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Contents

The Effectiveness of Different Rate of Penetration With Different Shapes in Cone Penetration Test (CPT) on Recess Batu Pahat Soft Soil

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الخلاصة

يستخدم اختبار اختراق المخروط على نطاق واسع لتقييم خصائص التربة في الموقع و وصف الموقع. والنتائج المباشرة من اختبار اختراق المخروط هي مقاومة المخروط ، احتكاك الجوانب وضغط الماء داخل المسام، اليوم تشهد أغلب مناطق العالم انخفاضًا في مساحة التربة الجيدة من أجل التنمية ، وبالتالي يحتاج المهندسون إلى حل بديل في البناء على التربة الرطبة. الهدف من هذه الدراسة هو قياس مقاومة الأطراف باستخدام أنواع مختلفة من مجموعة أشكال بمعدلات اختراق مختلفة. شكلى الكرة والحرف تى بار تعرضان العديد من المزايا بدلا من الشكل المخروطى التقليدي لاختبار قوة مقاومة الاختراق للتربة الناعمة .معدلات سرعة الاختراق المستخدمة كانت كالتالى 5مم / ثانية ، 20 مم / ثانية ، 40 مم / ثانية. أظهرت النتائج المتحصلة من الشكلين تي بار والكرة ارتفاعًا يتراوح ما بين 2-4 مرات وأعلى بمقدار 3-5 مرات على التوالي مقارنة بالشكل المخروطى التقليدي عندما أستخدمت في تربة باتو باهات.

الكلمات المفتاحية: معدل الاختراق ، اختبار اختراق المخروط ، مقاومة المخروط ، شكل الكرة ، شكل تى

Abstract:

The cone penetration test (CPT) is widely used for the evaluation of in-situ soil properties and site characterization. The direct results from the cone penetration test are cone resistance, sleeve friction and pore water pressure. Today every part

of the world experience a decrease in the good soil area for development and therefore engineers need to have an alternative solution in construction on soft soil. The aim of this study was to measure the tip resistance for the different type of tips shape at different rate of penetration using the conventional cone, ball and T-bar tips. The ball and T-bar tips offer several advantages to conventional tip used for the in-situ estimation of penetration resistance and strength of soft soil. The rates of penetration used were 5 mm/s, 20 mm/s, 40 mm/s. The results based on tip shapes showed that the ball and T-bar give 2-4 times higher and 3-5 times higher respectively than the standard tip. For Batu Pahat clay, tips with higher surface area gave better results and based on the tip shapes used in this, the T-bar tip gave better results. For the penetration rate .
Keywords: Rate of penetration, Cone penetration test, Cone resistance, Ball shape, T-bar shape, Tip resistance.

1. Introduction

The cone penetration test (CPT) is among the most popular site investigation methods that provide ground data with simple, rapid, accurate and economic process. The cone has several built in electronic sensors such as pore pressure meter and load cells and it pushes into the ground with a constant rate and the soil parameters can be continuously measured. [1,2]

One of the most common parameters measured from the CPT is the tip resistance. The value can be calculated by load cell and projected area of cone shape.

Instead of the conventional CPT, T-bar or Ball penetration tests (these tests will be called TPT and BPT, respectively hereafter) have gained attention .As more detailed description of these penetration tests will be presented in the following section, the most significant advantage of TPT and BPT over the Conventional CPT is its accuracy in measurement of the tip resistance, although the whole penetration resistance increases because of large cross section area of TPT or BPT. Using TPT and BPT, site investigation was carried out with different of penetration rate 5mm/sec, 20mm/sec and 40mm/sec, however the objective of this paper is to determine the tip resistance to overcome the problems of the CPT in soft soil and to assess the effectiveness of tip shape in Batu Pahat soft soil.

2. Literature review

According to Dung et al, were carried out the ball penetration test by using a 20 ton capacity CPT machine which is able to conduct the CPTU in dense similar to that of the CPTU except that the balls were used Instead of the cone tip. To evaluate the variation of the ball factors with respect to ball Sizes, Four different ball sizes were used as illustrated in Fig (1). The balls Type-1 to Type-3 were made of duralumin while the smallest size was additionally made of copper.

Type 4 shows a step of the BPT at the moment just before the ball Type-2 was carried out. Table (1) shows basic parameters of the balls. In study, the balls were made to associate with the cone of 15 cm², Thus the ball connector diameters were all the same of 4.37 cm. The projected area is the cross sectional area of the ball corresponding to the maximum diameter, and the projected area ratio is the ratio of the cone cross sectional area to the ball projected area. [3]

Fig (1). Ball Types Used for the Tests [3]

Table (1): Basic Parameters of The Balls [3]

Parameter	Type 1	Type 2	Type 3	Type 4
Diameter (cm)	11.28	8.74	6.18	4.37
Projected area (cm²)	100	60	30	15
Area of rod (cm2)	15	15	15	15
Projected area ratio	0.15	0.25	0.5	1.0

Zhou and Randolph, in 2007 they fabricated the cylindrical T-bar and spherical ball shapes because they have become popular as alternative to conventional cone penetrometer for characteristic the strength of soft sediment and fabricated shapes they offer several important advantages over the cone, including improved resolution of the measured resistance, reduced uncertainty owing to correction for the overburden stress compared with a cone penetrometer. [4,5]

Instead of the conventional CPT, T-bar or ball penetration tests (these tests will be called TPT,BPT respectively hereafter) have gained attention (for example Randolph, 2004). As more detailed description of theses penetration tests will be presented in the following section the most significant advantage of TPT and BPT over conventional CPT is its accuracy in measurement of tip resistance, although the whole penetration resistance increases because of large Crosse section area of TBT, BPT

3. Methodology

Cone Penetration Tests (CPT) :

The cone penetration test CPT tests were conducted using a standard cone dimension of 35.7 mm and a projected area of 10. Penetration rate was carried out at 5mm/sec. 20 mm/sec and 40 mm/sec to get different cone resistance, the intervals recorded readings every 0.01 m. cone resistance was computed from equation no (1).

q_c= cell load/projected area (1)

Where (q_c) cone resistance, cell load, projected area is cross sectional area.

T-bar tests were conducted by unscrewing from probe and replacing it with the T-bar. The T-bar used in this case is similar to the T-bar used by NGI and COFS being 250 mm long and 40mm in diameter with smooth surface. [6]

Tests were conducted in the same as conventional rate of penetration CPT tests although and two rate of penetration one less than conventional rate 5 mm/sec and another one more than conventional rate 40 mm/sec conducted at same situ.

