ISSN: 0976-3104
SUPPLEMENT ISSUE
Zolfegharifar and Bosak.

ARTICLE OPEN ACCESS

STUDY OF BEHBAHAN CITY VELOCITY WAVES SHEAR

SY Zolfegharifar1[1,2] , M Bosak [2]

[1]*Department of Geotechnics &Transportation, Faculty of Civil Engineering, Universiti Teknologi Malaysia, MALAYSIA*

[2]*Department of Civil Engineering, Yasooj Branch, Islamic Azad University, Yasooj, IRAN*

ABSTRACT

Behbahan town as one af the important cities of Khuzestan province located in oil reservoirs range and power transfer lines because of sitting in boundary under the making –land units and zagrosprehole at front fault side of mountain that caused heavy earthy uakes with it is movement and also existence of occurousareas.study of previous earth quakes shows that local geology situations ,soil,sediments,and aerobic rocks on bed rock cause aggration of land movements arising of earthquake and it can be said that most importandfactorin final control of area earth quake to structure is building characteristics.sectional waves is animportand extraordinary property of soil which is strongly related to soil dynamic and trembling geoTechnic phenomenons and land movement that is caused by earthquake is by reason of sectional-waves spreading from rock bed towards soil upper layers,that ,irturn cause sectional trans formation along spreading.For acquisition to this assessment,different geotechnical and geology in formation related to Behbahan city Is collected and sectional waves rate is computed bypre send empirical relations

Published on: 25th– Sept-2016

KEY WORDS

earth, quake,land-making, trmbling,bulding,stanard penetration number,sectional

***Corresponding author:Email:**yzfsayyed2@live.utm.my;**Tel:** +989013617474; **Fax:**+987433313212

INTRODUCTION

Earth movements which caused by earth quake is because of sectional waves dispersion from bed rock toward upper layers[1].to do widening carefully, we should spend much expenses to do special actions such as sounding about different limitations specially its financial costs, possibility of new soun ding did not exist in studied area and for knowledge of geo technical situation, we take action to collect results of accomplished laboratorial or open-air tests in considered erea, it is used governmental or private institutions geo technical reports such as accomplished studies for different projects like construction of residential buildings, determining under-ground water and ect. By reason of not being geo technical sunding, it is tried touse accomplished studies by oil companies located around Behbahan city ti achieve mire exact in formation from soil layers han profile. thus, researches data are used in analyze of soil layers response in earth quake interval resarch about 16 geotechnical sounding and wet is stusied, and these soundings involve different brigade to 20 meters depth map of geo technical sondding place is shown in figure1.of course, there are remarks in clarifying some of place geotechnical featurers that we will point them in next section. Dependingon extent of needed information ,degree of earth quake danger widening is divided in to less care arena(Grade-1),mean care(Grade-2)and muchcare (Grade-3) [2].Forlittle care widening basedon survey pressent data from damages resulting of past earth quakes, special information arena has little cost care.in mean care arena, much more geotechnical in formation is required them methods with little care and so necessary time and cost to do these studies compared to little care studies, is more.al o ,we can use geotechnical reports of private and governmental (teoropen-air test results in considered area.for much care (Grade-3) geotechnical ex cavations, to accoplishpentrtion Tests(CPT-SPT),sampling soil for laboratorial tests, geotechnical ways and collecting present in formation. From erea is necessary. expenses of this kind of earth quake danger widning is much,but exact widning is justifiable for places involovinghigt earth quake danger potential,and vital and sensetive present facilities and future of geotchical studies in behbahan city is seetional wave rate determination with least cost and make studies in shortest time,flattenig care with attention to quality ,and extend present and collected information ,is considered mean care.summary of gotechnicstuy results as sample for 1,2 and 16 sounding is presented in **[Figure-1]** .

