

# **BINDER FOR OUTCOME "4"**

**“an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts”**

**COLLEGE OF ENGINEERING  
CIVIL ENGINEERING DEPARTMENT  
PRAIRIE VIEW A&M UNIVERSITY**

**BINDER CONTAINING REPRESENTATIVE  
ASSIGNMENTS FROM ALL COURSES USED TO  
ASSESS OUTCOME “4”**

**Academic Years 2019-2020, 2020-2021, 2021-2022**

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- 3. List of courses used to assess this outcome**
- 4. Summary Assessment Results and Continuous Improvements for outcome**
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  - CVEG 4053/4302 Transportation Engineering Design**
  - CVEG 4472/4200 Sr. Design & Professionalism I**
  - CVEG 4482/4201 Sr. Design & Professionalism II**
  - CVEG 4093/4304 Systems Engineering**
  - CVEG 2304 Global Development Issues (Beginning AY 2021-2022)**
  - CVEG 3102 Professional Engineering (Beginning AY 2021-2022)**



## 2. Description of Outcome "4" and its Performance Criteria

### Outcome 4:

*An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*

### Sub-Outcomes and Performance Criteria

4.1: Respond to ethical and professional needs in making informed judgments on the impact of engineering solutions

4.2: Consider the impact of engineering solutions in global, economic, environmental, and societal contexts

## 3. List of Courses Used to Assess the Outcome

Outcome 4 is assessed in the following courses:

CVEG 4053/4302 Transportation Engineering Design

CVEG 4472/4200 Sr. Design & Professionalism I

CVEG 4482/4201 Sr. Design & Professionalism II

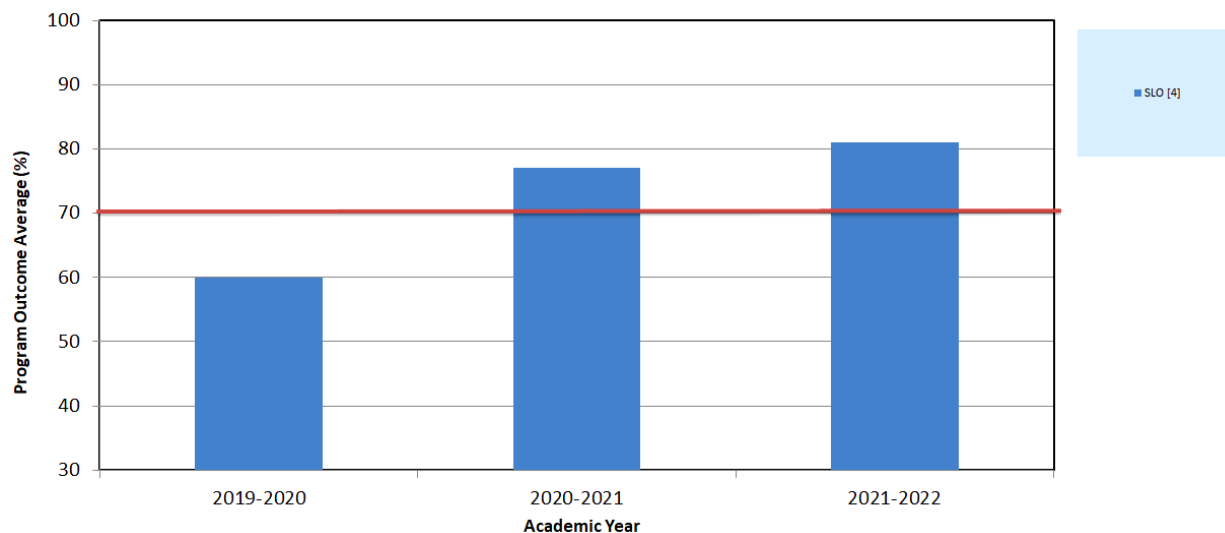
CVEG 4093/4304 Systems Engineering

CVEG 2304 Global Development Issues (Beginning AY 2021-2022)

CVEG 3102 Professional Engineering (Beginning AY 2021-2022)

## 4. Summary Assessment Results and Continuous Improvements for Outcome "4" over the Assessment Years.

The direct average performance for all students in the 6 courses used to assess outcome 4 for the past three academic years are shown below



## 5. Problems identified and recommended actions to be taken to address problems

### 1. At the course level

| Problems Identified in the Various Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Recommended Actions Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Basis for Action                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <p>1. In CVEG 4053, students experienced challenges in being able to design specific components to a real world transportation problem that require addressing public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.</p> <p>2. Most students did well in the ethical quiz in CVEG 4472 while a few were not able to comprehend meaning of terms and words in proper context which lowered their score.</p> <p>3. Students performed well in this area in CVEG 4482 though there is room for improvement. It is essential to continue the practice of informing students about this outcome and persist to give this section of the report greater attention.</p> <p>4. A video presentation of a Civil Engineering disaster was used in CVEG 4093 to drive home the ethical dimensions in engineering and the importance of making ethical decisions. More emphasis will need to be directed in the future to analyze ethical issues that arise in practice.</p> | <p>(1) Recommend exposing the students to more examples that focus on specific design components to a real world transportation problem involving aspects of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.</p> <p>(2) Introduction of ethics in lower level courses may work well and enhance student's overall understanding of case studies upper level course like CVEG 4472.</p> <p>(3) Continue to require a section of the final report in CVEG 4482 particularly address the environmental, societal and economic issues.</p> <p>(4) A paper assignment on ethics and professionalism in CVEG 4093 could improve students' understanding and appreciation of professional and ethical issues and will be explored.</p> | <p>To support continuous improvement and meet the Departmental target direct average of 70%</p> |

### 2. At Department Level

- (1) Faculty informed students of what ethics and professionalism mean in civil engineering.
- (2) Faculty engaged students in preparation and delivery of technical reports that support professional responsibilities in light of their engineering design solutions.
- (3) Faculty provided constructive feedback to the students on the impact of engineering solutions in global, economic and societal contexts.

#### Basis of Action:

To support continuous improvement and meet the Departmental target direct average of 70%

**6. Sample Assignments and Justification of suitability of assignment for measuring the outcome in the following courses:**

**CVEG 4053 Transportation Engineering Design**  
**CVEG 4472 Sr. Design & Professionalism I**  
**CVEG 4482 Sr. Design & Professionalism II**  
**CVEG 4093 Systems Engineering**

**OUTCOME “4” SPECIFIC ASSIGNMENTS  
USED TO ASSESS THE OUTCOME IN**

**CVEG 4053  
TRANSPORTATION ENGINEERING DESIGN**

**CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET  
CVEG 4053: TRANSPORTATION ENGINEERING DESIGN  
FALL 2019**

**Instructor: Dr. Judy A. Perkins**

**Title of Assignment**

**EXAMINATION #1**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor.

**Check the ethical dimensions related to this assignment**

| Requires students to |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|                      | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| X                    | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      | global context                                                                                                                                |
| x                    | economic context                                                                                                                              |
| x                    | and societal context.                                                                                                                         |

**Brief justification of why this assignment is suitable for this outcome**

Students have Examination questions to complete and having prior knowledge of an array of constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, there are required to make informed judgments that will consider the impact of an engineering solution in an economic and societal context.

# ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design

Fall 2019

Examination I

26 September 2019

Provide complete answers to each question or problem listed below in order to obtain full credit for your responses

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

## Term Project Parking Task

1. The Piedmont Authority for Regional Transportation (PART) is conducting a feasibility study regarding a Park-N-Ride Facility to be placed on the 40.6 acre site located at Highway 66 and Old Salem Road. The Site Plan must meet \_\_\_\_\_ Ordinances. (10-points)
2. Currently, there is a 75,000 square foot two-story concrete structure on the site that must be demolished and removed before any new construction can begin. For the demolition effort, what are **ALL** the requirements that **MUST** be addressed to complete the demolition effort? (10-points)

## Chapter 11 - The Transportation Planning Process

1. What does the acronym EIS stands for? To receive full credit for your response, the correct name for each letter of the acronym must be written. (5-points)
2. The urban transportation planning process is sometimes referred to as the "3C" process. Provide below the name of each of the 3Cs. To receive full credit for your response, the correct name must be written. (15-points)
  - a.
  - b.
  - c.

4. Select a current transportation problem in your community or state. Briefly define the situation and define the problem. Indicate options available and the major impacts of each option on the community or state. (20-points):

[illegible]

## Chapter 15 - Geometric Design of Highway Facilities

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

**Table 15.1** Minimum Design Speeds for Rural Collector Roads

| <i>Type of Terrain</i> | <i>Design Speed (mi/h) for Specified Design Volume (veh/day)</i> |                    |                  |
|------------------------|------------------------------------------------------------------|--------------------|------------------|
|                        | <i>0 to 400</i>                                                  | <i>400 to 2000</i> | <i>Over 2000</i> |
| Level                  | 40                                                               | 50                 | 60               |
| Rolling                | 30                                                               | 40                 | 50               |
| Mountainous            | 20                                                               | 30                 | 40               |

Note: Where practical, design speeds higher than those shown should be considered.

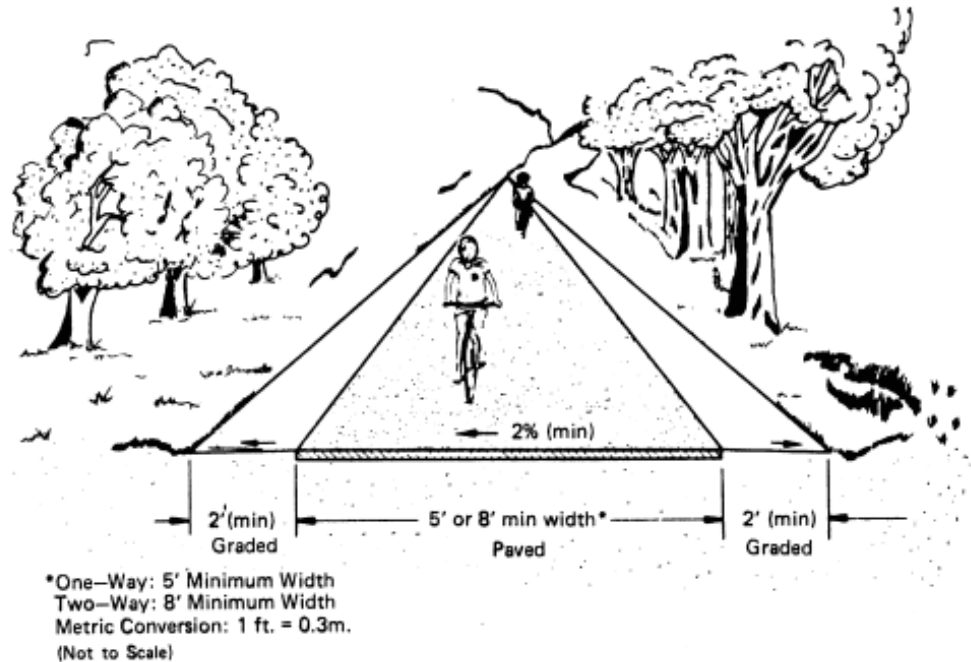
SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

**Place Answer Here** \_\_\_\_\_

2. What are two factors that influence highway design? (10-points)
  - a.
  - b.
3. As the number of large trucks increase it is pertinent to design roadway facilities with these trucks in mind. The two special roadway facilities for heavy vehicles are categorized as (1) Climbing Lanes and (2) Emergency Escape Ramps. Provide a brief description for each of the special roadway facilities listed below. (20-points)
  - a. Climbing Lanes
  - b. Emergency Escape Ramps



4. A typical layout for a bicycle path on a separate right-of-way is shown below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)



**Figure 15.30** Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a.
- b.
- c.
- d.

CVEG 4053 Transportation Engineering Design Course Syllabus

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the student learning outcomes for CVEG 4053-P01-Transportation Engineering Design course. (15-points):

**GRADING SCHEME FOR ASSIGNMENT**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**

**CVEG 4053 – Transportation Engineering Design**  
**Fall 2019**  
**Examination I - Solution**  
**26 September 2019**

Provide complete answers to each question or problem listed below in order to obtain full credit for your responses

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Term Project Parking Task

1. The Piedmont Authority for Regional Transportation (PART) is conducting a feasibility study regarding a Park-N-Ride Facility to be placed on the 40.6 acre site located at Highway 66 and Old Salem Road. The Site Plan must meet \_\_\_\_\_ Ordinances. (10-points)

**Winston-Salem Forsyth County's Unified Development Ordinances.**

2. Currently, there is a 75,000 square foot two-story concrete structure on the site that must be demolished and removed before any new construction can begin. For the demolition effort, what are **ALL** the requirements that **MUST** be addressed to complete the demolition effort? (10-points)

**(a) truck type used, (b) number of trucks, (c) location of dumping site, (d) transportation cost, and (e) total demolition cost.**

Chapter 11 - The Transportation Planning Process

1. Select a current transportation problem in your community or state. Briefly define the situation and define the problem. Indicate options available and the major impacts of each option on the community or state. (20-points):

**Open-Ended Response. Must address Situation Definition, Problem Definition, Options, and Impacts of Each Option on the community or state**

2. Using the steps of the transportation planning process and those from the Decision Process/Design Process/Problem Solving Model, identify which step(s) from both that are equivalent to one another. To receive full credit for each step identified, the correct name of the step must be written and the sequential order of the step must be correct. (20-points)

| Transportation Planning Process | Decision Process/Design Process/Problem Solving Model |
|---------------------------------|-------------------------------------------------------|
| Situation definition            | Recognition of Problem                                |
| Problem Definition              | Definition of the Goal(s) or Objective(s)             |
| Search for Solutions            | Assembly of Relevant Data                             |
| Analysis of Performance         | Identification of Feasible Alternatives               |
| Evaluation of Alternatives      | Selection of Criterion for Judging Alternatives       |
| Choice of Project               | Compare the Interrelationships                        |
| Specification and Construction  | Determine Outcomes of Alternatives                    |
| Provide/Seek Feedback           | Choose the Best Alternative                           |
|                                 | Provide/Seek Feedback                                 |

3. What does the acronym EIS stands for? To receive full credit for your response, the correct name for each letter of the acronym must be written. (5-points)

### Environmental Impact Statement

4. The urban transportation planning process is sometimes referred to as the "3C" process. Provide below the name of each of the 3Cs. To receive full credit for your response, the correct name must be written. (15-points)

- a. **Comprehensive**
- b. **Continuous**
- c. **Cooperative**

### Chapter 15 - Geometric Design of Highway Facilities

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

**Table 15.1** Minimum Design Speeds for Rural Collector Roads

| Type of Terrain | Design Speed (mi/h) for Specified Design Volume (veh/day) |             |           |
|-----------------|-----------------------------------------------------------|-------------|-----------|
|                 | 0 to 400                                                  | 400 to 2000 | Over 2000 |
| Level           | 40                                                        | 50          | 60        |
| Rolling         | 30                                                        | 40          | 50        |
| Mountainous     | 20                                                        | 30          | 40        |

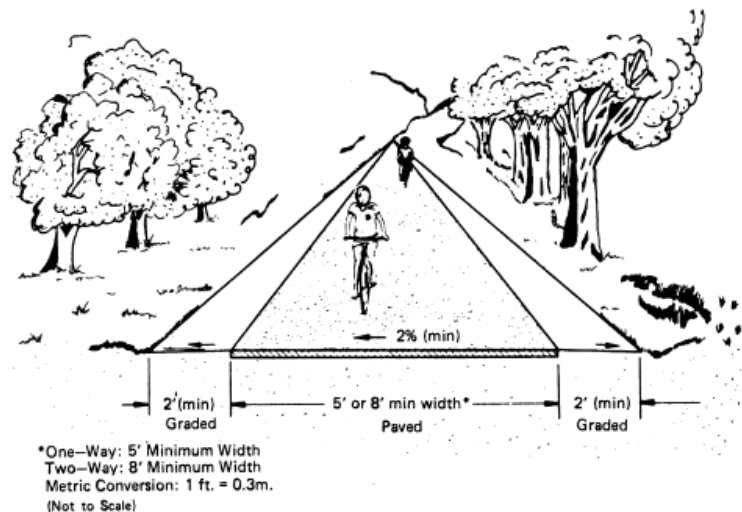
Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

### 40 mph

2. What are two factors that influence highway design? (10-points)  
Students should select any two factors from list below.
- Functional classification
  - Design hourly traffic volume and mix

- Design speed
  - Design vehicle
  - Cross section of the highways
  - Presence of heavy vehicles on steep grades
  - Topography of area
  - Level of service available funds
  - Safety
  - Social and environmental factors
3. As the number of large trucks increase it is pertinent to design facilities with these trucks in mind. The two special facilities for heavy vehicles are categorized as (1) Climbing Lanes and (2) Emergency Escape Ramps. Provide a brief description for each of the special facilities listed below. (20-points)
- a. **Climbing Lanes**
- Is an extra lane in the upgrade direction
  - Eliminates the need for light vehicles to reduce speed
- b. **Emergency Escape Ramps**
- Provided on the downgrade of a highway
  - Gives room for a truck that has lost control to regain control
4. A typical layout for a bicycle path on a separate right-of-way is shown below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below **ALL** of the conditions when the width for the two-way path may be 8-feet. (20-points)



**Figure 15.30** Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a. Low bicycle volumes at all times
- b. Vertical and horizontal alignments are properly designed to provide frequent safe passing conditions
- c. Only occasional use of path by pedestrians, and
- d. The absence of maintenance vehicles

CVEG 4053 Transportation Engineering Design Course Syllabus

1. The student learning outcomes for this course describes what the student will be able to do upon successful completion of the course. Provide below the student learning outcomes for this course. (15-points):

**Student Learning Outcomes:**

|          | Upon successful completion of this course, students will be able to<br>( <b>bold</b> letters in brackets correspond to ABET Criterion 3 measured in the course): | Program Learning Outcome # Alignment* | Core Curriculum Outcome Alignment |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| <b>1</b> | Be able to demonstrate the fundamentals of transportation engineering design ( <b>c</b> );                                                                       | ABET 3 ( <b>1, 3-5</b> )              |                                   |
| <b>2</b> | Be able to demonstrate their knowledge of contemporary issues ( <b>j</b> ); and                                                                                  | ABET 3 ( <b>1, 3-5</b> )              |                                   |
| <b>3</b> | Be able to demonstrate an understanding of multi-objective decision-making.                                                                                      | ABET 3 ( <b>3- 5</b> )                |                                   |

\* The Civil Engineering Program Learning Outcomes are derived from ABET Criterion 3 (Student Outcomes)

## SECTION-P01

Last Name (ONLY) Crittenden

Roster Number 5 ✓

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department  
CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination I  
26 September 2019

94  
150

Provide complete answers to each question or problem listed below in order to obtain full credit for your responses

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

### Term Project Parking Task

(X7) 1. The Piedmont Authority for Regional Transportation (PART) is conducting a feasibility study regarding a Park-N-Ride Facility to be placed on the 40.6 acre site located at Highway 66 and Old Salem Road. The Site Plan must meet Winston-Salem Forsyth Unified County Ordinance - Development - 1 (10-points)

(+10) 2. Currently, there is a 75,000 square foot two-story concrete structure on the site that must be demolished and removed before any new construction can begin. For the demolition effort, what are ALL the requirements that MUST be addressed to complete the demolition effort? (10-points)  
The number of trucks, type of truck, location of dumping site, Transportation cost & total cost of demolition

### Chapter 11 - The Transportation Planning Process

(+5) 1. What does the acronym EIS stand for? To receive full credit for your response, the correct name for each letter of the acronym must be written. (5-points)

Environmental Impact Statement

(+13) 2. The urban transportation planning process is sometimes referred to as the "3C" process. Provide below the name of each of the 3Cs. To receive full credit for your response, the correct name must be written. (15-points)

- a. Cooperative ✓
- b. Continue Spelling incorrect - 2 ✓
- c. Comprehensive ✓

35  
1000

Last Name (ONLY) C. Hender

Roster Number 5

3. Using the steps of the transportation planning process and those from the Decision Process/Design Process/Problem Solving Model, identify which step(s) from both list that are equivalent to one another. Use the table below to insert your response. Ensure that you properly align the steps that are equivalent to one another. To receive full credit for each step identified, the correct name of the step must be written and the sequential order of the step must be correct. (20-points)

| Transportation Planning Process | Decision Process/Design Process/Problem Solving Model |
|---------------------------------|-------------------------------------------------------|
| Situation Definition            | Problem X                                             |
| Problem Definition              | Define objectives or Goals ✓                          |
| Search for solution             | Propose solutions X                                   |
| Analysis ?                      | Analyse proposed solution X                           |
| Evaluate ?                      | Evaluate proposed solution X                          |
| Choose Project                  | Choose an Alternative X                               |
| Specifications ?                | Design Alternative X                                  |
| Feed back                       | Feed back ✓                                           |
|                                 | - 2 orders incorrect                                  |

- 2 order incorrect

④

Last Name (ONLY) Criffield

Roster Number 5

4. Select a current transportation problem in your community or state. Briefly define the situation and define the problem. Indicate options available and the major impacts of each option on the community or state. (20-points):

Situation - Only two way on & off campus with the number of vehicle & student increasing every year. causing build up of cars on campus

Problem define - Reduce the amount of time it take to get off campus

- Options - 1) open up the back way by phase 3  
2) create an exit somewhere else on campus  
3) do a park n ride off campus  
4) lower the amount of student allowed to drive

- Impact
- 1) will allow student to get on & off campus faster when heading to brookside & that area. will cost the city money to build bridge to reopen
  - 2) Cost of construct & the decision of where could cause stir in student, where shall the entrance be located how much will it cost who's paying for it. increase in tuition
  - 3) Environmentally a lot of concrete, & could get negative feedback from the community. will increase tuition
  - 4) will cause immediate student intervention, disturb the social climate. Require better shuttle, decision on how to choose who gets what.



Last Name (ONLY) C. Hender

Roster Number 5

**Chapter 15 - Geometric Design of Highway Facilities**

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

**Table 15.1** Minimum Design Speeds for Rural Collector Roads

| Type of Terrain    | Design Speed (mi/h) for Specified Design Volume (veh/day) |             |           |
|--------------------|-----------------------------------------------------------|-------------|-----------|
|                    | 0 to 400                                                  | 400 to 2000 | Over 2000 |
| Level              | 40                                                        | 50          | 60        |
| Rolling            | 30                                                        | 40          | 50        |
| <u>Mountainous</u> | 20                                                        | 30          | <u>40</u> |

Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From A Policy on Geometric Design of Highways and Streets, 2004, AASHTO, Washington, D.C. Used by permission.

Place Answer Here 40 mi/hr ✓

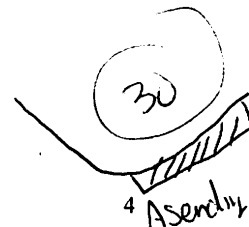
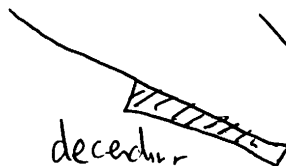
2. What are two factors that influence highway design? (10-points)

- a. Design speed ✓  
b. Design Vehicle ✓

3. As the number of large trucks increase it is pertinent to design roadway facilities with these trucks in mind. The two special roadway facilities for heavy vehicles are categorized as (1) Climbing Lanes and (2) Emergency Escape Ramps. Provide a brief description for each of the special roadway facilities listed below. (20-points)

- a. Climbing Lanes  
are extra lanes to help large vehicles regain control like an emergency shoulder ~~but for~~ -5 direction of grade

- b. Emergency Escape Ramps  
are ramps that help vehicle regain control. can be sand pile, or ascending slope, horizontal slope or descending slope



Last Name (ONLY) C. Hender

Roster Number 5

4. A typical layout for a bicycle path on a separate right-of-way is shown below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)

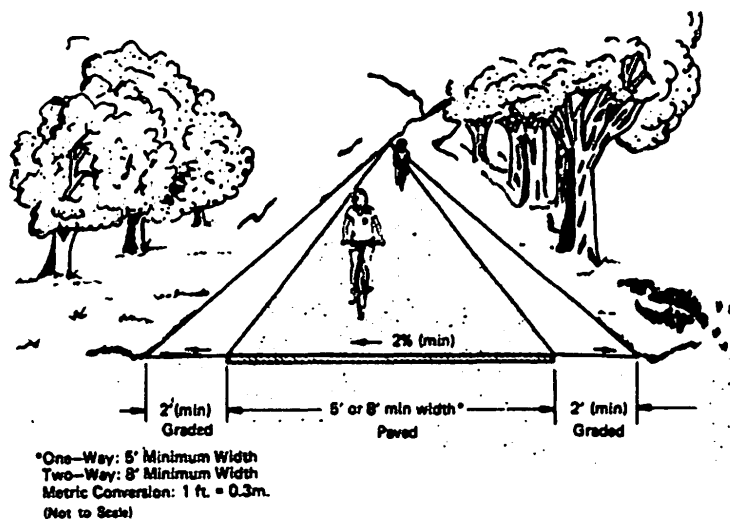


Figure 15.30 Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a. if there is low traffic volume always! +5
- b. If pedestrians use the path as well not fully completed
- c. if design speed is ~~20~~ 20 mi/h. x
- d. if path is paved x

5

Last Name (ONLY) C. Hender

Roster Number 5

**CVEG 4053 Transportation Engineering Design Course Syllabus**

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the student learning outcomes for CVEG 4053-P01-Transportation Engineering Design course. (15-points):

To have the ability to recognize ethical & professional responsibilities in engineering situation, & make informed judgements.

Must also be able to consider the impact on their solution to the globe, environment, ~~Society~~ Society & financially.

we cover ABET criteria 1, 3, 4, & 5

& Student learning outcomes 1, 2, & 3

what are they?

