TOPOGRAPHIC SURVEY COMPARISON OF STRATEGIC QUARRY SITES IN ILOCOS SUR

ENGR. FRANKLYN T. AMISTAD
ENGR. NORMA A ESGUERRA
DR. **ALFREDO R.** RABENA

ABSTRACT

The study aimed to compare the topographic survey conducted in Phase I and proved assumption that river bank depression occurs during the quarrying operations.

The data obtained in the survey were compared with those of the available data in Phase I. The volume was computed through the average-end-area method. Only three (3) among the four (4) quarry sites of the first phase was considered namely: Namruangan, Cabugao; Paing, Bantay, and Bio, Tagudin, Ilocos Sur.. Libtong Tagudin, Ilocos Sur was not considered because quarrying has been stopped. The volume quarried in Phase I was noted to be negligible. It was found out that for the span of one year, the volume hauled at the quarry sites were 28,395 cu. meter; 634 cu. meter, 2,068 cu. meter for Namruangan, Cabugao, Paing, Bantay and Bio, Tagudin, Ilocos Sur respectively.

It was observed that there is a decrease in elevation of the water line of the river in Paing and Bio quarry sites and there is a shifting of water line to 40 meters south in both quarry sites mentioned. Replacement of extracted aggregates really occurs as proven by the additional 248 cu. meters volume filled in Bio, Tagudin, Ilocos Sur. But there was depression created during the extraction operation and many were not filled up completely.

Objectives of the Study

General

a. to determine the present status of the quarry sites in Ilocos Sur,
b. To assess whether or not quarrying is minimal, moderate or excessive;
c. to recommend effective measures of control to regulate excessive quarrying, in case the present measures are in lax.

Specific

a. to conduct further topographic survey of the sites in Phase I;
b. to prove the assumptions that riverbank depressions during quanying operations are completely filled up after floods.

Review of Related Literature

Erosion, the downward movement of surface materials due to gravity, is a constant geologic process which no human can stop. Its effect is gradual, sometimes unnoticed, provided it is not being triggered somewhere along the process. Forter (1983) cited that one way of triggering erosion is by undercutting the earth's slope. Undercutting is rampant on riverbeds due to the continuous quarrying operations for gravel and sand – the indispensable aggregates of concrete for construction.

As Bruce (1981) observed in his professional chair lecture, erosion is oftenly triggered in many construction sites and off-sites in the Philippines, particularly on projects involving major earth-moving activities. It was also observed that damages due to erosion during construction are, in most cases ignored by engineers and developers. Only when the damage becomes so disastrous to man's life and property loss that people start to act.

Hipolito (1989) stressed out that environmental control, particularly the areas which have developed scouring could be effectively monitored through topographic surveying. Through this survey, the configuration of the earth's surface with

all the natural and artificial features of selected ground fossils are detennined. Davis et al (1981) mentioned the scheme of work to be done in a topographic survey to be as follows:

1. Establishment of a horizontal control by measuring angular and linear measurements of a certain point.
2. Establishment of the vertical control by detennining the elevation of control points by leveling.
3. Determining the elevations and locations of some important features as may deem necessary for the preparation of the topographic map.
4. Computations of elevations, distances and angles as obtained from the previous field work undertaken
5. Preparation of the topographic map, which is actually a representation of the terrestrial relief.

The instrument to be used are: transit, steel taps, level, stadia rod, and range pole. Likewise, the survey team is composed of at least five men.

Methodology

A reconnaissance was done to establish the best point to locate certain permanent points in the ground as reference points in the survey. The topographic maps prepared for the first phase of the study were also used as bases in the computation of the volume extracted after one year. Contour lines were drawn at 0.5 meter interval.

The volume was computed through the average-end-area method. There were only three (3) major quarry sites for the survey namely: Namruangan, Cabugao; Paing, Bantay and Bio, Tagudin, Ilocos Sur. Libtong, Tagudin, Ilocos Sur was no longer considered in this second phase of study because quarrying had been stopped. And the volume quarried in the first phase was considered negligible, hence, the elevation of points on the maps taken at NAMRIA is lower than the present elevation. This is due to the natural replacement of soil and pebbles coming from the sea.

