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Case Study For Project Base Learning By Change The Structural Foundation System During The Execution Of Project And It Implications On Project Management

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Abstract

The case study describes the project base learning system by changing the foundation system during the execution of project and its implication on the Financial, Time and Green building. It describes the importance of analysis for the causes of delay, difficulties in execution, over ambitious planning, incorrect task assessment, lack of task clarity, and prevention of delay by mitigation or acceleration, identifying the risks, mapping resources and taking appropriate collective decisions by the project management.

A detailed case study has been carried out for a project consisting of 122 villas on a hill terrain with facility building. In spite of initial delays, the project was completing on time by implementing mitigation and acceleration measures by changing the structural foundation system during the execution of project without affecting the progress and completion date. This project sets an example for project base learning to arrest the initial delay by proper measures, appropriate collective decisions, teamwork and contribution from all the stakeholders to achieve success.

Project description

Project is located in the prime locality of Muscat. Muna Garden project is development to redefine luxury real estate by the distinguishable design and atmosphere. This project consists of 122 built high quality units that come in generally two models (figure -1). The villa type" K" is a luxury stream twin villa block model that separates the two units in an extraordinary style. Both units in villa type K feature a private pool that sits on roof to the open sky to enjoy the moment. The villa type "J" is basic models that bring the luxury affordable. The villa type "J" are built in blocks of 3 or 4 units, where all units are remarkably separated in a creative manner to refresh distinguishability between the units (figure -2).The complex features a Recreation Centre, 24/7 security, easy handover and financing and facility management mobile app for complex residents (figure -3).

Figure -1 (site plan)

Figure -2 (3D view of villa and profile of finish floor level)

Figure -3 (Recreation Centre)

Soil exploration report and its recommendations

Sub surface condition with reference to soil investigation report # J -5577 by Oman Drilling & soil technology Co. LLC.

Filled up layer soil layer consist of reddish to greyish brown loose , silt sand with and without Gravel depth varies from 4 m to 15.2m and at places completely weather LIME STONE depth varies from 9m to 20m.Rock Quality Description varies from Very poor to Poor with reference to BS -5930.

Considering the sulphate and chloride content of the sub soil, concrete cover should be 75mm with protective treatment. Highly Irregular Bedrock Profile, Very Soft Soil Immediately above Limestone Bedrock.

Recommendations

Option -1

Excavating and rejecting filled up sandy soil in the whole plot area up to natural ground level (lime rock level) i.e. 4.0m to 15.2 m depth below the present ground level. Then the foundation may be at depth of 1.5 m below the natural ground level. Isolated pad footing type foundations may be considered for design with net allowable bearing pressure of 200 kpa and net allowable bearing pressure of 150kpa for the design of raft.

Option -2

Excavating and rejecting filled up sandy soil in the whole plot area up to natural ground level (lime rock level) i.e. 4.0m to 15.2 m depth below the present ground level. Whole plot area to be backfill with well graded granular engineering filling material with a geogrid at every 450mm intervals.

Isolated pad footing type foundations may be considered for design with net allowable bearing pressure of 150 kpa and net allowable bearing pressure of 120kpa for the design of raft.

Option -3

Pile foundations – Bearing capacity of piles depends largely on soil properties, type of pile, Method of installation.

Initial structural foundation system

Based on the above recommendations from the soil investigating report, all the three options are explored and financial implications are presented to project management. Option -1 is considered as most economical solution although it is time consuming.

Difficulties in executions, lack of task clarity for planning

Since the project is located in prime location a dense built environment. Following are the difficulties face by the contractor during the execution.

Deep excavation with shoring all around, unsafe for the adjacent roads and buildings.

Limitations in available space for performing work and setting up storage areas Difficulties in logistics (access roads)

Dynamic (e.g. vibrations) and mechanical loads influencing the structure and the ground Negative influence on humans due to noise, traffic movements,

Difficulties in handling the excavation equipment's, such as break down, safe equipment's movement, excavation in hot temperature.

Lack of task clarity for planning.

During the excavation it has been notice that hard strata starting from is at 6m depth though mentioned 4m in soil investigating report. This has a major impact on the depth of excavation, also affecting the height of stub columns below ground. Even though sub structure is a measurable item in BOQ. There is an overall escalation of project cost.