THE IIOAB JOURNAL
ISSN: 0976-3104

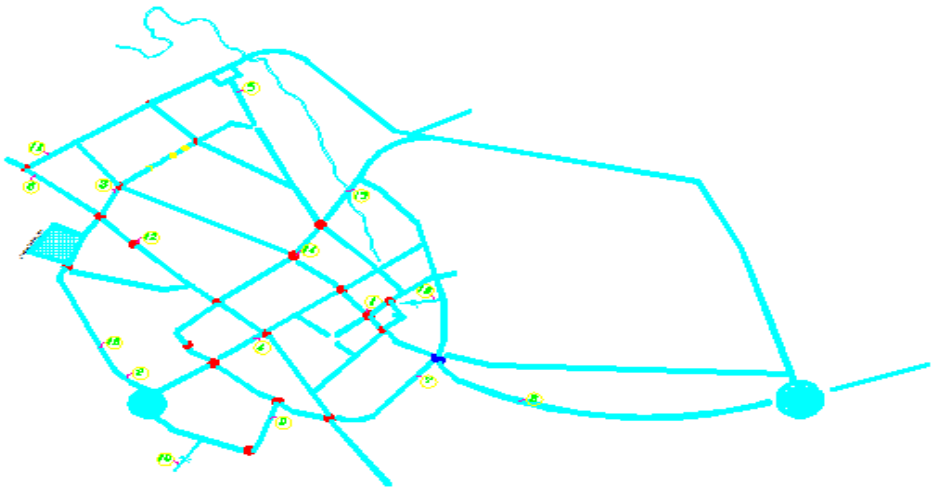

Fig: 1. Place and number of sample geotechnical sounds in present study

MATERIALS AND METHODS

Geotechnical remarks of studied place

In [**Table-1**]with attention to ex cavation high costs for exact determination of behbahan alluvium thick ness,it is tried to collect in formation in this field.attained information ftom oil company and water and sewage organization,maron dam and also study of geology maps shows that behbahan soil thck ness is 250 to 35 meters. 2.2.Mass,ps=1/95g/cm3.of curse,it is tried that in every soudinganalyze,for 20 meter,depths downward,spt number to ascertain sectional wave rate estimated based upper layers of same soun ding.Because of that special weight change has not much effect on analyzing layers,special mass of soil with fixed extent,ps=1/95,in depths under 20 meters is supposed for all soundings.

measured number spt in geo techni studies is measured intermsof N10 (penration number based standard eneryyratio 10%).Nnumbers in prresenceunder ground water for depths nder 15 meters with assumpion that spt number of these depth measures besedonspt number upper layers,for N>15 adjust in form of N=N-15(N-15)(there is not sounding for number 1,2).

Table:1. Summary of granular test results,eterberyglimits,moisturepercentag and standard penetration number.

Borehole	Dep	$w\%$	$LL\%$	$PI\%$	SPT	ρ_w	USCS
1	0-2	30	-	-	13	1.83	-
	2-4	-	23	7	50	2.2	GC-GM
	4-6	9.1	26	10	28	1.95	CL
	6-10	28	25	9	85	2	CL
	10-13	-	25	8	50	1.98	CL
	13-16	-	28	12	70	2	CL
	16-20	-	26	9	50	1.98	CL
2	0-3	28	25	10	50/11	1.85	CL
	3-6	28	23	7	50/15	1.85	CL-ML
	6-10	28	24	8	50/9	1.85	CL
	10-16	-	26	10	50	1.85	CL
	16-20	-	-	-	50	1.98	CL
16	0-1	-	-	-	13	1.83	CL
	1-3	8.3	36	15	13	1.67	CL
	3-4	10.6	34	15	13	1.69	CL
	4-5	10.6	34	15	14	1.71	CL
	5-6	16	34	14	14	1.75	CL
	6-8	22.7	33	13	14	1.87	CL
	8-14	-	-	10	14	1.95	CL

