CHAPTER-VI
ENVIRONMENTAL MANAGEMENT PLAN

6.0 INTRODUCTION

The mining activities involve, dozing, drilling, blasting, excavation, loading, haulage and transportation of limestone to cement plant. These activities lead to generation of air borne dust, which can cause Air Pollution in and around the mining lease area, if appropriate control measures are not taken. Similarly mining causes Land Degradation, Noise and Water Pollution etc. in the area.

The Calcom Cement India Ltd. is fully aware of the responsibility of maintaining clean and green environment whilst opening and working a mine in Virgin area like New Umrangshu. The company will therefore, endeavor to incorporate appropriate environmental protection norms while working the deposit. Wherever adverse situation may arise will be mitigated so as to keep the mining scenario not only compatible with the pre-mining physiographic scenario of the region but to better it.

The limestone mining will be done by systematic benches following the natural slope of the hill face. The deposit will be worked in 3 separate sectors as created by the course of Amrang nalla in the lease area. A proper barrier zone will be left on either side of the Amrang nalla to protect its natural drainage.

In order to minimize impacts of mining on different environmental parameters and to keep air and water quality within prescribed limits of CPCB, a comprehensive Environmental Management Plan (EMP) is prepared to strictly follow it. This helps in resolving all environmental and ecological issues due to mining in the area. The environmental management plan includes all measures and safety precautions necessary for safe mining along with rehabilitation measures for mined out areas.
6.1 MANAGEMENT OF TOP SOIL AND OVER BURDEN

The total production of 7.0 million tones of limestone will be produced in the western sector and generating about 2.77 Mm$^3$ over burden of which about 0.25 Mm$^3$ will be topsoil. The topsoil will be directly utilized by spreading over the Amrang nalla barrier for creating green zone through plantation.

The over burden will be dumped in the pre selected dumping ground in the southeastern part of the western sector over an area of about 9 hectares. The topsoil generated in later years will also be directly utilized for green zone development and rehabilitation of over burden dumps.

Therefore no special dumps will be necessary for storage & protection of topsoil. The main over burden dump will be in the higher ground of eastern sector ultimately covering an area of about 150 hectares at the end of life of mine.

6.2 LAND RECLAMATION AND REHABILITATION

In closing years of the overburden material will be used for covering the narrower zones created between lower benches and barrier zone of Amrang nalla to bring the worked out area in harmony with the natural physiographic.

No water body will be created in the mine area. The benches will be designed with mild slope toward lower ground. The run off water will be directed through pre designed nallas to the lower course of Amrang nalla. A few pits will be dug at the nalla to arrest silt, so that clean water flows in the Amrang nalla. The pits will be cleaned at regular intervals, particularly before start of the rainy season.

The worked out mine slopes will be reclaimed through plantation after digging 1 m dip pit of size 0.6 m x 0.6 m filling them up with silt, soil and organic manure (cow dung etc) before planting sampling of local for growing species.

The slope of the over burden dumps will be generally towards the Amrang nalla. Protective wall and appropriate drainage channel for the rain water
will be made surrounding the dump. The height of the over burden dump above ground level will be 15 m to 20 m and slope will be about 15°. The dumps will ultimately be settled by leveling, spreading soil and planting.

6.3 AIR ENVIRONMENT

Air pollutants generated during mining operations mainly include particulate matters due to drilling, blasting, dozing, excavation, loading, unloading and transportation in form of dust, smoke, organic gases, oxides of carbon, sulfur, nitrogen etc. These can have adverse effects on the human health conditions, depending upon the concentration, particle size and duration of the above pollutants.

The result of the air quality survey and parameters tested proves that the SPM concentration is within the permissible limit but after increasing mining activity the SPM concentration may become high close to the source at about 0.5 Km. But beyond this the concentration will be well within the permissible limit. Ambient air quality monitoring conducted around the study area revealed that the concentration of SPM is in the range between 117 $\mu$g/m$^3$ to 224 $\mu$g/m$^3$. These are well within the prescribed limits prescribed by Central Pollution Control Board (CPCB). As far as $SO_2$ and $NO_x$ are concerned, they are also well within the CPCB limits for residential and industrial areas. However, strict measures will be adopted to minimize the air pollution as discussed below.