Crises of manpower in gulf region have a major impact on the backfilling activity. Backfilling the whole plot with an imported granular filling material in layers of 150mm and testing each layer with proctor compaction test is a tedious and time consuming process. Moreover requires additional quality control supervision, manpower and Machinery.

Project Environmental impact

As per the recommendations from soil investigation report filled up soil to be rejected and whole plot to be back filled with an imported granular well grade material having dry density of 2.35kn/sqm. This density can be achieved only by importing river base material (wadi base material). This will have major impact on the natural resources, environmental and topographical of site. As a result, there is a huge quantity of excavated material need to be dispose by comply with the requirements of the ministry of environmental and Natural resources.

Potential impacts on the air quality during the huge quantity of excavation will be due to the fugitive dust and the exhaust gases generated in and around the construction site due to vehicular Movement and D G set operations. Dust is major component of air pollution, generated mainly from the following excavation activities: Site clearance and use of heavy vehicles and machinery/ equipment etc. at construction Site; storing of huge quantity of back filing material and Handling of backfilling materials by mixing the water before compaction is tedious time consuming job. Environmental impact of huge quantity of excavation and back filling is shown in figure -4.

Since the location of site is in the prime location, movement of earth moving equipment's produces noise above the tolerance level during the night, so there is restriction in working late hours. So only option is left over is work in day time.

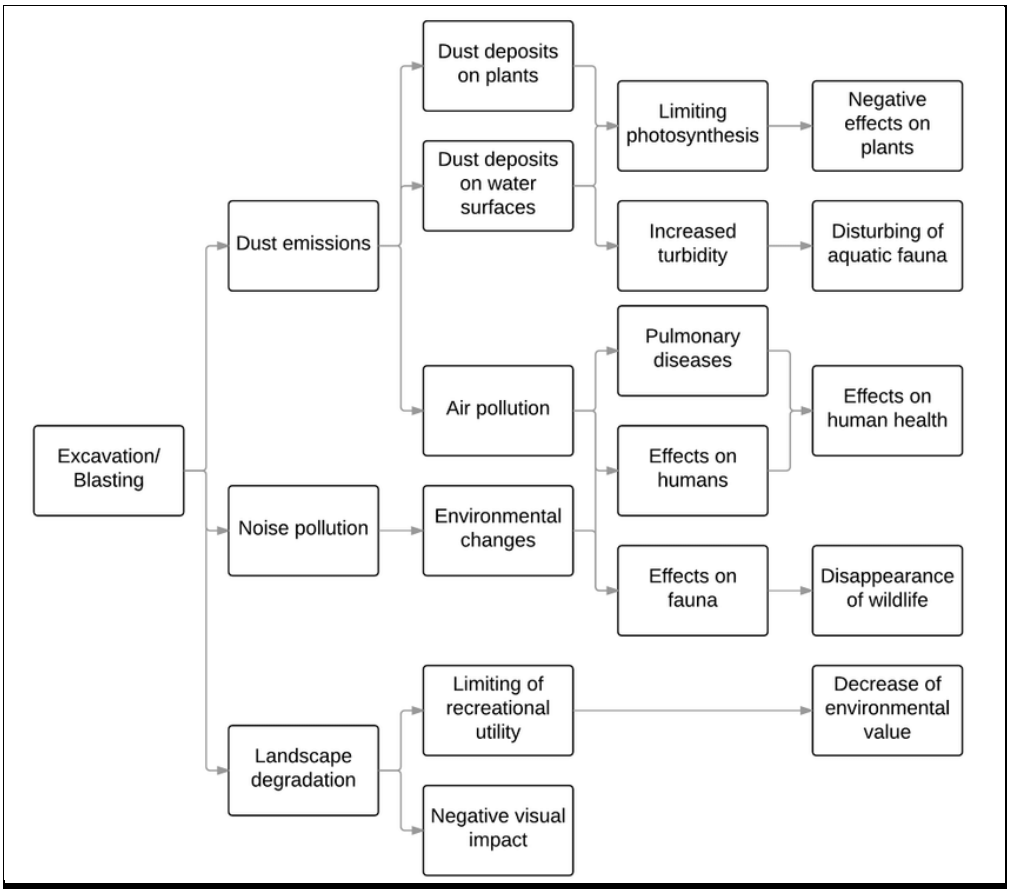

Figure -4 (The environmental impact generated by excavation)

Mitigation by changing the structural foundation system

By reviewing the aspects such as

Difficulties in handling the huge quantity of excavation and back filling.

