A Study on the Relationship between Siltation and Flow Parameters of a Typical Alluvial River-Manas, A Tributary of Brahmaputra

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Abstract— *Silt is defined as the granular material of size somewhere between sand and clay. Silt may occur as a soil or as sediment mixed with water as known as a suspended load in a body of water such as a river. It may also exist as soil deposited at the bottom of a water body. The natural process of the decay of organisms into the water can lead to the production of silt at the bottom of a river. Silt can be generated in the streams by mining, agriculture and other industries and sewage. Through these study an attempt has been made to record periodical observations of the river Manas, a tributary flowing into the Brahmaputra river, to record its different hydrodynamic properties viz. amount of silt carried, velocity during the period, discharge, cross-sectional properties etc. and to study its various aspects and then recommend some enhancing eng*ineering solutions.

Keywords*—*Discharge, Granular material, Hydrodynamic properties, Silt, Suspended load, Velocity.

I. INTRODUCTION

India is known as one of the most flood-affected countries in the world. In every year some or other part of the country get inundated during floods. Therefore floods are now considered as natural disaster. However, compare to the other natural disasters such as, earthquakes, landslides, etc, flood is still be possible to manage to a great extent. Structural measures & non-structural measures are the two widely known options for flood management. Mixtures of both the options are used for controlling the floods in these days.

Assam one the North-Eastern states of India is gifted with the mighty river Brahmaputra. It has enriched the inhabitants with rich alluvial soil and with its civilization.

But due to the geographical and many other reasons it has now become a cause of sorrow for some people in many parts of the region. The erosional activity of flowing water is one of the most critical threats amongst them. The causes of the river erosions are, deforestation, heavy rainfall, flood, strong current of the river bed, silt deposition etc.

As such, in order to divert this and to protect the bank from cutting and eroding; various river training works have been undertaken. Lots of financial and educational resources have been spent in this regard with little fruitful result so far, but in most of the cases it has been seen that these measures is not yielding satisfactory result. Absence of standardized data for the design purpose for different channels may be one of the reasons behind such failures, even if flow parameters are different for different channels. Thus, there remains a knowledge vacuum and hence a scope for serious study. With this objective keeping in mind, this project work is initiated to study the seasonal variations of different hydraulic parameters of a particular channel reach over a period of 8months to give some satisfactorily solution match the prevailing situation in the field.

II. SITE OBSERVATION

2.1 THE STUDIED REACH: MANAS:

In this paper it describes study of river Manas a tributary of Brahmaputra passing through the lower Assam region. It runs 104km through Assam. It passes throuh areas such as Bhandara No 3, Balarpet, Bashbari No 6, Gonbinna, Golapara West pt3, Golapara pt1,Matraghola, Boroichala and finally joins the mighty Brahmaputra River at Jogighopa. Our study is mainly concentrated upon Golapara pt1 area where its average width is 51 meters for a section of 0.3kms. The entire section is then divided equally into six sections each measuring 50 meters. Different flow and dimension related parameters at each sections are observed periodically after every fortnight or so and the observations are duely recorded.

Fig.1: Google image of the studied reach, River Manas (Source: Google earth)

2.2 METHODS:

1. The entire section of 300m is first divided into six sections equally, each sections measuring 50m .
2. The depth of water and cross section along with various flow parameters of the river is calculated.
3. At each section the depth of the flow is measured in 3m interval along the cross section.
4. The velocity of the flow is measured with the help of a float and a stopwatch.
5. For the calculation of silt, the river water is collected from about a depth equal to one third of the flow depth on a graduated cylindrical container measuring 100 ml. The percentage of silt load carried by the flowing water is then calculated as the ratio of the volume of silt collected in the container to the volume of water in the container.
6. Sieve Analysis is done to find the shape parameter co-efficient of uniformity C_u and co-efficient of curvature C_c.

$$C_u = \frac{D60}{D10}$$

$$C_c = \frac{D30^2}{D10 \times D60}$$

Where, the D_{10} represents a size in mm such that 10% of the particles are finer than this size. The D_{10} is called effective size.

D_{60} represents a size in mm such that 60% of the particles are finer than this size.

D_{30} represents a size in mm such that 30% of the particles are finer than this size.