The Ball used in this study rather than to conventional CPT without pore pressure. the diameter of the ball 100 mm and smooth spherical surface however Penetration of the Ball was conducted in the same method as CPT tests at a rate of 20 mm/sec, and two different rates more, first one 5 mm/sec and second is 40 mm/sec, and measurements of intervals 0.01 m. [7]

Fig (2) Cone ,T-bar & Ball shapes used in this study

T-bar, ball, and conventional CPT penetrometers were implemented at Batu Pahat characterized test site The site were chosen based on previous research and characterization indicating the large range of cone resistance in T- bar values more than ball because the projected area of T-bar greater than ball and conventional CPT

Table (2) Results of Tip resistance Penetration Tests in Cone

Rate of penetration	5 mm/sec	20 mm/sec	40 mm/sec
Depth (m)	1-4	1-4	1-4
Cone resistance (Mpa)	0.114-0.171	0.26-0.29	0.21-0.26
Ball resistance (Mpa)	0.56-1.05	0.9-1.19	1.23-1.38
T-bar resistance (Mpa)	1.12-2.63	1.26-1.73	1.41-1.74
Cone resistance (Mpa)	0.23-1.04	0.32-1.05	0.30-1.44
Ball resistance (Mpa)	1.27-2.53	1.33-2.51	1.36-3.03
T-bar resistance (Mpa)	1.15-2.63	1.51-2.88	1.59-3.51

4. Results and Discussion

Influence of shapes .

Cone Shape:

The Testing at the RECESS Batu Pahat site was the first comparative study of the different rate of penetration conducted in soft clay soil. Three rates have been used, one of them smaller than the standard rate of 20mm/s and another one higher than standard rate 40mm/s. The rates were used until 8m depth to evaluate the rate effect on CPT in soft clay. The measured cone resistance q_c are shown in Fig (3).

The data from Table (3) shows that q_c have increased with the increase of Penetration rate. This is in accordance with (Danziger and Lunne 2012), the general trend results between q_c20/q_c40 less affected than q_c5/q_c20 and q_{c5}/q_c40 pointed out in the table and Fig (3).

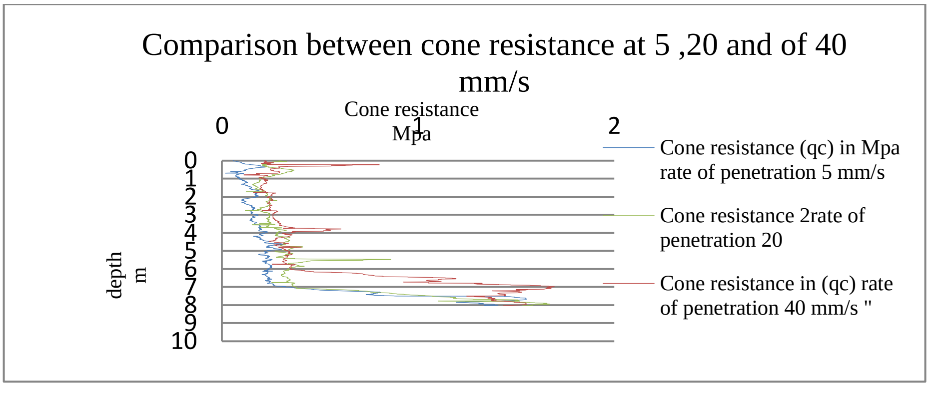

Fig (3) Comparison Between Cone Shape Resistance In Different Rate Of Penetration

Table (3) Difference Between qc5/qc20,qc5/qc40 and qc20/qc40

Depth (m)	q_c5/q_c20 %	q_c5/q_c40 %	$q_c20/q_{c4}0$ %
0-1	30-40	30-70	10-20
1-2	20-40	30-50	10-20
2-3	30-50	30-60	10-20
3-4	20-30	40-60	20-10
4-5	30-40	40-70	10-30
5-6	20-50	10-40	10-20
6-7	20-40	30-40	10-20
7-8	30-50	30-70	20-30

Ball Shape :

When performed BPT in Batu Pahat's soft clay with the various rates 5, 20, 40 mm/s and 80 cm^2. Most of the results showed an increase of resistance with different rate increase, within the first 2 meters $q_{ball}5/q_{ball}20$,

$q_{ball}5/q_{ball}40$ the q_{ball} increased about 30-50% but the difference between q_c20/q_c40 decreased from 10-20%. In lower depths the percent of resistance mostly increases from 0-10%, so the effective rate of penetration when I used the ball shape decreased with the depth, but at the surface I got good results especially with low and high penetration of rate of 5mm/s and 40mm/s. But the resistance of the rate 20,40mm/s is slightly corresponding at depths between 4-6 m. finally the rate of Penetration effected on Batu Pahat soft clay from a ball shape but effectiveness less than the cone shape. Fig (4)

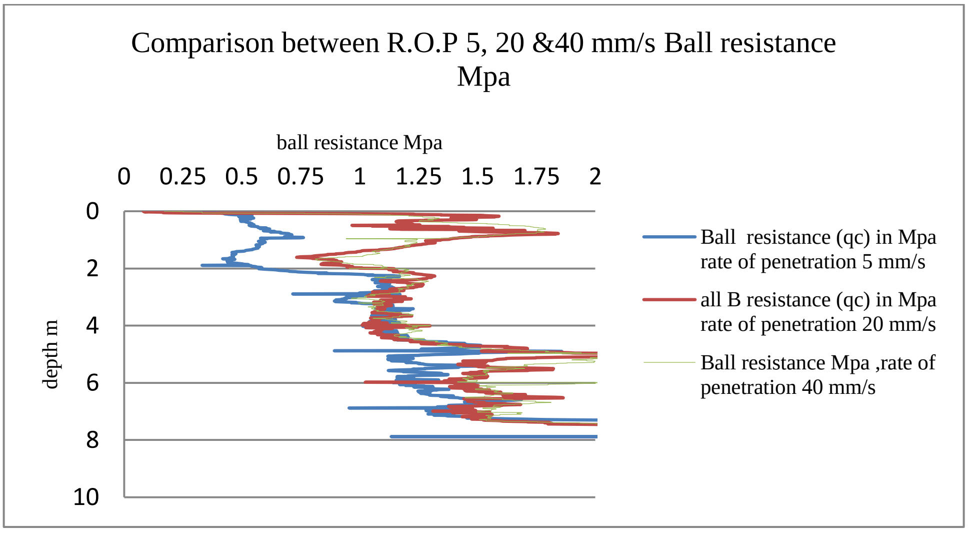

Fig (4) Comparison Between Shape Resistance In Different Rate Of Penetration

Table (4) Difference Between $q_{ball}5/q_{ball}20$,$q_{ball}5/q_{ball}40$ and $q_{ball}20/q_{ball}4$

Depth m	q_{ball} 5/q_{ball} 20 %	q_{ball} 5/q_{ball}40 %	q_{ball}20/q_{ball} 40 %
0-1	20-50	30-50	10-20
1-2	40-50	40-60	0-10
2-3	10-30	10-30	0
3-4	1-10	1-10	0
4-5	1-5	1-5	0
5-6	1-4	1-5	0
6-7	10-20	10-30	0-10
7-8	1-10	5-15	1-5

T-bar shape :

When performing TPT in Batu Pahat's soft clay with the various rates 5,20,40mm/s and 100 cm^2, Most of the results showed an increase of resistance when the penetration rate increased according to (Danziger and Lunne 2012) . The T-bar resistance increased about 0 to 10% per $q_{T\text{-bar}}$ 5/$q_{T\text{-bar}}$ 20 and 10% to 20% per $q_{T\text{-bar5}}$/$q_{T\text{-bar}}$40 in the first three meters but the resistance is more than affected when the different rate of penetration is qc20/qc40, the resistance increased about 0%-10% as pointed out that in Table (5) . The different rate is less affected in the lower depths from 4-8m. The resistance induced from different rates is more corresponding, which means the different rate of penetration is less affected in Batu Pahat soft clay, especially when using a bigger projected area instead of the standard cone.