5

## SECTION-P02

Last Name (ONLY) ZIDA

Roster Number 19

**Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department**

**CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination I  
24 September 2019**

140 EXCELLENT  
150 JOB!

**Provide complete answers to each question or problem listed below in order to obtain full credit for your responses**

(Measure Outcome "4" - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts)

### **Chapter 11 - The Transportation Planning Process**

1. Transportation planning serves as the foundation to implementing two other key areas of the transportation specialty and they are as following (10-points):

(+5) Design and construction  
X

2. What are the basic elements of the transportation planning process? To receive full credit for any element you list, the sequential order of that element must be correct. (20-points)

(+20)

- Situation Definition ✓
- Problem Definition ✓
- Search for solutions ✓
- Analysis of Performance ✓
- Evaluation of Alternatives ✓
- Choice of Project ✓
- Specification and construction ✓
- Provide / seek feedback ✓

25

- (+20) 3. There is a common approach to forecast future travel demand. List the components to the common approach, briefly describe each component of the common approach, and list the traffic volume(s) that is produced by the components of the common approach. (20-points)
- Population and economic analysis which evaluates the need of facilities and available funds.
  - land use analysis which determines where the facilities will be located
  - Trip generation which determines the number of trips
  - Trip distribution which determines the origin and destination of the trips
  - Modal split: which determines the main mode of transportation
  - Traffic Assignment which determines the route to minimize the travel time
- Annual forecast Daily Traffic (ADT) and Average Daily Traffic (ADT) are produced by the components of the common approach.
4. In regards to the physical design of transportation facilities, provide responses to the following questions. (20-points)

- (+20)
- What is the meaning of Design - Design refers to the more detailed and concrete part of the process
  - What are the main elements to the Overall Design Process - open-ended, interactive and coordinated process of gathering information and decision making

#### Chapter 15 - Geometric Design of Highway Facilities

1. Bicycles are a viable alternative mode of transportation popular in what two areas? (10-points)

- (+15)
- urban area ✓
  - rural area ✗

2. What are two factors that influence highway design? (10-points)

- (+10)
- design speed ✓
  - design vehicle ✓

Last Name (ONLY) ZIDA

Roster Number 19

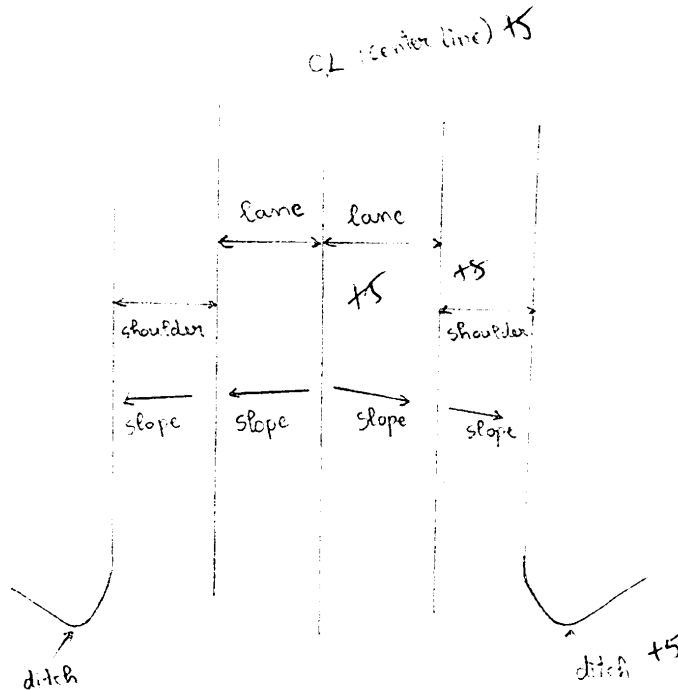
3. Highways are classified in terms of their service. List below the functional classification hierarchy of the highway system in the order of limited local traffic and combined with complete access control. (20-points)

- Highway / interstate ✓
- Arterials (major and minor arterials) ✓
- Collectors (major and minor collectors) ✓
- Local roads and streets ✓

(+20)

4. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Be sure to properly label all aspects of your cross-sectional illustration? (20-points)

(+20)



cross-section of a two-lane highway

(40)

Last Name (ONLY) ZIDA

Roster Number 19

**Term Project Parking Task**

(+20)

1. What agency is conducting a feasibility study regarding the Rest Area Facility your group is required to create a 2D conceptual layout design of the overall Rest Area Facility as well as the detailed parking design for the facility in order to capture major features and functions that will need to be articulated to meet design specifications. (10-points)

North Carolina Department of Transportation (NCDOT) ✓

2. What is the size (in acres) of the site that your Rest Area Facility will be located on? (10-points)

The site size is 40.6 acres. ✓

(10)

## SECTION-P01

Last Name (ONLY) Ridgley

Roster Number 19

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department  
CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination I  
26 September 2019

50  
150

Provide complete answers to each question or problem listed below in order to obtain full credit for your responses

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

### Term Project Parking Task

1. The Piedmont Authority for Regional Transportation (PART) is conducting a feasibility study regarding a Park-N-Ride Facility to be placed on the 40.6 acre site located at Highway 66 and Old Salem Road. The Site Plan must meet Winston Salem Forsyth County's Unified Ordinances. (10-points)

Development -1

2. Currently, there is a 75,000 square foot two-story concrete structure on the site that must be demolished and removed before any new construction can begin. For the demolition effort, what are ALL the requirements that MUST be addressed to complete the demolition effort? (10-points)

The requirements that must be addressed to complete the demolition efforts are identifying the type of dump truck, the location of the dump site, the cost, and the haul capacity of the truck. +2

? total demolition or transportation

### Chapter 11 - The Transportation Planning Process

1. What does the acronym EIS stand for? To receive full credit for your response, the correct name for each letter of the acronym must be written. (5-points)

X

2. The urban transportation planning process is sometimes referred to as the "3C" process. Provide below the name of each of the 3Cs. To receive full credit for your response, the correct name must be written. (15-points)

X a. The First "C" is CO

✓ b. the second "C" is C

X c. The third "C" is C

13



Last Name (ONLY) Ridgley

Roster Number 19

3. Using the steps of the transportation planning process and those from the Decision Process/Design Process/Problem Solving Model, identify which step(s) from both list that are equivalent to one another. Use the table below to insert your response. Ensure that you properly align the steps that are equivalent to one another. To receive full credit for each step identified, the correct name of the step must be written and the sequential order of the step must be correct. (20-points)

[illegible]

5

Last Name (ONLY) Ridgley

Roster Number 19

4. Select a current transportation problem in your community or state. Briefly define the situation and define the problem. Indicate options available and the major impacts of each option on the community or state. (20-points):

A current transportation problem in my community or state was broadcasted by a group from Texas A&M where they discovered that Houston Traffic is in the top ranked cities in the U.S. with the worst traffic. Individuals have wasted a lot of hours, milages on cars as well as gas just waiting in traffic. The problem is that Houston's population is growing very fast and the need for road expansions and etc. is needed as well to accomodate the rapid population growth. There are options available such as toll roads, which are very helping to people due to them not having to wait in extensive traffic. Though, I feel that Houston should think of solutions to expand/build more roadways and freeways that will accomodate the rapid population growth.

Impact on community. 

(20)

Last Name (ONLY) Ridgley

Roster Number 19

**Chapter 15 - Geometric Design of Highway Facilities**

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

(7)  
X5

**Table 15.1 Minimum Design Speeds for Rural Collector Roads**

| Type of Terrain | Design Speed (mi/h) for Specified Design Volume (veh/day) |             |           |
|-----------------|-----------------------------------------------------------|-------------|-----------|
|                 | 0 to 400                                                  | 400 to 2000 | Over 2000 |
| Level           | 40                                                        | 50          | 60        |
| Rolling         | 30                                                        | 40          | 50        |
| Mountainous     | 20                                                        | 30          | 40        |

Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

Place Answer Here 40 mi/h ✓

2. What are two factors that influence highway design? (10-points)

(10)  
+10

- a. one factor that influences highway design are the type of vehicles that will be driving on that road. (cars, 18-wheelers, etc)  
b. one factor that can influence highway design are the weather conditions. Thinking outside the box. Good idea

3. As the number of large trucks increase it is pertinent to design roadway facilities with these trucks in mind. The two special roadway facilities for heavy vehicles are categorized as (1) Climbing Lanes and (2) Emergency Escape Ramps. Provide a brief description for each of the special roadway facilities listed below. (20-points)

(20)  
+20

- a. Climbing Lanes - climbing ~~vehicles~~ <sup>lanes</sup> are for heavy vehicles to go up so the incline of the grade will slow them down.  
b. Emergency Escape Ramps - emergency escape ramps are for heavy vehicles to exit due to them about to lose control. ✓

(35)  
35

Last Name (ONLY)

Ridgley

Roster Number 19

4. A typical layout for a bicycle path on a separate right-of-way is shown below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)

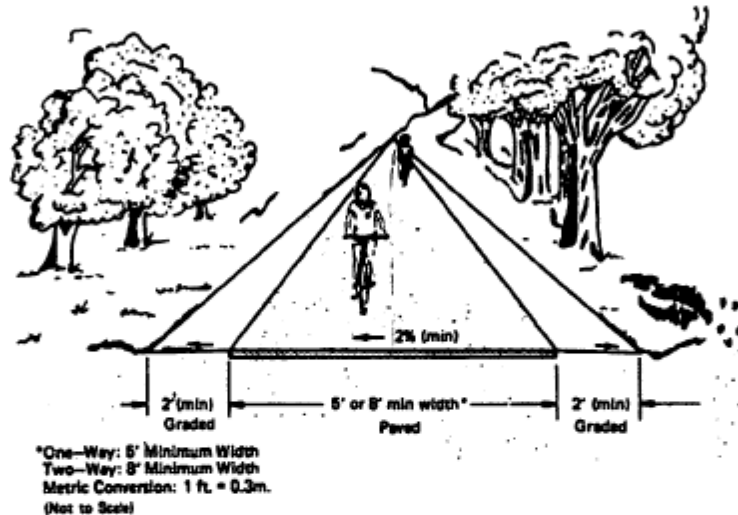


Figure 15.30 Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- The width may be 8 feet because there is no median to separate the two bike lanes.
- The width may be 8 feet because there is no curbs on the bike lanes.
- The width may be 8 feet due to the percent of the grade.
- 



Last Name (ONLY) Ridgley

Roster Number 19

**CVEG 4053 Transportation Engineering Design Course Syllabus**

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the student learning outcomes for CVEG 4053-P01-Transportation Engineering Design course. (15-points):

- X → horizontal alignment
- vertical alignment
- exposure to various softwares
- 
- 
- 



## SECTION-P02

Last Name (ONLY) Walker

Roster Number 17

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design  
Fall 2019

Examination I  
24 September 2019

30  
150

Provide complete answers to each question or problem listed below in order to obtain full credit for your responses

(Measure Outcome "4" - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts)

### Chapter 11 - The Transportation Planning Process

1. Transportation planning serves as the foundation to implementing two other key areas of the transportation specialty and they are as following (10-points):

(10)

Design  
operations

2. What are the basic elements of the transportation planning process? To receive full credit for any element you list, the sequential order of that element must be correct. (20-points)

~~1. Analysis of current travel patterns~~  
+ Forecast future travel patterns  
- Propose transportation infrastructure  
- Evaluation of the proposed alternative project

~~- Saturation Recognition  
- Problem Definition  
- Search of solutions  
- Analysis of performance  
- Choice of project  
- Specification and construction  
- Evaluation of alternatives  
- Provide service for project~~

(10)

Last Name (ONLY) \_\_\_\_\_

Roster Number \_\_\_\_\_

3. There is a common approach to forecast future travel demand. List the components to the common approach, briefly describe each component of the common approach, and list the traffic volume(s) that is produced by the components of the common approach. (20-points)

✓ Data Collection  
✓ Analysis of existing condition  
✓ Forecast of future demands

4. In regards to the physical design of transportation facilities, provide responses to the following questions. (20-points)

a. What is the meaning of Design -

✓ finding out the dimensions of a structural member and other materials.

b. What are the main elements to the Overall Design Process -

✓ Provide and seek feedback  
Evaluation of alternative

Chapter 15 - Geometric Design of Highway Facilities

1. Bicycles are a viable alternative mode of transportation popular in what two areas? (10-points)

a. Urban

b. Rural

2. What are two factors that influence highway design? (10-points)

a.

b.

~~Annual average daily traffic~~ AADT (Annual average daily traffic)  
~~Annual average daily traffic~~ ADT (Average daily traffic)  
DHTV

(10)

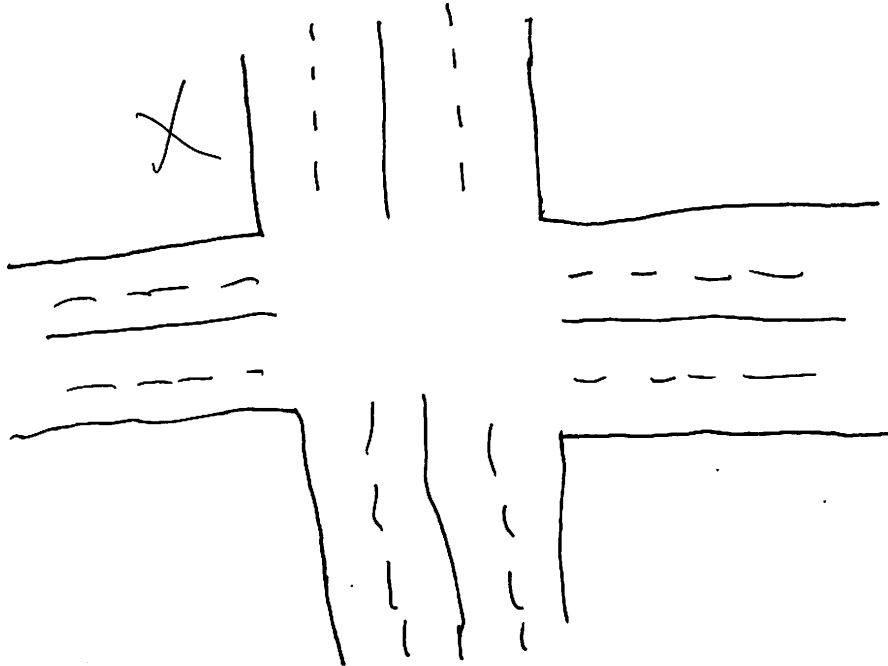
Last Name (ONLY) \_\_\_\_\_

Roster Number \_\_\_\_\_

3. Highways are classified in terms of their service. List below the functional classification hierarchy of the highway system in the order of limited local traffic and combined with complete access control. (20-points)

X

4. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Be sure to properly label all aspects of your cross-sectional illustration? (20-points)





Last Name (ONLY) \_\_\_\_\_

Roster Number \_\_\_\_\_

**Term Project Parking Task**

1. What agency is conducting a feasibility study regarding the Rest Area Facility your group is required to create a 2D conceptual layout design of the overall Rest Area Facility as well as the detailed parking design for the facility in order to capture major features and functions that will need to be articulated to meet design specifications. (10-points)

(+10)

✓ North Carolina Department of Transportation

2. What is the size (in acres) of the site that your Rest Area Facility will be located on? (10-points)

411.6 acres

(10)

**CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET  
CVEG 4053: TRANSPORTATION ENGINEERING DESIGN  
FALL 2019**

**Instructor: Dr. Judy A. Perkins**

**Title of Assignment**

**EXAMINATION #2 – BONUS QUESTIONS**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

| Requires students to |   |                                                                                                                                               |
|----------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>X</b>             |   | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| <b>X</b>             |   | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      |   | global context                                                                                                                                |
|                      | x | economic context                                                                                                                              |
|                      | x | and societal context.                                                                                                                         |

**Brief justification of the suitability of assignment for the outcome**

Responding to the Examination questions allows the student to apply their knowledge of traffic characteristics in order to recognize ethical and professional responsibilities in an engineering situations and make an informed judgment that will consider the impact of the engineering solution in an economic and societal context.

**ASSIGNMENT STATEMENT/QUESTIONS**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**

**CVEG 4053 – Transportation Engineering Design**  
**Fall 2019**  
**Examination II**  
**22 October 2019**

**Instructions:** Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (10-points)
2. A horizontal curve with a 1000 feet radius is to be provided for two perpendicular roads. The station of the PI is 12+00. Determine the angle of intersection, degree of curvature, tangent distance, external distance, middle ordinate, length of curve, station of PC, and station of PT. **(45-points)**. (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)

Project Scope of Work - Task 3 - Vertical Alignment

1. When evaluating symmetrical vertical crest or sag curves, provide the curve location(s) for which the offset values are the same. (10-points)

Project Scope of Work - Task 6 - Cross-Sectional Sketch

1. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Be sure to properly label all aspects of your cross-sectional illustration? (20-points)

COGO Software

1. What is the meaning of the “04” command/code? (5-points)
2. Which command/code computes the high point of a crest curve? (5-points)

3. Command/code “13” provides you with the distance between any two points as well as the bearing between those same two points. Define bearing and provide an example of a bearing of a line. Ensure that you use the standard notation when providing your example of a line bearing. (10-points)
4. What is the meaning of the “02” command/code? (5-points)
5. What is the meaning of the “50” command/code? (5-points)
6. Which is the meaning of the “10” command/code? (5-points)
7. Which is the meaning of the “70” command/code? (5-points)

YARD (Plus) Software

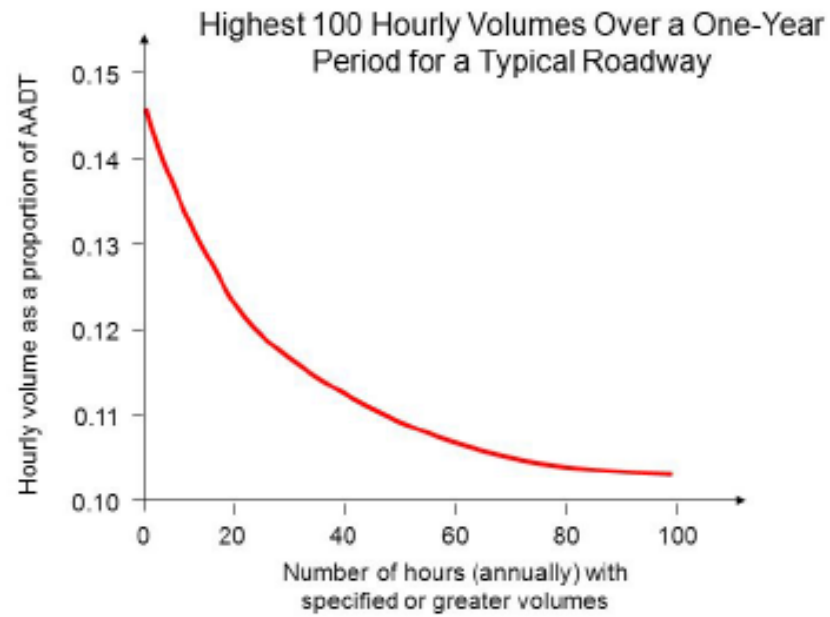
1. What is the format for entering the shrinkage/swell factor into the Yard (Plus) software? (5-points)
2. What two types of elevations must be obtained for each station and then entered into the Yard (Plus) software? (10-points)
  - a.
  - b.
3. If you was given a 8.5% swell factor, how would this be entered into the Yard (Plus) software? (5-points)
4. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)

**BONUS - The response must be completely correct in order to receive FULL credit.**

Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the “knee” of the curve? (5-points)
2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points)

## Typical Graph



**GRADING SCHEME FOR ASSIGNMENT**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**

**CVEG 4053 – Transportation Engineering Design**  
**Fall 2019**  
**Examination II - Solution**  
**22 October 2019**

**Instructions:** Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (15-points)

**Use a protractor to measure the angle between the two intersecting tangents drawn to create the point of intersection (PI).**

2. A horizontal curve with a 1000 feet radius is to be provided for two perpendicular roads. The station of the PI is 12+00. Determine the angle of intersection, degree of curvature, tangent distance, external distance, middle ordinate, length of curve, station of PC, and station of PT. **(45-points)**. (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)

**Determine the following:**

- a. Intersection of Angle

Since the roads are perpendicular, the Angle of Intersection is 90°.

- b. Degree of Curve

$$\text{The Degree of Curve} = \frac{5729.58}{R}$$

$R = 1000$  ft. Therefore,

$$D = \frac{5729.58}{1000} = 5.73^\circ$$

c. Tangent Distance

The Tangent Distance is

$$T = R \tan(I/2)$$

$I = 90^\circ$  (from question 1). Therefore,

$$T = (1000) \tan(90/2) = 1000.00 \text{ ft}$$

d. External Distance

The External Distance is

$$\begin{aligned} E &= R[(\sec I/2) - 1] \\ &= 1000[1.41421 - 1] = 414.21 \text{ ft} \end{aligned}$$

e. Middle Ordinate

The length of the Middle Ordinate is

$$M = R - R \cos \frac{I}{2}$$

$$R = 1000.00$$

$$I = 90^\circ$$

$$\text{Therefore: } M = 292.89 \text{ ft}$$

f. Length of Curve

The Length of Curve is

$$\begin{aligned} L &= \frac{100I}{D} \\ &= \frac{100(90)}{5.72958} = 1570.80 \text{ ft} \end{aligned}$$

g. Station of the PC

Station of  $PC$  = station of  $PI$  – Tangent Distance:

$$PC = 12+00.00 - 1000.00 = 2+00.00$$

h. Station of the PT

Station of  $PT$  equals station of  $PC$  plus Length of Curve:

$$\begin{aligned} PT &= PC + L \\ &= 2+00.00 + 1570.80 \\ &= 17+70.80 \end{aligned}$$

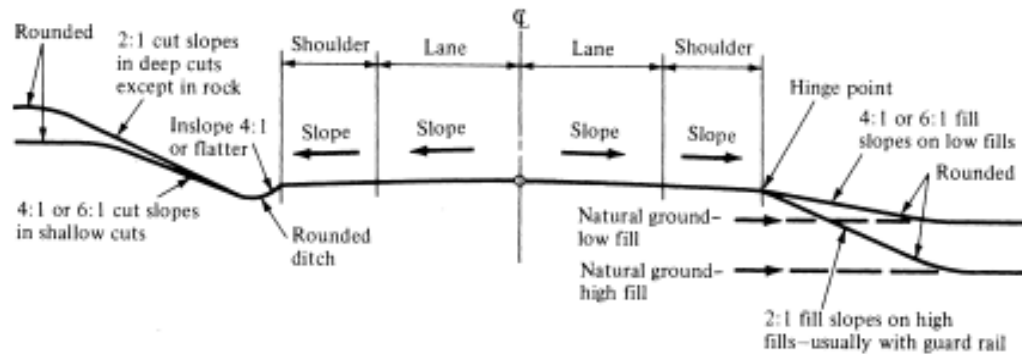
### Project Scope of Work - Task 3 - Vertical Alignment

1. When evaluating symmetrical vertical crest or sag curves, provide the curve location(s) for which the offset values are the same. (10-points)

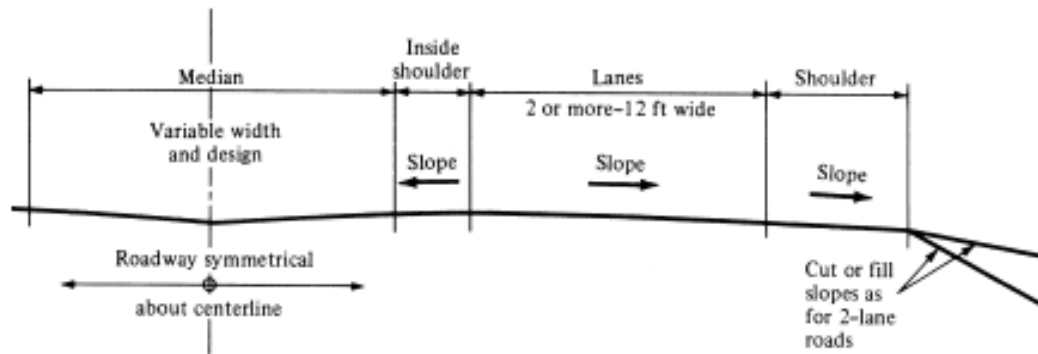
### **PVC and PVT or VPC and VPT**

### Project Scope of Work - Task 6 - Cross-Sectional Sketch

1. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Be sure to properly label all aspects of your cross-sectional illustration? (20-points)



**Figure 15.4** Typical Cross Section for Two-Lane Highways



**Figure 15.5** Typical Cross Section for Multilane Highways (half section)

### COGO Software

1. What is the meaning of the “04” command/code? (5-points)

### **End of Run**

2. Which command/code computes the high point of a crest curve? (5-points)



3. Command/code “13” provides you with the distance between any two points as well as the bearing between those same two points. Define bearing and provide an example of a bearing of a line. Ensure that you use the standard notation when providing your example of a line bearing. (10-points)

**Designate direction of a line as well as angle between two intersecting tangents (e.g., lines). Examples are S 35° E; N 30° W; S 55° W; or N 70° E**

**or**

**A bearing is the clockwise or counterclockwise angle between north or south and a direction. For example, bearings are recorded as N57°E, S51°E, S21°W, N87°W, or N15°W.**

4. What is the meaning of the “02” command/code? (5-points)

**Insert text**

5. What is the meaning of the “50” command/code? (5-points)

**Horizontal Alignment**

6. Which is the meaning of the “10” command/code? (5-points)

**Last point number on the horizontal alignment**

7. Which is the meaning of the “70” command/code? (5-points)

**Vertical Alignment**

**YARD (Plus) Software**

5. What is the format for entering the shrinkage/swell factor into the Yard (Plus) software? (5-points)

**The shrinkage/swell factor is entered as a percentage**

6. What two types of elevations must be obtained for each station and then entered into the Yard (Plus) software? (10-points)

**c. Existing Ground Elevations**

**d. Proposed Profile Elevations**

7. If you was given a 8.5% swell factor, how would this be entered into the Yard (Plus) software? (5-points)

**-8.5**

8. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)

**Integer value (no decimal point)**

**BONUS - The response must be completely correct in order to receive FULL credit.**

Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

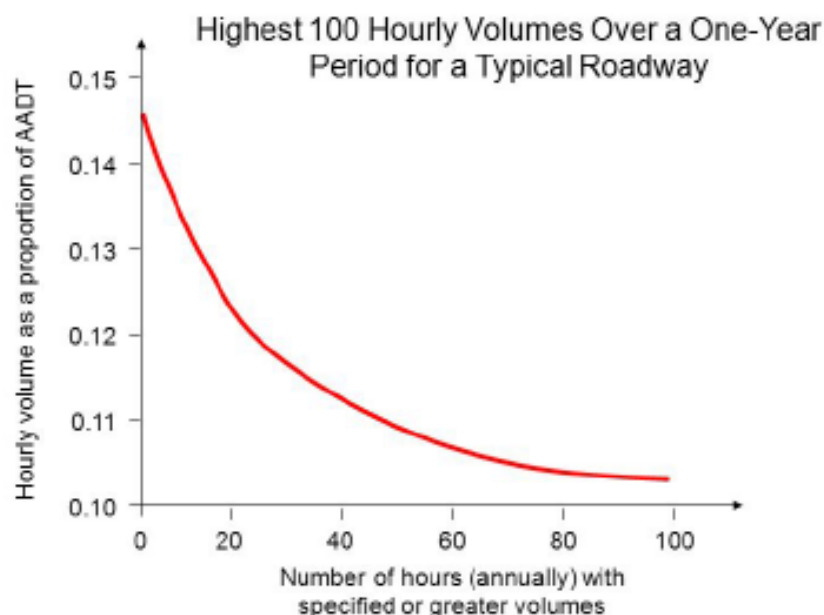
1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the “knee” of the curve? (5-points)

**30th Highest Hourly Volume**

2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points)

**~ 0.12**

## Typical Graph



# SECTION-P01

Last Name (ONLY) Crittenden

Roster Number 5

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination II  
22 October 2019

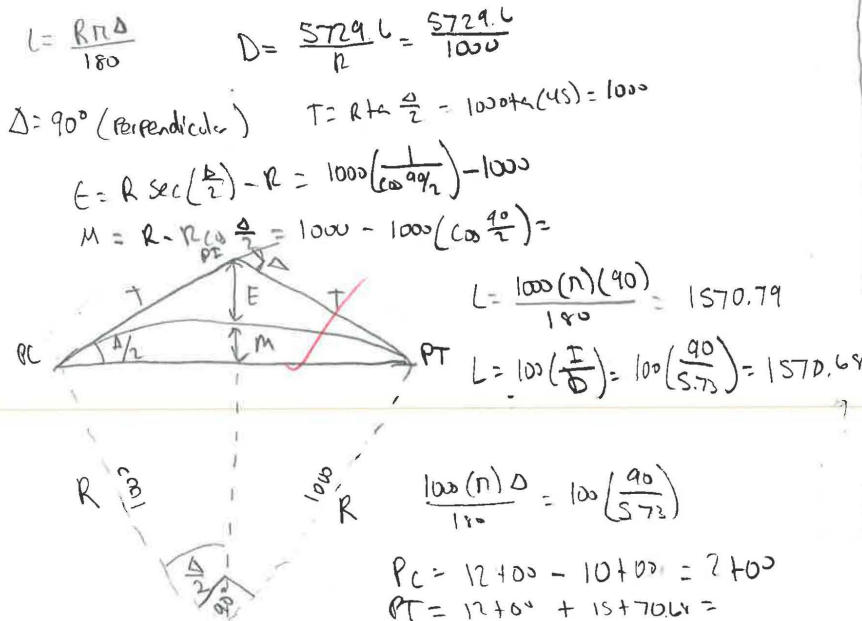
140  
150

Instructions: Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

## Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (10-points) *to get our central angle first we measured with a protractor. And we also we organized the tangent equation from  $T = R \tan \frac{\Delta}{2}$  to  $\Delta = \tan^{-1}(\frac{T}{R}) \cdot 2$  since we could measure R & T directly from the map*
2. A horizontal curve with a 1000 feet radius is to be provided for two perpendicular roads. The station of the PI is 12+00. Determine the angle of intersection, degree of curvature, tangent distance, external distance, middle ordinate, length of curve, station of PC, and station of PT. (45-points). (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)



$\Delta = 5.73^\circ$  or  $5^\circ 43' 48''$   
 $T = 1000 \text{ ft}$  ✓  
 $E = 414.23 \text{ ft}$  ✓  
 $M = 292.89 \text{ ft}$  ✓  
 $L = 1570.69 \text{ ft}$  ✓  
 $PC = 2+00$  ✓  
 $PT = 27+70.69$  ✓  
 $I = 90^\circ (\Delta)$  ✓

50 1

Last Name (ONLY) C. Hender

Roster Number 5

- ✗ If you was given a 8.5% swell factor, how would this be entered into the Yard (Plus) software? (5-points)

✓ -8.5

4. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)

✓ Must be integer

Interval of whole numbers no partial stations or decimals

**BONUS** - The response must be completely correct in order to receive FULL credit.

Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

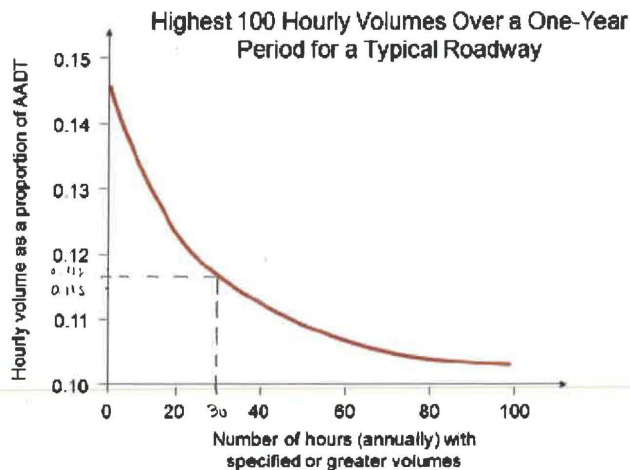
1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the "knee" of the curve? (5-points)

30<sup>th</sup> hour ✓

2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points)

0.117 ✓

## Typical Graph



20

# SECTION-P02

Zida, 19

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination II  
22 October 2019

stat<sup>o</sup> elevat<sup>o</sup>  
VPC 4600  
VPI 5300  
VPT 5400

125.9  
150

Instructions: Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

## Project Scope of Work - Task 2 - Horizontal Alignment

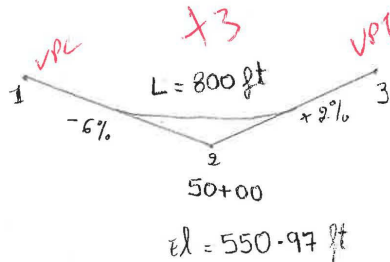
- Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (10-points)  
The central angle of our horizontal curves was obtained by laying out the tangents of the road and where the back tangent and the forward tangent meet, we used a protractor to measure the angle.