Discussion of Results

Namruangan, Cabugao, Ilocos Sur

The survey is conducted on October 1997, almost a year after the first survey was done. The site is a portion of lot 11,540, PSC-43 Cabugao cadastre covering an area of about 4.5 hectares. The mentioned quarry site is a natural deposit of purely sand, about 150 meters east of the China sea. Generally the site has high hills of sand with grasses sprawling over it.

The surveyor sighted three (3) tuning points. The elevations of Tl to T3 are 2.438, 1.692 and 4.992 meters, respectively.

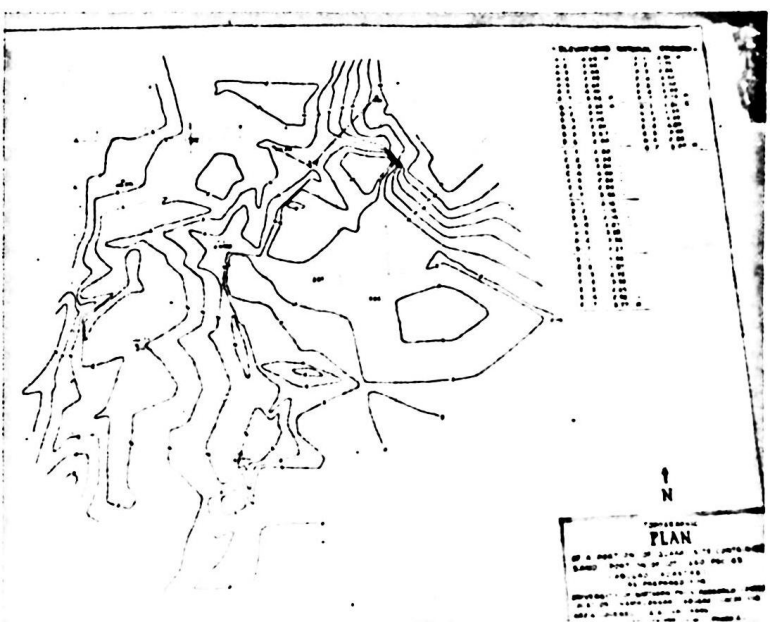

Figure 1

Topographic Map of Quarry Sites of Namruangan, Cabugao, Ilocos Sur

In the map, it is evident that spots have been quarried because of the decrease elevation from a maximum 9.0 meters to 4.0 meters. Traces of excavation because a loader was present during the time of survey.

The volume excavated is found to be 28,395 cubic meters. If hauling will be continuous for ten years the area will be relatively flat.

For coastal regions where sand dunes are prone to develop, hauling of sand and gravel could help develop a once barren land into a profitable form land in the future, if desired by the steward who talces care of the resource.

Paing, Bantay, Ilocos Sur

The survey is done in November 1997, a year after the first survey which was conducted by the same surveyor. The surveyed quarry site covers portions of lots 9619, 9623, 9634, 10227, 9635, 9636, 9641 and PLS-1055-D, situated at Bantay Public Land Subdivision. Figure 2)