6.3.1 Prevention and Control of Air Pollution

A. Dust Pollution

The main pollutant in air is Suspended Particulate Matter (SPM), which is generated due to various mining activities. However, to reduce the impact of dust pollution the following steps have been taken during various mining activities.
a) During drilling operations
   i) The drilling machines equipped with dust collector arrangement and jackhammer with wet drilling arrangement will be used to prevent the generation and spread of dust.
   ii) The personnel working on the drills will be being provided with dusk mask as PPE.

b) During blasting operation
   i) Blasting will be conducted at different faces at different times.
   ii) Blasting of limited holes will keep vibrations under control.
   iii) Use of delay detonators will also help in controlling ground vibration and Noise pollution. While drilling, blast holes dust will be kept under control by dust extractions and or wet drilling.
   iv) The mine area is away from any human habitat. Thus will not create any problem to any one due regarding ground vibration, noise etc.
   v) With the good blasting system, dozing of broken rocks will be less where by dust due to dozing will be also less.
   vi) Blasting will be done at midday during the lunch break, or at the end of the shift when there are no people around the working area except blaster and his team.
   vii) High-density primers in conjunction with ANFO with millisecond delay detonators will be used to restrict air blast and vibrations.

c) During loading operation
   i) The optimum bucket size loading equipments will be used which reduces the number of buckets passes to fill the dumper by dropping material from height and thus have comparatively less dust generation. However the
propagation of this dust will be confined to loading point only and will not affect any person, as the operators of excavator and dumpers sit in closed cabin with AC otherwise equipped with dust mask. The water sprinkled over blasted muck pile will very much reduce propagation of dust during loading.

ii) Skilled operators are to operate excavators.

d) During Transport operation

i) All the haulage roads including the main ramp from crusher to mines pit will be kept wide, leveled, compacted with road roller, properly maintained and water sprayed regularly during the shift operation to prevent generation of fugitive dust due to movement of dumpers.

ii) To minimize dust pollution green belt plantation will be done all along the haul road from mines to plant whereas possible.

iii) The haul roads will be kept wide to support two-way traffic.

e) Plantation work will be carried out

i) In order to reduce air pollution in the surroundings, green belt will be developed around the mines office, workshop, waste dump yard site mine approach road, and along mine boundary etc.

ii) Waste dumping sites will be vegetating by suitable trees to prevent air pollution during stormy winds.

f) Monitoring of air pollution

i) Periodic air quality survey will be carried out to monitor the changes consequent upon mining activities as per the norms of Assam Pollution Control Board / MoEF.

B. Prevention and control of Gaseous Pollution

In mining activities, the only source of gaseous emissions will be from blasting and the engines of Heavy Earth Moving Machines (HEMM). Controlled blasting and optimization of use of explosive
energy helps in reducing the above emissions. Proper maintenance of machines improves combustion process and reduces gaseous pollution. Good maintenance and monitoring of fuel and oil does not allow the gaseous emissions to be appreciably higher than the ambient condition. The effect of these gases will be limited to the surrounding of the equipment in operation only and do not affect the human being since the available person at that point. Operator of the equipments will be sitting inside a closed chamber with protective mask.

6.3.2 Protection of Sites of Cultural, Historical and Scenic Importance due to Mining Activity

These sites do not exist in study area therefore measures will be not required.

6.4 NOISE ENVIRONMENT AND GROUND VIBRATION

6.4.1 Noise Abatement and Control

The latest designed HEMM will be used in mining and due care will be taken to minimize generation of noise.

(i) Generation of noise due to HEMM is confined close to the machineries. The noise will be reduced by proper maintenance.

(ii) Controlled blasting produce noise within permissible limits. Periodical noise monitoring will be done and records are maintained.

(iii) In order to reduce effect of noise earmuffs will be provided to operators and other employees working in higher noise zone.

(iv) Suitable green belt will be developed in the mine site area to check the propagation of noise.

(v) The practice of wet drilling will be carried out with the help of sharp drill bits. This will help in reducing noise generation during drilling.

(vi) Proper stemming of holes will be adhered to.
(vii) Blasting will avoided in the morning and evening hours.

(viii) High density primers and millisecond delay detonators shall be used to restrict air blast, vibration and noise.

