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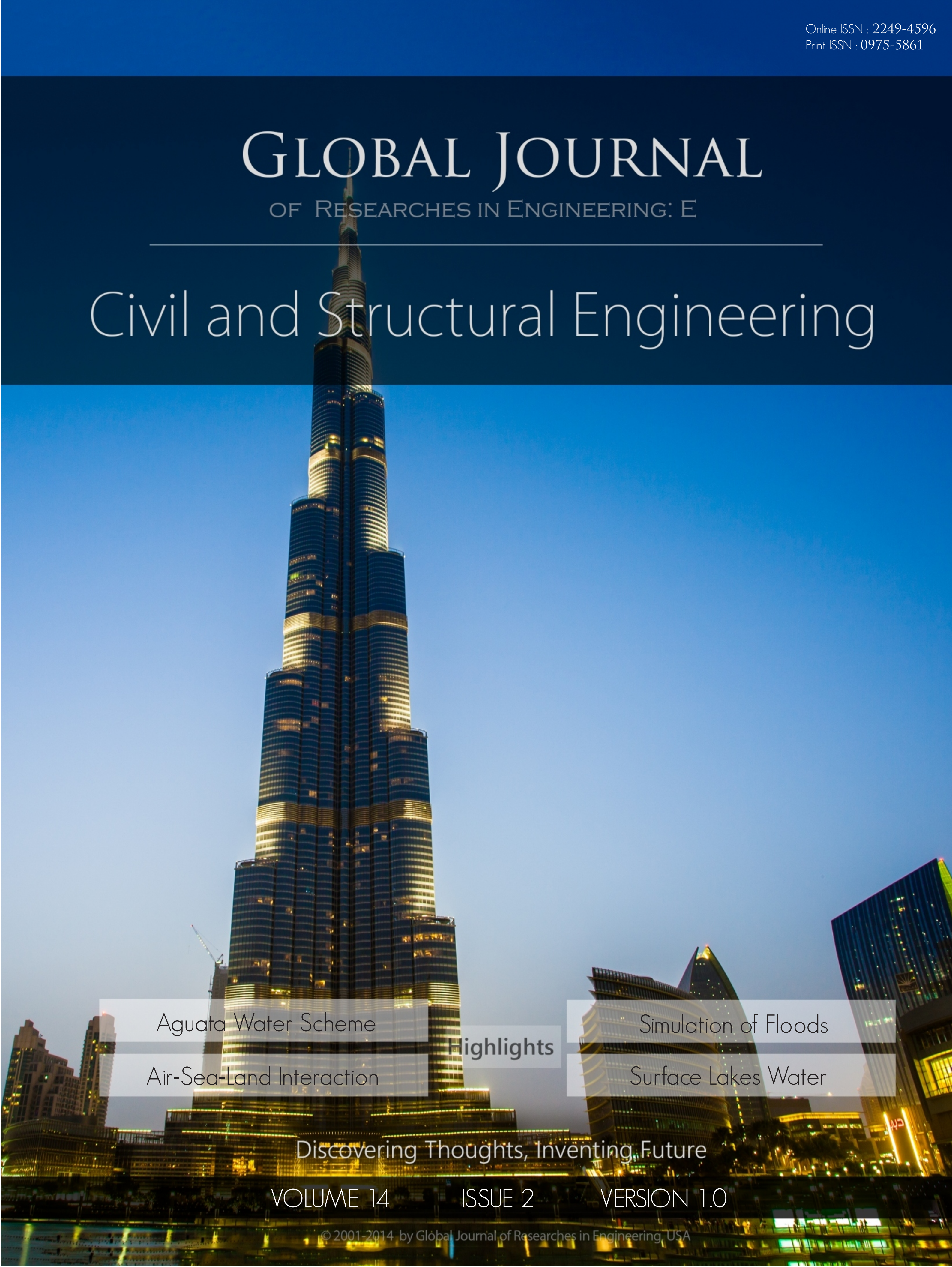

Highlights

Aguata Water Scheme

Air-Sea-Land Interaction

Simulation of Floods

Surface Lakes Water

Discovering Thoughts, Inventing Future

VOLUME 14 ISSUE 2 VERSION 1.0

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Rapid Estimations of Air-Sea-Land Interaction Parameters during a Tropical Cyclone

By Professor S. A. Hsu
Louisiana State University, United States

Abstract- Hurricane Ivan in 2004 and Hurricanes Katrina and Rita in 2005 devastated northern Gulf of Mexico and its coastal regions with catastrophic impacts in some regions. On the basis of applied physics of air-sea-land interaction, following formulas are derived and validated using the minimum sealevel pressure (Po in mb) as the most important input. They are: (1) Maximum wind speed (in m/s)= 6.3 (1013 - Po) 0.5; (2) Max significant wave height (in m) = 0.20 (1013 – Po); (3) Max wave setup (in feet)= 0.11 (1013 – Po); (4) Max surface drift velocity (in m/s) = 0.22 (1013 – Po) 0.5; (5) Most probable shoaling depth (in m) = (1013 – Po); (6) Max storm surge (in feet) = 0.23*(1010 – Po)*Fs*Fm, where Fs is a shoaling factor (not the shoaling depth) and Fm is a correction factor for storm motion; And(7) Max bottom (seabed) stress (in N/m^2) = 0.016 (1013 – Po). Examples for the applications of these formulas are provided.

Keywords: hurricane winds; hurricane waves; currents during hurricane; wave setup during hurricane; shoaling depth during hurricane; storm surge during hurricane; wave setup during hurricane; shoaling depth during hurricane; seabed stress during hurricane.

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RAPIDESTIMATIONSOFAIRSEALANDINTERACTIONPARAMETERSDURING ATROPICALCYCLONE

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I. Introduction

In 2004 Hurricane Ivan and again in 2005 Hurricane Katrina (Fig.1) devastated numerous oil and gas production facilities in the north central Gulf of Mexico (see e.g. Figs.2 and 3) as well as over 1,800 fatalities and countless destruction and damages to the near shore infrastructures including bridges (e.g. Figs 4 and 5) and buildings (costing about $81 billion in damages). In order to rapidly estimate these destructions before and after the land-falling tropical cyclones, this article provides civil and structural engineers with engineering meteorology and oceanography so that educated assessments may be made. While numerical simulations of these destructive forces can be made, the purpose of this paper is for those engineers working with emergency managers and legal professionals who may not have the access of numerical modeling of computational fluid dynamics.

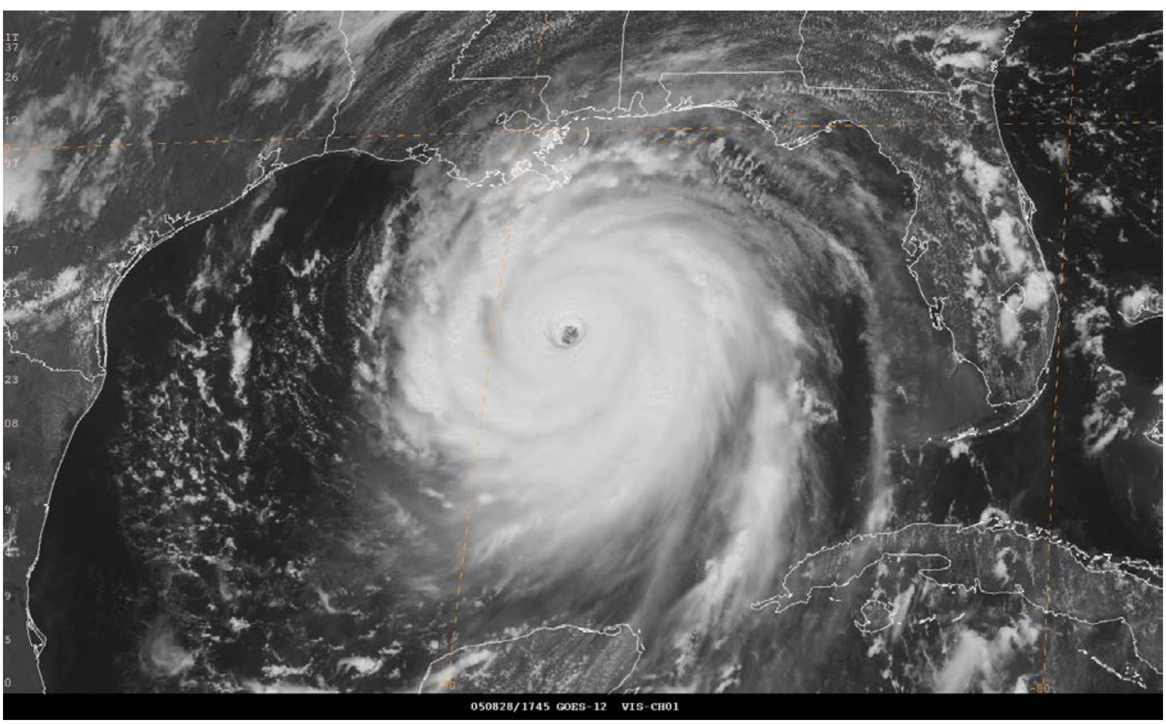

Figure 1 : GOES-12 visible image of Hurricane Katrina over the central Gulf of Mexico at 1745 UTC 28 August 2005, near the time of its peak intensity of 150kt (www.nhc.noaa.gov)

Author: Coastal Studies Institute, Louisiana State University. e-mail: sahsu@lsu.edu

Figure 2 : Mars Tension-leg platform (From http://en.wikipedia.org/wiki/Mars_(oil_platform)

Figure 3 : Mars platform showing damage from Hurricane Katrina in 2005 (From http://en.wikipedia.org/wiki/Mars_(oil_platform))

According to Wang and Oey (2008), this billion-dollar platform was designed to withstand "140-mph winds and crashing waves up to 70ft high simultaneously".

Figure 4 : Interstate I-10 over Mobile Bay damaged by Hurricane Ivan in 2004 (From FHWA-NHI-07-096). According to FHWA, the wave setup on top of the storm surge was the cause

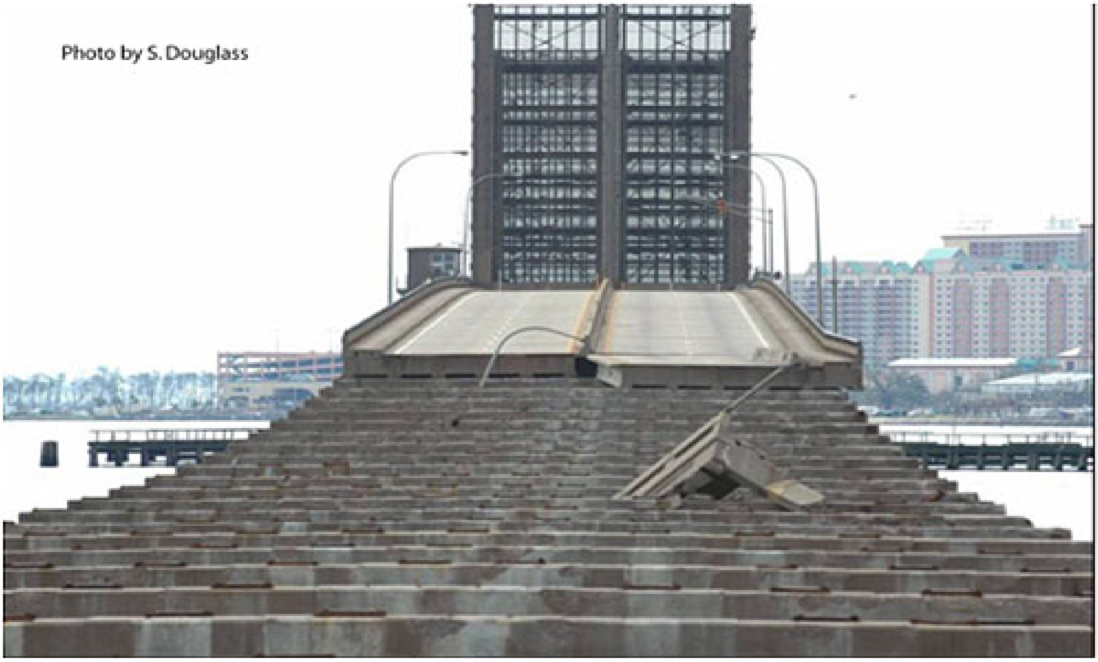

Figure 5 : US 90 bridge over Biloxi Bay, Mississippi was damaged by Katrina. Since the spans at higher elevations were not removed, the wave setup on top of the storm surge is more important than the wind loading (photo looking southwest from Ocean Springs 2/19/06, from FHWA-NHI-07-096)

II. Estimating Hurricane Winds

According to Hsu (1988), from the cyclostrophic equation when the centrifugal force is balanced by the pressure gradient force, we have

$$U_a^2/\Upsilon = (1/\varrho)\,\Delta P/\Delta\Upsilon = (1/\varrho)\,(P_n - P_0)/(\Upsilon - 0) \qquad (1)$$

Where U_a is the maximum sustained wind speed above the surface boundary layer, Υ is the radius of the hurricane, ϱ is the density of air, $\Delta P/\Delta\Upsilon$ is the radial pressure gradient, P_n is the pressure outside the hurricane effect (=1013mb, the mean sea level pressure), P_0 is the hurricane's minimum central pressure. Because ϱ = 1.2 kg m^{-3},

$$\Delta P = (1013 - P_0)\text{mb, and } 1 \text{ mb} = 100 \text{ N m}^{-2} = 100 \text{ kg m}^{-1}\text{ s}^{-2}, (1)$$

Becomes

$$U_a = [(100 \text{ kg m}^{-1}\text{ s}^{-2})/(1.2 \text{ kg m}^{-3})]^{0.5} * (\Delta P)^{0.5} = 9\,(\Delta P)^{0.5} \quad (2)$$

According to Powell (1982), $U_{10} = 0.7\ U_a$; therefore,

$$U_{10} = 6.3\,(\Delta P)^{0.5} = 6.3\,(1013 - P_0)^{0.5} \qquad (3)$$

Where U_{10} is the wind speed at 10 m in m/s and ΔP is in mb.

On the basis of the datasets provided in Powell and Reinhold (2007), Eq. (3) has been verified by Hsu (2008) and is illustrated in Fig.6. In addition, according to Li et al. (2013) for 26 tropical cyclones with circle eyes over both Atlantic and north Pacific Basins, Eq.(3) is further validated in Fig.7. Since the slope of these linear regressions is almost equal to one with high correlation coefficients (for R = 0.82 and 0.89), Eq. (3) can be used operationally. Note that, although there was no derivation like aforementioned discussions, Eq. (3) has been employed by Simpson and Riehl (1981, p. 278, Fig. 127).

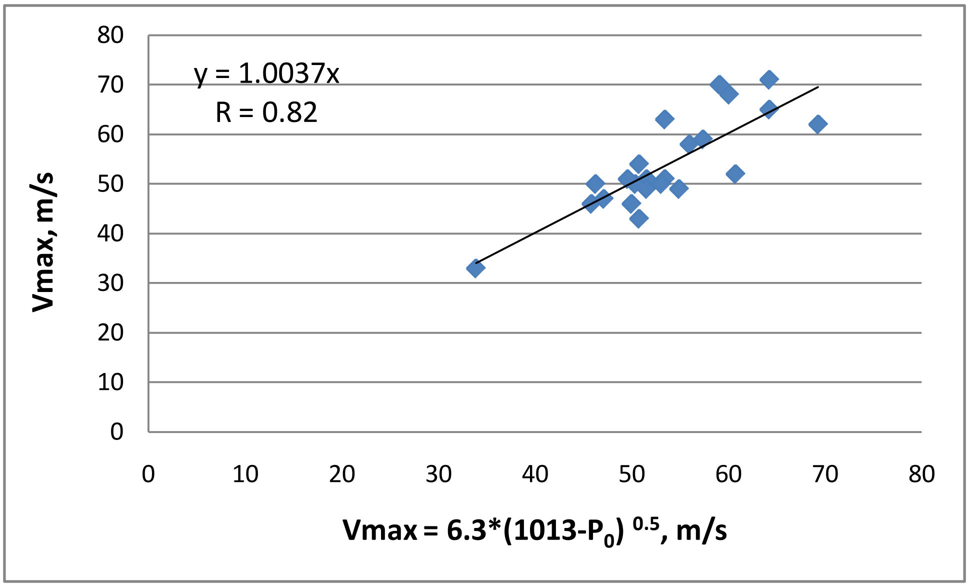

Figure 6 : Verification of Eq.(3) based on the dataset provided in Powell and Reinhold (2007)

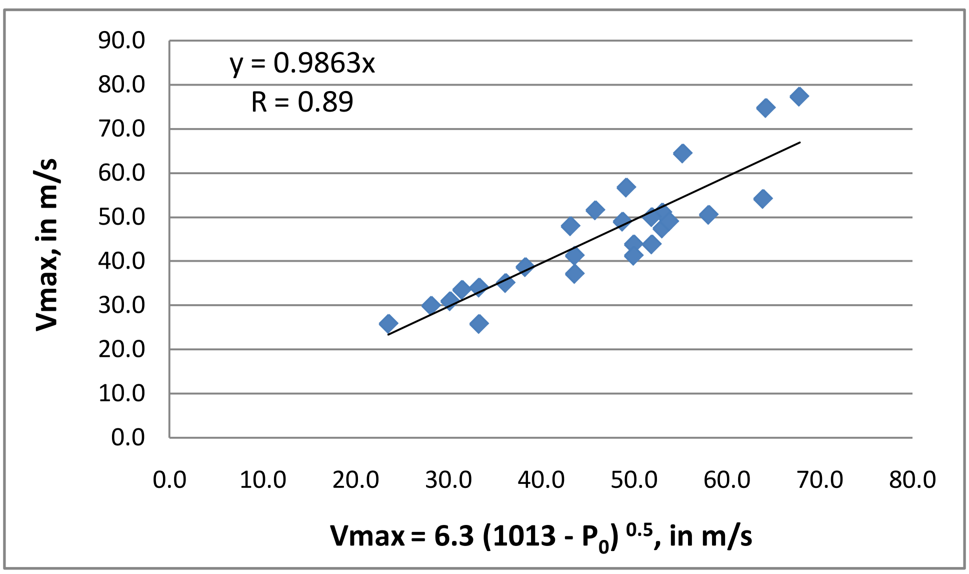

Figure 7 : Further validation of Eq. (3) based on the dataset provided in Li et al (2013)

III. Estimating Hurricane Waves

According to the Shore Protection Manual (see USACE, 1984),

$$(g\ H_s/U_{10}\hat{}2) = 0.0016\ (g\ F/U_{10}\hat{}2)\ \hat{}\ (1/2) \quad (4)$$

$$(g\ T_m/U_{10}) = 0.2857\ (g\ F/U_{10}\hat{}2)\ \hat{}\ (1/3) \quad (5)$$

$$T_p = 0.95\ T_m \quad (6)$$

$$T_p = 12.1\ (H_s/g)\ \hat{}\ (1/2) \quad (7)$$

Where g is the acceleration of gravity, H_s is the significant wave height, F is the fetch, T_m is the period of the peak of the wave spectrum, and T_p is the dominant wave period. Both T_p and H_s are measured and reported routinely by NDBC (see www.ndbc.noaa.gov).

During Hurricanes Ivan (2004) and Katrina (2005), large waves occurred. Using the data available online (see www.ndbc.noaa.gov) at Buoy 42040, Equation (7) is verified as show in Fig.8. Since the slope of this linear regression is close to one with a relatively high correlation coefficient (R = 0.85), Eq. (7) can be used operationally.

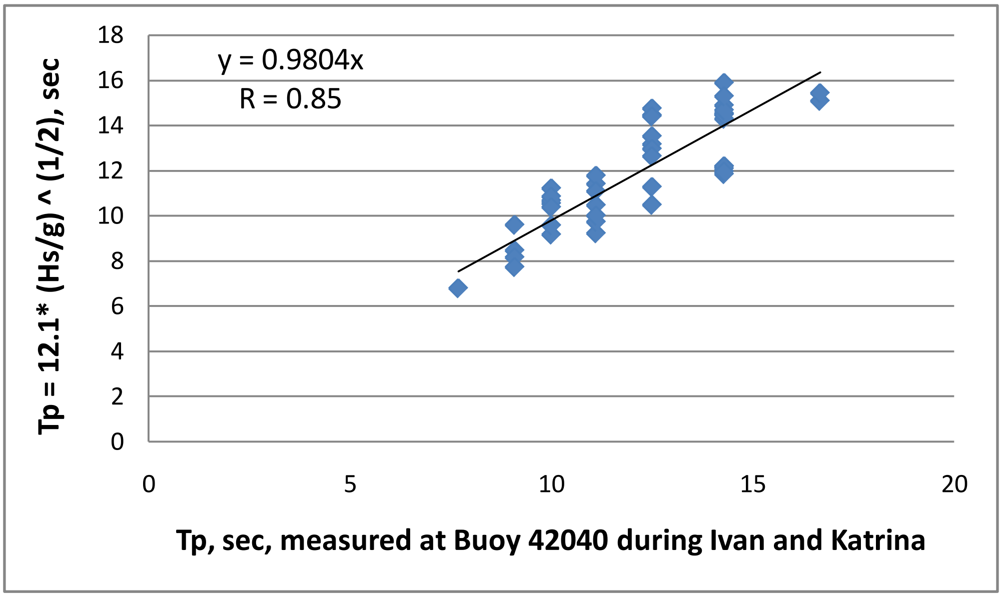

Figure 8 : Verification of Eq. (7) during Hurricanes Ivan and Katrina

Now, eliminating the fetch parameter, F, and rearraging Eqs. (4) and (5), we have

$$(g\,H_s/U_{10}\text{^}2) = 0.0113\,(gTp/U_{10})\text{ ^ }(3/2) \qquad (8)$$

Equation (8) is validated in Fig.9 based on datasets not only in Hsu (2003) but also extending all measurements with the pressure less than 1013mb.

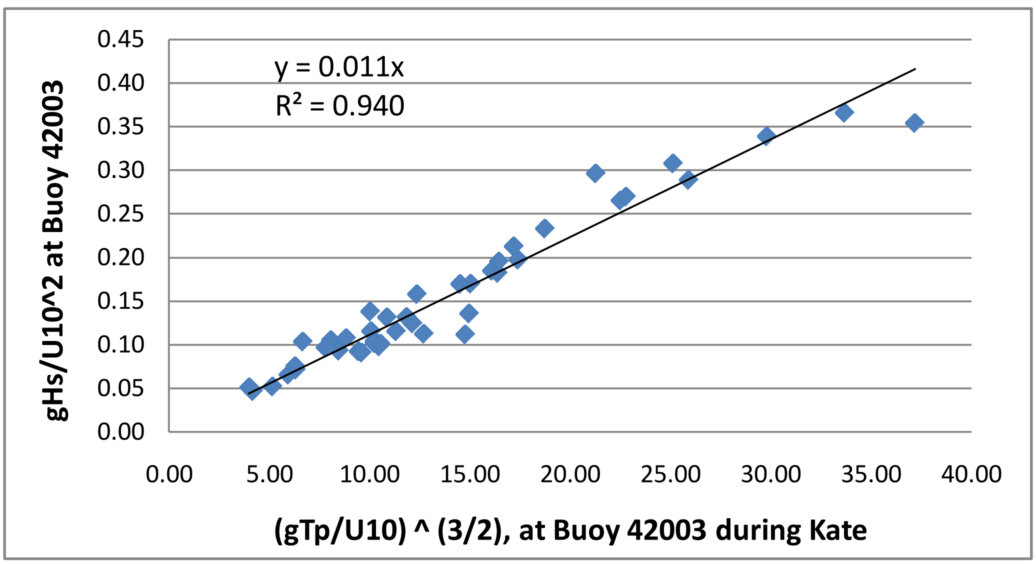

Figure 9 : Validation of Eq. (8) during Hurricane Kate (data source: www.ndbc.noaa.gov) for all measurements with pressure < 1013mb

For operational applications, the coefficient needs to be changed from 0.0113 to 0.0112 so that

$$(g\,H_s/U_{10}\text{^}2) = 0.0112\,(gT_p/U_{10})\text{ ^ }(3/2) \qquad (9)$$

Substituting Eq. (7) into (9), one gets

$$Hs = 0.0050\,U_{10}\text{^}2 \qquad (10)$$

$$U_{10} = 14.1(H_s\text{^}0.5) \qquad (11)$$

Now, from Eq. (3), we have

$$H_{smax} = 0.20\,(1013 - P_o) \qquad (12)$$

Where H_{smax} is the maximum significant wave height in meters.

Validations of Eq. (12) are provided in Fig. 10. Further verifications are provided in Hsu (2009) for Hurricane Ike. Furthermore, During Ivan NHC's Hurricane Report indicates that P_o = 931mb near the max H_s= 16m (Fig.12) and during Katrina P_o =927.4mb at Buoy 42007 in the vicinity of Buoy 42040 where max H_s = 17m (Fig.13). These maximum significant wave heights for Ivan and Katrina are nearly identical to those estimated by Eq. (12).

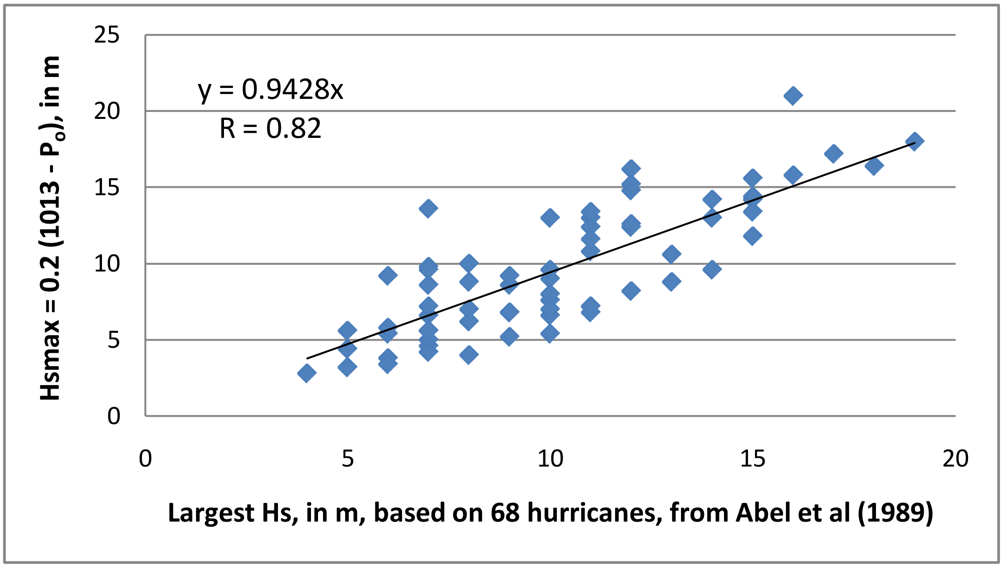

Figure 10 : Validation of Eq. (12) based on the datasets provided in Abel et al (1989)

Verification of Eq. (12) for a typhoon is presented as follows:

According to the Joint Typhoon Warning Center (see Fig. 11), on 6 October 2007, Super Typhoon Krosa was near northeastern Taiwan. The minimum sea-level pressure, P_o = 929mb. Substituting this value into Eq. (12), we get the maximum significant wave height to be approximately 17m. Now, according to Liu et al. (2008), the maximum trough-to-crest wave height was measured to be 32.3m by a data buoy near northeast Taiwan in the western Pacific that was operating during the passage of Krosa.

According to the World Meteorological Organization (1998), the maximum trough-to-crest wave height may be statistically approximated by 1.9 times the significant wave height. Therefore, the maximum significant wave height is 32.3/1.9 = 17m during Typhoon Krosa near NE Taiwan. This value is identical to the result using Eq. (12). In addition, Eq. (12) is found to be consistent with Wave watch III modeling in the South China Sea during Typhoon Muifa in 2004 (see Chu and Cheng, 2008).We can say that Eq. (12) is applicable during a typhoon.

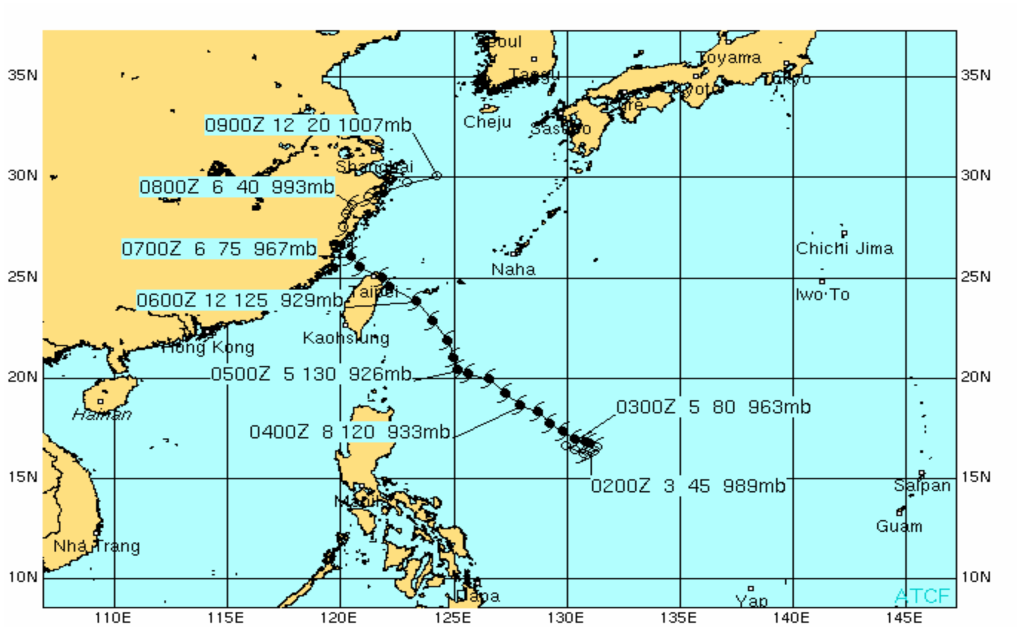

Figure 11 : Best Track of Super Typhoon Krosa in October 2007
(http://www.usno.navy.mil/NOOC/nmfc-ph/RSS/jtwc/atcr/2007atcr.pdf)

IV. Estimating Maximum Wave Setup

According to Dean and Dalrymple (2002, page 84),the wave setup is a phenomenon that occurs primarily within the wave breaking zone and results a super elevation of the water level. According to Guza and Thornton (1981), the max wave setup, W_{setmax}, is approximately,

$$W_{setmax} = 0.17\ H_{smax} = 0.034\ (1013 - P_o) \qquad (13a)$$

$$W_{setmax}\ (\text{in feet}) = 0.11\ (1013 - P_o) \qquad (13b)$$

Where H_{smax} is the maximum significant wave height in deep-water before shoaling and P_o in mb.

During Ivan in 2004 and Katrina in 2005, values of H_{smax} are available from NDBC as shown in Figs. (12) and (13), respectively. Substituting the average value of 16m into Eq. (13a), the maximum wave setup was about 2.72m or 8.9ft. This value is in good agreement with ADCIRC modeling (see Douglass, 2006) (see Fig.14). Note that the value of 8ft for the wave setup has been used in wave force estimation for the failure of the Biloxi Bridge during Katrina (Fig.5) (see, e.g., McPherson (2008).For simplicity, it is illustrated as follows:

Since Force = pressure*area, we have

Force per unit area = pressure = density*gravitational acceleration*height

= unit (or specific) weight of water*height

$= 62.4(\text{lb/ft}^3)*W_{setmax} = 62.4*8 = 499\text{lb/ft}^2.$

Therefore, this 8ft wave setup can exert approximately 500 pound wave force per square foot impacted on the Biloxi Bridge during Katrina.

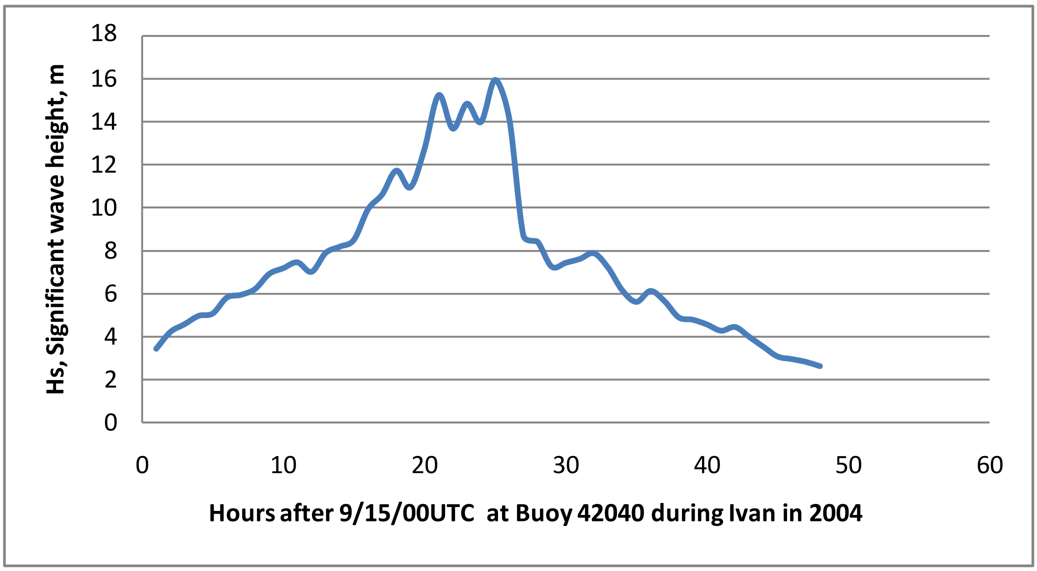

Figure 12 : Measurements of significant wave height at NDBC Buoy 42040 during Ivan

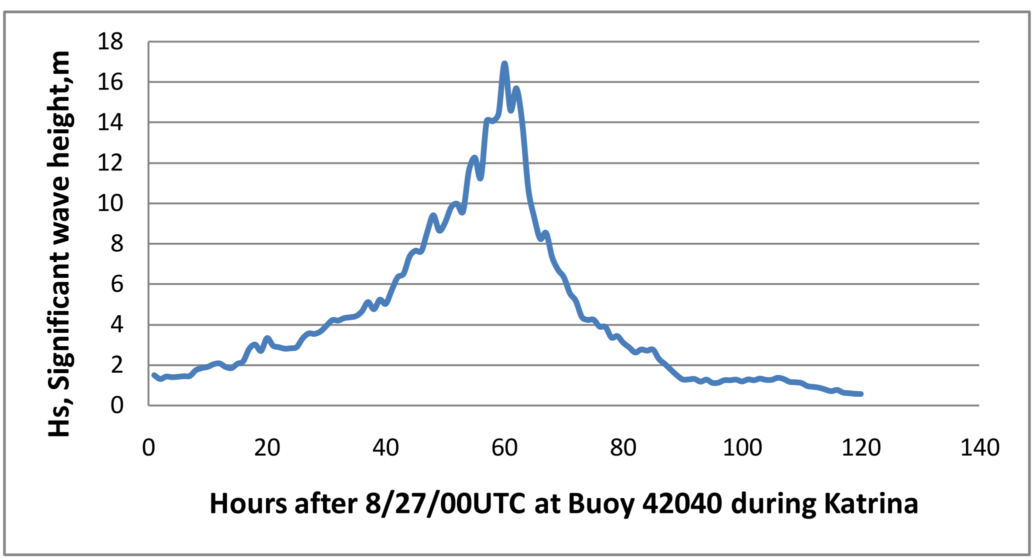

Figure 13 : Measurements of the significant wave height at Buoy 42040 during Katrina

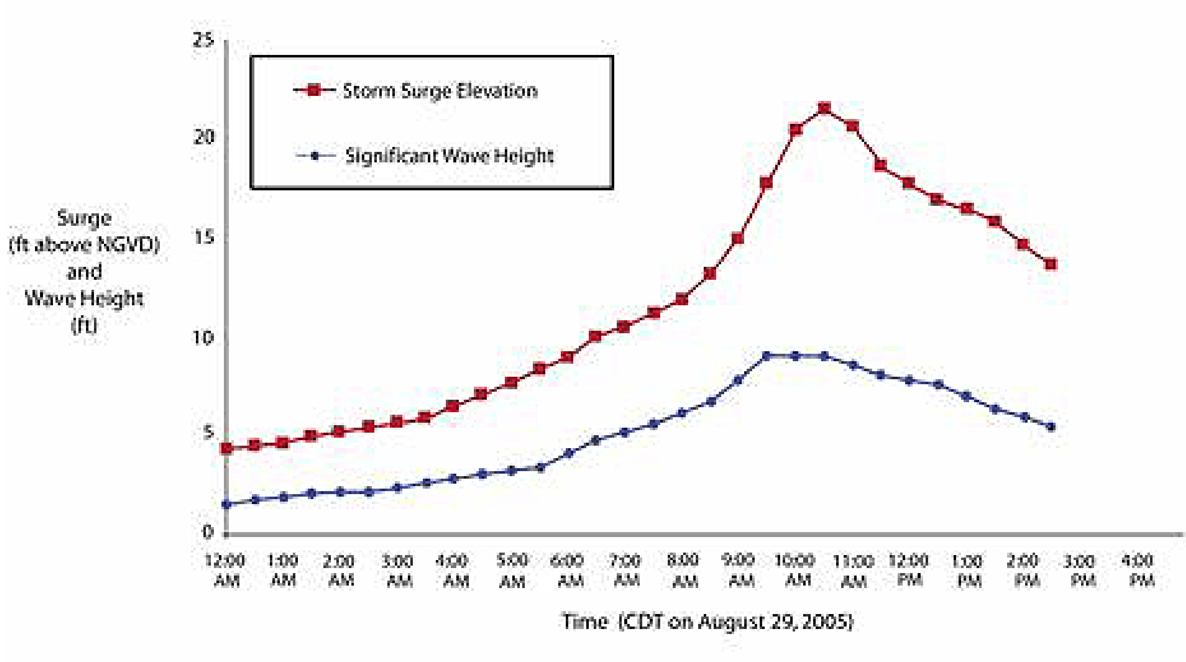

Figure 14 : Storm surge hydrograph as estimated by ADCIRC modeling for Hurricane Katrina at the US 90 Bridge across Biloxi Bay, MS (Fig.5) (from Douglass, et al., 2006)

V. Estimating Hurricane-Generated Currents

According to Hsu (2003), the magnitude of surface drift velocity, U_{sea} is

$$U_{sea} = 0.22 \; P \; U_{10} \qquad (14)$$

Where P is the turbulence intensity which is related to the gust factor, G, as follows:

$$G = 1 + 2P \qquad (15)$$

According to Stewart (2004) and Fig.15, during Ivan, G= 73kts/55kts = 1.327 at 10m at Buoy 42040 and G = 135kts/102kts = 1.324 at 122m at a nearby oil rig (NDBC station #42364, see www.ndbc.noaa.gov). Since the G values at 10 and 122m are nearly identical, we substitute either value into Eq.(15) and get P = 0.16. Substituting this P value into Eq. (14) and applying Eq. (3), we get

$$U_{sea} = 0.22 \, (1013\text{-}P_o)^{0.5} \qquad (16)$$

Now, according to the Tropical Cyclone Report for Hurricane Ivan (see p.9 in Stewart, 2004 at www.nhc.noaa.gov), P_o= 931 mb. Substituting this value into Eq.(16), we have U_{sea}= 2.0 m/s. Comparisons this value against both measurements and modeling results (Fig.16) show that Eq.(16) is consistent with both measurements and numerical modeling. Further verification for Eq. (16) during Katrina is illustrated as follows: According to Knabb et al (2005), P_o = 902 mb occurred at 18UTC28August 2005 (at 26.3N and 88.6W). Substituting this value into Eq. (16), U_{sea}= 2.3 m/s. This value is in good agreement with that of modeling results by Wang and Oey (2008, Fig.4).

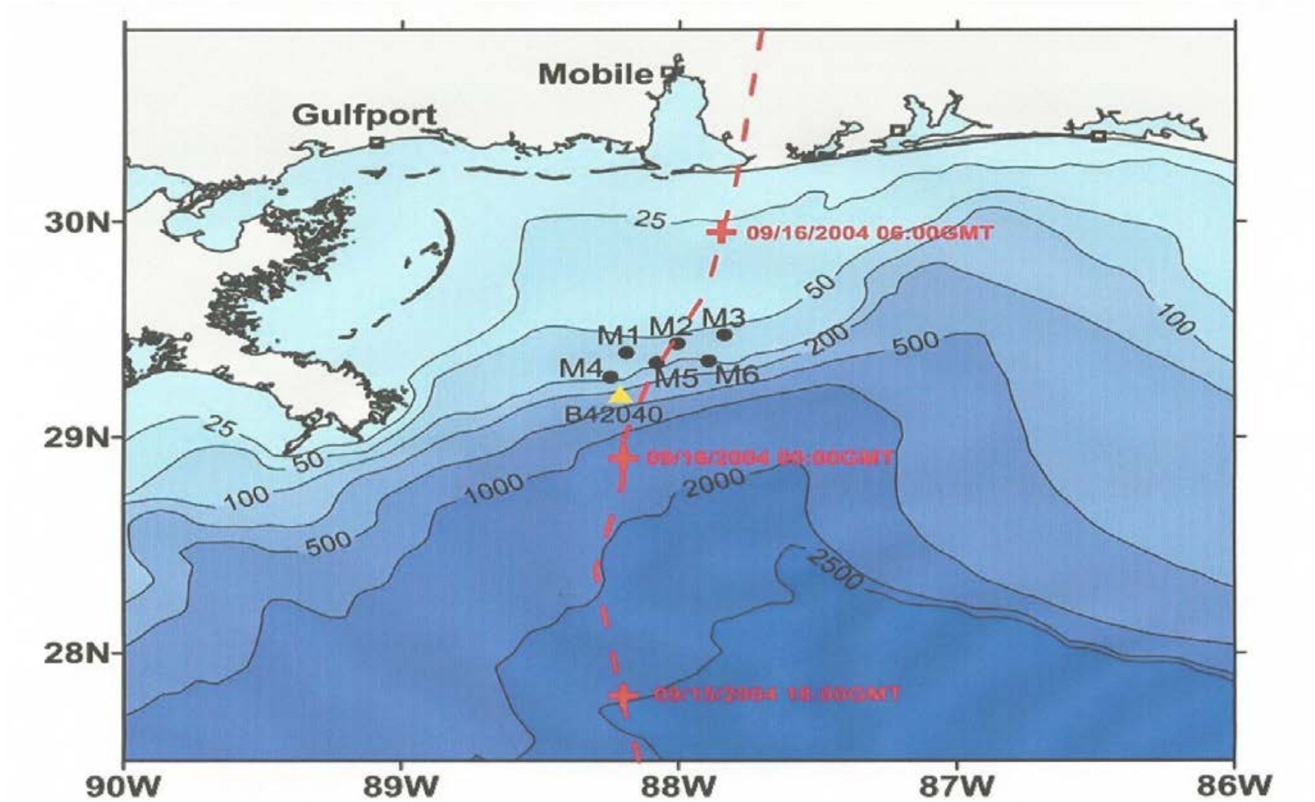

Figure 15 : Ivan Track and measurement stations (see Wijesekera et al., at http://www.motherjones.com/files/Source_177__High_Sea-Floor_ Stress_Induced_by_Extreme_Hurricane_Waves_1.pdf)

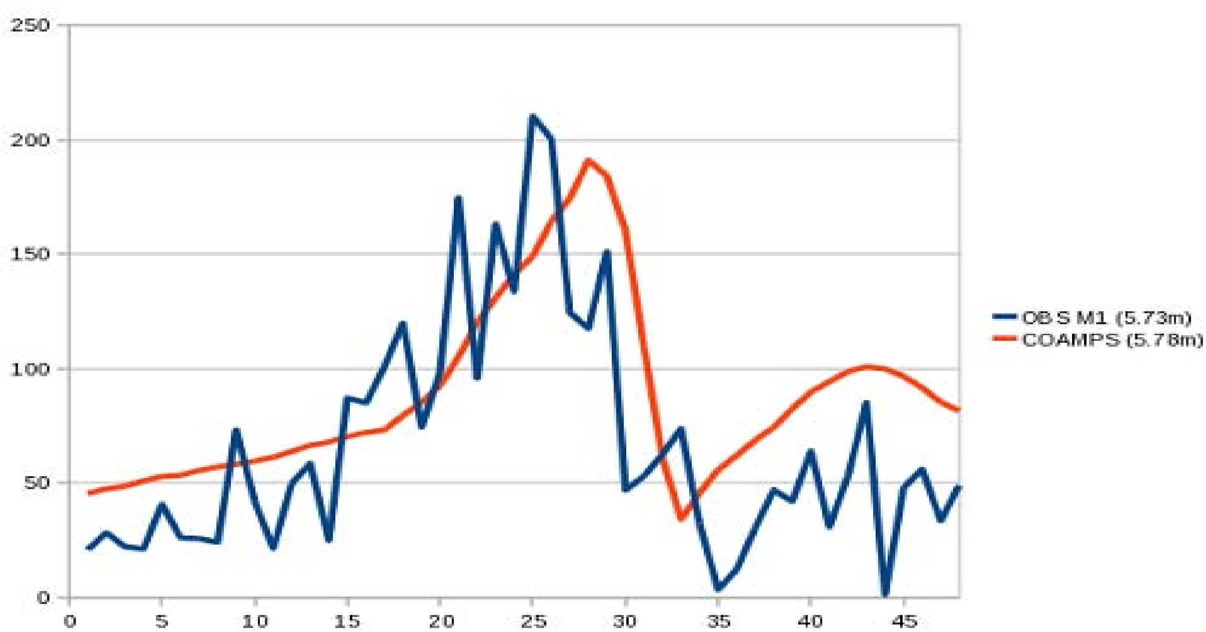

Figure 16 : ADCP measurements of the near surface current speed (cm/s) at approximately 6 m water depth (blue) and Model simulation (red) at NRL Station M1 (see Fig. 15) (see Chen et al., at www.onr.navy.mil/reports/FY10/npchen.pdf) over a 48-hour period from September 16, 2004

VI. Estimating Shoaling Depth

From Taylor and Yelland (2001) and Equations (7) and (12), the shoaling depth is

$$D_{shoaling} = 0.2\ L_p = 0.2\ gT_p^2/2\pi = 4.7\ Hs = 4.7 * 0.2\ (1013 - P_o) \quad (17)$$

Where L_p is the wave length.