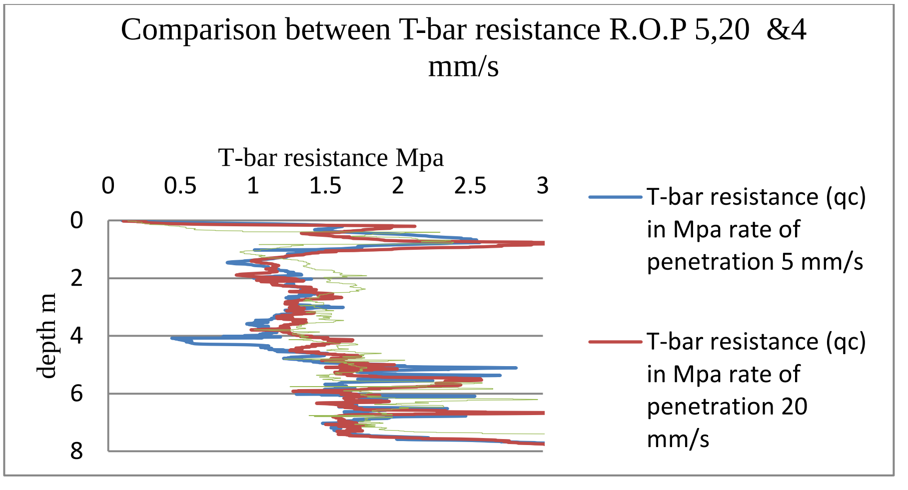

Fig (5) Compare Between Shape Resistance In Different Rate Of Penetration

Table (5) Difference Between $q_{T\text{-}bar}5/q_{T\text{-}barl}20, q_{T\text{-}bar}5/q_{T\text{-}bar}40$ and $q_{T\text{-}bar}20/q_{T\text{-}bar}40$

Depth m	$q_{T\text{-}bar5}/q_{T\text{-}bar\ 20}$ %	$q_{Tbar5}/q_{T\text{-}bar40}$ %	$q_{T\text{-}bar\ 20}/q_{T\text{-}bar\ 40}$ %
0-1	0-10	10-20	0-10
1-2	0-10	10-20	0-10
2-3	0-10	10-20	0-10
3-4	1-10	1-10	0
4-5	10-20	10-20	0
5-6	1-5	1-5	0
6-7	1-5	1-5	0
7-8	1-5	1-5	0

5. Conclusion

From in-situ tests carried out at Batu Pahat soft clay site to investigate the effect of tip shape in soft soil, the test was carried out by three different shape standard cone shape, ball and T-bar shape at several depths to evaluate the penetration resistance. The CPT, Ball and T-Bar shapes were carried out at the same speed 5mm/sec, 20mm/sec and 40 mm/sec. The conclusion as follows :

1. The measured cone penetration resistances, ball and T-bar penetration resistance (q_{cone}, $q_{T\text{-}bar}$, q_{ball}) generally, smaller shape produces smaller penetration resistance.
2. The measured q_{ball} resistances more affected than T-bar shape in soft Batu Pahat clay because the ball shape is more sensitive than T-bar shape
3. The ball and T-bar penetration resistance are found close to similar. This finding implies that the balls and T-bar would the projected area close to each other.

4. The effectiveness rate of penetration on soft soil Batu Pahat when using T-bar shape especially between 5mm/s and 20 mm/s but less influence in high rate of penetration 40 mm/s the qt-bar 20 and qt-bar 40 they are quite similar.
5. It is found that the relationship between the rate of penetration and tip resistance is close similar when exceeds 20 mm./s

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Figuring out Cutting Lag Time and Receiving of Core Cuttings from Core Barrel During Drilling of Formations

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الخلاصة

جميعنا يستعمل النفط ولكن من الصعب أن يتخيل العالم الحديث بدون نفط، ومن الصعب أيضا الحصول على النفط واستخراجه من الأرض، وبالطبع أنه لا نستطيع رؤية النفط المحاصر في أعماق الأرض. من الضروري للجيولوجيين دراسة الصخور بدقة عندما يتحققوا أو يعلموا أن الصخور في مكان ما تحتوي على النفط ومن هنا تجري عملية الحفر.

النفط والغاز كلاهما ليس من أنواع الصخور ولكنهما يشتقان من الصخور، مثل الصخور الرسوبية والتي من أهمها صخور الحجر الرملي، الحجر الجيري والدولومايت والتي يمكن أن تكون مسامية ونفاذة للنفط والغاز والماء وهي بالتالي تمثل مكامن نفطية. معظم الشركات النفطية تتطلب معمل بيولوجي على مواقع حفر أبارها، وذلك لإجراء فحوصات أولية على الفتات الصخري وعلى الطبقات الحاوية للنفط والغاز أثناء عمليات الحفر. المصدر الرئيسي للحصول على المعلومات الجيولوجية تحت السطح هو من خلال الفتات الصخري ومن خلال العينات الأسطوانية اللبية.

الفتات الصخري هو قطع صغيرة من الصخور تنتج خلال عملية الحفر، أما العينات الاسطوانية اللبية هي عبارة عن عينات صلبة دائرية الشكل ذات أقطار وأطوال مختلفة يتم حفرها لغرض التعرف على نوع الصخر وأنواع السوائل في المكمن.

خلال عمليات الحفر يتم دفع سائل حفر من السطح خلال عمود الحفر ويتوجه هذا السائل مباشرة الي قاع البئر ثم يعود هذا السائل الي السطح وذلك عن طريق الفراغ الدوراني بين عمود الحفر وجدران البئر وعند عودة هذا السائل إلى السطح يتم غربلته وتنقيته وإعادته إلى قاع البئر مرة ثانية. هناك فاصل زمني بين لحظة حفر الطبقة وبين عودة فتات هذه الطبقة إلى السطح ويسمى هذا الزمن "الزمن الفاصل" والذي يمثل العمق الحقيقي الذي أتى منه الفتات الصخري من قاع البئر.

تهتم هذه الورقة البحثية بكيفية حساب الزمن الفاصل الذي يحتاجه الفتات الصخري لكي يصل من قاع البئر إلى السطح كما تهتم هذه الورقة أيضاً بكيفية الحصول على العينات اللبية من جلباب اللب أثناء عمليات حفر اللب.