(ix) The noise pressure level and vibrations generated by blasting will be of very short duration, generally less than 0.5 second. It should not, therefore cause any adverse problem to the inhabitants in the surrounding area.

(x) For suppressing the noise caused by heavy earth moving equipment, green belt on the roadside and plantation in the mines and colony areas will be done.

(xi) In order to reduce the effect of noise pollution, earmuffs will be provided to all operators and employees working at mining site as a safety measure.

(xii) Periodical monitoring of noise level of mining machines and at some locations in the mining site will be carried out with the help of noise level meter.

6.4.2 Vibration Abatement

Sources of vibration due mining activity in the area are anticipated due to operation of Heavy Earth Moving Machines like dozers, dumpers, drill machines and blasting. However, following precautions are taken for abatement of vibration due to present mining project. The factors affecting ground vibration include, geological structures, explosive charge per delay, blast design parameters, method of initiation, explosive type used etc.

A. Vibration due to Machines

Taking following measures minimizes vibrations due to machines:

1. Proper maintenance, oiling and greasing of machines at regular intervals reduced generation of vibration due to machines.

2. Machines will be operated by trained operators.
B. Ground Vibration due to Blasting

Depending on the type of structures and the dominant excitation frequency, the peak particle velocity (ppv) on the ground adjacent to the structures is not exceeding the values given below in the table as per the DGMS (Director General of Mines Safety) guidelines.

Permissible standards of ground vibration due to blasting as per guidelines of Director General of Mines Safety (DGMS), Dhanbad are as follows.

<table>
<thead>
<tr>
<th>TYPE OF STRUCTURE</th>
<th>DOMINANT EXCITATION FREQUENCY, HZ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;8 HZ</td>
</tr>
<tr>
<td>A. Buildings / Structures not belong to the owner</td>
<td></td>
</tr>
<tr>
<td>Domestic houses / structures (Kuchha, Brick &amp; cement)</td>
<td>5</td>
</tr>
<tr>
<td>Industrial Buildings (RRC &amp; Framed structures)</td>
<td>10</td>
</tr>
<tr>
<td>Objectives of historical importance &amp; sensitive structures</td>
<td>2</td>
</tr>
<tr>
<td>B. Buildings belonging to owner with limited span of life</td>
<td></td>
</tr>
<tr>
<td>Domestic houses/structures (Kuchha, brick &amp; cement)</td>
<td>10</td>
</tr>
<tr>
<td>Industrial buildings (RRC, Framed structures)</td>
<td>15</td>
</tr>
</tbody>
</table>

*Source – DGMS Tech Circular No.7 of 1997

To keep ground vibration due to blasting well within the above mentioned prescribed limits of DGMS, following measures have been taken.

(i) Drilling and blasting will be carried in the supervision of qualified persons.

(ii) ANFO explosive will be use which has low velocity of detonation, which reduces ground vibrations.

(iii) The limestone mine will be a strike wise stretch of working. Therefore blasting will be conducted at various points at different time. Blasting of limited holes at any given time will keep vibration under control.

(iv) Delay detonators will also help in controlling ground vibration.

(v) Blasting will be avoided in the morning and evening hours.
(vi) Avoiding blast on foggy days, at night time and at times of high wind velocity.

6.5 WATER ENVIRONMENT

6.5.1 Natural Drainage

The mining lease area is part of a hilly terrain characterized by isolated hillocks in an over all south easterly sloping hill range. The topographic variation is between 270 m to 435 m above M.S.L. in the mining lease area. The passage of the Amrang nalla through the middle of the mining lease area guides the drainage pattern. The drainage of the area is part of the Kopili River valley master drainage systems.

The area constitutes part of the heavy rainfall zone of NE hilly terrain of Assam. The average annual rainfall is about 1670mm. The Langyen nalla flowing eastward in the valley south of the area collects the rain water through the Amrang nalla and other local seasonal nallas. The Langyan nalla discharge in the Kopili river drainage system.

The mine planning is done to have no disturbance at any point to natural drainage system.

(A) Effluent discharge

The liquid effluents can contaminate surface and ground water bodies, soil and biological environment, will proper care is not taken. The following measures will be taken to minimize adverse impacts for water effluents.

(i) Since the mining area is in hilly terrain no accumulation of water in the quarry is expected. The impact of mining excavation on the hydrography of the area will be practically nil.