THE IIOAB JOURNAL
ISSN: 0976-3104

RESULTS

Correlation between sectional wave rate (vs) and spt number

Earth tremblins that caused by earth quake is because of spreading swares that are known as sectional waves, cause sectional trans formation along spreading[2].with attention to particles Trembling direction,sectional waves are divided into two elements SV(movement in vertical surface) ,SH(movement in horizontalsurface. Sectional waves is an extra or denary property that is strongly related to soil dynamic phenomenon's and trembling geoterch nicetoday ,to determine sectional wave rate for soil layers that is one of the important parameters in addition to object module Gs',we can act in two ways:1-tests with little tension ,2-tests with high tension. Tests with low tension(tremblinggeophysics tests)usually act in tension rageswitch are not they are mostly in congestion under 0/001%Because of this ,most of them are wave spreading based theory in linear materials.most of them are related to measurement of volume waves rate that are easily connectable with soil module in coge.since,most sectional,conge,trembling geophisical tests produce less than 0/0003%measured sectional wave rates are usable for compuationGmax[1]:

$$G_{max} = \rho v_{\beta}^{2} \quad (1)$$

using measured sectinal wave rates,are usually most reliable way to measure open-air numbers Gmax for a special layer of soil and trembling geophysic tests are usually used for this .for tedts of which present conge is less than 0/0001 such as open-air trembling tests G,result of tests is G_{max}.highcongesation test are most common type formesuring conge properties abov soils such as resistance.so,their result is also connected tration test (spt) is oldest and most common open-air test geotechnicaplications.Number SPT is number of standard hammer strokes invilvin 64kg weght that is necessary for penetration 30 cm from standard to-floor tube spt in to soil.spt number is used for different aims such as internal friction angle θ and special weigt for soily.soe modification is made to lessen error.inherentsuchasGmax with penetration parmeterswich are relevant to more much conges,from in formation variance that take action according them,and also from attained results changes by different researchers.because of this ,utility of such relations is limitd to primary estimation Gmax[3].it is suggested some rempirical relations among vs and SPTnumbr.witch some of them is explainable as following:with city ,an cheapier method to determine sectional wave rate by helping .sorrelation bed ween sectional wave rate and number of standard penetration strokes (SPT)is presented.Yapaneseresearchaerli(1992)[4]:

$$V_S = 82.8(N^{0.134})(D+1)^{0.225} \quad (2)$$

$$V_S = 84.5(N^{0.118})(D+1)^{0.246} \quad (3)$$

where D is considered layer and Nis standard penetration.
Relations(2) and(3) are forcl and ml/cl soils.
Hardian and richart (1963),reported obtained results from intenisfication column on otava dry sand.in these equations,vs is related to porosity ratio and applied effective pressure and explaain as following [1].

$$V_S = (19.7 - 9.06e)\sigma_0'^{0.25} \qquad \sigma_0' \geq 95.8\,KN/m^2 \quad (4)$$

$$V_S = (11.36 - 5.35e)\sigma_0'^{0.3} \qquad \sigma_0' < 95.8\,KN/m^2 \quad (5)$$

In above equations,$v_s$and σ_0'units are orderly interms of m/S and N/M^2. 60 average of lateral effective pressure equals with octahedral effective tension $\sigma_0' = \frac{1}{3}(\sigma_1' + \sigma_2' + \sigma_3')$ which in that $\sigma_1', \sigma_2', \sigma_3'$ are oredrlyminimum ,mean and maximum main efective tension of soil.Harian and richart suggested following redationbasdon different tests of grain soils.

$$V_S = (18.43 - 6.2e)\sigma_0'^{0.25} \quad (6)$$

Schmertmann(1978)msuggestedfollwing relation forsand:

$$V_S = 10to\,20N_{60} \quad (7)$$

Seed etal(1986),and later,jamilkowski(1978),presented an approximate relation for sectional wavesrate of different soils.

$$V_S = C_1 N_{60}^{0.17} Z^{0.2} F_1 F_2 \quad (8)$$

C_1=said and colleaqus,jamiolkwskietal suggested 69 and 53/50
Z=dephwherespt number is obtained for 60%entergy and is intermsofm.

