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DESIGN AND ANALYSI OF SEDIMENTAION TANK

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Abstract:

Understanding the effect of any unit of Water Treatment Plant (WTP) on the performance of the other units is very important in optimal design of a WTP. In some of the WTP a Primary settling is done in the unit of Pre-Sedimentation Tank (PST) in entrance of raw water to the WTP. In some WTP, the unit of PST is used only in flood condition. Regarding the high-cast of equipment and maintenance of PST, more studies are needed for evaluation of the role and performance of the PST on the other units of the WTP .This study was done in Salman Farsi WTP. The removal efficiency of turbidity for PST, clarifier, filters and backwash interval time in filters in flood and non-flood conditions and use and non-use of PST were examined and evaluated. Coagulant and chlorine consumption were also compared in the presence and absence of pre-sedimentation basin during non-flood condition. The results showed that in non- flood condition and using from PST, the PST didn't play significant role in decreasing the turbidity and coagulant consumption increased compared to none use of PST. In this condition, consumption of gaseous chlorine of 900 kilograms in one month is more than in none-use of PST condition. In flood condition and non-use of PST filtration, efficiency is considerably reduced and filters backwash interval time is decreased more than 3 times and rate of water treatment is reduced by 20 percent.

Overall, the results showed if PST is absent in low turbidity, Total costs will reduce; Instead, in the absence of PST in flood condition the rate of water production reduces, and quickly clogging of the filters is happened .

Key words: water treatment plant, pre-sedimentation tank, turbidity, settling, filter.

Introduction:

Sedimentation is recommended as simple and low cost pre-treatment of water prior to application of other purification treatments such as filtration and disinfection methods. It removes undesirable small particulate suspended matters (sand, silt and clay) and some biological contaminants from water under the influence of gravity.

It also improves the visual qualities of the water and increases its acceptance by consumers. The longer the water is sediment, the more the suspended solids and pathogens will settle to the bottom of the container. Sedimentation is a simple low cost pre-treatment technology to reduce settable solids and some microbes from water under the influence of gravity prior to application of other purification methods. It also improves the visual qualities of the water and increases its

acceptance by consumers For the treatment of highly turbid raw water during the rainy season, solids loadings including larger particles decreased substantially with the application of pre-sedimentation in the water treatment plant during the rainy season (Kwak et al.,2010). Contaminants from raw water could be removed step-by-step following sequential treatment processes. The selection and arrangement of different treatment processes are of great importance for achieving high contaminant removal efficiency.

Pre-sedimentation has various effects on water treatment plant operation, and the produced water depends on raw water quality. Optimization is needed. For increasing the efficiency of produced water, optimization of conventional drinking water treatment plant means" to attain the most efficient or effective use" of water treatment plant regarding some principles. There are achievements of consistently high quality finished water on a continuous basis, and importance to focus on overall plant performance (Angreni, 2009). Researches have shown that Pre-Sedimentation Tanks (PST) cause some problems in the water treatment plants. Concentration and suspended particle characteristics could be influenced by performance and efficiency of sedimentation tank (Sammarraee et al.,2009) though the PST decreases the turbidity, low turbidity causes water to become ”tough,” and hardly can be tackled in subsequent units of water treatment plants (Al Rawi and Bilal, 2013) and not always increasing in raw water turbidity results in an increase in turbidity removal efficiency (Al Ani and Awaid, 2013).

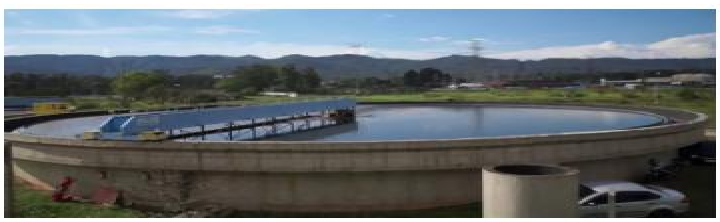
The re-sults of examining the impacts of filter backwash water and membrane backwash water recycles on water quality in coagulation–sedimentation processes showed a significantly higher removal of dissolved organic carbon from the raw water that was in blended with 5 and 10% by volume of filter backwash water as compared to control trials where backwash water was not added (Gottfried et. al., 2008).