(ii) No liquid effluent will be generating during mining, which may pollute the surface or ground water of the area.

(iii) No water body will be created in the mine area. The benches will be designed with mild slope toward lower ground & Amrang Nalla.

(iv) The run off water will be directed through pre designed courses to the lower course of Amrang nalla. A few pits will be dug at these
courses to arrest silt, so that clean water flows in the Amrang nalla. The pits will be cleaned at regular intervals, particularly before start of the rainy season.

(v) Periodical water quality survey will be carried out as per CPCB norms.

(B) Mine Water discharge

The rainwater is discharge in Amrang nalla. The following precautions are taken to prevent adverse impact of mine water.

(i) Since no ground water is present at working depth of the mine there is no chance of contamination of ground water. The surface run off through the open pit mine will be guided and desilted through directional channel before discharge in Amrang nalla at its lower course.

(ii) Within the surface mine area, a wide barrier zone will be left on either side of the Amrang nalla. This barrier zone will be converted to a green zone by utilizing the top soil. Thus there will not be any scope of adverse impact on water regime of the area.

6.6 LAND ENVIRONMENT

6.6.1 Management for Land use

The New Umranagshu mining lease will be worked through 3 different open pits in a synchronizing way to ultimately produce 7.0 million tones/year of limestone for about 16 years. A total of 112 million tones of mineable reserve are to be worked and about 120 Mm$^3$ of overburden to be removed. An area of about 200 Hecto is likely to be degraded. The mine degraded area will be rehabilitated by filling and dressing the mined area with overburden and top soil respectively. The reclaimed area will be covered with plantation so as to merge esthetically with the surrounding area.
6.6.2 Reclamation Plan for Land use in Mining

Reclamation of the mine area at the end of its life will be proposed to carried out in the following manner:

- The soil preserved in the overburden dump is proposed to be utilized for spreading and compacting over the mined out benches.
- Plantation will be carried out over reclaimed area.
- Local species of trees will be planted in consultation with forest deptt.
- Stabilization by plantation on slope of the dumps will be carried out.
- Both sides of the main haul roads will be covered with the trees.

6.6.3 Measures planned to minimize impact on soil environment of the area.

Most of the part of mining lease area is rocky in nature. Topsoil is stored separately and used for plantation work in the mined out area.

Green belt development around the area minimizes the impact of mining on soil characteristics like its texture, chemistry & even soil erosion in the area.

6.6.4 Environmental Management Plan to minimize impact on agricultural practice of the area.

- All possible measures are taken to reduce air, water and land pollution.
- Plantation work to be carried out in the area for green belt development and gardening will help in retention of water in the area while helps in increase moisture level of the soil.
6.7 BIOLOGICAL ENVIRONMENT

6.7.1 Green Belt Development

The green belt in the lease area will be designed; taking into consideration of the availability of area as the efficiency of green belt in pollution control mainly depends on its width of green belt, distance from pollution sources, side of the habitat from working place and tree height. The green belts will be designed to control SPM, gaseous pollutants, noise, surface run off and soil erosion etc. Trees planted in at mines are mainly Mango, Jackfruit, Eucalyptus, Neem, Gamari, Silver Oak, Jamun, Teak etc.

It will be proposed to plant at least 1000 trees/year in continuation of the afforestation programme by the mines with suitable plant species as suggested by forest deptt.

Plantation covers in and around the mine workings generally helps in:

i. Stabilizing erodible slopes to minimize pollution
ii. Control of dust
iii. Enhancement of aesthetic value
iv. Maximizing evapo-transpiration, which helps minimizing run off
v. Reducing noise

For re-vegetation, the plants and saplings suitable for the existing soils and site conditions are considered. It will be recommended to plant fast growing local plant species, which can adapt to the local climate.

This will be done in consultation with concerned Forest Department.

6.7.2 Proposed Plantation Programme

The management proposes for plantation in the mining lease area. The number of the trees proposed to be planted 1000 trees per year.

Proper watering, manuring and fencing are proposed for healthy growth of trees in the area.
6.7.3 Measures for Minimizing Impact on Flora

However, all possible steps will be taken to prevent pollution of air, water and soil environment due to mining activity in the area.