Therefore, Shoaling depth ≈ $(1013 - P_o)$, in meters (18)

According to Wijesekera et al (2010, see www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA523020), during the passage of Ivan (see Fig. 15), the bottom stress was dominated by the wind-induced stresses, and exceeded critical levels at depths as large as 90 meters. Now, substituting P_o = 931mb into Eq. (18), we get that the shoaling depth was 82 m during Ivan. Since this estimate is consistent with the measurements, Eq. (18) may be useful as a first approximation.

VII. Estimating Storm Surges

According to Hsu (2013), for estimating the storm surges caused by the wind-stress tide,

$$gD(dS/dx) = \tau_{sx}/\rho_w \quad (19)$$

$$\tau_{sx} = \rho_a\ C_d\ V^2 \quad (20)$$

$$S - S_0 = [\rho_a\ C_d/(\rho_w\ g)](F/D)\ V^2 \quad (21)$$

$$S = K_1\ V^2 = K_2\ (1013 - P_o) \quad (22)$$

$$S = K_3\ H_s \quad (23)$$

Where g is the acceleration due to gravity, D is the water depth, S represents the wind-stress tide along the prevailing wind direction, x, τ_{sx} is the wind stress along x, ρ_a and ρ_w are the density of air and water, respectively, C_d is the drag coefficient, V is the wind speed, S_o is the astronomical tide, F is the fetch along x, and K_1, K_2, and K_3 are constants to be determined by high water marks and P_o is the minimum sea-level pressure in mb.

Eq. (22) has been verified by Hsu (2013) during Hurricane Sandy in 2012 and by Hsu (2012) during Hurricane Irene in 2011, both hurricanes affected the New York area.

Eq. (23) is evaluated as follows:

During Hurricane Ike in 2008, extensive damages and coastal flooding were inflicted along the coasts of upper Texas and southwestern Louisiana. According to the data available thru NDBC, three stations are employed for our analysis: they were NDBC Buoy 42035 located about 22 NM east of Galveston, TX and two NOS water level stations (Figs.17 thru 19). Since these R^2 (coefficient of determination) values are very high, we can say that Eq. (23) can be used operationally.

In addition, on the basis of wind-wave interaction during Hurricane Georges in 1998, K_3=0.285 (see Hsu, 2004). From Fig.18, K_3=0.276. Because the difference between these K_3 values is only 3%, we can again say that Eq. (23) is useful.

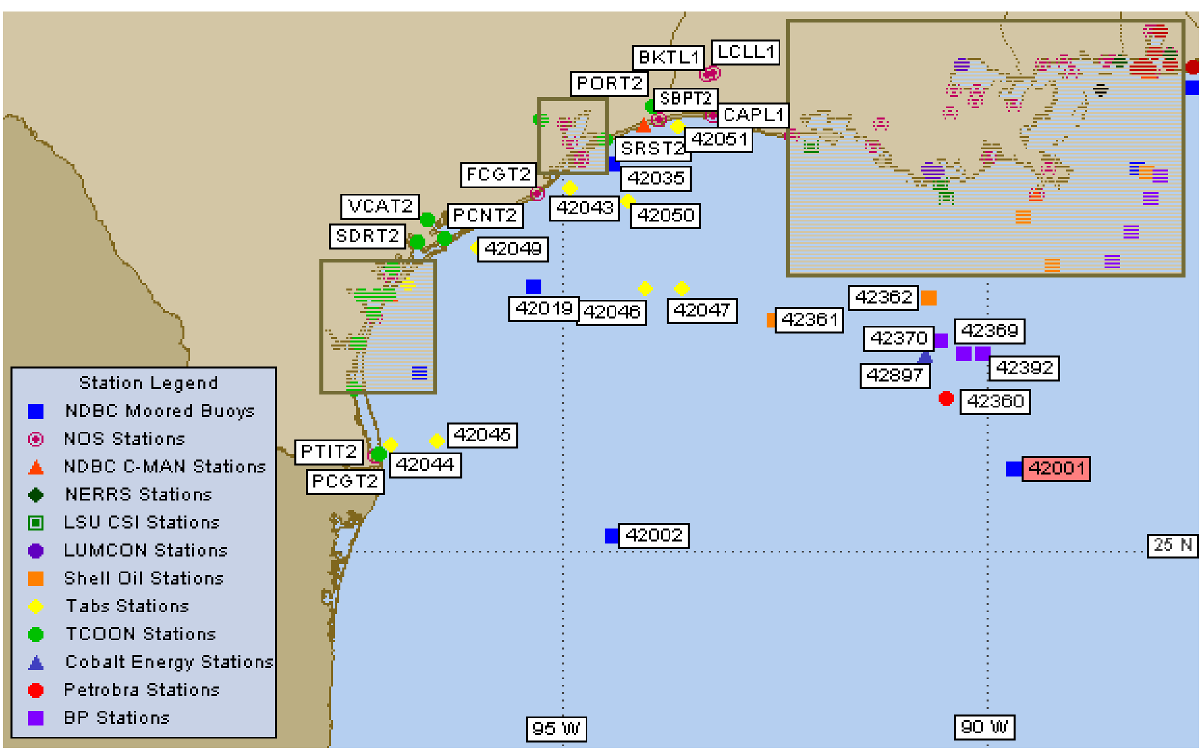

Figure 17 : Location map for NDBC Buoy 42035 and NOS Stations CAPL1 and GSPT2 (inside the box for Galveston, TX) (see www.ndbc.noaa.gov)

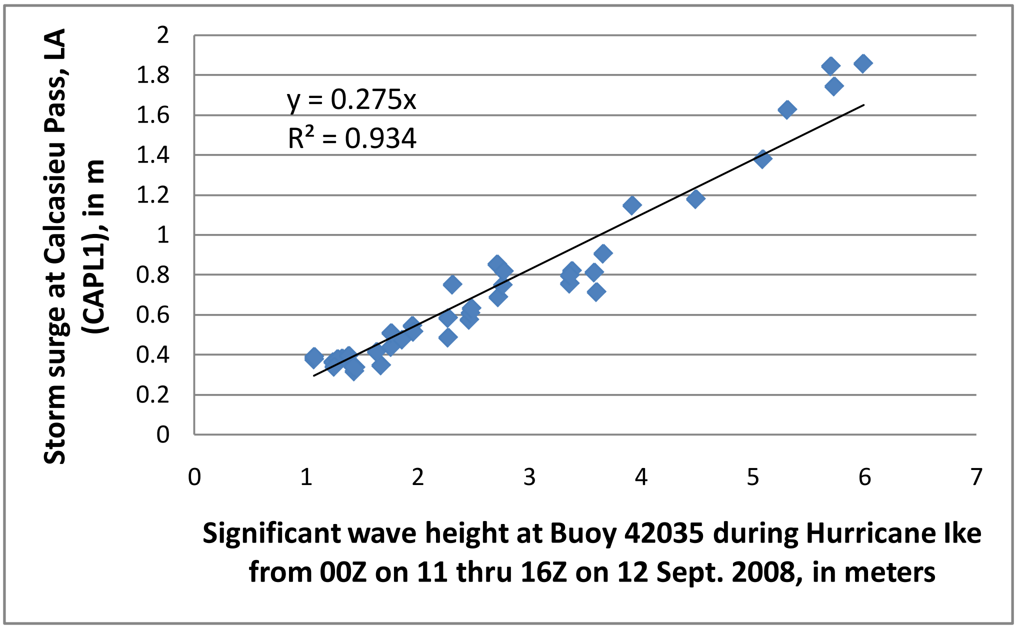

Figure 18 : Validation of Eq. (23) during the passage of Hurricane Ike

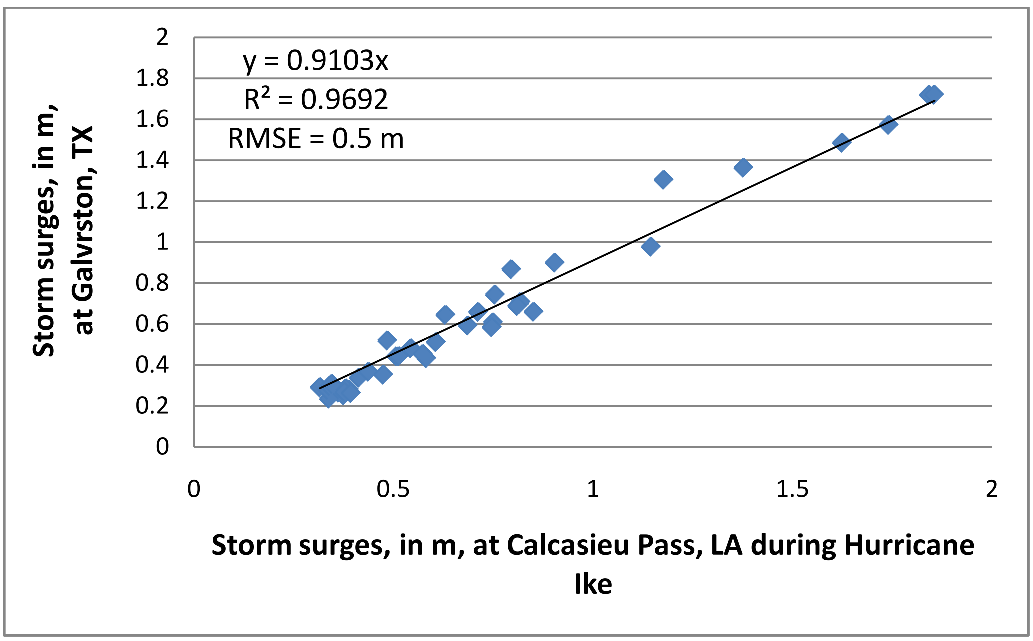

Figure 19 : Storm surges on the right-hand side of Ike track

Maximum storm surge elevation without wave setups, S, can also be estimated analytically (see Hsu, 1988 and 2004, and Hsu et al., 2006) as

$$S \text{ (in feet)} = 0.23*(1010 - P_o)* F_s* F_m \qquad (24)$$

Where P_o is the minimum sea-level pressure in mb, F_s is a shoaling factor (see Fig. 20), and F_m is a correction factor for storm motion (see Fig. 21).

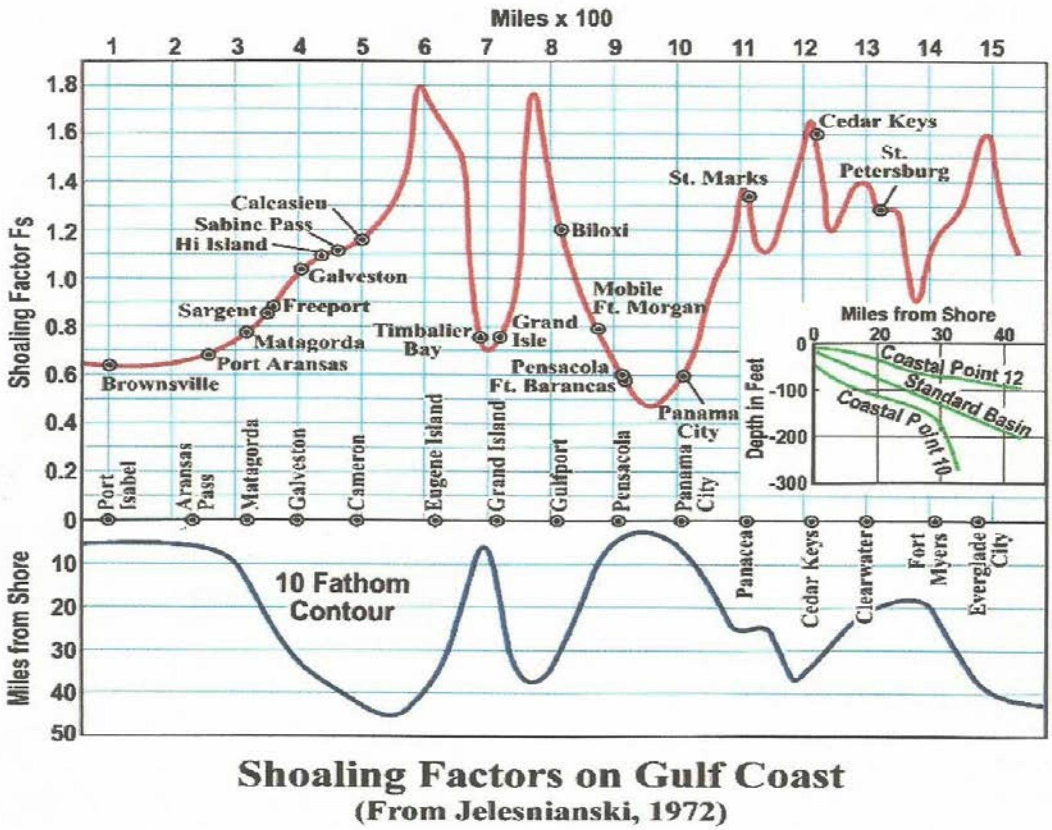

Figure 20 : The Shoaling factor, F_s, for Eq. (24) (from Jelesnianski, 1972)

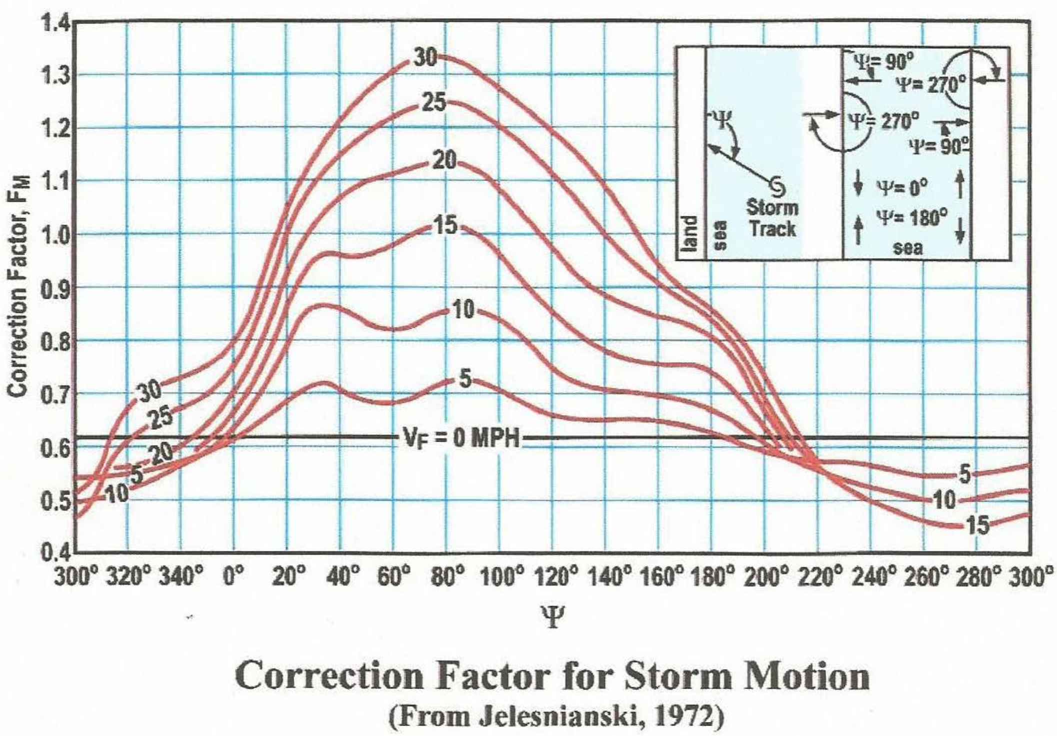

Figure 21 : Correction factor for storm movement, F_m, used in Eq. (24) (from Jelesnianski, 1972)

An application for Eq. (24) to estimate the storm surge in the vicinity of Biloxi Bridge (Fig.5) is presented as follows:

According to the Tropical Cyclone Report for Hurricane Katrina issued by the National Hurricane Center (NHC) (see http://www.nhc.noaa.gov/pdf/TCR-AL1220 05_Kat rina.pdf). The lowest pressure was 927.4mb (see NHC, Page 32) recorded at Buoy 42007, which was located about 25 miles due south of Biloxi.

Now, substituting P_o=927.4mb, F_s=1.2 for Biloxi, MS, and F_m=1.0, according to the NHC Advisories at the time of Katrina landfall near LA/MS border, which was approximately 15 mph, into Eq. (24), we have

$$S = 0.23^* (1010 - 927.4)^*1.2^*1.0 = 23 \text{ feet.}$$

Since this value is in excellent agreement with the results of ADCIRC modeling (Fig. 14) and high-water mark survey by FEMA (2006), we can say that Eq. (24) is useful for practical use.

VIII. Estimating the Stress on Seabed

According to Wijesekera et al (2010, see www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA523020), strong surface waves and currents generated by major hurricanes can produce extreme forces at the seabed that scour the sea floor and cause massive underwater mudslides. The combined current-wave stress, $\tau_{cw,}$ on the sea floor is approximately related to the wind stress, U^2, so that from Eq. (3), we have

$$\tau_{cw} = 0.0004\ U_{10}\hat{}2 = 0.016\ (1013 - P_o) \qquad (25)$$

Note that the units of bottom stress are N/m^2 or Pa and P_o is in mb.

The critical bottom stress to initiate the sediment movement is provided in Table 1. It can be seen that for the median grain sand of 0.06 mm and finer ones, a tropical storm force (P_o=1005mb, approximately) wind can start these sands in motion at water depth shallower than 8 m according to Eq.(18). Now, on the basis of Eq. (25) and Fig.15, the bottom stresses caused by Ivan (when P_o=931mb) and Katrina (P_o=927mb) could have exceeded 1.31 and 1.38 Pa, respectively, more than 10 times of the critical bottom stress needed to set the sediment in motion. These estimates may be used to explain massive sediment transport near the seabed shallower than 80-90m that in turn caused numerous structural failure and pipeline displacements due to strong near-bottom orbital wave velocity (>2m/s) and near-bottom currents ranged from 0.40 to 1.20 m/s at all moorings (see Fig.15) during Ivan's passage (Teague et al., 2006).

Table 1 : Critical stress thresholds for sand mixtures of select median grain sizes following Souls by (1997)

Median Grain Size (d50, mm)	Median Grain Size (d50, Phi)	Critical Stress (Pa)
2.00	-1.0	1.17
1.00	0.0	0.48
0.50	1.0	0.26
0.25	2.0	0.19
0.13	3.0	0.15
0.06	4.0	0.12

IX. Conclusions

On the basis of aforementioned analyses, during a tropical cyclone, several air-sea-land interaction parameters can be estimated rapidly using the minimum sea-level pressure (P_o, in mb) as the most important input.

They are:

a) Maximum wind speed (in m/s)= 6.3 $(1013 - P_o)^{0.5}$.
b) Max significant wave height (in m) = 0.20 $(1013 - P_o)$.
c) Max wave setup (in feet)= 0.11 $(1013 - P_o)$.
d) Max surface drift velocity (in m/s) = 0.22 $(1013 - P_o)^{0.5}$.
e) Most probable shoaling depth (in m) = $(1013 - P_o)$.
f) Max storm surge (in feet)= $0.23^*(1010 - P_o)^*F_s{}^*F_m$, where F_s is a shoaling factor (not the shoaling depth) and F_m is a correction factor for storm motion. And,
g) Max bottom (seabed) stress (in N/m^2)= 0.016 $(1013 - P_o)$.

Now, using Katrina as an example and application (see Fig.22 and Fig.1), by setting P_o= 902mb, we have, from (1) above, max wind speed = 66 m/s= 148 mph, and (2), max significant wave height = 22.2m= 73ft. Referring back to Fig.2 and 3, since both wind speed and wave height as estimated exceeded the designed limits (140 mph winds and 70ft wave height), the designed criteria for the Gulf of Mexico need to be re-examined as suggested by many engineers (see, e.g. Cruz and Krausmann, 2008).

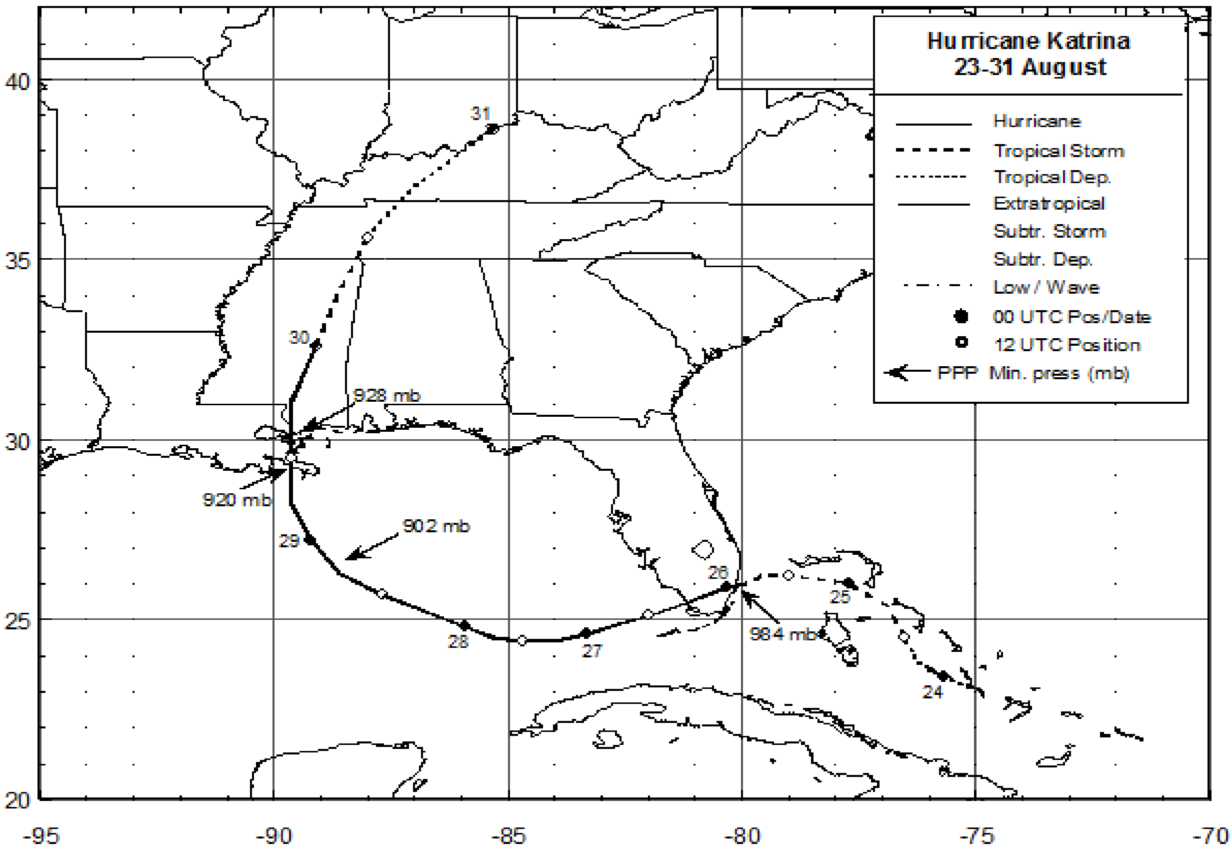

Figure 22 : Best track of Katrina (www.nhc.noaa.gov)

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Direct Filtration for Drinking Water, Habbaniyah Lake (Iraq)

By Dr. Faiz Al-Kathily

Abstract- This research aims at elimination of the sedimentation stage from water purification systems, here waters supplied from lakes. chemical are used to coagulate any remaining suspended materials before the filtration stage, chemical used include alum with some catalyst, such as poly electrolytes.

An integrated 5,50 m high Direct filtration unit was constructed in the laboratory, it included four main units: an axial flocculating unit, a filtration unit, injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board is also included tot give reading at each 10cm of filter height . Water is supplied to the system through a constant head tank by gravity action. filtration is done through two mediums, a crushed brick layer2 to 5mm sizes(30to40)cm deep and a quartz sand layer 0-.60to 0.75mm (30to40)cm deep.

GJRE-E Classification : FOR Code: 290801

DIRECTFILTRATIONFORDRINKINGWATERHABBANIYAHLAKEIRAQ

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The partial part was done in two stages:-

The first stage included the laboratory procedure, using the constructed filtration system, Baghdad water supply was used, with the addition of kaolin (fine mud used as turbidity)to increase turbidity to find the best combination of variables, loading ,to highest water yield together with highest efficiency, experiments were run to find the effect of filtration rate, type &and depth of filtration materials, effect of coagulating material and added catalyst in addition to the control of flocculation time and velocity gradient.

The second stage included the study of the effects of magnitude of turbidity and type of coagulating materials on water yield & on efficiency of filtration system, experiments of this stage were run in habbaniyah, using lake water and water treatment plant of touristic village, by eliminating the sedimentation stage of the plant, the pressurized filtration unit was used, 0.2to0.5mm charcoal, 0.2to 0.5mm sand,

Results of Above Showed that

1. It is possible to use direct filtration procedure in both laboratory and field with increasing efficiency through proper control of mixing, turbidity, filtration rate and velocity gradient.
2. Habbaniyah Lake water maximum Turbidity is around 70,0 mg/l .
3. TSS in the lake water is between 600-700 mg/l which is expectable for drinking purpose.
4. Dissolved Oxygen is high in Habbaniyah Lake water which give good indication for the good Quality of water and less Organic materials.
5. Direct filtration gives V. good Results for filter working cycle, and quantities of water production& Quality.
6. It is recommended to Use Polymer with Alum for Coagulation for better Results.
7. Experimental field tests Filter efficiency increased when using polymers after 8.0 hr of working,
8. Experimental Tests using Habbaniyah water and Polymers with Alum as coagulants shows that Filter working time increased up to 27,0 hours.
9. Filtration efficiency about 67% at field tests, and up to 98% at laboratory Tests.
10. Experimental Tests using Habbaniyah water gives clear product water 1.48 FTU. (1.92 NTU).
11. It is important to check Coagulant potential value to have better Results.
12. Pressure Filters can be used for direct filtration.IN ADDITION TO Rapid Gravity Filters.
13. Feasibility Study shows a big advantages of constructing water treatment plants Using Direct filtration from Habbaniyah Lake with capacities equal or bigger than 500,000 m3 /day,

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I. Purpose

The purposes of the direct filtration process include: compliance with treatment technique regulatory requirements; targeting impurities; and producing safe and aesthetically pleasing drinking water. When source water is generally within the turbidity range of 1 to 5 NTU, it may be a candidate for direct filtration.

II. Introduction

Water purification is the removal of contaminants from untreated water to produce drinking water that is pure enough for the most critical of its intended uses, usually for human consumption. Substances that are removed during the process of drinking water treatment include suspended solids, bacteria, algae, viruses, fungi, minerals such as iron, manganese and sulfur, and other chemical pollutants such as fertilisers.

Measures taken to ensure water quality not only relate to the treatment of the water, but to its conveyance and distribution after treatment as well. It is therefore common practice to have residual disinfectants in the treated water in order to kill any bacteriological contamination during distribution.

World Health Organization (WHO) guidelines are generally followed throughout the world for drinking water quality requirements. In addition to the WHO guidelines, each country or territory or water supply body can have their own guidelines in order for consumers to have access to safe drinking water.

Natural/or Artificial Lakes in Iraq normally extending over a huge area that trapped large amounts of Turbidity. Lakes provide long detention times, low water speed that can be negligible, allowing for adequate settling of the larger turbidity particles and suspended solids. In general, larger lakes have lower turbidity levels. Algae are common and normal inhabitants of surface waters and are encountered in every water supply that is exposed to sunlight. Algae typically range in size from 5 to 100 microns.

Many microorganisms commonly found in source waters do not pose health risk to humans, As Filters represent the key unit process for particles removal in all surface water treatment. Optimization used prior to the filtration process will control loading rates while allowing the system to achieve maximum filtration rates. Direct filtration is one of several treatment processes that can be applied in combination with others to produce potable water. Low turbidity (<20 NTU) and algae count in the order of 106 units/liter among other factors,

III. History of the Gravity Water Filter

1835… London, England. Queen Victoria recognized the increasing health dangers of the drinking water supply. Cholera and typhoid epidemics were commonplace.

She requested John Doulton (of later to become Royal Doulton), to produce a water filter with his ceramic making capabilities. Using various earth and clay materials, he created the first gravity water filter stoneware, Doulton water filters. With her satisfaction in the filter, Queen Victoria bestowed upon Doulton the right to apply the Royal Crest to each of his units.

1862… John Doulton's son, Henry Doulton introduced the Doulton Manganour (new, efficient purifying medium which could be readily renewed), carbon water filter. With Louis Pasteur's new findings about bacteria in this same period, a more advanced understanding of bacteria made it possible for the creation of a porous ceramic which could filter out tiny organisms. Gravity fed water filtration! and the Berkey…? We're getting there…

1901… King Edward VII knighted Henry Doulton and honored his company use to the word ROYAL in reference to its products. Hence the name "Royal Berkey", one of the larger gravity water filter units available today. Doulton's water filters gained popularity and wide spread use by hospitals, laboratories and residential water filtration throughout the world as far away as Africa and the Middle east.

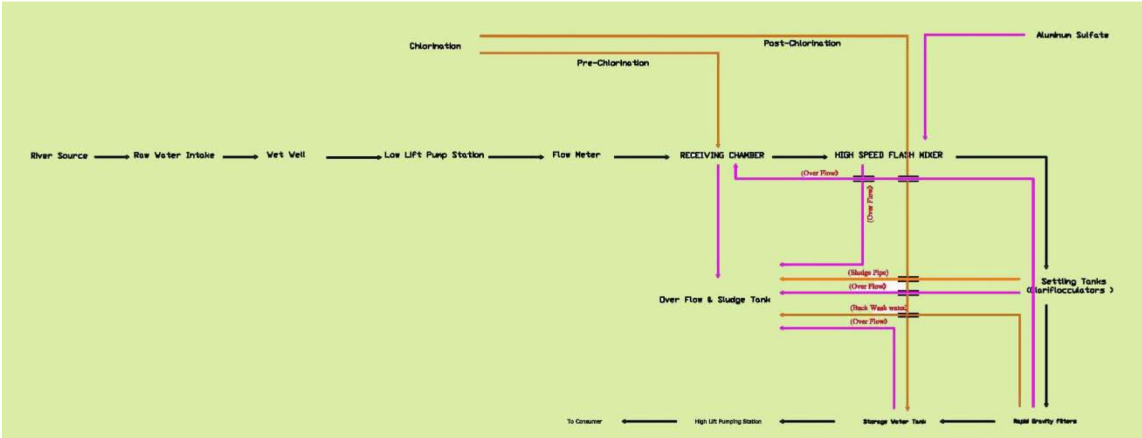
Throughout the decades, the Doulton company modified the ceramic filters by adding small, pure silver particles (anti-microbial), which made the filter elements self-sterilizing and they registered the trade name "British Berkefeld". Once these improvements were made, the gravity filters became popular with, and trusted by relief organizations such as UNICEF, the Peace Corps, Red Cross and used in over 140 countries throughout the world.

1998…Through a distribution partnership with British Berkefeld, the US based company, "New Millennium Concepts", began distributing their products locally. NML pushed the envelope of the product and created the "Black Berkey" purification element. Black Berkey purification elements are more powerful than any other gravity filter element currently available. They were tested with 10,000 times the amount of pathogens required for standard protocol and removed 100% of the pathogens (tested under an electron microscope), setting a new standard in water purification.

IV. Processes for Drinking Water Treatment

A combination selected from the following processes is used for municipal drinking water treatment worldwide:

- Pre-chlorination - for algae control and arresting any biological growth
- Aeration - along with pre-chlorination for removal of dissolved iron and manganese
- Coagulation - for flocculation
- Coagulant aids, also known as polyelectrolyte - to improve coagulation and for thicker floc formation
- Sedimentation - for solids separation, that is, removal of suspended solids trapped in the floc
- Filtration - removing particles from water
- Desalination - Process of removing salt from the water
- Disinfection - for killing bacteria.



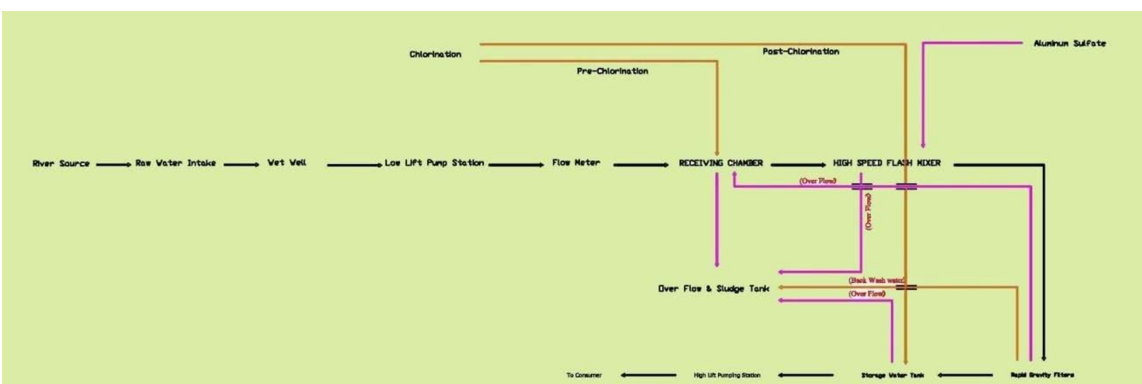
Traditional water Treatment pant Flow Diagram - Using Rapid Gravity Filters

Technologies for potable water treatment are well developed, and generalized designs are available that are used by many water utilities (public or private). In addition, a number of private companies provide patented technological solutions. Automation of water and waste-water treatment is common in the developed world. Capital costs, operating costs available quality monitoring technologies, locally available skills typically dictate the level of automation adopted.

V. Advantage of Direct Filtration Process

Several advantages can be realized when compared to the conventional systems. The advantages of this system may be summarized as follow.

- has low capital and running cost, Lose (1951) and Monscvitz (1978),
- easy to construct and to use, Foly (1967) and Hutchison (1977),
- requires minimum number and small size of the treatment units, thus occupies less surface area as compared to most conventional systems,
- Requires less number of labor, facilities, and equipments, companied with the conventional systems.
- require less dose of chemicals and coagulants (Fadel 1989),
- has a reliable effluent with negligible algae problems (Fadel and Barakat, 2004; Fadel et al., 2004).
- can be applied for several types of water having low, medium, or high turbidity,
- can be washed by raw water with suitable period of ripening, and
- does not require periodical surface and cleaning, thus produces less amount of wastewater.



Direct Filtration Flow Diagram - Using Rapid Gravity Filtration

VI. Effect of Filter Depth on the Removal Efficiency

It is well known that, the filter depth has a direct relation with the filter efficiency, i.e., increasing the filter depth will increase the filter efficiency. The effect of filter depth on the removal efficiency of the direct filter. The new investigations are, when the filter depth is shorter than 0.4 m, no significant efficiency is observed. For filter depth ranging from 0.4 -0.8 m, a significant increase is observed in the filter efficiency.

VII. Effect of Filtration Rate on the Removal Efficiency

1st- The filtration Rate slowly affect the removal efficiency when filtration Rate < 4 $m^3/m^2/h$.

2nd– The removal efficiency reaches up to 80 %. When filtration rate is 4 $m^3/m^2/hr$ >filtration Rate< 12 $m^3/m^2/hr$,

3rd- With more increase in filtration Rate, the removal efficiency comes down to less than 40%.

VIII. Effect of Media Particle Size on Removal Efficiency

The Media particle size strongly affects the filter efficiency.

1st- High effect of grain size on the performance of direct filtration. Removal efficiency comes down to insignificant value at using particle of size >5mm.

2nd- Particle size of 0.1-2 mm is recommended. At some cases of pre-treatment work, particle size greater than 3 mm may be of use.

IX. Effect of Alum dose Concentration on the Removal Efficiency

Several factors may Govern the optimum dose of alum such as, size of Turbidity particles, turbidity level, and the G potential of Coagulation, surface loading, etc. many studies shows the effect of coagulant dosage on the performance of direct filtration, some stated that, there exist an optimum dose at which the filter produces high effluent efficiency.

X. Filtration Mechanism

Filtration depends mainly on kind of particles, and the filter media. In addition to Rate of filtration, Dosage and type of coagulants Used In general One or more of below factors affect the filtration:-

1st- deposit mechanism, as the particles bigger than the size of media porosity will be settled over the media, also the suspended solid take a specifies path depend mainly on porosity but even though some of the particles pass through the media, as there are some factors affecting the mechanism such as direct distortion, Brownian movement or van der wave forces,

2nd– fixation mechanism, which is the sedimentation of particles over the filter Surface as part of slow filtration flow, or vibration of particles because of different electrical charges ,or van der waals forces.

3rd– detachment mechanism, as part of above forces and particles being catch either over the surface /or in side media porosity, the filtration rate may increase, and the flow may change from laminar flow to Turbulent, so particles may separated again and move deep or even pass through the filter media, this can be solved using stronger polymers, and variable filtration flow,

To solve above we can do either

1st– increase particles size inside the media be injecting polymers inside the filter.

2nd– reduce particle size inside the passing solution by pumping water from down to up.

3rd– Reduce filtration rate. Inside each layer. Which can be done using radial filtration?

XI. Theoretical Analysis of Filtration

As deep filter media used to inshore removal of collides, then continues increase in head losses till the filter reach its blocked stage. And then Back wash should be done.

XII. Laboratory Tests Performed

An integrated 5,50 m high Direct filtration unit was constructed in the laboratory, it included four main units: an axial flocculating unit, a filtration unit , injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board is also included tot give reading at each 10cm of filter height . Water is supplied to the system through a constant head tank by gravity action. filtration is done through two mediums ,a coarse media layer with 2 to 5mm sizes (30to40)cm deep, and a quartz sand layer 0-.60to 0.75mm (30to40)cm deep.