الكلمات الدالة: الصخور الرسوبية- الحجر الرملي- الحجر الجيري- الدولوميت– الفتات الصخري- العينات اللبية- سائل الحفر- جلباب اللب.

ABSTRACT:

Most of us use oil, and it is difficult to imagine the modern world without oil, but oil and gas are not, easy to find and get out of the earth. It is of course we cannot see the oil which is trapped deep, down in the ground. Geologists must study rocks carefully, and when they know rocks in a certain place, containing oil or gas, drilling processes will then take place. Oil and gas are obviously not rocks, but they are, derived from rocks, like sedimentary rocks.

Petroleum occurs in the pores of sedimentary rocks, the most common are, sandstones, limestone and dolomites, which may contain porosity and permeability filled with oil, gas and water and they can act as reservoir rocks. Most drilling oil companies require a mudlogging unit on their wells, to provide identification and evaluation, of oil and gas bearing formations, during drilling operations. The main, source of geologic data are the cuttings of rocks produced in the process of drilling a well, whears core cuttings are a cylindrical rock sample of different diameters, used to understand, the subsurface conditions, like rock type, pore fluids and detailed reservoir characteristics. In rotary drilling, the drilling fluid is pumped, from the surface, down inside the drill string, and through vents in the, drilling bit at the bottom hole, this fluid returns, back to the surface through the annulus between, the drill string and the walls of the hole carrying well cuttings from the bottom hole up to the surface, were they are collected. There is always a time Lag between when the formation is drilled and when cuttings returns back to the surface, this time is called "lag time". This time used is to ascertain the true representative depth from which cuttings come, controlled by the slip velocity of drilling fluid. The objective of this study is to calculate and figure out the lag time required for well cuttings to reach from the bottom of the well up to the surface and receiving core cutting from core barrel during drilling formation which produce cuttings. A case study for the well (f- 22) drilled to a total depth of 12000 feet, and a core cuttings are taken in this well through the Gargaf formation represents a reservoir rock in this well, and figuring out the lag time of well cuttings form the bottom of the well up to surface.

Keywords: Sedimentary rocks, Well cuttings, Core cuttings, Limestone, Dolomites, Sandstone, Drilling fluid.

INTRODUCTION:

The Quality of well cutting, is a result of the improved drilling practices, working with well cuttings, confronted with two problems, the sample quality and sample quantity, the quality of well cuttings is largely depends on the properties of drilling fluids like mud viscosity and mud density, and if the drilling fluid properties are independent, considerable mixing of well cuttings to reach the surface, cutting may contaminate with cavings, and these cavings carried with true formation cuttings, the size, shape of well cuttings depend on the character of the rock type, and the, sharpness of drilling bit, when well cuttings reach the surface, the whole depth from which cuttings are come is recorded on the sample envelopes and bags, this depth is measured from the top of rotary table.

Representative cuttings, are accurately correlated to the depth from which they come from the bottom of hole.

Every rig has a shale shaker screen, for separating, well cuttings from the drilling fluid as they reach the surface, well cuttings are collected every 10- feet interval in normal situations, but might be collected every 5- feet interval in drilling through pay zones, or any drilling break occurs. In collection of well cuttings it is better to place a piece of board or any catching box should be placed at the foot of the shale shaker in order to collect the complete representative (10-feet) sample drilled.

It is possible in sometimes to pick up a sufficient, amount of representative material for mechanical analysis, for grain size distribution therefore core samples usually requited. Coring is the act of the retrieving a whole sample of the down hole formations, for analysis purpose at the surface. Coring is of the most techniques used to understand the subsurface conditions such as lithology type, pore hole fluids, core samples and well cuttings are needed for porosity, permeability, fluid content measurements because like these properties of the reservoir rocks are important in petroleum technology.

2. METHODOLOGY

The methodology used in this study is a case study for the well (f- 22) drilled to a total depth of 12000 feet, core is taken in this well through the Gargaf formation represents a reservoir rock in this well, open hole is drilled from the casing shoe set at (9220.31) feet up to total depth (12000) feet. The actual data are obtained from offset wells close to the well (f-22) and from company drilling reports. The objective of this study is to:

1. Figuring out surface to bottom and bottom lag time for cuttings collected during the drilling of the well (f-22) from (0-12000) feet.
2. Handling, description and boxing of core samples drilled in the well (f-22) through Gargaf formation at the interval (10860-10890) feet for (30) feet length using conventional coring method.
3. Two improved methods for obtaining subsurface information's about the formations drilled in the well (f-22), these two methods are :

- Examination of well cuttings under Binocular microscope in mudlogging unit.
- Examination of core samples under both Binocular microscope and ultraviolet box.

3. DISCUSSION AND RESULTS:

3.1 METHODS OF FIGURING OUT LAG TIME.

During the drilling operation of the well (f-22) from the surface (waha limestone) to the total depth (Gargaf sandstone), well cutting from this well are collected each 10-feet interval, the collection is based on the lag time which is that time required for the cutting to reach out to the surface from the bottom of the hole[2].

While drilling there are several methods used to figure out the lagtime, these are, solid method and the mathematical calculation method, the solid methods include, gas detector method and solid materials like rice, wood shavings, the mathematical calculation by using standard mathematical equations. There two lag times to be calculated, these are, surface to bottom time and bottom to surface lag time.

3.1.1 Surface to Bottom lag time: this time is the time required to pump a certain volume of mud from mud pumps at the surface until it reaches to the bottom of the hole at total depth of 12000 feet as showing in figure(1).

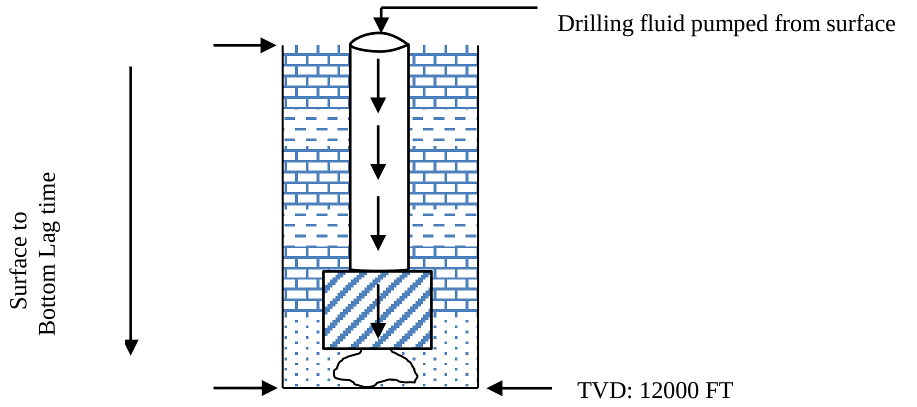

Fig (1) Surface to Bottom Lag time

3.1.2 Bottom to surface lag time: This is the time required for well cuttings to reach the surface from the bottom of the hole at (12000) feet as showing in figure(2).