Environmental impact by the quantity of dust produce and noise pollution during earth moving equipment.

Shoring for the 10 to 15 m depth excavation.

Contractor requested to review the decision for foundation system to complete the project in time by overcoming the initial delays. Project management decide to re explore the option of pile foundation. Contractor proposed the pile design by employing piling sub-contractor. Preliminary design meetings held

between the pile designer and project structural consultants to agree the soil parameters, codes of reference, external road codes, and shoring design concept.

Piling sub-contractor submitted design shop drawings and structural calculations for review of structural consultants after the review by the project consultant drawings are revised and revise drawings and calculations submitted to municipality for review and approval.

Retaining wall is replaced with the continuous piles, short Crete is done to the irregular surface to achieve smooth surface basement wall.

Roads are design by the road design consultants as per the codes requirements. External area is design by considering the settlement aspects.

Time and Financial implications

Building permits from municipality is obtained after three weeks of submission; this whole process of design from design submission to design approval from the municipality took five weeks. Meanwhile site was progressing with mock-up villa other 8 units which were started before. So work did not stop during the approval of pile design. Schedule of mock-up villa is revised to meet the project requirements (figure -5)

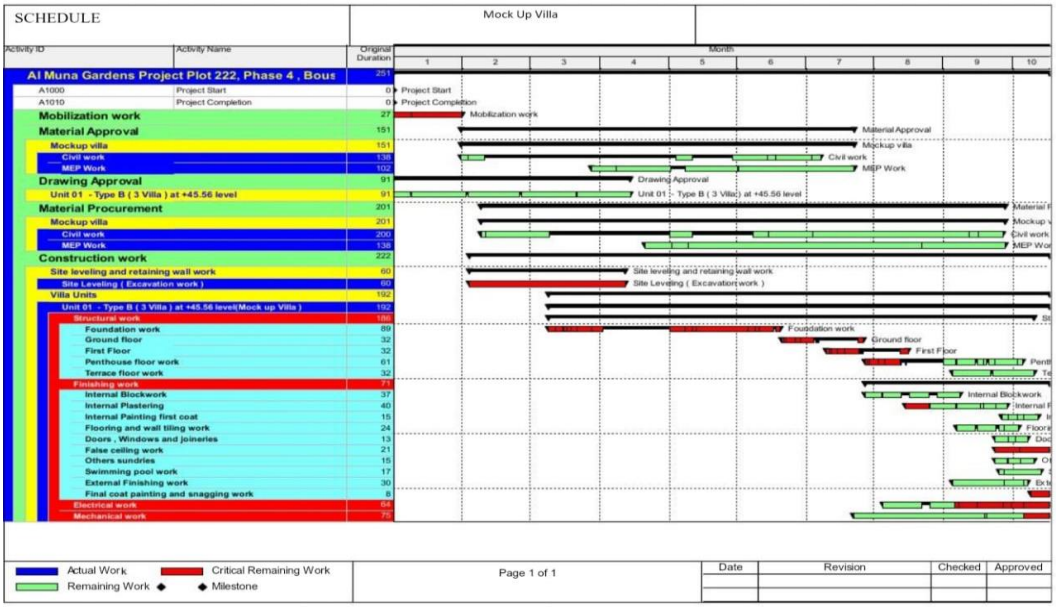

Figure -5 (Schedule of mock up villa)

Pile Foundation works for each unit completed within two weeks, whereas this was taking three months earlier with the excavation, isolated foundations, columns, water proofing, backfilling till the plinth beam in each layer of 150mm, protector compaction testing of each layer.

Initial delay occurred in the project is recovered and moreover this gave positive feedback among the stake holders.

Al though Financial aspects of implementing the pile foundation are costly affair. Still the additional cost of pile foundation equally shared by the client and contractor since this proposal has a mutual benefits. Early completion of project is beneficial to the both parties (figure -6).