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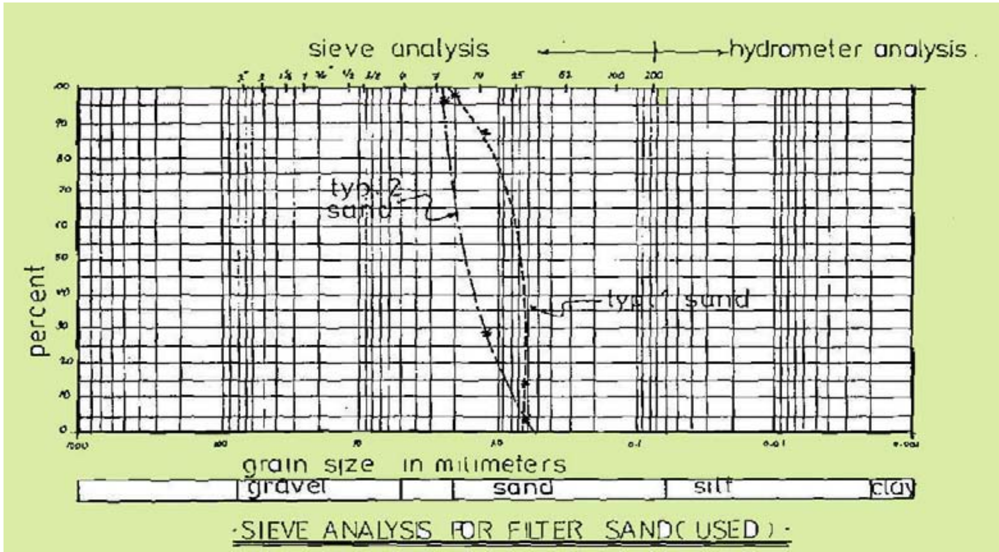

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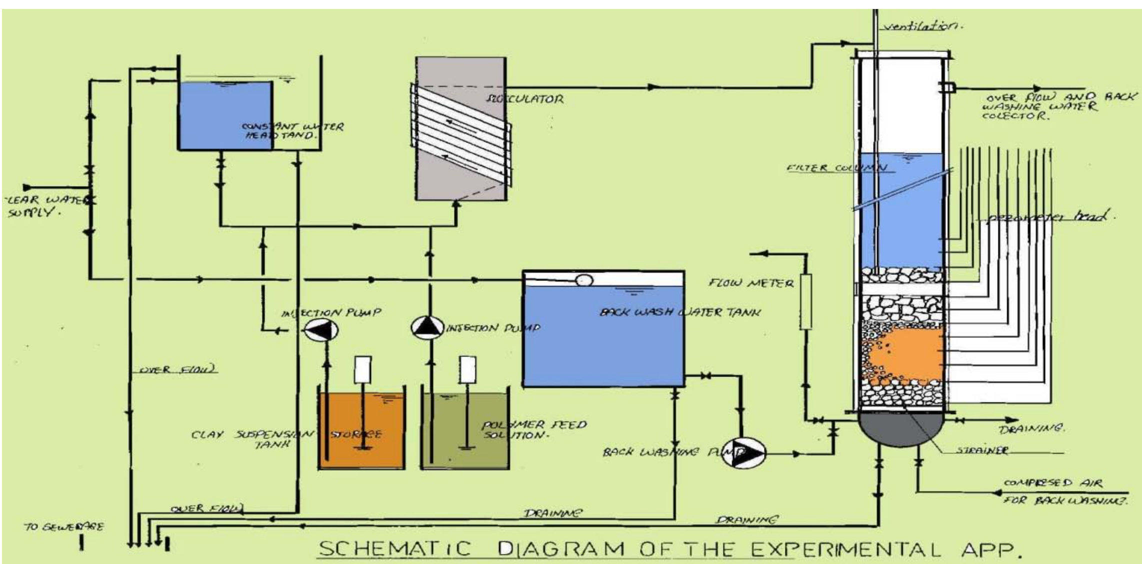
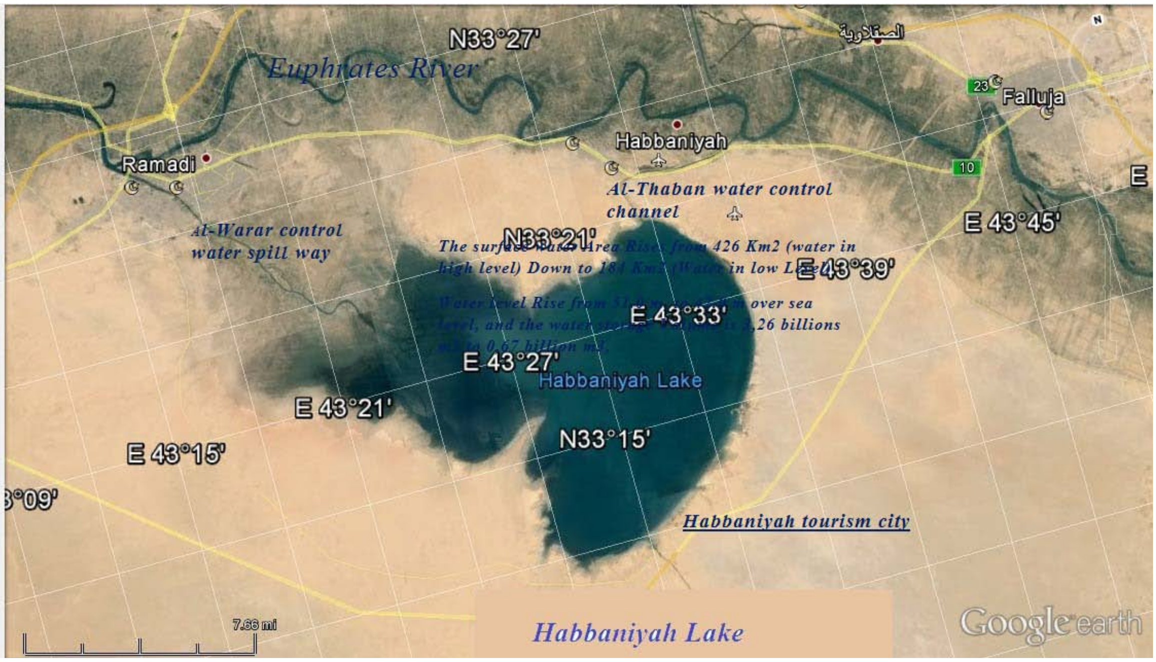


XIII. Habbaniyah Lake

All Results mostly theoretical in laboratory, will never give a good idea for the advantages of direct filtration for the rezones that all environmental changes are mostly controlled in the lab, with some real exceptions that there are many field test using the Direct filtration using water from lakes in many country such as USA ,UK ,Egypt ,Brazil., Argentina and allot others , all the test shows that this method is very good in producing a good quality of Drinking water and long Run of filters with a special parameters for each individual case, this lead the need to make field test for the water of Habbaniyah lake in Iraq which is located in the middle of Iraq ,in the south west of Baghdad city (Capital of Iraq) ,see map below



This artificial lake is deeded with water from Euphrates River through Al-Warar control water spill way which have a maximum discharge of 2,800 m3/sec and channel Total length of 8,000 m, the water is drown off through Al-Thaban water control channel length 9,300 m that have normal water discharge of 200 m3/sec, the south of Habbaniyah lake was connected with water channel to Razzazah Lake and Hour Abo Debis the east side of the lake is a low level Ground which can be flood when water level's rises in this Lake,

The surface water Area Rises from 426 Km2 (water in high level) Down to 184 Km2 (Water in low Level)

Water level Rise from 51.0 m, to 42.0 m over sea level, and the water storage Volume is 3,26 billions m3 to 0,67 billion m3,

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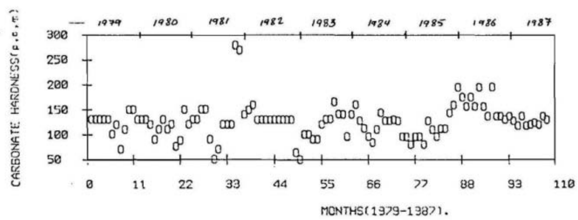
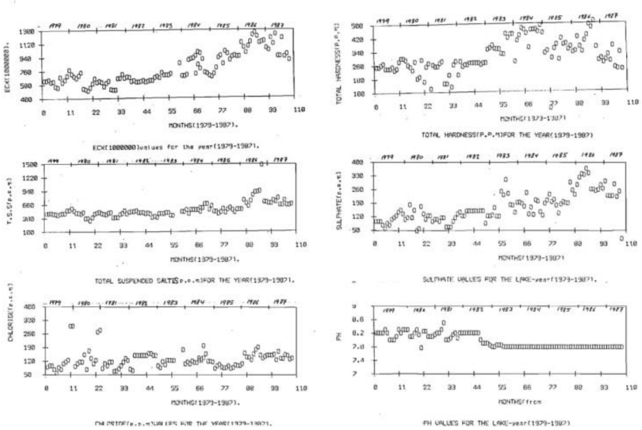
a) Lake Water Analysis

Some water analysis was made for water samples collected near -Thaban water control channel collected by ministry of agriculture and water recourses , all test results with maximum Turbidity <100 mg/l which is very convenient for Direct Filtration.

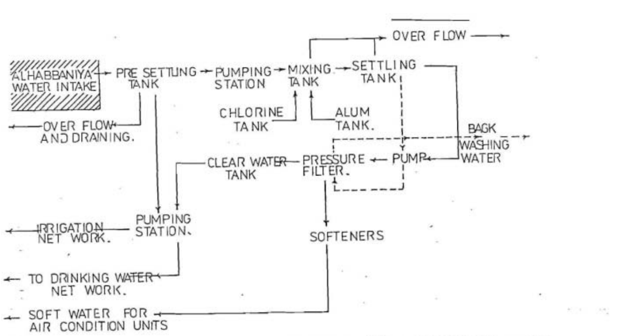


CARBONTE HARDNESS(p.p.m)VALUES FOR THE YEAR(1979-1987).



b) Existing Water Treatment Plant for Habbaniyah Tourism City

Located north east of Al-Thaban water control channel, consist of four compact Units, with total water production of 2,000 m^3/day,

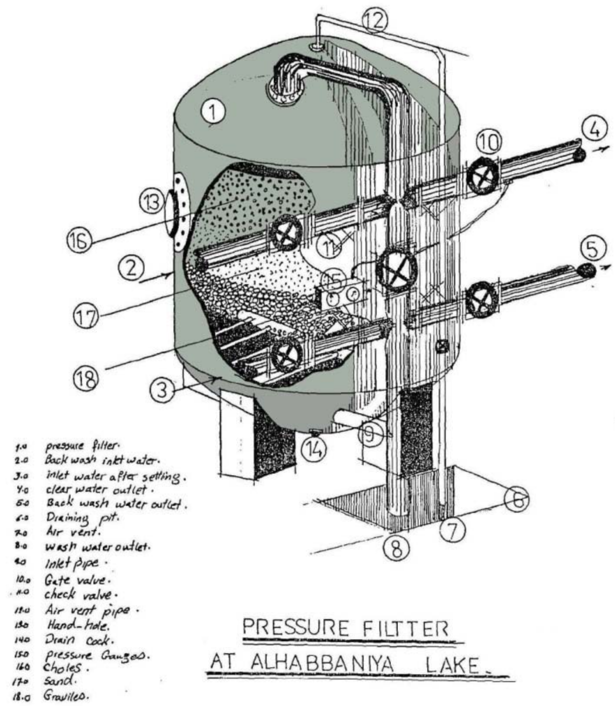


FLOW DIAGRAM FOR ALHABBANIYA WATER TREATMENT PLANT

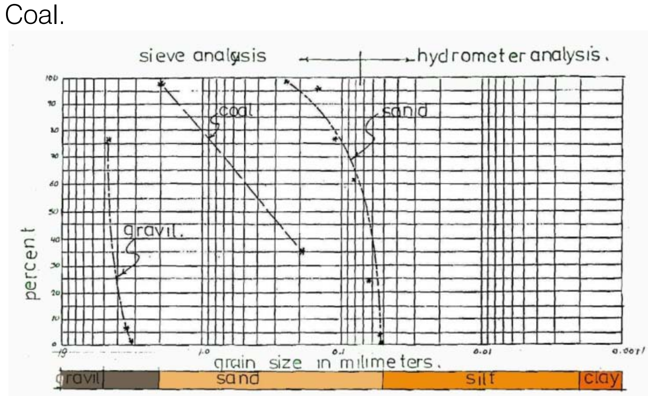
Raw water pumped from the lake to underground water storage tank Depth 8,0 m ,water stays for about one hour then water is pumped to the coagulation & settling tanks .

Because of the traditional treatment sequence used in this existing plant, a hard work has to be done to modify the plant to direct filtration system and start the field tests,

c) Filter Units Used In The Plant



There are four filter Units in the Existing plant, pressure Type filters ,Vertical Type with Dia .1,90 m and height of 2.10m water pumped from settling tank Via Ercole Marelli pump to the filters, the same pumps are Used for Back washing of filters through Control System. Back Wash water is pumped back to the lake. All inlet and out let of filters are provided with pressure gages, and the back wash normally done automatically. The back wash was done usually in four stages to prevent the flushing of the filter media, filters with multimedia three layers equal in Depth, Aggregate & fine Sand, and Coal.

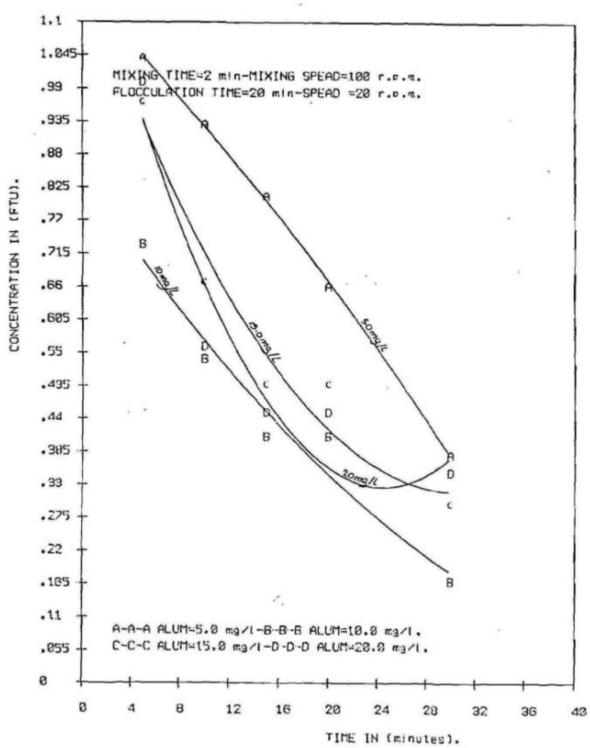


SIEVE ANALYSIS FOR ALHABBANIYA FILTER MATERIAL.

XIV. Field Tests

a) Jar Test

At the beginning we have to choose which Dose of Alum is the Best for Habbaniyah Lake, a jar Test was performed; Attached figure shows the relation between dosing of Alums and filters performers.



JAR TEST FOR HABBANIYA LAKE WATER(TURBIDITY=6.7 FTU).

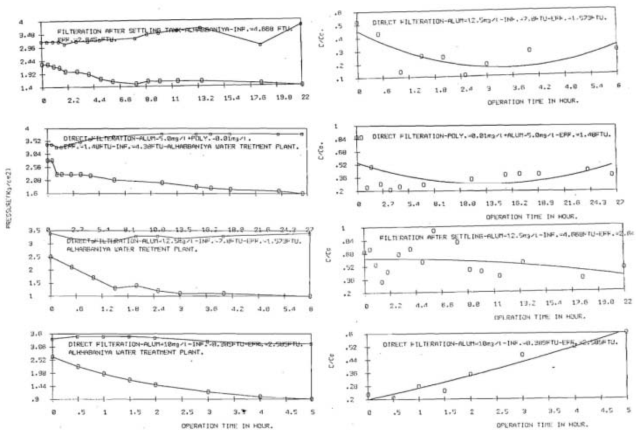
b) Experimental Field Test

To start the test at site using Direct filtration ,and Lake water first a diversion has been made for Unit No.3,the Primary Settling tank was canceled, two group of test was made using lake water with Turbidity >10.0 mg/l first using Alum As coagulant ,and second Group used Alum in addition to Polyelectrolyte.

No.	Test Type	Av.Inlet Water Turbidity in (FTU)	Av.Out let Turbidity in (FTU)	Filter efficiency	Type of Coagulants Used in the Test	Time of operation in (hr.)	Water production in (m3)
1	Direct Filtration	8.385	2.585	69.17	Alum 10mg/l	5.80	211.99
2	Direct Filtration	7.80	1.573	79.83	Alum 12.5 mg/l	6.00	271.50
3	Direct Filtration	4.39	1.48	86.25	Poly. 0.01mg/l +Alum5 mg/l	27.00	1189.88
4	Direct Filtration	4.668	2.645	43.33	Alum 12.5 mg/l	22.00	1353.13

c) Field Test Results

Field first group of tests used Alum as Coagulant with Dosage of 10.0 mg/l and 12.5 mg/l, water produced with very high Quality compared with conventional treatment sequence but the filter working time was about 5-6 hours compared with 12 hours if the plant is working with its original sequence , test was repeated using assistance coagulants like polymers with Dosage of 0.01 mg/l in addition to Alum dosage concentration 5,0 mg/l , filter working time increased up to 27,0 hours ,with filtration efficiency about 67% ,and clear product water 1.48 FTU , see Table above, below figure showing production of water relative to head losses, and head losses with time,



It was also clear that filter efficiency increased when using polymers after 8.0 hr of working,

d) Experimental Results

i. Habbaniyah Lake water maximum Turbidity is around 70,0 mg/l .
ii. TSS in the lake water is between 600-700 mg/l which is expectable for drinking purpose.
iii. Dissolved Oxygen is high which give good indication for the good Quality of water and less Organic materials.
iv. Direct filtration gives V. good Results for filter working cycle, and quantities of water production& Quality.
v. It is recommended to Use Polymer with Alum for Coagulation for better Results.
vi. Filter efficiency increased when using polymers after 8.0 hr of working,
vii. Filter working time increased up to 27,0 hours.
viii. filtration efficiency about 67%
ix. clear product water 1.48 FTU
x. It is important to check Coagulant potential value to have better Results.
xi. This shows clearly that pressure Filters can be used for direct filtration in addition to Rapid Gravity Filters.

e) Experimental Equations Resulted

Experimental equations for the Total water Production (one filter cycle), Using Habbaniyah water, Direct Filtration, & Pressure filters can be show As Follow

i. Using Alum As main Coagulant , with Dosage of 10.0 mg/l,

$$WP=68765*(LOG\ 2400 / Delta\ H)$$

ii. Using Alum As main Coagulant , with Dosage of 12.5 mg/l,

$$WP=637.37*(LOG\ 2400 / Delta\ H)$$

iii. Using Alum & polymer As Coagulant , with Dosage of 5.0 mg/l Alum ,in addition to Poly.0.01 mg/l,

$$WP=1976.33*(LOG\ 2400 / Delta\ H)$$

iv. Using Alum As main Coagulant , with Dosage of 15,0 mg/l,

$$WP=3176.59*(LOG\ 2400 / Delta\ H)$$

Where:-

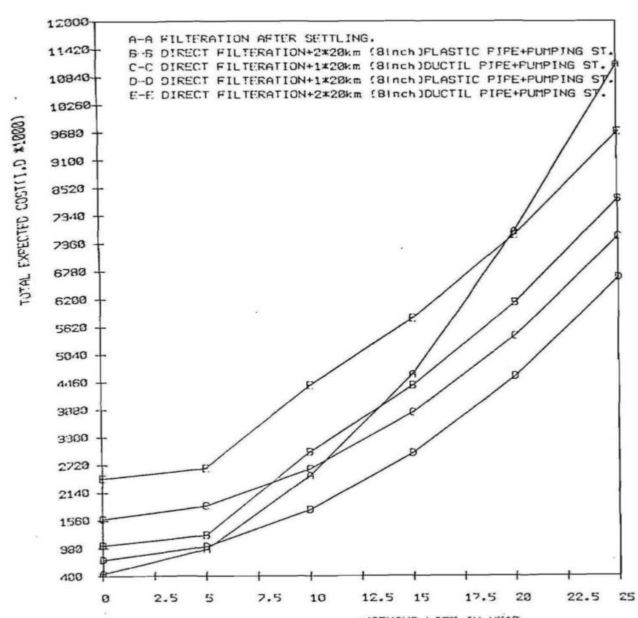
WP = Water Production in m3/filter Run (till Back Wash is required)

Delta H = Total Filter head losses at the beginning (when t=0)

XV. Feasibility Study

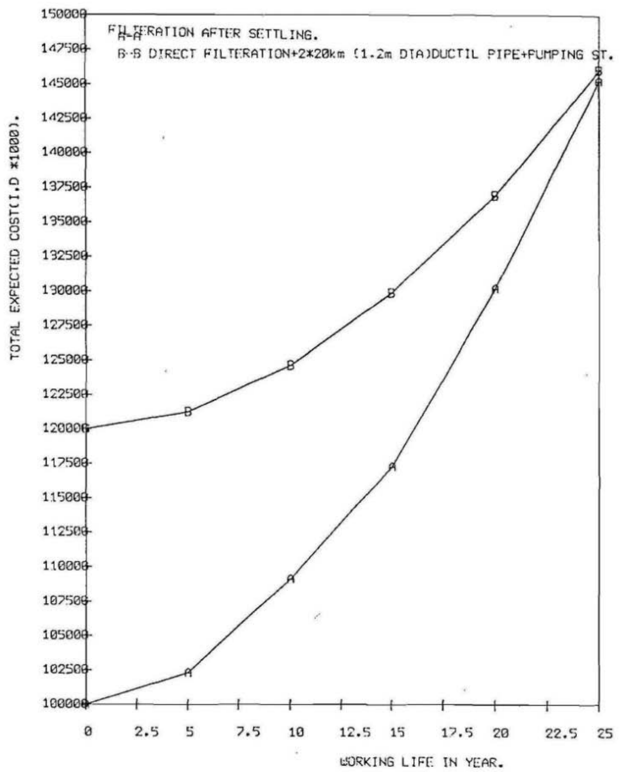
As any work needs to be evaluated through feasibility study, in which all future expenses should be considered as effective factors, Habbaniyah Lake is surrounded with many big cites, so this study will conceder falluja city to evaluate using direct filtration water plants ,the city is about 20 Km to the east ,also results will be compared with conventional treatment plants using Euphrates River water for this comparison we suggested using plants with capacities of 2,000 m3/day, 100,000 m3/day , 250,000 m3/day , 500,000 m3/day,

Estimated costs for settling tanks is about 20-30% of total plant initial costs, this study will consider the running and maintenance cost of the plants, keeping in mind that the expected annual influence in worker salary is about 5%,and the influence in construction materials and equipment is around 33%, annual Bank found of 10% is considered, below is a figure for 2,00 m^3/day plant , the study clearly shows that this size of plants will not give any benefit before 5 years,

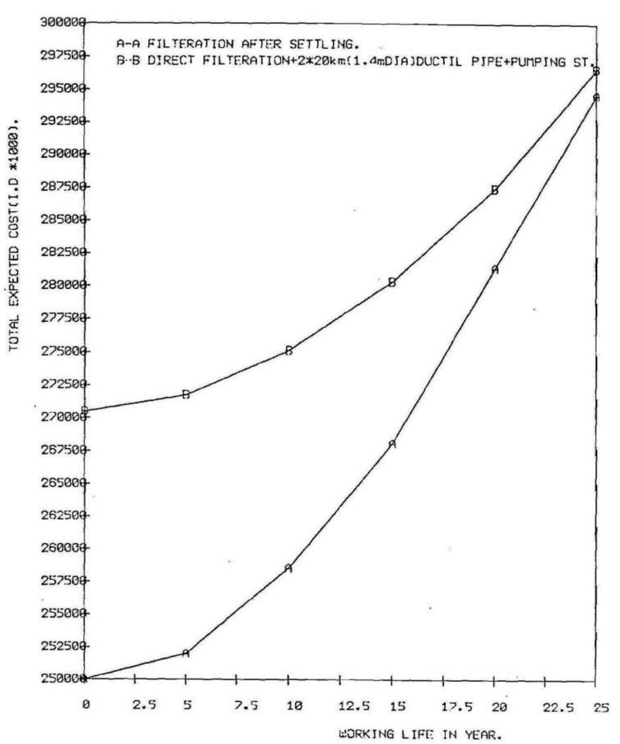


2,000 m3/day WATER TREATMENT PLANT AT ALHABBANIYA LAKE.

Feasibility study for Constructing Direct Filtration plants with capacity of 100,000 m^3/hr and 250,000 m^3/hr shows that there is no benefits compared with conventional plants if constructed inside Al-Falluja city on Euphrates River,

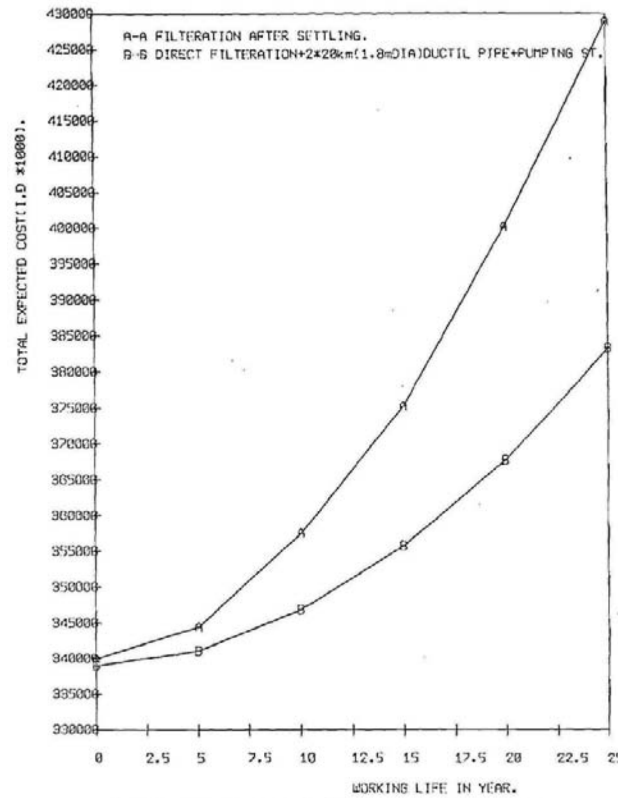


100000m3 WATER TREATMENT PLANT AT ALHABBANIYA LAKE.



250000m3/day WATER TREATMENT PLANT AT ALHABBANIYA LAKE.

Figure below for water treatment plant with capacity of 500,000 m3/day using Direct filtration, it can be seen clearly the advantage of such plants and the benefit in its low initial costs too,



500000m3/day WATER TREATMENT PLANT AT ALHABBANIYA LAKE.

a) Results from Feasibility Study

It is clearly understood from above study, there is a big advantages of constructing water treatment plants Using Direct filtration from Habbaniyah Lake with capacities equal or bigger than 500,000 me /day,

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Relationship between Porosity, the Maximum Dry Density and the Mechanical Behavior of Stabilized Dune Sands

By Abderrahmane Ghrieb, Ratiba Mitiche-Kettab & Salim Guettala
University of Djelfa, Algeria

Abstract- In this paper, the stabilization of studied dune sands was made by compaction and addition of stabilization agents; cement and fillered sand. The cement percentage ranges from 2 to 10% with a step of 2%, and that of the fillered sand from 0 to 30% with a step of 10%, sixty mixtures have been prepared. For each mixture, the optimal normal Proctor, the porosity accessible to water, the compressive strength, the splitting tensile strength and the elasticity modulus were investigated. The data so developed were statistically analyzed in order to examine the influence of the dune sand origin and the proportioning of stabilization agent on the porosity, and establish the links between porosity, the maximum dry density and the mechanical behavior (MB) of stabilized dune sands. Through the results obtained, relationships between porosity, the maximum dry density and the mechanical behavior were performed in an acceptable manner, irrespective of the dune sand origin and the stabilization agent content.

Keywords: dune sands; stabilization; relationship; porosity accessible to water; maximum dry density; mechanical behavior.

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Abstract- In this paper, the stabilization of studied dune sands was made by compaction and addition of stabilization agents; cement and fillered sand. The cement percentage ranges from 2 to 10% with a step of 2%, and that of the fillered sand from 0 to 30% with a step of 10%, sixty mixtures have been prepared. For each mixture, the optimal normal Proctor, the porosity accessible to water, the compressive strength, the splitting tensile strength and the elasticity modulus were investigated. The data so developed were statistically analyzed in order to examine the influence of the dune sand origin and the proportioning of stabilization agent on the porosity, and establish the links between porosity, the maximum dry density and the mechanical behavior (MB) of stabilized dune sands. Through the results obtained, relationships between porosity, the maximum dry density and the mechanical behavior were performed in an acceptable manner, irrespective of the dune sand origin and the stabilization agent content.

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I. Introduction

This is the second paper in a series reporting on the results an investigation into the physical and mechanical properties of stabilized dune sands of the Djelfa region (Algeria). The first paper [1, 2] reported on the utilization of stabilized dune sand in road foundation layers. The aim of the work presented in the first paper is the valorization of dune sand, which is abundant in Djelfa. This study consists of valorizing a local material in road construction. The results obtained show that the formulations selected have sufficient performances to be used in road foundation layers. The studied dune sands of the region of Djelfa belong to the D1 class according to the classification of the technical guideline on embankment and capping layer construction (GTR). They are poorly graded and contain a high proportion of fine elements (high porosity); their stabilization requires the addition of a granular corrector. The maximum dry density increased with cement addiition, owing to the higher absolute density of the cement. However, the optimal water content decreases. The increase in the maximum dry density with sand FS addition is attributed to the increase in the compactness of the mixtures. The addition of sand FS takes part in a very positive way to correct the grading of the studied sands, by improvement of the compactness of the mixtures and consequently the mechanical performance, particularly the compressive and tensile strength. The effect of the origin of sand on the physical characteristics and mechanical is very significant. This is attributable to the relative distinction of grading for each of sand. The use of sand FS improves the mechanical performances tested (tensile and compressive strength and elasticity modulus).They develop satisfactory mechanical performances to consider their valorization in road foundation layers. This second paper investigates the relationship between porosity accessible to water, the maximum dry density and the mechanical behaviour (MB) and presents empirical models that have been developed to describe this relationship. Stabilized dune sand is a porous material. In other words, it contains pores or voids. These pores are crucial to affect the mechanical behavior and durability of cement-based materials [3]. Indeed, a low porosity is the best defence against any aggressive agents. Porosity is a natural consequence of the quantity of water added more than is necessary to cement hydration, and of the voids present in the aggregate [4,5]. The inconvenience of this porosity is marked at two levels: on the strength and durability of cement-based materials. The compressive strength, the splitting tensile strength and elasticity modulus of cement-based materials are important design parameters in civil engineering. The splitting tensile test has been reported as indirect measure of the tensile strength of cement-based materials [6,7]. It has been used widely in practice due to its testing ease, simplicity of specimen preparation, and possible field applications, particularly in road engineering. In our study, the stabilization of studied sands (three dune sands of the Djelfa region) is made by compaction and the addition of a cement and a granular corrector; the cement percentage ranges from 2 to 10% with a step of 2%, and that of the granular corrector from 0 to 30% with

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a step of 10%, Sixty mixtures have been prepared. For each mixture, the optimal normal Proctor, the porosity accessible to water, the compressive strength, the splitting tensile strength and elasticity modulus were determined. The main objective of this paper was to study the effects of the addition of stabilization agents on the porosity accessible to water and its relationship with the maximum dry density and the mechanical behavior (compressive strength, the splitting tensile strength and elasticity modulus).

II. Experimental Program

a) *Materials*

i. *Cement*

The cement used is of composite cement (CEM II/A) class 42.5 MPa with 20% to limestone fillers. The clinker is from the cement factory of M'sila. Specific density = 3.06 g/cm^3 and fineness = 3.918 cm^2/g. The mineralogical composition of clinker is presented in Table 1. The potential mineralogical composition of the clinker is calculated according to the empirical formula of Bogue [8].

Table 1 : Mineralogical composition of clinker (%)

C_3S	C_2S	C_3A	C_4AF
81.18	2.79	6.85	9.18

ii. *Fillered Sand (FS)*

This sand comes from the centre of crushing Ben Labiad (municipality of Zakkar) located at approximately 40 Km in the south-east of the Djelfa centre (Fig. 1). The addition of this sand consists to improve the grading of studied sands (porosity about 45%) in order to reduce these voids. This increase in the compactness permits to develop better mechanical performances [1,2]. The fillered sand, is of calcareous nature consisting mainly of calcite (95.23%), specific density = 2.64 g/cm^3. The grading curve of sand is given in Fig. 2. The chemical analysis shows that this sand contains almost no harmful elements (0.23% of chlorides and 0.01% of sulphates).

iii. *Studied Sands*

Fig. 1 shows the locations of the studied sands. This work has been undertaken on three types of dune sand in the Djelfa region (Algeria); sand of El-Masrane (SM) (municipality of Hassi Bahbah located about 35 Km north of the Djelfa centre), sand of Zaafrane (SZ) (municipality of Zaafrane located about 57 Km northwest of the Djelfa centre) and sand of El-Amra (SA) (municipality of Ain El-Ibil located approximately 40 Km southwest of the Djelfa centre).

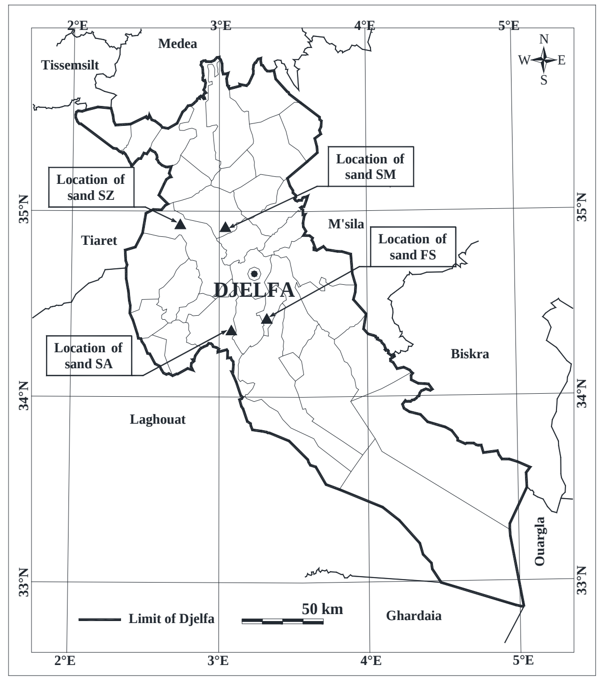

Figure 1 : Vicinity map showing locations of studied sands [1]

The different results of the physical characteristics of the studied sands are summarized in Table 2. Fig. 3 shows the grading curves of the studied sands. It can clearly be seen that 90% of the elements are lower than 0.5 mm. These sands can be classified from a granular viewpoint as fine sands [9]. The grading is very tight; nearly 90% of the grains have a dimension ranging between 0.1 mm and 0.5 mm. the sand alone could not have a sufficiently large compactness, and thus non adequate mechanical performances (compressive and the splitting tensile strength). It should be noted that the considered sands, need therefore to be granularly corrected.

Table 2 : Physical characteristics of the studied sands

Physical characteristics	Sands		
	SM	SZ	SA
Apparent density (g/cm^3)	1.40	1.44	1.42
Specific density (g/cm^3)	2.58	2.56	2.60
Porosity (%)	46.00	44.00	45.00
Compactness (%)	54.00	56.00	55.00

Visual sand equivalent (%)	74.00	53.00	57.00
Sand equivalent with the piston (%)	71.00	44.00	52.00
Blue value (for 100 g)	0.09	0.07	0.06
Fineness modulus	1.47	0.88	1.28

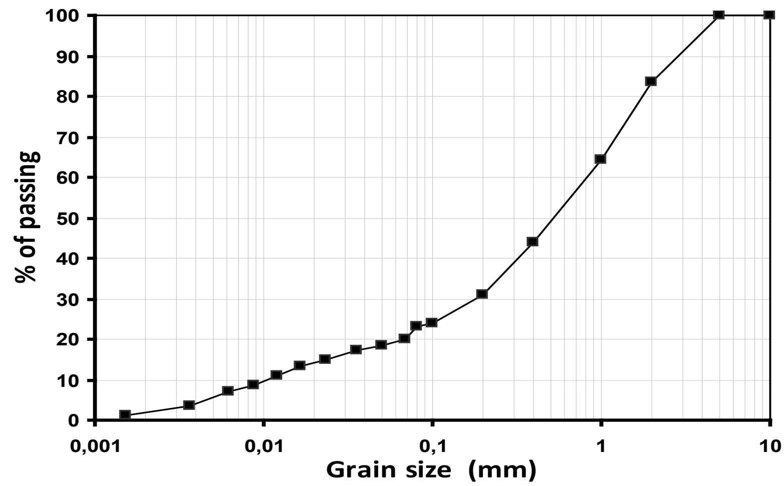

Figure 2 : Grading curve of sand (FS)

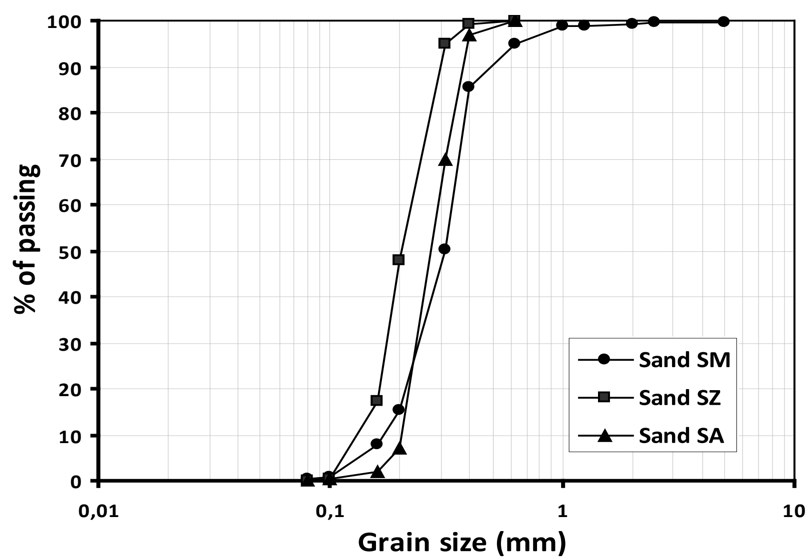

Figure 3 : Grading curves of the studied sands (SM, SZ, SA)

The chemical composition (Table 3) shows that the studied sands are principally made up of silica. The contents of the essential harmful substances (sulphates and chlorides) lie within the tolerable limits recommended by standard NF P 18-011 (this standard gives the definition and classification of chemically aggressive environments). This allows us to use a Portland cement as a binder or as an agent of stabilization. The choice of a cement of class CEM I (ordinary Portland cement) or CEM II (composite cement) is very suitable [1].

Table 3 : Proportions of essential elements containing in the studied sands.

Chemical composition (%)	Sands		
	SM	SZ	SA
Silica	97.63	97.43	97.14

Sulfates	Traces	Traces	Traces
Chlorides	0.85	0.82	0.78
Organic matter	1.17	0.93	0.76

b) *Tests Conducted*

i. *Proctor Compaction Test*

The mixtures are compacted by using normal Proctor energy according to ASTM D1557-09 Standard [10]. The test was carried out just after mixing operation and therefore could not take into account the effect of the hydration of cement. The values obtained of the optimal normal Proctor (maximum dry density and optimal water content) are required for the preparation of specimens that will be tested in this study (the specimens are made up at the optimal normal Proctor).

ii. *Mechanical strengths and elasticity modulus test*

The compression strength test was carried out according to EN 13286-41 standard [11]. Three specimens were tested at 28 days for each mix proportions. The splitting tensile test was run at 90 days according to EN 13286-42 standard [12]. Similar to the compressive test, the splitting tensile test was carried out on triplicate specimens and average the splitting tensile strength values were obtained. The elasticity modulus test was effectuated according to ASTM C469 standard [13]. The specimens were removed from their conservation and tested in simple compression on a universal press with a capacity of 300 KN. It is equipped with a force sensor and a displacement sensor connected to a data acquisition program (Fig. 4). The force sensor is connected to the upper cross member of the press. The velocity of displacement of the plate was fixed at 0.2 mm/min. This test was conducted in laboratory of the building materials - University of Djelfa.

Figure 4 : Universal testing machine used

The precision of the force sensor is 0.01 KN, and that of the displacement sensor is 0.002 mm. The elasticity modulus is determined in the linear elastic range of the material and in the relative value of the axial strain versus axial deformation.

iii. *Water Porosimetry Test*

The most method used for characterization is undoubtedly the measurement of porosity accessible to water. It provides a total result (total porosity), indicator of the material quality. From the volume of the specimen, we can calculate its porosity representing the ratio of the pore volume to its total volume [3]. On an experimental basis, either by hydrostatic weighing of a saturated specimen, it then determines the total volume of the specimen (fraction porous and solid) and calculates its porosity, P (%) from the following relation:

$$(P\ (\%) = ((M_{SSD} - M_D) / (M_{SSD} - M_{HYD})) \times 100\%).$$

Where:

P: porosity determined experimentally by hydro-static weighing, excluding the volume of trapped air and/or trained (%);

M_{SSD}: mass of saturated surface dry specimen, weighing air (g);

M_D: dry mass of specimen (g);

M_{HYD}: hydrostatic mass of saturated surface dry specimen, weighing in water (g).

This method has been used to measure the porosity of the cement-based materials successfully [14-17]. The water porosimetry is determined by method of hydrostatic weighing (Fig. 5) which is based on the Archimedes' principle on a sample saturated and submerged in a wetting fluid (water). The procedure for evolution the porosity is as follows: The specimens are dried in an oven at 105 °C until constant mass (M_D). Then, the specimens are saturated by imbibitions in a cell during 24 h by complete immersion. Then a hydrostatic weighing of the saturated specimens immersed in water (M_{HYD}) and a weighing in air of the saturated specimens wiped with a wet rag (M_{SSD}). The method used in this test is that established by ASTM designation C 624 [3]. This test was conducted in laboratory of the building materials - University of Djelfa.

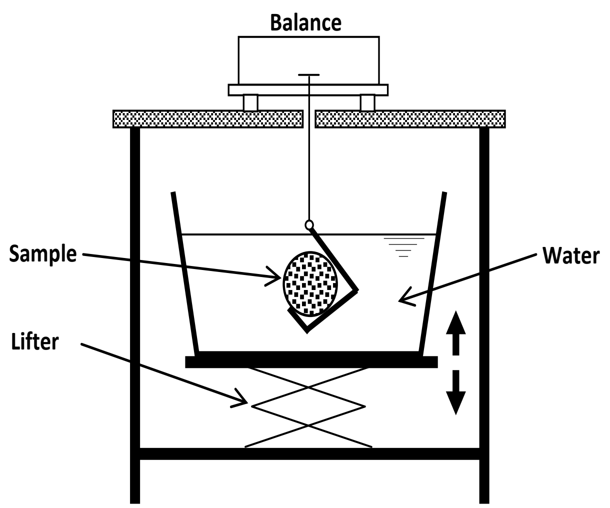

Figure 5 : Measurement of hydrostatic weighing

c) Mix proportions and specimens preparation

The stabilization of studied dune sands was made by:

- Mechanical stabilization: reduction of voids by the compaction operation.
- Physical stabilization: correction of the grading of studied sands by addition of a granular corrector (sand FS).
- Chemical stabilization: obtaining mechanical strength by addition of a hydraulic binder (cement).

The cement percentage ranges from 2 to 10% with a step of 2%, and that of the fillered sand from 0 to 30% with a step of 10% (the percentages based on the weight of dry mixture). Sixty (60) mixtures are to be studied in this investigation. The mixtures are denoted by SX-PS-PC-PFS; where X represents the sand source, PS the sand percentage, PC the cement percentage, and PFS the percentage of fillered sand, respectively. Details of the mixtures proportions are given in Table 4. For each mixture, the optimal normal Proctor (ONP), the porosity accessible to water, the compressive strength, the splitting tensile strength and elasticity modulus were determined. The specimen's preparation was made by static compression according to EN 13286-53 standard [18], this operation allows obtaining ends of the specimens perfectly perpendicular with the cylinder axis (not taking into account the effect of the ends on compressive strength). The moulds used allow obtaining a cylindrical specimen of 80 mm in diameter and 80 mm in height. The specimens were preserved in tight bags with a temperature of 20 ± 2 °C until the time of test.

Table 4 : Mixtures proportions

Mixtures			% of dune sand	% of cement	% of sand FS
SM series	SZ series	SA series			
SM 98-02-00	SZ 98-02-00	SA 98-02-00	98	2	
SM 96-04-00	SZ 96-04-00	SA 96-04-00	96	4	
SM 94-06-00	SZ 94-06-00	SA 94-06-00	94	6	0
SM 92-08-00	SZ 92-08-00	SA 92-08-00	92	8	
SM 90-10-00	SZ 90-10-00	SA 90-10-00	90	10	
SM 88-02-10	SZ 88-02-10	SA 88-02-10	88	2	
SM 86-04-10	SZ 86-04-10	SA 86-04-10	86	4	
SM 84-06-10	SZ 84-06-10	SA 84-06-10	84	6	10
SM 82-08-10	SZ 82-08-10	SA 82-08-10	82	8	
SM 80-10-10	SZ 80-10-10	SA 80-10-10	80	10	
SM 78-02-20	SZ 78-02-20	SA 78-02-20	78	2	
SM 76-04-20	SZ 76-04-20	SA 76-04-20	76	4	
SM 74-06-20	SZ 74-06-20	SA 74-06-20	74	6	20
SM 72-08-20	SZ 72-08-20	SA 72-08-20	72	8	
SM 70-10-20	SZ 70-10-20	SA 70-10-20	70	10	
SM 68-02-30	SZ 68-02-30	SA 68-02-30	68	2	
SM 66-04-30	SZ 66-04-30	SA 66-04-30	66	4	
SM 64-06-30	SZ 64-06-30	SA 64-06-30	64	6	30
SM 62-08-30	SZ 62-08-30	SA 62-08-30	62	8	
SM 60-10-30	SZ 60-10-30	SA 60-10-30	60	10	

III. Test Results and Discussion

a) Evolution of the porosity accessible to water

The results shown in Fig. 6 proves that for a constant sand FS proportioning, the increase in the quantity of cement added to the mixture, influences negatively and in a very significant way the porosity. This indicates that the addition of cement participates in the improvement of the mixtures compactness. The same remark can be made concerning the influence of sand FS proportioning on the porosity; which explains the effectiveness of the granular corrector used to improve the mixtures compactness (Fig. 7). The added cement in the presence of water tends to lubricate the sand particles thereby resulting in a denser packing during the compaction process; which explains the decrease of the porosity. Moreover, the cement and the FS particles tend to occupy, the voids between the dune sands particles, hence, resulting in a denser sand matrix [1,19] (the cement and the sand FS participate in improving the mixtures compactness). For 2% cement and 0% sand FS, the porosity varied from 26.87%, 26% and 26.22% respectively for the sands SM, SZ and SA, , and increased with the cement and the sand FS content to a maximum value of about 16.78%, 17.70% and 18.31% respectively for 10% cement and 30% sand FS addition.