Plantation will be carried out to develop green belt at and around the mines site to arrest dust at source. Under green belt development programme, those botanical species, which are locally suitable, will be planted. This green belt adds to the faunal environment of the area too as better environment is created for them.

6.7.4 Measures for Minimizing Impact on Fauna

Although the mining lease area comes under unclassified mixed degraded forestland, but as such, no adverse impact of the mining activity on animals found beyond the mining lease area is anticipated. The following measures will be taken to minimize the impact of mining on faunal environment of the area.

i) Precautions will be taken to control pollution to Air, Water, Land and Noise environment to below permissible limits.

ii) Greenery development in the mines area helps in creating habitats for local faunal species and to attract birds, insects and reptiles from distant places.

6.8 SOCIO-ECONOMIC ENVIRONMENT

6.8.1 Management plan for Socio-Economic Environment

In general, socio-economic environment will have positive impact due to the mining project in the area. The salient features of the possible likely scene are as follows:

i) The mining in the area will create rural employment.

ii) Social welfare programme like provision of medical facilities educational facilities, water supply, recreational amenities for the employees as well as for nearby villagers.
iii) Local people will be taken into confidence in all activities so as to redress their grievances, if any, and to meet their aspirations and thus to make them partner in developmental process.

6.8.2 Employment

In the recruitment process of the organization, local people will be given preference on the basis of their qualification and experience and as per the requirement of project.

6.8.3 Industrial Hygiene, Occupational Hazards and Safety

The working conditions in the mines are governed by the directions of the Director General of Mines Safety (DGMS) and Indian Bureau of Mines (IBM). As per the provisions of the Mines Act, the management of Calcom Cement India Ltd. will take all necessary precautions. Normal sanitary, bathing and cleaning facilities will be provided within the premises. The management will carry out be periodic health check up of workers of all sections.

Occupational hazards involved in mines are related to dust pollution, noise pollution, blasting and injuries from equipments, fall from high places and electric shocks. DGMS has given necessary guidelines for safety against these occupational hazards. The management will strictly follow these guidelines.

All necessary first aid and medical facilities will be provided to the workers. The mine will be well equipped with proper fire protection and fire fighting equipment. All operators and mechanics will be trained to handle fire fighting equipments. One dispensary equipped with all medical facilities will be provided nearby mine office. One Ambulance will be kept ready for 24 hours at site. Further all the necessary protective equipments will be provided to persons working in hazardous areas.
6.9 ENVIRONMENTAL MONITORING

6.9.1 Air Pollution Monitoring

Ambient air quality monitoring will be carried out as per State and Central Pollution Control Board’s guidelines by the following methods:

1. Suspended Particulate Matter : By Respirable Dust Sampler
2. Respirable Suspended Particulate Matter : By Respirable Dust Sampler
3. Sulphur Dioxide (SO₂) : ISI 5182 Part II: 2001
4. Nitrogen Oxides (NOx) : CPCB Method

6.9.2 Noise Level Monitoring

Monitoring of noise level at mine site and at work environment will be carried out as suggested by concerned Regional Officer of Assam State Pollution Control Board / MOEF.

6.10 ENVIRONMENTAL MANAGEMENT ORGANIZATION

The organization for environmental management at New Umrangshu Limestone Mine (AIDC) will be as follows.

The New Umrangshu Limestone Mine (AIDC) will be a high production (7.0 MTPA) mine. For proper and scientific environment management plan, good execution will be necessary. The work of environment management plan at New Umrangshu Limestone Mine (AIDC) will be looked after by the officer designated as "Safety and Environment officer" who will be a graduate mining engineer or post graduate in geology with proper training and experience in mining environment. He will be directly reporting to the mine manager.

The environmental officer will have a group of trained scientists under him who will look after all the pollution monitoring and control activities and keep the up to data records in a bound paged register/file.
The environment officer will also be responsible for planning and execution of plantation activity in the mining lease area, for development of "green belt" as also for "Biological reclamation of overburden (OB) dumps". Further, the officer will also be responsible for getting the garland drain and pitched stone wall around the overburden (OB) dumps as also drains to carry mine run off during rainy season, clear, particular before on set of monsoon.