## Project Scope of Work - Task 3 - Vertical Alignment

- When evaluating symmetrical vertical crest or sag curves, provide the curve location(s) for which the offset values are the same. (10-points)

The offset values are the same at the VPC and VPT locations.

- For the two grade lines  $g_1 = -6\%$  and  $g_2 = +2\%$  that intersect at station 50+00, it has an elevation of 550.97 feet. The length of curve is 800 feet. Compute the stations and elevations of the VPC, VPI, VPT, and all points along the curve (i.e., use a 200-foot interval). Display your response in a table format and for this problem, you do not need to block the final answer(s). (48-points) (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)



$$VPC_{STA} = VPI_{STA} - \frac{L}{2}$$

$$= 50+00 - \frac{800}{2}$$

$$VPC = 46+00$$

$$VPT_{STA} = VPI_{STA} + \frac{L}{2}$$

$$= 50+00 + \frac{800}{2}$$

$$VPT = 54+00$$

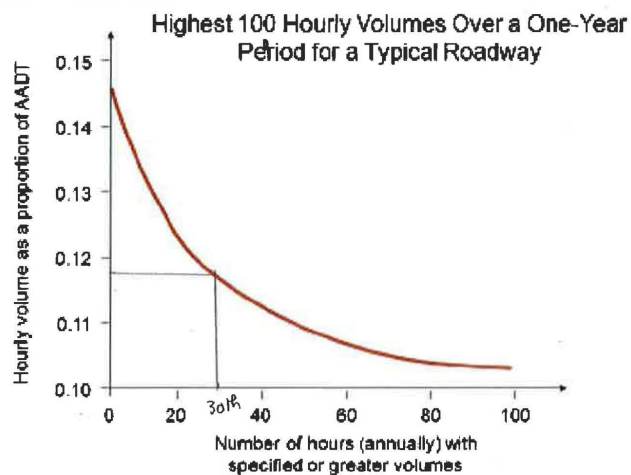
35.9

**BONUS - The response must be completely correct in order to receive FULL credit.**

Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the "knee" of the curve? (5-points) *30<sup>th</sup> number of hour*
2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points) *The approximate hourly volume as a proportion of AADT is 0.118*

## Typical Graph



9



# SECTION-P01

Last Name (ONLY) Ridgley

Roster Number 19

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination II  
22 October 2019

126.5  
150

Instructions: Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

## Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (10-points) *back*  
The steps taken to obtain the central angle for any one of the horizontal curves drawn on the topography map for my term project are listed as followed. We first had to begin by having a full understanding
2. A horizontal curve with a 1000 feet radius is to be provided for two perpendicular roads. The station of the PI is 12+00. Determine the angle of intersection, degree of curvature, tangent distance, external distance, middle ordinate, length of curve, station of PC, and station of PT. (45-points). (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)

given:  $R = 1000\text{ft}$

PI station: 12+00

approach: ① since its two perpendicular roads  $\Delta = 90^\circ$

$$\textcircled{2} R = \frac{5729.6}{D} \rightarrow \frac{5729.6}{R} = \frac{5729.6}{1000} = 5.73 = D$$

find:

- angle of intersection
- degree of curvature
- tangent distance
- external distance
- middle ordinate
- length of curve
- station of PC
- station of PT

$$\textcircled{3} T = R \left( \tan \frac{\Delta}{2} \right) = 1000 \text{ft} \left( \tan \frac{90^\circ}{2} \right) = 1000 \text{ft} \quad T = 1000 \text{ft}$$

$$\textcircled{4} E = R \left[ \frac{1}{\cos \left( \frac{\Delta}{2} \right)} - 1 \right] = 1000 \left[ \frac{1}{\cos \left( \frac{90^\circ}{2} \right)} - 1 \right] = 1414.21 \text{ft} = E$$

$$\textcircled{5} M = R \left[ 1 - \cos \left( \frac{\Delta}{2} \right) \right] = 1000 \left[ 1 - \cos \left( \frac{90^\circ}{2} \right) \right] = 292.89 \text{ft} = M$$

$$\textcircled{6} Lc = \frac{\Delta}{D} (100) = \frac{90}{5.73} (100) = 1570.68 \text{ft} = L$$

$$\textcircled{7} PC = PI - T = 12+00 - 10+00 = 2+00 \quad PC = 2+00$$

$$\textcircled{8} PT = PC + L = 2+00 + 1570.68 = 17+70.68 \quad PT = 17+70.68$$

diagram missing -5

49

Last Name (ONLY) \_\_\_\_\_

Roster Number \_\_\_\_\_

3. If you was given a 8.5% swell factor, how would this be entered into the Yard (Plus) software? (5-points) If I was given a 8.5% swell factor it would be entered into yard(plus) software as -8.5.

4. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points) When entering into yard(plus) software the station interval has to be an integer value (no decimal point)

**BONUS - The response must be completely correct in order to receive FULL credit.**

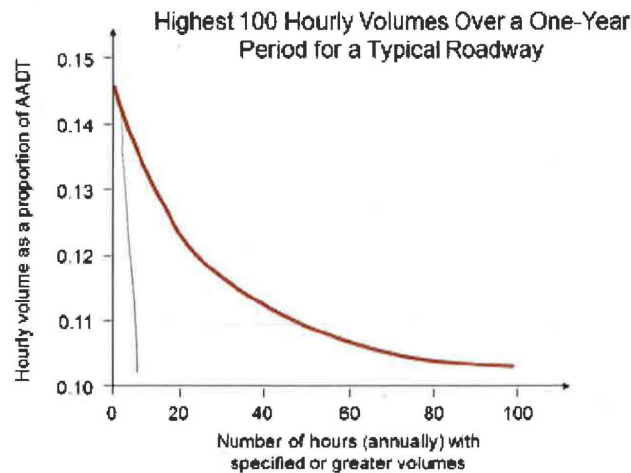
Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the "knee" of the curve? (5-points)

The number of hours is 3.

2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points) The approximately hourly volume is 14.

## Typical Graph



10



# SECTION-P02

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

CVEG 4053 – Transportation Engineering Design  
Fall 2019  
Examination II  
22 October 2019

Frida  
Rubi  
#13

51.35  
150

Instructions: Provide complete answers to each question or problem listed below in order to obtain full credit for your responses. If any calculations are required, you must show all steps. Your numerical answer should not go beyond two places after the decimal point. For computational problems, ALWAYS include a diagram to facilitate your understanding of what is given in the problem.

If you need additional space, please write on the back of the page.

## Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (10-points) *our central angle was obtained by measuring with a protractor at the intersection. we looked at our elevation lines from North and South and west to east.*

## Project Scope of Work - Task 3 - Vertical Alignment

1. When evaluating symmetrical vertical crest or sag curves, provide the curve location(s) for which the offset values are the same. (10-points)

+6.7

VPI, VPC, VPT

-3.3

2. For the two grade lines  $g_1 = -6\%$  and  $g_2 = +2\%$  that intersect at station 50+00, it has an elevation of 550.97 feet. The length of curve is 800 feet. Compute the stations and elevations of the VPC, VPI, VPT, and all points along the curve (i.e., use a 200-foot interval). Display your response in a table format and for this problem, you do not need to block the final answer(s). (48-points) (Measure Program Learning Outcome ABET Criterion 3 (1) - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics)

*drawn manually*  
 $L/2 = 400$

$$E = \frac{|g_2 - g_1| (L)}{800} = \frac{|2 - 6| (800)}{800} = 5.99$$

$$VPC = 50+00 + 400 = 54+00$$

+2.45

|     |       |
|-----|-------|
| VPC | 54+00 |
| VPI |       |
| VPT |       |

$$VPI =$$

$$x = \frac{|+6| (800)}{2 - 6} = -600$$

**BONUS** - The response must be completely correct in order to receive FULL credit.

Measure Program Learning Outcome ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

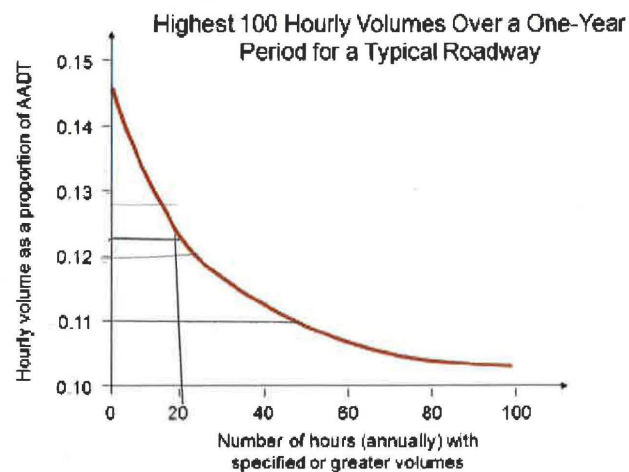
1. Using the typical graph below, what number of hours (annually) with specific or greater volumes is directly linked to the “knee” of the curve? (5-points)

20 hours X

2. Using the response from Question #1, approximately what hourly volume is a proportion of the AADT? (5-points)

0.125 X  
0.118 X

## Typical Graph



**CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET  
CVEG 4053: TRANSPORTATION ENGINEERING DESIGN  
FALL 2020**

**Instructor: Dr. Judy A. Perkins**

**Title of Assignment**

**EXAMINATION #1**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor.

**Check the ethical dimensions related to this assignment**

| Requires students to |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|                      | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| X                    | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      | global context                                                                                                                                |
| x                    | economic context                                                                                                                              |
| x                    | and societal context.                                                                                                                         |

**Brief justification of why this assignment is suitable for this outcome**

Students have Examination questions to complete and having prior knowledge of an array of constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, they are required to make informed judgments that will consider the impact of an engineering solution in an economic and societal context.

**ASSIGNMENT STATEMENT/QUESTIONS**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**  
**CVEG 4053 – Transportation Engineering Design**  
**Fall 2020**  
**Examination I**  
**1 October 2020**

**CLOSED NOTES AND BOOKS**  
**ONLY USE EQUATION SHEET**

*Provide complete answers to each question or problem listed below in order to obtain full credit for your responses*

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**Chapter 15 - Geometric Design of Highway Facilities**

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

**Table 15.1** Minimum Design Speeds for Rural Collector Roads

| <i>Type of Terrain</i> | <i>Design Speed (mi/h) for Specified Design Volume (veh/day)</i> |                    |                  |
|------------------------|------------------------------------------------------------------|--------------------|------------------|
|                        | <i>0 to 400</i>                                                  | <i>400 to 2000</i> | <i>Over 2000</i> |
| Level                  | 40                                                               | 50                 | 60               |
| Rolling                | 30                                                               | 40                 | 50               |
| Mountainous            | 20                                                               | 30                 | 40               |

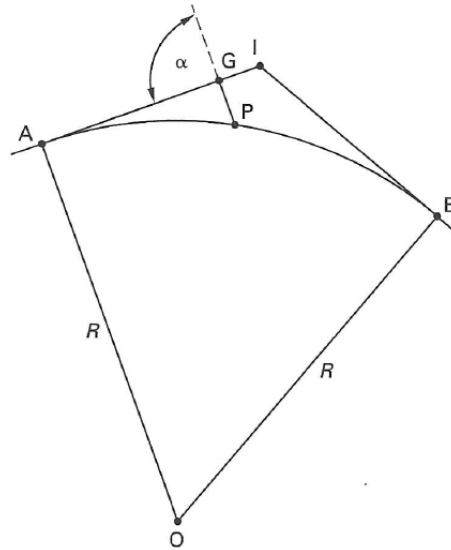
Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

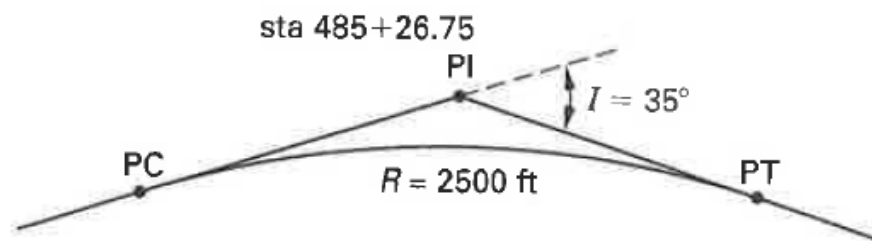
**Place Answer Here \_\_\_\_\_**

2. What are two factors that influence highway design? (10-points)
  - a.
  - b.

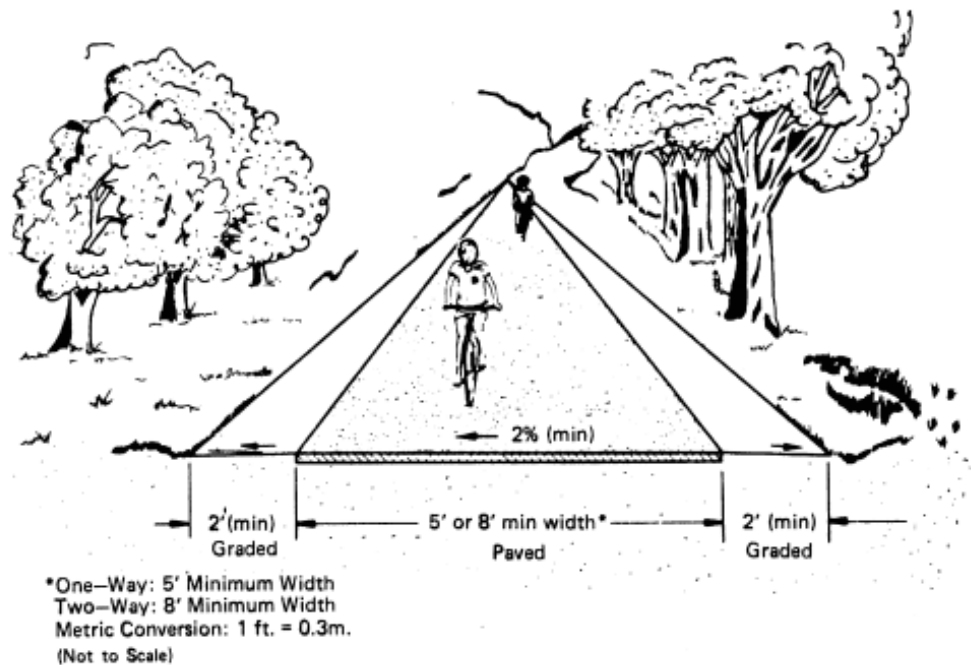
3. List below the functional classification hierarchy of the roadway system in the order starting with roads that have both unrestricted access and no through traffic. (20-points)
4. As per the illustration shown below,  $AG$  is 400-feet, angle  $\alpha$  is 90-degree, and the degree of curve is 12-degrees. What is most nearly the distance of  $GP$ ? (30-points)



5. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Properly label all aspects of your typical cross-sectional illustration. (20-points)
6. A circular horizontal curve has a radius of 2500-feet and a deflection angle of 35-degrees. The  $PI$  of the curve is at station 485+75. What is the station of the  $PT$ ? (30-points)



7. A typical layout for a bicycle path on a separate right-of-way is below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)



**Figure 15.30** Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a.
- b.
- c.
- d.

### **CVEG 4053 Transportation Engineering Design Course Syllabus**

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the **“specific”** student learning outcomes for CUEG 4053-P01-Transportation Engineering Design course. (15-points):

**GRADING SCHEME FOR ASSIGNMENT**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**  
**CVEG 4053 – Transportation Engineering Design**  
**Fall 2020**  
**Examination I - Solution**  
**1 October 2020**

**CLOSED NOTES AND BOOKS**  
**ONLY USE EQUATION SHEET**

*Provide complete answers to each question or problem listed below in order to obtain full credit for your responses*

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**Chapter 15 - Geometric Design of Highway Facilities**

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

**Table 15.1** Minimum Design Speeds for Rural Collector Roads

| <i>Type of Terrain</i> | <i>Design Speed (mi/h) for Specified Design Volume (veh/day)</i> |                    |                  |
|------------------------|------------------------------------------------------------------|--------------------|------------------|
|                        | <i>0 to 400</i>                                                  | <i>400 to 2000</i> | <i>Over 2000</i> |
| Level                  | 40                                                               | 50                 | 60               |
| Rolling                | 30                                                               | 40                 | 50               |
| Mountainous            | 20                                                               | 30                 | 40               |

Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

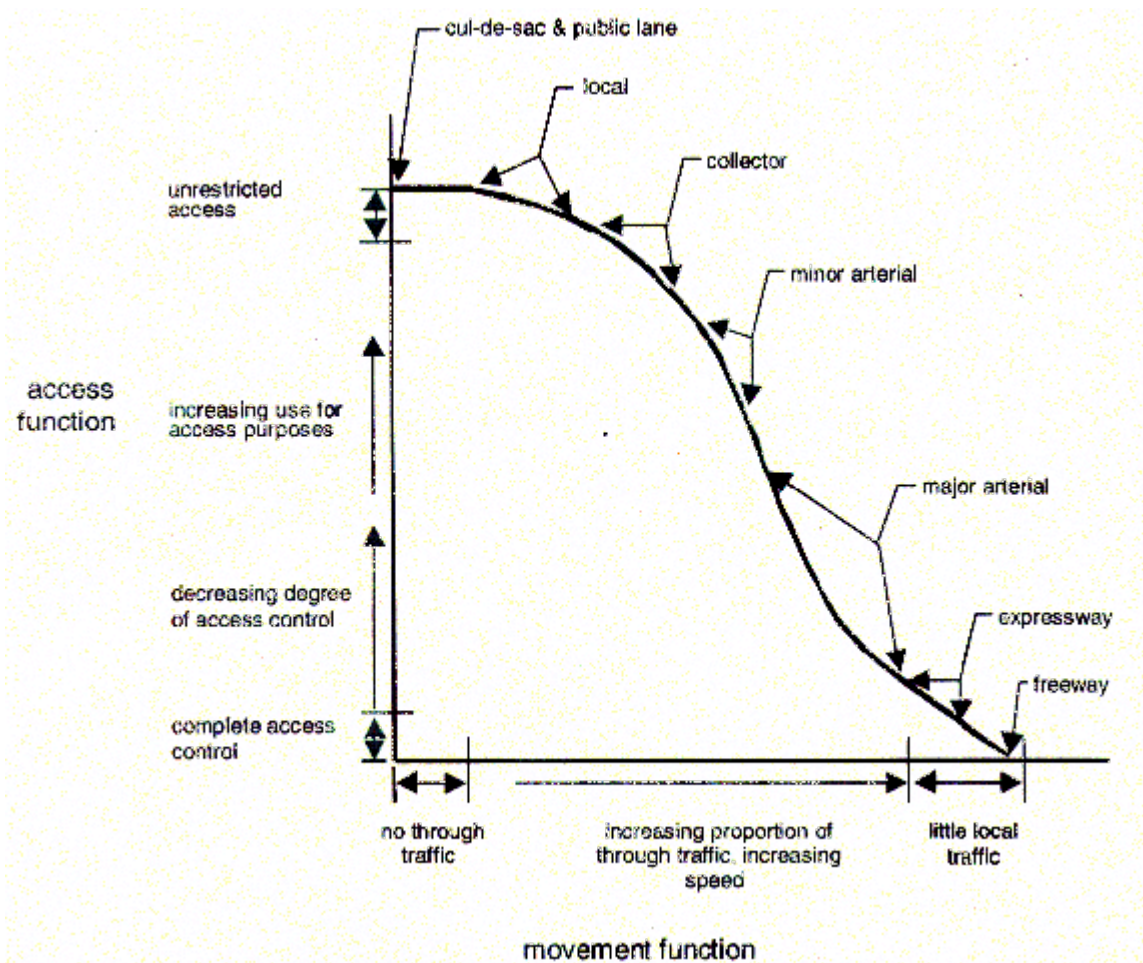
**Place Answer Here 40 mph**

2. What are two factors that influence highway design? (10-points)  
Students should select any two factors from list below.
  - Functional classification
  - Design hourly traffic volume and mix
  - Design speed
  - Design vehicle
  - Cross section of the highways



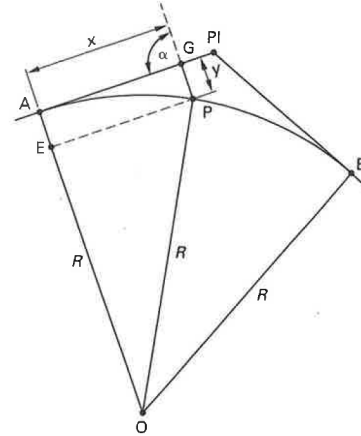
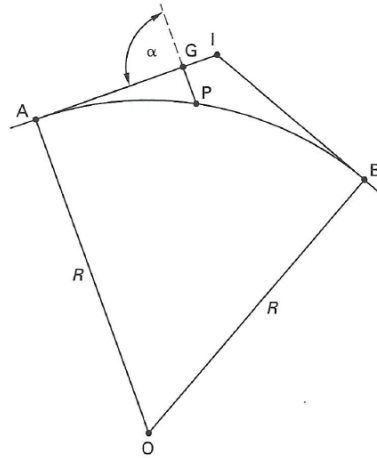
- Presence of heavy vehicles on steep grades
- Topography of area
- Level of service available funds
- Safety
- Social and environmental factors

- List below the functional classification hierarchy of the roadway system in the order starting with roads that have both unrestricted access and no through traffic. (20-points)
  - Local roads and streets
  - Collectors
  - Arterials
  - Freeways/Interstates





4. As per the illustration shown below,  $AG$  is 400-feet, angle  $\alpha$  is 90-degree, and the degree of curve is 12-degrees. What is most nearly the distance of  $GP$ ? (30-points)



$$AG = x - EP$$

$$GP = y$$

$$OE = OA - y$$

For right triangle OEP,  $OE = \text{Square Root of } (R^2 - x^2)$

Find the curve radius,  $D = (180^\circ) (100)/\pi(R)$

$$OA = R = 5729.58/D = 5729.58/12^\circ = 477.465\text{-feet}$$

$$OE = \text{Square Root of } = (477.47)^2 - (400)^2 = 227972.83 - 160000 = 67972.83 = 260.72\text{-feet}$$

$$y = OA - OE = 477.465 - 260.72 = 216.75\text{-feet}$$

5. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Properly label all aspects of your typical cross-sectional illustration. (20-points)

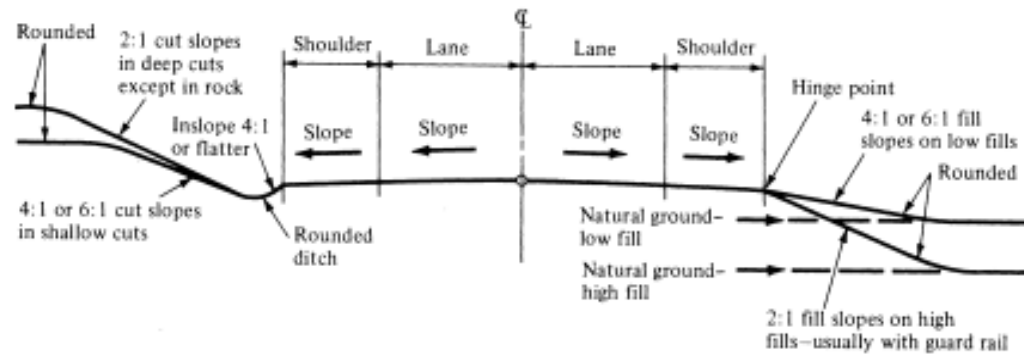


Figure 15.4 Typical Cross Section for Two-Lane Highways

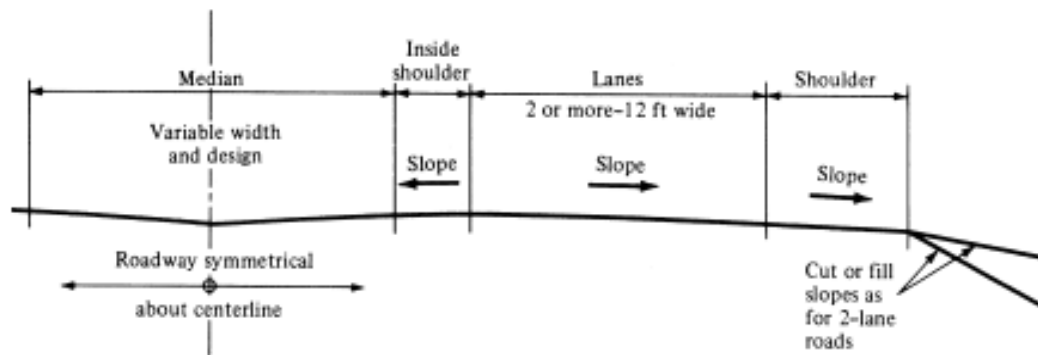
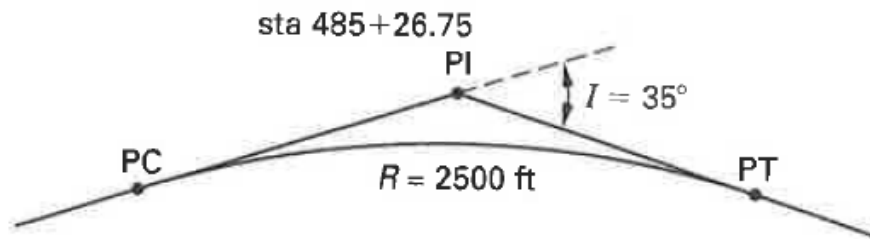


Figure 15.5 Typical Cross Section for Multilane Highways (half section)

6. A circular horizontal curve has a radius of 2500-feet and a deflection angle of 35-degrees. The *PI* of the curve is at station 485+75. What is the station of the *PT*? (30-points)



### SOLUTION 15

Solve for the length of the curve tangent.

$$\begin{aligned} T &= R \tan \frac{I}{2} = (2500 \text{ ft}) \tan \frac{35^\circ}{2} \\ &= (2500 \text{ ft}) (0.315299) \\ &= 788.25 \text{ ft} \end{aligned}$$

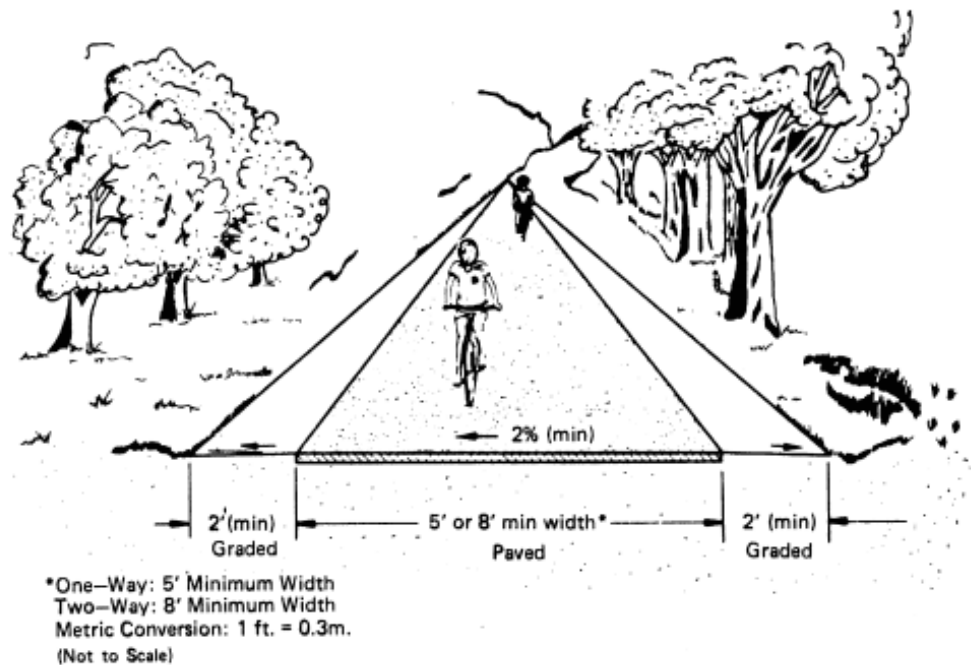
Find the station of the point of curvature (PC).

$$\begin{array}{r} \text{PI sta } 485+26.75 \\ - \quad 7 \quad 88.25 \\ \hline \text{PC sta } 477+38.5 \end{array}$$

$$L = R (\pi) (\Delta)/180^\circ = (2500) (35^\circ) (\pi) / 180^\circ = 1527.16\text{-feet}$$

$$\text{PT}_{\text{station}} = \text{PC}_{\text{station}} + L = 47738.5 + 1527.16 = 49265.66 = 492+65.66 \text{ (feet-station)}$$

7. A typical layout for a bicycle path on a separate right-of-way is below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)



**Figure 15.30** Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a. Low bicycle volumes at all times
- b. Vertical and horizontal alignments are properly designed to provide frequent safe passing conditions
- c. Only occasional use of path by pedestrians, and
- d. The absence of maintenance vehicles

**CVEG 4053 Transportation Engineering Design Course Syllabus**

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the **“specific”** student learning outcomes for CUEG 4053-P01-Transportation Engineering Design course. (15-points):

**Student Learning Outcomes:**

|          | Upon successful completion of this course, students will be able to<br>( <b>bold</b> letters in brackets correspond to ABET Criterion 3 measured in the course): | Program Learning Outcome # Alignment* | Core Curriculum Outcome Alignment |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------------------------------|
| <b>1</b> | Be able to demonstrate the fundamentals of transportation engineering design ( <b>c</b> );                                                                       | ABET 3 ( <b>1, 3-5</b> )              |                                   |
| <b>2</b> | Be able to demonstrate their knowledge of contemporary issues ( <b>j</b> ); and                                                                                  | ABET 3 ( <b>1, 3-5</b> )              |                                   |
| <b>3</b> | Be able to demonstrate an understanding of multi-objective decision-making.                                                                                      | ABET 3 ( <b>3- 5</b> )                |                                   |

\* The Civil Engineering Program Learning Outcomes are derived from ABET Criterion 3 (Student Outcomes)

Last Name Senegal

First Name Dakaylon

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department  
CVEG 4053 – Transportation Engineering Design  
Fall 2020  
Examination I  
1 October 2020

118.5  
150

CLOSED NOTES AND BOOKS  
ONLY USE EQUATION SHEET

*Provide complete answers to each question or problem listed below in order to obtain full credit for your responses*

Program Learning Outcome, ABET Criterion 3 (4) - an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Chapter 15 - Geometric Design of Highway Facilities

1. Using Table 15.1 shown below, what is the design speed for a rural collector road when the terrain is mountainous and there are over 2000 vehicles/day that travels on the road? (5-points)

Table 15.1 Minimum Design Speeds for Rural Collector Roads

| Type of Terrain | Design Speed (mi/h) for Specified Design Volume (veh/day) |             |           |
|-----------------|-----------------------------------------------------------|-------------|-----------|
|                 | 0 to 400                                                  | 400 to 2000 | Over 2000 |
| Level           | 40                                                        | 50          | 60        |
| Rolling         | 30                                                        | 40          | 50        |
| Mountainous     | 20                                                        | 30          | 40        |

Note: Where practical, design speeds higher than those shown should be considered.