Pre-sedimentation also can cause some other problems as same as increasing fecal coli- form via sediments to water flow. Fecal coliform percent increases sometimes due to sediments in sedimentation tank (Al Hashemi et al., 2013). Problematic algae, species that do not settle or are not easily removed by water treatment processes, are common in many water treatment plants (Joh et al.,2011). As the PST in tropical climate is adequate place for growing algae, operators need to control algae in these tanks. Pre-chlorination is a common and effective method for the control of algal growth in conventional water treatment plants (Ibrahim et al., 2011). Amount of chlorine consumption is related to algae mass. Increase in consumption of chlorine can be one of the disadvantages of its use (PST) in inadequate conditions. Pre-chlorination produces harmful byproducts as same as Tri-halo Methane (THM) (Sadiq and Rodriguez, 2004; Sharp et al., 2006; Joh et al., 2011; Al Hashemi et al., 2013; Özdemir, 2014). The goal of this paper is evaluation of the role and performance of the PST on the other units of the WTP in flood and non-flood conditions.

over the last two decades, there has been a large growth in the application of computational fluid dynamics (CFD) to design of facilities. CFD has many advantages over traditional modelling approaches as it is a low-cost, high speed

CIRCULAR TANKS:

In plain sedimentation, these are generally not used but in sedimentation, with coagulation, they are mostly used.



On the basis of the flow of water there are two types of circular sedimentation tanks;

Radial Flow Circular Tank: Through the central inlet pipe placed in-side the deflector box the water enters in this tank and deflector box deflects the water downwards. Then through the holes provided in the bottom sides of the deflector box, it goes out, and towards the circumference of the tank, the water flows radially from the deflector box where an outlet is provided on the full periphery.

HOPPER BOTTOM TANKS:In these tanks, water flows upward and downward and these are vertical flow tanks. From the top into deflector-box water enters in these tanks and the water reverses its direction and starts flowing upward around the deflector box after flowing downward inside the deflector box.

The suspended particles having specific gravity more than one cannot follow the water at the time of reversing its direction and settle in the bottom from where under hydrostatic pressure they are removed through the sludge outlet pipe.

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To collect the clear water, rows of decanting channels are provided at the top, and water is taken out from the outlet channel provided on one side of the tank after flowing in the channel. In sedimentation with the coagulation process, these tanks are mostly used.

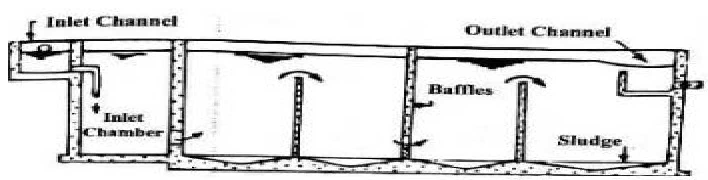
FILL & DRAWN SEDIMENTATION TANK:

In this type water from the inlet is stored for some time that maybe 24 hours and the suspended particles are settled at the bottom of the tank at that time. The water is discharged through the outlet after 24 hours.

Then the settled particles are removed and this action requires 6 to 12 hours so, in case of fill and draw-type sedimentation tank, one complete action of sedimentation requires 30 to 40 hours

CONTINUOUS FLOW TANK:

The water is not allowed to rest in this case and with a very small velocity, flow always takes place. The suspended particles are settled at the bottom of the tank during this flow and this may be in the vertical or horizontal direction.



ADVANTAGES OF SEDIMENTATION TANK:

There are the following advantages of these tanks such as;

1. It is low cost and simple water pre-treatment technology.
2. It has low operating costs and handles a wide range of flows.
3. To settle out suspended solids, the coagulants reduce the time required.
4. It has high clarification efficiency and easy sludge removal properties.
5. For plants with constant flow rates and quality, it is best suited.
6. For free or at a low cost, natural coagulants can sometimes be obtained.

