

## Risk Assessment for Stone Quarry

Mining is among the most hazardous activities all around the world, being always accompanied with different accidents, injuries, loss of lives, and land damages. Dimension stone quarrying constitutes a big portion of mining activities. Risk assessment is all about assessment of risks involved and preventive measures proposed to be taken to avoid accidents arising out of such risks. There is an urgent need to be aware of the risks of an accident before steps can be taken to prevent it happening. It may not always be obvious that a workplace task could lead to an accident. This is why risk assessments are carried out.

In risk assessment the words Hazards and Risks are often used and it is necessary to be clear what Hazards and Risks are:-

- A hazard is anything that has the potential to cause harm.
- The risk is how likely it is that a hazard may cause actual harm.

Having defined the work to be undertaken, risk assessment will give a clearer picture of what could go wrong and how serious an accident could be. It will depend upon following a set model which will enable the risk to be assessed.

### Five steps of risk assessment

Step 1: Identify the hazards

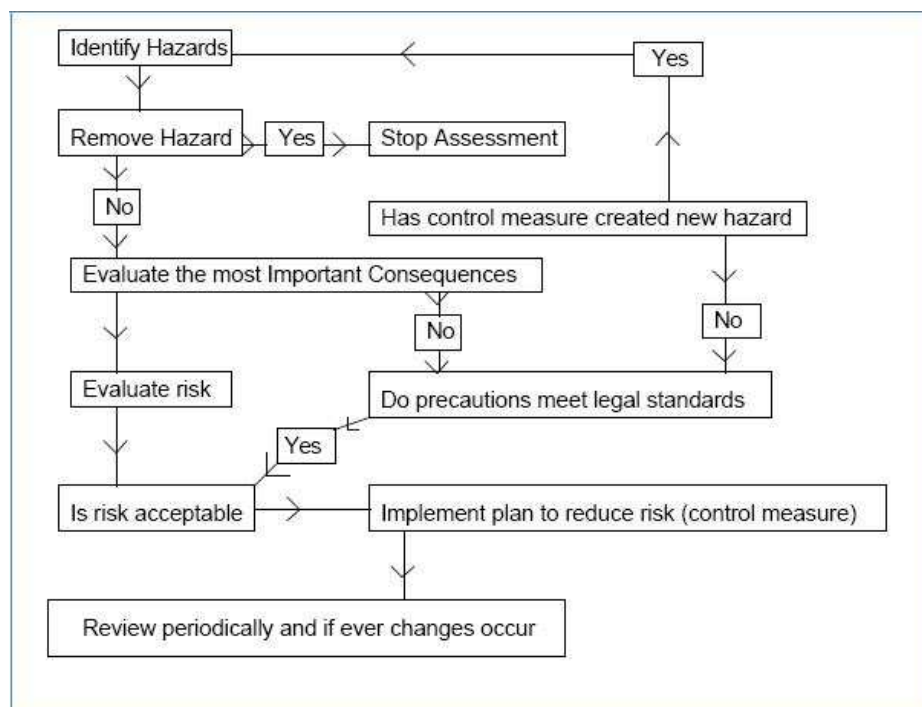
Step 2: Decide who might be harmed and how

Step 3: Evaluate the risks and decide on precautions

Step 4: Record the findings and implement precautionary measures proposed

Step 5: Review assessment and update if necessary

### Model for Risk Assessment



This model is best understood by working through the steps listed below

1. **Identify the hazard** - How an accident might happen? Consider what or how things could go wrong when the activity is carried out.
2. **Identify who is at risk** - Who is involved in the activity? Who else could be at risk?
3. **Remove the hazard** - Can the activity be carried out in another way so as to eliminate the hazard?
4. **Evaluate the risk** - How likely is an accident to happen? How serious would the injury be if there is an accident while carrying out the activity?
5. **Decide on control measures** - look at what measures have been taken already to ensure that persons do not have an accident. For example, have suitable and sufficient guards been fitted? Decide whether anything else needs to be done. For example, it may be necessary to provide extra training in the safe use of machinery and only allow trained workers to use it.
6. **Record the assessment** - The risk assessment should be recorded.
7. **Review** - The assessment will need to be reviewed every time there are changes in the workplace, for example new members of staff, new equipment, new systems of work And new location.

### **Hazard identification at Stone quarry site**

Hazard identification and risk assessment is a continual process. At mining operation following could be the main hazard:

- Fall of sides
- Drilling operation
- Blasting operation
- Health Hazard
- Accident at site
- Transportation
- Natural hazards

Hazard identification is performed to identify whatever could cause injury, damage, ill-health, financial loss and loss of reputation to the organization. Hazard identification is an analysis to determine whether a risk agent under plausible conditions would cause harm to population or the environment.

