# Evaluation of Applicability of Geotextiles in Piling

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ABSTRACT: The application of geotextiles in stabilising weak ground and improving performance of irrigation features like canal lining is well known in the field of civil engineering. The geotextile is also used to serve as wick drains. In recent years some attempts were made to use geotextiles as a sacrificial liner for bored cast in sit piles. Such liners are expected to protect concrete from aggressive environment, reduce negative skin friction and ensure integrity of shaft by eliminating necking of piles.

Since the geotextile liners are quite cheap as compared to conventional steel liners the temptation to use it is very high. The authors have been associated with the construction of piles with geofabric as liners. The experience was not too pleasant. The paper discusses the field problems and performance of such liners and mechanics of behaviour.

## 1. INTRODUCTION

Soft Marine clay deposite are encounted in and around Bombay and for that matter all along the cost line of India in variable thickness. The bored cast in situ piles are commonly used to support structures in this area. These piles are surrounded by very soft marine clay and have to withstand aggressive environment. To overcome problems posed by the adverse subsurface conditions has been the prime objective of all designes associated with piling. The coventional steel liners are too costly and that is how the use of geofabric in lieu of steel liners was contomplated.

From geosynthetics one may obtain geotextile, geogrid and geomembrances. They are highly flexible and do not have ability to negotiate compressive forces. It can resist tension. The thickness of these materials is very small as compared to length and width. The mechanical properties are measured in terms of in terms of force per unit width; strain is measured as L/L and 'E' is defined as

$$E = \frac{F/\text{unit width}}{L/L}$$

For last ten years some geotechnical consultants in India are favouring geotextile/geofabric liners. It is claimed by the users of geotextile liners that the liner serves following purposes.

a) Prevents 'Neck' in the pile. It ensures uniformity of the pile diameter by preventing side collapse of bore during concreting.

b) It acts as a barrier between the chemically aggressive soil and the concrete thus preventing corrossion of concrete and steel.

c) It reduces negative skin friction. By virtue of its smooth surface it acts as a slikp layer between concrete column of pile and surrounding soil. The downward drag acting on the pile created by the relative movements of the soil surrounding pile is thus

drastically reduced thereby increasing the load carrying capacity of piles.

d) It is quite cheep as compaired to the conventional steel liner. The cost of geofabric will be hardly 1/6 of steel liner.

e) The steel liners will have to be welded as the bore progresses while the geofabric is available in pre fabricatied tube form and can be convininetly slipped over the reinforcement cage since it is extremely light the handling is easy.

## 2. PERFORMANCE OF GEOFABRIC LINER

The earliest use of geofabric as liner for bored cast in situ piles in India is reported to be around 1985. However in the begining there were not many takers. Recently for last three years or so, consultants in city of Bombay are showing greater inclination to adipt geofabric liner for bored cast in situ piles. Accidently it so happened in one project that the cut off level was lowered so as to accomodate some changes in planning. This lead to exposing a great number of piles. What was observed was simply a nightmere. The piles with geofabric liner showed terrible errosion.

On the strength of the experience stated the exposure of initial thirty piles with geofabric liner was decided by the clients in another project. Inspite of best efforts by contracting agency the piles when exposed were badly eroded.

These two happenings coupled with few other exposures of fabric lined piles revealed that following problems and destress were observed particularly in the upper portion of piles.

1) Erosion of concrete.
2) Entrapment of geofabric in pile concrete.
3) Twisting and tearing of geofabric liner.
4) Raising of reinforcement cage during tremie concrete.
5) Exposure of reinforcement.

## 3. REASONS OF FAILURE AND DISTRESS

The exposed piles revealed that damage was in the top portion of pile stub within the cased length of bore. This means that during withdrawal of casings the force applied to pull out is leading to tearing of fabric.

The reinforcement was observed to come up with concrete during the surging operation at the time of tremie concrete. The upward and downward movement of tremie leads to the entanglement of loosely tied fabric around the cage with tremie pipes and thus the upwared movement of tremie caused fabric and reinforcement to come up.

The entrapment of geofabric in concrete as consequence of tremie action is noted. The loose geofabric tied around the reinforcement cage gets entagled with tremie and thus entrapped fabric in concrete resulted.

The forces at the time of withdrawal of easings are casing the twisting of geofabric.

The tidal conditions met along the sea coast also have a effect on the geofabric. At low tide the receding

water has a considerable velocity and this causes local bending. Moreover the poured concrete at the bottom starts setting when the concreting of the upper portion of pile is in progress. The partially set pile socketed in weathered rock offers a partial fixity and hence at the time low tide the sucking pressure causes the cantilever condition of the upper portion leading to a considerable amount of bending stresses. The bursting of geofabric was noted at many places.

Exposure of reinforcement as a result of bursting of geofabric or tearing away of fabric was a very common feature observed in nearly 80% of exposed piles. The pull out force during casing extraction and canlever bending of the pile due to receding tide are responsible for the exposure of reinforcement.

The purpose of geofabric is to keep aggressive soil water system away from pile shaft. This is really not accomplished as the bottom of the cage is kept open. The attempt to close bottom with geofabric resulted in floation of cage and cage would not go down. The geofabric is tied to reinforcement by bindling wire and these are the points from where leakage of water can take place. In brief the claim that geofabric liner offers barrier between aggressive soil water systems and freshly laid concrete is not strictly valid.