DISADVANTAGES OF SEDIMENTATION TANK:

There are the following disadvantages such as;

1. To protect against freezing in a cold climate it needs covering units.
2. Mechanical drive unit and shaft bearings unit require frequent maintenance.

LITERATURE REVIEW

Mahesh Tandon (2005) has assessed that with the event of each veritable quake, there has been already, essentially an overall proclivity to build the limit sales of the structure to modify such occasions. It is essentially in the most recent decade that new strategies have been suitably best in class to deal with this issue monetarily. The current general practice has moved towards a showcase based structure plan, wherein the element is on usefulness and success under various degrees of monstrosity of seismic quakes. Moreover, he pondered that There is degree after both „passive" control by upheld indicating structures correspondingly as „active" control by express gadgets for seismic quake safe developments. The sensible use of these contemplations can incite moderate and safe development structures .

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Y. Vinod Kumar and Dr. Chava Srinivas (2015) 3 have introduced a total assessment of box course by utilizing computational strategies, for example, Grillage evaluation and Finite portion technique. Grillage appraisal is versatile in nature and can be applied to verity of system decks having both clear and complex structures adequately and sureness. Grillage assessment has done by most ordinarily utilizing softwre STAAD Pro. Their standard target was to know the direct of box funnel and grouping of stresses the degree that Shear power and bowing second qualities.

Lande Abhijeet Chandrakant , Patil Vidya Malgonda (2014) 4 saw that partner plan of box pipe consolidates thought of weight cases and factors like live weight, productive width, dispersal of weight through fill, impact factor, co-equipped for earth pressure, and so forth. The assistant fragments are required to be proposed to withstand most uncommon bowing second and shear power. So outperform wants program is made for assessment and it is separated and programming results. So assessment of box course is cultivated for it for different box conditions and key plan is proposed for basic cases.

This paper shows the near assessment of evaluation of standard framework utilizing STAAD programming and of FEM utilizing ANSYS programming. System –

• Analysis and plan by STAAD star.

• Analysis strategy got for RCC box is MDM (Moment Distribution Method).

• Designing Box Bridge considering LSM. Different cases those are to be for the most part gotten for orchestrating:

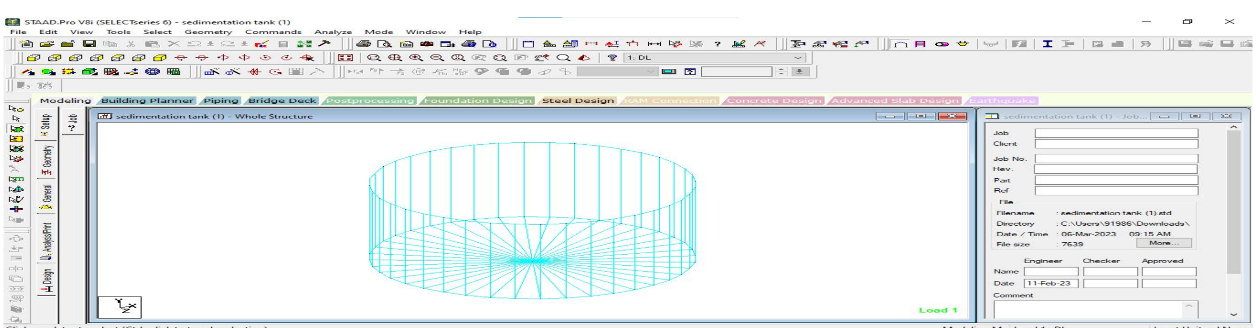
Case 1: Dead weight and live weight acting from outside comparably as earth pressure, while no water pressure from inside (for example Structure of Box Bridge by thinking about the compartment in void conditions, no water will spill out of it)