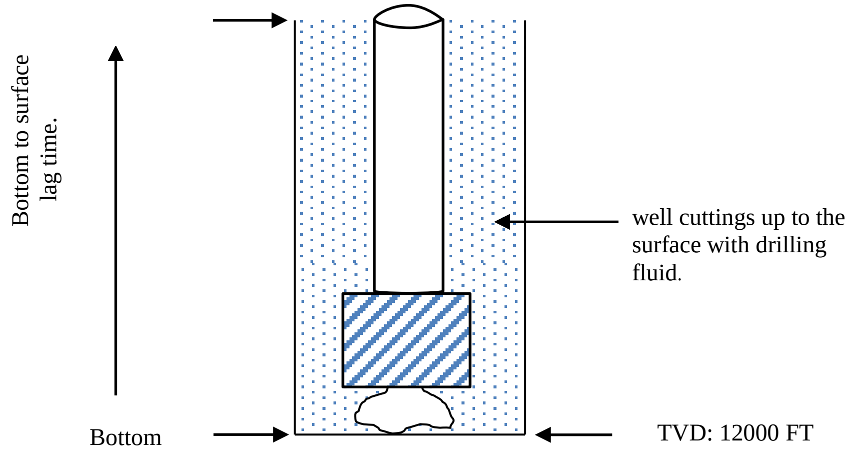

Fig (2) Bottom to surface lag time.

Before calculating the lag time either surface to bottom or bottom to surface time, it is required data about drill pipes, drill collars, casing pipes, mud pumps, hole sizes, casing shoes and rotation rate of mud pumps. These data are collected and available from daily drilling reports or from the driller and assistants drillers on rig floor. [5,6]. The data required in calculation lag time is generally outlined in table (1) as given below.

Table (1) Data required in lag calculations

Drill pipe outside and inside diameters.
Drill collars outside and inside diameters.
Casing pipe inside diameter.
Open hole diameter.
Bottom hole assembly (Drill collars + Bit).
Casing shoe depth.
Mud pump output.
Mud pump rate.
Total well depth.
Note: The outside and inside diameter are measured in inches, the depth is measured in feet and the mud volume is measured in barrels.

NOMENCLATURE: The following abbreviations are used in calculations of lag time and they are presented in table (2) given below.

Table (2) Abbreviations, Used in lag Calculations

OD	Outside diameter.
ID	Inside diameter.
BHA	Bottom hole assembly.
P.O.P	Pump output.
S.P.M	Strokes per minute.
bbls	Barrels.

The Mathematical equations used in calculation are presented in table (3) given below:

Table (3) Standard equations for lag time calculation.

Capacity= $\frac{(ID)^2}{1029.4}$ bbls/ft

Displacement= $\frac{(OD)^2-(ID)^2}{1029.4}$ bbls/ft

Volume of mud inside pipe = capacity * length

Volume of mud with displacement =

(capacity + Displacement)* length

Annular volume without open hole =

[Volume of casing] – [Volume in drill string]

Note:

Drill string includes volume in drill pipe and volume in drill collar.

Annular volume with open hole and casing =

[Volume of casing + Volume open hole] – [Volume of drill string]

Surface to bottom lag time = $\frac{volume\ of\ drill\ string}{p.o.p}$

Bottom to surface lag time = $\frac{Aannular\ volume}{P.O.P}$

Lag time in minutes = $\frac{Lag\ time\ in\ stroke}{SPM}$

Note: lag time calculations are changes by changes of, casing diameter, bottom hole assembly and pump output.

3.1.4 CALCLULATION PROCEDURE:

The Following Drilling data for the well (f-22) is obtained from the driller:

TVD: 12000 Ft.
Casing Shoe: 9220.31ft.
Drill Pipe (OD): 5-inch.
Drill pipe (ID): 4.276-inch.
Casing (ID): 8.625- inch.
Hole diameter: 8.5- inch.
Bottom hole assembly: 430.22 ft.
Drill collar (OD): 6- inch.
Drill collar (ID): 2.50- inch.
Pump out put (P.o.p): 0.158 bbls/ Stroke.
Pump rate (SPM): 60 Strokes per minute.

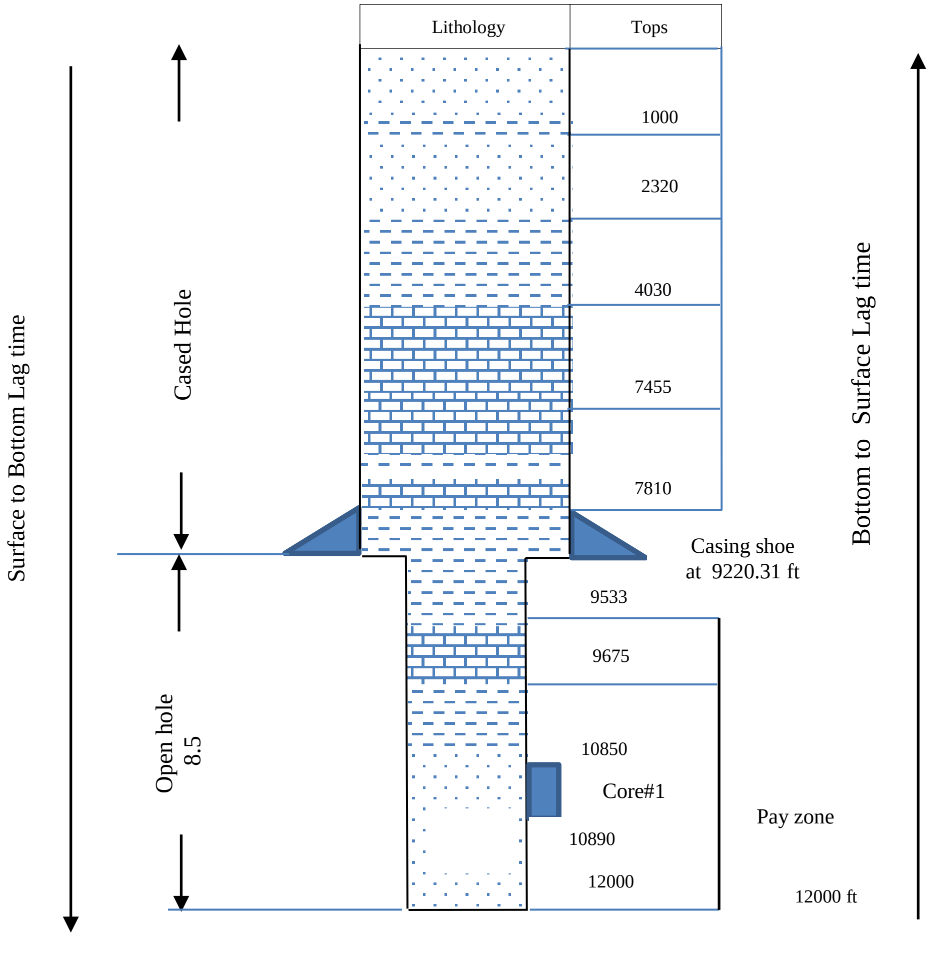

Fig (3) Well (f-22) lithological column

3.1.5 SURFACE TO BOTTOM LAG TIME AT SHOE:

Drill Pipe Length = casing shoe – BHA

= 9220.31-430.22

= 8790.09Ft

Volume of Mud in drill pipe = Capacity * Length

$= \frac{(4.276)^2}{1029.4} * 8790.09 = 156.13\ bbls$

Volume of Mud in drill collar = capacity * length

$= \frac{(2.50)^2}{1029.4} * 430.22 = 2.61\ bbls$

Total volume of mud in drill pipe + drill collar

= 156.13 bbls + 2.61 bbls

= 158.74 bbls

Surface to bottom lag time at

Casing shoe (9220.31 ft)