If the soils are very soft having a shear strength less than or equal to 0.1 kg/cm 2 then the drilling mud may not retain the exposed bore necessiatinguse of casings during the development of bore. This means in such situations geofabric liner can not be used for reasons explained earlier. In case of sites reclaimed using boulders etc. the bore enlarges at the time of withdrawl of casing and this has lead to geofabric tearing in the upper portions on account of loss of support of soil.

## 4. ENGINEERING MECHANIC OF GEOFABRIC LINER.

The stages of construction from the start of concreting the pile to the completion of concreting the pile are given in the sketch.

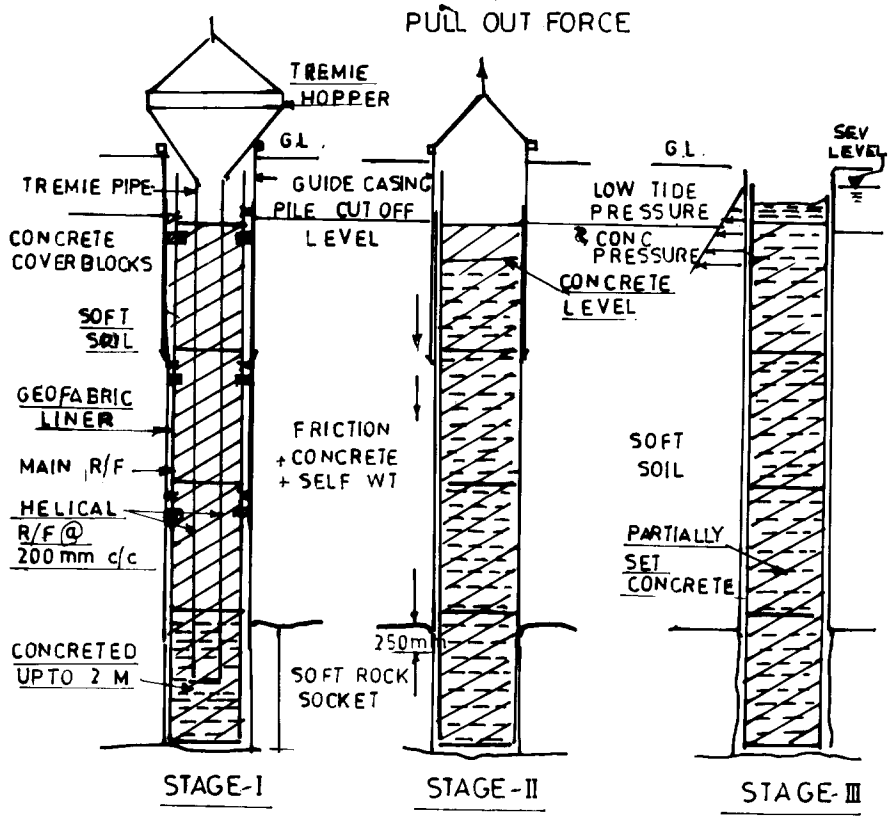
1. **Stage One**

Indicates the initial concrete load poured in the geofabric liner in contact with soil. The geofabric can be looked upon as a thin cyliner subjected to Hoop stress of the order of "PD" units where 'P' is concrete pressure and 'D' is the diameter of pile. If the soild is not offering any support then pouring of about two bags of concrete will cause Hoop failure of fabric. This is a serious restriction as even smallest hopper used in practice is 0.5 $M^3$ capacity. However in actual field condition the fabric will touch the sides of the bore preventing further enlargement and hence stresses (except in strata where cavities are met like the newly reclaimed site with boulders as filling material in that event the height of concrete column goes beyond the 2 bag volume the hoop stresses in fabric will be cross limiting value).

2. **Stage two represents the condition** at the time of withdrawal of casings. There are substential forces developed while withdrawing the casings. The soil surrounded offers friction and the concrete inside adds to the forces of friction required to be overcome so as to retrieve the casings. This leads to a large direct tensile force in the form of pull applied by the piling winch. Consider a 500 mm dia pile with four meter long casings and concrete inside casings for height of 2 meter. The soil however weak may have a friction force of 1 t/m2 (Cohesion). This force plus the concrete and self weight of casings will amount to a substantial force. The casing to geofabric contact is smooth yet assumption of = .25 between the two is reasonable. This force is far in excess of the tensil strength of fabric. The horizantal cracks developed on the exposed piles in the top portion fully support the theoritical calculations.

3. In the top portion of the piles located on the coastal area there will be low tide pressure prartially action on the pile circumference. In these situations the hoop stress conditions do not hold good. the piles will be subjected to bending resulting in

| TECHNICAL SPECIFICATIONS OF GEOFABRIC | |
|---|---|
| TENSILE STRENGTH - KN/m | |
| WARP | 15 |
| WEFT | 25 |
| ELONGATION (%) | 18 |
| BURSTING STRENGTH Kg/cm2 | 25 |
| JOINT BREAKNG - STRENGTH KN/m | 20 |
| WATER PENETRATION | NIL |
| TOLERANCE LIMIT | ±10% |




CONSTRUCTION STAGES OF PILES WITH GEOFABRIC LINER

bursting of geofabric. There was ample evidence of bursting type of failure, provided by exposed piles.

## 4. CONCLUSIONS

From the performance of geofabric in the field it is certain that use of fabric as used today is counter productive.

In case the geofabric is to be used then the fabric should be provided only below the cased length of bore.

Even in sites reclaimed with large boulders etc. the geofabric use should be restricted below reclaimed level.

The geofgabric material used today are not reinforced. The reinforced fabric may solve the problem.

In general a prudent approach is desired in using the fabric.

## REFERENCES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