III. RESULT AND OBSERVATION

A river reach as shown in the map has been studied over a period of 8 months for different hydrodynamic parameters. The summaries of observation are tabulated as under:

a. **Graphical Representation of Field observations over a time of Eight months:**

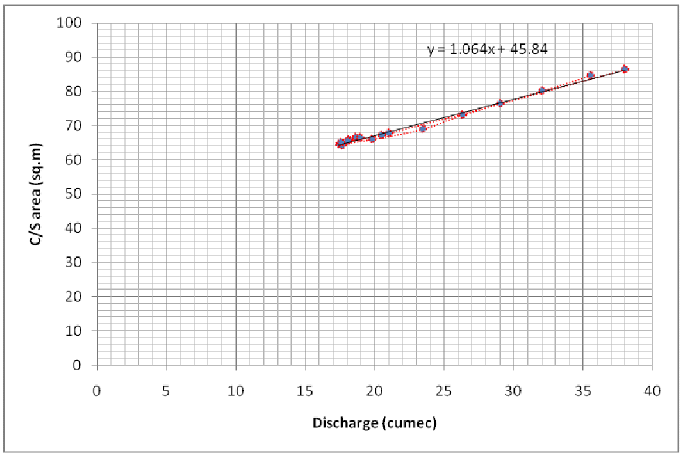

Fig. 2: Discharge vs. C/S area

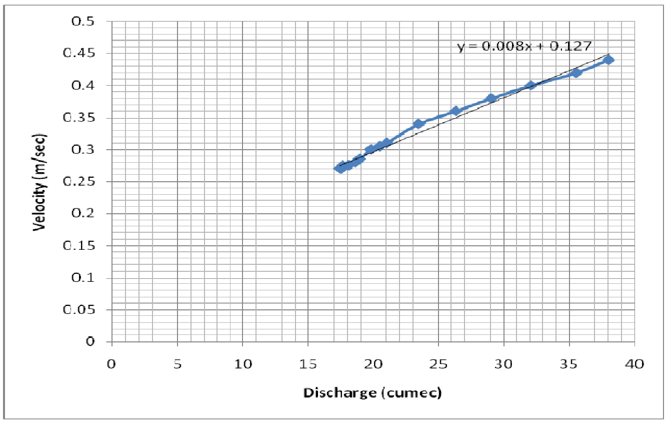

Fig. 3: Discharge vs. Velocity

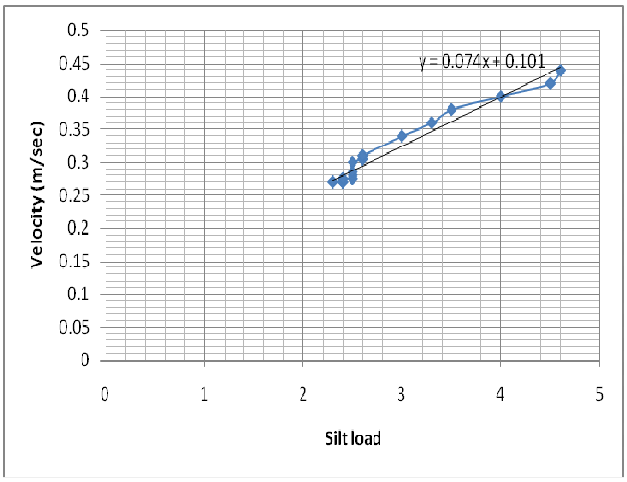

Fig. 4: Silt load vs. Velocity

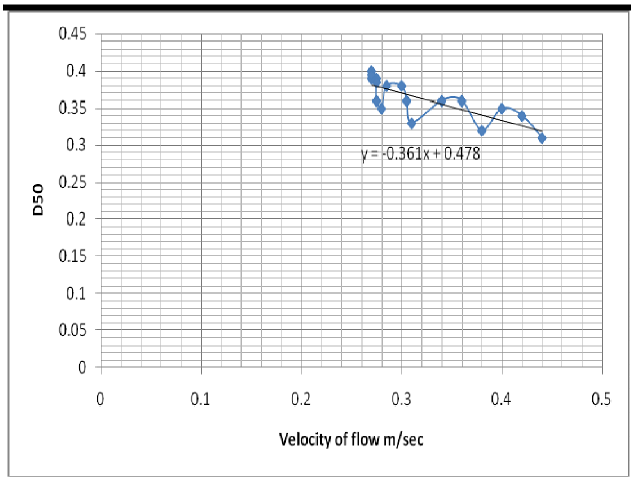

Fig. 5: Velocity of flow vs. D50

3.2. Sieve analysis of the river bed materials collected during field observations:

Table 1

Date	C_u	C_c	Soil type	Silt factor (f)
26/09/15	2.22	1.25	Poorly graded Fine sand (SP)	1.026
08/10/15	2.00	1.05		1.041
21/10/15	1.90	1.07		1.056
02/11/15	2.11	1.03		1.06
15/11/15	2.00	1.02		1.084
25/11/15	2.10	1.07		1.113
08/12/15	2.10	1.11		1.05
23/12/15	2.35	1.15		1.04
04/01/16	2.17	1.04		1.099
18/01/16	2.16	1.16		1.084
02/02/16	1.95	1.08		1.099
15/02/16	1.95	1.15		1.11
28/02/16	2.00	0.91		1.09
10/03/16	2.00	1.125		1.056
23/03/16	2.277	1.387		1.011
05/04/16	2.105	1.032		0.996
19/04/16	2.277	1.139		0.98

Where: Silt factor (f) = $1.76\sqrt{D_{50}}$

3.3 Summary of Field observations over a time of Eight months

Table. 2

Date	AVG. DEPTH OF FLOW (m)	AVG. AREA OF C/S (sq.m)	AVG. VELOCITY OF FLOW THROUGH SECTION (m/sec)	AVG. DISCHARGE THROUGH SECTION (cumec)	AVG. VOLUME OF FLOW (cu.m)	avg. SILT CARRIED IN % OF VOLUME OF WATER	VOLUME OF SILT CARRIED within the flow section of 300m (cumec)
26/09/15	1.78	84.67	0.42	35.56	25401	4.5	1143.05
08/10/15	1.67	80.20	0.40	32.08	24060	4.0	962.40
21/10/15	1.64	73.13	0.36	26.32	21939	3.3	723.99
02/11/15	1.54	69.00	0.34	23.46	20700	3.0	621.00
15/11/15	1.38	66.03	0.30	19.80	19809	2.6	515.03