Hazard identification is an analysis which is in many ways involves a detailed study of various

operations and processes, epidemiology, ergonomics.

The objectives of Hazard identification and risk assessment (HIRA) are to,

- Identify any operation / thing that may cause injury, damage, ill-health
- Prioritize the risks in terms of urgency of required attentions
- Discover preventive or mitigating actions that can be taken in each case
- Create awareness in all concerned in each and every factor and activity that may cause injury, damage or ill health
- Enhance decision making by brining all concerned and effected parties into the HIRA process
- Encourage employees to take ownership of their own safety in terms of recognizing and reporting hazards and participating in the discovery and implementations of the solutions that will prevent incidents or mitigate the consequence
- Build a team approach to Safety Health and Environment Management

#### **Fall of sides**

- Fall of sides in a quarry can be a constant source of risk if the workings are not properly designed and if statutory provisions are not implemented in letter and spirit.
- Overall slope angles of benches will be 37°.
- No disaster like land slide is anticipated as the height of benches will be 3m and width will be at least 3 m.
- Unmanageable heights are not created.
- Loose sides are properly dressed.
- Nature and structure of the rocks will be properly studied for their slips / fault lines.
- No tree, loose stone or debris will be permitted to remain within 3 meters of the edge or side of any excavation (regulation 106(4) of MMR 1961)
- No undercutting of any face or sides will be permitted so as to cause any overhanging (regulation 106(5) of MMR 1961)

#### **Drilling Operation**

Drilling of holes for blasting, is essential for excavation of hard rock. The main hazards associated with drilling are:-

- Falls from the edge of a bench
- Dust created during drilling operations
- Noise
- Entrapment in or being struck by a moving part of the drilling equipment.

While the primary hazard is that of the driller falling over the edge of a working or abandoned bench, there is risk of boulders or materials falling onto workers at the foot of the face if proper precautions are not taken.

A face and bench is a necessary part of a working quarry and therefore risk to the driller occurs during the drilling of the first line of holes parallel with the working edge of the bench. Subsequent parallel lines of holes are not likely to give rise to such a high-risk of falling off the edge of the bench.

A number of preventive measures can be taken and the first is to ensure that the equipment is suitable for the job and that the person in charge of the drilling machine is competent to carry out the drilling operation; part of the training should include instructions to always face Towards the open edge of the bench so that any inadvertent backward step is away from the edge.

One of the measures that can be taken to reduce the risk off the edge of the bench is to provide suitable portable rail fencing which can be erected between the drilling operations and the edge of the bench. Another is to attach a safety line to the drilling rig and provide a harness for the driller to wear.

Restrict access to the area to all persons except those necessary for the drilling operation

### **Dust from the drilling operation**

The hazard is the inhalation of dust which is created during the drilling operation.

- Properly applied control measures can substantially reduce the risk to the drill operator.
- Wet drilling is carried out by constantly injecting a jet of water at the drill bit inside the hole, which prevents dust generation.
- In case due to any reason, wet drilling is not possible (due to non availability of water), exhaust/ vacuum system is provided which removes the dust from the drill hole continuously and discharges the same in a dust collector specially provided for the purpose.

### **Noise**

- Drilling operations give rise to harmful levels of noise. It is created by both drilling the hole and the operation of the drill rig itself.
- It is impractical to remove the hazard at the hole completely, but new generation drill rigs are quieter by virtue of its design. The noise created is harmful to anyone who is within a zone around the drilling machine at which the noise level is above that considered to be safe for persons to work without having to use control measures.
- The noise levels around drilling equipment should be measured and the risk assessed.
- No-one, except those necessary for the work in hand, i.e. driller and his assistant, should

- be allowed inside the designated drilling area.
- The risk is highest with older machines. Newer large drilling machines are provided with sound insulated operating cabins which control the noise level within the cabins to acceptable levels.
- Other control measures include training operators and providing them with ear protection, although the latter should only be seen as an interim precaution until a permanent solution can be found.
- The risk can be high if no preventive measures are taken.

### **Mitigation measures**

#### **DRILLING:**

1. Drilling machine shall be fitted with dust suppression, collection and disposal arrangement.
  2. Deep wetting of drilling zones shall be done by water sprinkling before starting drilling.
  3. During the drilling operations efforts shall be made to reduce dust generation by taking appropriate measures
- **Entrapment in or being struck by a moving and revolving part of the drilling equipment.**
  - There may be a number of hazards, principally those of moving the drilling rig around the site from one hole to another or from one working face to another.
  - The primary hazards associated with the movement of equipment on site and dangerous parts of the drilling rig are an integral part of operating a drill.
  - Those most at risk will be persons having needed to move and operate the drilling rig.
  - The risk of an accident occurring will be low if the dangerous parts of the equipment are properly guarded, operators are well trained and supervised and only those essential to the work are involved in the activities.
  - However, the risk of an accident will be high if the dangerous parts are exposed and the operators poorly trained and supervised.