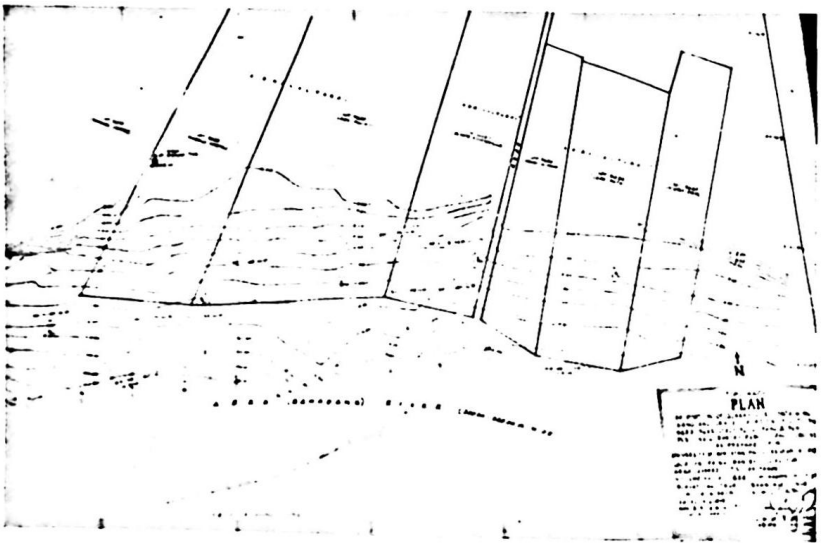

Figure 2

Topographic Map of Quarry Sites at Paing, Bantay, Ilocos Sur

The surveyed site covered in this second phase of the study is approximately 75,000 square meters or 7.5 hectare. The site is adjoining Abra River or Banaoang River which is about 200 to 300 metes in width. It is a natural deposit of river-sand, stones and gravel. The terrain was found to be relatively flat. As to date, however, there are no traces of hauling by contractors, which must be due to the rainy and stonny seasons that had passed or there must have been orders to stop the extraction of the rich natural resources which are indispensable for concrete construction.

A Benchmark (BM) is sighted which has a coordinate of 42919.96N and 41929.06E and has an elevation of 4.618 meters. Said point on the ground is more than 2 kilometers west of Quirino Bridge. On the map, the scale is 1:1000 with a contour interval of *0.5* meter which is the same as the scale used in Phase I of the said study. The surveyor sighted five turning points to determine the elevations of some points on the ground. The elevations of T, to *T,* are 2,363, 1.785, 1.029, 0.397 and -0.137, respectively.

The water line has moved to a mean distance of 45 meters away from the water line last year. The present elevation of water line is from 0.51 to – 1.11 meters, about 0.5 meter lower than last year's elevation. The decrease in elevation will cause the water flow to move west moving toward the delta.

If the water level will rise to a height of approximately 5 meters, the agricultural lands adjacent to the river will be flooded, destroying the plants and agricultural crops of the farmers. Furthermore, the edges on land will be washed out by the water, since no trees are present along the river banks.

As mentioned, the area surveyed is 75,000 square meters and the extracted amount of earth computed on the same site is approximately 634 cu. meters. This means that, if hauling operations will go on there will be more or less 6,340 cu. meters in ten years causing some points to be negative in elevation. This will cause the river to divert to another route resulting to floods in the adjacent barangays during raining season.

Bio, Tagudin, Ilocos Sur

The survey is done November 1997, one year after the first survey of Phase I of the study. The surveyed quarry site covers a 10-hectare area,

characterized as stoney and bouldery with relatively flat elevation. The water flowing in the said river keeps getting shallower and narrower, due to the El Niiio phenomenon. The width of the mentioned river is 300 to 500 meters which separates the provinces of Ilocos Sur and La Union. The site overlooks the forest or timberland in the north and six (6) meters wide Dona Alicia Syquia Memorial Bridge in the east. During the survey, there were some excavations noticed which were not present during the first phase of the study.