$= \frac{158.74\ bbls}{0.158\frac{bbls}{stroke}}$

= 1005 Strokes

$= \frac{1005\ stroke}{60\frac{stroke}{minute}}$

= 17 Minutes

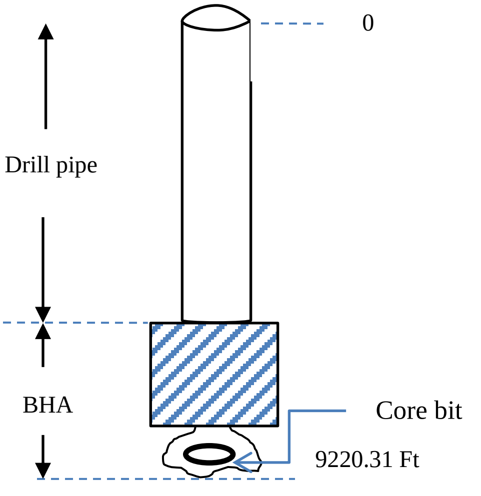

Fig (4) Drill

From calculations, for mud to reach to bottom at 9220.31 ft.

From the surface, it requires (1005) strokes or (17) minutes.

3.1.6 BOTTOM TO SURFACE Lag Time At (9220.31) Ft

Volume of mud in drill pipe with displacement of drill pipe

= (Capacity + displacement) * length

$= [= \frac{(4.276)^2}{1029.4} + \frac{(OD)^2-(ID)^2}{1029.4}] * 8790.09\ ft = 213.45\ bbls$

Volume of mud in drill collar with drill collar displacement

= [capacity + displacement] * length

$= [\frac{(2.50)^2}{1029.4} + \frac{(6)^2-(2.50)^2}{1029.4}] * 430.22 = 15.04\ bbls$

Volume of mud in casing = capacity * length

$= \frac{(8.625)^2}{1029.4} * 9220.31 = 666.31\ bbls$

Annular volume = [volume casing] – [volume drill pipe + volume drill collar]

= [666.31 bbls] – [213.45+15.04]

= 666.31 – 228.49 = 437.82 bbls.

Bottom to surface lag time at casing shoe

$$= \frac{437.82\ bbls}{0.158\frac{bbls}{stroke}} = 2771 \text{ strokes}$$

$$= \frac{2771\ stroke}{60\frac{stroke}{minute}} = 46 \text{ minutes}$$

From calculations, for well cuttings to reach the surface from the bottom at (9220.31)ft it requires (2771) strokes or (46) minutes.

SURFACE TO BOTTOM LAG AT (12000) FT

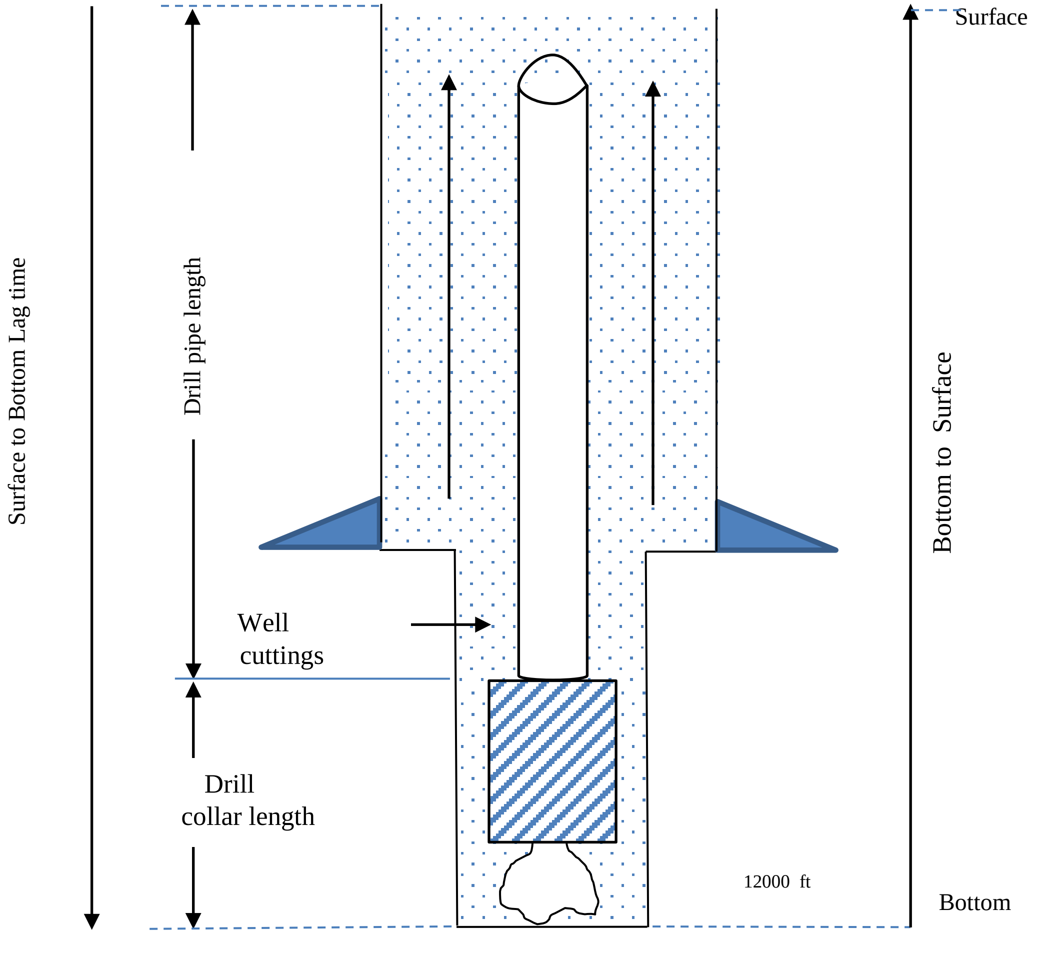

Fig (5) Surface To Bottom Lag At (12000) Ft.

Drill pipe length is increase because depth is increase from (9220.31 ft – 12000ft) :

Length of drill pipe = TVD – BHA

= 12000 -430.22 = 11569.78 FT.