THE IIOAB JOURNAL ISSN: 0976-3104

F_1-is age parametor,for alluvium deposit and old alluvium deposit is 1ind 1/3,respectively.
F_2=is determinaed for every kind of soil with regarding to following **[Table-2]:**

Table: 2.show kind of soil

	Clay	Fine sand	Med sand	Coarse sand	Sand & Gravel	Gravel
F_2	1.0	1.09	1.07	1.11	1.15	1.45

Yoshidetal (1988),presented following relating for different soils[5].

$$V_s = C_1(\gamma z)^{0.14} N_{60}^{0.25} \quad (9)$$

where y2=mean pressure and load in depth z intermsofKPa.
C1=is determined for every kind soil with attention to below **[Table-3]**

Table: 3. Show kind of soil

Soil	Fine sand	25% gravel	50% gravel	All soils
C_1	49	56	60	55

Bazeyar and coworkers presented following relation for iran soil (N<=50)

$$V_s = 134 D^{0.2} N^{0.3} \quad (10)$$

Where D is considered layer depth ,nis standard penetration.
Jafari and coworkers presented following relation for Tehran soil
Vs=100N0/53 (11) vs=43/3 N0/03 (12)
(11)and(12) relations is for non-adhesive and adhesive soils, respectively.
Toniuchi(1982),Imai presented following relation for large-grain soils [5]:

$$V_s = 75.4 N_{67}^{0.351} \quad (13)$$

Go to and ohta (1978)suggestedfollowng relation[5]:

$$V_s = 94.2 N_{67}^{0.34} \quad (14)$$

this relation along with relations (15),(16),(17),(18) are relations that present secional wave rate vs h terms of nor spt for different soils:

All types of soils $V_s = 85.34 N^{0.348}$ (15)
Clay $V_s = 85.6 N^{0.34}$ (16)
Sand $V_s = 81.32 N^{0.34}$ (17)
Gravel $V_s = 104.6 N^{0.34}$ (18)

DISCUSSION

In addition to above cases,sectional wave rate vs inter msof soil depth H is presnted for different types of soil[6]:

$$V_s = 92.12 H^{0.339} \quad (19)$$

$$V_s = 78.98 H^{0.312} \quad (20)$$

$$V_s = 78.98 H^{0.312} \quad (21)$$

$$V_s = 178.1 H^{0.312} \quad (22)$$

THE IIOAB JOURNAL
ISSN: 0976-3104

Relationas(19)to(21)are for ;all types of soil ,clay ,standard Gravel soils,respectively.
In all relations,sevctional wave rate is in terms of (m/s) and his interms of(m).
By placing relations (15)with(19),(16) wih(20),(17)with(21)and (18) with(22),following relations is achieved between H and N.

$$N = 1.244H^{0.974} \quad (23)$$

$$N = 0.789H^{0.918} \quad (24)$$

$$N = 1.905H^{0.918} \quad (25)$$

$$N = 4.784H^{0.918} \quad (26)$$

We can use relations (23) to (26) for pleaces that (N)SPT is not clear in soil depths.
(26)relation and formula bsedontype,depth,SPT number and soil geology period is presented in different forms which fitting to changes in these parmeters,sectionalwavee rate of soil layers is identified.As we can observe,most of heserelatiosre presented by japaneses.because of that obtained relations is more coonsistend with japan soil and jeologysituation,It is not used relations15 to 26.relations 11 and 12 which are special to tehran soil are not used.In **[Table-4]** relation Bto H .are used for compting sectional wave rate of cley soil and relationyto s are used for computing section al waves in lorg-grain soils relations A and I are used for both soils.relations T to W are special for sand soils.