SOURCE: From *A Policy on Geometric Design of Highways and Streets*, 2004, AASHTO, Washington, D.C. Used by permission.

Place Answer Here 40 mph (+5)

2. What are two factors that influence highway design? (10-points)

a. Topography of where highway is located

b. Design Speed

OK (+5)

(+5)

(15)

Last Name Senegal

First Name Dakylon

3. List below the functional classification hierarchy of the roadway system in the order starting with roads that have both unrestricted access and no through traffic. (20-points)

Local Street, collector, Arterial, Freeway

. incomplete list

+10

28

4. As per the illustration shown below,  $AG$  is 400-feet, angle  $\alpha$  is 90-degree, and the degree of curve is 12-degrees. What is most nearly the distance of  $GP$ ? (30-points)

Given =  $AG = 400\text{ft}$

$\alpha = 90^\circ$

$\delta$  of curve =  $12^\circ$

Approach:

$$\text{Radius} = \frac{5729.58}{12}$$

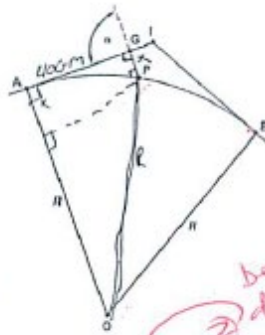
$$= \frac{5729.58}{12} = 477.465\text{ft}$$

$$\text{In } \triangle AGP \quad (OP)^2 = AP^2 + GP^2$$

$$R^2 = (400)^2 + (R-x)^2$$

$$(477.465)^2 = (400)^2 + (477.465 - x)^2$$

$$GP = x = 216.75\text{ft}$$



beyond decimal point

-2

How is this possible?  
See discussion info on next page dated 12/5/2020

+10

+10

Last Name Senegal

First Name Daylon

3. List below the functional classification hierarchy of the roadway system in the order starting with roads that have both unrestricted access and no through traffic. (20-points)

Local street, collector, Arterial, Freeway

4. As per the illustration shown below,  $AG$  is 400-feet, angle  $a$  is 90-degree, and the degree of curve is 12-degrees. What is most nearly the distance of  $GP$ ? (30-points)

Given =  $AG = 400 \text{ ft}$

$a = 90^\circ$

$\delta$  of curve =  $12^\circ$

Approach:

$$\text{Radius} = \frac{5729.58}{\delta}$$

$$= \frac{5729.58}{12} = 477.465 \text{ ft}$$

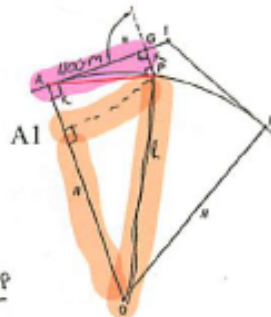
$OAP = OP^2 = AIP^2 + AIO^2$  per 12/5/2020 virtual session discussion.

In  $\triangle OBP$  ( $OP^2 = BP^2 + BO^2$ )

$$R^2 = (400)^2 + (R - x)^2$$

$$(477.465)^2 = (400)^2 + (477.465 - x)^2$$

$$GP = x = 216.75 \text{ ft}$$

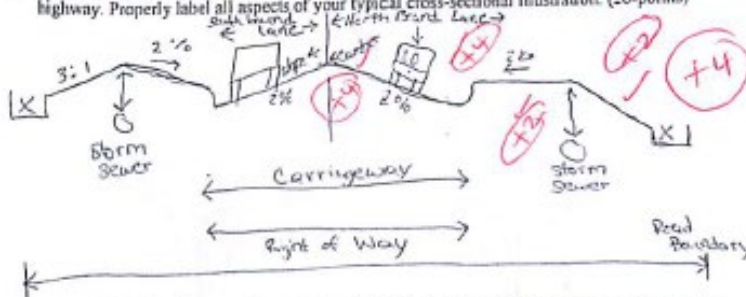




Last Name Senega

First Name Ditaph

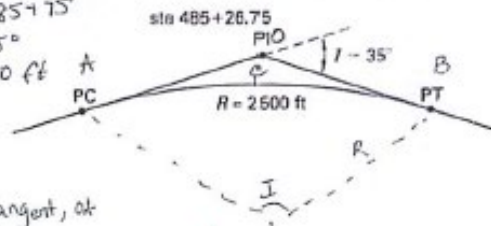
5. In the space below, draw an illustration of a typical roadway cross-section of a two-lane highway. Properly label all aspects of your typical cross-sectional illustration. (20-points)



6. A circular horizontal curve has a radius of 2500-feet and a deflection angle of 35-degrees. The *PI* of the curve is at station 485+75. What is the station of the *PT*? (30-points)

Given:  $PI = 485+75$   
 $I = 35^\circ$   
 $R = 2500 \text{ ft}$

Approach:



Length of Tangent,  $at$   
 $= R \tan \frac{I}{2}$

$= 2500 \tan 17.5^\circ$   
 $= 788.247'$

Length of curve,  $A \rightarrow B$

$= R I$   
 $= 2500 \times 35 \times \frac{\pi}{180} = 1527.163'$

Calculation of  $PT = \text{Station of } PI - \text{length of tangent} + \text{Length of curve}$   
 $= 48526.75 - 788.247 + 1527.163$   
 $= 4925.67 \text{ units}$

Station of  $PT = 492+65.67$

X meth error - 2

+2.75

30.5

Last Name Senegal

First Name Danaylon

7. A typical layout for a bicycle path on a separate right-of-way is below in Figure 15.30. The minimum recommended width is 10-feet for two-way paths, and 5-feet for one-way paths. Describe below four conditions when the width for the two-way path may be 8-feet. (20-points)

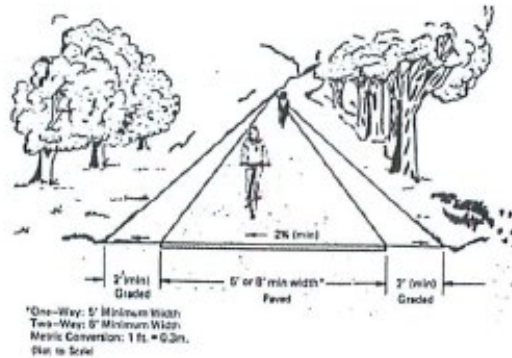


Figure 15.30 Bicycle Path on Separated Right-of-Way

SOURCE: From *Guide for Development of Bicycle Facilities*, 1999, AASHTO, Washington, D.C. Used by permission.

- a. Lower # of cyclists ✓
- b. Vertical + Horizontal alignment are designed to provide frequent safe passing conditions. ✓
- c. Occasional use of path by a pedestrian(s) ✓
- d. The absence of maintenance vehicles. ✓

20

20

Last Name Senegal

First Name Danaylon

CVEG 4053 Transportation Engineering Design Course Syllabus

1. The student learning outcomes for this course describes what each student will be able to do upon successful completion of the course. Provide below the "specific" student learning outcomes for CVEG 4053-P01-Transportation Engineering Design course. (15-points):

• Demonstrate the fundamentals of transportation engineering design. ✓

• Demonstrate their knowledge of contemporary issues ✓

• Demonstrate an understanding of multi-objective decision-making. ✓

(15)

(15)

**CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET  
CVEG 4053: TRANSPORTATION ENGINEERING DESIGN  
FALL 2020**

**Instructor: Dr. Judy A. Perkins**

**Title of Assignment**

**EXAMINATION #2**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

| Requires students to |   |                                                                                                                                               |
|----------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>X</b>             |   | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| <b>X</b>             |   | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      |   | global context                                                                                                                                |
|                      | x | economic context                                                                                                                              |
|                      | x | and societal context.                                                                                                                         |

**Brief justification of the suitability of assignment for the outcome**

Responding to the Examination questions allows the student to apply their knowledge of traffic characteristics in order to recognize ethical and professional responsibilities in an engineering situations and make an informed judgment that will consider the impact of the engineering solution in an economic and societal context.

**ASSIGNMENT STATEMENT/QUESTIONS**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**  
**CVEG 4053 – Transportation Engineering Design**  
**Fall 2020**  
**Examination II**  
**Given: 12 November 2020**  
**Due: 17 November 2020 NLT 7am CST in Dropbox Folder**  
**OPEN NOTES & OPEN BOOK**  
**“HONOR CODE” EFFECTIVE on 12 November 2020**

**ABET Outcome “1”**-an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics; and

**ABET Outcome “4”**- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Instructions:**

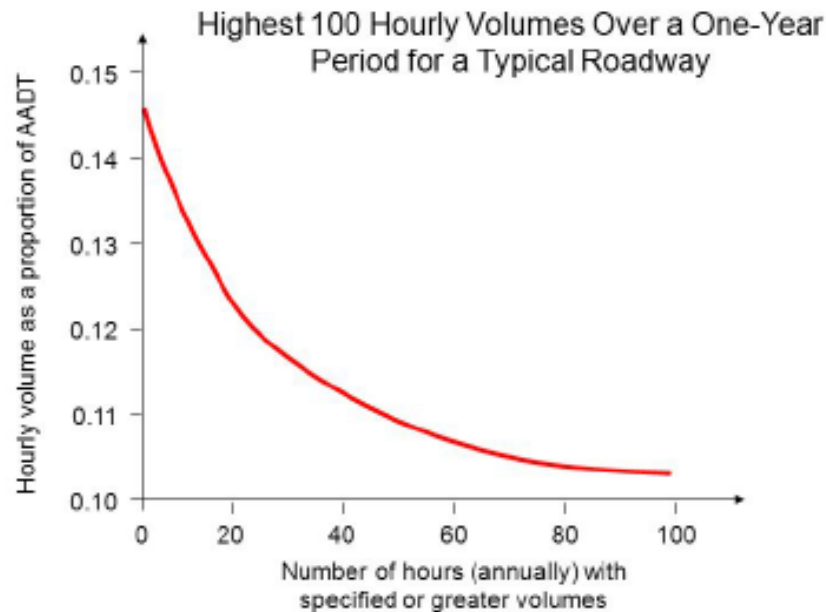
- Provide complete answers to each question or problem listed below in order to obtain full credit for your responses.
- If any calculations are required, you must show all steps.
- Use the format - Given, Find, Approach, and Blocking of Answers - when solving problems that involve calculations.
- For computational problems, you may want to consider including a diagram to facilitate your understanding of the problem.
- Your numerical answer at each step of your calculations should not go beyond two places after the decimal point.
- Place ALL your work on the exam pages. NO EXCEPTIONS. You can write on the back of the page.

Project Scope of Work - Task 1 - Design Calculations

1. Use the following information to determine the number of total lanes required. (25-points)
  - Undivided Highway
  - Rural Environment
  - Rolling Terrain
  - 8% Trucks
  - PHF = 0.9
  - LOS = D
  - Forecasted AADT = 6780 vpd
  - Growth Rate = 2% per annum
  - Current Year is 2018
  - Design Year is 2035

- During the peak period, it is expected that 66% of the traffic will flow in the dominant direction
- Determine K from the typical graph listed below

## Typical Graph



### **Project Scope of Work - Task 2 - Horizontal Alignment**

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (15-points)

### **Project Scope of Work - Task 5 - Drainage**

1. Compute the runoff coefficient for a 165-acre rural drainage area consisting of three different ground cover types which are as follows: (a) Steep grass area (2:1) = 15%; (b) Forested area = 30%; and (c) Cultivated fields = 55%. (20-points)
2. What are the three properties of rainfall that primarily concern highway engineers? (15-points)

### **COGO Software**

1. What is the meaning of the acronym COGO? (5-points)
2. What is the meaning of the “04” command/code? (5-points)
3. Which command/code computes the high point of a crest curve? (5-points)
4. Command/code “51” computes the station of a given end point. The output provides information, which falls under three specific headings (i.e., POINT; C/L STATION; AND OFFSET). (10-points)
  - a. What does C/L STATION mean?
  - b. What does OFFSET mean?
5. What is the meaning of the “02” command/code? (5-points)
6. What is the meaning of the “50” command/code? (5-points)
7. Which is the meaning of the “10” command/code? (5-points)
8. Which is the meaning of the “71” command/code? (5-points)

### **YARD (Plus) Software**

1. What two types of elevations must be obtained for each station and then entered into the Yard (Plus) software? (10-points)
2. If you was given the swell factor of 6.5%, how would this be entered into the Yard (Plus) software? (5-points)
3. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)
4. The Yard (Plus) software will provide you with a print out of results from the data inputs, what is the name of the two data points from the results print out needed to plot the mass diagram? (10-points)

**GRADING SCHEME FOR ASSIGNMENT**  
**Prairie View A&M University**  
**Roy G. Perry College of Engineering**  
**Civil & Environmental Engineering Department**

**CVEG 4053 – Transportation Engineering Design**  
**Fall 2020**

**Examination II - Solution**

**12 November 2020**

**OPEN NOTES & OPEN BOOK**  
**“HONOR CODE” is in EFFECT**

**ABET Outcome “1”**-an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

**ABET Outcome “4”**- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts;

**Instructions:**

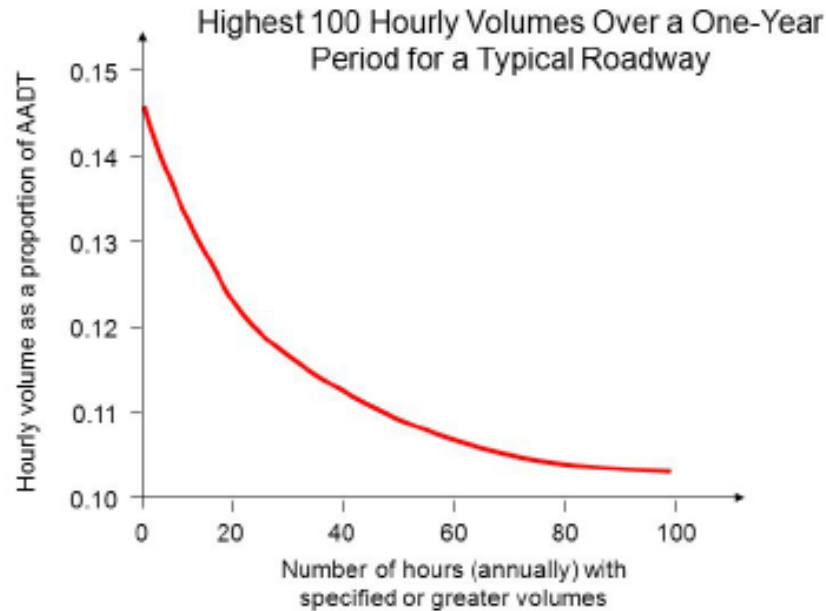
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- For computational problems, you may want to consider including a diagram to facilitate your understanding of the problem.
- Your numerical answer should not go beyond two places after the decimal point.
- Place ALL on the exam pages. NO EXCEPTIONS. You can write on the back of the page.

**Project Scope of Work - Task 1 - Design Calculations**

1. Use the following information to determine the number of total lanes required. (25-points)
  - Undivided Highway
  - Rural Environment
  - Rolling Terrain
  - 8% Trucks
  - PHF = 0.9
  - LOS = D
  - Forecasted AADT = 6780 vpd
  - Growth Rate = 2% per annum
  - Current Year is 2018
  - Design Year is 2035
  - During the peak period, it is expected that 66% of the traffic will flow in the dominant direction
  - Determine K from the typical graph listed below



## Typical Graph



K range is 0.115, 0.116, 0.117

$$\text{DDHV} = \text{Forecasted AADT} \times K \times D = 6780 (0.116) (0.66) = 519.08 \text{ vphpd}$$

$$\text{DDHV} = \text{Forecasted AADT} \times K \times D = 6780 (0.115) (0.66) = 514.61 \text{ vphpd}$$

$$\text{DDHV} = \text{Forecasted AADT} \times K \times D = 6780 (0.117) (0.66) = 523.55 \text{ vphpd}$$

$$\text{SFL}_D = 1400 \text{ vphpl}$$

$$f_E = 0.95$$

$$N = \text{DDHV} / \text{SFL}_D (f_E) (\text{PHF}) = 519.08 / (1400) (0.95) (0.9) = 519.08 / 1197 = 0.433 \text{ lanes} \sim 1 \text{ lane in each direction for a total of 2 lanes for the entire facility}$$

$$N = \text{DDHV} / \text{SFL}_D (f_E) (\text{PHF}) = 514.61 / (1400) (0.95) (0.9) = 514.61 / 1197 = 0.429 \text{ lanes} \sim 1 \text{ lane in each direction for a total of 2 lanes for the entire facility}$$

$$N = \text{DDHV} / \text{SFL}_D (f_E) (\text{PHF}) = 523.55 / (1400) (0.95) (0.9) = 523.55 / 1197 = 0.437 \text{ lanes} \sim 1 \text{ lane in each direction for a total of 2 lanes for the entire facility}$$

### **Project Scope of Work - Task 2 - Horizontal Alignment**

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (15-points)

**Use a protractor to measure the angle between the two intersecting tangents drawn to create the point of intersection (PI).**

### **Project Scope of Work - Task 5 - Drainage**

1. Compute the runoff coefficient for a 165-acre rural drainage area consisting of three different ground cover types which are as follows: (a) Steep grass area (2:1) = 15%; (b) Forested area = 30%; and (c) Cultivated fields = 55%. (20-points)

Step 1 - Determine the runoff coefficients for each of the three groundcover-type areas from Table 16.2 found in the textbook

| Type of Cover             | % Area | Coefficient | Low Range | High Range |
|---------------------------|--------|-------------|-----------|------------|
| Steep grass covered (2:1) | 15     | 0.60        | 0.50      | 0.70       |
| Forested area             | 30     | 0.20        | 0.10      | 0.30       |
| Cultivated fields         | 55     | 0.30        | 0.20      | 0.40       |

Step 2 - Calculate the weighted run-off coefficient using Equation 16.1.

$$C_w = 165 [(0.15)(0.60) + (0.30)(0.20) + (0.55)(0.30)]/165$$

$$C_w = 0.315 \text{ unitless}$$

$$C_w = 165 [(0.15)(0.50) + (0.30)(0.10) + (0.55)(0.20)]/165 = 0.075 + 0.03 + 0.11$$

$$C_w = 0.215 \text{ unitless}$$

$$C_w = 165 [(0.15)(0.70) + (0.30)(0.30) + (0.55)(0.40)]/165 = 0.105 + 0.09 + 0.22$$

$$C_w = 0.415 \text{ unitless}$$

2. What are the three properties of rainfall that primarily concern highway engineers? (15-points)  
  
(a) Intensity  
(b) Duration  
(c) Frequency

## **COGO Software**

1. What is the meaning of the acronym COGO? (5-points)

### **Coordinate Geometry**

2. What is the meaning of the “04” command/code? (5-points)

### **End of Run**

3. Which command/code computes the high point of a crest curve? (5-points)

### **74**

4. Command/code “51” computes the station of a given end point. The output provides information which falls under three specific headings (i.e., POINT; C/L STATION; AND OFFSET). (10-points)

- a. What does C/L STATION mean?

### **Centerline station**

- b. What does OFFSET mean?

**The vertical distance, either above or below, the centerline of the roadway or the offset is the vertical distance between the tangent elevation and the curve elevation.**

5. What is the meaning of the “02” command/code? (5-points)

### **Insert text**

6. What is the meaning of the “50” command/code? (5-points)

### **Horizontal Alignment**

7. Which is the meaning of the “10” command/code? (5-points)

**Last point number on the horizontal alignment. Find distance only from point to point**

8. Which is the meaning of the “71” command/code? (5-points)

**Last point number on the vertical alignment**

### **YARD (Plus) Software**

1. What two types of elevations must be obtained for each station and then entered into the Yard (Plus) software? (10-points)

- a. Existing Ground Elevations
- b. Proposed Profile Elevations

2. If you was given a 8.5% shrinkage factor, how would this be entered into the Yard (Plus) software? (5-points)

**8.5**

3. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)

**Integer value (no decimal point)**

4. The Yard (Plus) software will provide you with a print out of results from the data inputs, what is the name of the two data points from the results print out needed to plot the mass diagram? (10-points)

- a. Stations
- b. Mass Ordinates

First Name Nayani

Last Name Corvera

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department  
CVEG 4053 – Transportation Engineering Design  
Fall 2020

Examination II

Given: 12 November 2020

Due: 17 November 2020 NLT 7am CST in Dropbox Folder

**OPEN NOTES & OPEN BOOK**

**“HONOR CODE” EFFECTIVE on 12 November 2020**

146  
150

ABET Outcome “1”- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics; and  
ABET Outcome “4”- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Instructions:

- Provide complete answers to each question or problem listed below in order to obtain full credit for your responses.
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- Use the format - Given, Find, Approach, and Blocking of Answers - when solving problems that involve calculations.
- For computational problems, you may want to consider including a diagram to facilitate your understanding of the problem.
- Your numerical answer at each step of your calculations should not go beyond two places after the decimal point.
- Place ALL your work on the exam pages. NO EXCEPTIONS. You can write on the back of the page.

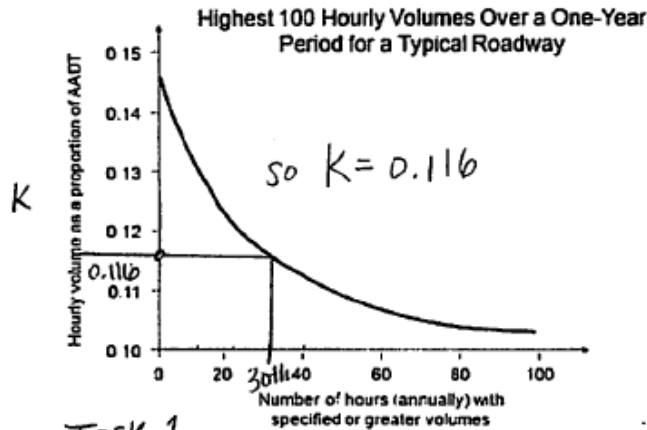
Project Scope of Work - Task I - Design Calculations

1. Use the following information to determine the number of total lanes required. (25-points)
  - Undivided Highway
  - Rural Environment
  - Rolling Terrain
  - 8% Trucks
  - PHF = 0.9
  - LOS = D
  - Forecasted AADT = 6780 vpd
  - Growth Rate = 2% per annum
  - Current Year is 2018
  - Design Year is 2035
  - During the peak period, it is expected that 66% of the traffic will flow in the dominant direction
  - Determine K from the typical graph listed below

First Name Nayani

Last Name Correra

## Typical Graph



From Task 1  
 Given: bulleted points page 1 and graph above is given data  
 Find: Total # of lanes = ? and  $K = ?$

Approach:

$$N, \# \text{ lane(s)} = \frac{DDHV}{SFL (F_e) PHF} = ?$$

where, Peak Hourly Factor (PHF) given = 0.9

Using Highway Capacity Manual for Rural type 3 Undersaturated  
 then environmental factor,  $F_e = 0.95$

Using Service flow rate per lane for planning application (SFL)  
 surface flow rate for LOS-D, rolling terrain, and  
 80% Truck so  $SFL = 1400 \text{ veh/hr}$

→ back

## Directional Design Hourly Volume (DDHV)

$$DDHV = AADT * K * D$$

where,

Annual Average Daily Traffic (AADT) given = 6780 vpd

K Factor found from given graph = 0.116

$$D \text{ (directional distribution)} = \frac{66\%}{100} = 0.66$$

$$DDHV = 6780 \text{ vpd} \times 0.116 \times 0.66 \\ = 519.0768 \approx 519.08 \text{ veh/hr/day}^{-2}$$

$$N = \frac{DDHV}{SFL(fe) PHF} = \frac{519.08 \text{ veh/hr}}{1400 \frac{\text{veh}}{\text{hr}} (0.95) 0.9} \\ = 0.433650794 \approx 0.43 < 1 \text{ lane}$$

$$\text{Total \# lanes} = 1 \times 2 = 2 \text{ lanes}$$

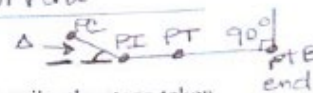
# of total lanes required = 2 lanes

$$K = 0.116$$

73

First Name Nayani

Last Name Correra



### Project Scope of Work - Task 2 - Horizontal Alignment

1. Referencing your horizontal alignment for your term project, briefly describe the steps taken to obtain the central angle for any one of your horizontal curves drawn on the topography map. (15-points)

- created/designed horizontal alignment w/ given restriction
- For Curve 3, determined central angle from PI to PC due to having to have alignment intersect at 90° degree with ending point
- the central angle,  $\Delta$  was measured with protractor to be 29°

### Project Scope of Work - Task 5 - Drainage

1. Compute the runoff coefficient for a 165-acre rural drainage area consisting of three different ground cover types which are as follows: (a) Steep grass area (2:1) = 15%; (b) Forested area = 30%; and (c) Cultivated fields = 55%. (20-points)

Given: Area = 165-acre, (a) steep grass area (2:1) = 15%,  
(b) forested area = 30%, (c) cultivated fields = 55%

Find: Runoff coefficient (C)

Approach: Used Table 16.2 a "Values of Runoff Coefficient, C" used smallest value coefficient for each ground cover

$$C = (0.15 \times 0.5) + (0.3 \times 0.1) + (0.55 \times 0.2) \\ = (0.075) + (0.03) + (0.11) = 0.215 \approx 0.22$$

$$C = 0.22$$

2. What are the three properties of rainfall that primarily concern highway engineers? (15-points)

- 1- intensity
- 2- duration
- 3- frequency

### COGO Software

1. What is the meaning of the acronym COGO? (5-points)

Coordinate Geometry

2. What is the meaning of the "04" command/code? (5-points)

- 1. END OF RUN command
- 2. END OF RUN command
- 3. EXIT COGO Program



First Name Nayani

Last Name Corvera

3. Which command/code computes the high point of a crest curve? (5-points)

command 74 ✓

4. Command/code "51" computes the station of a given end point. The output provides information, which falls under three specific headings (i.e., POINT; C/L STATION; AND OFFSET). (10-points)

- a. What does C/L STATION mean? ✓

Center Line Station

The center line of road designed.