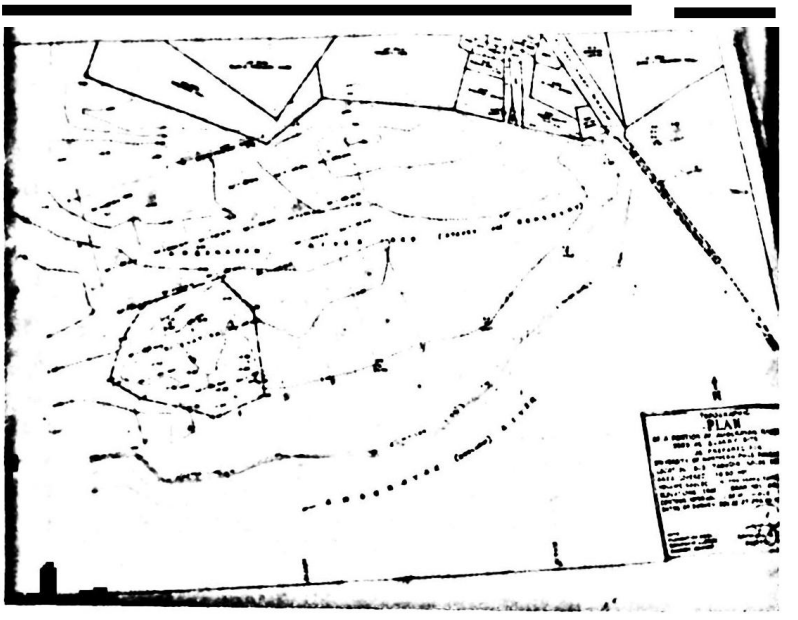

Figure 3

Topographic Map of Quarry Sites at Bio, Tagudin, Ilocos Sur

It is noticed in the map, that the water line has shifted south with a mean distance of approximately 43 meters. The elevation of the water line decreases from 0.05 to -.05. Some 248 cu. meters of soil has been filled into the site, which could have been carried by water or by loaders used in the

quarrying of soil aggregates. The excavated volume (extracted) is about 2,316 cu. meters. Thus the net volume extracted in the site is 2,068 cu. meters. And if quarrying would go on, for ten years the estimated volume of hauled would be 20,680 cu. meters. This would create a wide depression which would impound voluminous amount of water during rainy season causing flood in the western barangays of Tagudin and some parts of La Union. This will also result to the destruction of properties of the residents because of the volume of water in the river channel. Since the velocity of water and the overturning force is proportional to the volume of water, this force may erode the riverbank and sediment deposits would accumulate within the riverbed. But in the contrary this would impound water during dry season because this may cause the water to be stagnant.

Such deposits would cause the river flow to meander or to seek a secondary route. There will be impounded water, clogging the flow of the river.

Another probable condition that might arise is the shifting of the water line which would widen the hauling area of contractor, thus changing the river course. The riverbed would widen to cover the nearby barangay eroding vegetation and formland.

Conclusions

In view of the foregoing discussions, the researchers formulated the following conclusions:

1. The observed decrease in elevation of the water line of the rivers in Paing and Bio quarry sites is attributed partly by the sand and gravel extractions along the river banks, while at a certain angle, the lowering of the water line elevation could probably be due to El Nino phenomenon.

2. Likewise, the shifting of the water line to 40 meters south in both Paing and Bio quarry sites is again partly caused by the sand and gravel extraction, and by the El Nino phenomenon.

3. Replacements of extracted materials do really occur as proven by the additional 248 cu. meters volume filled in at Bio quarry site. Nevertheless, depressions created during the extraction operation may not be replenished completely as the volume of replacements depends upon the volume and frequency of flood that occur.

4. Hauling of sand and gravel is not always unfavorable to the environment. Depending upon the owner's plan and desires, a lot of sand dunes could be converted into agricultural land through excessive extraction.

Recommendations

This research deduces the following recommendations to provide better management of quarry sites.

1. A continuous monitoring of the quarry sites elevation should be done for 2 to 3 years through topographic survey inorder to:

   a. establish the most probable volume of replacement brought by the floods every year. The most probable replaced volume per quarry site will determine the allowable amount extraction in a particular quarry site in a year. This method of restricting hauling operations to safeguard our rivers from flooding is believed to be more effective since we just base our extractions from the ability of the river to flatten its bank's depressions.

   b. To determine the annual shifts of the water line, shifting of the water line is brought about by the lowering elevation of the riverbank and bed. An analysis of the direction and cause of shifting would lead environmentalist to predict the river flow, thereby anticipating any untoward incident that may happen in the future.

2. A survey of all sand and gravel deposits in Ilocos Sur, especially the privately owned lots, to know which of them would wish to convert their present sand and gravel deposits into agricultural

lands. Such cases would be offered as quarry sites ignored to give time for our rivers to attain their natural state of ecological balance.

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