### **Blasting & Handling of Explosives**

#### **Storage and use of explosives**

Explosives by virtue of their nature have the potential for the most serious and catastrophic accidents in the mining industry yet the way they are used are an excellent example of how risk assessment is properly applied. For example only authorized and trained blaster (holding blasters certificate granted by DGMS) and his assistant will be allowed to handle explosives

and carry out blasting operations.

Use of explosives is specialized work. Planning for a round of shots is necessary to ensure that the face is properly surveyed, holes correctly drilled, direction logged, the weight of explosive suitable for good fragmentation and the continuity of the initiator are but a few of the steps necessary to ensure its safe use. Poorly designed shots can result in misfires, early ignition and flying rock. Further,

1. Blast hole geometry shall be properly designed.
  2. Blast site shall be wetted before and after blasting operations are completed.
  3. Only optimum quantity of permissible explosives shall be used so that the vibrations do not damage the structures/houses if the quarrying operations are close to human habitation.
  4. Blasting shall be conducted only during favorable weather conditions and only during the day time and permissible hours.
  5. While carrying out blasting operations near habitations, wide publicity will be given in the local area through announcement and other available media so that local people become aware of the blasting activities being undertaken in the area and take appropriate precautions.
  6. The vibrations should be monitored periodically in consultation with the local Mining authorities.
  7. The storage of the explosives and its transfer to and from the quarry area shall be strictly in accordance with the conditions listed in the permission granted by Explosives Department
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- Proper and safe storage of explosives in approved and Licensed Magazine.
  - Proper, safe and careful handling and use of explosives by competent Blasters having Blaster's Certificate of Competency issued by DGMS.
  - Proper security system to prevent theft/ pilferage, unauthorized entry into Magazine area and checking authorized persons to prevent carrying of match box, lights, mobile phones, cigarette or Bidi etc. will be put in place.
  - The explosives of class 2 shall be used in their original cartridge packing and such cartridge shall not be cut for making cartridge of different size.
  - Explosives shall be conveyed in special containers.
  - Explosives and detonators shall not be carried in the same container
  - The holes which have been charged with explosives will not be left unattended till blasting is completed.

- Before starting charging, clear audible warning signals by Sirens will be given so that people nearby can take shelter.

### **Heavy Earth moving Machinery (HEMM):**

- The operator/ transporter shall carry out regular maintenance of the machinery and vehicles as per manufacturer's guidelines.
- The speed limit shall be adhered to.
- Operator's cabin of the HEMMs should preferably be air conditioned or at least air tight.
- The smoke emission should conform to the standards notified in Motor Vehicle Act.
- The trucks carrying the mined products shall be covered with tarpaulin so that there are no fugitive emissions during transportation.
- The transportation should not be through the busy roads in the city/towns/villages if by pass roads are available

### **Water Management**

- A garland drain shall be provided around the pits to prevent run off rain water entering the mine workings.
- Proper drainage will be maintained to eliminate inundation of working pits during rains from run-off water.
- There is no danger of flooding or inundation of the proposed quarry as there is no such river or nala around.
- Mining operations will be carried out in a systematic manner well above the ground water table; therefore, there will be no disturbance to ground water quality due to mining activity.

### **Natural resource conservation**

- A green belt will be developed all around the mining lease area.
- The excavated top soil will be reused for plantation in the green belt area.
- In any case the natural habitats of the existing flora and fauna will not be disturbed.
- Use of traditional knowledge in all aspects of conservation;
- Water conservation techniques will be employed.
- Time to time analysis of the soil, water resources etc will be done in order to analyze the negative impacts of mining activities on the environment.

### **Fire Management**

Sufficient fire extinguishers will be installed at selected locations such as mine office, garage, stores

etc. Besides, sufficient water hydrants with sufficient length of hosepipes will be made available on the surface for fire protection. Mine personnel will be trained for use of fire extinguishers.

### **Loading Operations Management**

Loading of stone at the proposed production site will be done manually/ by shovel

The main hazard associated with loading is rock falling on to the driver, vehicle/ loading eqpt. toppling over due to uneven ground, failure of hydraulic systems, fires and falls while gaining access to operating cabins and reversing of dumpers at the time of placement for loading by shovel/loader,

Good access must be provided to operators cabins which should be of suitable strength to protect the driver in the event of rock falling against the cab or if the vehicle rolls over.