- b. What does OFFSET mean?

Amount of distance from the center line.  
type? ✓

5. What is the meaning of the "02" command/code? (5-points)

allows user to input notes as text in  
between commands ✓

6. What is the meaning of the "50" command/code? (5-points)

command 50 used to get curve data  
for horizontal alignment ✓

7. Which is the meaning of the "10" command/code? (5-points)

distance between two points ✓

8. Which is the meaning of the "71" command/code? (5-points)

• end of alignment  
• command for the last one of the vertical curve  
data: elevations for VPI and the station and  
elevation on sequential nodes ✓

**YARD (Plus) Software**

1. What two types of elevations must be obtained for each station and then entered into the Yard (Plus) software? (10-points)

The existing and proposed ground elevations. ✓

44

First Name Nayani

Last Name Correra

2. If you was given the swell factor of 6.5%, how would this be entered into the Yard (Plus) software? (5-points)

✓ A 6.5% swell factor is entered as -6.5.

3. What type of value must the station interval be in regards to entering it into the Yard (Plus) software? (5-points)

✓ The station interval has to be an integer value (no decimal point).

4. The Yard (Plus) software will provide you with a print out of results from the data inputs, what is the name of the two data points from the results print out needed to plot the mass diagram? (10-points)

✓ Use Station and <sup>mass -1</sup>Ordinate data points from results print out to plot mass diagram.

 19

**OUTCOME “4” SPECIFIC ASSIGNMENTS  
USED TO ASSESS THE OUTCOME IN**

**CVEG 4472  
SENIOR DESIGN & PROFESSIONALISM I**

**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**  
**CVEG 4472 Senior Design and Professionalism I**  
**OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

**FALL 2019**

**Instructor: Dr. R. Radha**

**Title of Assignment**

**Assignment and test to understand professional and ethical responsibility**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

|                      |                                                                                                                                               |                       |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Requires students to |                                                                                                                                               |                       |
| <b>X</b>             | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |                       |
| <b>X</b>             | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |                       |
|                      | x                                                                                                                                             | global context        |
|                      | x                                                                                                                                             | economic context      |
|                      | x                                                                                                                                             | and societal context. |

**Brief justification of the suitability of assignment for the outcome**

**Reading and homework assignments are given to students to learn professional and ethical responsibility. Examples and class discussions will give students exposure to different situations and think thru the new situations to take correct decisions**

**CVEG 4472 Senior Design and Professionalism I  
FALL 2019**

**ASSIGNMENT STATEMENT/QUESTIONS  
GRADING SCHEME FOR ASSIGNMENT**

|               |                   |
|---------------|-------------------|
| Assignment    | 50 points         |
| Test          | 50 points         |
| <b>Total:</b> | <b>100 points</b> |

**See below Student Sample for Crit. 4**

**Insert here Student Sample Crit. 4**

Ethics Quiz

Fall 2019

CVEG 4472

Name: Zida <sup>60</sup>  
Last Marielou  
First

Answer all Questions below by circling the correct answer:

D 1. What is the direct result of ethical behavior?

- A. Your reputation will be enhanced.
- B. You will be rewarded economically.
- ☒ C. You will feel good about yourself.
- D. Neither a, b, or c

2. Complete the sentence: "if you check the calculations for a licensed (registered) friend who has gone into a consulting business for himself/herself,

- A. "you should be paid for your work."
- ☒ B. "your friend's client should be told of your involvement."
- C. "you do not need to be licensed or registered yourself."
- D. "your friend assumes all the liability for your work."

C 3. What does it mean when a design professional accepts a punishment for an unethical act from his technical society "with prejudice?"

- A. The professional's race, creed, and national origin were Considered in deciding on the punishment.
- B. The professional's race, creed, and national origin were Not considered in deciding on the punishment.
- C. Even after the sentence is served or punishment is completed, there may be further actions taken.
- ☒ D. The professional is held in bad report for the period of prejudice.



B 4. While supervising a construction project in a developing country, an Engineer discovers that his client's project manager is treating laborers in an unsafe and inhumane manner (but for that country, legal). When he protests, the Engineer is told by the company executives that the company has no choice if it wishes to remain competitive in the regions, and he should accept this as the way things are. What would Ethics require the Engineer to do?

A. Take no action – the company is acting in a perfectly legal manner.

B. Withdraw from the project, returning any fees he may have already received.

☒ C. Report the company to the proper authorities for its human rights abuses.

D. Assist the laborers in organizing a strike to obtain better working conditions.

5. Two engineers submitted sealed bids to a prospective client for a design project. The client told Engineer A how much Engineer B had bid and invited Engineer A to beat that amount. Engineer A really wants the project and honestly believes he can do a better job than Engineer B. What should he do?

A. He should submit another quote, but only if he can perform the work adequately at the reduced price.

B. He should withdraw from consideration for the project.

☒ C. He should remain in consideration for the project, but not change his bid.

D. He should bargain with the client for the cost of the work.



6. You are a city Engineer in charge of receiving bids on behalf of the city council. A contractor's bid arrives with two tickets to a professional football game. The bid is the lowest received. What should you do?

- ☒ A. Return the tickets and accept the bid.
- B. Return the tickets and reject the bid.
- C. Discard the tickets and accept the bid.
- D. Discard the tickets and reject the bid.

7. The first and foremost obligation of registered professional engineers is to:

- ☒ A. The public welfare
- B. Their employer
- C. The government
- D. The engineering profession

8. Registered professional engineers should undertake services for clients only when:

- A. They really need the fees
- B. Their own bid is the lowest one
- ☒ C. They are fully technically competent to carry out the services
- D. Carrying out the services would not involve excessive time or effort

9. The Model Rules of Professional Conduct require registered engineers to conform to all but one of the following rules. Which rule is not required?

- ☒ A. Do not charge excessive fees
- B. Do not compete unfairly with others
- C. Perform services only in the areas of their competence
- D. Avoid conflicts of interest

- C 10. You are a quality control engineer of a completely produced U.S. made product compliance. You notice one subcontractor used foreign-made bolts. The customer urgently needs this product. What should you do?
- A. Say nothing and deliver hoping no one notices
  - B. Find, or invent, some equivalent violation of contract where the customer is responsible. Tell them you will ignore the violation if they ignore your violation
  - C. Tell the customer and let them decide
  - ☒ D. Put all efforts into trying to find a legal loophole in the original specs.

**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**  
**CVEG 4472 Senior Design and Professionalism I**  
**OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

**FALL 2020**

**Instructor: Dr. R. Radha**

**Title of Assignment**

**Assignment and test to understand professional and ethical responsibility**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

| Requires students to |   |                                                                                                                                               |
|----------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>X</b>             |   | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| <b>X</b>             |   | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      | x | global context                                                                                                                                |
|                      | x | economic context                                                                                                                              |
|                      | x | and societal context.                                                                                                                         |

**Brief justification of the suitability of assignment for the outcome**

**Reading and homework assignments are given to students to learn professional and ethical responsibility. Examples and class discussions will give students exposure to different situations and think thru the new situations to take correct decisions**

**CVEG 4472 Senior Design and Professionalism I  
FALL 2020**

**ASSIGNMENT STATEMENT/QUESTIONS  
GRADING SCHEME FOR ASSIGNMENT**

|               |                   |
|---------------|-------------------|
| Assignment    | 50 points         |
| Test          | 50 points         |
| <b>Total:</b> | <b>100 points</b> |

See below Student Sample for Crit. 4 (or as attachment to the report)

**Insert here Student Sample Crit. 4**

## **ASSIGNMENTS FOR OUTCOME “4”**

**An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.**

**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING  
CVEG 4200 Senior Design and Professionalism I  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

**FALL 2021**

**Instructor: Dr. Md Jobair Bin Alam**

**Title of Assignment**

**Assignment and test to understand professional and ethical responsibility**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

| Requires students to |   |                                                                                                                                               |
|----------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>X</b>             |   | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |
| <b>X</b>             |   | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |
|                      | x | global context                                                                                                                                |
|                      | x | economic context                                                                                                                              |
|                      | x | and societal context.                                                                                                                         |

**Brief justification of the suitability of assignment for the outcome**

**Reading and homework assignments are given to students to learn professional and ethical responsibility. Examples and class discussions will give students exposure to different situations and think through the new situations to take correct decisions**

**CVEG 4200 Senior Design and Professionalism I  
FALL 2021**

**ASSIGNMENT STATEMENT/QUESTIONS  
GRADING SCHEME FOR ASSIGNMENT**

|               |                   |
|---------------|-------------------|
| Assignment    | 100 points        |
| <b>Total:</b> | <b>100 points</b> |



**Insert here Student Sample Crit. 4**

Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department

90



**CVEG 4200: Senior Design and Professionalism I**

**Section: P01**

**Course Number: 17739**

**Title: Assignment # 2: Ethics**

**Submitted By: Abram Auguste (Roster # 1)**

**Submitted To: Dr. Alam, Md. Jobair**

**Issue Date: October 21, 2021**

**Due Date: October 31, 20201 NLT 5:00 p.m.**

## **Problem 1**

Review the Code of Ethics from ASCE (attached in CANVAS, also with this attachment). Based on your review,

- (1) demonstrate your understanding of professional code for your senior design project. Also,
- (2) describe your ethical responsibility, in general, to be successful in professional career.

**\*Not more than 2 pages\***

## **Problem 2**

Review the two case studies (link below) on professional ethics. Based on your review,

- (1) provide justification on what should be the approach to be ethical and professionally competent.
- (2) With respect to your senior design project, describe (a) global, (b) economic, (c) environmental, and (d) societal contexts

Global Impact: investigate a given engineering problem, and explain how proposed engineering solutions to similar problems may be adopted in different parts of the world

Societal Impact: investigate a given engineering problem, and develop engineering solutions that take into account societal factors.

Economic Impact: investigate a given engineering problem, and develop solutions that take into account economic factors.

Environmental Impact: investigate a given engineering problem, and develop solutions that take into account environmental impact.

**\*Not more than 2 pages\***

- (1) <https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases/giving-in-or-giving-up/>
- (2) <https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases/a-marshlands-fleeting-flourishing/>

## Part A

The underlying principles discussed in the code ethics helps guide an engineers moral compass in the field of engineering. The key points under the code helps to promote a safe, fair, and educational environment for all engineers and with the general public. Promoting a safe and conducive environment helps to promote the fields and morals of the engineering profession. The code of ethics is applicable to the senior design project in that it sets a frame of working as a collective in a group environment while promoting engineering principles amongst our team members. As professional students the code states that we should uphold the honor, integrity, and dignity of the profession; represent their professional qualifications and experience truthfully; also to educate the public on the role of civil engineering in society. As our group pursues the concepts surrounding the senior design project we are working diligently and with integrity to understand information surrounding the senior design, investigation, and problem solving. In addition, efforts are being made to present the final product of the design to the ISC board members and our cohorts who attend the presentation. The code of ethics concepts apply to the senior design classroom since knowledge is being shared both between the instructors and the students. The information that we are learning in the classroom and as we navigate the design project will directly influence the general public since the students are the future engineers that will build structures that will impact the general public. The designs implemented will improve society and promote engineering as a whole. If the designs are faulty then harm can be made to the public which can ultimately lead to death. That is why the code of ethics state that we MUST communicate in a timely manner to clients and employers any risks and limitations related to their work; and present clearly and promptly the consequences to clients and present to employers if their engineering judgement is overruled where health, safety, and welfare of the public may be endangered. The safety we exercise as engineers will ultimately be correlated with the foundations learned in the classroom and through job experience. That is why it is important that we approach the project with the truth and sincerity of our knowledge base and progressively learn the material as we move forward both in the classroom and with the design project.

My ethical responsibility consists of doing right by the general public, consistent professional growth, and to constantly advance my knowledge of engineering to assure the safety of the general public. rest on my knowledge base and commitment to both the general public and nature collectively.

Under the fact pattern Ashton was assigned to build their construction headquarters in a specific region in East Africa. In order to obtain building permits in the region, Ashton had to negotiate with the local government. As she begins negotiations, she realizes that bribery is both a common and expected practice. If she does not bribe the local officials, she will not be able to build PDRC's headquarters in that region and consequently will lose the contracts. Also, it is illegal for a U.S. citizen to bribe a foreign official in order to obtain business. Under the set of circumstances it would have been ethical for Ashton to turn down the contract or refuse the process of bribery in order to proceed with business as usual. the fundamental principle under the code of ethics state that an engineer must treat all persons with respect, dignity, and fairness in a manner that fosters equitable participation without regard to personal identity; uphold the honor, integrity, and dignity of the profession. The principles outlined by the code of ethics are concepts that follow engineers both domestically and

internationally. The simple fact that Ashton is doing work in East Africa does not negate the fact that she has to uphold the Code of Ethics and standards outside of the United States of America. The fact that Ashton is a representation of all engineers under the licensing board. The best business and professional practice would be for Ashton to refuse to compromise her ethical standards

## Part B

Solomon's main role is to advise clients on what type of action to take when they are faced with risks and liabilities while conducting certain projects. Solomon's client prioritized a cost-effective plan, the environment would be subject to a certain percentage of contamination that would, within five to ten years, stifle the marshlands flourishing. Under the set of circumstances Solomon should push for a more fiscally demanding, yet sustainable strategy--at the risk of his client backing out of the partnership altogether. The Code of ethics reads under the first guideline set for societal standards that first and foremost, protect the health, safety, and welfare of the public. Getting rid of an environmental importance would terminate all wildlife that depends on the marshland. The financial strategy on the client is not more important than nature itself. Solomon should advise the client of contingent plans that can benefit both the marshland and the client together.

## Impacts

**Global:** The senior design project sets the engineering framework for students as they pursue their engineering careers. The foundations of engineering are established through the classroom and influence their work throughout their careers which influences both local engineering and engineering on a global scale. America has led the way for structural influences across the world. The American infrastructure has been seen as a leading competitor and sets America as a first world country. When the Surfside condominium collapse occurred on June 24, 2021 in Miami Florida, the news outlets both locally and internationally were stunned because such collapses don't occur here in the U.S. A media frenzy was set for organizations to get to the bottom of the situation and to better understand why the collapse occurred. I recall one outlet stating that "This just doesn't happen here in the U.S." referring to the collapse. The result of the collapse led to countries around the world taking notes on best procedures with setting zone laws to prevent collapses in the future. The analysis of such collapse cause engineers to reflect on their work and best practices when executing a structural design. Therefore, it is imperative that as we progress throughout the senior design that we take notes on best practices since our work can avoid similar situations like that of the surfside building collapse.

**Societal:** Our work as Engineers begin in the classroom and with the assessments of preliminary exposure like that of our senior design project. Civil engineers, especially, influence societal convenience when it pertains to civil matter like living and transportation. The slightest mishap with a calculation can lead to infrastructure collapse or even death. That is why it is important to take copious notes in the classroom and to perform well with the senior design project. It is important that our analysis on designs

are sound since we will have the lives of the general public at our hands. Not only should our design be sound but there should exist quality assurance measures in every step of our work. As it relates to senior design the Internal Advisory council will serve as the quality assurance of our work assuring that our understanding is sound. Such exposure will lead to good work that the general public will use in our society.

**Economic:** The economical analysis is why we are hired as engineers. Companies hire us to save them money and materials. Also, our sound analysis can help avoid repeating a project. The senior design project helps to focus our understanding of budgeting to prevent excess spending. As we progressed with our senior design project we followed a rubric and guideline to help structure our approach with the design. Without such guidance we would have wasted valuable time and energy with our execution. In the professional world such wasted time can lead to additional expenses as working professionals that the corporations would be responsible for. Also, the poor performance could lead to employees getting fired.

**Environmental:** Lastly, the environmental impact of our design can impact the natural habitat if our design is not properly executed. As we excavate and alter nature for human benefit we also impact how animals and nature interact. Our work will include tearing down trees, excavating land, altering water movements, and removing natural animal cycles. We need to be mindful of how animals live and have plans in place to avoid disturbing their life cycles. Interfering with an animal cycle can lead to animal extinction as has occurred in the past. That is why it is important to not only execute our design but we must take into consideration how we can better the living conditions of animals near the project site. Factoring water sources, vegetation in our design, and following zoning codes catered to animals and vegetation in the area. An example would include Park Rangers planting fish in an artificial pond put in place by engineers. The fish draws birds and wildlife to the water source which in turn causes them to live without fear of extinction.

Civil & Environmental Engineering Department  
Prairie View A&M University



80

CVEG 4200 P01 Senior Design and Professionalism 1

Roster Number 2

Fall 2021

Homework Assignment #2

Submitted by:

Autumn Carter

Due: October 31, 2021

To

Dr. J. Alam

As professional engineers we have this mindset of building infrastructure to appeal to the eyes of people in the world, or to provide improved roadways and services. That questions do we think of everyone's safety and how long the sustainability of life will be inputted into these buildings or roadways while constructing projects. After viewing multiple catastrophic disasters in America just alone from the Florida International University pedestrian bridge to the Florida condominium casualty causing a severe number of deaths; these individuals' safety was not taken into consideration. After thoroughly reviewing the code of ethics it brought attention to a specific section which is the mission statement stating; *"Members of The American Society of Civil Engineers conduct themselves with integrity and professionalism, and above all else protect and advance the health, safety, and welfare of the public through the practice of civil engineering."* From interpretation I received that holding yourself to have strong morals as a professional. Either to be honest to yourself and project, so that you can excel while providing protection of health, safety, and welfare to the public.

As to conducting my senior design project I will take on the responsibility as an inspiring civil engineer to conduct myself in a manner that resembles a professional in training. That includes following the fundamental principles of creating safe resilient and sustainable infrastructure, treating all persons with respect, dignity, and fairness in a manner that fosters equitable participation without regards to personal identity. Consider the current and anticipated needs of society, and utilize knowledge and skills to enhance life for humanity. Working alongside my colleagues will give us a brighter understanding of how work is done in the field. Assuring all structures and planning is up to par for the development of the amazon IT hub and distribution center.

To be a successful professional engineer it comes with hard work and dedication. Speaking from personal experience it all starts with undergraduate. During this time you are learning the fundamentals of engineering and what is there to expect during design projects. Everything starts with attending class; I've always believed that missing a day of class equaled up to missing three weeks. Attending is beneficial to gain the proper knowledge. Following the code of ethics action as a professional is to uphold the honor, integrity, and dignity of the profession, practice engineering in compliance with all legal requirements in the jurisdiction of the practice. Represent their professional qualifications and experience truthfully and always reject practices of unfair competition. Never do anything to jeopardize your license from being suspended or even if terminated from further practices. Remember to educate the public on the role of civil



engineering in society and continue professional development to enhance their technical and non-technical competencies.

### **Case 1**

In this case we have Ashton who's trying to start a contract in East Africa for international development. This scenario ends with her communicating with the local government to earn her contract to construct the headquarter facility. She's left with the option to fraudulently commit bribery which is illegal. The next approach she should take from an ethical and professional aspect is to; reject practices if things aren't negotiated in a legal matter., because in civil engineering bribery is not ethical; having a zero tolerance for bribery, fraud, and corruption in all forms, and reporting violations to the proper authorities. If things aren't handled in an ethical manner, resign from moving forward with this client. There are always bigger and better opportunities; when one door closes, multiple open.

### **Case 2**

In this case I believe Solomon should push for a more sustainable strategy that will not jeopardize the environment. Each and every source of water has to meet federal regulations whether it's being used or not because it can become harmful to both humans and aquatic life and even the environment. One thing the ASCE pushes for is health, safety, and welfare of the public. This is the number one priority as a civil engineer. Although the client came with options that are cost effective which we like to hear always finding the lowest cost, it isn't easy to decide life over budget. Knowing that as an engineer you are here to swerve the people. I believe Solomon should continue to push his client to reach required regulations even if it costs a bit more.

Global Impact- Pollution from landfills not following Federal and governmental regulations.

Social Impact-Failed infrastructure

Economical Impact- A change in funding for a firm that can either jeopardize them for the worst or earn a must investment that isn't good.

Environmental Impact- Trying to conserve funds to be more cost efficient; where the environmental impact would be high contamination of surface water to eliminate cerion processes in cleaning water.

Jerral T. Walker,

CVEG 4200 Pol, Senior Design and  
Professionalism 1

Homework # 2  
Given:

Oct 21, 2021

Due:

October 31, 2021

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## Problem #1

1) Demonstrate your understanding of professional Code for your Senior Design Project.

Considering the Senior design project apposed to the the professional code given, each engineer should forefill thier duties accordingly. I am the water resource engineer for our senior design project where we are to design a business an distribution center, IT Hub, and office development ~~on~~ a 400-acre site in Walter County.

Based upon Society corresponding to my role in the design project I must work design to protect the health of the public. I must do so by still trying to improve the quality of my design. For an example, by improving how much water I can get from one place to another in a safe and efficient way. Based upon the Natural and built environment, I must follow the rules and regulations given by the state and County. When Considering clients and employer I must work to please my Customer in the most professional way. This is done by being honest, about conflict such as time, and money.

Further <sup>continue</sup> more by doing what the Customer asks to meet their wants and wishes. Communication is the most important part when working for your customer to make sure both parties have a great understanding of what's being done and when. Under the peers, I must give credit where it's due. I also have to complete a design that ensures the safety of them as well as something that even possible to build. I must have a respectable supervision and managing skills.

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A professional code of ethic offers a set of guideline teams that can be used to make good decisions to make my work environment better. My responsibilities are to be honest, trustworthy, loyal, respectful to others, respect laws/standards, safety, and taking accountability. By following these principles I will be a successful engineer.



## Problem #2

### Case 1) (1.1)

Based on the first case study the approach to be ethical would be to be honest with PDRC and let them know why she isn't willing to proceed with the project. It is not ethical to be dishonest and untrustworthy. In that case she needs to resign and apply to a company that abides by the code of ethics.

### Case 2

In this case Solomon should push for a more fiscally demanding and sustainable strategy. It is unethical to not use resource wisely to meet the regulations and standards. Therefore Solomon should stop constructing until a more ethical plan or design has been completed.

(1.2)

### Global.

- 1) In respects to global impacts of my Senior design climate change plays a huge role in my design. To solve this problem that it may cause would be to educate and have self awareness. Also look into new conservation tech, recycle waste water and improve irrigation and water use.

**OUTCOME “4” SPECIFIC ASSIGNMENTS  
USED TO ASSESS THE OUTCOME IN**

**CVEG 4482  
SENIOR DESIGN & PROFESSIONALISM II**

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**SENIOR DESIGN AND PROFESSIONALISM II**

**Instructor: Dr. Radha**

**Title of Assignment**

Final Report

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**Brief Description of the suitability of this assignment for the outcome**

Issues facing engineering projects vary over time. Things that were not important 20 years ago, such as sustainability, can become important. The environmental division's section of the report best shows how contemporary issues were addressed during the design phase.



## **INSTRUCTOR'S COMMENTS:**

1. Project Report Sections addresses and justifies the project results from an environmental and societal standpoint.
2. The report also shows how the negative impact to people and the environment will be minimized.
3. Standards and Codes were used and cited.
4. References used were listed in the report.
5. City of Houston Manual, Harris County and TxDOT practices were used.
6. Score is 78 for 100.

**Sample student work is provided in the following pages**

ABOVE AVERAGE

Senior Design and Professionalism I I

CVEG 4482



Submitted By:

Cameron Lavergne  
Joseline Vicente  
Daniel Doyle

To:

Dr. Radha and Johnny Gant:  
Senior Design Instructors

Department of Civil and Environmental Engineering  
Roy G. Perry College of Engineering  
Prairie View A&M University

April 30th, 2020

**LETTER OF TRANSMITTAL**



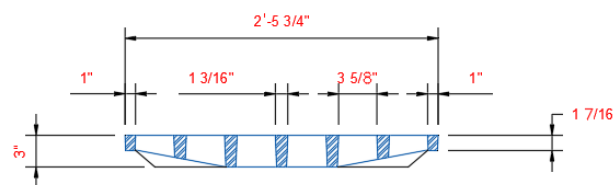
April 30, 2020

**Black Onyx Engineering Group**  
 Prairie View Gardens Masterplan  
 2106 Pecan Round Way  
 Prairie View, Texas 77446

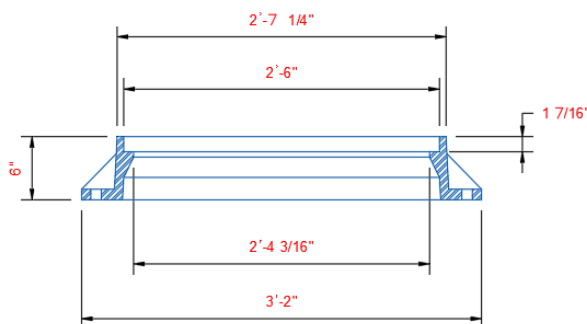
Dear Dr. Radha and Mr. Gant,

The attached technical report contains the civil engineering design services provided by Black Onyx Engineers. The design includes a commercial master plan, roads, intersections, sidewalks, driveways, parking lots, landscaping, detention pond, storm water collection system, traffic study, etc. The report includes details of all phases of the project including:

- Transportation Design
- Traffic Design
- Water resources Design
- Environmental Design
- Structural Design
- Geotechnical Design
- Cost Estimates



GRATE SECTION A-A



FRAME SECTION A-A

Black Onyx has proposed a Commercial master plan at the intersection, with 4 corners building footprints, parking, stripping, inlet locations, curbs, to driveways onto main streets. However, all codes and design constraints come from Harris County or the City of Houston.

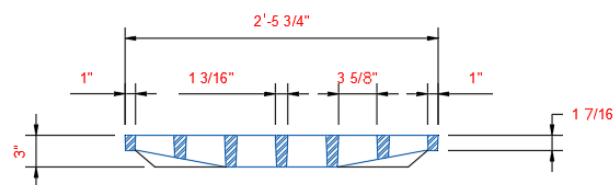
Any questions regarding this report can be addressed to any member of the Black Onyx Engineering group. You can contact members via email at [clavergne1@student.pvamu.edu](mailto:clavergne1@student.pvamu.edu), [ddoyle3@student.pvamu.edu](mailto:ddoyle3@student.pvamu.edu), and [jvicente@student.pvamu.edu](mailto:jvicente@student.pvamu.edu)

Sincerely,

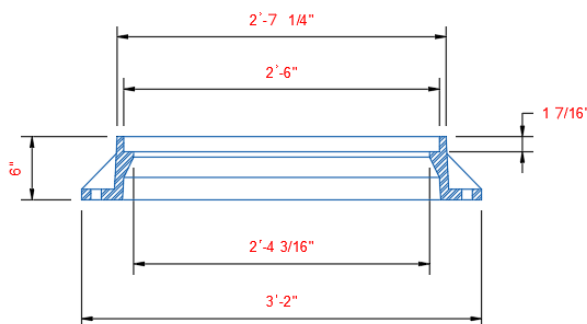
Cameron Lavergne  
Daniel Doyle  
Joseline Vicente

## ACKNOWLEDGEMENTS

This report was prepared by Cameron Lavergne, Daniel Doyle, and Joseline Vicente.



GRATE SECTION A-A



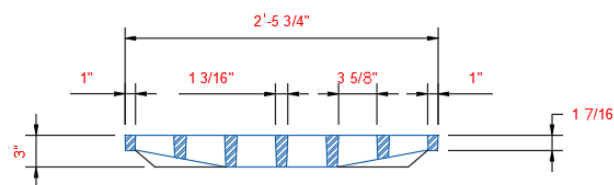
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## PROJECT SUMMARY/GOALS

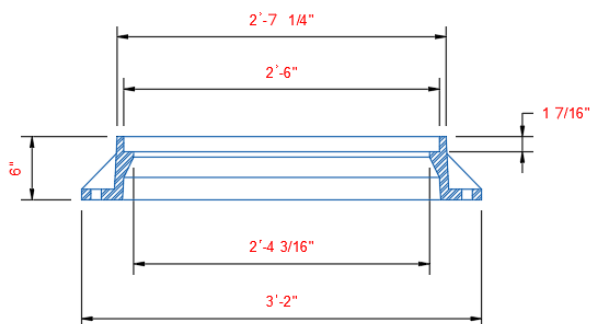
Blck Onyx Engineers have been selected to develop and design a project with a commercial master plan on a site located in on the FM 2020 and Collector Road. The scope of the project will include Civil Engineering Design services for the entire site including, roads, intersections, sidewalks, parking lots and driveways, landscaping, detention pond, storm-water collection system, traffic warrant study, and etc.