25/11/15	1.34	64.53	0.27	17.42	19359	2.5	483.98
08/12/15	1.35	64.20	0.275	17.65	19260	2.4	462.24
23/12/15	1.38	66.55	0.28	18.63	19965	2.5	499.13
04/01/16	1.36	65.88	0.275	18.12	19764	2.5	494.10
18/01/16	1.365	66.46	0.285	18.94	19938	2.5	498.45
02/02/16	1.355	65.00	0.27	17.55	19500	2.4	468
15/02/16	1.36	65.08	0.27	17.57	19524	2.3	449.05
28/02/16	1.365	65.63	0.275	18.05	19689	2.4	472.54
10/03/16	1.39	67.19	0.305	20.49	20157	2.5	503.93

23/03/16	1.395	67.80	0.31	21.02	20340	2.6	528.84
05/04/16	1.65	76.45	0.38	29.05	22935	3.5	802.73
19/04/16	1.81	86.45	0.44	38.04	25935	4.6	1193.01

IV. CONCLUSION

In this study, an attempt has been made to find out different hydraulic parameter of the studied tributary. From the above mentioned seasonal data and graph it can be conclude that:

1. Fig. 2 shows that as discharge increases cross sectional area also increases. This is quite obvious from the fact that increased c/s area causes more volume of flow. Thus the field observations get well with the theoretical concept.
2. Fig. 3 shows that discharge increases with increase in velocity. This observation is also well supported by theoretical concepts.
3. Fig. 4 shows that as velocity increases silt load also increases. This observation can be explained from the fact that as velocity of flow increases, more and more portion of the bed load will be converted from contact load to suspended load. Thus the volume of silt carried in the flowing water increases.
4. Fig. 5 shows a trend that D_{50} decreases as the velocity increases. This is quite obvious from the fact that as velocity increases, the heavier bed material will be carried by the flow of water. Hence the av. size of the bed material eventually gets reduced.

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