Case 2: Dead weight and live weight acting from outside likewise as earth pressure, while water pressure acting from inside (for example arranging the by considering that it is half full)

Case 3: Dead weight and live weight acting from outside also as earth pressure, while water pressure acting from inside (for example sorting out the holder by pondering that it is full. Considering case one, as it is the most extremely horrendous conceivable case for sorting out range. Handiness Limit State – For the confinements given in load blend basically will be thought of. For the weight goals given in load mixes 1 to 5 will be thought of. The estimation of YfL for creep and shrinkage of cement and prestressed (recalling optional impacts for statically dark structures) will be taken as.

Ludicrous Limit State – To check the plans of 10.3 weight mixes 1 to 4 will be thought of. The estimation of YfL for the impacts of shrinkage and, where vital, of creep will be taken as 1.2. In discovering the deterrent of individuals to vertical shear and twist YfL for the prestressing power will be taken as 1.15 where it unreasonably impacts the limitation and 0.87 in different cases. In enrolling optional impacts in statically sketchy structures YfL for prestressing power might be taken as 1.0.

GENERATION OF NODES: The nodes are generated based on the dimensions of the building. The building is divided into equal number of known grids. Then the grid spacing is given on the STAAD PRO 2004 window. The software automatically generates grids with specified spacing.



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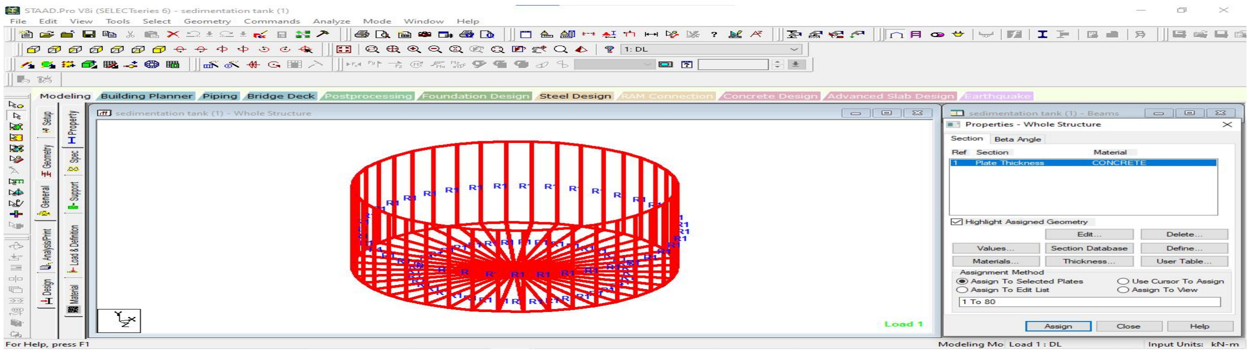
General:

Property assign:



SUPPORTS:

A structural support is a part of a building or structure that provides the necessary stiffness and strength in order to resist the internal forces (vertical forces of gravity and lateral forces due to wind and earthquakes) and guide them safely to the ground. External loads (actions of other bodies) that act on buildings cause internal forces (forces and couples by the rest of the structure) in building support structures. Supports can be either at the end or at any intermediate point along a structural member or a constituent part of a building and they are referred to as connections, joints or restraints.

Building support structures, no matter what materials are used, have to give accurate and safe results. A structure depends less on the weight and stiffness of a material and more on its geometry for stability. Whatever the condition is, a specific rigidity is necessary for connection designs. The support connection type has effects on the load bearing capacity of each element, which makes up a structural system. Each support condition influences the behaviour of the elements and therefore, the system. Structures can be either Horizontal-span support systems (floor and roof structures) or Vertical building structure systems (walls, frames, cores, etc.)

Roller supports

A roller support allows thermal expansion and contraction of the span and prevents damage on other structural members such as a pinned support. The typical application of roller supports is in large bridges. In civil engineering, roller supports can be seen at one end of a bridge.