All aspects of civil engineering are used in this design project. Objectives for this project are to:

- Become familiar with regulatory agencies
- Strengthen civil engineering design, technical report skills, and presentation skills
- Learn design process of solving real world engineering problems



GRATE SECTION A-A



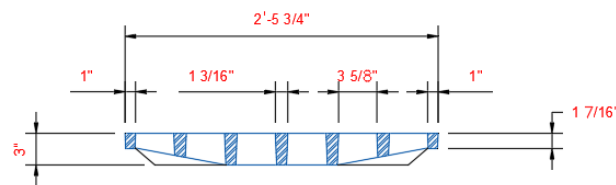
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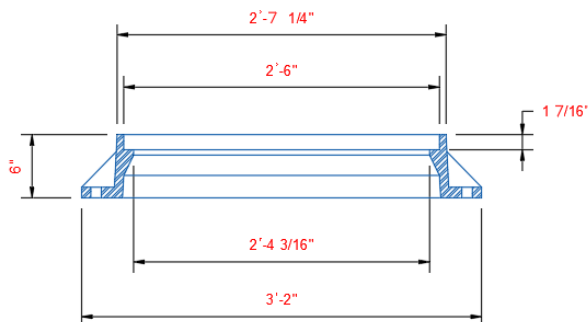
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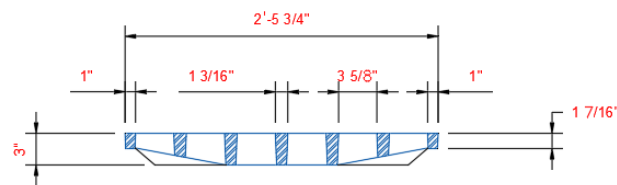


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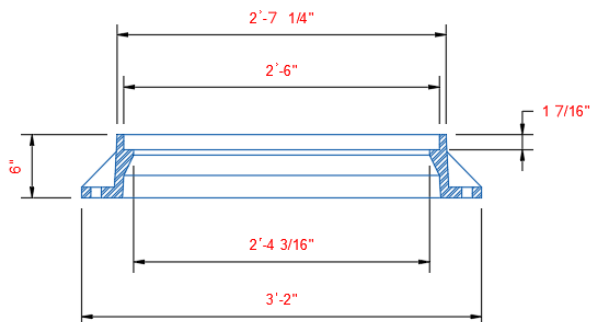


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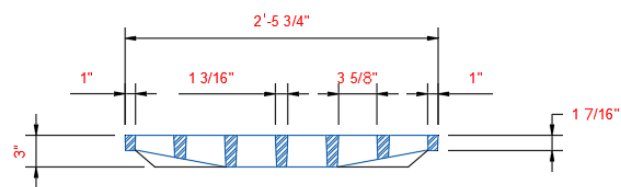


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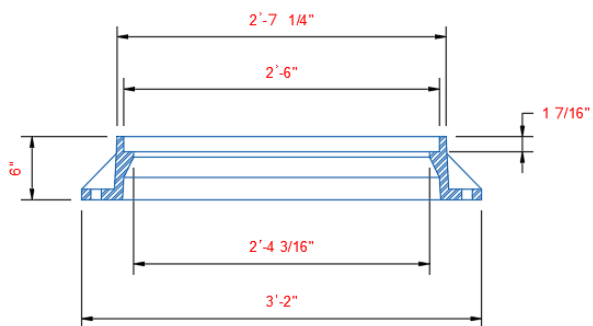


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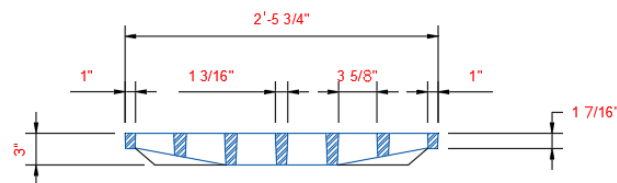
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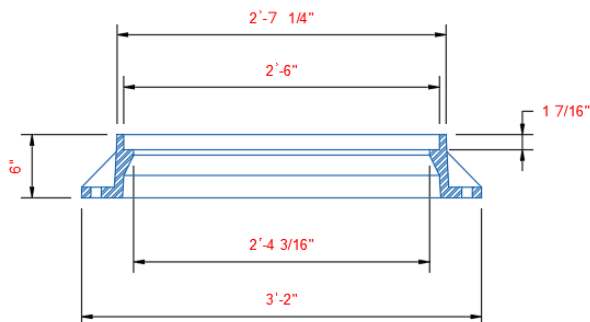
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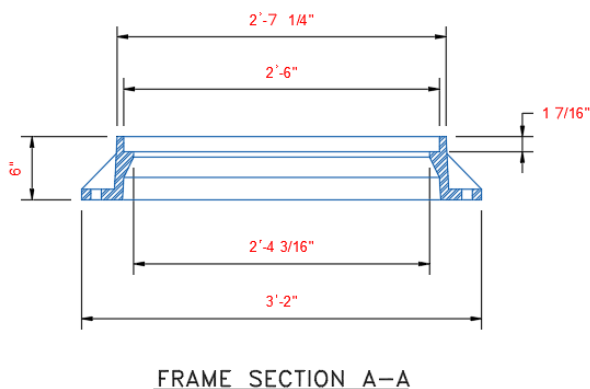
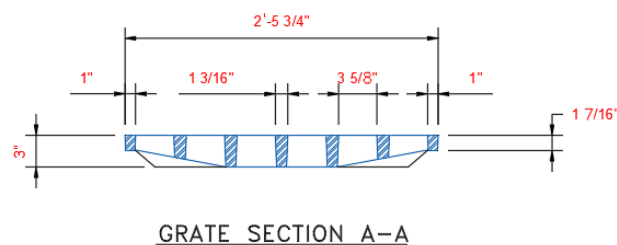


GRATE SECTION A-A



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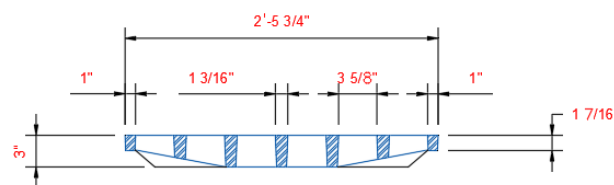
## PROJECT SCOPE

### Problem Statement

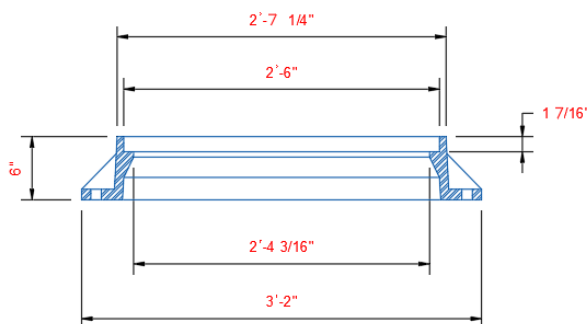
PV Civil Engineers had been selected to develop and design a Project with a commercial master plan on a site located off of FM 2020 and Collector Road. The scope of the project will include Civil Engineering Design services for the entire site including, roads, intersections, sidewalks, parking lots and driveways, landscaping, detention pond, storm-water collection system, traffic warrant study, and etc. The site plan boundary and topographic survey maps were provided.

### Project Goals & Objectives

- Familiarize the students with aspects of the Civil Engineering site design process necessary to develop a competitive proposal related to site development.
- Strengthen civil engineering design, technical report writing, and presentation skills.
- Reinforce team building activities, problem solving techniques, learn design process and finding solutions of real life civil engineering problems.
- Familiarize the student with the different regulatory agencies.
- Students are required to seek information from unlimited sources and encouraged to ask questions.



GRATE SECTION A-A



FRAME SECTION A-A

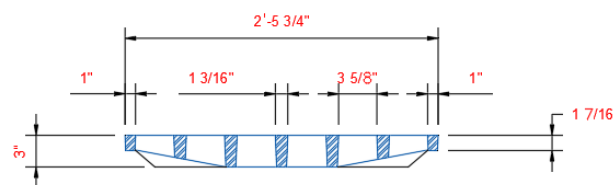
## Initial Project Constraints

1. Show north arrows.
2. Prepare all drawings for 24x36 scale (may plot 11x17 for reports).
3. Show bar scales.
4. Use City of Houston 2-year rainfall event for stormwater calculations.
5. Plot all final drawings in paper space.
6. Building setback line from the right-of-way is minimum 25'.

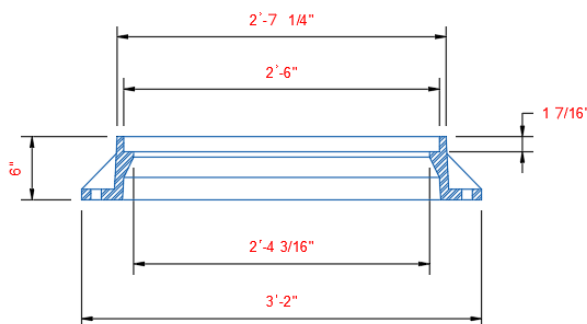
## 1. EXISTING CONDITIONS

The following figure shows the existing conditions of the provided site plan.

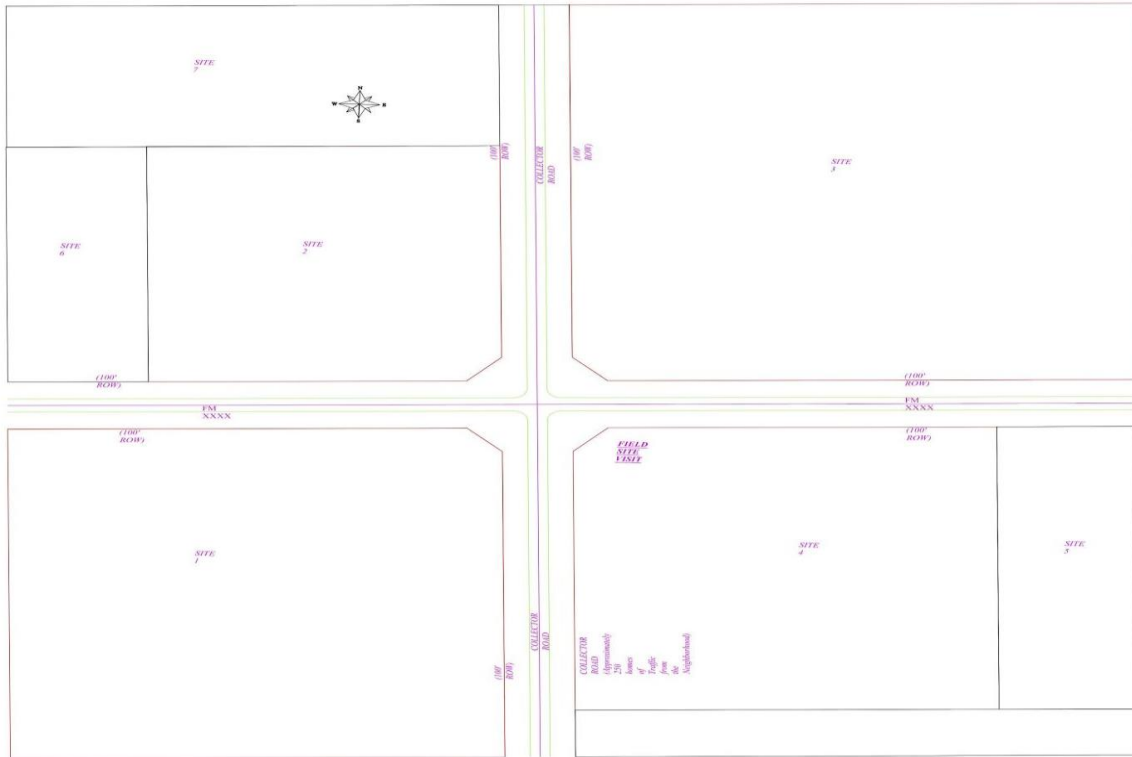
The given property had FM2020 and Collector Road intersecting. The square footage of each building was provided by the client. Walmart has square footage of 275000, CVS has square footage of 15000, Walgreens has square footage of 25000, Chase Bank has square footage of 9500, the Car Wash has square footage of 55000, Shell Gas Station has square footage of 65000, Kroger Grocery Store has square footage of 80000, Whataburger has square footage of 12650 and 24-Hour Fitness has square footage of 67250. The footprint of each building was designed according to the Harris Country and the City of Houston codes.



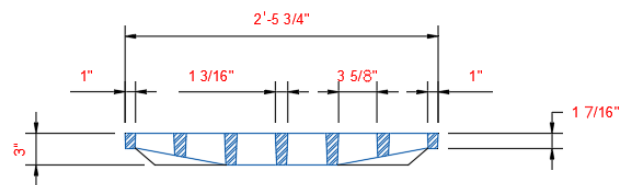
GRATE SECTION A-A



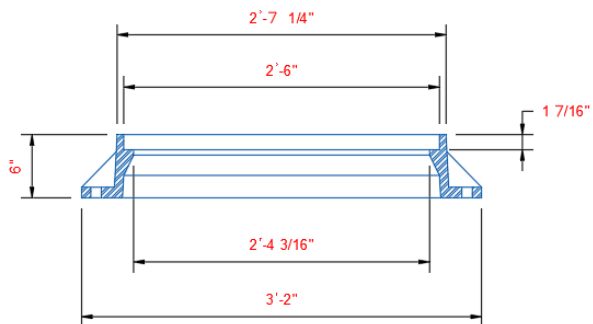
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**Figure 1: Existing Conditions**



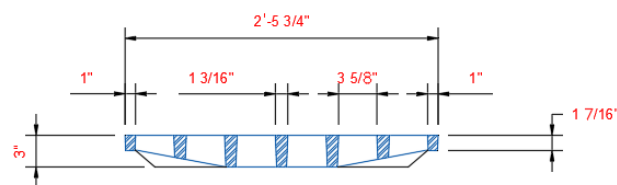
**GRATE SECTION A-A**



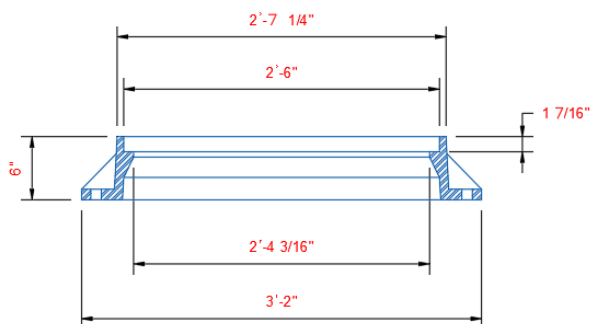
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## 2. COMMERCIAL SITE PLAN

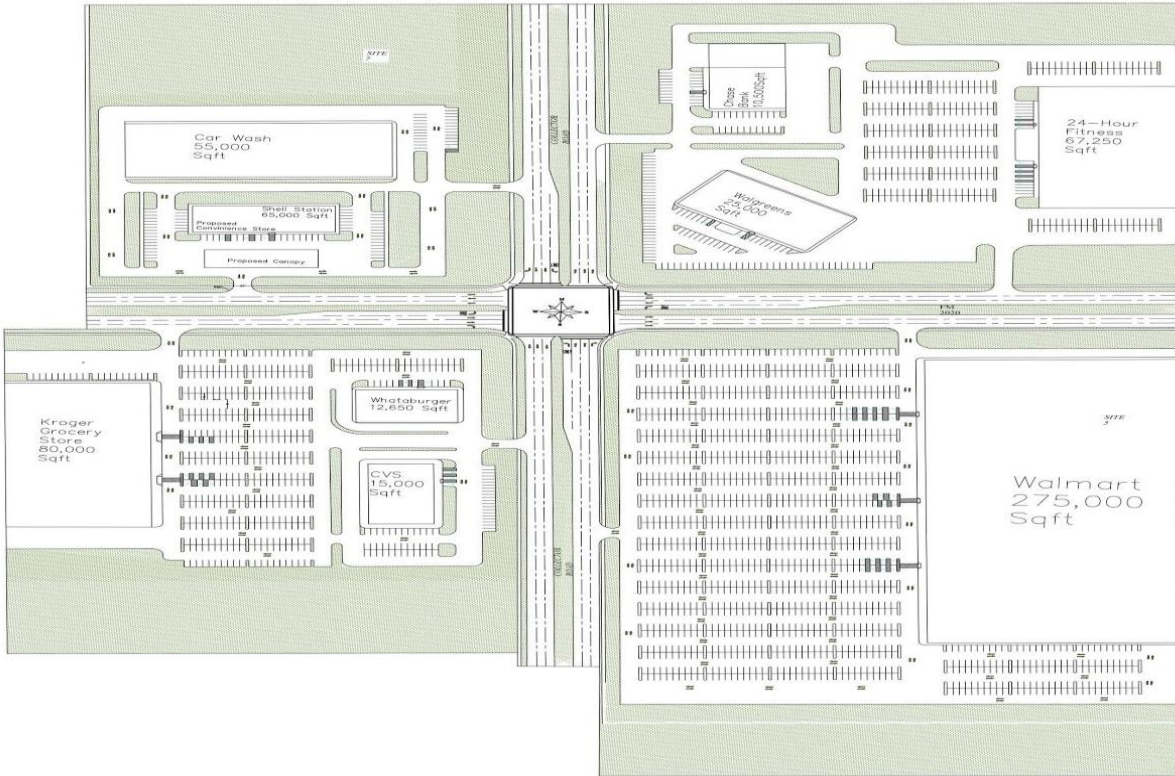
By taking into consideration a 25 foot minimum setback line from the right-of-way, and the square footage of each building and also the required parking for each building, the commercial site plan was developed separated by the two roads intersecting. A 6 foot sidewalk was provided next to the right of way. The planting strip dimensions provided next to the right-of-way, varied on each corner of the strip mall.



GRATE SECTION A-A

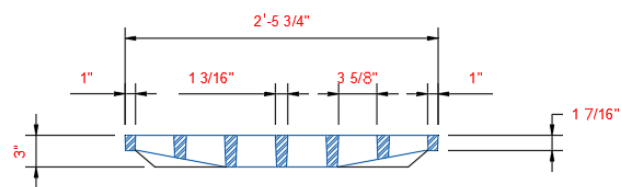


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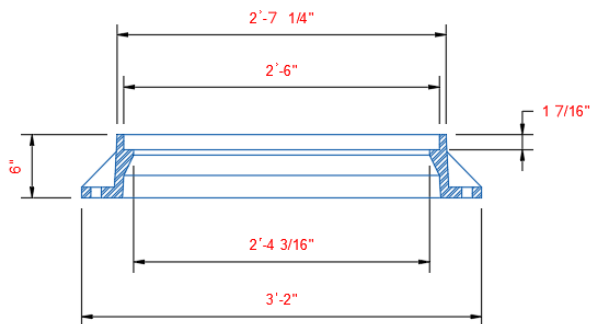


**Figure 2: Strip Mall Site Plan**

### 3. TRAFFIC



**GRATE SECTION A-A**



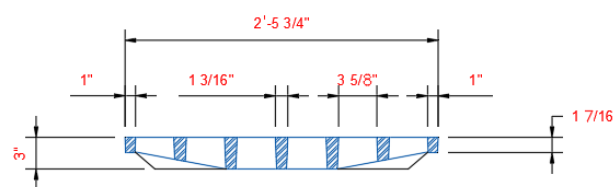
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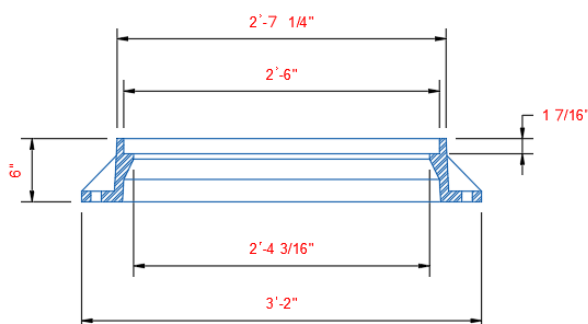
Desiring to know the number of lanes required on each road, the number of trips generated by the land use for each development was determined using the Trip Generation manual.

After calculating the numbers of trips, the basic volume generated in both FM2020 and Collector Road was approximately 1000 vehicles per lane. According to AASHTO's criteria for new developments, there is a need of three lanes in each direction in both FM2020 and Collector Road.

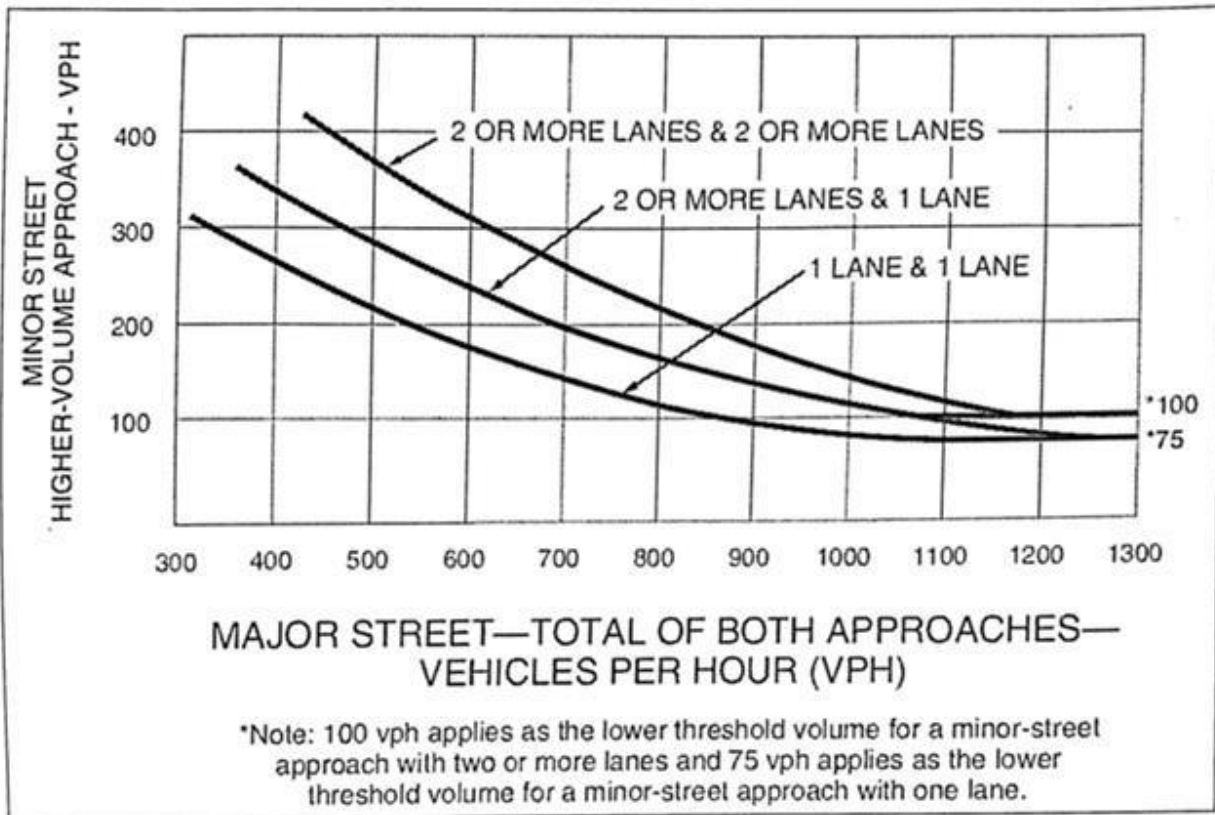
By using the signal warrant study at the intersection of FM2020 and the Collector Road it was determined that this new commercial development needed 2 or more lanes for both streets in each direction. The warrant 3 from the Manual on Uniform Traffic Control Devices, shown on the following figure helped on the determination of the number of lanes.



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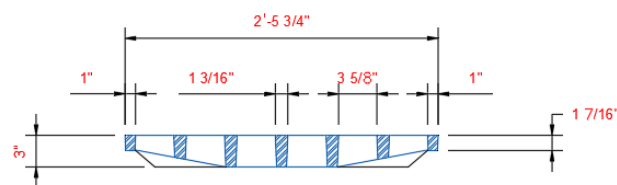
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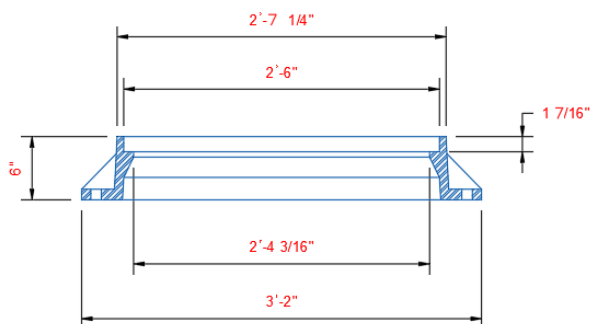
**Figure 3:** Warrant 3, Peak Hour (70 Percent Factor)

### 3.1. Signalization

It was required by the client for the design of traffic signals for the intersection of FM2020 and

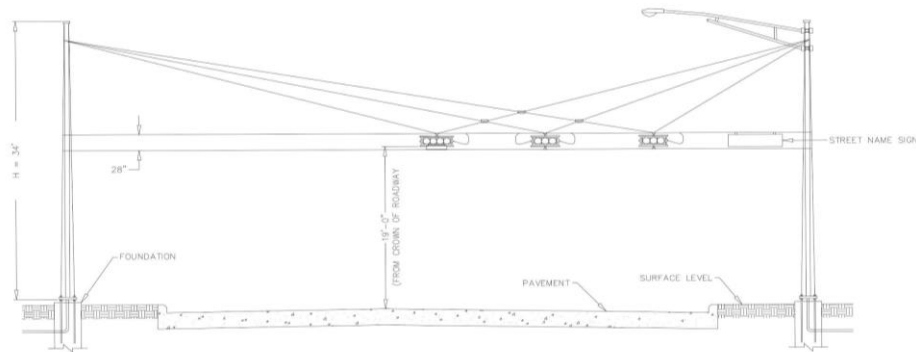


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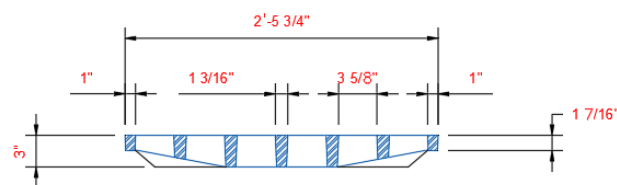


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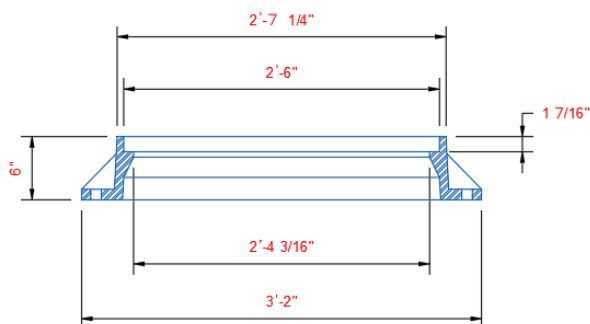
Collector Road. The following figure is the design of a traffic light typically used in Harris County. The traffic signal includes three LED traffic signals, but according to the number of lanes designed for this project, the correct traffic signal would include four LED traffic signals, one for each lane. The LED traffic signals are supported by two poles one on each end. The traffic signals poles are supported by a base plate that typically has a diameter of 21 inches. This type of traffic light have a design load of 3500 lbs. The 10036 foundation type is the one most used.



**Figure 4: Traffic Signal Design**



**GRATE SECTION A-A**



**FRAME SECTION A-A**

### 3.2. Vehicle detection Systems

According to the City of Houston standards, inductive loop vehicle detection systems. Inductive loops are considered the most reliable traffic classification detection method available.

Inductive loops work like a metal detector as they measure the change in the field when a vehicle passes over them. Once a vehicle drives over a loop sensor the loop field changes which allows the detection device to detect the presence of a vehicle.