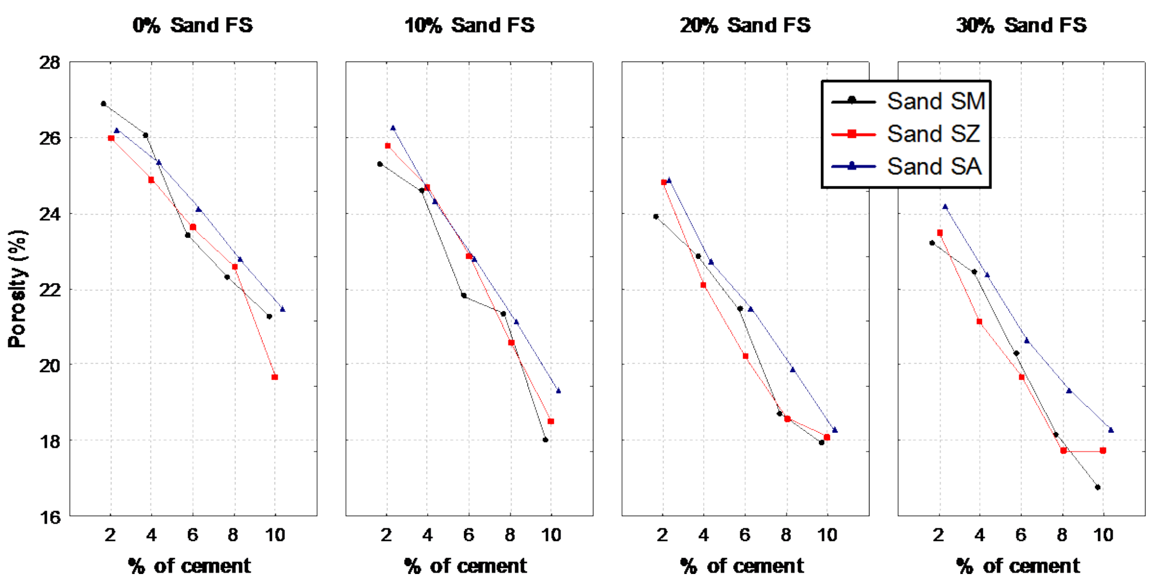

Figure 6 : Evolution of porosity as a function of the cement percentage

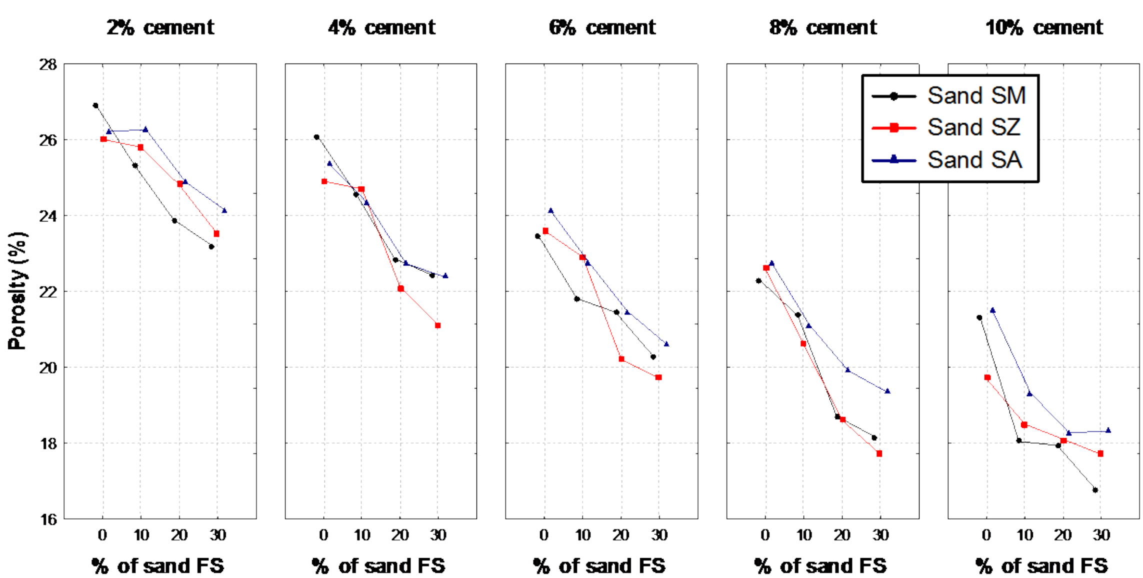

Figure 7 : Evolution of porosity as a function of the sand percentage (FS)

b) Relationship between porosity and the maximum dry density

Fig. 8 shows the relationship between porosity and the maximum dry density of the stabilized dune sands; the regression coefficient (R^2) is presented. We can notice that for different dune sands origins and different stabilization agent percentages the porosity accessible to water is significantly linked to the maximum dry density. A regression coefficient of more than (0.80) indicates a good relationship between porosity and the maximum dry density [20]. This relationship is of decreasing order and follows a linear function. It can be represented by the equation: ($P = -36.12 \times \gamma d + 87.33$); regression coefficient ($R^2 = 0.81$). These results show that it is possible to estimate the porosity of the stabilized dune sands when the maximum dry density is known. Where: P: porosity accessible to water (%); γ_d: maximum dry density (g/cm^3).

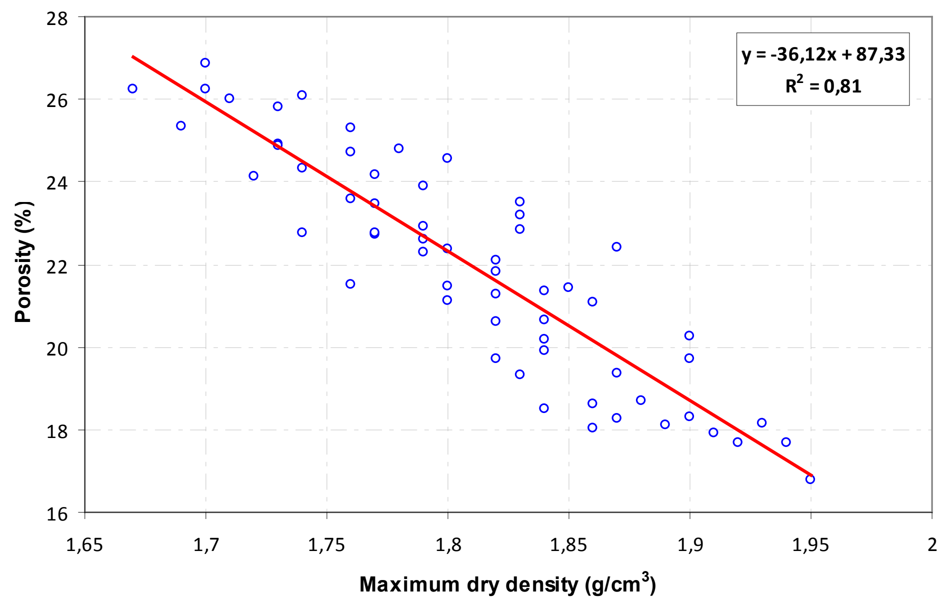

Figure 8 : Relationship between porosity and the maximum dry density

c) Relationship between porosity and the mechanical behavior

Fig. 9 indicates that the mechanical behavior (MB) of stabilized dune sands ((1) compressive strength, (2) the splitting tensile strength and (3) elasticity modulus) decrease with an increase in the porosity. The experimental data, depicted in Fig. 9, were utilized to develop a relationship equation between porosity and the mechanical behavior of the stabilized dune sands. The relationship between the fitted parameters is of decreasing order and follows an exponential function as: ($MB = a \times e^{(-b \times P)}$). Where: MB: are the mechanical behavior (compressive strength, the splitting tensile strength and elasticity modulus); P: is the porosity accessible to water; (a) and (b): are the empirical constants. The constants (a) and (b) were obtained through the regression analysis of the experimental data. The best-fit values of constants (a), (b) and the regression coefficient are summarized in Table 5. A regression coefficient of more than (0.85) indicates an excellent relationship between the fitted parameters [20]. Therefore, the data in Table 5 indicate a significant relationship between porosity and the mechanical behavior of the stabilized dune sands (compressive strength, the splitting tensile strength and elasticity modulus). It is to be noted that the relationship equation relating porosity accessible to water and mechanical behavior of the stabilized dune sands, developed in the present work, would help to estimate the compressive strength, the splitting tensile strength and elasticity modulus of these materials, irrespective of the dune sand origin and the stabilization agent content. It should be noted that the relationships reported in this paper were developed for the dune sands of the Djelfa region (Algeria), which have been stabilized by compaction and by addition of composite cement and the sand FS, as such similar relationships may need to be developed for other types of dune sands and agents of stabilization.

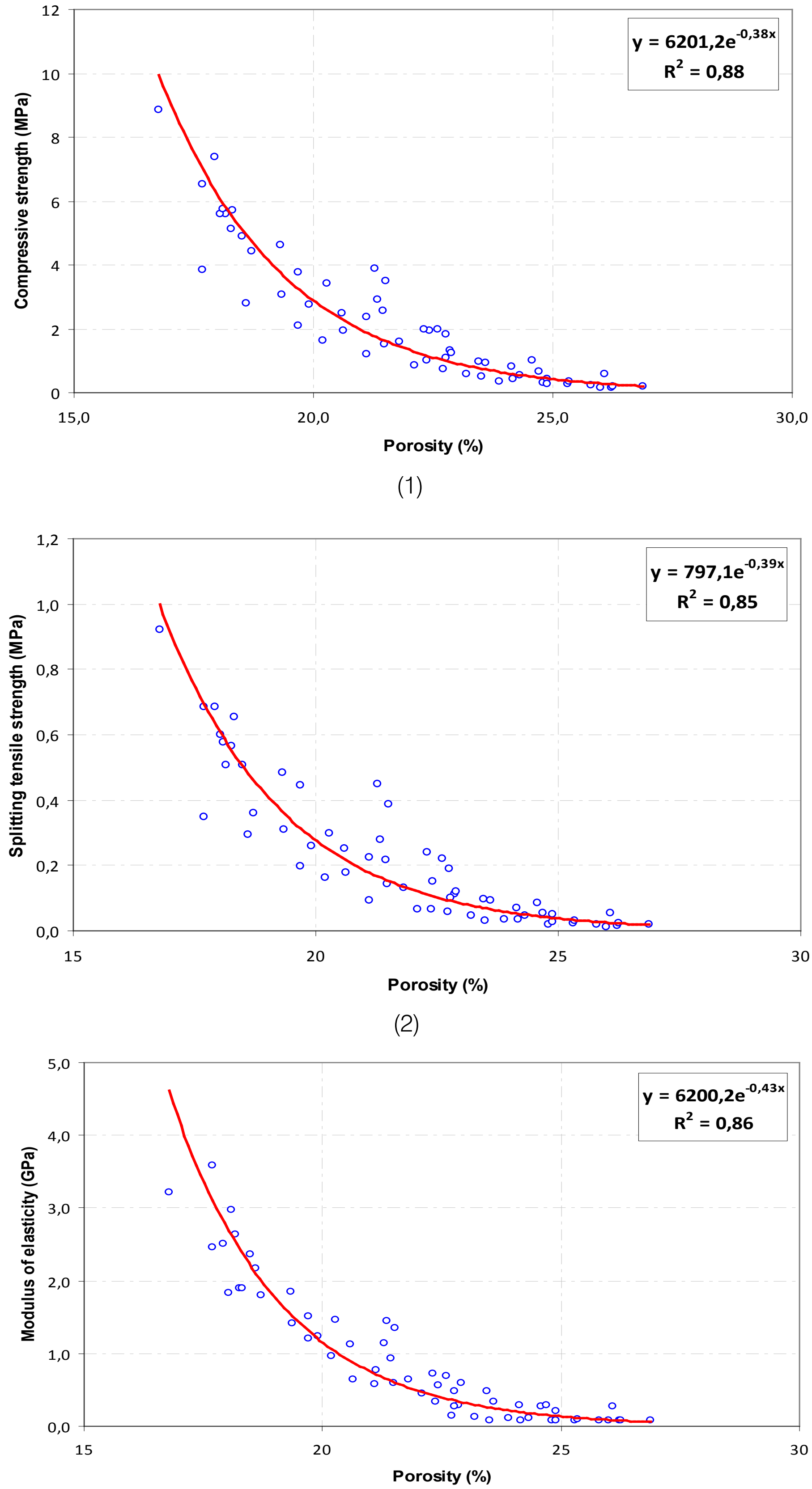

Figure 9 : Relationship between porosity and the mechanical behavior (MB), (1) : Compressive strength; (2) : Splitting tensile strength; (3) : Modulus of elasticity

Table 6 : Constants (a) and (b) and regressions coefficients (R^2)

Mechanical behaviours (MB)	a	b	R^2
Compressive strength	6201.2	0.38	0.88
Splitting tensile strength	797.1	0.39	0.85
Modulus of elasticity	6200.2	0.43	0.86

IV. Conclusion

The main objective of this paper was to study the effects of the addition of stabilization agents on the porosity and its relationship with the maximum dry density and the mechanical behavior (compressive strength, the splitting tensile strength and elasticity modulus). Based on the results of this experimental study, the following conclusions could be drawn:

- The increase in the quantity of stabilization agent added to the mixture, influences negatively and in a very significant way the porosity. This indicates that the addition of cement and sand FS participates in the improvement of the mixtures compactness.
- For different dune sands origins and different stabilization agent percentages the porosity accessible to water is significantly linked to the maximum dry density. A regression coefficient of more than (0.80). Indicates a good relationship between porosity and the maximum dry density. This relationship shows that it is possible to estimate the porosity of stabilized dune sands when the maximum dry density is known.
- The mechanical behavior data of stabilized studied sands were related to the porosity accessible to water through a single equation noted below: ($MB = a \times e^{(-b \times P)}$). Where: MB: are the mechanical behavior (compressive strength, the splitting tensile strength and elasticity modulus); P: is the porosity accessible to water; (a) and (b): are the empirical constants. An excellent relationship was noted between mechanical behavior and the porosity accessible to water, expressed in terms of the above expression. The relationships developed in the present work are related to the dune sands of Djelfa region, the composite cement and the sand FS. They could be utilized to estimate the compressive strength, the splitting tensile strength and elasticity modulus of other stabilized sands knowing the porosity accessible to water, of course, with a certain error degree.

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Direct Filtration using Surface Lakes Water in Iraq

By Dr. Faiz Al-Kathily

Abstract- As Direct filtration provides an alternative treatment process to coagulation and settling of low turbidity waters used for the treatment of good quality water supplies. The primary objectives for using a direct filtration treatment in municipal plants are to obtain quality water, at minimum coagulation dosage, without sacrificing filter production capacity.

GJRE-E Classification : FOR Code: 090599

DIRECTFILTRATIONUSINGSURFACELAKESWATERINIRAQ

Strictly as per the compliance and regulations of :

Direct Filtration using Surface Lakes Water in Iraq

Dr. Faiz Al-Kathily *(BSc, HDPE, MSc, PHD)*

Abstract- As Direct filtration provides an alternative treatment process to coagulation and settling of low turbidity waters used for the treatment of good quality water supplies. The primary objectives for using a direct filtration treatment in municipal plants are to obtain quality water, at minimum coagulation dosage, without sacrificing filter production capacity.

I. Direct Filtration using Surface Lakes Water in Iraq

Processes for drinking water treatment

A combination selected from the following processes is used for municipal drinking water treatment worldwide:

- Pre-chlorination - for algae control and arresting any biological growth
- Aeration - along with pre-chlorination for removal of dissolved iron and
- manganese
- Coagulation - for flocculation
- Coagulant aids, also known as polyelectrolyte - to improve coagulation and for
- thicker floc formation
- Sedimentation - for solids separation, that is, removal of suspended solids trapped
- in the floc
- *Filtration* - removing particles from water
- Desalination - Process of removing salt from the water
- Disinfection - for killing bacteria.

There is no unique solution (selection of processes) for any type of water. Also, it is difficult to standardize the solution in the form of processes for water from different sources. Treatability studies for each source of water in different seasons need to be carried out to arrive at most appropriate processes.

Technologies for potable water treatment are well developed, and generalized designs are available that are used by many water utilities (public or private). In addition, a number of private companies provide patented technological solutions. Automation of water and waste-water treatment is common in the developed world. Capital costs, operating costs available quality monitoring technologies, locally available skills typically dictate the level of automation adopted.

II. Purpose

This research aims at elimination of the sedimentation stage from water purification systems, here waters supplied from lakes. In this case, chemical are used to coagulate any remaining suspended materials before the filtration stage, chemical used include alum with some catalyst, such as poly electrolytes this is called Direct Filtration.

The purposes of the direct filtration process include: compliance with treatment technique regulatory requirements; targeting impurities; and producing safe and aesthetically pleasing drinking water. When source water is generally within the turbidity range of 1 to 10 NTU, it may be a candidate for direct filtration.

This study addresses the applicability of Direct Filtration (DF) as a candidate process to produce potable water from Lakes or areas under the influence of those Lakes,

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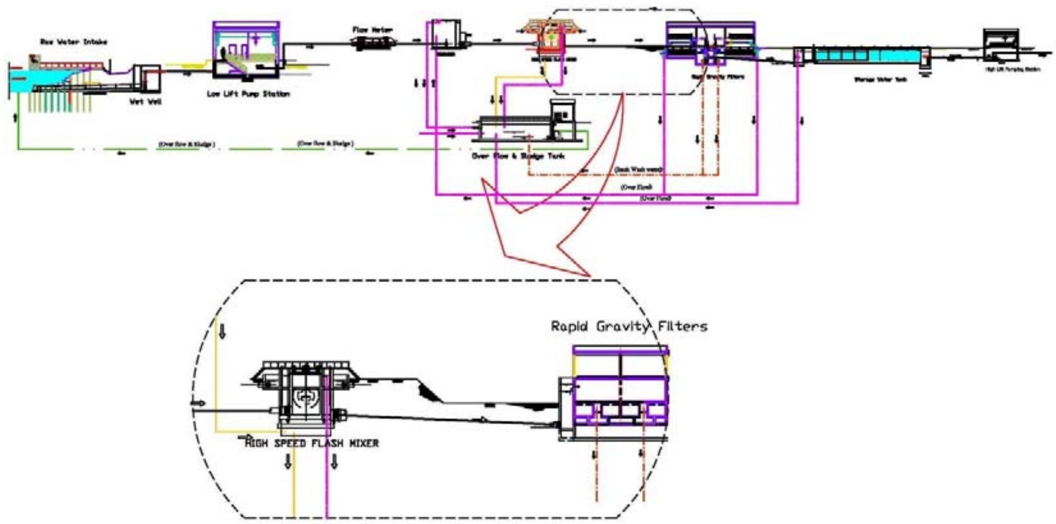
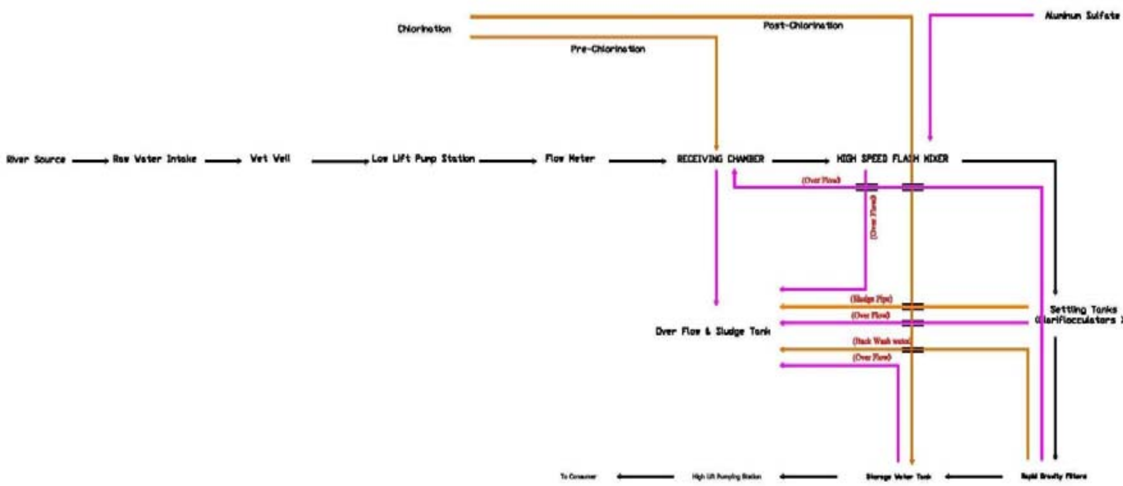
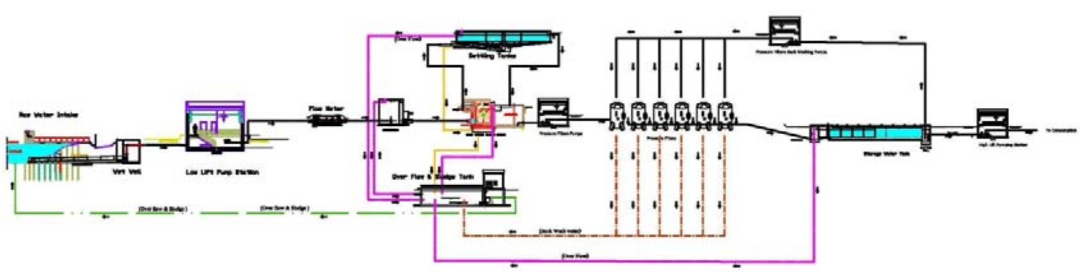


Direct Filtration Hydraulic profile - Using Rapid Gravity Filters

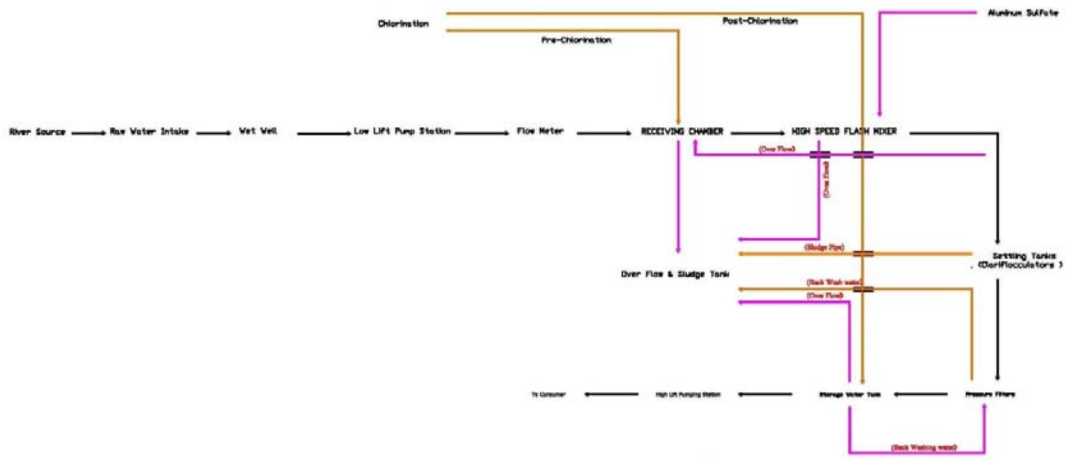


Traditional water Treatment pant Flow Diagram - Using Rapid Gravity Filters

Higher filter capacity is achieved by obtaining a more uniform solids loading distribution and by utilizing as much as 98% of the media bed. Direct filtration differs from conventional treatment in that it does not provide for solids removal by settling but does allow for mixing of coagulant chemicals prior to filtration.



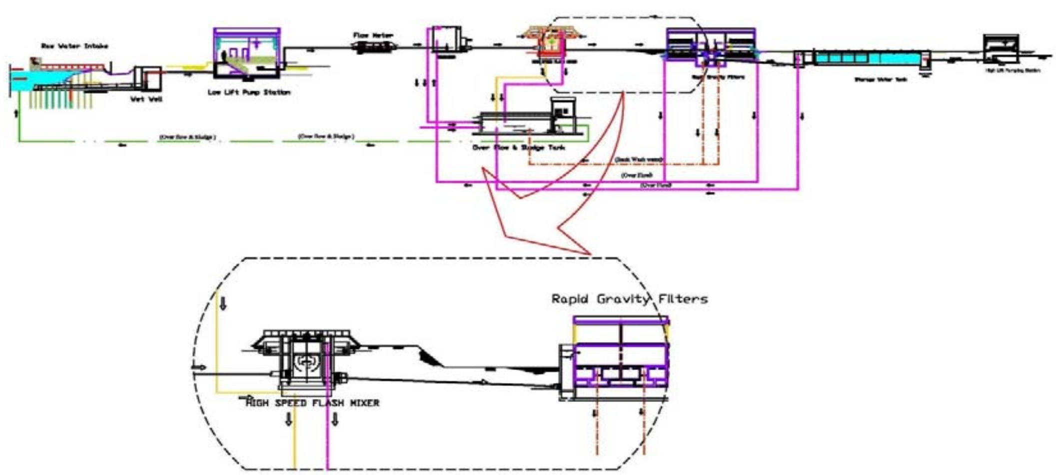
Traditional water Treatment pant Hydraulic Profile -Using Pressure Filters



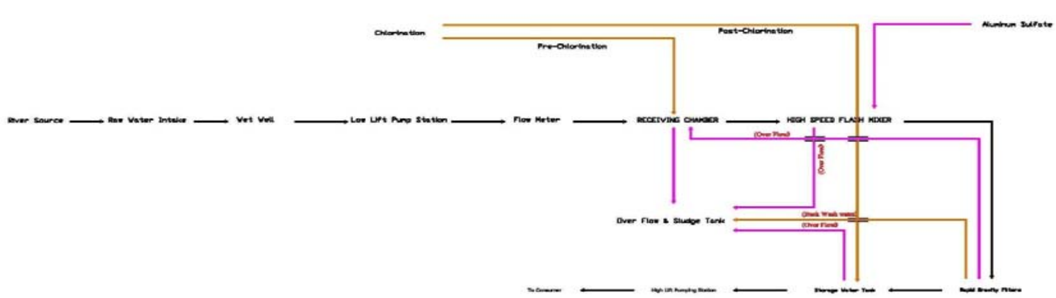
Traditional water Treatment pant Flow Diagram - Using Pressure Filters

In typical direction filtration operations, coagulants bearing a cationic charge are most often used. Polymers are accepted by the US Environmental protection Agency (EPA) and Public health & Safety Organization (NSF) for use in potable water.

The major difference between conventional traditional treatment plant and direct filtration is the absence of a separation process, such as sedimentation or flotation, between coagulant addition and filtration. Direct filtration can be preceded by preoxidation, may be accompanied by Powdered Activated Carbon (PAC) addition, and in some cases followed by Granular Activated Carbon (GAC) adsorption.

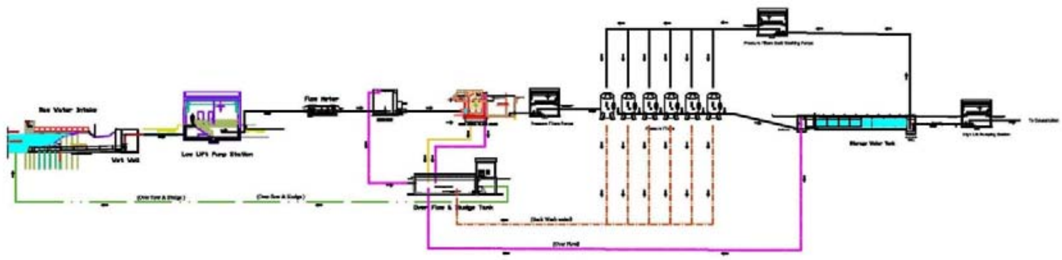


Direct Filtration Hydraulic profile - Using Rapid Gravity Filters

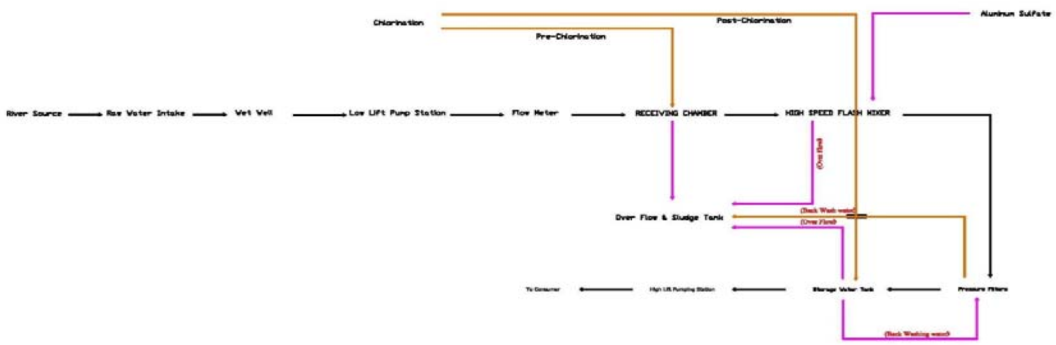


Direct Filtration Flow Diagram - Using Rapid Gravity Filtration

The same basic general physical chemical principles described in conventional treatment apply to direct filtration. Low coagulant dosages and high-intensity, short duration flocculation in a tank or in the media pores are used in direct filtration to promote the formation of a pinpoint sized floc which can penetrate the filter depth maximizing the filter beds storage capacity.



Direct Filtration Hydraulic profile - Using Pressure Filters



Direct Filtration Flow Diagram - Using Reassure Filters

Direct filtration(DF) has several advantages compared to conventional treatment: (1) lower chemical costs due to lower coagulant dosages used in direct filtration, (2) lower capital costs as the sedimentation (and sometimes the flocculation) tank is not needed, and (3) lower operation and maintenance costs as the sedimentation (and sometimes the flocculation) tank need not to be powered or maintained.

There are also disadvantages to direct filtration, including: (1) it cannot handle water supplies that are high in turbidity and/or color, (2) short response time for operators to adjust treatment to changes in source water quality, and (3) less detention time for controlling seasonal taste and odor problems.

Water quality parameters such as pH, temperature, and alkalinity may dictate effectiveness of direct filtration. The pH affects the speciation of the coagulant as well as its solubility, the speciation of the contaminants, and the filterability of particles.

Temperature also impacts the process because it affects the viscosity of the water. At lower temperature waters can decrease the hydrolysis and precipitation kinetics. Some of the alternative coagulants such as poly-aluminum chloride can be advantageous over the traditional aluminum and iron salts in low temperature conditions as these coagulants are already hydrolyzed, and therefore temperature tends to have less effect on the coagulation process.

III. Water Purification

Water purification is the removal of contaminants from untreated water to produce drinking water that is pure enough for the most critical of its intended uses, usually for human consumption. Substances that are removed during the process of drinking water treatment include suspended solids, bacteria, algae, viruses, fungi, minerals such as iron, manganese and sulfur, and other chemical pollutants such as fertilizers.

Measures taken to ensure water quality not only relate to the treatment of the water, but to its conveyance and distribution after treatment as well. It is therefore common practice to have residual disinfectants in the treated water in order to kill any bacteriological contamination during distribution.

World Health Organization (WHO) guidelines are generally followed throughout the world for drinking water quality requirements. In addition to the WHO guidelines, each country or territory or water supply body can have their own guidelines in order for consumers to have access to safe drinking water.

IV. Advantage of Direct Filtration Process

Several advantages can be realized when compared to the conventional systems. The advantages of this system may be summarized as follow.

- has low capital and running cost, Lose (1951) and Monscvitz (1978),
- easy to construct and to use, Foly (1967) and Hutchison (1977),
- Requires minimum number and small size of the treatment units, thus occupies less surface area as compared to most conventional systems,

- Requires less number of labor, facilities, and equipments, companied with the conventional systems.
- require less dose of chemicals and coagulants (Fadel 1989),
- has a reliable effluent with negligible algae problems (Fadel and Barakat,
- can be applied for several types of water having low, medium, or high turbidity,
- can be washed by raw water with suitable period of ripening, and
- does not require periodical surface and cleaning, thus produces less amount of wastewater.

V. Effect of Filter Depth on the Removal Efficiency

It is will known that, the filter depth has a direct relation with the filter efficiency, i.e., increasing the filter depth will increase the filter efficiency. In the present case, Fig. (2) shows the effect of filter depth on the removal efficiency of the direct filter. The new investigation of the present case is that, when the filter depth is shorter than 0.4 m, no significant efficiency is observed. For filter depth ranging from 0.4 -0.8 m, a drastic increase is observed in the filter efficiency. For filter depth more than 0.8 m, moderate increase is observed in the removal efficiency. From Fig. (2), it is clear that the removal efficiency may reach 99.0 % when the filter depth reaches 1.2m according to the running conditions. From which, the maximum depth was taken as 1.25 m. With more increase in the filter depth, insignificant increase is obtained in the filter efficiency. At the optimum conditions of particle size, alum dose of 35.0 mg/L (liquid alum with 27 % conc.), run time of 20 hr, surface loading of 3.5 m/hr and temperature of 32 C°.

VI. Effect of Surface Loading on the Removal Efficiency

Surface loading slowly affect the removal efficiency when filtration rate is less than 4 m3/m2/h. Increasing the surface loading up to 12 m3/m2/hr, the removal efficiency reaches to 23 %. With more increase in water level, the removal efficiency comes down to less than 57%. At the optimum conditions of particle size of 4 mm, alum dose of 35.0 mg/L, run time of 20 hr, filter depth of 1.25 m and temperature of 32°C,

VII. Effect of Particle Size of the Media on the Removal Efficiency

The particle size of the media plays the most important role on the filter efficiency. As found in many literatures, Chuang and Kun-Yan Li (1997) have confirmed that, there exist a high the effect of grain size on the performance of direct filtration. The removal efficiency comes down to insignificant value at using particle of size 50 mm for the filter. In practice the particle size of 3-5 mm is recommended. However, at some cases of pre-treatment work, particle size greater than 5 mm may be of use. At the optimum condition of alum dose of 15 mg/L, filter depth of 0.40 m, surface loading of 5.0 m/hr, run time of 8-20 hr ..etc,

VIII. Effect of Alum Dose Concentration on the Removal Efficiency

Several factors may Govern the optimum dose of alum such as, turbidity level of raw water, surface loading, ... etc. Chuang and Li (1997) have studied the effect of coagulant dosage on the performance of direct filtration; they stated that, there exists an optimum dose at which the filter produces high effluent efficiency.

IX. Effect of Run Length on the Removal Efficiency

The other factor, which affects on the filter efficiency, is the running time relative to the beginning and the end of the washing time. When the run time is done after the washing immediately, low level efficiency is obtained. On the other hand, if the run time is conducted just before the washing time, high level efficiency is obtained.

X. Physical Properties of Direct Filtration

Because the type of flocculation process typically used in direct filtration is not as efficient as conventional treatment in forming floc, variable water turbidity and bacterial levels constitute problems for maintaining good filter effluent quality. Thus, direct filtration is primarily used only for the treatment of good quality sources characterized by turbidity of less than 10 to 1 NTU, & color of less than 20 to 40 units, and low concentrations of algae iron and manganese. For water supplies that are consistently very low in turbidity and color, the flocculation tank is sometimes omitted and the process is then referred to as in-line filtration.

XI. Mechanical of Filtration

Filtration depend mainly on kind of particles, and the filter media. In general factors affect the filtration are:-

1st- deposit mechanism, as the particles bigger than the size of media porosity will be settled over the media, also the suspended solid take a specifies path depend mainly on porosity but even though some of the particles pass through the media, as there are some factors affecting the mechanism such as direct distortion, Brownian movement or van der wave forces, 2nd – fixation mechanism, which is the sedimentation of particles over the filter Surface as part of slow filtration flow, or vibration of particles because of different electrical charges, or van der waals forces.

3rd – detachment mechanism, as part of above forces and particles being catch either over the surface

2nd – fixation mechanism, which is the sedimentation of particles over the filter Surface as part of slow filtration flow, or vibration of particles because of different electrical charges, or van der waals forces.

3rd – detachment mechanism, as part of above forces and particles being catch either over the surface /or in side media porosity, the filtration rate may increase, and the flow may change from laminar flow to Turbulent, so particles may separated again and move deep or even pass through the filter media, this can be solved using stronger polymers, and variable filtration flow,

Turbidity Injection

To solve above we can do either

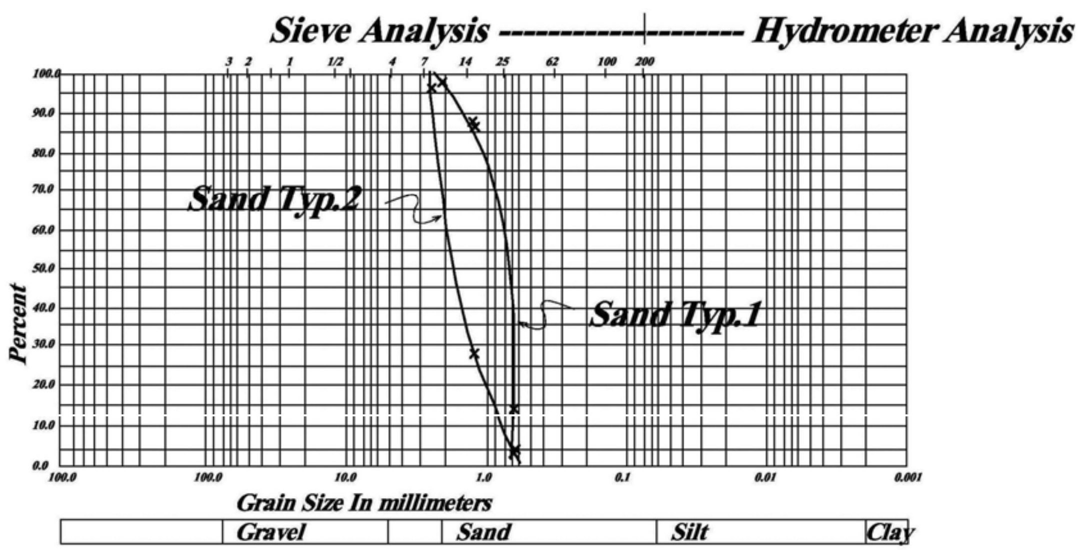
1st – increase particles size inside the media be injecting polymers inside the filter.

2nd – reduce particle size inside the passing solution by pumping water from down to up.

3rd – Reduce filtration rate. Inside each layer. Which can be done using radial filtration?

XII. Laboratory Experiment

Works and test first made in the laboratory using filtration Plexiglas tube inside Dia.21cm, height 280 cm, there are some gates on levels 75cm, 125cm, 280cm, to easy excess to filtration media, as per attached fig. the turbidity was controlled by dosing the Rate Via apartment also the coagulant dosage, then coagulation and flocculation using spiral tubes,

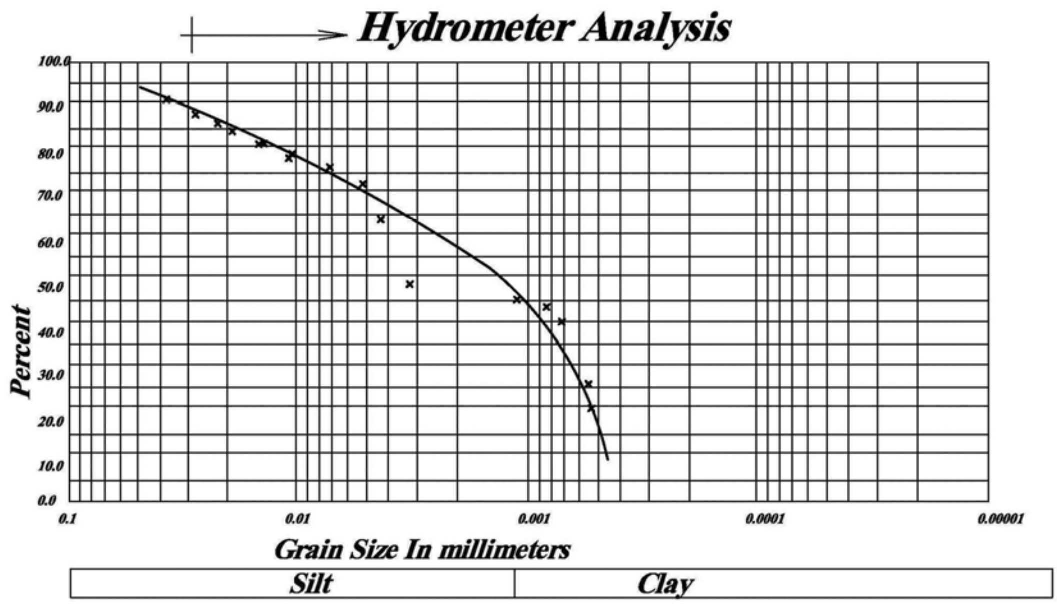


Sieve Analysis for Filter Sand (USED)

Sieve Analysis For Filter Sand (Used)

Specification	coefficients of permeability	density	porosity	specific weight	D10	D16	D50	D60	Effective Size	Coefficient of non uniformity	Geometric mean size	Geometric standard deviation
Material	cm/sec	gm/cm3	%	G					(E)	(U)	(Mg)	
Sand Typ.1	0.205	1.775	30.799	2.565	0.6	0.58	0.65	0.7	0.6	1.1666	0.65	1.1206
Sand Typ.2	0.445	1.569	37.506	2.511	0.75	0.9	1.8	2	0.75	2.6666	1.8	2
Crashed Brick Typ.1	8.78	1.072	55.72	2.421	4.5	4.8	7	8	4.5	1.77	7	1.4583
Crashed Brick Typ.2	4.155	1.145	52.705	2.421	2.9	3	3.5	4	2	1.379	3.5	1.1666
Sand (1+2) (1:1)	0.553	1.531	40.56	2.576								

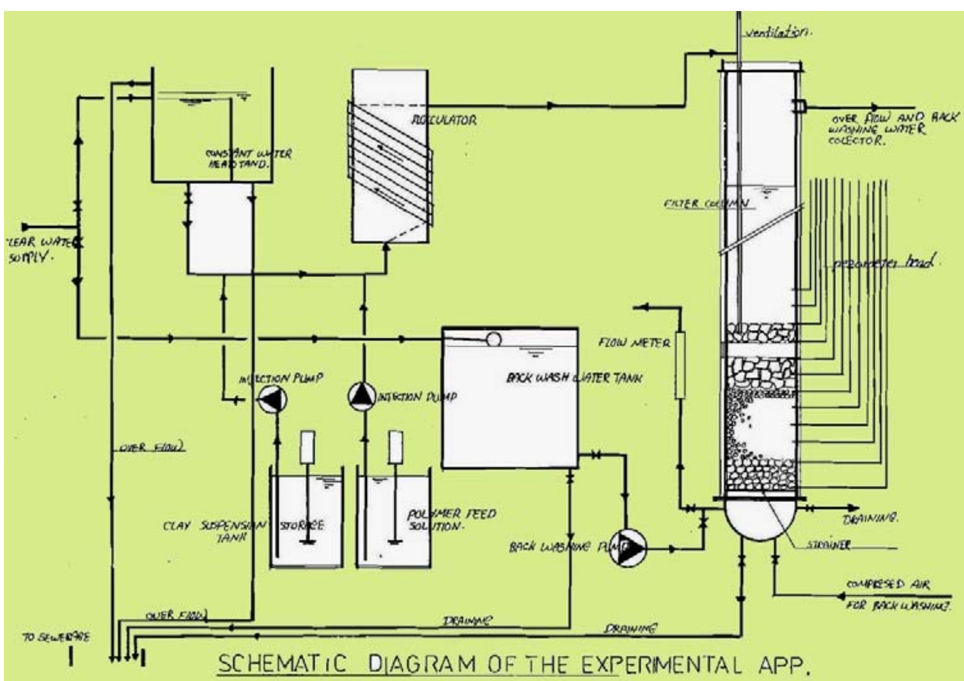
The turbidity in laboratory test was produced and controlled within the experimental test using fine mud (kaolin) mixed with very clear water with dosage and pumped to coagulation system Via prelistatic pump. Our laboratory turbidity calculation was done using RALANGE-LTP.5 using FTU Units, that are why we have first to make calibration for the Dosage of Kaolin and the turbidity calculation apparatus.



Sieve Analysis for the Turbidity Used In The Tests

a) Unit Operation

All the experimental test was done using variable filtration Rate, in which water Rise during filtration cycle as the filtration increase in its losses due to continues separation of Turbidity within filter media and cake deposit on filter surface.