Volume of mud in drill pipe = capacity * length

$$= \frac{(4.276)^2}{1029.4} * 11569.78 = 204.92 \text{ bbl}$$

Volume of mud in drill collar = Capacity * length

$$= \frac{(2.50)^2}{1029.4} * 430.22 = 2.61 \text{ bbl}$$

Total volume of mud in drill pipe + drill collar

= 204.92 + 2.61 = 207.53 bbls

Surface to bottom Lag time at 12000 FT

$$= \frac{207.53}{0.158} = 1313 \text{ strokes}$$

$$= \frac{1313}{60} = 22 \text{ minutes}$$

From calculations, the mud requires (1313) strokes to reach the bottom at 12000 Ft or (22) minutes.

BOTTOM TO SURFACE LAG TIME AT 12000 FT

Volume of mud in drill pipe with drill pipe displacement = [capacity+ displacement] * length.

$$11569.78 * \left[\frac{(4.276)^2}{1029.4} + \frac{(5)^2-(4.276)^2}{1029.4}\right] = 280.98 \text{ bbls.}$$

Volume of mud in drill collar with drill collar displacement = [capacity + displacement] * length

$$430.22 * \frac{(6)^2-(2.50)^2}{1029.4} + \frac{(2.50)^2}{1029.4} = 15.04 \text{ bbls}$$

Total volume of drill pipe + drill collar = 280.98+15.04 = 296.025 bbls

Volume of mud in casing is calculate before as (666.31) barrels.

Volume of mud in open hole $8\frac{1}{2}$ inch.

Length of open hole = TFD – Casing shoe

= 12000-9220.31 =2779.69 ft.

Volume of mud in8 $\frac{1}{2}$ open hole = capacity * length

$= \frac{(8.5)^2}{1029.4} * 2779.69 = 195.09$ bbl

Annular volume = [volume casing + volume open hole]-[volume drill pipe+ volume drill collar)

=[666.31+195.09] –[280.98 +150.04] = [861.4-296.25]= 565.375 bbls

Bottom to surface lag time at 12000 ft = $\frac{565.375}{0.158}$ = 3578 strokes

$= \frac{3578}{60}$ = 59 minutes.

For well cutting to reach the surface from the hole it requires.

(3578) strokes, or (59) minute. From these calculation, the lag time is increasing with increase of depth. Table (4) given below summarize the results with respect to depth.

Table (4) Variations of lag time with depth

Depth/ft	**Surface to bottom lag time**	**Bottom to surface lag time**
9220.31	1005 strokes	2771 strokes
12000	1313 strokes	3578 strokes

MUD CYCL: The total mud cycle refers to the surface to bottom plus the bottom to surface, lag time .

Table (5) illustrates the total mud cycle at casing shoe calculations and total depth calculations.

Table (5) Total Mud Cycle

Depth	Surface to Bottom	Bottom to surface	Total mud cycle
9220.31	1005	2771	3776
12000	1313	3578	4891

To verify the validity of hand calculations . or even computer calculations a test can be carried out by using solid materials like rice, wood shavings and corn or by using carbide grains and this is a best test to be used in verifying lag time calculations.

Drop a cup- full of carbide through drill pipe at connection time and adjust the pump stroke counter in the lagging unit to zero reading at the time of dropping through drill pipe, the driller will start connection, the carbide will reaches to the bottom of the hole and then back to the surface with drilling fluid, when gas returns to surface, a gas peak of methane will appears on Gas charts, subtract the surface to bottom lag time from the total stroke recorded from the counter which is already calculated and the rest is the real lag time from bottom to surface.

4. CORE CUTTINGS

Coring would provide a means of obtaining substitute data for geological or engineering use. The coring program for the well (f-22) is to cut a(30- feet) core interval from (10860-10890) feet through Gargaf sandstone in order to:

- Definition of porosity, permeability , fluid saturations and type of lithology.
- Locating oil-water contact and gas- water contact.
- information's for calibration and improved interpretation of well logging[1,5].

4.1- RECEIVING THE CORE

While the core is being cut during the coring operation in well (f-22) , drilling rate and gas records are concerned, and cuttings of core are collected every foot from shale shaker, because of the possibility incomplete or negligible core recovery. The drilling rate while coring varies with the type of core bit, pump pressure, weight on bit, rotation of bit, and type of formation cored. Before the core is arrived the surface, the shipping boxes should be prepared, these boxes are a large and wooden, metal or cardboard boxes divided into narrow parallel portions to store the core samples at the surface as they are removed from core barrel, these boxes are usually of three feet long and have be taken to the rig floor, to carry the core samples, the boxes should be lightly numbered for example (1of 6) and marked with Top (T) and bottom (B). When the core barrel is arrives the surface, it is often the well site responsibility to supervise the collection of the core from the barrel the barrel is usually hung in the derrick, and suspended about one meter from the rotary table and the opening of the table is closed by a steel plate, the core barrel is kept only twenty or thirty centimeters above the steel plate and every piece is coming out from the barrel, the core boxes are arranged on the rig floor in order to which they are to be filled. At this point care must be taken to ensure the correct orientation to provide the top from bottom confuse as the core samples comes out from the barrel, since the bottom of the core is comes first, then the first piece of core should be placed at the bottom end of the box marked Number one and so on, till the core box one is filled up, and box Number will contain the lower three feet of the core, fig (6) illustrates the method of boxing cores.

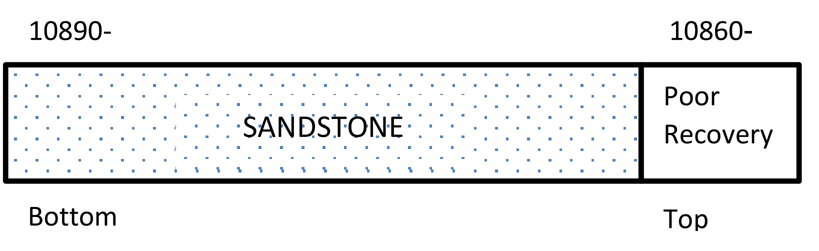

Fig (6) The method of boxing cores.