Table:4. Presented relations for determining sectional wave of behbahan soil

NO.	SOURCE	RELATIONSHIP
A		$G_{max} = \rho v_s^2$
B	Lee (1992)	$V_S = 82.8(N^{0.134})(D+1)^{0.225}$
C	Lee (1992)	$V_S = 84.5(N^{0.118})(D+1)^{0.346}$
D	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1\times1$
E	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1\times1\times1.3$
F	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1\times1$
G	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1\times1\times1.3$
H	Yoshid et al (1988)	$V_S = 55(\gamma z)^{0.14}N_{60}^{.025}$
I	Bazyar et al	$V_S = 134D^{0.2}N^{0.3}$
J	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1.45\times1$
K	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1.45\times1.3$
L	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1.45\times1$
M	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1.45\times1.3$
N	Tonouchi (1982)and Lmai	$V_S = 75.4N_{67}^{0.331}$
O	Ohta & Goto (1978)	$V_S = 94.2N_{67}^{0.34}$
P	Yoshid et al (1988)	$V_S = 60(\gamma z)^{0.14}N_{60}^{.025}$
Q	Hardin, B. O., and Richart, F . E., Jr. (1963).	$V_S = (18.43-6.2e)\sigma_0'^{0.25}$
R		$V_S = (11.36-5.35e)\sigma_0'^{0.3}$
S		$V_S = (19.7-9.06e)\sigma_0'^{0.25}$
T	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1\times1.07$
U	Seed et al (1986)	$V_S = 69N_{60}^{0.17}Z^{0.2}\times1.3\times1.07$
V	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1\times1.07$
W	Jamiolkowski et al (1978)	$V_S = 53.5N_{60}^{0.17}Z^{0.2}\times1.3\times1.07$

CONCLUSION

When diffused volume waves resultiny.ffoult break arrive in land between different geology materials,thay reflect and refract.while waves spreading rate in less depth materials is generally less then materials under them, arieted rays that en counter with horizonal layer from tier.Usualy re flect in more vorticaldirection.when waves arrive earth surfase ,their numerous refractions cause their direction tobeperpendicular to earth surface.One of the importand parameters in trembling geo technic computer program and one dimension earth reply,is sectional wave rate by two ways .firstly,sechanal wave rate is directly determined by using trembling ways.In second way,sectional rate of soil layers is determinaed by use of empirical relations between sectional wave rate vs and number of standard penotration test storks spt.Because of that first method is expensive,second way is mostly used.insecond way ,sectional wave rate iof soil layers is deter minedbasdon test result spt and by present empirical relations betwennvs,spt.some of effective factors in determining these relations are geology age effects,depth and soil type.In this research,many relations is used to determine sectinnal wave rate,but best relation wich was consistent with our regien is selected and average is achieved.also ,new relations based on present relations for places where has not spt number or there is in low depth present by author.it should be mentioned that this type of relathan studied area ,so thay are not without error.

CONFLICT OF INTEREST

None

ACKNOWLEDGEMENT

None

FINANCIAL DISCLOSURE

None

REFERENCES

[1] Aktan T, Farouq Ali, CM. lY75, Effect of cyclic and in situheating on the absolute permeabilities, elastic constants, and electrical resistivities of rocks: Sot. Petr Eng., 5633.

[2] Backus MM, Castagna, JP, Iregory, AR. [1979] Sonic logwaveforms from geothermal well. Brazoria Co., Texas: Presented at 49th Annual International SEG Meeting, New Orleans.

[3] Castagna JP, Batzle ML, Eastwood RL. [1985] Relatioship between compressional-wave and shear wave velocities in clastic silicate rocks. Geophy. 50:571-581.

[4] Krief M, Garat J,Stellingwerff J, Ventre, J.[1990] A petrophysical interpretation using the velocities of P and S waves (full-waveform sonic). The Log Analyst, 31, November,355-369.

[5] Xu S, White RE.[1996] A physical model for shear-wave velocity prediction: Geophysical Prospecting, 44: 687-717.