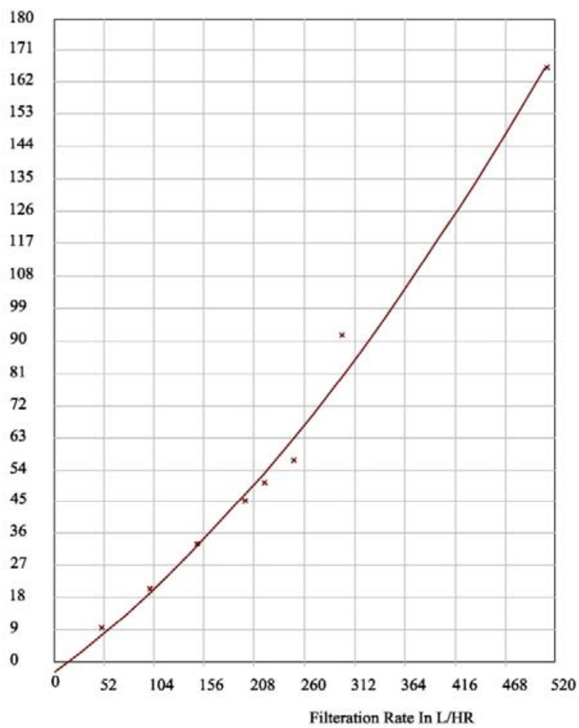


b) Filtration Media

Sand filtration used within experimental tests either within single media filter or multimedia filtration can be seen in fig. also some new filtration media is proposed as first layer using crashed Brick after sieving also can be seen within fig. attached all those media layers was distributed over aggregate layer with particles 0.8-to 1.0 cm Dia.

c) Experimental Test

About 70 laboratory test was conducted using deferent dosage, and different media layers, and different type & dosage of coagulant,



The Value Of (G) With Filteration Rate for This Study

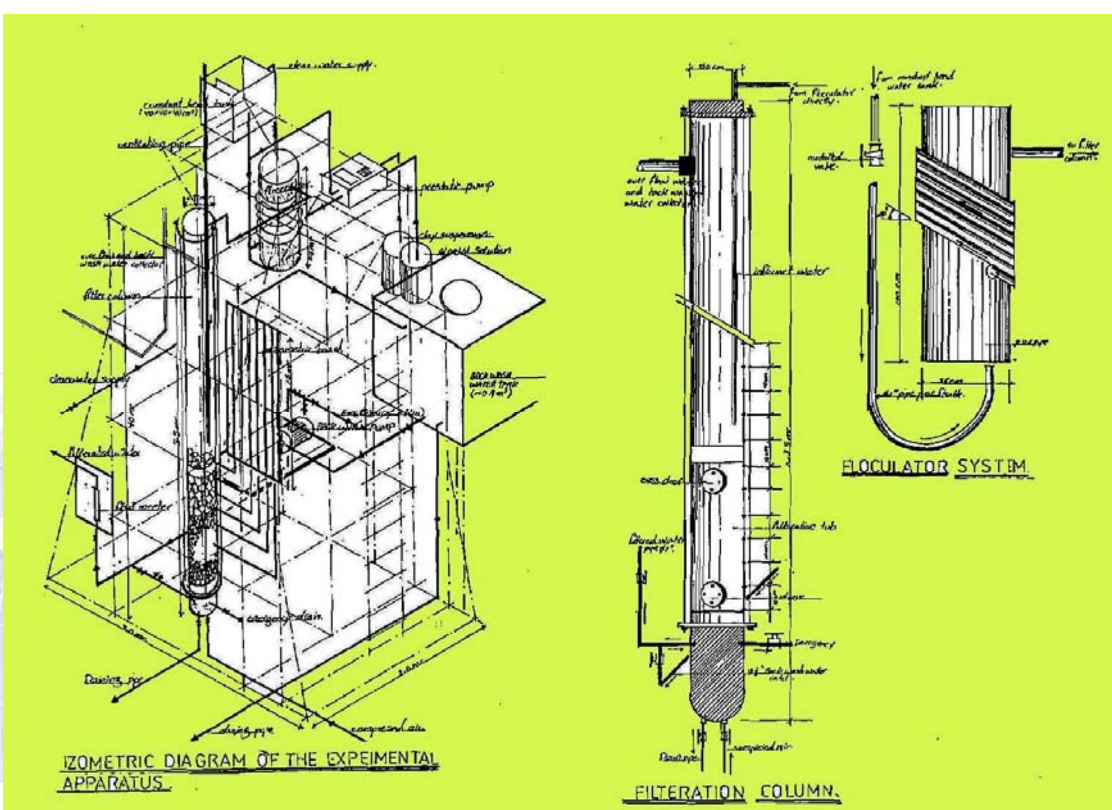
d) Experimental Results

Results of above showed that:-

- *1st* – it is possible to use direct filtration procedure in both laboratory and field with increasing efficiency through proper control of mixing, turbidity, filtration rate and velocity gradient.
- *2nd* – it is possible to use crushed brick, stone or Aggregate (20to50mm) as first layer, in addition to the sand layer,
- *3rd* - increase filtration efficiency up to 98%.

e) Laboratory Test

An integrated 5.50 m high Direct filtration unit was constructed in the laboratory, It included four main units: an axial flocculating unit, a filtration unit, injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board is also included tot give reading at each 10cm of filter height. Water is supplied to the system through a constant head tank by gravity action. Filtration is done through two mediums, a crushed brick layer2 to 5mm sizes (30to40) cm deep and a quartz sand layer 0.60to 0.75mm (30to40)cm deep.



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Direct filtration (DF) has several advantages compared to conventional treatment: (1) lower chemical costs due to lower coagulant dosages used in direct filtration, (2) lower capital costs as the sedimentation (and sometimes the flocculation) tank is not needed, and (3) lower operation and maintenance costs as the sedimentation (and sometimes the flocculation) tank need not to be powered or maintained.

There are also disadvantages to direct filtration, including: (1) it cannot handle water supplies that are high in turbidity and/or color, (2) short response time for operators to adjust treatment to changes in source water quality, and (3) less detention time for controlling seasonal taste and odor problems.

Water quality parameters such as pH, temperature, and alkalinity may dictate effectiveness of direct filtration. The pH affects the speciation of the coagulant as well as its solubility, the speciation of the contaminants, and the filterability of particles. Temperature also impacts the process because it affects the viscosity of the water. At lower temperature waters can decrease the hydrolysis and precipitation kinetics. Some of the alternative coagulants such as poly-aluminum chloride can be advantageous over the traditional aluminum and iron salts in low temperature conditions as these coagulants are already hydrolyzed, and therefore temperature tends to have less effect on the coagulation process.

Parameters used to characterize the direct filtration process include filter loading rate, filter run time, filter media, and head loss. Typical direct filtration loading rates range from 2 to 10 m3/m2/hr; however, filter loading rates greater than 10 m3/m2/hr have been used in some places (but no records was foreseen). This can be a critical parameter because it determines the water velocity through the filter bed can impact the depth to which particles pass through the media. The filter run time describes the length of time between filter backwashes during which a filter is in production mode.. As the filter run time increases and the concentration of solids in the media increases, the filtration process often performs better with regard to particulate contaminant removal. Head loss is the pressure drop that occurs when water flow through the filter media. Its development during the filtration run gives an indication of how quickly the filter is approaching the terminal head loss and the end of the run.

Residuals generated by the direct filtration process include coagulation solids (sludge) and spent backwash (BW). The amount of residuals that is generated in direct filtration (DF) is significantly less than in conventional treatment. This is a consequence of the lower coagulant dosages that are used in direct filtration (DF).

f) Iraqi Artificial Lakes and Dam lakes

Iraq considered one of the rich countries in water recourses as there are artificial water lakes distributed at different location of the country in addition to many Dams lake and water control project providing Artificial Lakes , As the mains water recourses are tigers & Euphrates Rivers, both are with good water quality with Turbidity that Rises' during flood seasons, This turbidity needs to be removed in water treatment plants by both physical and chemical methods, Lakes changes in raw water quality. Long detention times resulted in lower turbidity where clearer water favored increased growth of phytoplankton.

Summary Data for Important Lakes In Iraq

No.	Name	Length In Km.	Width in Km.	App.Area In Km2	App.Parametars in Km	Remarks
1	Tharthar Lake	71.25	6.18 to 30.07	1,499.62	382.50	Refer To Fig.s No.1,2,3,4
2	Razazza Lake	27.47	2.23 to 9.64	141.80	124.96	Water Surface Area could be Extend to 1,810 Km2 During Flood , Lake Volume of Water Reserved Up to 26,000,000,000 m3, can be considered the 2nd Biggest water Lake in Iraq. Refer To Fig.s No.1,3,5,7
3	Habbaniyah lake	27.30	9.00 to 18.00	261.00	86.83	Refer To Fig.s No.1,6,7
4	Mousul Dam Lake	48.52	6.00 to 12.00	239.39	223.52	Refer To Fig.s No.1,8,9
5	Darbandikhan Lake	59.64	9.59 to 37.94	391.72	473.79	Refer To Fig.s No.1,10,11
6	Dukan Lake	27.36	2.87 to 17.62	155.21	117.11	Refer To Fig.s No.1,12,13
7	Almamlaha Lake	57.44	1.76 to 12.72	463.84	22.45	located south of Basra city ,far South of Iraq, very salted Water, with high concentration of Mgo.could not be user for Drinking ,Refer To Fig.s No.1,14
8	Al-Qadisiyah Dam Lake	52.94	7.43 to 17.54	556.04	176.74	Refer To Fig.s No.1,15
9	Chebayish Lake	77.71	10.08 to 38.04	1,460.87	458.72	Refer To Fig.s No.1,16,17
10	Amara Ahwar	77.96	7.65 to 32.03	1,496.90	290.70	Area(Inside Iraq)=1058.61 Km2,Parameter (Inside Iraq) =261.90 Km, Refer To Fig.s No.1,18
11	Anah Lake	35.36	5.97 to 16.76	336.57	270.38	Refer To Fig.s No.1,19,20
12	Hammar Lake	25.25	4.31 to 9.31	151.51	96.61	Refer To Fig.s No.1,21
13	Sawa Lake	4.40	0.73 to 1.83	4.70	11.71	Refer To Fig.s No.1,22

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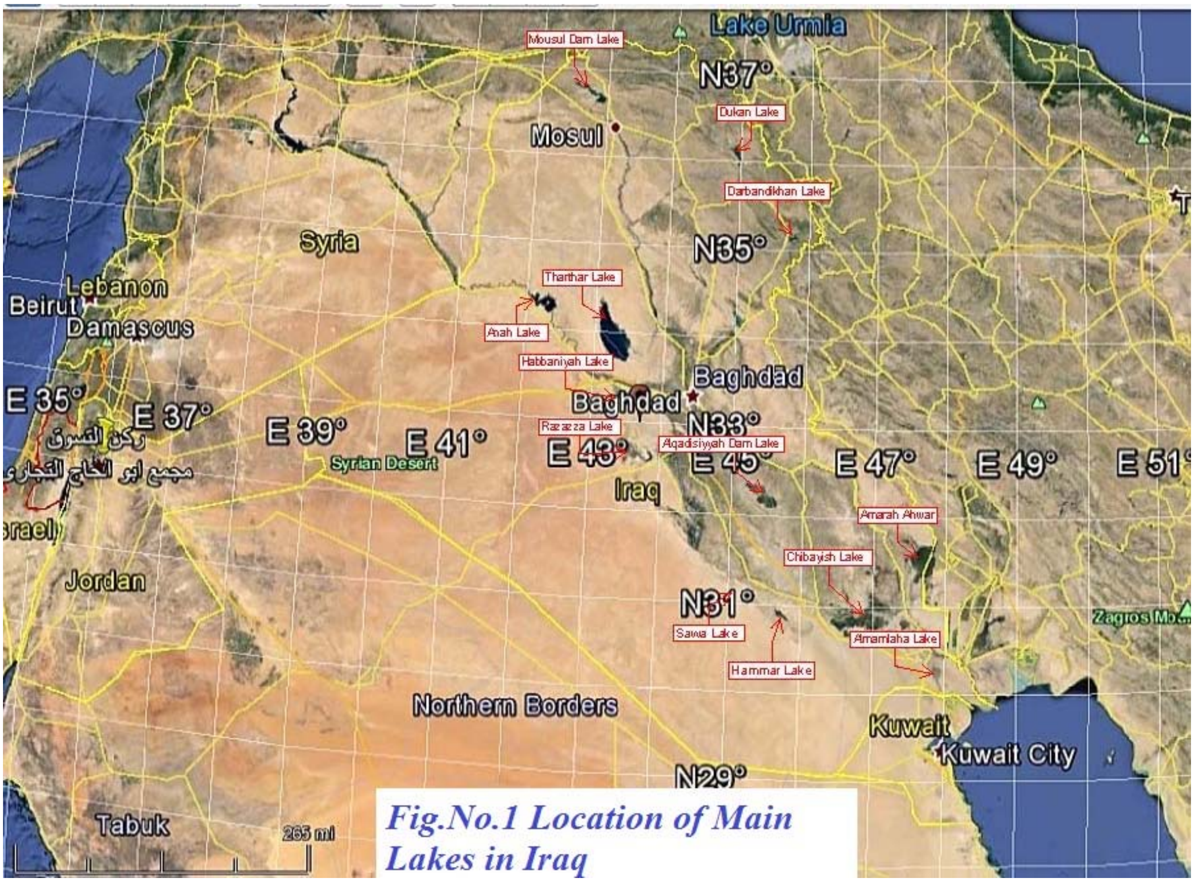

Fig.No.1 Location of Main Lakes in Iraq

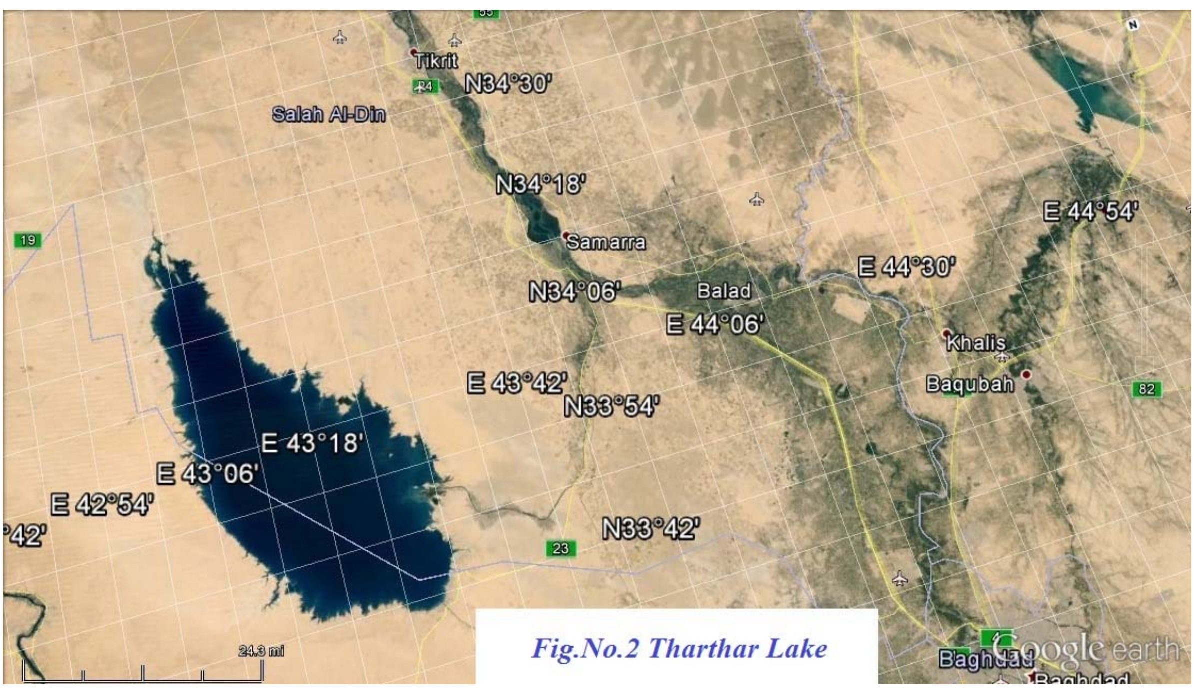

Fig.No.2 Tharthar Lake

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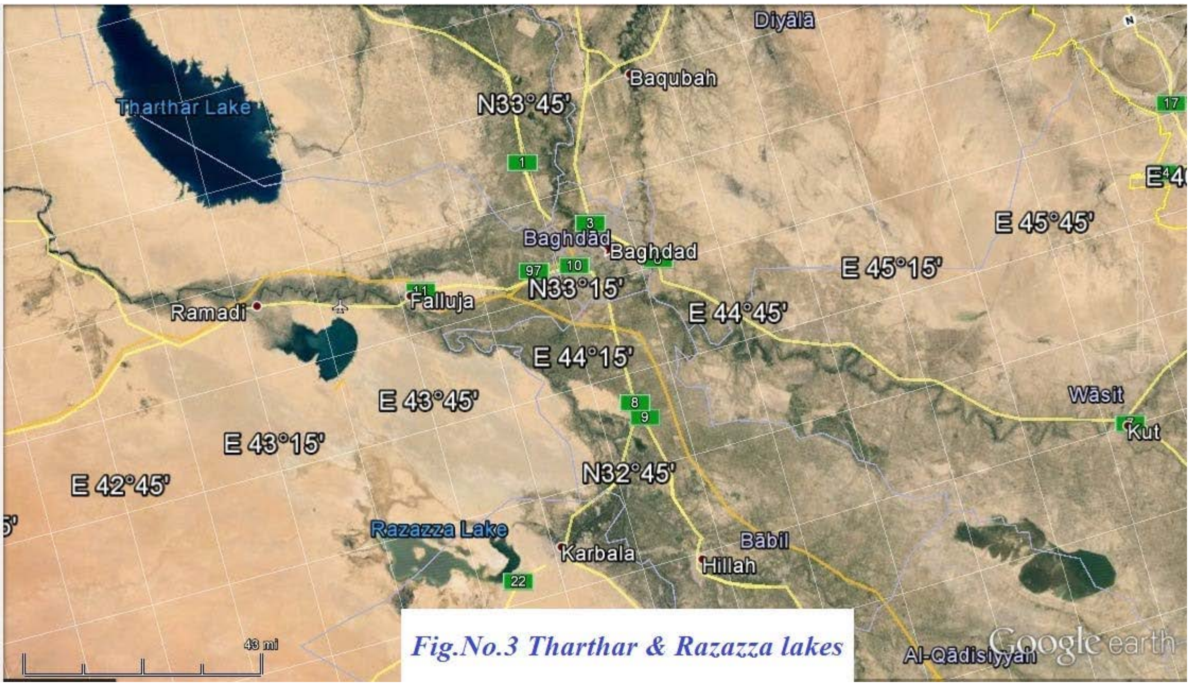

Fig.No.3 Tharthar & Razazza lakes

Fig.No.4 Tharthar Dam

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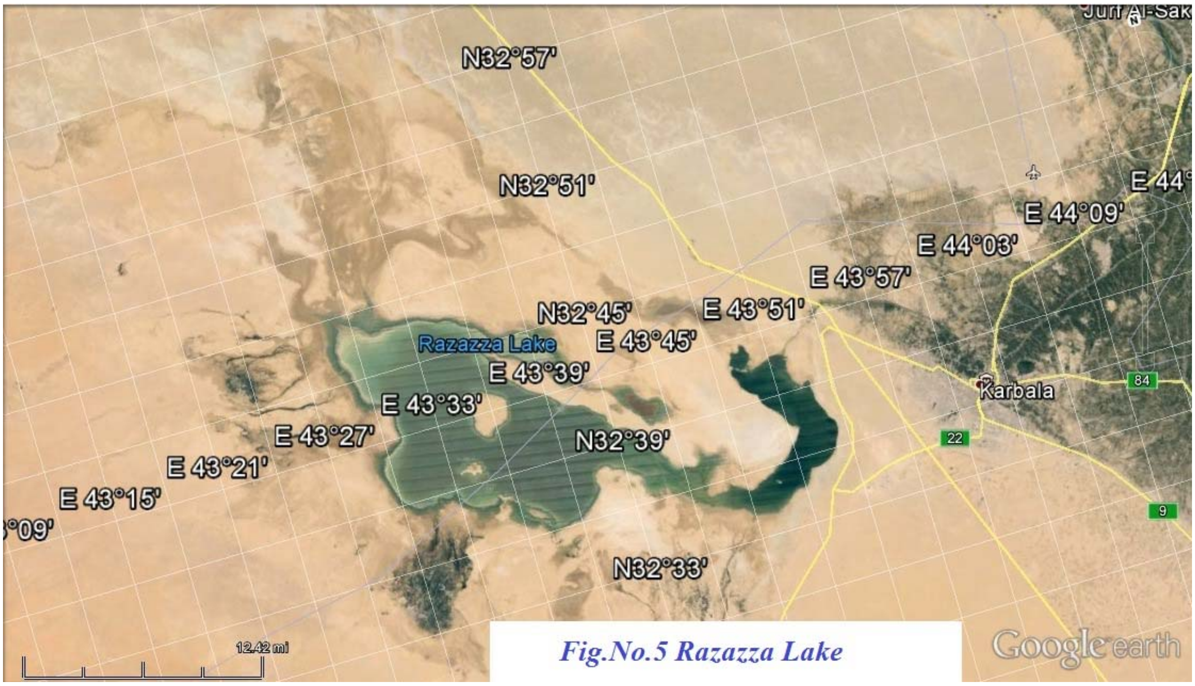

Fig.No.5 Razazza Lake

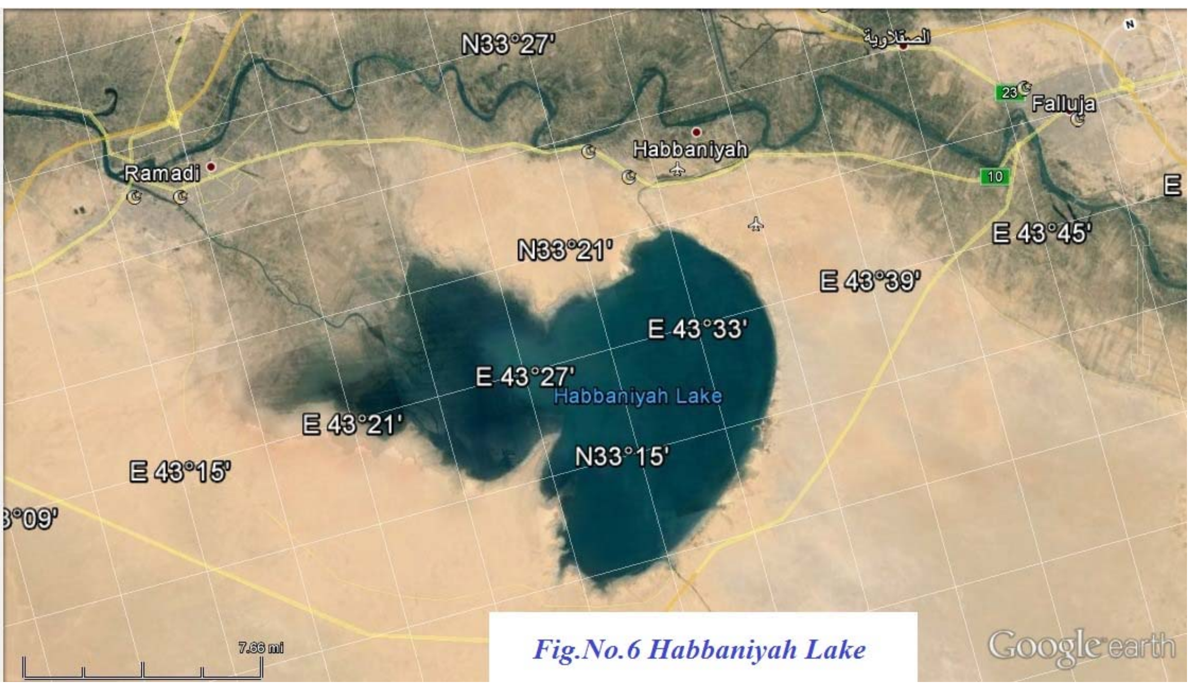

Fig.No.6 Habbaniyah Lake

Fig.No.7 Habbaniyah & Razazza Lake

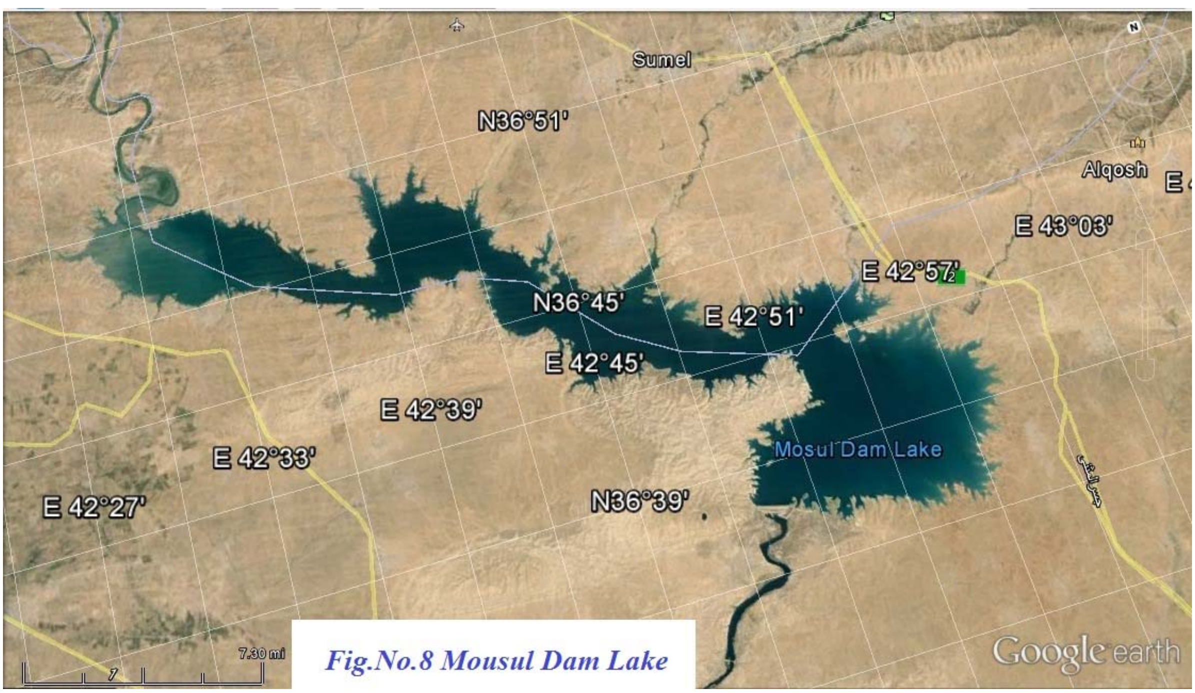

Fig.No.8 Mousul Dam Lake

Fig.No.9 Mousul Dam

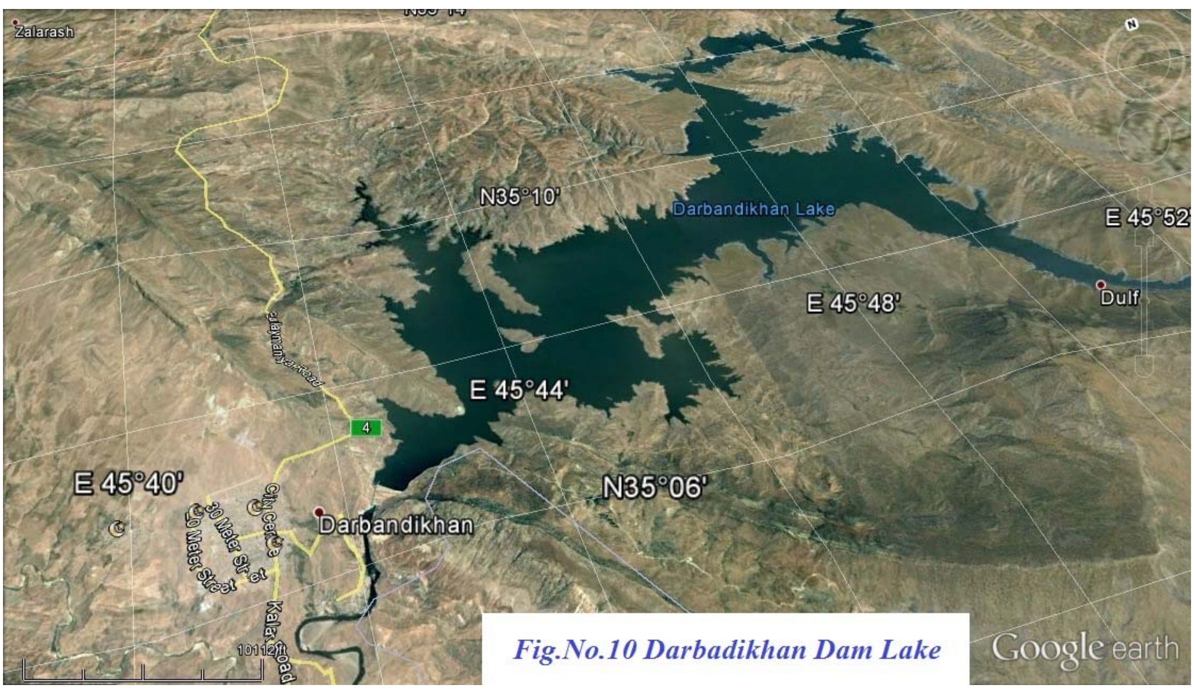

Fig.No.10 Darbadikhan Dam Lake

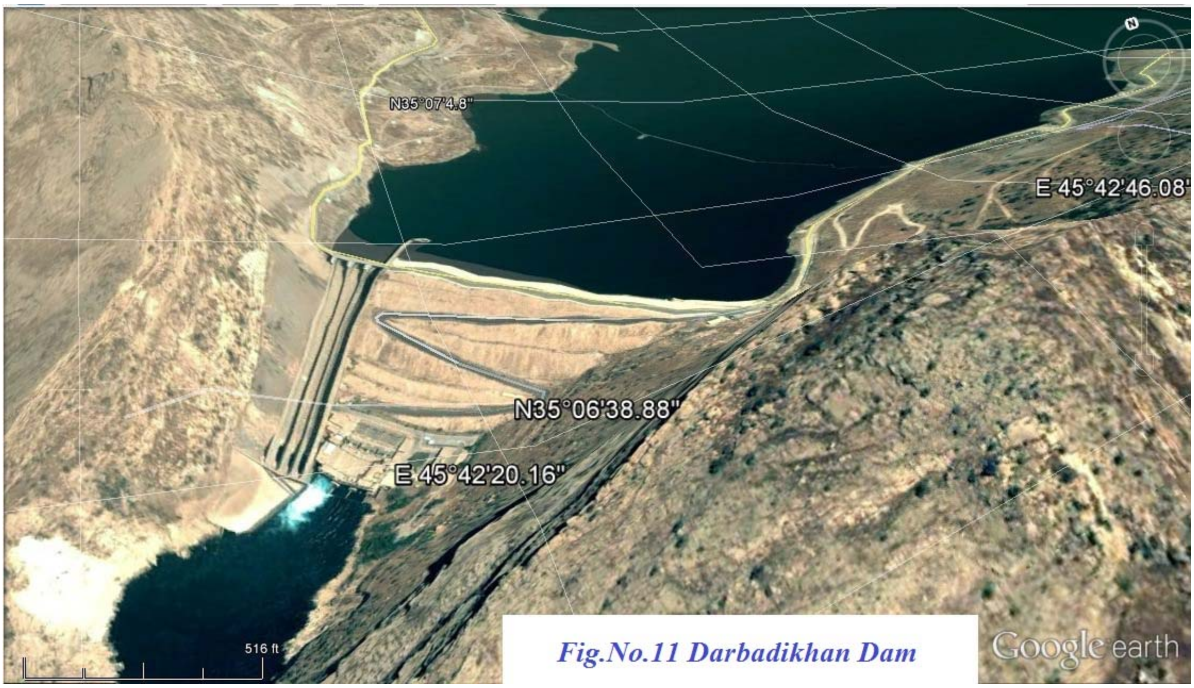

Fig.No.11 Darbadikhan Dam

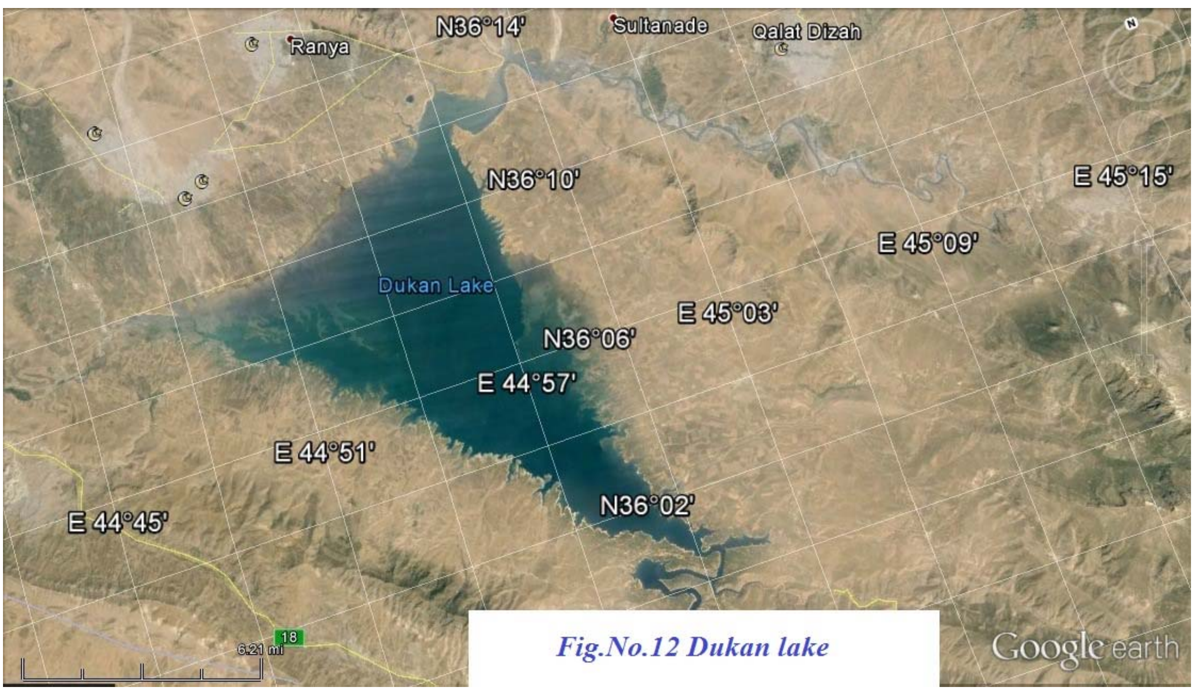

Fig.No.12 Dukan lake

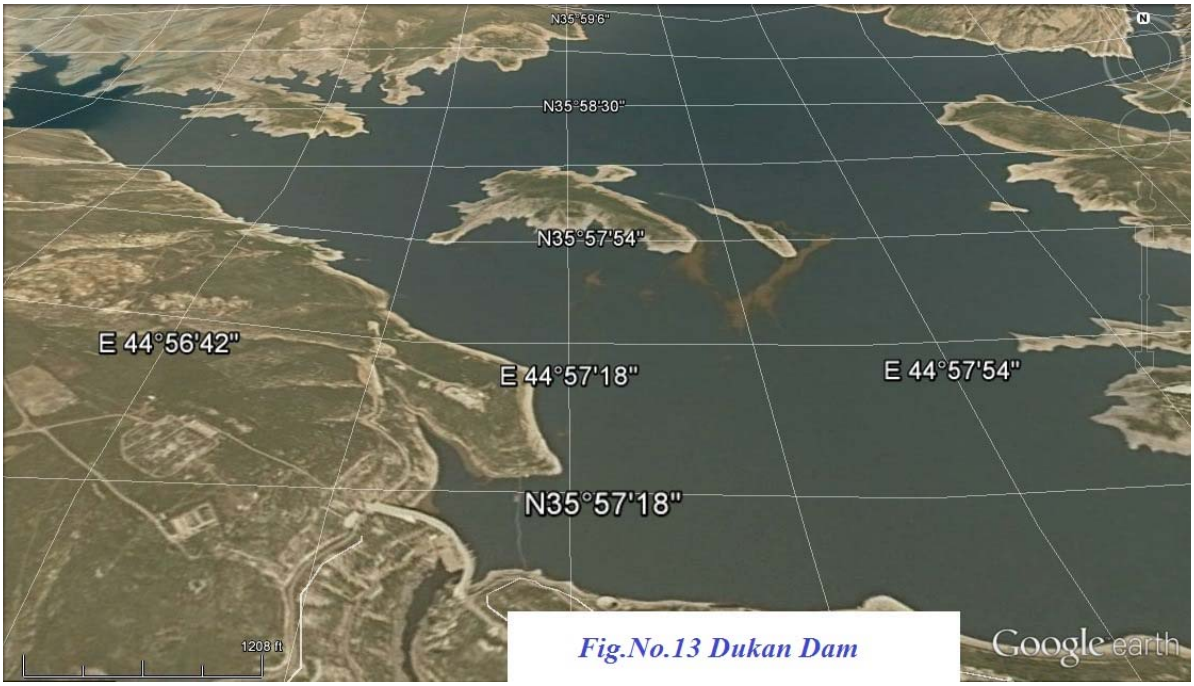

Fig.No.13 Dukan Dam

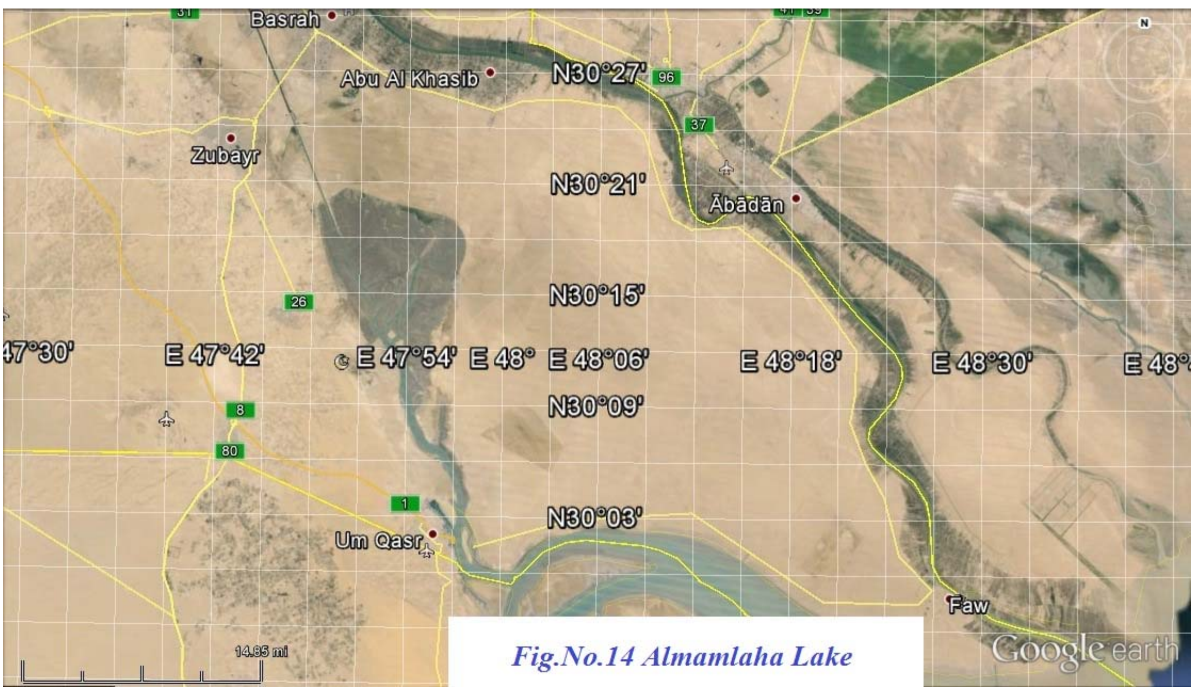

Fig.No.14 Almamlaha Lake

Fig.No.15 AlQadisiyyah Lake

The construction of many High water Dams in Iraq led to the formation of Natural/or Artificial Lakes normally extending over a huge area that trapped large amounts of Turbidity. Lakes and reservoirs provide long detention times, low water speed that can be negligible, allowing for adequate settling of the larger turbidity particles and suspended solids. In general, larger reservoirs or lakes have lower turbidity levels. Algae are common and normal inhabitants of surface waters and are encountered in every water supply that is exposed to sunlight. Algae typically range in size from 5 to 100 microns.