A roller support cannot prevent translational movements in horizontal or lateral directions and any rotational movement but prevents vertical translations. Its reaction force is a single linear force perpendicular to, and away from, the surface (upward or downward). This support type is assumed to be capable of resisting normal displacement.

It can be rubber bearings, rocker or a set of gears allowing a limited amount of lateral movement. A structure on roller skates, for example, remains in place as long as it must only support itself. As soon as lateral load pushes on the structure, a structure on roller skates will roll away in response to the force.

Pinned support

A pinned support attaches the only web of a beam to a girder called a shear connection. The support can exert a force on a member acting in any direction and prevent translational movements, or relative displacement of the member-ends in all directions but cannot prevent any rotational movements.[1] Its reaction forces are single linear forces of unknown direction or horizontal and vertical forces which are components of the single force of unknown direction.

A pinned support is just like a human elbow. It can be extended and flexed (rotation), but you cannot move your forearm left to right (translation). One benefit of pinned supports is not having internal moment forces and only their axial force playing a big role in designing them. However, a single pinned support cannot completely restrain a structure. At least two supports are needed to resist the moment. Applying in trusses is one frequent way we can use this support.

Fixed support

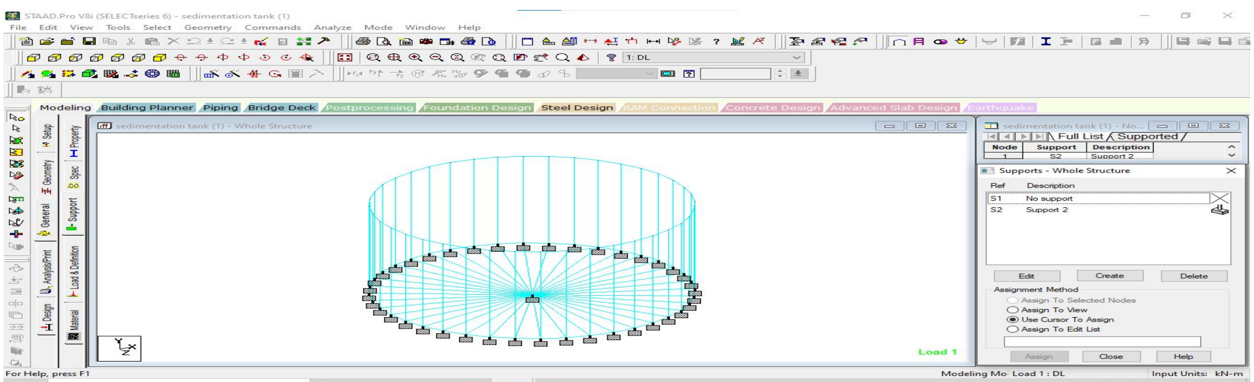
Rigid or fixed supports maintain the angular relationship between the joined elements and provide both force and moment resistance. It exerts forces acting in any direction and prevents all translational movements (horizontal and vertical) as well as all rotational movements of a member. These supports' reaction forces are horizontal and vertical components of a linear resultant; a moment. It is a rigid type of support or connection. The application of the fixed support is beneficial when we can only use single support, and people most widely used this type as the only support for a cantilever They are common in beam-to-column connections of moment-resisting steel frames and beam, column and slab connections in concrete frames.

Hanger support

A hanger support only exerts a force and prevents a member from acting or translating away in the direction of the hanger. However, this support cannot prevent translational movement in all directions and any rotational movement. This is one of the simplest structural forms in which the elements are in pure tension. Structures of this type range from simple guyed or stayed structures to large cable-supported bridge and roof systems.

Simple support

A simple support is basically where the structural member rests on an external structure as in two concrete blocks holding a resting plank of wood on their tops. This support is similar to roller support in a sense that restrains vertical forces but not horizontal forces. Therefore, it is not widely used in real life structures unless the engineer can be sure that the member will not translate.