6.11 REGULATORY STANDARDS AND APPROVALS

6.11.1 Regulatory Standards

6.11.1.1 Air Quality

The Central Pollution Control Board (CPCB) has promulgated the limits for Ambient Air Quality.

Pollution Control Board vides their circular dated 20th April 1994 are shown in table 6.11.1.

6.11.1.2 Noise and Ground Vibration

The limits of occupational safety and health administration (OSHA) for noise quality are presented in Table 6.11.2. The safe values of ground vibrations for various structures as recommended by CMRS are in Table 6.11.3.

6.12 APPROVALS

The management of New Umrangshu Limestone Mine (AIDC) has obtained necessary approvals from the Indian Bureau of Mines (IBM), and shall take approvals from the chief inspector of explosives – Nagpur and the director general of mines safety Dhanbad as may be required.
## Table 6.11.1

### NATIONAL AMBIENT AIR QUALITY STANDARDS

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Time weighted average</th>
<th>Concentration in ambient air</th>
<th>Method of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Industrial area</td>
<td>Residential Rural &amp; other areas</td>
</tr>
<tr>
<td>Sulphur Dioxide (SO2)</td>
<td>Annual Average * 24 hours **</td>
<td>80 µg/m³</td>
<td>60 µg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 µg/m³</td>
<td>80 µg/m³</td>
</tr>
<tr>
<td>Oxides of Nitrogen as NO2</td>
<td>Annual Average * 24 hours **</td>
<td>80 µg/m³</td>
<td>60 µg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 µg/m³</td>
<td>80 µg/m³</td>
</tr>
<tr>
<td>Suspended Particulate Matter (SPM)</td>
<td>Annual Average * 24 Hours **</td>
<td>360 µg/m³</td>
<td>140 µg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500 µg/m³</td>
<td>200 µg/m³</td>
</tr>
<tr>
<td>Respirable Particulate Matter (size less than 10 mm) (RPM)</td>
<td>Annual Average* 24 Hours **</td>
<td>120 µg/m³</td>
<td>60 µg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150 µg/m³</td>
<td>100 µg/m³</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>Annual Average * 24 Hours **</td>
<td>1.0 µg/m³</td>
<td>0.75 µg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5 µg/m³</td>
<td>1.00 µg/m³</td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>8 Hours** 1 Hours</td>
<td>5.0 mg/m³</td>
<td>2.0 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.0 mg/m³</td>
<td></td>
</tr>
</tbody>
</table>

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly / 8 hourly values should be net 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days.

**NOTE:**

1. National Ambient Air Quality Standard. The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.

2. Whenever and wherever two consecutive values exceeds the limit specified above for the respective category, it would be considered adequate reason to institute regular / continuous monitoring and further investigations.

3. The State Government / State Board shall notify the sensitive and other areas in the respective states.
### TABLE – 6.6.2

**Damage Risk Criteria For Hearing Loss: Occupational Safety And Health Administration (OSHA)**

<table>
<thead>
<tr>
<th><strong>MAXIMUM ALLOWABLE DURATION (HOURS PER DAY)</strong></th>
<th><strong>NOISE LEVEL dB(A) (SLOW RESPONSE)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1.5</td>
<td>102</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>0.5</td>
<td>110</td>
</tr>
<tr>
<td>0.25 or less</td>
<td>115</td>
</tr>
</tbody>
</table>

### TABLE – 6.6.3

**Safe Values Of Ground Vibration for Different Structures Recommended By CMRS**

<table>
<thead>
<tr>
<th><strong>TYPE OF STRUCTURE</strong></th>
<th><strong>PEAK PARTICLE VELOCITY (mm/s)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel or reinforced concrete structure i.e. factories, bridges, steel towers, etc. (at all ground)</td>
<td>50.0</td>
</tr>
<tr>
<td>Building with foundation walls and floors, in concrete, concrete walls or good quality thick masonry walls like industrial buildings of low height (8 – 10m)</td>
<td>25.0</td>
</tr>
<tr>
<td>Buildings with masonry walls and wooden ceiling and housing i.e. poor repair, residential buildings of low heights (8-10m).</td>
<td>12.5</td>
</tr>
<tr>
<td>Object of historical importance or other sensitive structure of mud or kutcha houses having roof and without joints.</td>
<td>5.0</td>
</tr>
</tbody>
</table>