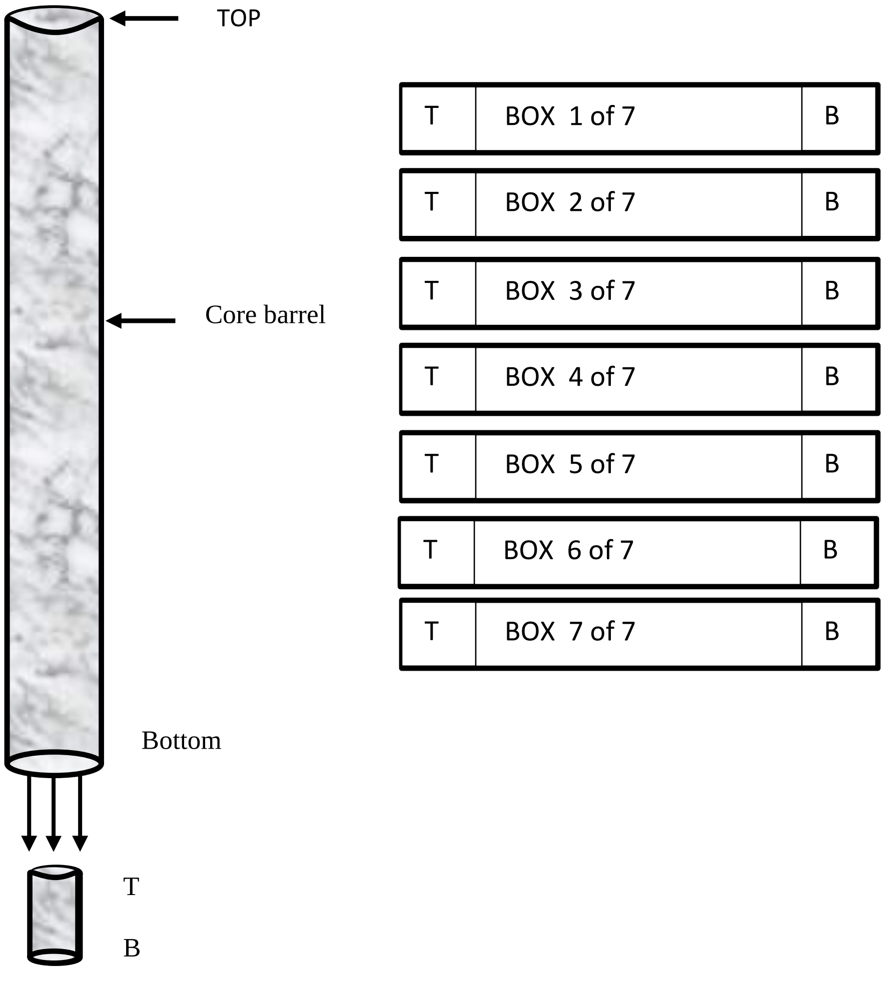

Fig (7) Receiving core from core barrel.

When all core has been removed from the barrel it taken to the logging unit and laid on a steel board and the length of recovered should be measured accurately.

When measuring the core which taken in Gargaf formation for interval (10860-10890) feet, the recovery is not equal to the cored interval, the recovered core is only (18) feet from (30) feet drilled, the missing portion of core may lost in the bottom of the hole, the core recovery percentage is calculated as:

$$\text{Recovery\%} = \frac{18}{30} *100 = 60\%$$

The cored interval for the well (f-22) is showing in fig (8)

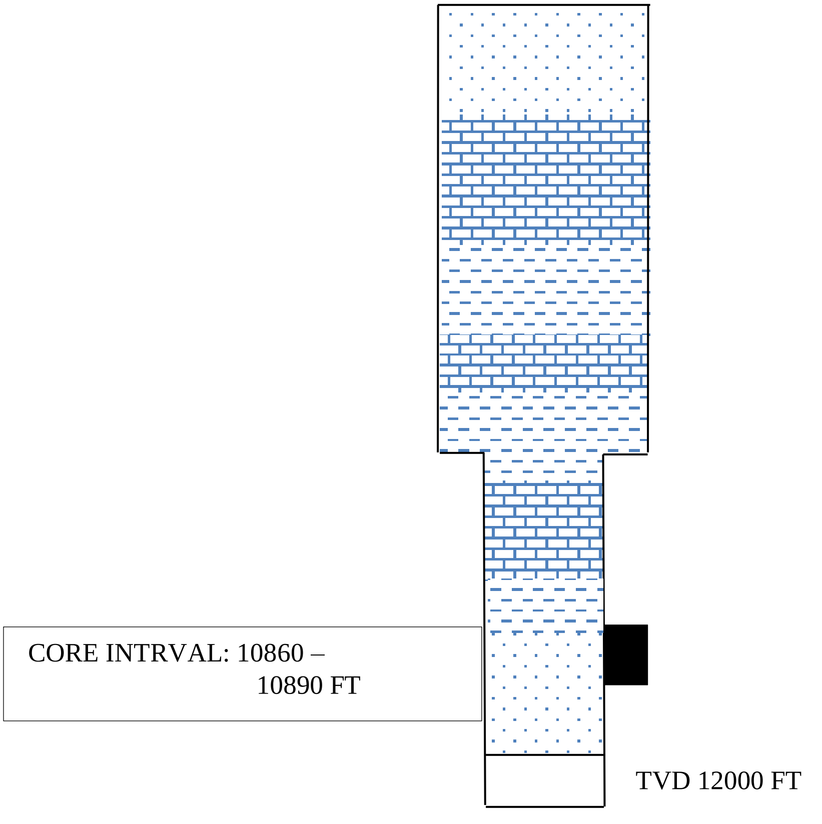

FIG (8) CORE INTERVAL WELL (F-22)

4.2 EXAMINING CORE SAMPLES:

After the core has been washed or wiped clean, a geological inspection can be performed.

The description of core samples is the responsibility of the well site geologist, geologist logger is advised to make a description also to be included on the mud lagging. Gross characteristics like, dip, fractures, bedding irregularities, should be noted from the core, along with thickness of each bed measured to the near inch, more detailed descriptions made from examination of core samples under binocular microscope for lithological alterations and under ultraviolet light for evidence of oil fluorescence. The description of core samples of potential reservoir rocks should be more detailed than cores with no prospects.

In description of core cuttings the following properties should be identified and described in a logical order as outlined below:

- Rock Type: sandstone, limestone, dolomite, etc. lag time depends on rock density.
- Color.
- Hardness.
- Grain shape: angular, sub angular, rounded, sub rounded,
- Grain Size: according to Wentworth scale. Very fine cuttings are carried out quickly rather than coarse grain cuttings.
- Sorting: well sorted, moderately sorted, poorly sorted.
- Major Characteristics.
- Sedimentary Structures.
- Porosity.
- Oil Shows.

CONCLUSIONS:

Lag Time calculations and Handling of cores presented in this study leads to the following conclusions:

1. In drilling operations there are two important times, surface to bottom time and bottom to surface time by which well cuttings are collected.
2. Correct Lag Time and correct catching of well cutting at their representative depths from which they come reflects in a good well formation tops.
3. In case of total lost circulation there is no well cuttings and drilling blind but lag time is necessary to evaluate gas readings if any.
4. Solid methods and gas detector methods are of great importance in verifying Lag time calculations.
5. Well cuttings may collected also from the desanders, disillters and mud cleaners, to establish the quantity of sand and fine solids while drilling unconsolidated formations.
6. Core cuttings have a great significance in that they assists in the solution of many problems in geology such as determination of oil and water contact or oil and gas contact and in the development of oil and gas fields.

7. Care must be taken when collecting core cuttings from core barrel to avoid the confuses of top and bottom of the drilled core cuttings.

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