LOADS ACTING:

Loads can usually be considered to be primary or secondary. Secondary loads are those loads due to temperature changes, construction eccentricities, shrinkage of structural materials, settlement of foundations, or other such loads. Despite the fact that each and every load and loading 14 combination should be considered in order to reduce the chance of structural failure, the determination of the loading remains a statistical exercise. Each and every load cannot be foreseen; thus, it is critical to determine the worst case that is reasonable to assume to act upon the structure. The sources of primary loading include the materials from which the structure was built, the occupants, their furniture, and various weather conditions, as well as unique loading conditions experienced during construction, extreme weather and natural catastrophes. Primary loads are divided into DEAD LOADS and LIVE LOADS. When considering the possible combinations of these two categories of loading, the odds of certain loads occurring simultaneously are assumed to be null.

The loads taken for analysis are dead load, live load, wind load and seismic load. Since the structure will be erected in zone-3, seismic design should also be done. The loading standards ensure structural safety and eliminate wastage that may be caused due to unnecessary heavy loading without proper assessment.

CALUCLATION:

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500 Persons

1 person ===> 100 lit/day

Volume(v) =500*100 = 5000000 lit

1cu.m = 1000lit

5000000*1/100

V =500 cu.m

Volume =2*3.14*r^2*3

For circular tank

Asumme height = 3m

500/(2*3.14*5) = r^2

r = 5.515 m.

V = 2*3.14*((5.20)^2)*3

V = 4999.87 m

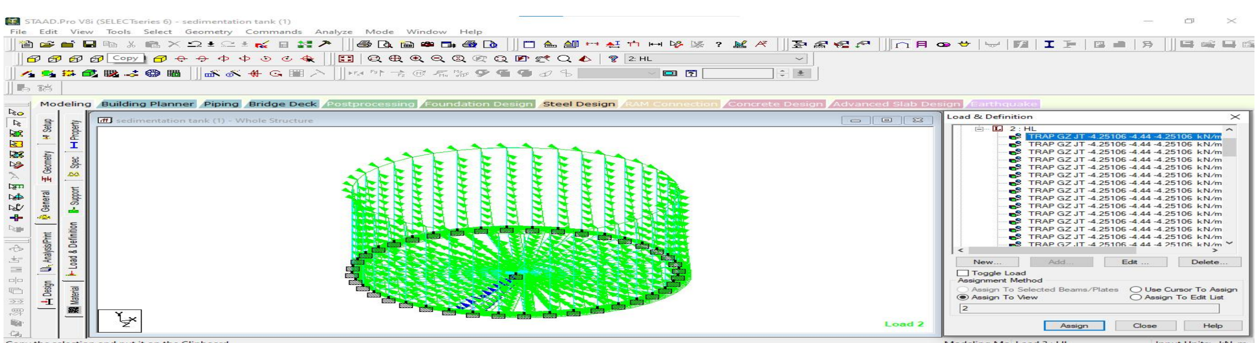
Since capacity is less than eq 1….