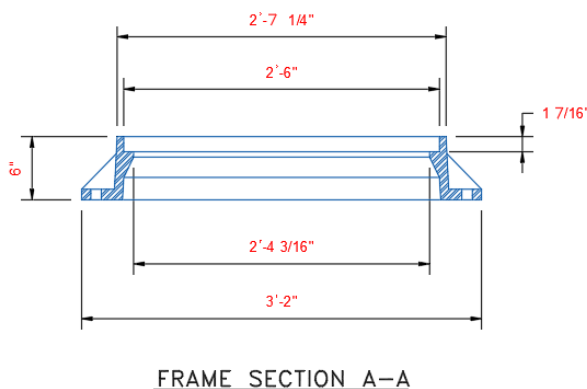
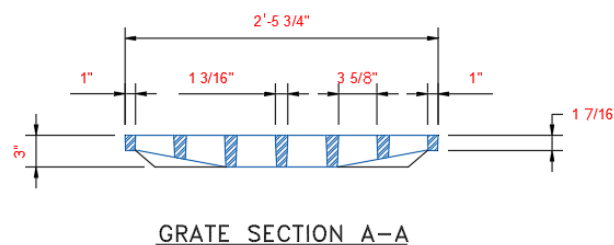
### 3.3. Parking Lots

The parking lot design objective is to maximize the total number of parking spaces in the space available with the following considerations:

- The parking lots were designed to provide continuous flow of traffic through the lot, safe movement of pedestrians from parking to buildings.
- All parking lots are accessible to people with disabilities

Parking lots were provided at the four corners of the commercial site at an angle of 90 degrees.

The minimum number of accessible parking spaces required depended on the total number of parking spaces in the lot and the total number of parking spaces in the lot are determined according to the square footage of the buildings.



A total number of four-hundred parking stalls were designed for the Kroger facility, one being van accessible and seven accessibles. Sixty parking stalls were provided for the CVS facility, one being van accessible and two accessibles. Fifty-one parking stalls were provided for the Whataburger facility, one being van accessible and two accessible.

The Shell gas station has a total number of sixty-five parking stalls, one van accessible and two accessibles. Twenty-five parking stalls were provided for the Car wash, one being van accessible.

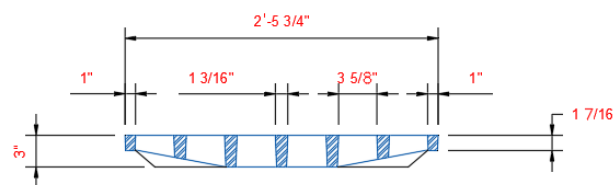
One-hundred parking stalls were provided for the Walgreens facility, one being van accessible and three accessible. Forty-two parking stalls were provided for the Chase facility, one accessible and one van accessible. Threehundred and thirty-seven parking stalls were provided for the 24-Hours Fitness facility, one being van accessible and seven accessibles.

All parking lots are two-way traffic, and also twenty-five foot circulation areas were provided.

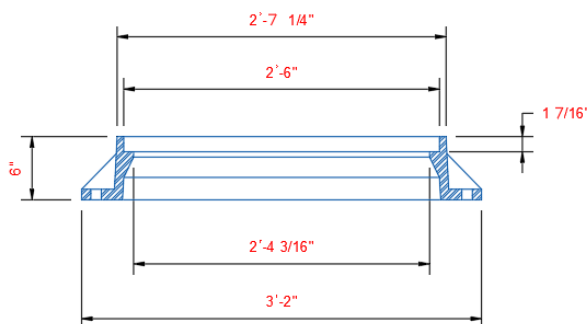
Twenty-five foot wide driveways right-of-ways with an angle of 20 foot were provided on the parking lots. All accessible parking spaces are conveniently located near to the building entrance.

Six foot wide and 5 inches thick sidewalks were provided.

### 3.4.1 Light Pole Foundation

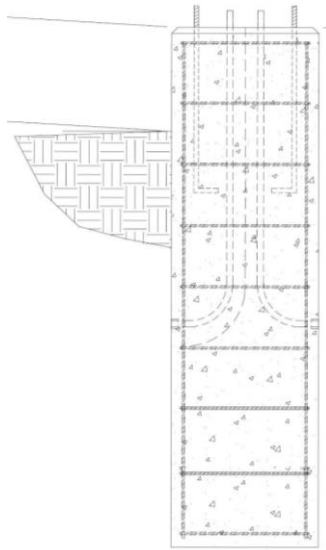


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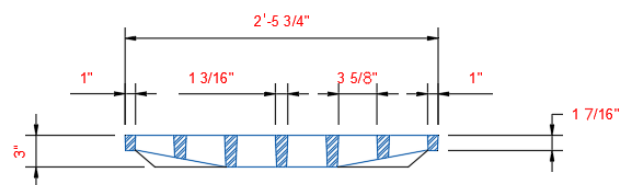


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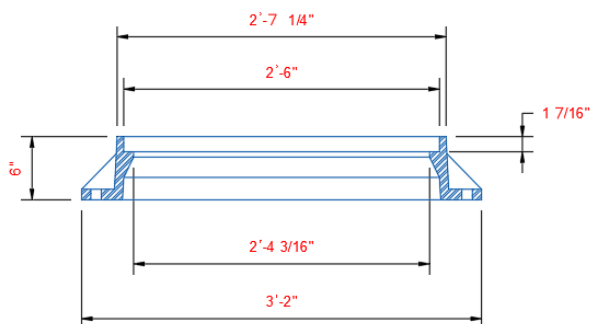
The following figure is a City of Houston's requirement of how a light pole foundation should be. Light poles foundations are two foot above the grade, eight foot below the grade and typically have a diameter of 2 foot. This foundation design is for 30 ft light foundation design. For the reinforcement of the foundation #4 reinforced bars are used.



**Figure 5: Light Pole Foundation**



GRATE SECTION A-A



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### 3.5. Striping

Parking spaces were permanently marked with striping in accordance with all federal, state and local standards. Parking stalls strips are four inches wide and extended the full length of the space.

All parking lots striping have white color in order to enhance visibility.

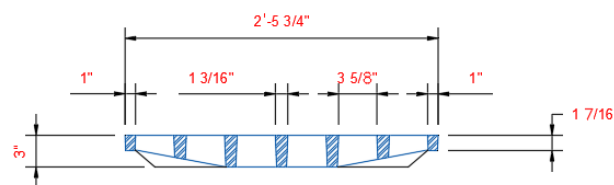
All parking spaces, exclusive of access drives or aisles, consist of a rectangular of eight and one-half 8.5 feet wide by eighteen (18) feet in length.

Accessible parking stalls for disabled persons were provided to conform the details and guidelines found in the Architectural Barriers Act – State of Texas and in the Texas Accessibility Standards (TAS). The number of the accessible parking spaces provided

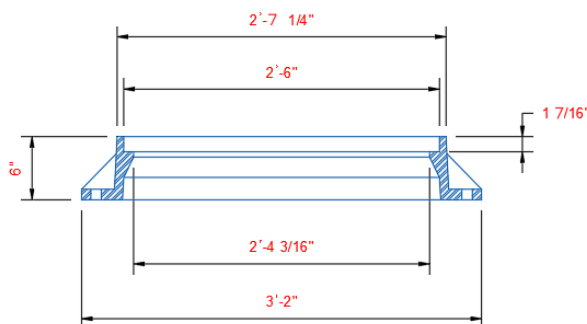
Accessible parking spaces are usually 8' wide with a 5' wide adjacent access aisle. Van accessible spaces require a 11' wide space with a 5' wide adjacent access aisle. Some parking spaces share a common access aisle.

Two-way access into parking facilities are identified by directional arrows.

## 4. TRANSPORTATION



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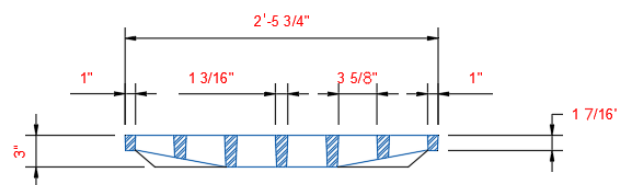
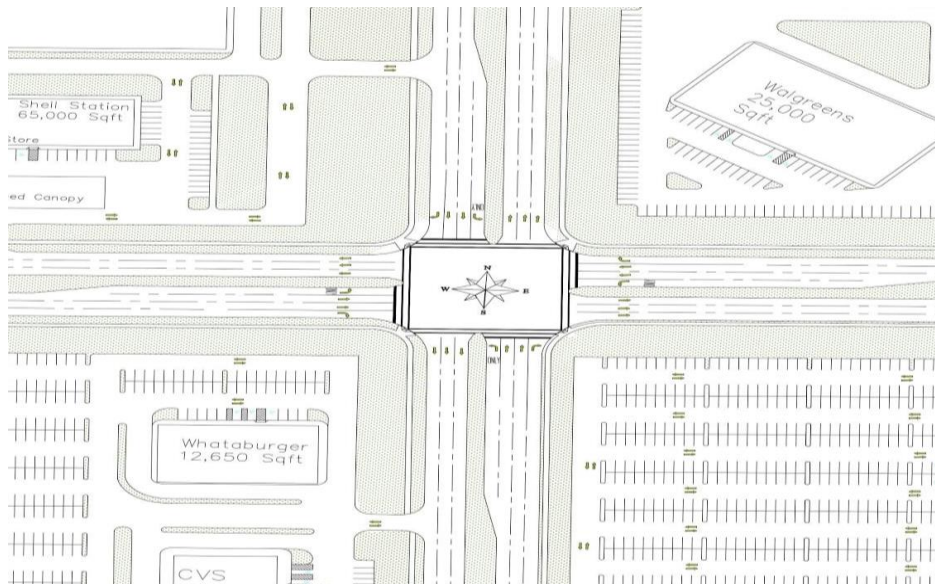


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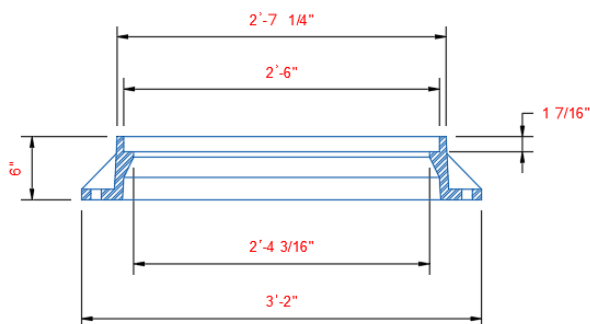
#### 4.1. Roadway Lanes

Three lanes with a left turn roadway were provided, each lane being 12 foot wide. The traffic lanes are separated by broken white lines usually 4 inches thick. The two ways traffic lanes are separated by a raised 26 foot median.

Twenty-four inches wide stop lines were provided at the intersection. The stop lines were used to indicate the point behind which vehicles are required to stop, in compliance with the traffic light signal. Crosswalk solid lines 12 inches wide were provided.



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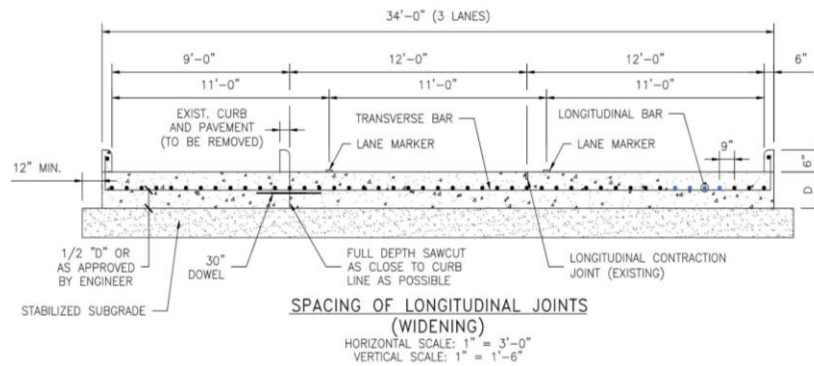
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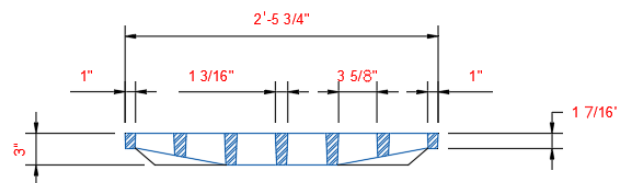
**Figure 6 : Intersection Layout**

#### 4.2. Pavement Details

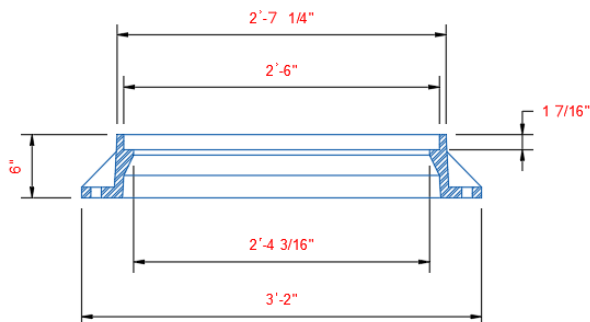
The following figures are typical of Houston's standard for how a typical concrete curb and also the spacing of longitudinal joints should look.



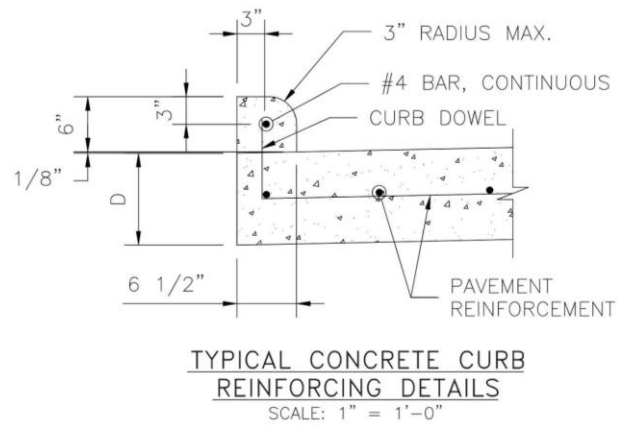
**Figure 7: Spacing of Longitudinal Joints**



**GRATE SECTION A-A**



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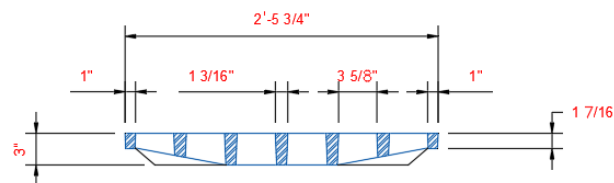
**Figure 8: Typical Concrete Curb**

## 5. WATER RESOURCES

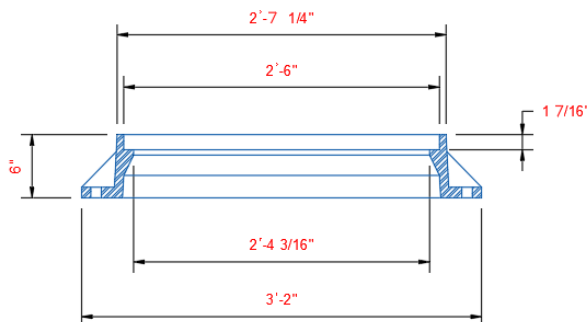
### 5.1. Detention Pond

For this project, detention ponds were required in order for the water collected on the lots to be held, and prevent the water from flowing outside of the property. The total impervious area in acres was obtained by measuring it on autocad, and by using the total area the total volume was calculated.

Based on the total volume, the dimensions of the truncated square pyramid shape detention pond were obtained.

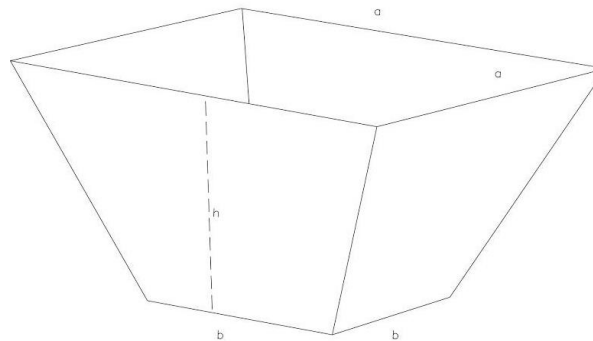


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The following figure shows a truncated square pyramid shape with the letters that represent its dimensions. The designed detention pond has a bottom area of 150 by 150 foot, top area of 175 by 175 foot and a height of 14.5 foot.

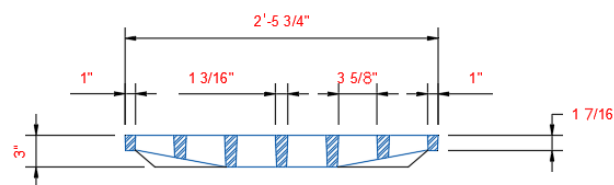


**Figure 9:** Truncated square pyramid shape detention pond

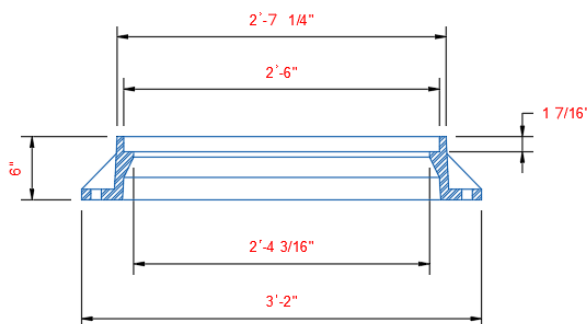
## 5.2 Storm Water Collection

Grading and drainage is done on a commercial lot in order to direct storm water and keep the flow of water steadily moving so that flood conditions are limited. Water falls into the inlet through a grate instead of an opening in the curb. Designers use many variations of this inlet type, and the format of the grate itself varies widely as each foundry may have its own series of standard fabrication molds.

Grate inlets adapt to urban roadway features such as driveways, street intersections, and



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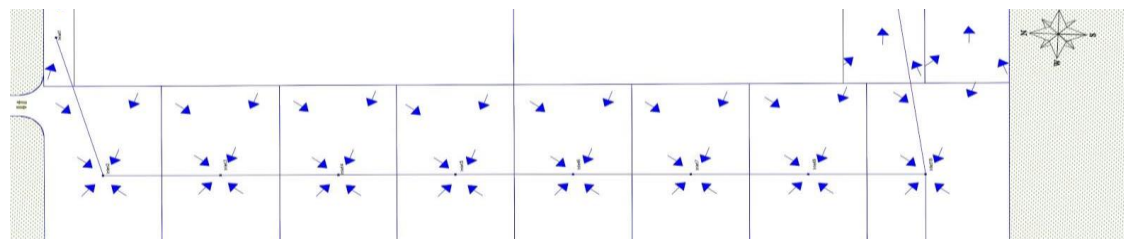


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medians. When grate inlets are specified, the grate configuration and orientation should be compatible with bicycle and wheelchair safety.

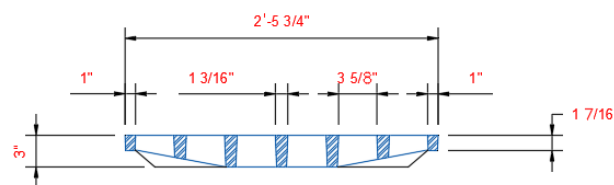
Access to the storm drain system through a grate inlet is excellent in that, usually, the grate is removable. On the other hand, maintenance of grate inlets can be a continuing problem during the life of the facility; the propensity to collect debris makes grate inlets a constant object of maintenance attention. As such debris accumulates it obstructs the flow of surface water into the inlet.

The lot was divided into 19 different drainage areas each of them having its own inlet. The following figure shows where the inlets were placed and also the way water flows into them.

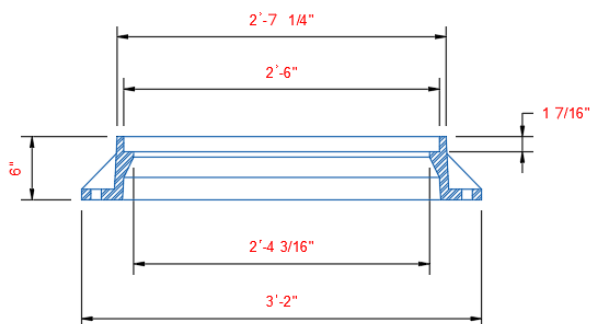


**Figure 10:** Inlets with drainage arrows

In order to calculate pipe diameter and size, velocity and also flow going through each inlet that flow into the Walmart detention pond a drainage chart was created. Using standard numbers from the city of Houston and Harris County's 100 year rainfall data, and the impervious and pervious areas.



GRATE SECTION A-A



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The following table contains thirteen columns and nineteen rows, this columns represent the drainage areas, total drainage areas, runoff coefficient, time of concentration, intensity, flow, pipe lengths, diameter of pipes, manning's coefficient, slope and velocity.

The flow of water (Q) was determined using the following rational equation:

$$Q = CIA$$

Intensity ( I ) was determined using the following equation:

$$I = \frac{b}{(d + eA)^n}$$

Where b, d, and e were obtained from the rainfall frequency for 100 year rainfall events.

The runoff coefficient (C) for commercial places is 0.80.

The time of concentration, Tc, was determined from the following equation:

$$T_c = 10L^{0.1761} + 15$$

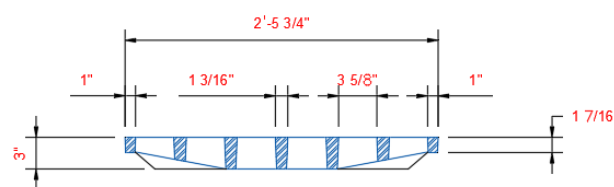
The length of pipe was obtained by measuring it on autocad.

The diameter of the pipes was determined using the following manning's equation for flow.

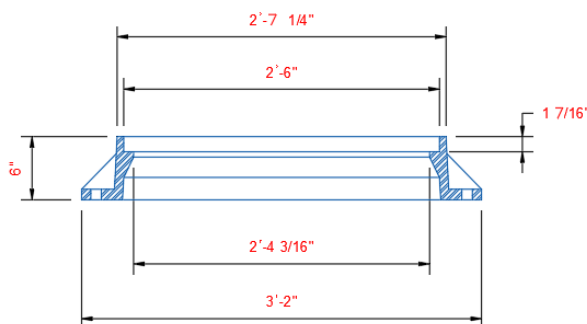
$$Q = \frac{1.49}{n} \times \frac{\pi}{4} D^2 \times \left(\frac{D}{4}\right)^{\frac{2}{3}} \times (S)^{\frac{1}{2}}$$

Manning's coefficient (n) of 0.015 was used based on the choice of using concrete pipes.

By using manning's equation for velocity purposes, the velocity of the pipes were obtained. The



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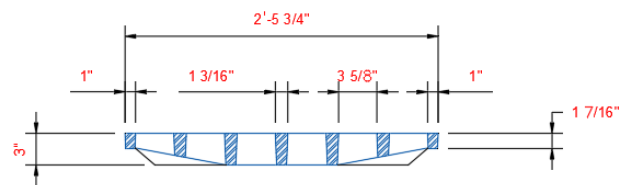
following equation was used:

$$Q = \frac{1.49}{C} \times \left(\frac{D}{4}\right)^{\frac{2}{3}} \times (S)^{\frac{1}{2}}$$

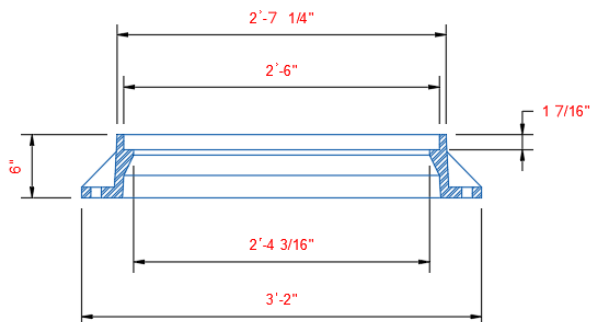
The pipes diameter varied from 10.9 to 23.6 inches.

**Table 1: Drainage Calculations**

| Inlet | Drainage Area / acres | Total Drainage Area (acres) | C Factor | Time of concentration min | Intensity | flow (Q)= CIA | Pipe Length (ft) | Size D in | mannings coefficient | slope | Velocity |
|-------|-----------------------|-----------------------------|----------|---------------------------|-----------|---------------|------------------|-----------|----------------------|-------|----------|
| 1     | 3.82                  | 3.82                        | 0.8      | 27.66                     | 6.72      | 20.55         | 171.6            | 19.1      | 0.015                | 0.02  | 7.6      |
| 2     | 0.63                  | 4.45                        | 0.8      | 28.01                     | 6.69      | 23.82         | 118.1            | 20.0      | 0.015                | 0.02  | 7.8      |
| 3     | 0.59                  | 5.04                        | 0.8      | 28.30                     | 6.66      | 26.88         | 118.1            | 20.6      | 0.015                | 0.02  | 8.0      |
| 4     | 0.59                  | 5.64                        | 0.8      | 28.56                     | 6.63      | 29.92         | 118.1            | 21.4      | 0.015                | 0.02  | 8.2      |
| 5     | 0.59                  | 6.23                        | 0.8      | 28.80                     | 6.61      | 32.95         | 118.1            | 22.0      | 0.015                | 0.02  | 8.3      |
| 6     | 0.59                  | 6.83                        | 0.8      | 29.02                     | 6.59      | 35.97         | 118.1            | 22.6      | 0.015                | 0.02  | 8.5      |
| 7     | 0.59                  | 7.42                        | 0.8      | 29.23                     | 6.57      | 38.98         | 118.1            | 23.1      | 0.015                | 0.02  | 8.6      |
| 8     | 0.59                  | 8.01                        | 0.8      | 29.43                     | 6.55      | 41.98         | 118.1            | 23.6      | 0.015                | 0.02  | 8.8      |
| 9     | 3.35                  | 11.36                       | 0.8      | 30.34                     | 6.46      | 58.73         | 77.2             | 26.2      | 0.015                | 0.02  | 9.4      |
| 10    | 0.56                  | 0.56                        | 0.8      | 24.04                     | 7.12      | 3.21          | 118.1            | 10.9      | 0.015                | 0.02  | 5.2      |
| 11    | 0.56                  | 1.13                        | 0.8      | 25.22                     | 6.98      | 6.31          | 118.1            | 13.4      | 0.015                | 0.02  | 6.0      |
| 12    | 0.56                  | 1.69                        | 0.8      | 25.97                     | 6.90      | 9.35          | 118.1            | 15.1      | 0.015                | 0.02  | 6.5      |
| 13    | 0.56                  | 2.26                        | 0.8      | 26.54                     | 6.84      | 12.36         | 118.1            | 16.4      | 0.015                | 0.02  | 6.9      |
| 14    | 0.58                  | 2.84                        | 0.8      | 27.02                     | 6.79      | 15.41         | 118.1            | 18.0      | 0.015                | 0.02  | 7.2      |
| 15    | 0.56                  | 3.40                        | 0.8      | 27.41                     | 6.75      | 18.37         | 118.1            | 18.4      | 0.015                | 0.02  | 7.4      |
| 16    | 0.56                  | 3.97                        | 0.8      | 27.75                     | 6.71      | 21.31         | 118.1            | 19.3      | 0.015                | 0.02  | 7.6      |
| 17    | 0.68                  | 4.65                        | 0.8      | 28.11                     | 6.68      | 24.84         | 208.3            | 20.2      | 0.015                | 0.02  | 7.9      |
| 18    | 0.73                  | 5.38                        | 0.8      | 28.45                     | 6.64      | 28.59         | 270.1            | 21.1      | 0.015                | 0.02  | 8.1      |
| 19    | 0.69                  | 6.07                        | 0.8      | 28.74                     | 6.62      | 32.12         | 125.9            | 21.8      | 0.015                | 0.02  | 8.3      |



**GRATE SECTION A-A**



**FRAME SECTION A-A**

### 5.3. Inflow and Outflow Hydrographs

It is necessary to adjust the capacity of the detention pond for flood purposes.

Reservoir routing derives the out-flow hydrograph from the detention pond.

Inflow hydrograph was determined at a time change of 900 seconds.

The inflow was determined by using the following equation:

$$Q = \left(\frac{Q_p}{2}\right) \left[1 - \left(\frac{Q_p}{Q_p}\right)\right] \quad Q \leq 1.25 Q_p$$

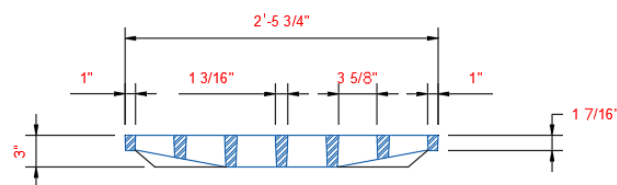
$$Q = 4.34 Q_p \left(-\frac{1.3 Q_p}{Q_p}\right) \quad Q < 1.25 Q_p$$

Time to peak discharge ( $t_p$ ) was obtained by the following formula:

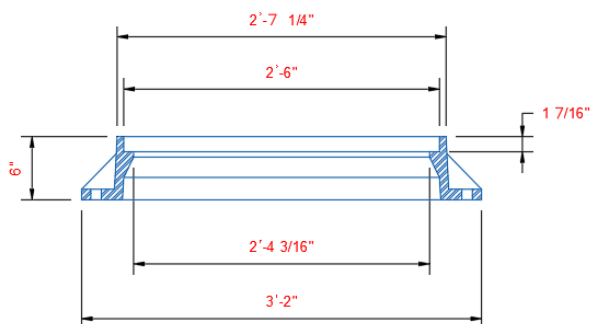
$$t_p = \frac{V}{1.39 Q_p}$$

Where (V) is the volume of the pond.

