CONSTRUCTION OF NEW AIRPORT AT PAKYONG
Sikkim, India

REINFORCED SOIL RETAINING WALLS/ HYDRAULIC & EROSION CONTROL /
SLOPE PROTECTION

Product: Terramesh System, Green Terramesh, ParaLink, Gabions, BioMac CC

Preamble:
Sikkim came into existence as a state of India in 1975. Due to its
land locked scenario, the state of Sikkim can only be
approached by road. By virtue of its lush green topography, with a
wide variety of flora-fauna and presence of Himalayas, it has
always been a place of tourist attraction. Sikkim is accessible via
nearest rail head at New Jalpaiguri and the nearest airport is at
Bagdogra which is 120km from Gangtok. Although, Sikkim has
ample scope of tourism development, due to non availability of
airport; the direct accessibility does not exist. For this reason, a
new airport is proposed to be constructed at Pakyong, which is
situated approximately 33km from the capital Gangtok.

Problem:
The site of proposed airport at Pakyong is on a hilly terrain having
valleys and spurs with an acquired area of around 200 acres. The
runway strip is planned along N-S direction and the hill is having a
natural slope from West (uphill cutting portion) to East (downhill
filling portion). Since a plane surface (min. 150m wide) is required
for the construction of structures, cutting of uphill portion should
be done and the same material shall be filled at downhill portion to
get the required level of runway.

The constraint that material from cutting should be used in filling is
mandatory. As such the entire project is to be designed in such a
way that, total volume of cutting shall be equal to total volume of
filling. The range of cutting and filling heights are 4m-111m and
4m-72m respectively.

Sikkim receives a very high annual rainfall. Due to heavy rainfall
intensity, storm water drain is one of the important aspects of this
project. Secondly, local people are using the water from the 11
Jhoras (natural streams) crossing runway to meet their day to day
water requirement. Proper drainage system has to be provided
along with the conveying structures of the existing Jhoras to en-
sure that maximum water is available for the habitants at down-
stream side.

One of the most specific requirements of the client, Airport Au-
thority of India (AAI) is to have an eco-friendly solution on cutting
side, as this area is direct visibility from runway and terminal build-
ing and the construction should not have adverse impact on the
environment and local habitat.

Client :
Airports Authority of India (AAI)

Main contractor :
Punjj Lloyd Ltd.,

Consultant:
Mott McDonald India Pvt Ltd.

Designer:
Maccaferri Environmental Solutions Pvt. Ltd.,

Products used & BOQ (BOQ - yet to be finalized )

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terramesh System</td>
<td>------- Nos</td>
</tr>
<tr>
<td>Green Terramesh</td>
<td>------- Nos</td>
</tr>
<tr>
<td>ParaLink</td>
<td>------- m²</td>
</tr>
<tr>
<td>Gabion</td>
<td>------- m³</td>
</tr>
</tbody>
</table>

Construction info:

Start Date: February 2009
Completion Date: In progress now...
Solution:
Maccferri Environmental Solutions Pvt. Ltd., India has proposed,

1. ParaMesh walls for stabilizing valley side filling (4 to 72m High)
2. Gabion toe walls (3m high) at cutting side to stabilize the slope
3. Protection works for Cutting / filing slopes with erosion control blanket type ‘BioMac CC’
4. Drainage Works for channelizing surface runoff and natural streams using Gabion cascades and RCC structures.

The terrain at site was mainly a mixture of soil and rocks. In upper strata, rock was fragmented and highly weathered. With depth, weathering decreases and soft to hard rock was encountered. Based on proper flying clearance required for the aircraft with respect to adjoining hills, the level and width of runway was fixed.

The uphill portion was cut and used for the filling operation to get the required leveled platform for runway. The cutting uphill slope will be stabilized by providing Gabion walls of height 3m, which will also act as drainage toe walls. The cut slopes to be covered with erosion control blanket made of coir. The coir mat would minimize the surface erosion due to rain and surface run off and at the same time promote quick growth of vegetation. Thus the cut slope will quickly get stabilized and blend with beautiful surroundings. The erosion control blankets are to be suitably anchored to the finished slope using “U” pins.

To retain the fill within the Airport boundary on valley side, retaining structure of height varying from 4 to 72 m were planned. ParaMesh system has been adopted for construction of retaining structures. ParaLink as a primary reinforcement of grades varying from 200 to 900 were introduced in the soil mass to retain the soil vertically or at steep slope by virtue of interaction between soil and reinforcing elements. To prevent sloughing failure of the facia and to achieve improved compaction, Green Terramesh, Terramesh or a combination of both were used depending on space availability and need for taking a concrete culvert through.

Once constructed, these ParaMesh structures will be the highest among the “Reinforced steep slope” structures in world.

Keeping in mind the fact that distributing natural system has a big impact on the stability of hill slopes, the drainage system was proposed in such a manner that no water will be retained by Airport interference. 11 No. Jhoras (Natural Streams) were identified within the site boundary among which 9 were crossing the runway strip.
As cutting of slopes (on West side) would result in loss of natural flow path for these 9 Jhoras, Gabion cascades were proposed to channelize these streams from top of cutting till top of Gabion toe wall and the surface run off was collected at the intercepting drain by providing series of catch water drains; Which finally distributes water into a longitudinal drains provided along the entire length of runway. The gradient of these longitudinal drains are designed to distribute the flow of these 9 Jhoras into 4 concrete culvert which runs transverse to the runway and discharges out through the bottom of ParaMesh Structure.

Since the height of fall from RCC culvert at downstream side is relatively high (9-11m), Gabion drop structures were proposed at culvert exit for energy dissipation and scour protection of ParaMesh foundation.

**Current Status of Project:** Works like ParaMesh construction, Laying of BioMac CC for cutting & filling slope and drainage activities are in progress currently, after the halt for Monsoon 2011. It is important to mention here that, these high ParaMesh structures successfully withstood the catastrophic seismic event that happened in Sikkim in September 2011, right after the monsoon period which enhances the criticality further.
While most of the other infrastructure failed in Sikkim, ParaMesh structures of this project performed excellent owing to their flexible nature, though the seismic event happened was theoretically more than the magnitude for which these structures were designed.