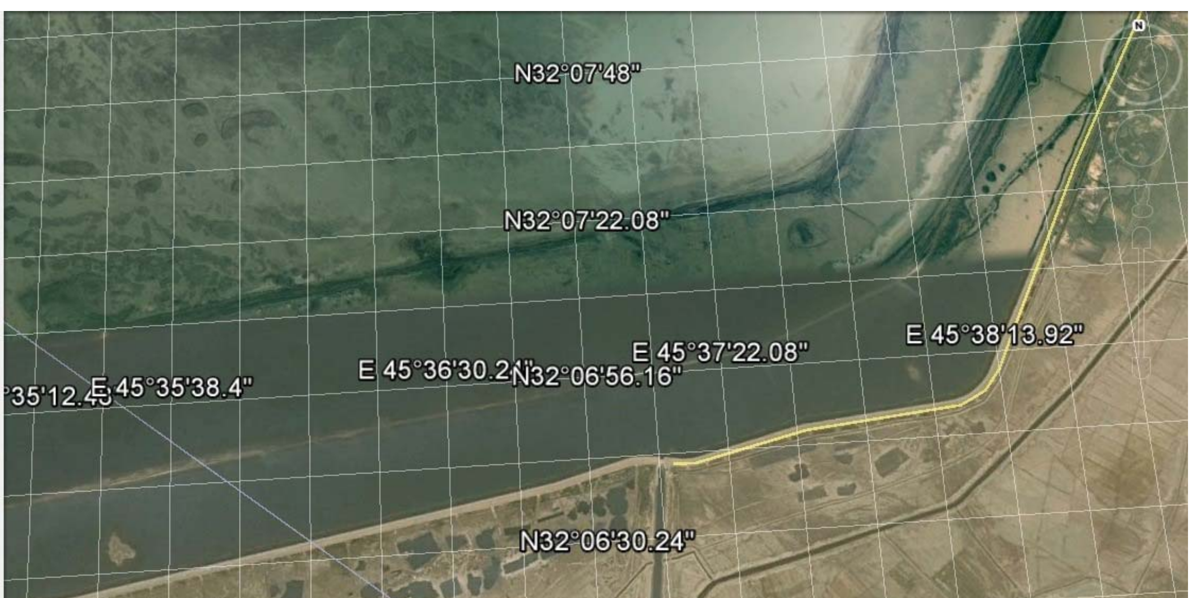

Fig.No.16 AlQadisiyyah Dam

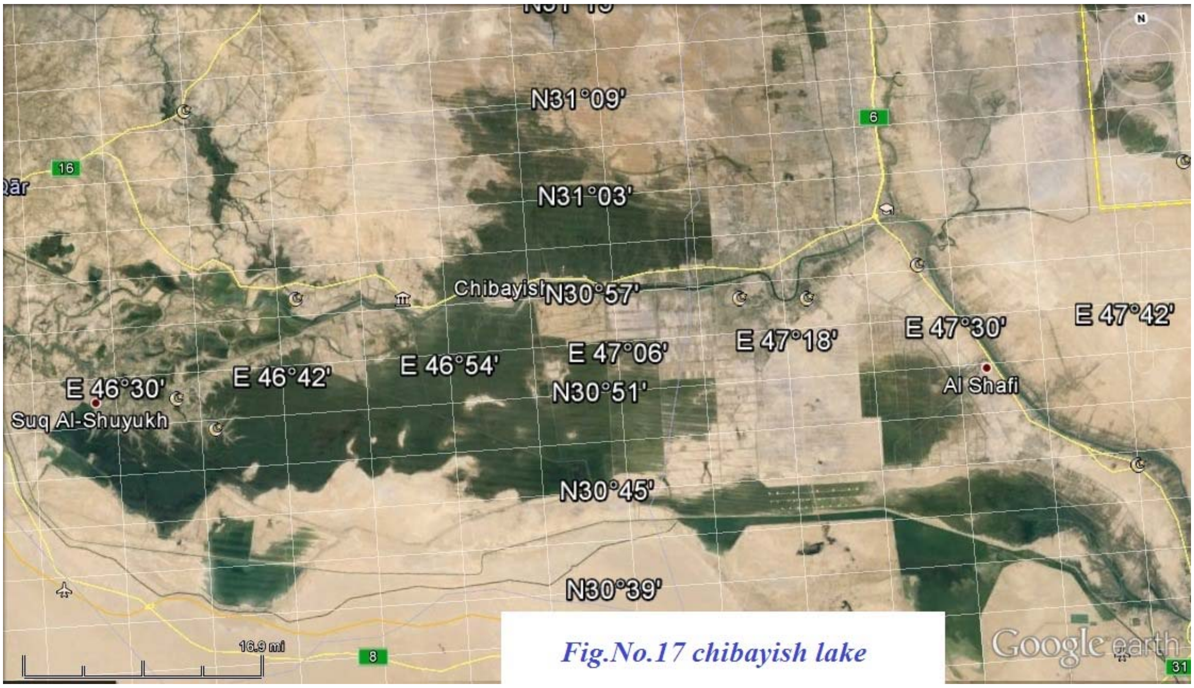

Fig.No.17 chibayish lake

Fig.No.18 Amarah Ahwar

Many microorganisms commonly found in source waters do not pose health risk to humans, others such as Cryptosporidium and Giardia can be sources of infectious and communicable diseases that can resist chlorine disinfection,

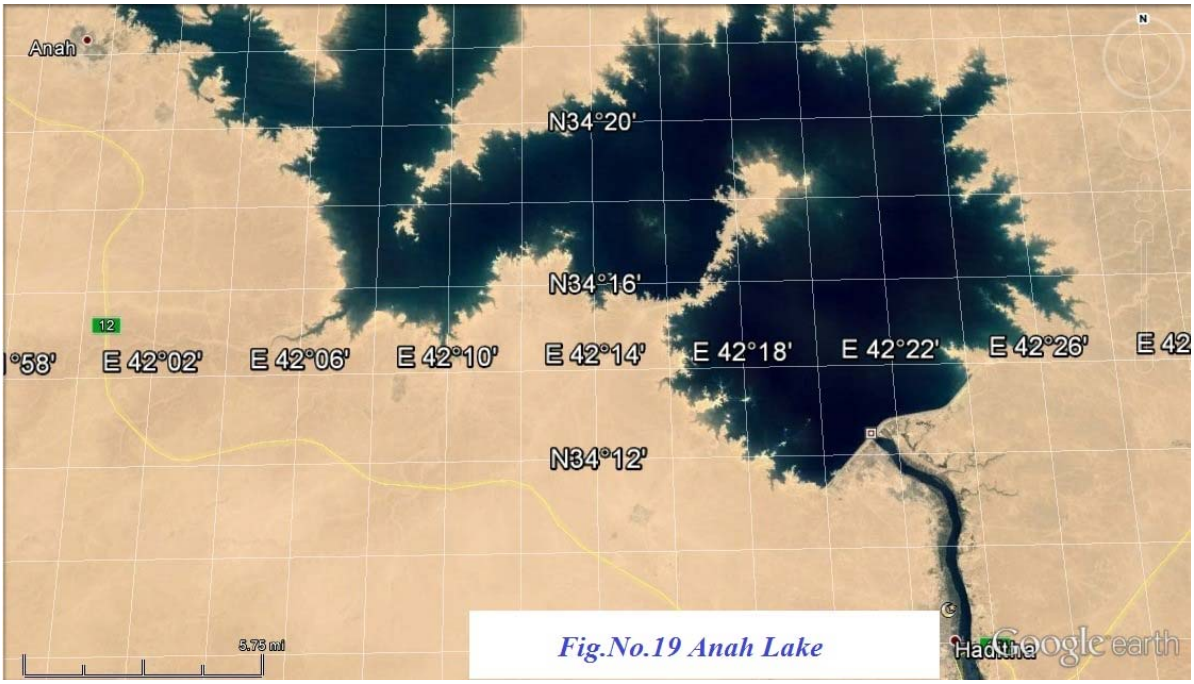

Fig.No.19 Anah Lake

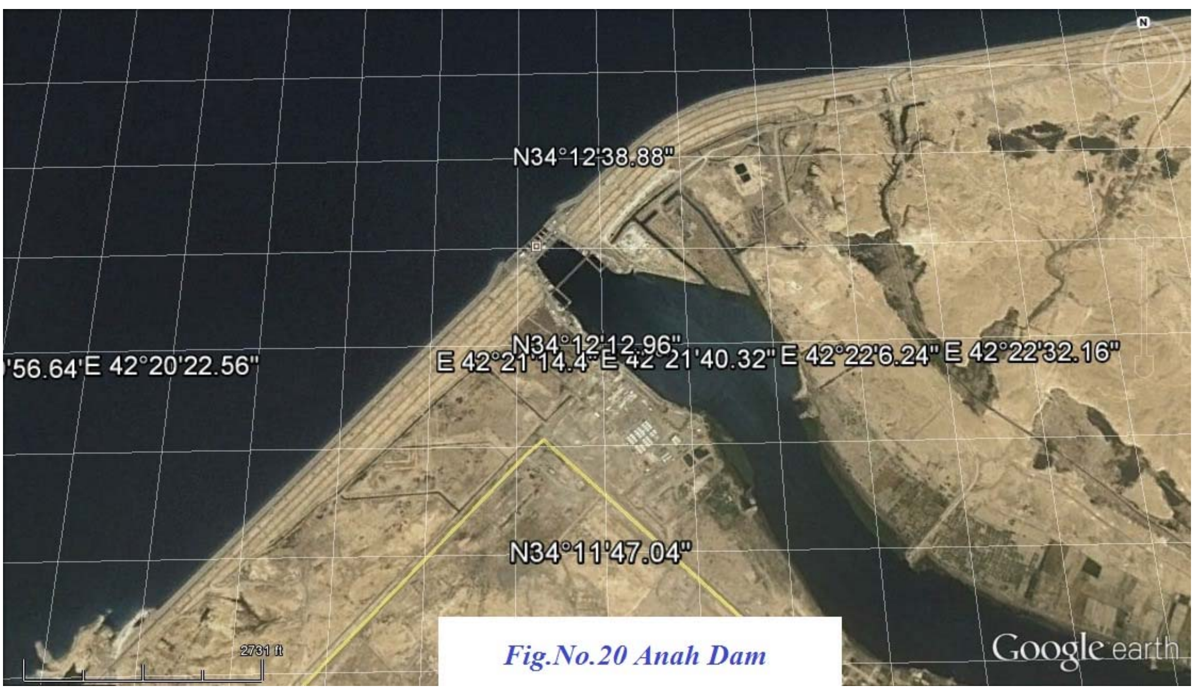

Fig.No.20 Anah Dam

From Above it is clearly understand that Filters represent the key unit process for particles removal in all surface water treatment. Optimization used prior to the

Filtration process will control loading rates while allowing the system to achieve maximum filtration rates. Direct filtration is one of several treatment processes that can be applied in combination with others to produce potable water. Low turbidity (<20 NTU) and algae count in the order of 106 units/liter among other factors,

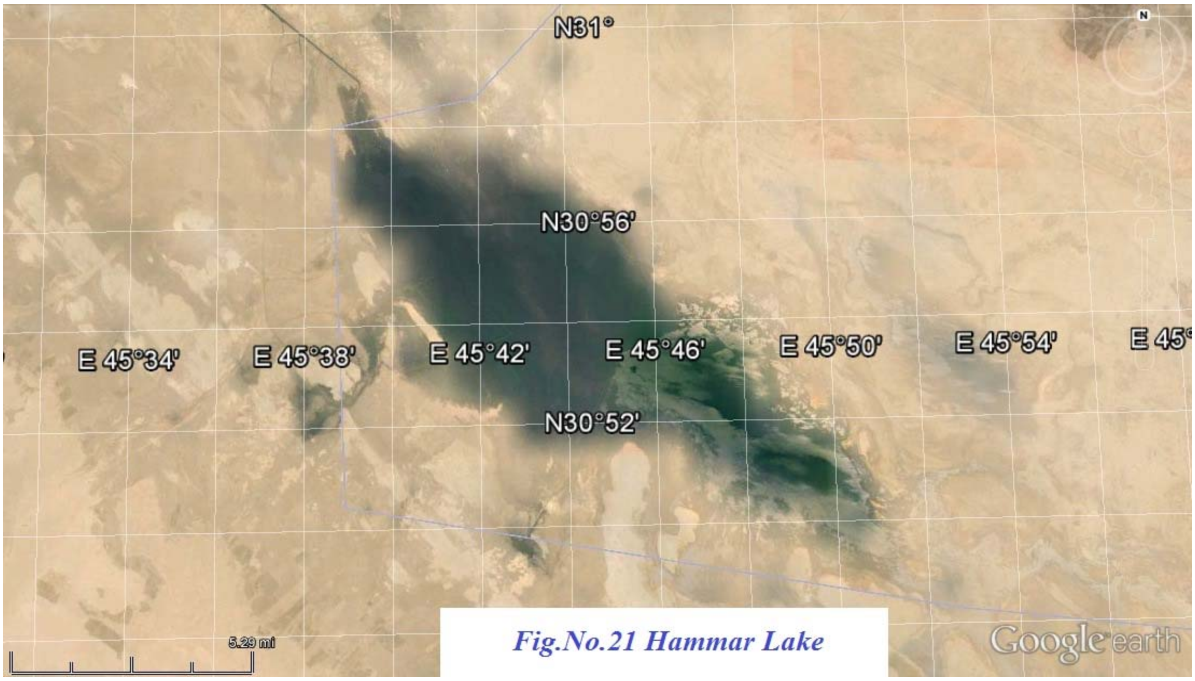

Fig.No.21 Hammar Lake

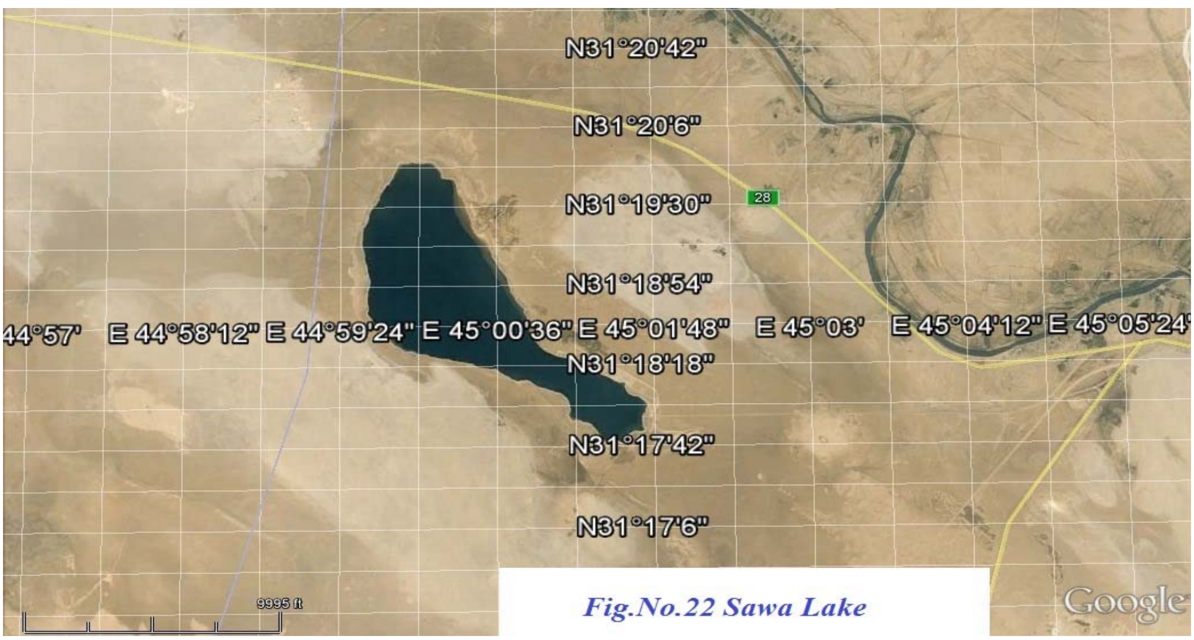

Fig.No.22 Sawa Lake

g) Lakes Turbidity

All records for more than 40 years shows that all the Iraqi lakes either natural lakes or artificial ,have very low concentration of Turbidity which ranges between 0.5 FTU Up To 10.0 FTU, and some times During Flood seasons could Rise up to 10FTU, in the other Side the TDS Ranges from 100mg/l (or even Less) Up to 10,000 mg/l for natural lakes such like chibayishlake, Amarh ahwar, Almamlaha Lake, This Rising concentration makes the water of those Lakes undrinkable, and the Purification needs for such lakes water needs more than the Removal of Turbidity, those further treatment is suggested such as Reverse Osmoses ,Or Ultra filtration system, or use of Menrlization plants for further Removal of TDS.

XIII. Tests Conclusions

It can be concluded from above discussion the following:-

- it is possible to use direct filtration procedure in both laboratory and field with increasing efficiency through proper control of mixing, turbidity, filtration rate and velocity gradient.
- Almost all Lakes have low Turbidity Concentration Due to long detention time, which acts like preliminary Artificial Settling tanks.(logon).
- Increase filtration efficiency up to 98%.
- Some of the artificial lakes in Iraq have high TDS Concentration which really makes the water

undrinkable. And need Further Treatment to Reduce the Salinity concentration.

- Water quality parameters such as pH, temperature, and alkalinity may dictate effectiveness of direct filtration. The pH affects the speciation of the coagulant as well as its solubility,

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Effective Community Participation in Reconstruction of Greater Aguata Water Scheme, Enhances Sustainability

By Otti, V. I., Ezenwaji, E. E., Aginam, H. C. & Nwafor, A. U.
Nnamdi Azikiwe University, Nigeria

Abstract- The paper focus on the concept of community participation on water scheme without being wholly controlled by the State Water Corporation, rather the communities are empowered to play more active roles in safeguarding and sustaining development programme, emphasising on purpose, decision making, training, operation and maintenance, participation model and benefits, with the aid of SPSS version 21 statistical package. Therefore, the communities are expected to influence and share control over development initiatives, decision and resources that affect them.

GJRE-E Classification : FOR Code: 090502

EFFECTIVECOMMUNITYPARTICIPATIONINRECONSTRUCTIONOFGREATERAGUATAWATERSCHEMEENHANCESSUSTAINABILITY

Effective Community Participation in Reconstruction of Greater Aguata Water Scheme, Enhances Sustainability

Otti, V. I. [α], Ezenwaji, E. E. [σ], Aginam, H. C. [ρ] & Nwafor, A. U. [ω]

Abstract- The paper focus on the concept of community participation on water scheme without being wholly controlled by the State Water Corporation, rather the communities are empowered to play more active roles in safeguarding and sustaining development programme, emphasising on purpose, decision making, training, operation and maintenance, participation model and benefits, with the aid of SPSS version 21 statistical package. Therefore, the communities are expected to influence and share control over development initiatives, decision and resources that affect them.

I. Introduction

The sustainable rural water supply scheme based on community participation is the key focus of Greater Aguata water scheme in partnership with State Water Corporation. The existing dilapidated project is considered for reconstruction and development for an effective community management system which emphasises on maintenance and operation immediately after reconstruction (UNICEF and WHO, 2000). Greater Aguata water project is considered for reconstruction in the year 1998 by the State government through Water Corporation, to boost water supply and reduces sanitation problem, Jacob and Price (2006).

Lockwood (2004) in his operation and maintenance strategies for community managed rural water supply system in Dominican Republic stated that both State government and the local communities should be involved in the responsibility of operation and maintenance of the rural water scheme which yields sustainable results.

The involvement of fourteen communities in Aguata Local government Area will form integral part of the project from the beginning to the end of the reconstruction and the communities in the management role requires decision that can have a major bearing on the ultimate success and sustainability of the project Vergnani (1994).

Rowlands (1995) opined in his empowerment examined development practice that participatory action research on the role of communities in the management of improved rural water supplies involves the understanding of the dynamic and the challenges inherent in the decision making process within the social environment in which the improved water supplies are located. The participation action research will enhance the understanding of the dynamic challenges and constraints of community management (Evans and Appletion, 1993).

The overall community participatory project components include, preparation, community selection, community diagnosis, problem identification, identification of promising solution, experimentation and monitory and evaluation (UNICEF and WHO, 2000).

Kilpatrick (2009), Narayan (1994) and World Bank (1987), observed that community participation is a dynamic process which is in a constant state of change and its assessment includes both qualitative and quantitative aspects, community participation should not base exclusively on the measurement of material, but a useful social effects or processes of development.

IRC 1993 explained the conceptual framework for assessing community participation is based on the flow components of:

- Assessing the understanding of community participation by all stakeholders in the project.
- Assessing the objective of community participation in the project by looking at what is the aim to achieve with community participation.
- Looking at who participates in the project.
- Knowing the intensity and level of community participation
- Establishing the instrument of sustainable community participation.
- Discovering the impact of community participation on the project.

At the Local Government level, the zonal manager from State Water Corporation collaborating with the communities forms a steering committee, which would be responsible for the training of extension workers, planning and supervision of project activities in the communities IRC (1991).

Obviously beneficial communities would not make a financial contribution, capital cost of the project.

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They would only provide unskilled labour, and mobilization and provision of locally available materials for construction of water points. After the construction phase the State water corporation takes care of training of pump distribution network and other appurtenance caretakers to be responsible for complex repairs and also monitory of the programme activities in large catchment area on voluntary basis.

II. Aims and Objectives

The objectives of community participation are as follow:

- To increase the knowledge and understanding the communities of the concept, process and strategies for enhancing community participation in good government.
- To promote the sense of Government Agency (water corporation) and spirit of engagement for social change among the staff and communities.
- To strengthen the capacity of community representatives to act as change agencies advocates.
- To expose participant to the different areas of community participation in institutional reforms initiative and good governance.
- To build the capacity of staff of Water Corporation and community representative in order to develop and implement action plans.
- To provide a forum experience sharing with successful programme and best practices in community participation in budget and tracking good governance with the staff of the water corporation.
- To ascertain the relationship between the variable and their correlation using SPSS version 21 statistical package.

III. Methodology

a) Area of study

Aguata situates in the latitude 6.0167 N and Longitude 7.0833 E, with a population 370,172 of both adult and children

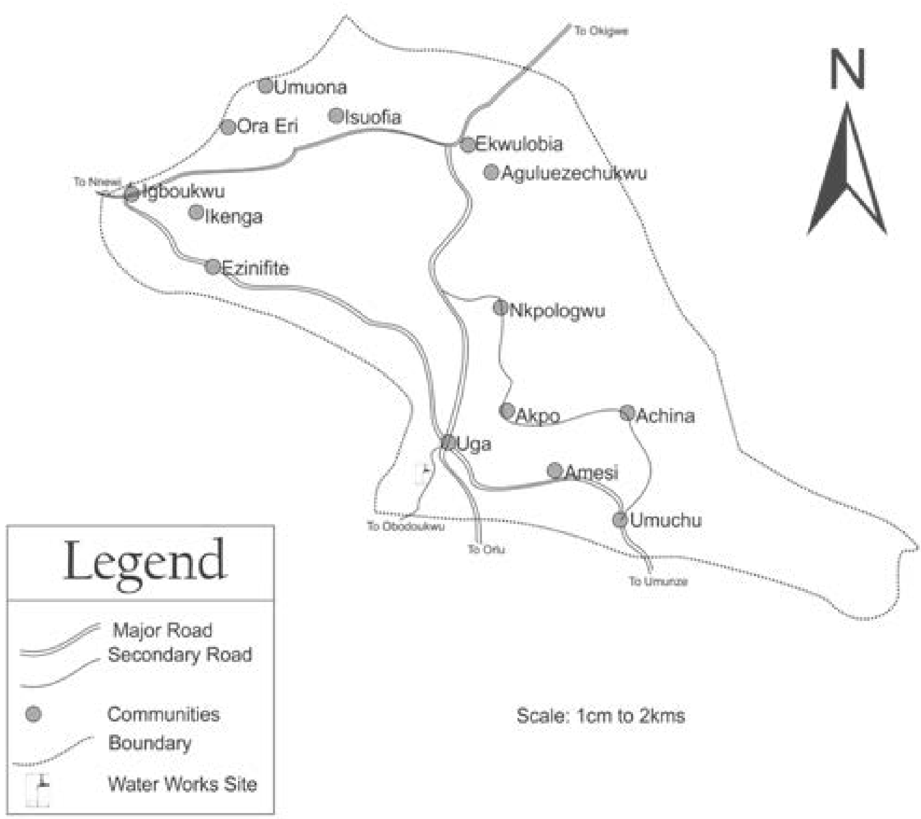

Figure 1 : Map showing Aguata L.G.A., its component communities

The State government had in the past solely been responsible for the provision and maintenance of water schemes in the rural area until recently when Anambra State Water Corporation started working in partnership with special focus on women has been on the increase since the State Water Corporation adopted community based management for all rural water schemes to ensure improved and sustainable supply of safe water, which number of projects and pilot-projects were successfully implemented in recent time (Lockwood, 2004). Obviously the prerequisite was to implement the community based management to the standard of the equal quality safe water supply to the communities.

More so, the communities are mobilized and adequately sensitized on project which results in formation of water and health committees Harvey and Skinner (2002).

Among the fourteen communities that made up Aguata Local Government Area only seven communities were allocated with overhead tanks, and the rest are connected through pipe borne-water Rifkin (1986) and IRC (1994), for the reason some communities are over bearing demand (consumption) more than their capacities. Therefore, with the aid of SPSS version 21 statistical package, the solution to the over bearing demand is determined by ascertaining the relationship between the variables (capacity, distance, production, maintenance, consumption and reconstruction (Table 1).

Table 1 : Communities with overhead tanks and variables

Community	Capacity (M^3)	Consumption (M^3)	Distance (M)	Cost of Reconstruction (₦)	Cost of Production (₦)	Cost Maintenance (₦)
UGA	100	90	5	6.5Mm	450,000	290,000
NKOLOGU	100	85	10	6.5Mm	450,000	310,000
EKWULOBIA	100	100	20	6.5Mm	450,000	350,000
ISUOFIA	60	55	25	4.5Mm	300,000	350,000
IGBOUKWU	45	85	30	3.0Mm	250,000	350,000
UMUCHU	45	80	10	3.0Mm	250,000	310,000
ACHINA	60	55	15	4.5Mm	300,000	310,000

IV. Analysis

In the below table 2, the data were collected from Anambra State Water Corporation and were analysed with the aid of SPSS version 21 to establish the relationship between the variables and their correlation. More so, null and alternative hypothesis were used to determine the variable of interest.

With the null hypothesis (H_0). There is no relationship between the variables of interest, while the alternative hypothesis (H_1). There is a relationship between the variables of interest.

Observation from Table 2, showed that results of the analysis have strong positive relationship of 0.988 between capacity and cost of construction, 1.00 between capacity and cost of production, while there exist no relationship between capacity and consumption, distance, maintenance.

There is also a strong positive correlation of 0.929 between distance and cost of maintenance. Also cost of production shows a strong positive relationship of 0.984 with cost of construction. Therefore, the correlation was carried out at significant level of 1% (that is $\alpha = 0.01$ 2-tailed).

Correlations

		CAPACITY (M^3)	CONSUMPTION (M^3)	DISTANCE (M)	COST OF CONSTRUCTION(N)	COST OF PRODUCTION(N)	COST OF MAINTENANCE
CAPACITY(M3)	Pearson Correlation	1	.538	-.481	.988**	1.000**	-.276
	Sig. (2-tailed)		.213	.274	.000	.000	.549
	Sum of Squares and Cross-products	4092.857	1453.571	-678.571	246428571.429	15000000.000	-1085714.286
	Covariance	682.143	242.262	-113.095	41071428.571	2500000.000	-180952.381
	N	7	7	7	7	7	7
CONSUMPTION(M3)	Pearson Correlation	.538	1	-.199	.405	.555	-.022
	Sig. (2-tailed)	.213		.668	.367	.196	.963
	Sum of Squares and Cross-products	1453.571	1785.714	-185.714	66785714.286	5500000.000	-57142.857
	Covariance	242.262	297.619	-30.952	11130952.381	916666.667	-9523.810
	N	7	7	7	7	7	7
DISTANCE(M)	Pearson Correlation	-.481	-.199	1	-.457	-.484	.929**
	Sig. (2-tailed)	.274	.668		.303	.271	.002
	Sum of Squares and Cross-products	-678.571	-185.714	485.714	-39285714.286	-2500000.000	1257142.857
	Covariance	-113.095	-30.952	80.952	-6547619.048	-416666.667	209523.810
	N	7	7	7	7	7	7
COST OF CONSTRUCTION(N)	Pearson Correlation	.988**	.405	-.457	1	.984**	-.262
	Sig. (2-tailed)	.000	.367	.303		.000	.570
	Sum of Squares and Cross-products	246428571.429	66785714.286	-39285714.286	15214285714285.713	900000000000.000	-62857142857.143
	Covariance	41071428.571	11130952.381	-6547619.048	2535714285714.286	150000000000.000	-10476190476.190
	N	7	7	7	7	7	7
	Pearson Correlation	1.000**	.555	-.484	.984**	1	-.278
	Sig. (2-tailed)	.000	.196	.271	.000		.546
	Sum of Squares and Cross-products	15000000.000	5500000.000	-2500000.000	900000000000.000	55000000000.000	-4000000000.000
	Covariance	2500000.000	916666.667	-416666.667	150000000000.000	9166666666.667	-666666666.667
	N	7	7	7	7	7	7
COST OF PRODUCTION(N)	Sig. (2-tailed)	.549	.963	.002	.570	.546	
	Sum of Squares and Cross-products	-1085714.286	-57142.857	1257142.857	-62857142857.143	-4000000000.000	3771428571.429
	Covariance	-180952.381	-9523.810	209523.810	-10476190476.190	-666666666.667	628571428.571
	N	7	7	7	7	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

V. Discussion

The important of community participation in rural water projects has been widely acknowledged in the millennium development goal of declaration of 2005. It is believed that community participation in its domain will enable communities to contribute towards designing of acceptable and user friendly designs, and makes communities to develop an interest in the operation and maintenance of projects in their areas.

Obviously there is adequate information describing community participation in water projects. However an accurate assessment of community participation has rarely been undertaken in recent time despite the uncertainty with regard to the success of community participation of Oakley 1991 which said participation is stronger in rhetoric than in practical reality, what is therefore required is an in-depth analysis of specific projects in order to find out what went wrong and what lesson could be learned.

More so, community participation is related to empowerment of skills and abilities to enable communities to manage better and to be able to start other development initiative (IRC 1994).

a) Constraints

- Sustainability and viability of a good project is dependent on community involvement, which may be undermined by external influence.
- Community participation is an essential component which involves more repairs and maintenance.
- Understanding variety of government approaches which are predominantly technically too much more process oriented.
- Task to improve project efficiency cost effectiveness or sustainability.
- Time, financial and skill constraints.

VI. Recommendation

These are the recommendations to the communities to be involved in

- Formation of water committee.
- Adoption of constitution.
- Election of committee members.
- Application of article of memorandum of understanding between government and communities.
- Selection of project and training agent.
- Input into feasibility study.
- Knowing the labour-rates for skilled and non-skilled workers.
- Community cash contribution rate should be in the emergency fund.
- Selection of skilled labour (Book keepers) Store keeper and supervisors.
- Approval of designs and implementation plan (i.e. technology choice, pipe layout).
- Hiring unskilled labour, composition and rotation of work teams.
- Selection of supplier and contractors.
- Expenditure decision.
- Monitoring progress against budgetary expenditure, operation and maintenance arrangement including tariff rate.

a) Benefits

- Ensures the needs and concerns of the people are met.
- Promotes accountability and transparency.
- Accelerates the pace of sustainable development.
- Reduces reckless and wasteful spending.
- Promotes good governance.
- Ensures prompt implementation and completion of projects.

VII. Conclusion

The State government after carefully examination of communities involving in the decision making, consequently that:

- Beneficiaries are happy and feel that they are part of the process, enhance sustainability.
- Ensure self-reliance and increases people sense of control over their issues.
- Wider coverage of intervention programme as more people are influenced by development projects.
- Resources are easily pooled to facilitate project implementation.
- Elevates the status of women since they have the opportunity to be actively involved in programmes.
- The community development is about local democracy that creates the environment for the free contest of competing ideals and interests.
- Identification of community development as an inseparable part of the society which has aims and objectives in fostering spirit of love and patriotism of their home town's welfare, progress and development.

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Simulation of Floods with 1d and 2d Hydraulic Models in the Guapi-Açu River Basin, Based on Gis Integration

By Leonardo Tristão Chargel
& Prof. Mônica de Aquino Galeano Massera da Hora
Fluminense Federal University, Brazil

Abstract- With a focus on water sustainability, Fluminense Federal University developed the Macacu Project, which included the integrated management of water resources in the basin of the Guapi-Açu River. One component of the project was the simulation of the rivers' flow patterns, supported by topographic and bathymetric surveys conducted in 2008. New surveying services were provided in 2012. From the data generated, new simulations with HEC-RAS (1D) and IBER (2D) models were performed by combining the use GIS. Hydrographs with return periods of 2, 10, 20 and 50 years were simulated and the results showed that areas potentially most affected by flooding are pasture and forest, but flooded spots were observed also in some constructed areas. The 2D model produced results more compatible with what would occur naturally in floodplains, but it requires a large amount of data and lengthy processing time.

Keywords: hydraulic modeling, GIS, HEC-RAS, IBER.

GJRE-E Classification : FOR Code: 290801, 290899

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I. Introduction

Advances in computation and improved mapping techniques allow increasingly precise assessment of the attributes mapped. Examples are the data interpolation methods used to determine spatial representation models. The use of GIS has made it much simpler to visualize and manipulate field data as well as to carry out spatial analyses and detect similar patterns, to help understand natural phenomena. Such systems can be applied to manage river basins, where all the information regarding hydrological variables, topo-bathymetric sections, land use and plant cover, among other aspects, enables the use of mathematical models to simulate the river behavior.

Modeling the hydrodynamic conditions of a watercourse's flow allows identification of areas subject to flooding and establishment of the flood levels for the risks chosen [1]. In this respect, to help update the results indicated by [2] obtained from the Macacu Project, in this study we attempted to develop new hydraulic simulations from data obtained in a new topographic survey carried out by the Rio de Janeiro State Environmental Secretariat [3] in the basin of the Guapi-Açu River, a tributary of the Macacu River, located in the eastern part of the Guanabara Bay Basin, in Rio de Janeiro state, Brazil. For this purpose, information from the project's GIS was integrated with the HEC-GeoRAS interface to feed the computational model in the HEC-RAS hydrodynamic modeling program in one dimension, and the results were compared with those produced by a two-dimensional IBER model, simulating unsteady flood wave regimes referring to return periods of 2, 10, 20 and 50 years.

II. Study Area

The Guapi-Açu River Basin is located in the eastern part of the Guanabara Bay Basin, Rio de Janeiro state, Brazil, as shown in Figure 1. This river basin is very important regarding water availability in the region, since it is responsible for supplying water to the region through the Imunana-Laranjal supply system [2]. The basin drains an area of approximately 560 km², with its main river, the Guapi-Açu, which flows into the Macacu River, together forming the Guapi-Macacu Basin. The basin covers parts of three municipalities, Cachoeira de Macacu, Itaborai and Guapimirim.

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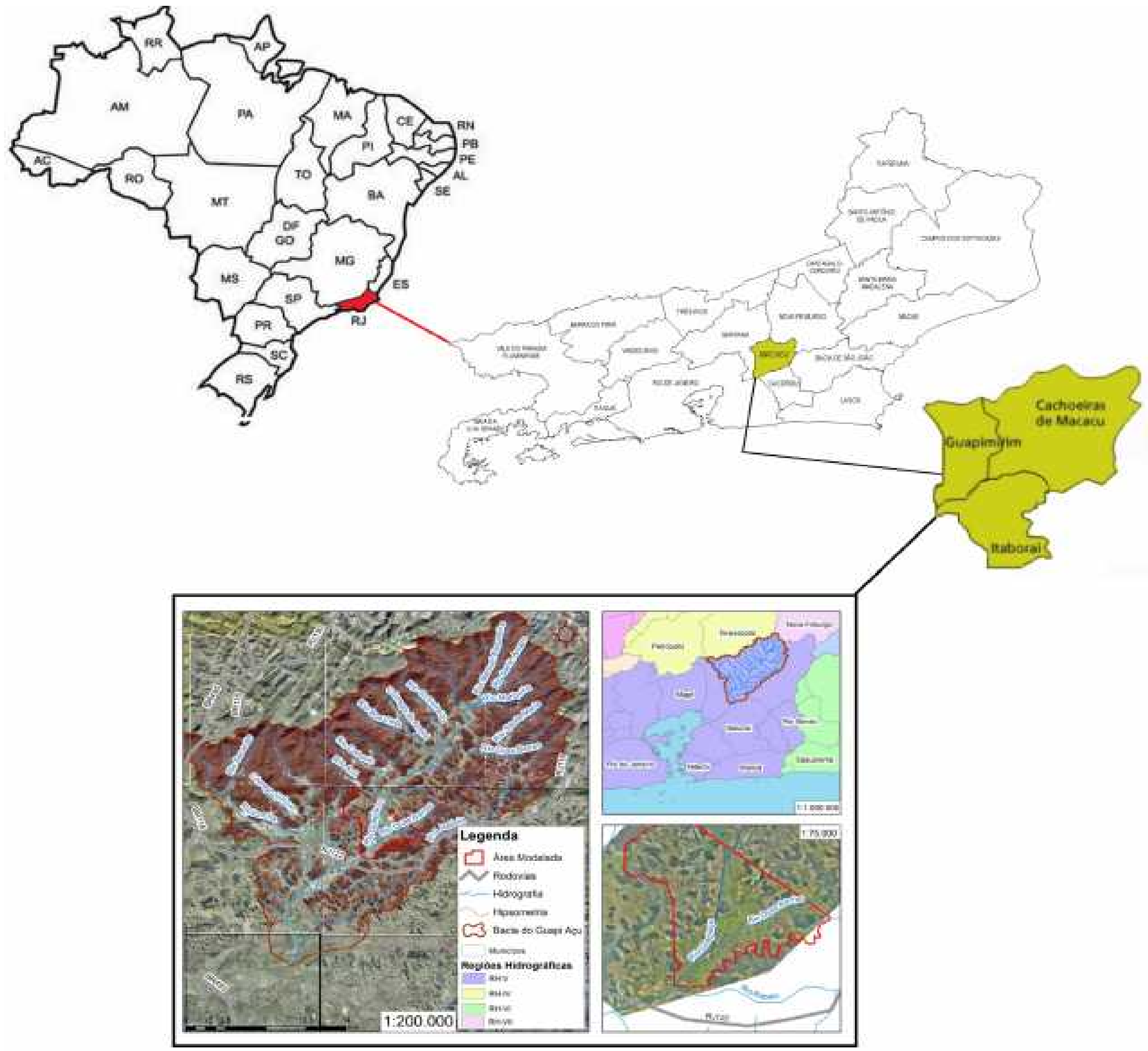

Figure 1 : Guapi-Açu River Basin, with the area of the flow simulation outlined in red

III. Materials and Methods

Hydraulic modeling requires a high level of topographic precision. In this study we used aerial photographs on a 1:8,000 scale supported by field survey data, provided by [3]. The area covered by these data starts at about 1 km from the bridge along highway RJ-122 crossing the Guapi-Açu River and reaches in a line of about 15 km in the upstream direction. However, due to the large computational effort for each simulation (average time more than 6 hours), we decided to reduce the area to be modeled to the segment between the bridge and 6 km in the upstream direction, as shown in Figure 1 inside the red outline. We divided the methodology adopted into three steps: (a) generation of a digital terrain model; (b) hydrological modeling, and (c) flood propagation modeling.

a) Digital Terrain Model (DTM)

According to [4], the computational instruments used in geoprocessing are called geographic information systems (GISs). Their purpose is to facilitate analysis by integrating data from different sources, creating a database containing georeferenced data. Based on this concept, we structured a GIS for the Guapi-Açu Basin from cartographic, planimetric and altimetric bases, on a scale of 1:8,000, with vertical distance between contour curves of 1 m. The software used was ArcGIS 10.1 from the Environmental Systems Research Institute (ESRI). The second step for structuring the GIS was to create a digital terrain model (DTM). This model can be understood as a synthetic surface representing the spatial distribution of the altimetry of a land area, which has continuous variation in the area of interest.

According to [5], geomorphological and hydrological consistency is attained when the raster of the DTM faithfully represents the characteristics of the terrain, such as the division lines of river basins, channels and concave and convex relief forms, and assures convergence of the surface flow to the drainage network mapped. Further according to him, the interpolation tool to generate the best DTM in terms of hydrological consistency is Topogrid. The correction of the relief by this model is carried out by a combination of local and global interpolation methods [6]. This combination allows sudden changes in slope in the drainage areas and dividing lines to be adjusted, generating a characteristic connected drainage structure defined by the erosive force of the water, a result also corroborated by [7]. The interpolation by Topogrid for the study area is presented in Figure 1 and further expanded in Figure 2.

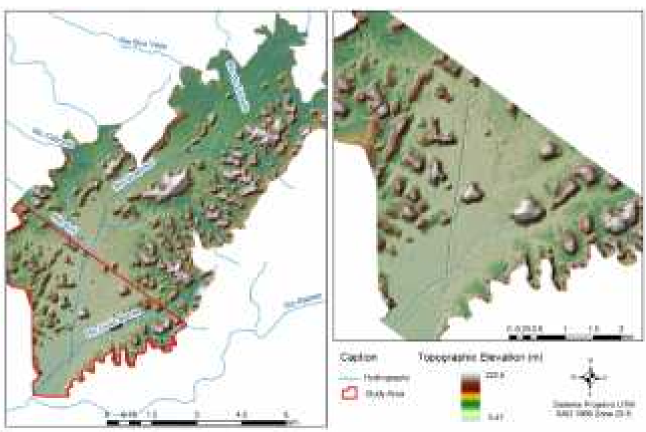

Figure 2 : DTM of the study area

The left part shows the entire region where the topographical survey was carried out by [3] while the right part shows the area considered in the simulations. At the end of the interpolation, the spatial resolution was 2 meters, i.e., the side of each pixel was 2 meters, meaning each cell of the DTM, measuring 4 m², had a single altimetric value. In structuring the DTM we used all the data from the survey, to minimize possible interpolation errors. The highest and lowest altitudes resulting from the DTM were 222.5 meters and 0.47 m.

b) Hydrological Model

The available information on the Guapi-Açu Basin comes from the Macacu Project developed by [2]. This project was a pioneering effort, for the purpose of constructing a dam called Guapi-Açu Jusante as a solution to meet water demand of the region, since the water basin is responsible for supplying water to about 2.5 million people. According to [8], the rainfall modeled in a hydrographic project is an idealized event associated with a return time (RT). In the present study, the RTs chosen were 2, 10, 20 and 50 years. To estimate the rainfall duration, we assumed it is equal to the concentration time in the basin studied, calculated by the formula proposed by Ventura [9], expressed by:

$$tc = 240 \cdot \sqrt{\frac{A \cdot L}{\Delta H}} \qquad (1)$$

Where tc is the concentration time, in minutes; A is the drainage area, in km²; L is the length of the thalweg, in km, and ΔH is the difference in height between the highest point of the thalweg and the outflow point, in m. After making the substitutions, considering the drainage area of 291.5 km², thalweg length of 26.5 km and hydraulic head of 1.085 meters, this equation produced a concentration time of 10.68 hours. The flow volume was estimated by the triangular unit hydrograph (TUH) method, proposed by the former United States Soil Conservation Service (SCS), now called the National Resources Conservation Service (NRCS). According to [8], this is one of the simplest and most widely used methods to estimate the surface runoff volume. In the TUH, the triangle's base represents the duration of the surface runoff (tb), the height represents peak flow (qp) and the area is the surface runoff volume (V), as indicated in Figure 3. Therefore, the parameters that characterize it are:

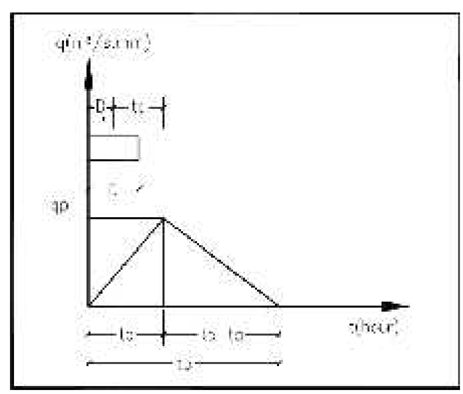

Figure 3 : Triangular Unit Hydrograph

$$tp = 0.6tc \qquad (2)$$

$$ta = \frac{D}{2} + tp \qquad (3)$$

$$tb = 2.67ta \qquad (4)$$

$$\frac{1}{5}tc \le D \le \frac{1}{3}tc \qquad (5)$$

Where tp is the peak time, in hours; ta is the ascension time, in hours; tb is the base duration time, in hours and D is the duration of the unit rainfall, in hours.

Substituting the surface runoff volume in the unit hydrograph equation (3) by the product of the basin area and an excess rainfall unit, and considering equation (6), yields the expression to calculate the peak flow of the hydrograph:

$$qp = 0.0208\frac{A}{ta} \qquad (6)$$

Where qp is the maximum flow for 1.0 mm of excess rainfall, in m3.s-1.mm.

The rainfall assumed in the project was taken from [10], expressed by:

$$I = \frac{726 \cdot RT^{0.264}}{(t+9)^{0.732}} \qquad (7)$$

Where I is the rainfall intensity, in mm/h; RT is the return time, in years, and t is the rainfall duration, in minutes.

To transform the rainfall into a uniform precipitation throughout the basin, we adopted the formulation proposed by [11], expressed by:

$$P = Po \cdot \left(1 - 0.10\log\frac{A}{Ao}\right) \qquad (8)$$

Where P is the distributed rainfall, in mm; Po is the rainfall, calculated from the equation (7), in mm; Ao is the basin area, in km², for which P equals Po. According to [11], it is usual to adopt Ao ≈ 25 km².

After defining the distributed rainfall, it is necessary to characterize the soil infiltration capacity, which is affected not only by the soil type, but also by the plant cover and type of land occupation and use in the basin in question. This parameter is defined by:

$$S = 25.4\left(\frac{1000}{CN} - 10\right) \qquad (9)$$

Where S is the potential retention of the soil, in mm and CN is the curve number, a function of the type of occupation. For the present study, we used a curve number equal to 50.

To construct the hydrograph it is necessary to define the effective rainfall (Pe), expressed in mm, which represents the portion of the rainfall that generates surface runoff. It is a function of the distributed rainfall and the soil retention potential and is defined as:

$$Pe = \frac{(P - 0.2S)^2}{P + 0.8S}, \text{ for } P > 0.2S \qquad (10)$$

$$Pe = 0.0, \text{ for } P < 0.2S \qquad (11)$$

c) *Flood Propagation Modeling*

Numerical models for application in fluvial studies are classified in conformity with different criteria:

- regarding the processes they describe;
- regarding the type of dominant flow; and
- regarding the dimensions of the domain.

Various authors and organizations have presented computer programs to solve equations describing non-uniform flows in watercourses, both in steady and varied regimes. In this study we adopted the HEC-RAS model and the IBER model.

i. *HEC-RAS model*

The HEC-RAS model and its extension to the GIS environment are free programs that can be found at the site www.hec.usace.army.mil/software/, produced by the US Army Corps of Engineers at the Hydrologic Engineering Center. It is a computational model to analyze the flow in watercourses and is currently available in version 4.1.

Over the years the program's capacity has been expanded so that it now can represent rivers with a combination of regimes, compound sections, bridges, sluices, culverts etc. The HEC-GeoRAS extension employed here allows the introduction of data automatically, as proposed by [12], and allows the identification of areas subject to flooding, besides establishing flood levels for chosen risks [1]. Its main limitation is that it is a one-dimensional model that works with cross-sections of the river of interest, so it does not produce good results for the unsteady flow regime. The arrangement of the cross-sections and the spacing between them, are depicted in Figure 4. We set out 36 cross-sections, with average length of 2,000 meters and average spacing of 200 meters.

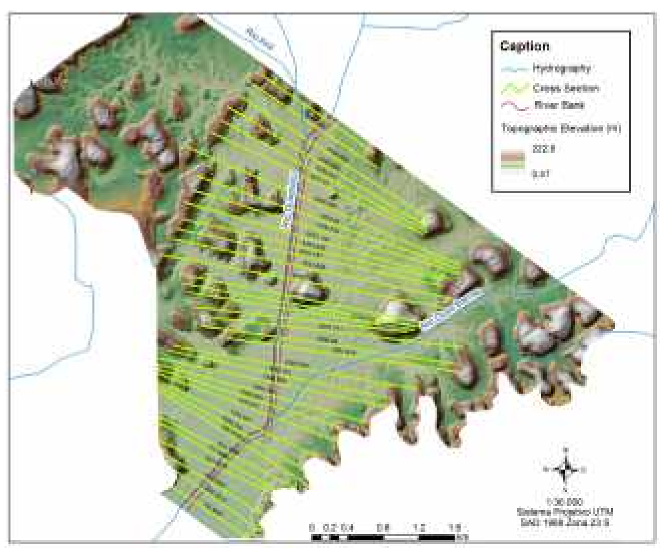

Figure 4 : Cross-sections and GIS environment

It can be seen in the figure that most of the area adjacent to the Guapi-Açu River was covered by the cross-sections.

