metro rail are resolved and the reach (that is, length of the corridor) increases, the ridership also grows resulting in increased benefits vis-à-vis cost of the project. A public transportation system can only be successful if it encourages the commuters to shift from their private vehicles to this system. A good public transportation system should ideally be a combination of various public transportation systems (for example, metro rail, mono rail etc.). Public transportation systems instead of competing with each other should be complimentary to each other. It requires an integrated approach from the design stage itself. Further, experience gained from similar projects from other

## International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: [www.ijirset.com](http://www.ijirset.com)

Vol. 8, Issue 7, July 2019

countries on various aspects related to construction, operation and environmental management can also be suitably used for any project to ensure that they are environmentally sustainable as well as socially acceptable.

### REFERENCES

- [1] Sahil Saproo "Detailed Study on Heavy Equipment's with Its Latest Technologies for Pune Metro Projects" International Journal of Innovative Research in Science, Engineering and Technology (A High Impact Factor, Monthly, Peer Reviewed Journal) Visit: [www.ijirset.com](http://www.ijirset.com) Vol. 7, Issue 5, May 2018
- [2] Chetan Shivatare "Pune Traffic Problems & Control Measures" Journal Of Information, Knowledge And Research In Civil Engineering ISSN: 0975 – 6744| NOV 16 TO OCT 17 | Volume 4, Issue 2
- [3] W N Deulkar "Pune Metro Rail Project: A Review" International Journal of Structural and Civil Engineering Research ISSN 2319 – 6009 [www.ijscer.com](http://www.ijscer.com) Vol. 4, No. 1, February 2015 © 2015 IJSCER. All Rights Reserved
- [4] Ashok Sreenivas "Urban Transport Planning: Lessons from the Proposed Pune Metro Rail"
- [5] Geetam Tiwari "Metro Rail and the City"
- [6] Neeraj Kumar "A Site Selection Scheme for Emergency Network Deployment: A metro city perspective" Research J. Engineering and Tech. 8(4): October-December 2017 347 ISSN 0976 2973(Print) [www.anvpublication.org](http://www.anvpublication.org) 2321-581X (online) [www.ijersonline.org](http://www.ijersonline.org)
- [7] Ajesh Pilaniya "A Review of Planning & Scheduling of a Pune Metro Rail Project using Primavera P6 Web" IJSRD - International Journal for Scientific Research & Development| Vol. 6, Issue 09, 2018 | ISSN (online): 2321-0613
- [8] Priyanka Chib "Optimization of Pune Metro Rail" International Journal of Engineering Trends and Technology (IJETT) – Volume17 Number7– Nov2014
- [9] Aftab Memon, Ismail Rehman, Ade Asmi Abdul Azis (2012), "Time & Cost performance in Construction Projects in Southern and Central Region of Peninsular Malaysia". International Journal of advances in applied sciences, Vol. I, March 2012, pp. 45-52
- [10] Al-Khalil, M.I. & Al-Ghafly, M.A. (1999). "Important causes of delay in public utility projects in Saudi Arabia". Construction Management and Economics, 17(5), pp. 647-655.
- [11] Apolot, Ruth, Alinaitwe, Henry & Tindiwensi, Dan. (2012), "An Investigation into the Causes of Delay & Cost Overrun in Uganda's Public Sector Construction Projects", Second International Conference on Advances in Engineering and Technology, pp. 305-311.
- [12] Assaf, S.A., Al-Khalil, M. & Al-Hazmi, M. (1995). Causes of delay in large building construction projects. Journal of Management in Engineering, 11(2), pp. 45-50.
- [13] Walid Kholif, Hossam Hosny & Abdelmonem Sanad, " Analysis of Time & Cost Overruns in Educational Building Projects in Egypt.", International Journal of Engineering and Technical Research, ISSN : 2321-0869, Vol.-1, Issue-10, Dec-2013