A person called 'spotter' will be provided at the place of loading to assist proper and safe reversing of trucks /dumpers for the purpose of loading as per statutory provisions.

### **Traffic Movement**

As a number of vehicles will be used for transportation of materials, there is some risk of accidents due to the traffic movement. All effective measures for good traffic management shall be adopted to prevent accidents in the mine. If possible traffic movement in the mine shall be unidirectional.

### **Transport Management**

Transportation may be categorized as any means of moving the mined product from the working face to the process plant/ market.

The usual method of transporting minerals from the working face is by trucks / tippers/dumpers. Large earth moving equipments are used for loading /transporting large quantity of mineral from a mine.

During transportation of minerals in the mining area, utmost care will be taken by the vehicle operator to avoid any accident with any incoming vehicle by keeping sufficient gap between the two vehicles, keep safe distance from the edge of the mine face, avoid any accident to a worker crossing the haul road and shall maintain low speed. The vehicle operator shall not try to overtake another vehicle.

To prevent accidents during transportation in mine area, the mines roads

- i. Shall be made smooth by occasionally rolling with a road roller
- ii. Shall be frequently cleaned of any stone /rock fallen from a plying dumper
- iii. Shall be designed with suitable gradient well within the specifications prescribed under MMR 1961
- iv. Shall be designed sufficiently wide for two way traffic or separate routes for incoming and



outgoing traffic shall be provided.

- v. Shall be kept suitably wetted to prevent dissipation of dust
- vi. Shall have designated points for crossing by workers.
- vii. Shall have suitable sign boards for information of the vehicle operator.

### **House keeping**

The provision and maintenance of a safe and healthy workplace is the most basic principle of health and safety. Dirty and untidy workplaces or walkways contribute to a very large proportion of trip and fall accidents. In the context of surface mining the provision of well defined roadways and walkways clear of obstruction and regular cleaning up of spillage will greatly reduce the potential risk for this type of accidents.

### **The Work Culture**

The application of risk assessment depends upon a full understanding of all aspects of the job being undertaken. In carrying out a risk assessment in relation to a particular task the evaluation must include a review of the knowledge, experience and training of those persons carrying out the work. A system of professional work culture shall be introduced to obtain safety and efficiency in operations.

### **Personal Competence**

It is considered that the knowledge, experience and training of personnel involved in work are critical to evaluate any risk assessment. A knowledgeable, experienced well-trained and competently supervised workforce will be at a lower risk of accidents than a poorly trained and badly supervised workforce. The mine should have competent persons for management, supervision and execution of various mining, drilling, blasting and transportation operations as per statutory provisions under MMR 1961.

### **Co-ordination**

It is essential to ensure that everyone engaged in the work is capable and understands his own role and that of the others and the responsibility of each other. This would be ensured through proper coordination. This is particularly important when contract workers undertake part or all of the work to be carried out.

### **Health hazards**

For the purpose of this document, health hazards should be interpreted as being harmful dust and noise which is emitted during surface mining operations. All suitable steps and precautions will be undertaken to ensure minimum health hazard

### **Personal Protective Equipment (PPE)**

The PPE shall be of good make and quality, wherever possible ISI certified, suitable for the hazard

e.g. a dust respirator fitted with the correct filter to capture the particular hazardous dust and maintained to recommended standards. As personal protective equipment only affords limited protection it should only be used as a last resort and as an interim arrangement until other steps are taken to reduce the risk of personal injury to an acceptable level.

### **OVERBURDEN Dumps Stabilization**

1. Overburden dumps shall be suitably located and designed keeping in view the quantity of overburden to be stored as also the length of time for which the dump is to be there.
2. A suitable retaining wall shall be provided around the dumps to prevent sediments from the dumps flowing downwards towards water body if any, or agriculture fields.
3. Check dams (one or more, as per requirement) shall be constructed for further arrest of sediments from the dumps.
4. Non-operative dumps shall be subjected to technical and biological reclamation.
5. Plantation over and around over burden dumps shall be carried out to ensure stability Of slopes, prevention of dust by wind action and soil erosion during the run off.

### **Risk in case of leaving deep mined out pit after completion of mining operations**

Where sufficient overburden is not available to back fill a mined out pit or it is not practically possible to back fill a mined out pit, the deep mined out pit may have to be left as it is. Such a deep open pit can be a cause of accident. On the other hand, such a pit may be converted into rain water harvesting pit, which may get filled up with rain water year after year. It will be necessary to safe guard such a pit by providing suitable fencing all around and further develop the same into a picnic stop by providing proper approach road to the site, a clean area with grass plantation for sitting and playing of children, suitable tree plantation for shade for the visitors. The pit could also be utilized gainfully in many other ways e.g. for fish culture etc.