When inputting the required information through the HEC-GeoRAS extension, it was necessary to attribute values to some variables, such as the average declivity upstream and downstream from the segment of interest. These values were taken from the DTM, corresponding to 0.005 m/m and 0.023 m/m, respectively. Besides declivity, the other input conditions were:

– initial consideration of a dry river, i.e., zero flow; and
– adoption of roughness coefficients of Manning, based on the orthophotos, and the land use pattern, as shown in Figure 5, [3].

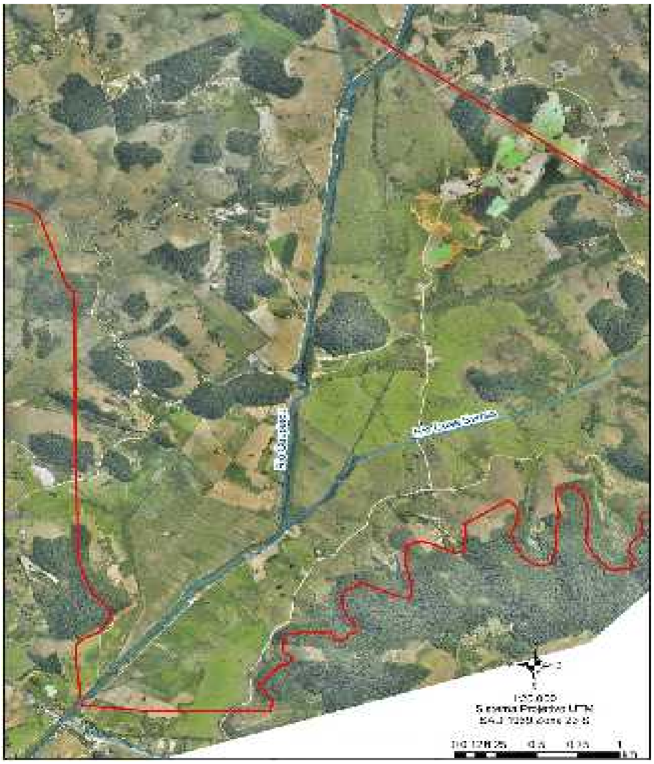

Figure 5 : Orthophoto of the modeled area

From Figure 5, it can be seen that the predominant land use is agriculture, with pasture along the river banks, with some areas of remaining forest and secondary vegetation. Table 1 reports the breakdown of land use and the respective Manning coefficients.

Table 1 : Land use and respective Manning roughness coefficients, as adapted from [13]

Land Use	Manning Coefficient
Water	0.025
Agriculture	0.045
Forest	0.180
Pasture	0.035
Secondary Vegetation	0.050

ii. *IBER Model*

The IBER model is also free and was developed by Universidad de A Coruña (UDC), Universitat Politècnica de Catalunya (UPC) and Centro Internacional de Métodos Numéricos en Ingeniería (CIMNE). It can be downloaded from http://iberaula.es/web/index.php. The IBER is a numerical simulation model of free flow and environmental processes in fluvial hydraulics, and can be applied to model river hydrodynamics, dam failures, flood-prone zones, sediment transport and tidal flows in estuaries.

The first step of the hydrodynamic modeling was to introduce the DTM in the model, with all the information on relief maintained (georeferenced data). This involved creating a triangular mesh with minimum sides of 2 meters and maximum of 100 meters, in the format of the DTM as shown in Figure 6.

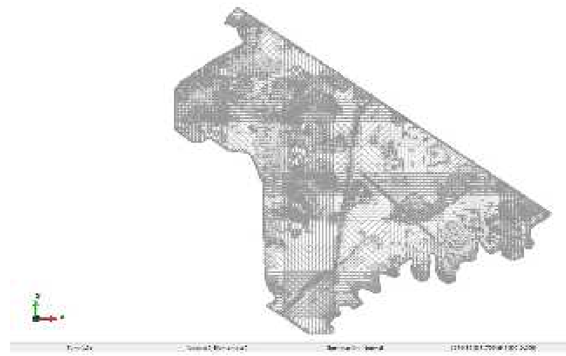

Figure 6 : DTM inserted in the program, highlighting the triangular mesh generated

After introducing the DTM, it was necessary to indicate in the mesh created at the entry position of the hydrograph, i.e., the upstream part of the Guapi-Açu River, as well as the exit from the hydrograph. As can be seen in Figure 6, the geometry is similar to that presented in the right side of Figure 2. The other condition added to the model was the inclusion of the Manning roughness coefficients, according to the values indicated in Table 1 for each type of land use.

IV. Results

By applying the formulas, it was possible to define the hydrographs. The peak flows with return times of 2, 10, 20 and 50 years are, respectively, 11.5 $m^3.s^{-1}$, 78.0 $m^3.s^{-1}$, 136 $m^3.s^{-1}$ and 256 $m^3.s^{-1}$, in all cases happening about 15 hours after the start of rainfall. The total response time of the basin to rainfall is about 30 hours. These hydrographs were used to establish the boundary conditions in the simulations.

For evaluation of the results produced by the one- and two-dimensional hydrodynamic models, in the next sections we present the input and output hydrograph of the river segment modeled, assuming a buffering effect of the natural channel and adjacent overflow areas, as well as maps showing flooded areas, to enable comparison of one model against the other.

a) 2-Year Return Time

The results of simulating the flood wave with return time of 2 years are presented in Figure 7. The blue line is the input in the models for RT of 2 years while the red line is the output of the HEC-RAS simulation and the green line is the output of the IBER simulation. The peak inflow is 11.5 m³.s-1 and the respective peak output flows are 10.8 m³.s-1 for the HEC-RAS model and 10.6 m³.s-1 for the IBER model.

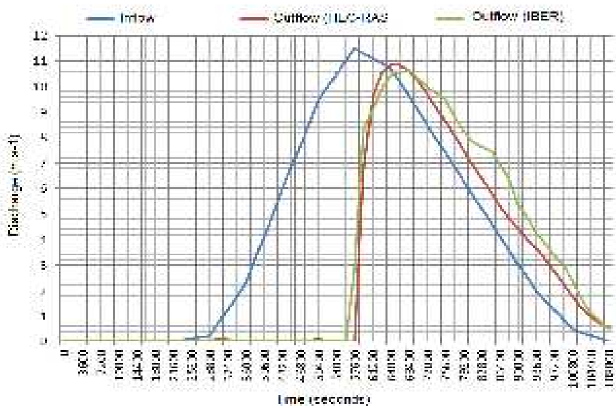

Figure 7 : Input and output hydrograph of the models for RT of 2 years

Both models present a buffer effect from the inflow peak, which was expected. The HEC-RAS presents a less pronounced buffer effect than the IBER, but the outflow volume presented by the IBER is greater than that of the HEC-RAS. Furthermore, the IBER output presents small elevations, in the form of peaks, while the 1D model does not show these peaks.

The maps in Figure 8 show the areas subject to flooding with a return time of 2 years (IBER on the left and HEC-RAS on the right).

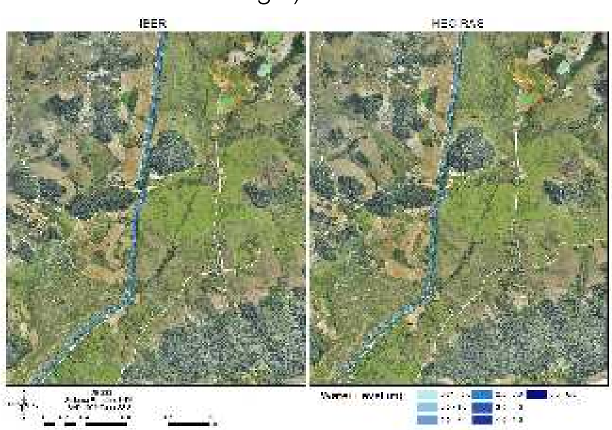

Figure 8 : 2 years RT flood: Areas subject to flooding

Analysis of the map shows that the flow with two-year return time does not overflow the natural river channel. The high water level varied from 0.0 to 5.0 meters above ground level. The HEC-RAS simulation presented greater high points than that with the IBER model. In general, both programs produced satisfactory results, where the passage of the flood wave occurred in the thalweg of the Guapi-Açu River.

ii. *10-Year Return Time*

The results of simulating the flood wave with return time of 10 years are presented in Figure 9. The peak inflow is 78.0 m³.s-1 while the peak outflows are 126.2 m³.s-1 for the HEC-RAS model and 75.4 m³.s-1 for the IBER model.

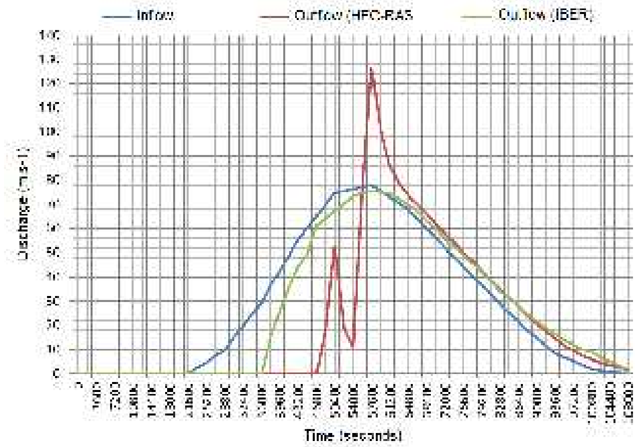

Figure 9 : Input and output hydrograph of the models for RT of 10 years

The increase in the peak outflow in relation to the inflow in the HEC-RAS simulation can be explained by the fact that at some points along the river the channel cannot hold the flow for a RT of 10 years. However, in the recession portion of the hydrograph, both the 1D and 2D models present similar aspects.

Figure 10 presents the inundated areas by passage of the flood wave for the 10-year RT (IBER on the left and HEC-RAS on the right). The maximum water level in the two models is 0.0 to 8.0 meters above ground level. The highest water levels are in the river's natural channel.

Figure 10 : 10 years RT flood: Areas subject to flooding

Analysis of the map shows that the natural channel of the Guapi-Açu River does not hold the peak flow for a 10-year RT. The result of the IBER simulation already presents some small flooded areas and a pool entering the channel of the Duas Barras River. In contrast, the result of the HEC-RAS simulation presents large adjacent areas that are flooded, some of them not connected to the Guapi-Açu River's channel, along with the formation of some lakes in lower-lying areas (due to the fact the program is one-dimensional). When the water level rises above the highest elevation of the areas adjacent to the channel, these lower-lying areas are shown as inundated. Figure 11 facilitates visualization of this effect.

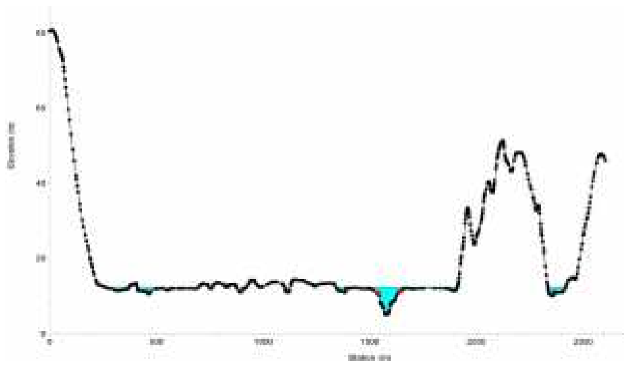

Figure 11 : Hypothetical cross-section showing the flooded areas adjacent to the main channel

As can be seen in Figure 11, the marginal areas of the main channel flood as soon as the water level in the section reaches the highest land elevation, i.e., in the main channel delimited by the margins (red points), and when the water level rises above the land adjacent to the channel, these are also considered areas reached by the flooding, due to the fact the HECRAS is a 1D model. The arrow indicates a place where there is no connection with the main channel, but the program considers it to be flooded even though the channel and the valley are separated by a ridge and are 1 km apart. When this information is taken to the GIS environment through the HEC-GeoRAS extension, these patterns are incorporated and appear on the map as flooded areas.

iii. *20-year return time*

The results of simulating the flood wave with return time of 20 years are presented in Figure 12. The peak inflow is 136.4 m³.s-1 against peak outflows of 130.8 m³.s-1 for the HEC-RAS and 133.1 m³.s-1 for the IBER.

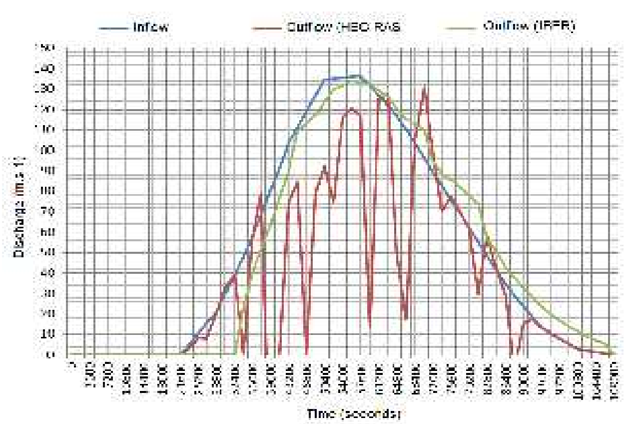

Figure 12 : Input and output hydrograph of the models for RT of 20 years

It can be seen that the hydrograph generated by the HEC-RAS simulation presents large peaks and troughs. According to [14], in an unstable numerical model, certain types of numerical error are magnified as the solution starts to oscillate, or the errors become so large that the calculations cannot continue. That fact here is due to the large flood plains adjacent to the channel, a feature that destabilizes the mathematical model, producing an incorrect output hydrograph. This instability occurred for the flows equal to or greater than that of the 20-year RT, preventing the simulations from presenting reliable results, or causing the model not to present any results at all.

Figure 13: presents the flood map for a RT of 20 years. The difference between the two models is clear. In the IBER simulation the adjacent flooded area is much smaller than that produced by the HEC-RAS. The IBER simulation can be considered more coherent with the ground levels, with flooding in the lowest areas, while the HEC-RAS model, due to the numerical instability, presented erroneous results, because all theflow remained upstream of the segment studied, inundating adjacent areas.

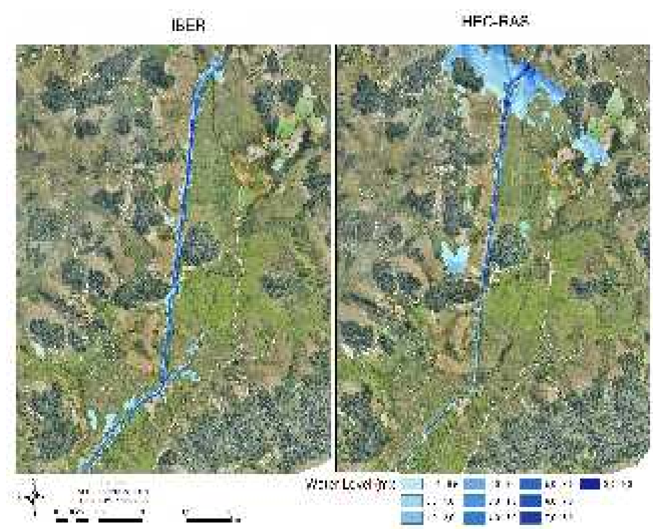

Figure 13 : 20 years RT flood: Areas subject to flooding

The variation in water level presented by the IBER was 0.0 to 9.0 meters, with a large part of this water volume being in the natural channel of the Guapi-Açu River. In the 20-year RT, some floodplain areas were already affected. The pooling of water was greater moving toward the natural channel of the Duas Barras River than for the 10-year RT, also reaching an irrigation canal from that river.

iv. *50-year return time*

The results of simulating the flood wave with return time of 50 years are presented in Figure 14. The HEC-RAS model was numerically unstable for this return time, as if all the flow would be contained in the hydrographic basin, without flowing to the output point studied. The peak inflow was 259.2 m³.s-1 and the IBER presented a peak outflow of 218.1 m³.s-1, reflecting a buffer effect of about 40 m³.s-1.

Figure 14 : Input and output hydrograph of the models for RT of 50 years

In the simulation of a 50-year RT, the buffer effect occurring in the natural channel was significant, due to the fact the alluvial plains are reached by the flood wave, buffering the flow in the main channel.

The map with the flooded areas for the RT of 50 years is presented in Figure 15, which depicts large areas reached by the flood wave, located in the lowestlying areas and in the meanders of the affluent rivers of the Guapi-Açu River and in irrigation canals.

Once again, the HEC-RAS model was unstable, and the result for flooded areas is not coherent. The overflow of the river channel occurred in the upstream part, as if all the flow would accumulate in the marginal areas, without any flow in the main channel.

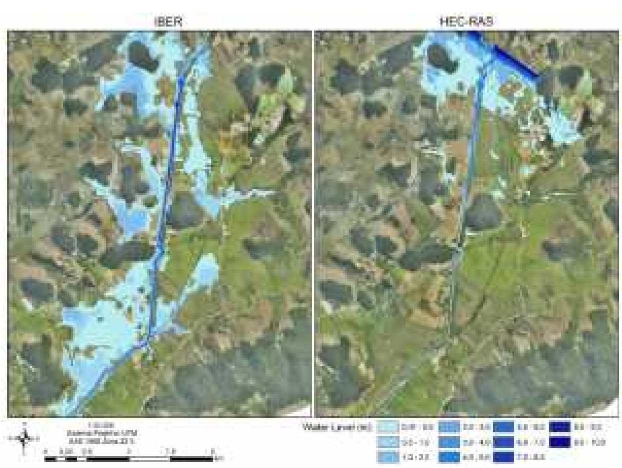

Figure 15 : 50 years RT flood: Areas subject to flooding

The IBER model presented large areas subject to flooding, but in these areas the water level was not greater than 2.0 meters above land height, while in the main channel the water level reached 10 meters above the land.

V. Conclusion

The HEC-RAS is an intuitive and easily manipulated program with user-friendly interface that presents reliable results for simulation of steady flow regimes, with low computational cost and time. Modeling with this program requires less input data than 2D models, without the need for great details like those from DTMs and other boundary conditions.

Based on the results of this study, we suggest using the HEC-RAS in regions where the main watercourse is well contained by the surrounding terrain, without large floodplains and confluences with other rivers. Nevertheless, it is still possible to generate good flood maps using this one-dimensional model as long as attention is paid to cases where calculation instability occurs in the unsteady regime. For the river segments similar to that studied here, the HEC-RAS model is recommended for passage of the flood wave with RT of 2 years, because it required less simulation time (only minutes) than the IBER model, which took hours, and the results of the two models converged, both for the outflow hydrograph and map of flooded areas.

However, to describe many natural phenomena, such as rivers with extensive floodplains, the confluence of rivers and wide and irregular channels, one-dimensional model can no longer be considered adequate.

The two-dimensional model presented results more compatible with what would really occur, but models like the IBER require data that are more attuned to the natural terrain conditions for the simulation to attain a reasonable degree of accuracy. This requires more precise topographical studies, making this modeling more expensive. Another relevant fact is that two-dimensional models require much more computational resources and time to produce satisfactory results. In the particular case of the IBER, although it has user-friendly interface, it is still very recent and is being improved, so it still presents some problems in inserting boundary conditions.

In summary, the two-dimensional model presented more coherent results for flows that overflowed the channel of the Guapi-Açu River, including presenting buffer for the return times of 50 years. Each model has its own peculiarities, and the user must judge which tool is best depending on the case. Both have good potential for use by planners when integrated with a GIS.

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Bending Moments in Beams of Two Way Slab Systems

By Ibrahim Mohammad Arman
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Abstract- Two way slabs are slabs in which the surface load is transferred in two directions. Two way slabs have many types: slabs supported on beams between all columns, slabs without beams and waffle slabs. Slabs with beams are commonly used for high loads and or large spans. The deflection in the slab panel depends mainly on the beams stiffness. The deflection at middle of panels decreases as the stiffness of the supporting beams increases. The internal forces and especially the bending moments are increased in the beams as their stiffness increases. This paper will illustrate the sequence of increase in beam moments as the beams stiffness increases. Slabs with different beams stiffness and longer span to short span ratios will be studied. Also, the principle of 45 degrees-load-distribution principle for beams will be discussed. The computer program sap2000 will be used in structural modeling.

Keywords: two way slab, sap2000, direct design method, beams.

GJRE-E Classification : FOR Code: 090506, 090502, 090599

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I. Introduction and Background

There are many methods that are used for analysis and design of two way slab systems. The accuracy of these methods depends on the assumptions that are stated in the method procedure. The most common method is the ACI direct design method. This method depends on determining the moments in the frames using coefficients. Then, the frame moments are distributed to the beam and the slab using tables. These tables depend on three main variables which are: type of moment; positive or negative, width of frame/ span length ratio and beam/slab flexural stiffness ratio. Really, these variables or factors are very important in distribution of moments in the beam and in the slab.

II. Methodology

Two way solid slabs with beams, having different beam/slab flexural stiffness ratios will be considered in this study. These slabs shall have different long span, L/short span, B ratios. This study will include four slabs with L/B of 1, 1.25, 1.5 and 2. Each slab shall have different values of beam/slab flexural stiffness ratios.

The slabs will be subjected to distributed gravity load of 15kN/m2 including weights of beams and slab. This load will be applied as an area load on the slab in sap2000 structural model and the self-weight of the structure is considered to be equal to zero.

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The four slabs shall have panels' spans of 8x8m, 8x6.4m, 8x5.33m and 8x4m. The small spans will be in x- direction (horizontal axis) and the long spans will be in y- direction (vertical axis). The slab thickness is 0.22m for all slabs. The beams in the two directions will have same dimensions. The beam sizes are 0.40m width and with variable depth that varies from 0.3m to 1.0m with step of 0.10m. The modifiers for effective moment of inertia will not be used. The supporting columns have a square cross section of 0.6m side length.

The slab system is modeled as three dimensional building structure that has a column height of 3.5m with columns below and above. The concrete modulus of elasticity, E is equal to $2.5x10^4$MPa.

Two perpendicular interior frames in each slab shall be studied. Frame A will be in y- direction with longer spans and frame B will be in x- direction with shorter spans. The moments in the beams of these two frames in each slab will be recorded to study the relation between the beam/slab stiffness ratio and the moment distribution to beams. In addition, these two frames shall be analyzed as plane frames with loads equal to frame width multiplied by the slab unit load and with triangular or trapezoidal load shape depends on the frame width, as stated by the 45 degrees- load- distribution principle, to study and compare the bending moments in these frames with that in the three dimensional models.

III. Three Dimensional Structural Analysis of Slabs

The computer program sap2000 is used for structural modeling of the slab systems. The slab is modeled as area elements while beams and columns are modeled as frame or line elements. The slab is subjected to uniformly distributed load of 15kN/m2. Using sap2000, the moments in beams will be determined. The beams are part of the frame column strip. The column strip stiffness is larger than middle strip stiffness, so the moments in the column strip are larger than the moments in the middle strip. The moment ratios for column strip depend on the aspect ratio of panels. The moment ratios for beams depend on their flexural stiffness. As the flexural stiffness of the beam increases the moments that will carry will increase show in tables 1 to 4. These tables illustrate the moment values in long direction interior beams and in short direction interior beams. The moments in the exterior

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span and in the interior span are stated in these tables. The main moments in beams are exterior negative moment, interior negative moment in exterior span, interior negative moment in interior span and positive moments in exterior and interior spans. All moment values are in kn.m.

Table 1 : Bending moments in beams for slab 8x8m from three dimensional structural analysis

Beam size, width x depth(mm)	Direction	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long, short	119.4	54.1	110.9	92.3	44.5	92.3
400x400	Long, short	174.8	101	181	157	84.9	157
400x500	Long, short	210	148.6	241.4	212.2	124.4	212.2
400x600	Long, short	223.6	190.5	288.3	253.8	155.6	253.8
400x700	Long, short	219.7	225.7	323.6	284.3	177.1	284.3
400x800	Long, short	203.2	257.7	345	307.1	190.1	307.1
400x900	Long, short	178.4	285.9	369.6	325.1	196.9	325.1
400x1000	Long, short	148.8	312.2	384.1	340	199.2	340

Table 2 : Bending moments in beams for slab 8x6.4m from three dimensional structural analysis

Beam size, width x depth(mm)	irection	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long	100.5	46.5	92	76.2	38	76.2
	Short	72.16	39.2	72	62.2	32.9	62.2
400x400	Long	148.4	86.5	151.6	131.9	73.2	131.9
	Short	102	69.5	113.5	100.5	58.9	100.5
400x500	Long	179.8	128	205	181.8	108.7	181.8
	Short	116.9	97.9	145.8	129.2	80.8	129.2
400x600	Long	193.8	165	248.5	221.4	137.8	221.4
	Short	117.8	121.5	168.1	148	95.2	148
400x700	Long	193.1	196.3	282.4	251.5	158.8	251.5
	Short	108.4	141.2	183.2	160.4	103	160.4
400x800	Long	181.6	223.6	308.6	274.6	172.4	274.6
	Short	92.5	158.4	193.4	169.3	106.1	169.3
400x900	Long	162.9	248.7	328.4	292.8	180.3	292.8
	Short	72.8	174.1	200.1	176.4	106.3	176.4
400x1000	Long	140.1	271.6	343.2	307.6	184	307.6

Table 3 : Bending moments in beams for slab 8x5.33m from three dimensional structural analysis

Beam size, width x depth(mm)	Direction	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long	88.3	41.3	79.5	66.5	34.4	66.5
	Short	47.3	29.8	49.7	44.2	25.8	44.2
400x400	Long	129.8	76.7	131.8	116.2	66.1	116.2
	Short	64.1	50.6	75.7	68.3	43.7	68.3
400x500	Long	157.9	113	179.7	161.4	98	161.4
	Short	69.7	68.3	93.8	84	56.5	84
400x600	Long	171.2	145.4	219.3	197.8	124.3	197.8
	Short	65.9	82.3	104.9	92.8	63.2	92.8
400x700	Long	171.9	172.9	250.6	225.8	143.4	225.8
	Short	56.1	94	111.3	97.8	65.5	97.8
400x800	Long	163.1	196.2	274.7	247.2	155.9	247.2

	Short	42.8	104.4	114.8	101.3	65.2	101.3
400x900	**Long**	148.2	217.9	293.1	263.9	163.2	263.9
	Short	27.8	114.3	116.4	104.2	63.5	104.2
400x1000	**Long**	129.6	237.6	306.8	277.4	166.9	277.4
	Short	12.5	123.6	116.8	106.8	61.3	106.8

Table 4 : Bending moments in beams for slab 8x4m from three dimensional structural analysis

Beam size, width x depth(mm)	**Direction**	**Exterior span**			**Interior span**		
		Exterior negative moment	**Positive moment**	**Interior negative moment**	**Interior negative moment**	**Positive moment**	**Interior negative moment**
400x300	**Long**	71.9	35.3	64.3	55.7	30.8	55.7
	Short	23.4	19.7	26.5	24.5	17.8	24.5
400x400	**Long**	105	63.9	107	97	57.3	97
	Short	28.9	30.7	37.8	35.1	27.5	35.1
400x500	**Long**	127.6	92.3	146.1	134.2	82.9	134.2
	Short	27.9	38.4	44	40.2	32.6	40.2
400x600	**Long**	138.6	117.1	178.3	163.8	103.4	163.8
	Short	22.5	43.9	46.7	41.9	34	41.9
400x700	**Long**	139.8	137.8	203.5	186.3	118	186.3
	Short	15	48.4	47.4	42.5	33.3	42.5
400x800	**Long**	133.6	155.3	222.8	203.2	127.4	203.2
	Short	6.6	52.8	46.8	42.7	31.8	42.7
400x900	**Long**	122.7	171.3	237.4	216.2	132.9	216.2
	Short	-2	57.1	45.4	43	30.1	43
400x1000	**Long**	109	186.1	248.3	226.7	135.5	226.7
	Short	-23	62.2	43.6	43.2	28.6	43.2

IV. Two Dimensional Structural Analysis of Beams

The computer program sap2000 is used for structural modeling of interior beams in the slab systems in long and in short directions. The frames that are composed of these beams and the supporting columns are analyzed as two dimensional structures. The frame has horizontal beams of three spans and top and bottom columns. The columns have a height of 3.5m. The analysis is done for beams of width 400mm and depth varies from 300 to 1000mm for the different slab systems. The load on the beam in the frame is equal to frame width multiplied by the slab area load. The loads on the slab are transferred to beams based on the 45 degrees- load- distribution principle. The shape of the span load whether it is triangle or trapezoid depends on the aspect ratio of the panel. The load shape is triangle for spans in a square panel, while the load shape is triangle for short span and trapezoid for long span in a rectangular panel. Tables 5 to 8 illustrate the moment values in the beams in the different slabs.

Table 5 : Moments in beams determined by 45 degrees- load distribution principle for two way slab 8x8m

Beam size, width x depth(mm)	**Direction**	**Exterior span**			**Interior span**		
		Exterior negative moment	**Positive moment**	**Interior negative moment**	**Interior negative moment**	**Positive moment**	**Interior negative moment**
400x300	**Long, short**	321.1	238.7	331.3	328.2	236.4	
400x400	**Long**	312	241.7	335.3	328.3	236.2	
400x500	**Long**	298.2	246.4	340.9	328.7	235.8	
400x600	**Long**	268.6	253	347.8	329.7	234.8	
400x700	**Long**	257.9	261.4	355	331.5	233.1	
400x800	**Long**	233.4	271.3	361.8	334.2	230.4	
400x900	**Long**	207.7	282.2	367.7	337.7	226.9	
400x1000	**Long**	182	293.8	372.3	341.8	222.7	

Table 6 : Moments in beams determined by 45 degrees- load distribution principle for two way slab 8x6.4m

Beam size, width x depth(mm)	Direction	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long	305.2	223.5	315	312	221.4	
	Short	154.5	124.1	160.8	158.9	122.9	
400x400	Long	296.6	226.3	318.8	312.1	221.2	
	Short	148.9	125.7	163.1	159	122.7	
400x500	Long	283.4	230.6	324.1	312.5	220.8	
	Short	140.6	128.3	166.3	159.3	122.4	
400x600	Long	266	236.8	330.6	313.5	219.9	
	Short	129.9	131.9	169.9	160	121.7	
400x700	Long	245	244.5	337.5	315.2	218.2	
	Short	117.3	136.4	173.5	161.2	120.6	
400x800	Long	221.7	253.7	344	317.7	215.7	
	Short	103.7	141.6	176.6	162.9	118.9	
400x900	Long	197.3	264	349.6	321	212.3	
	Short	89.8	147.4	179	164.9	116.8	
400x1000	Long	162.7	274.7	354	325	208.4	
	Short	76.4	153.3	180.6	167.2	114.5	

Table 7 : Moments in beams determined by 45 degrees- load distribution principle for two way slab 8x5.33m

Beam size, width x depth(mm)	Direction	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long	277.4	197.7	286.3	283.5	195.8	
	Short	85.5	71.3	87.7	86.5	70.4	
400x400	Long	269.5	200.3	289.7	283.6	195.7	
	Short	79.8	72.6	89.2	86.6	70.3	
400x500	Long	257.5	204.2	294.6	284	195.3	
	Short	74.4	74.5	91.1	86.8	70	
400x600	Long	241.6	209.8	300.5	284.9	194.4	
	Short	67.6	77.2	93.1	87.3	69.5	
400x700	Long	222.5	216.9	306.8	286.4	192.9	
	Short	59.8	80.4	95	88.2	68.7	
400x800	Long	201.2	225.3	312.7	288.7	190.6	
	Short	51.5	84	96.4	89.2	67.6	
400x900	Long	178.9	234,6	317.8	291.8	187.6	
	Short	43.4	87.9	97.4	90.5	66.3	
400x1000	Long	156.7	244.4	321.8	295.3	184	
	Short	35.6	91.8	97.9	91.8	65	

Table 8 : Moments in beams determined by 45 degrees- load distribution principle for two way slab 8x4m

Beam size, width x depth(mm)	Direction	Exterior span			Interior span		
		Exterior negative moment	Positive moment	Interior negative moment	Interior negative moment	Positive moment	Interior negative moment
400x300	Long	226.1	155.4	233.4	231.2	153.8	
	Short	30.6	30.3	32.7	32.2	29.8	
400x400	Long	219.7	157.5	236.2	231.3	153.7	
	Short	28.7	31	33.4	32.2	29.7	
400x500	Long	209.8	160.8	240.2	231.6	153.4	
	Short	26	32	34.1	32.4	29.5	

400x600	**Long**	196.8	165.3	245.1	232.3	152.7
	Short	22.8	33.4	34.9	32.6	29.3
400x700	**Long**	181.1	171.2	250.2	233.5	151.5
	Short	19.2	35	35.4	33.1	28.9
400x800	**Long**	163.6	178	255.1	235.4	149.6
	Short	15.6	36.8	35.6	33.5	28.4
400x900	**Long**	145.4	185.7	259.3	237.9	147.1
	Short	12.2	38.6	35.6	34	27.9
400x1000	**Long**	127.1	193.8	262.5	240.9	144.1
	Short	8.9	40.4	35.4	34.5	27.4

V. Moments in Beams

The moments in beams are determined from three- dimensional analysis of slab system and from two- dimensional analysis of frame. Three dimensional structural analysis shows that the moments in the beams are increased as their flexural stiffness increases. The negative moment at the exterior support increases as the stiffness ratio increases up to about one, then the moment decreases. The stiffness ratio is given by:

$$stiffness\ ratio = \frac{I_b}{I_s}\frac{L_2}{L_1}$$

Where:

Ib= the moment of inertia of the beam

Is= the moment of inertia of the slab

L1= span length center to center of supports (columns)

L2= frame width (half distance to next column lines)

This stiffness ratio is used in ACI (American Concrete Institute) direct design method as

$$\alpha_{f1}\frac{l_2}{l_1}$$

Where l2 is the frame width, l1 is the span length and $\alpha f1$ is beam moment of inertia divided by slab moment of inertia.

Tables 9 and 10 illustrate the percentage of moments in beams related to maximum obtained moment for stiffness ratios one and two respectively. This percentage represents the beam efficiency in the frame. It is shown that the beam efficiency for the positive moment in exterior span is about 77% and 71% for long and short beams respectively at stiffness ratio of two. The beam efficiency for the positive moment in interior span is not less than 90%, while the beam efficiency for interior negative moments is not less than 85% at stiffness ratio of two.

Table 9 : Beam efficiency for stiffness ratio of one

Slab	Direction	Positive moments %		Negative moments %	
		Exterior span	Interior span	Exterior span	Interior span
8x8		61	78	75	75
8x6.4	**long**	61	75	73	72
	short	60	80	76	75
8x5.33	**long**	61	74	72	71
	short	59	96	81	81
8x4	**long**	63	76	72	72
	short	60	100	100	91

Table 10 : Beam efficiency for stiffness ratio of two

Slab	Direction	Positive moments %		Negative moments %	
		Exterior span	Interior span	Exterior span	Interior span
8x8		77	92	87	87
8x6.4	**long**	77	90	86	86
	short	75	98	90	88
8x5.33	**long**	78	90	85	85
	short	71	100	97	89
8x4	**long**	79	90	86	86
	short	82	100	100	98

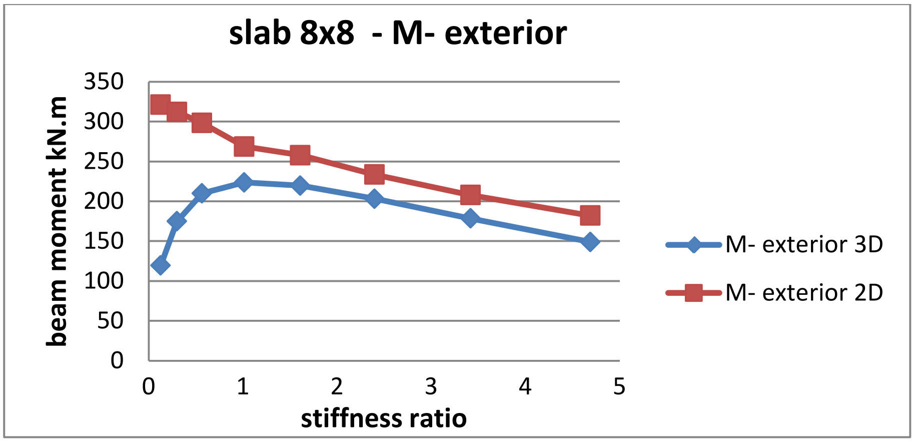
The two dimensional analysis of the frame illustrates that the moments in the interior span do not much vary as the flexural stiffness of the beam increases. It shown that, the negative moments in the interior span slightly increase as their flexural stiffness increases, while the positive moment slightly decreases. This variation of moment is about ±8%. The negative moment at exterior support (column) is much varied as the flexural stiffness of the beam increases. This moment will decrease as the flexural stiffness of the beam increases. This result is expected as the support fixity increases as the beam size decreases. It is known that the positive moment and the interior negative moment in the exterior span will increase as the exterior negative moment decreases. The increase percentage in exterior negative moment as the beam flexural stiffness decreases ranges from 175% to 340%. The percentage increase is about 12.5% and less than 33% for the interior negative moment and the positive moment in the exterior span respectively.

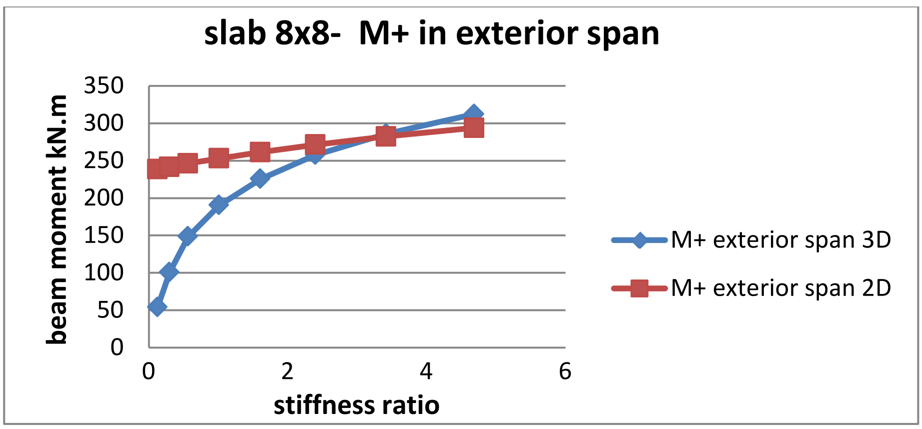
VI. Relation between Moments in Beams Determined by Three and Two Dimensional Structural Analyses

Figure 1 shows the relation between beam moments determined by three and two dimensional analyses. This figure illustrates that at a specified value of stiffness ratio, the moments in beams determined by three dimensional structural analysis of slabs are equal to that determine by two dimensional structural analysis of frame based on the 45 degrees- load- distribution principle. Table 11 shows the stiffness ratio for equal moments.