Assume radious r = (5.20)^2 *3

Volume(v) =509.43 cu.m

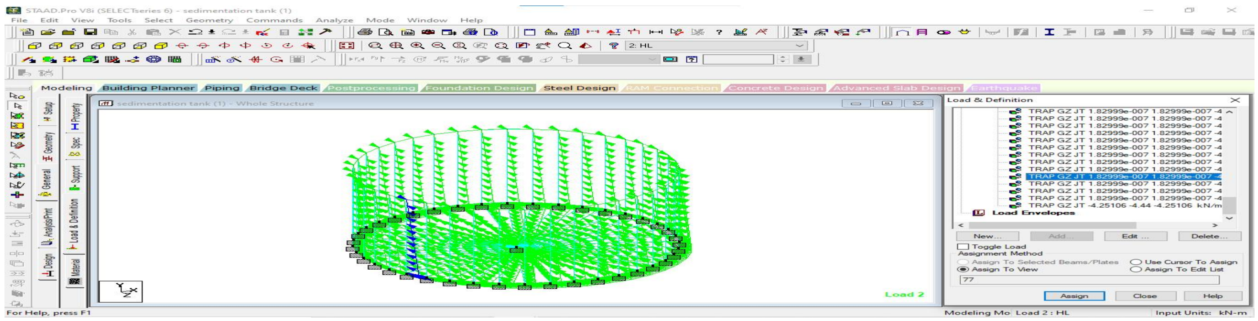
RadouS (r) =5.2m

DEAD LOADS :Dead Loads are those loads which are considered to act permanently; they are "dead," stationary, and unable to be removed. The self-weight of the structural members normally provides the largest portion of the dead load of a building. Permanent non-structural elements such as roofing, concrete, flooring, pipes, ducts, interior partition walls, Environmental Control Systems machinery, elevator machinery and all other construction systems within a building must also be included in the calculation of the total dead load.



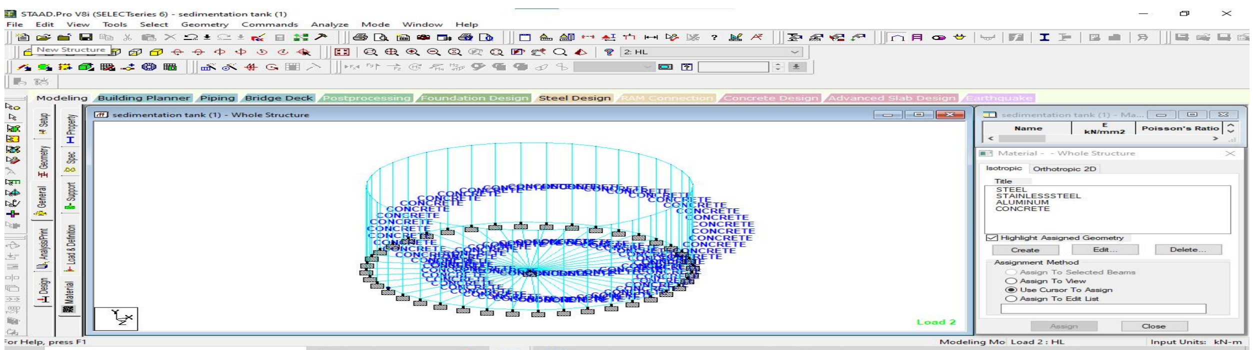
Hydraulic loads:

Hydraulic loading is defined in a wastewater treatment process unit as the volume of wastewater applied to the surface of the process unit per time period. It is often expressed in gallons per day per square foot (gpd/ft^2).