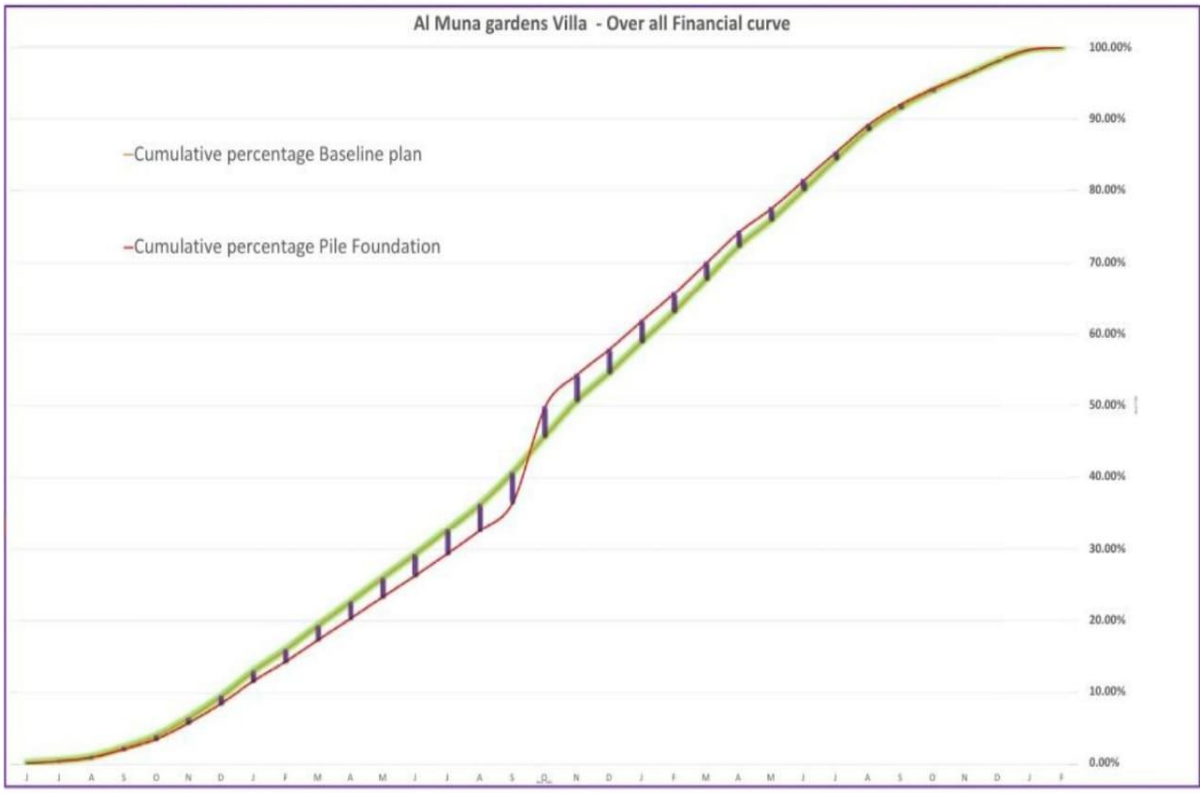

Figure -6 (Overall financial cash flow curve)

Conclusions and suggestions

1) The primary objective of completing the project on time did not happen and there is an uncertainty of completing the project itself hence this project can be termed as a failure from the planning point of view.
2) It can also be concluded the soil sub strata is highly unpredictable. Sufficient number of bore log not available.
3) It can be concluded that the foundation system adopted time consuming which is a direct effect on the cost flow of project.
4) To reduce the environmental impact “decision-makers need to integrate sustainability at all stages of the project life cycle”
5) The contractors should play a positive role in the project and do all possible measures to mitigate any delay that is possible by sequencing of work, deputing resources effectively.
6) The consultant took up critical issues of design of foundations and external roads with the client in time and ensured the Completion of design and approval are works in line with the program.
7) The modifications & changes not having a major time impact were done within the project duration. Major changes were analyzed and time impact done to enable the client to know the time and cost impact and upon his approval of the same the works were executed.

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