Table 11 : stiffness ratio at which moments in beams determined by three and two dimensional structural analyses are equal

Slab	Direction	L2/L1	Stiffness ratio
8x8	**Long, short**	**1**	>3
8x6.4	**long**	**1.25**	>3
	short	**0.8**	2
8x5.33	**long**	**1.5**	>3
	short	**0.67**	1
8x4	**long**	**2**	>3
	short	**0.5**	0.5





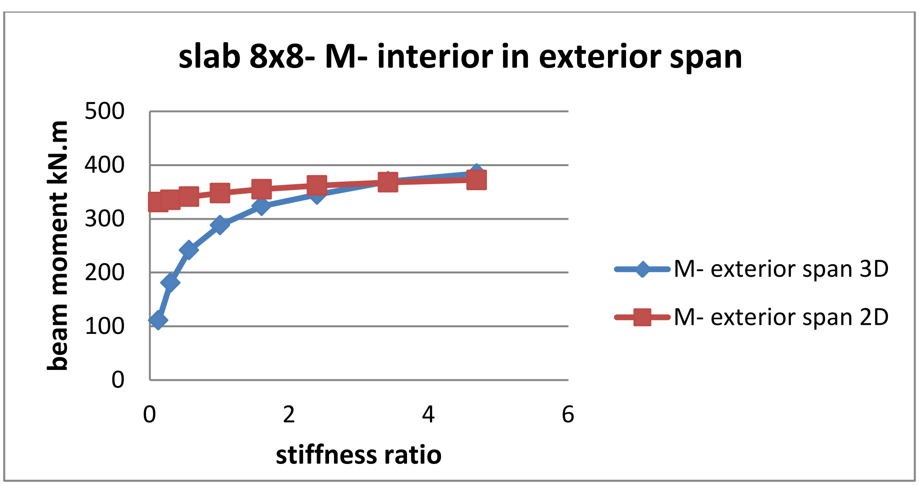
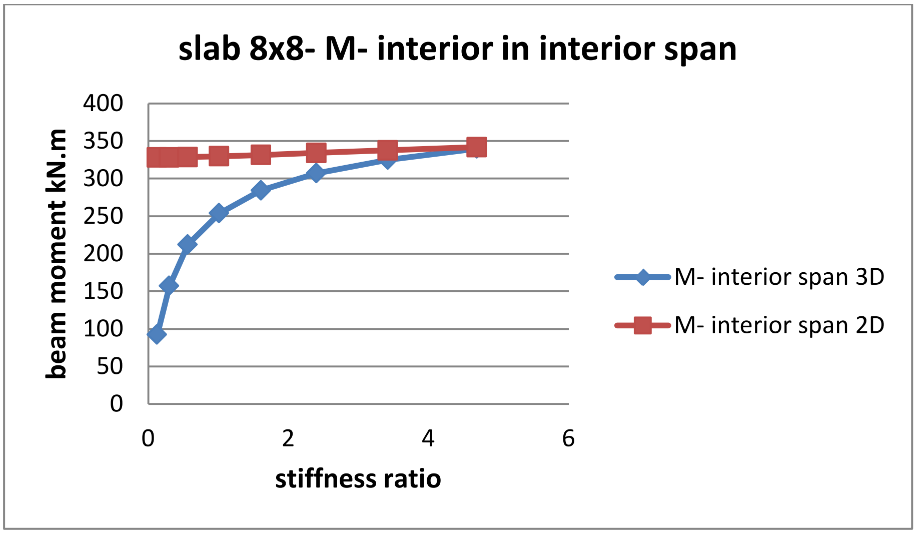
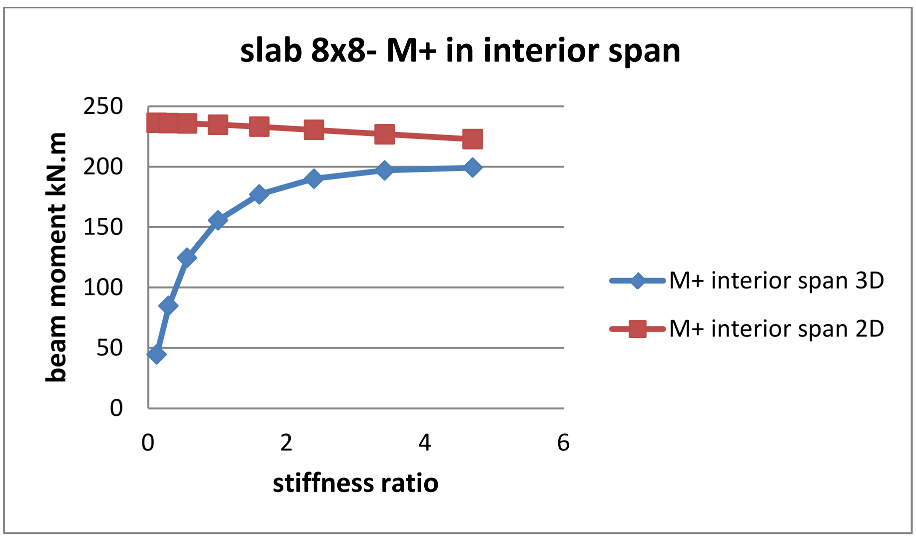


Figure 1 : Relation Between moments in beams determined by three and two dimensional analyses- A





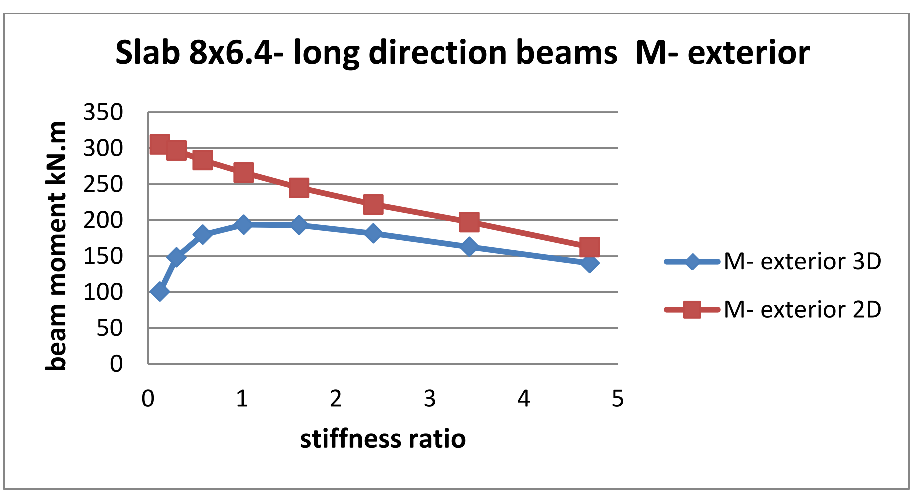
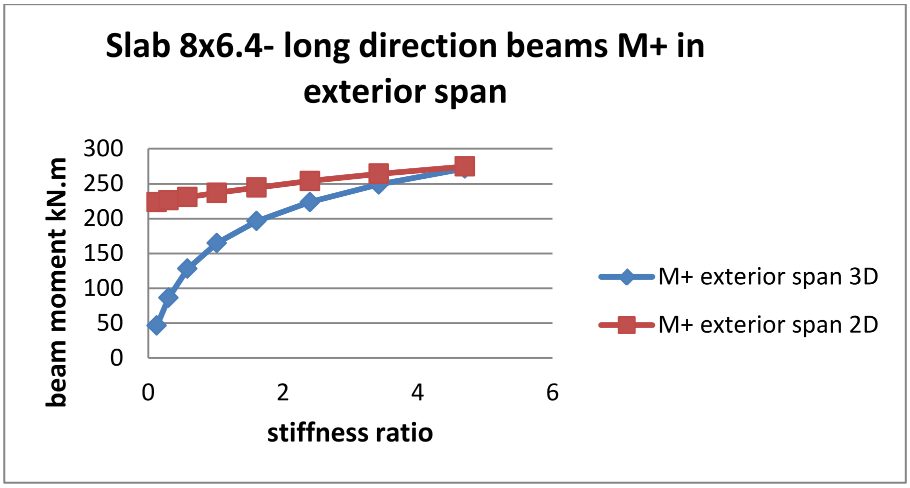
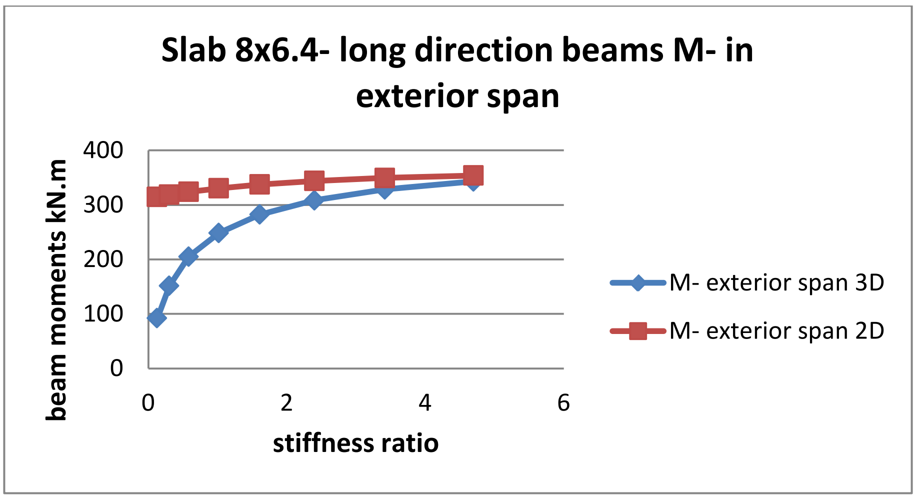


Figure 1 : Relation Between moments in beams determined by three and two dimensional analyses- B





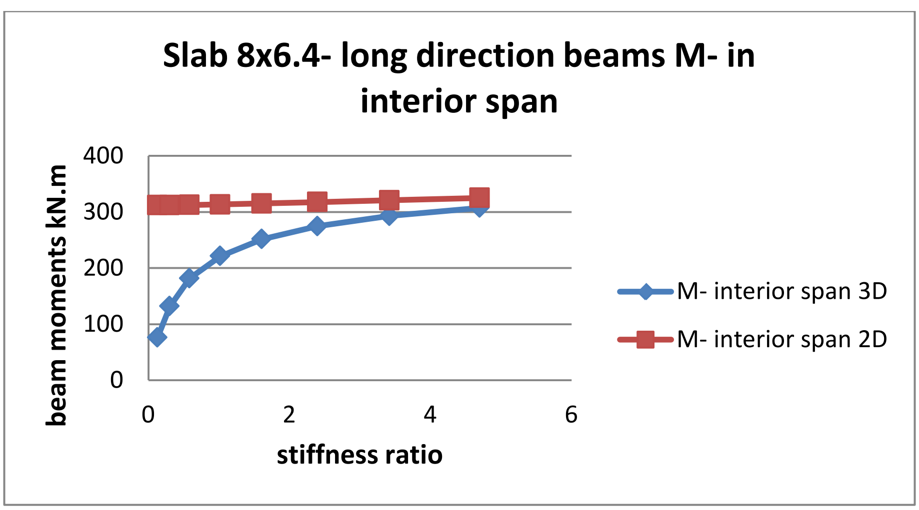
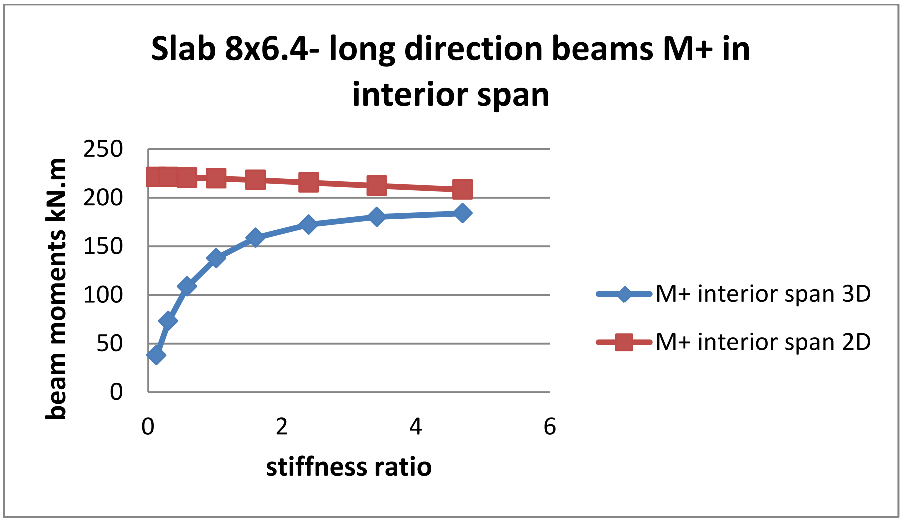
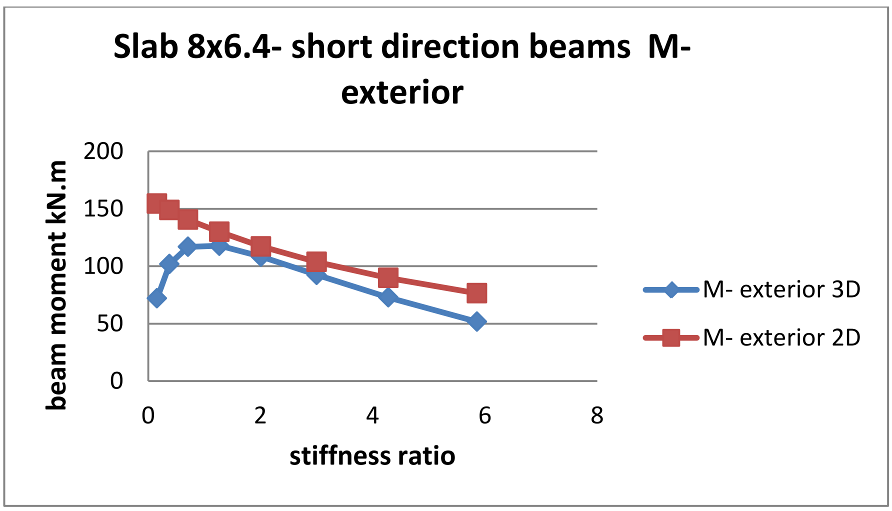


Figure 1 : Relation Between moments in beams determined by three and two dimensional analyses- C





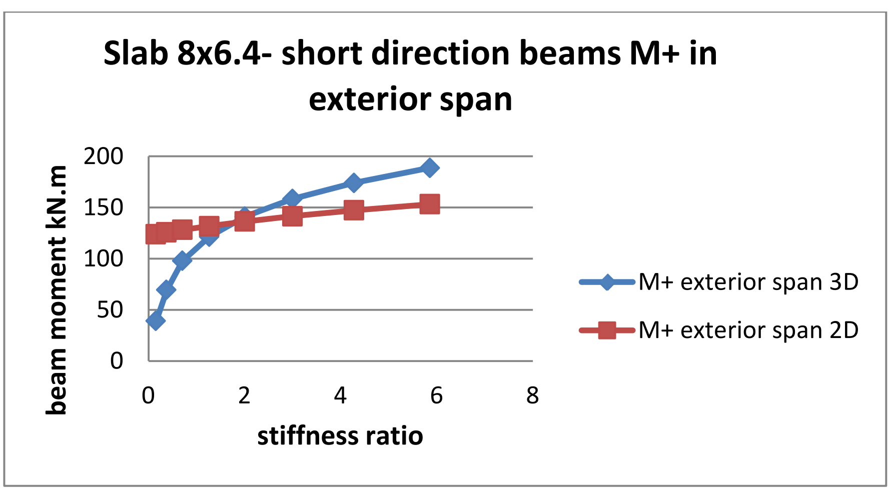
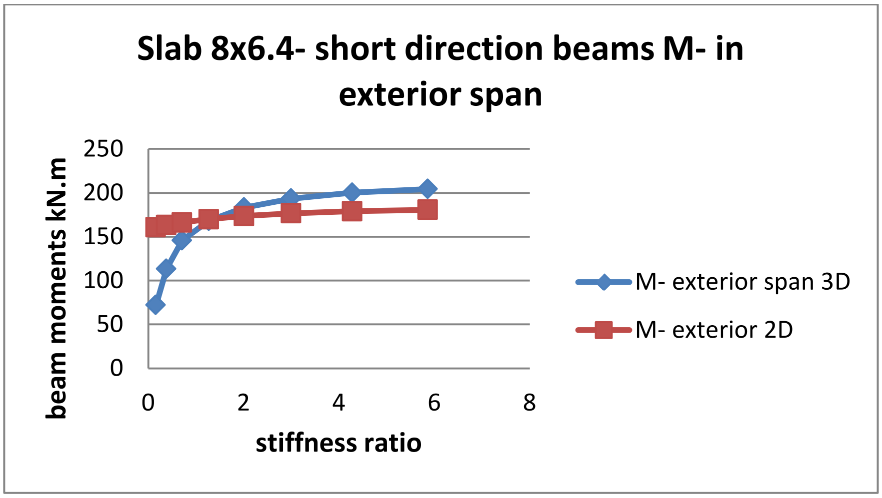
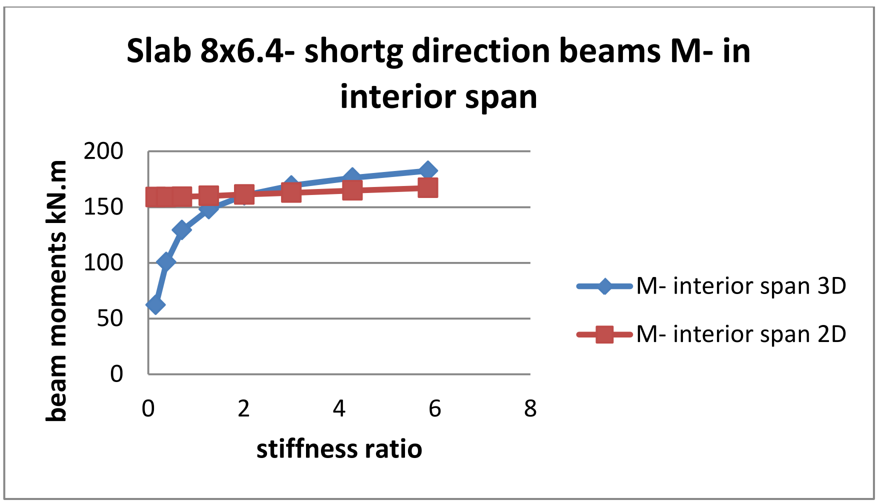


Figure 1 : Relation Between moments in beams determined by three and two dimensional analyses- D





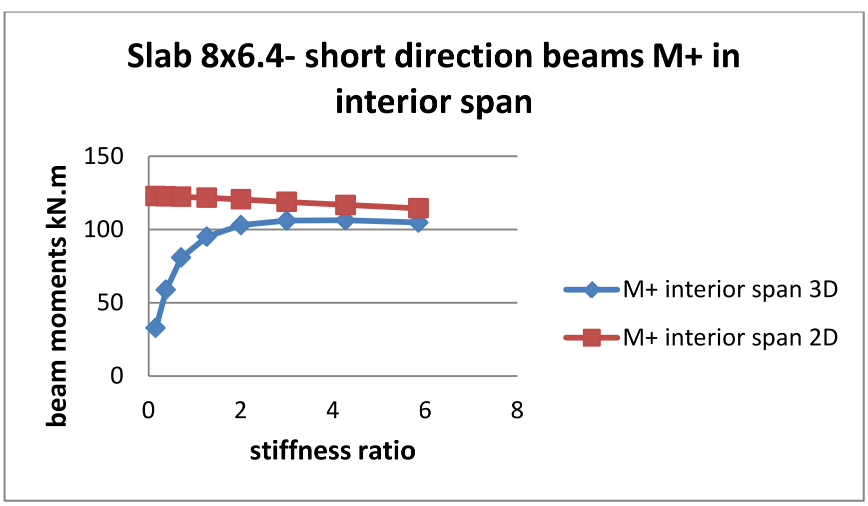


Figure 1 : relation between moments in beams determined by three and two dimensional analyses- E

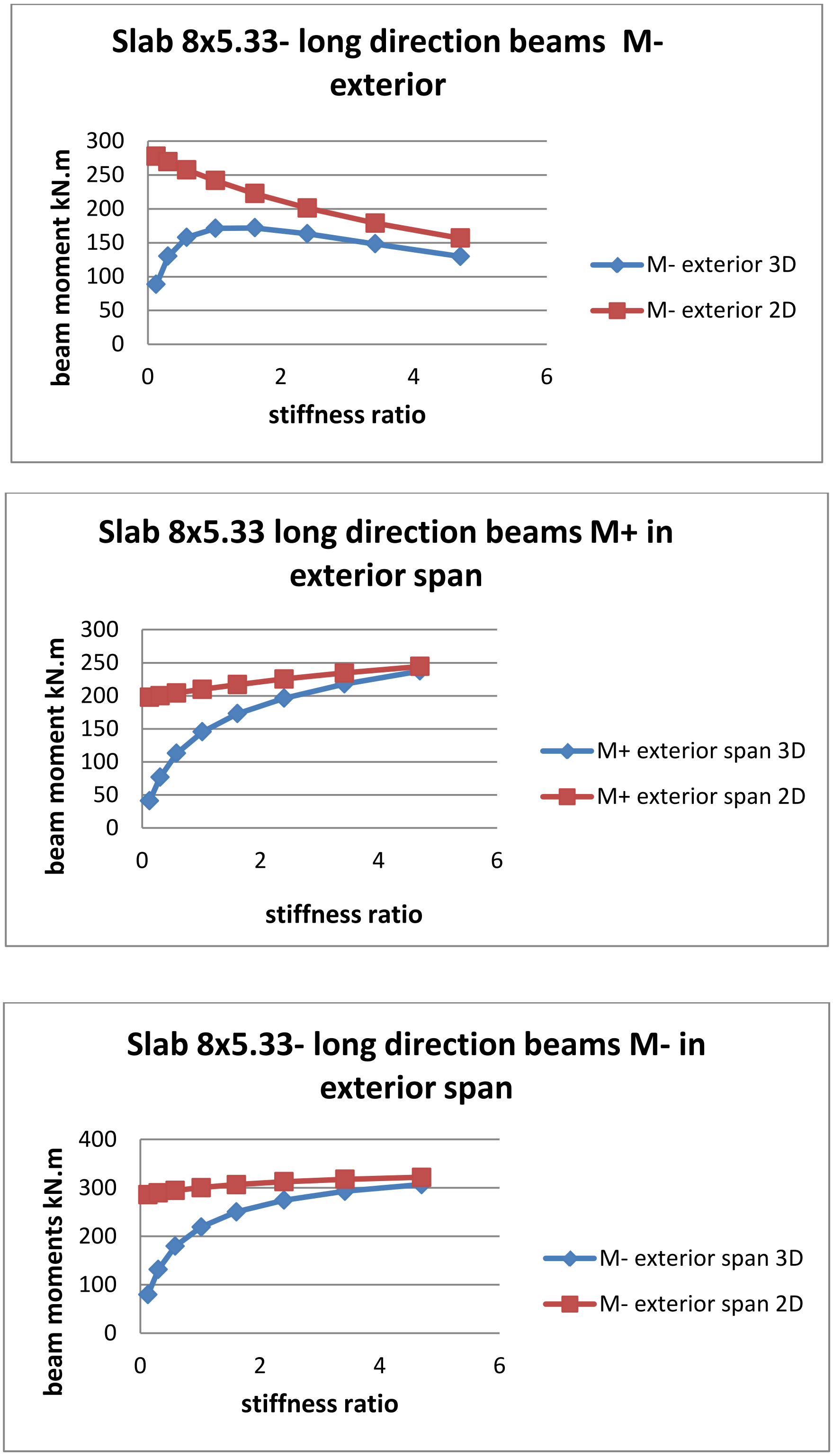


Figure 1 : Relation Between moments in beams determined by three and two dimensional analyses- F

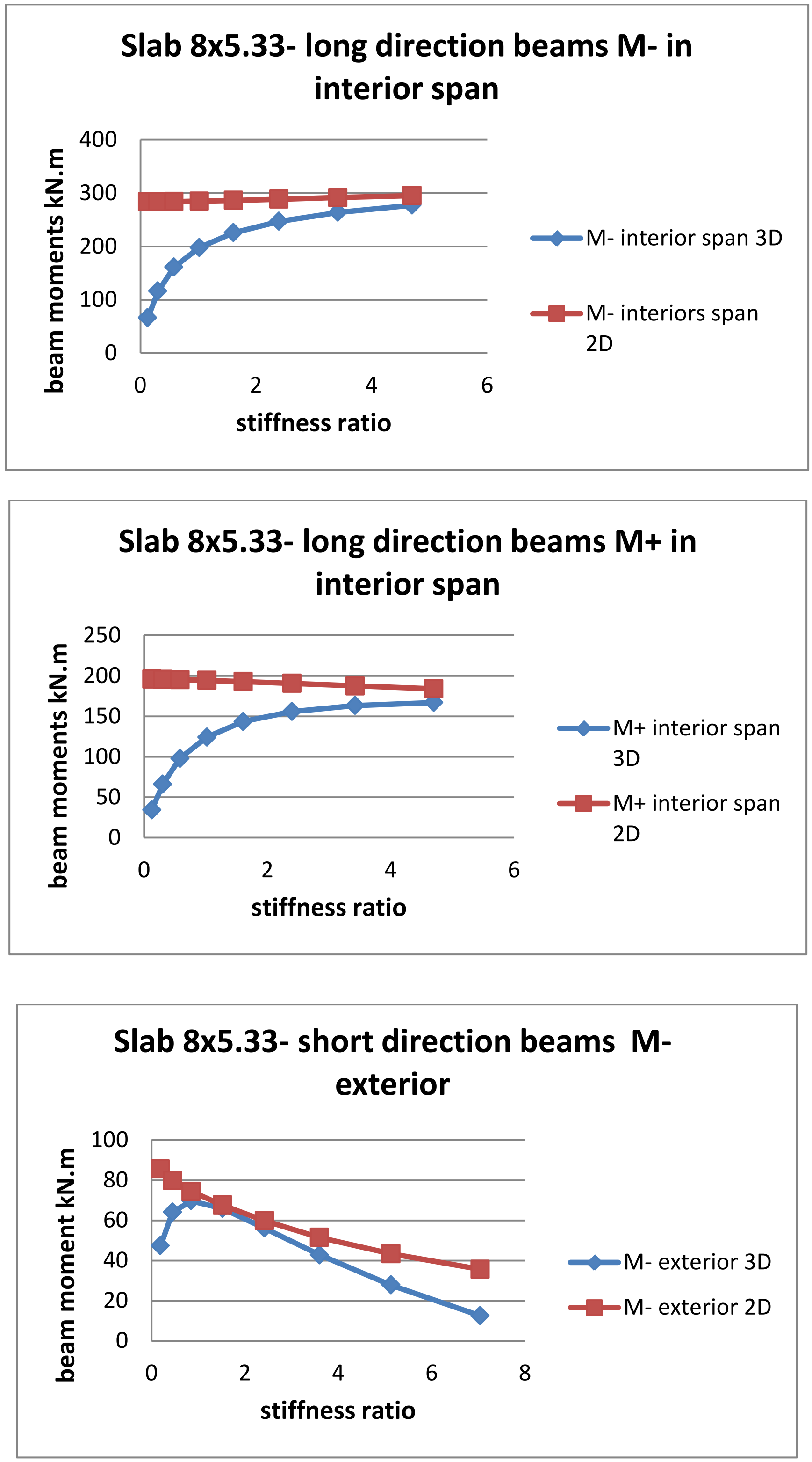
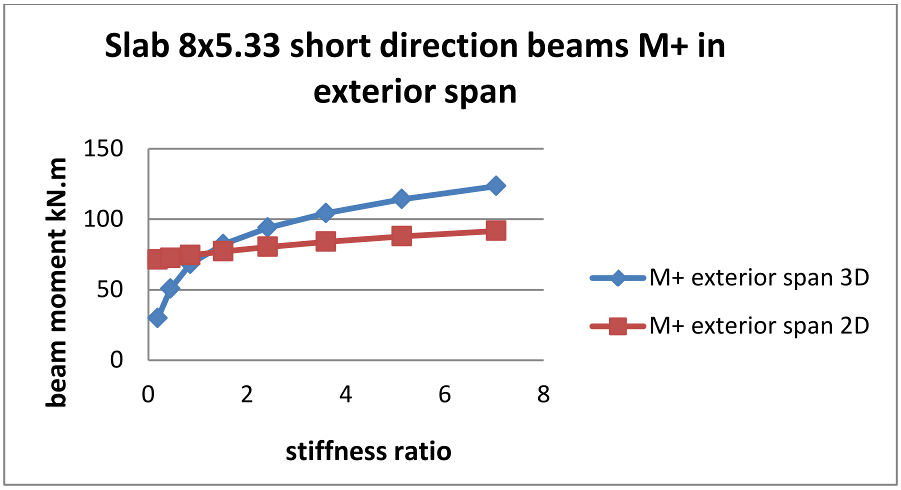
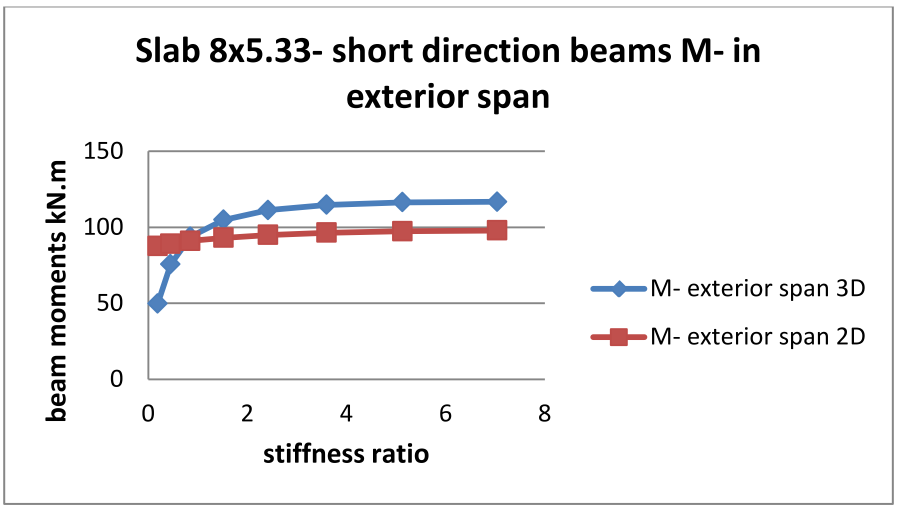


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- G





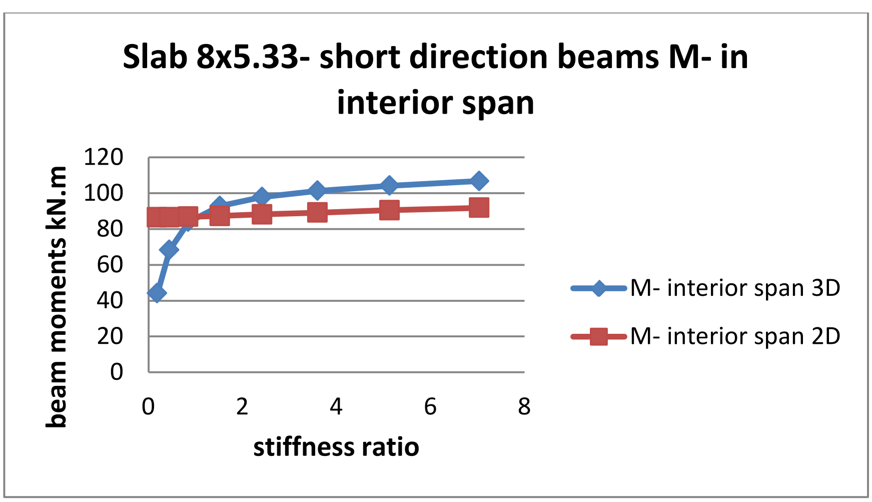
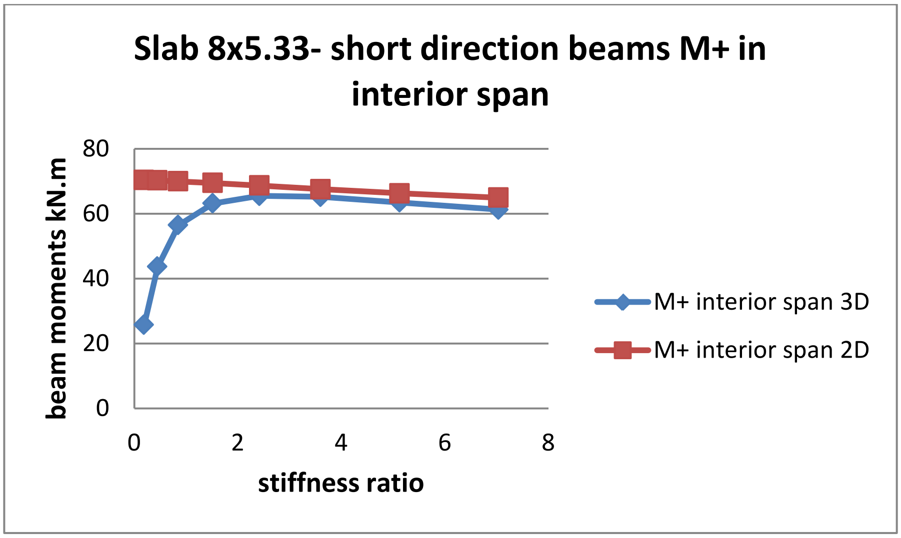
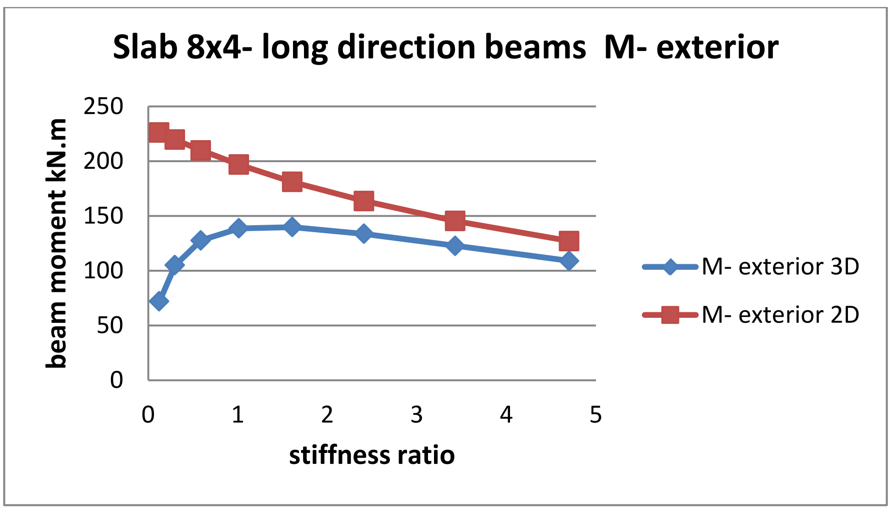


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- H





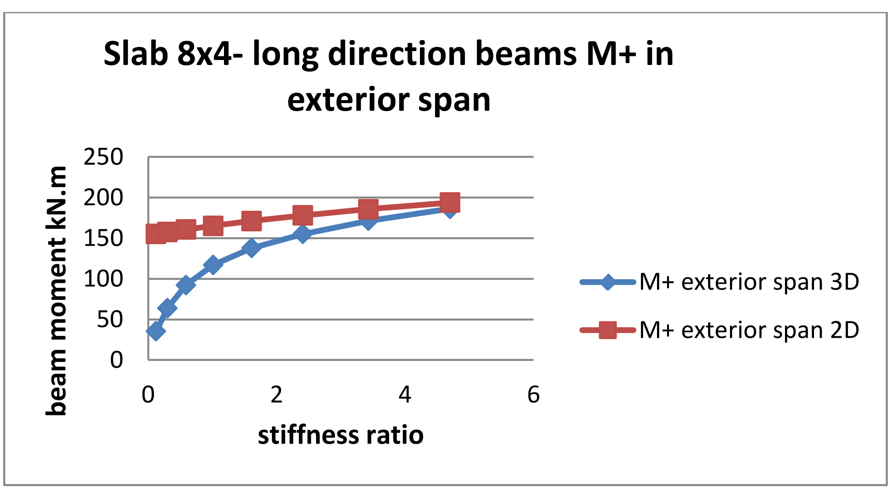
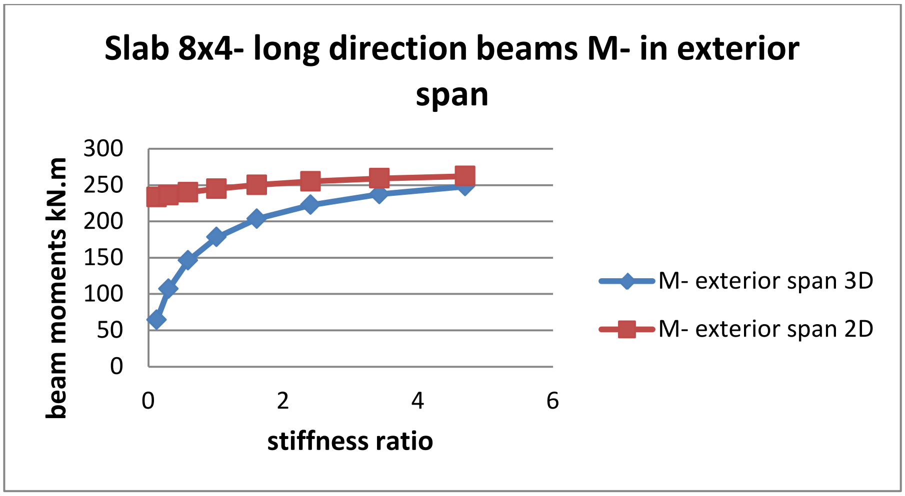
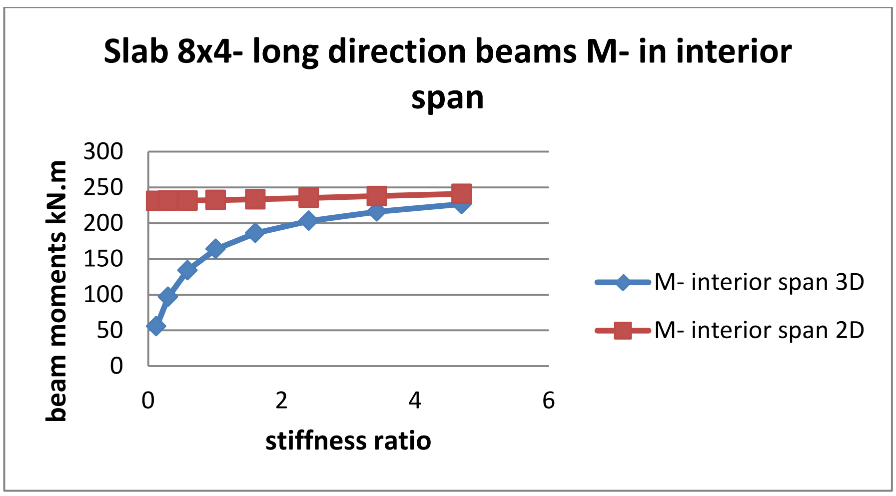


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- I





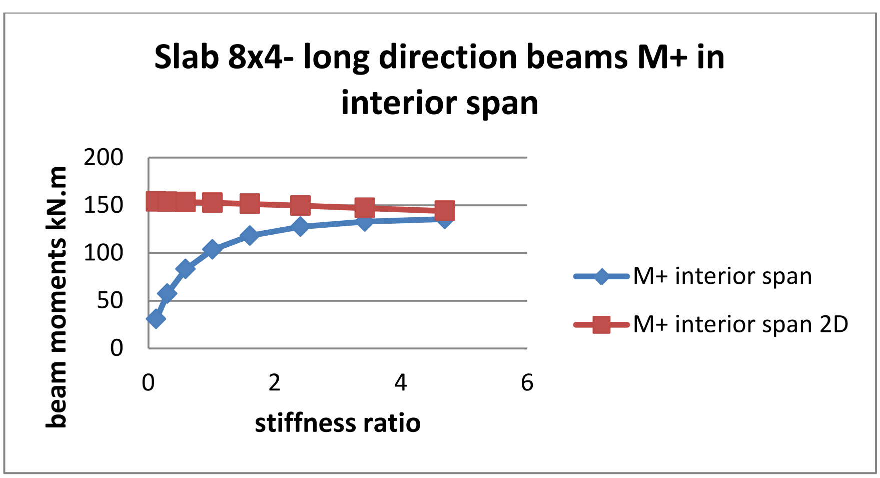
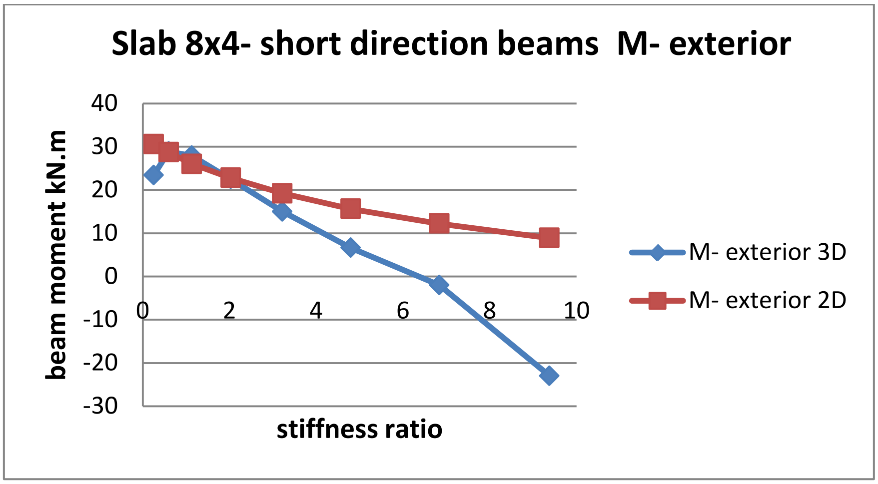
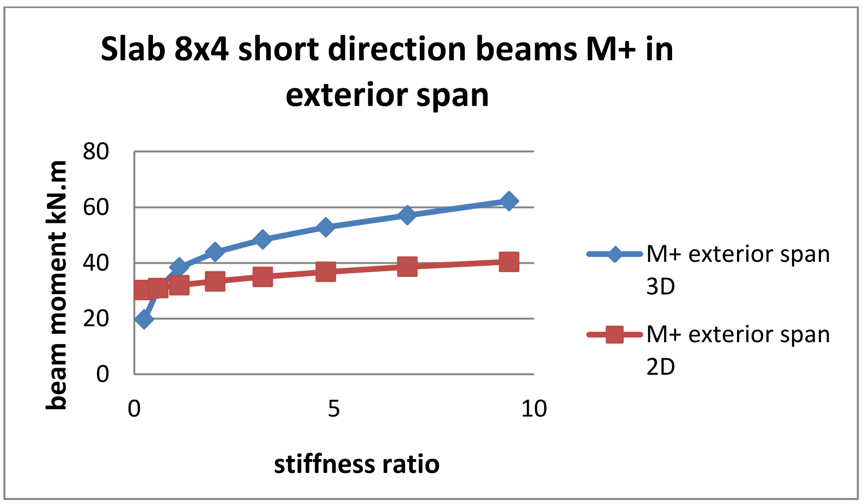


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- J





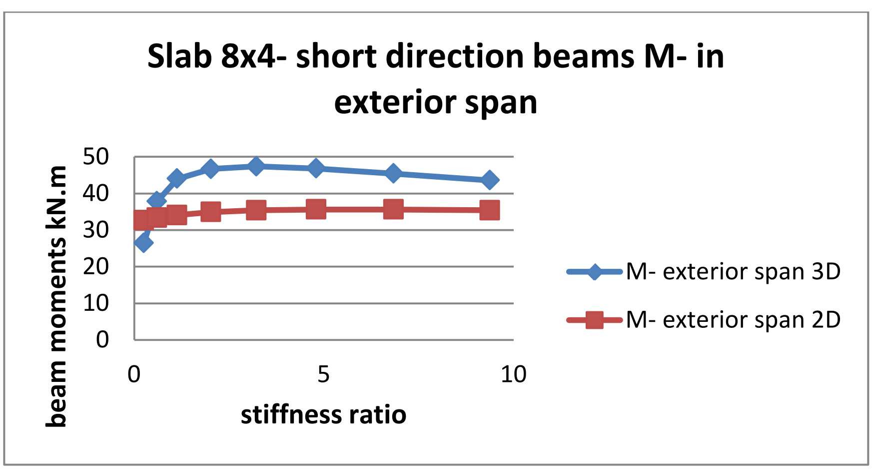
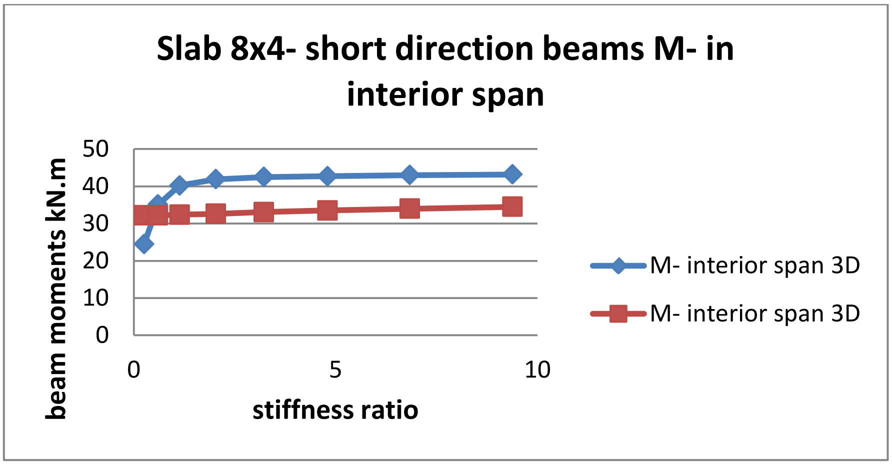


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- K



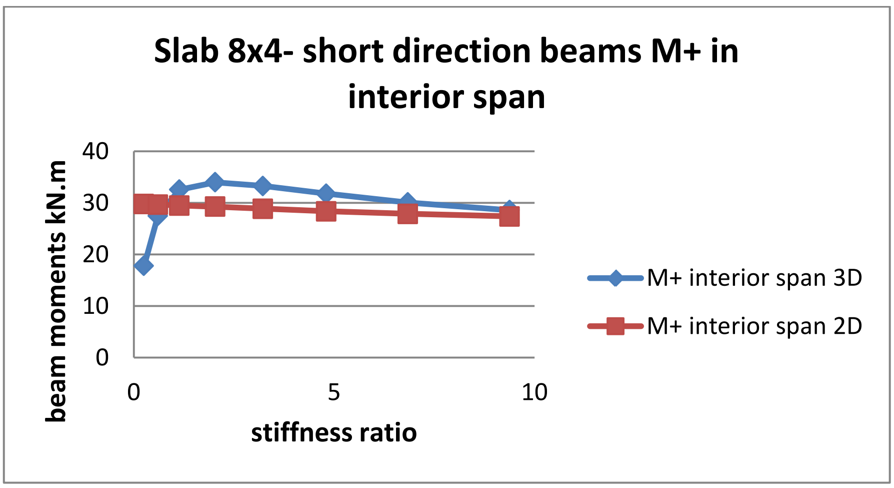


Figure 1 : Relation between moments in beams determined by three and two dimensional analyses- L

VII. Results and Recommendations

This paper shows that there is a difference in moments of beams in two way slabs between three dimensional structural analysis of slabs and the principle of 45 degrees-load-distribution. The results will be not far for a specific stiffness ratio. For rectangular panels, the difference between moment values will be acceptable for stiffness ratio not less than 3 for long spans, but in general the moments in beams determined by frame two dimensional analysis are slightly higher than the moments determined from three dimensional analysis. In short spans of rectangular panels, the difference between beam moments is acceptable at stiffness ratio of 2 for long span/short span of 1.25, 1 for long span/short span of 1.5 and 0.5 for long span/short span of 2. Also, the beam moments determined by three dimensional structural analysis will be larger than the beam moments determined by frame two dimensional structural analysis for stiffness ratios larger than these for short spans in rectangular panels.

In general, it is always recommended to use a finite element structural analysis program for analysis of two- way slab systems, as the distributions of internal forces in slab and beams depend on the span lengths and the relative stiffness between the structural members.

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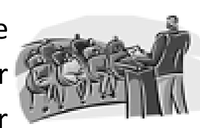

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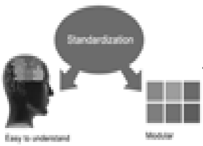

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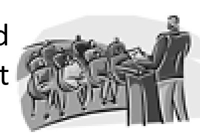

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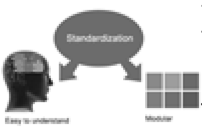

After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.

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Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
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"

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Administration Rules Listed Before Submitting Your Research Paper to Global Journals Inc. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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