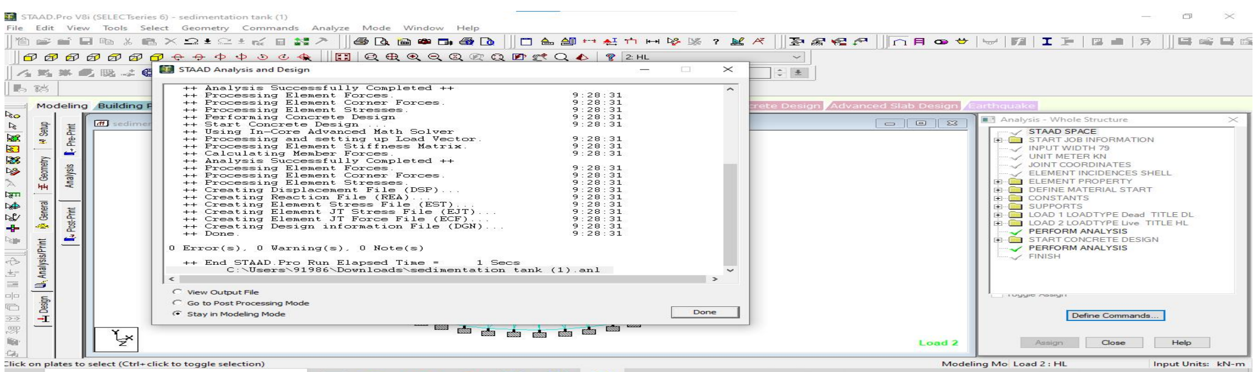


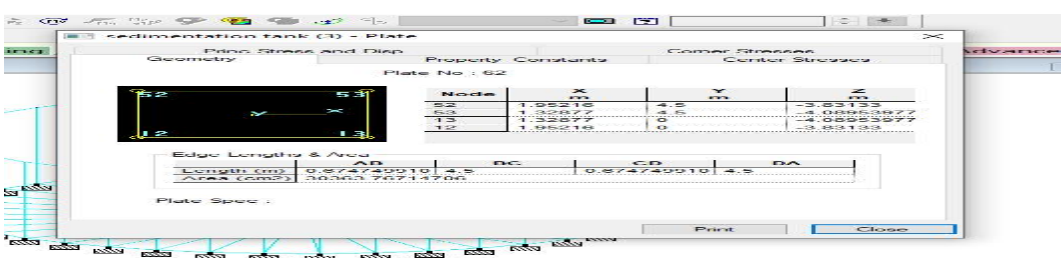
MATERIALS:

Assign the concrete materials for the structure, because of our structure is RRC STRUCTURE.

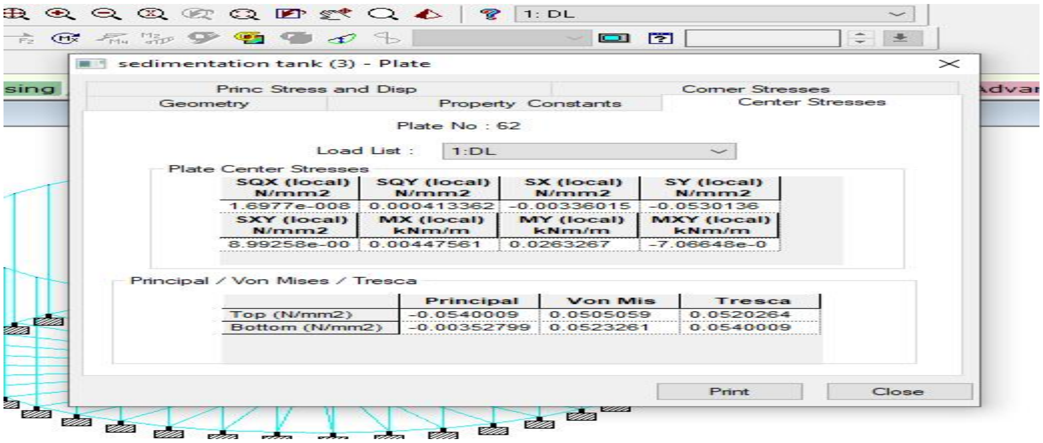


ANALYSIS/PRINT :





GEOMETRY OF PLATE NO 62



N

CENTERS STRESS ON PLATE NO 62

CORNER STRESS ON PLATE NO 62

Conclusion:

High turbidity water is a great challenge to water treatment works as it can be hard to remove. The pretreatment of high rate of turbidity water (>400 NTU) is a challenging issue that is touched upon in this study. A series of laboratory experiments are conducted to study the effect of height and position baffles on sedimentation tank performance. Results showed that turbidity removal is dependent on position and height the baffle and flow rate. As for the baffle spacing, a height of 14 cm from the bottom and 6 cm from inlet of the tank can be used for effective sedimentation. The highest turbidity removal efficiency with the optimized tank was 99.1% with the lowest at 95%. The results of the present show that sedimentation tank is feasible in pre-treating high turbid water for further treatment. The flow rate of 8 l/min was acceptable because it achieved lowest sedimentation turbidity. The quality of water treated using optimum position of baffle was well below the WHO guideline for drinking water of

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