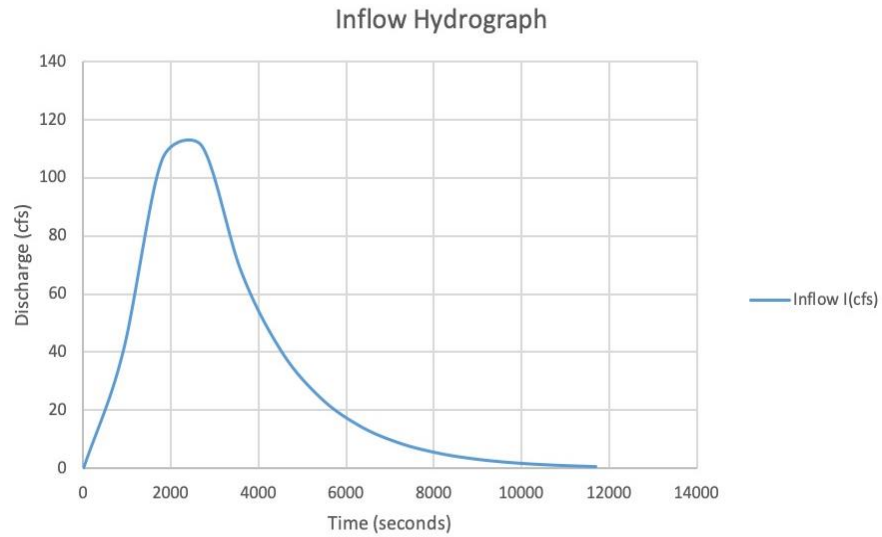
The peak discharge was obtained from the site runoff curves of 500-year frequency storm, taking in consideration the total drainage area in acres.



GRATE SECTION A-A



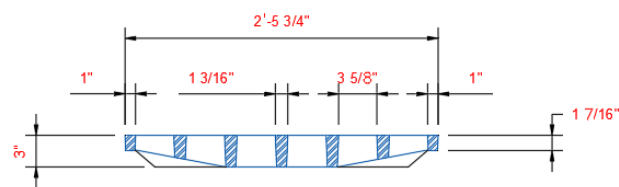
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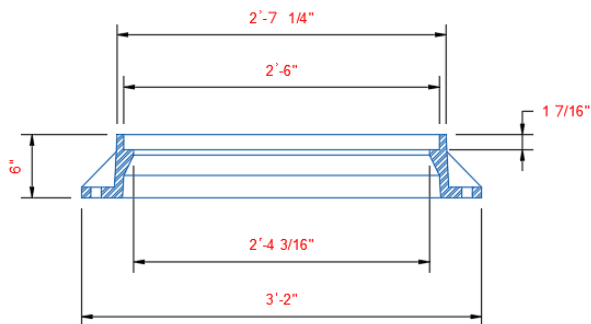
**Figure 11: Inflow Hydrograph**

Reservoir information was tabulated in the following table.

**Table 2: Data Tabulation**



**GRATE SECTION A-A**



**FRAME SECTION A-A**



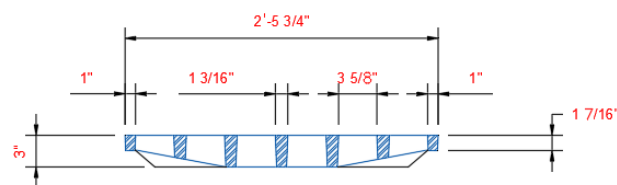
| Elevation (ft) | Head above crest (ft) | outflow O (cfs) | Storage (ft <sup>3</sup> ) | Reservoir area (acres) | Change in Storage ΔS (ac-ft) | Cumulative Storage (ac-ft) | Cumulative Storage (sfd) | 2s/Δt + O (cfs) | 2s/Δt - O (cfs) |
|----------------|-----------------------|-----------------|----------------------------|------------------------|------------------------------|----------------------------|--------------------------|-----------------|-----------------|
| 1.00           | 0.00                  | 0.00            | 383763.60                  | 8.81                   | 4.41                         | 0.00                       | 0.00                     | 0.00            | 0.00            |
| 2.00           | 0.50                  | 14.25           | 383763.60                  | 8.81                   | 4.41                         | 4.41                       | 2.22                     | 32.05           | 3.54            |
| 3.00           | 1.00                  | 20.16           | 383763.60                  | 8.81                   | 4.41                         | 8.81                       | 4.45                     | 55.75           | 15.44           |
| 4.00           | 1.50                  | 24.69           | 383763.60                  | 8.81                   | 4.41                         | 13.22                      | 6.67                     | 78.08           | 28.70           |
| 5.00           | 2.00                  | 28.51           | 383763.60                  | 8.81                   | 4.41                         | 17.62                      | 8.90                     | 99.70           | 42.68           |
| 6.00           | 2.50                  | 31.87           | 383763.60                  | 8.81                   | 4.41                         | 22.03                      | 11.12                    | 120.86          | 57.12           |
| 7.00           | 3.00                  | 34.92           | 383763.60                  | 8.81                   | 4.41                         | 26.43                      | 13.35                    | 141.70          | 71.87           |
| 8.00           | 3.50                  | 37.71           | 383763.60                  | 8.81                   | 4.41                         | 30.84                      | 15.57                    | 162.30          | 86.87           |
| 9.00           | 4.00                  | 40.32           | 383763.60                  | 8.81                   | 4.41                         | 35.24                      | 17.80                    | 182.70          | 102.07          |
| 10.00          | 4.50                  | 42.76           | 383763.60                  | 8.81                   | 4.41                         | 39.65                      | 20.02                    | 202.94          | 117.42          |
| 11.00          | 5.00                  | 45.08           | 383763.60                  | 8.81                   | 4.41                         | 44.05                      | 22.25                    | 223.06          | 132.90          |
| 12.00          | 5.50                  | 47.28           | 383763.60                  | 8.81                   | 4.41                         | 48.46                      | 24.47                    | 243.05          | 148.50          |
| 13.00          | 6.00                  | 49.38           | 383763.60                  | 8.81                   | 4.41                         | 52.86                      | 26.70                    | 262.95          | 164.20          |
| 14.00          | 6.50                  | 51.39           | 383763.60                  | 8.81                   | 4.41                         | 57.27                      | 28.92                    | 282.77          | 179.98          |
| 15.00          | 7.00                  | 53.33           | 383763.60                  | 8.81                   | 4.41                         | 61.67                      | 31.15                    | 302.51          | 195.84          |
| 16.00          | 7.50                  | 55.21           | 383763.60                  | 8.81                   | 4.41                         | 66.08                      | 33.37                    | 322.18          | 211.76          |
| 17.00          | 8.00                  | 57.02           | 383763.60                  | 8.81                   | 4.41                         | 70.48                      | 35.60                    | 341.79          | 227.75          |
| 18.00          | 8.5                   | 58.7722113      | 383763.60                  | 8.81                   | 4.41                         | 74.89                      | 37.82                    | 361.34          | 243.79          |
| 19             | 9                     | 60.4761065      | 383763.60                  | 8.81                   | 2.20                         | 77.09                      | 38.93                    | 371.94          | 250.99          |

This table contains elevation head above crest increased by 0.5 ft, detention pond storage, change in storage and the cumulative storage column. The following columns were obtained by adding or subtracting the outflow at each elevation from  $2s/\Delta t$ .

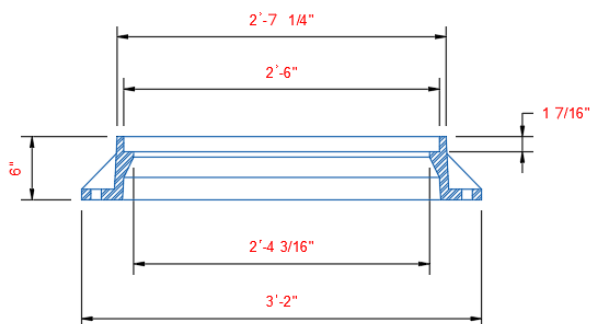
Outflow was obtained by using the following equation:

$$Q = C_d \sqrt{2gh}$$

**Table 3: Routing table**



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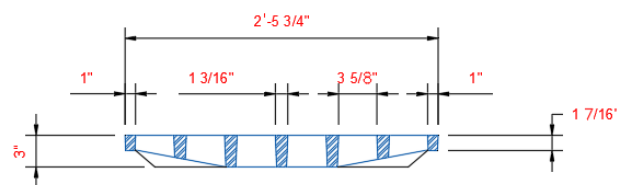


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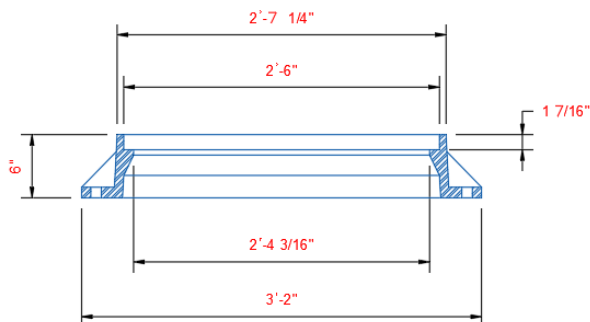
|       | ROUTING TABLE |                |                   |                   |               |
|-------|---------------|----------------|-------------------|-------------------|---------------|
| Index | Time (hours)  | Inflow I (cfs) | $2S/\Delta t - O$ | $2S/\Delta t + O$ | Outflow (cfs) |
| 1     | 0             | 0.0            | 0.00              | 0.00              | 0.00          |
| 2     | 0.25          | 39.91          | 7.00              | 39.91             | 17.00         |
| 3     | 0.5           | 106.54         | 77.00             | 153.45            | 36.70         |
| 4     | 0.75          | 111.26         | 182.50            | 294.80            | 52.50         |
| 5     | 1             | 68.07          | 240.00            | 361.83            | 58.80         |
| 6     | 1.25          | 40.93          | 235.00            | 349.00            | 57.80         |
| 7     | 1.5           | 24.61          | 190.00            | 300.54            | 53.00         |
| 8     | 1.75          | 14.79          | 137.00            | 229.40            | 46.00         |
| 9     | 2             | 8.90           | 85.00             | 160.69            | 37.80         |
| 10    | 2.25          | 5.35           | 42.00             | 99.25             | 28.70         |
| 11    | 2.5           | 3.22           | 12.00             | 50.57             | 19.00         |
| 12    | 2.75          | 1.93           | 3.00              | 17.15             | 8.00          |
| 13    | 3             | 1.16           | 1.00              | 6.10              | 2.30          |
| 14    | 3.25          | 0.70           | 0.00              | 2.86              | 0.50          |

This table contains time in hours, calculated inflow,  $2S/\Delta t - O$ ,  $2S/\Delta t + O$  and also the calculated outflow mentioned before.

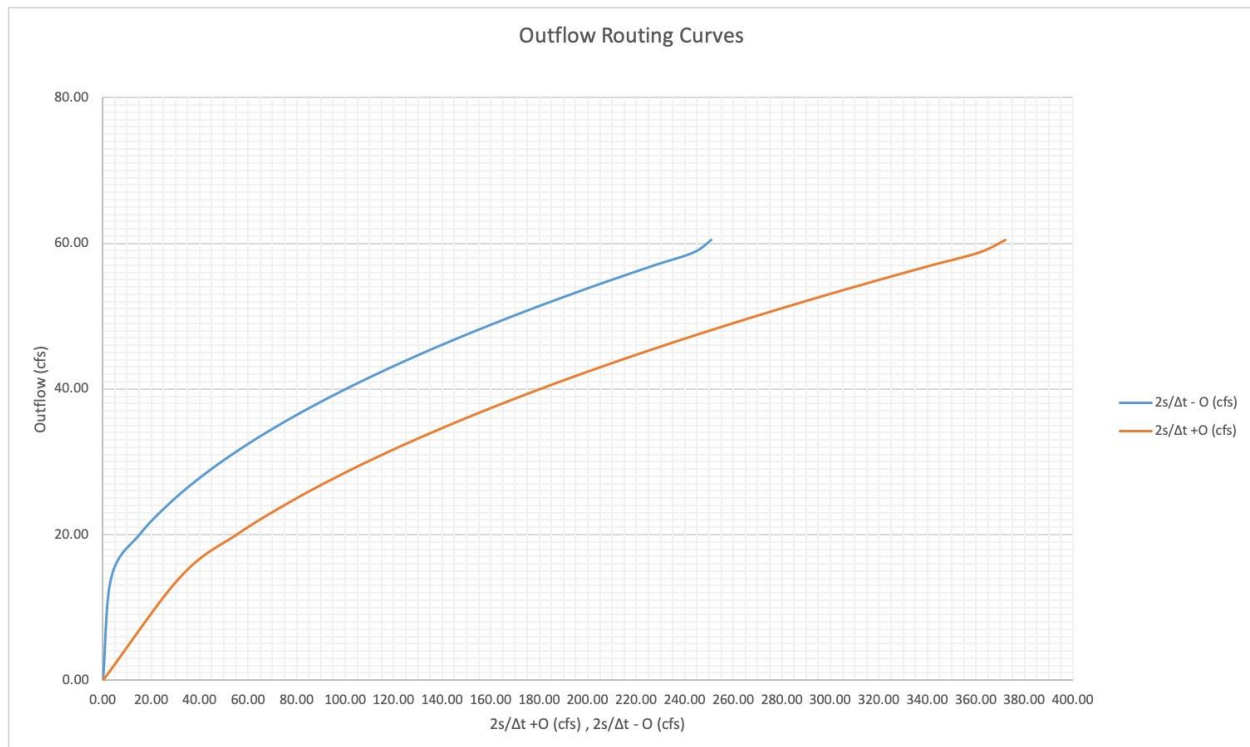
The following graph shows the relationship between the outflow versus  $2S/\Delta t \pm O$ . The outflow is located on the y-axis and  $2S/\Delta t \pm O$  are located on the x-axis.



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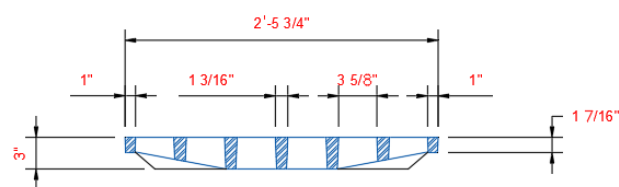


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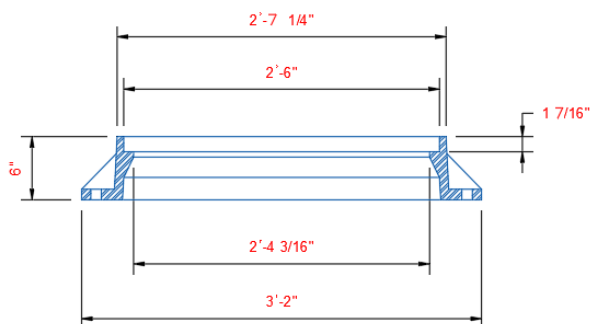


**Figure 12: Routing curves**

By using the observed outflow numbers on the routing curves and also by using the inflow data, the inflow and outflow hydrograph was graphed. Inflow represents hydrograph at

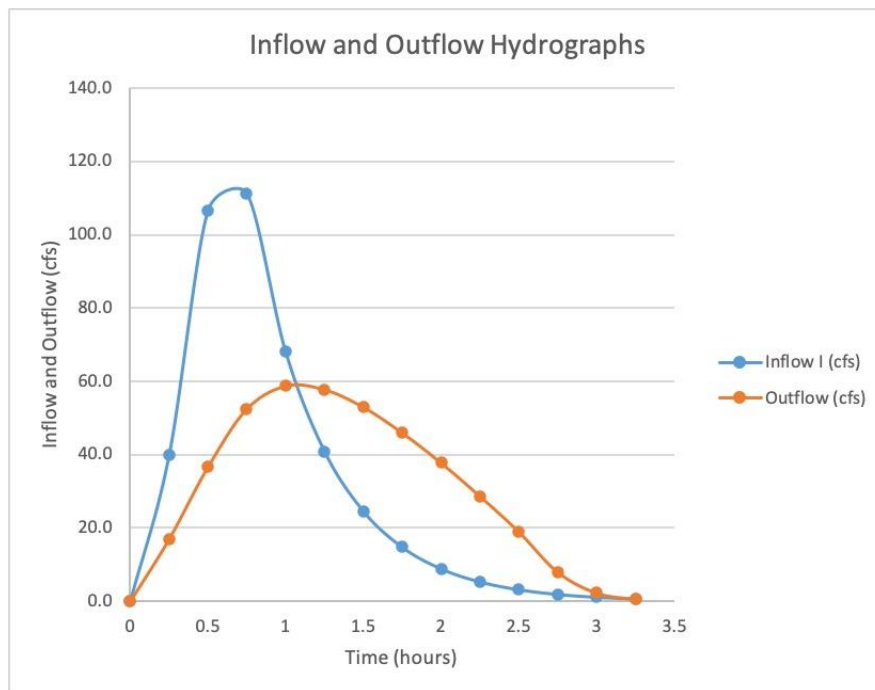


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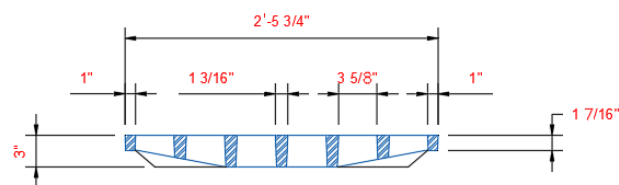
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upstream and outflow represents the routed hydrograph at downstream.

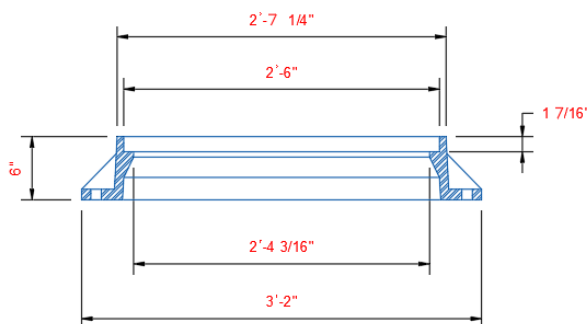


**Figure 13:** Inflow and Outflow Hydrographs

The previous figure shows a graphical representation of inflow and outflow hydrographs. The



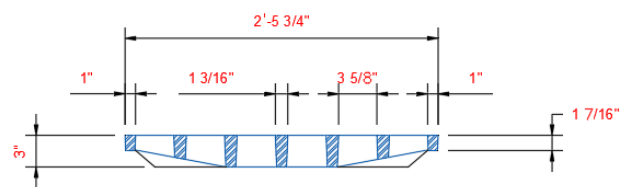
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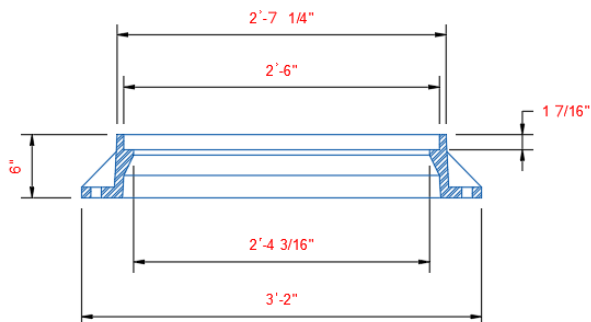
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resulting decrease in magnitude of the flood peak is the difference between both of the hydrographs and it is called attenuation. It was measured to be 52.46 cubic foot per second.

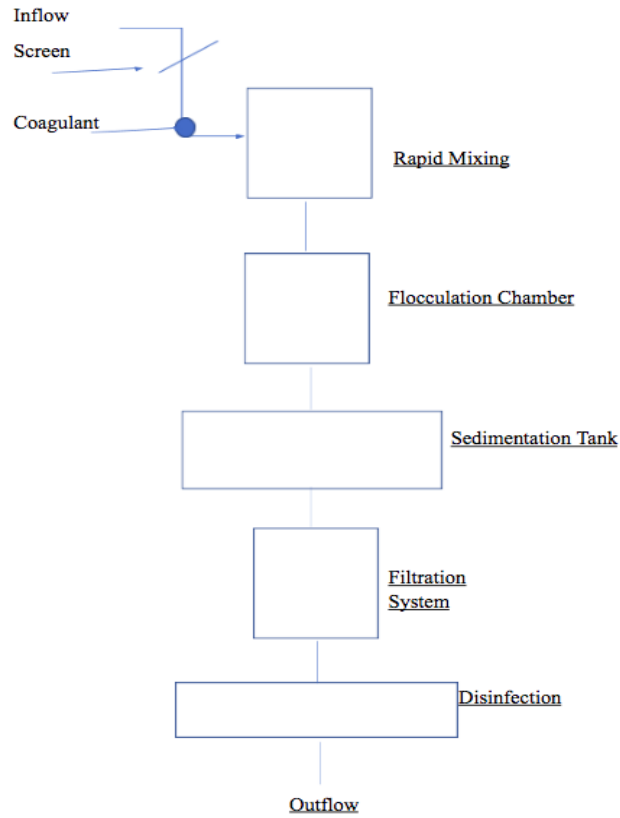
## 6. ENVIRONMENTAL



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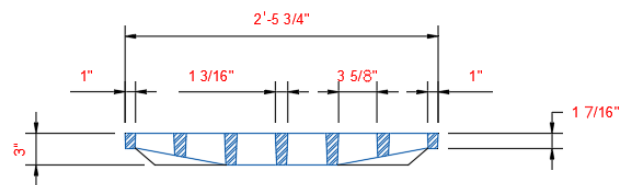


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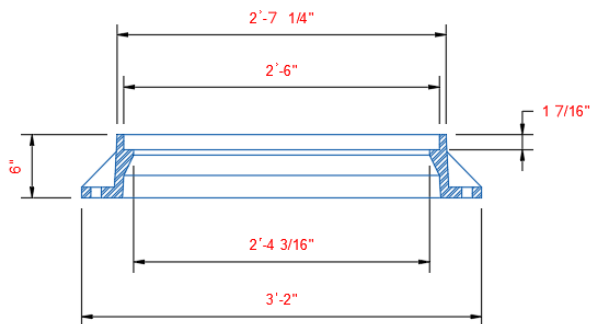


**Figure 14:** Water Treatment Schematic

It will be assumed that the water that will be used to supply the development will be surface water (similar to the majority of the City of Houston’s water supply). For this project, the water



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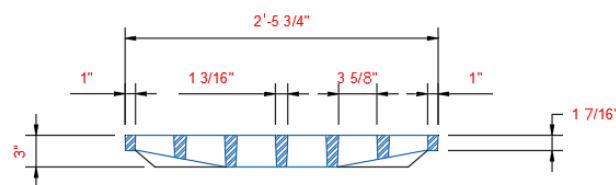


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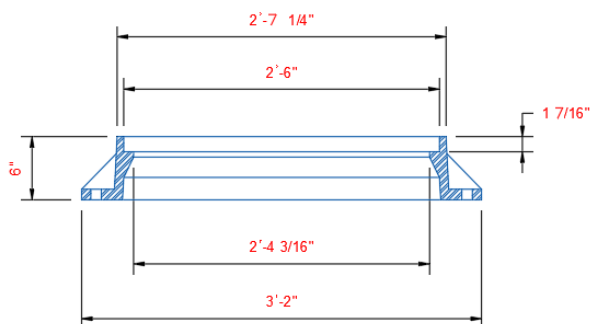
quality from the two rivers, the Trinity River and the Brazos River, was obtained from TCEQ and placed their values in the tables below -- both of these being rivers that the City of Houston uses for water purposes.

**Table 4: Water Quality for the Trinity River**

| Water System No.: |               | TX1010013 |     |       |
|-------------------|---------------|-----------|-----|-------|
| Constituent       | Concentration | Units     | MCL | Units |
| Turbidity         | 34.1          | NTU       | 4   | NTU   |
| Total Alkalinity  | 56.5          | mg/L      | 200 | mg/L  |
| Calcium           | 39.15         | mg/L      | 80  | mg/L  |
| Magnesium         | 3.625         | mg/L      | 30  | mg/L  |
| pH                | 7.3           |           |     |       |
| TDS               | 132.5         | mg/L      | 500 | mg/L  |
| Fluoride          | 0.115         | mg/L      | 4   | mg/L  |
| Chloride          | 18            | mg/L      | 5   | mg/L  |
| HAA5              | 30.55         | ug/L      | 60  | ug/L  |
| Total Hardness    | 105.5         | mg/L      | 120 | mg/l  |



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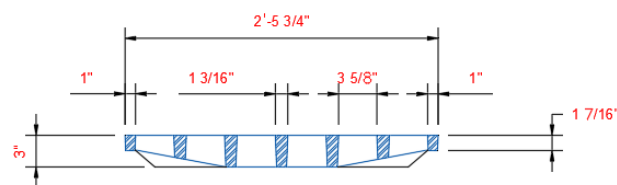


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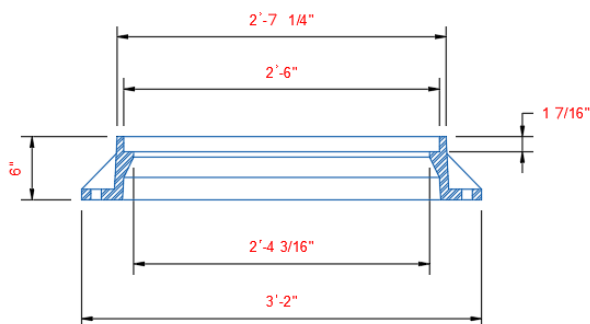
**Table 5: Water Quality for the Brazos River**

| Water System No.: |               | TX0840153 |     |       |
|-------------------|---------------|-----------|-----|-------|
| Constituent       | Concentration | Units     | MCL | Units |
| Turbidity         | 58.8          | NTU       | 4   | NTU   |
| Alkalinity        | 154           | mg/L      | 200 | mg/L  |
| Calcium           | 38.8          | mg/L      | 80  | mg/L  |
| Magnesium         | 7.13          | mg/L      | 30  | mg/L  |
| pH                | 7.1           | mg/L      |     |       |
| TDS               | 238           | mg/L      | 500 | mg/L  |
| Fluoride          | 0.53          | mg/L      | 4   | mg/L  |
| Chloride          | 47            | mg/L      | 5   | mg/L  |
| HAA5              | 15.2          | ug/L      | 60  | ug/L  |
| Total Hardness    | 126           | mg/L      | 120 | mg/l  |

The different stages of treatment that will be present in the water treatment plant will be for the treatment of high turbidity because it is surface water. Since there is a slightly high level in the total hardness, there will not be softening treatment to the water since the average of the two water sources do not exceed the maximum contaminant level for the hardness. Combining the two water sources, the final total hardness will be under the maximum contaminant level requirement from the EPA. The two water sources will be combined to treat the water at one water treatment plant for this development.



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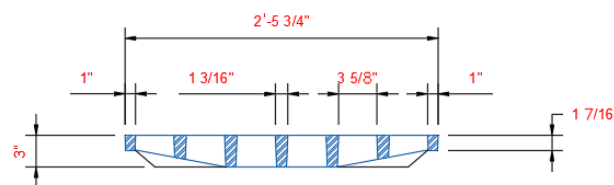
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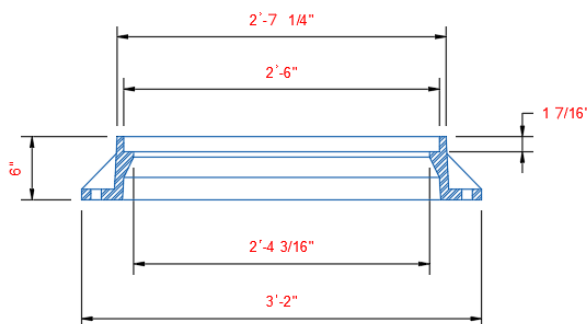
For the treatment of Turbidity, the components will be the introduction of a coagulant, a rapid mixing chamber, a flocculation basin, a sedimentation tank, and a filtration system, with the result being the distribution to the public. Since the water that is going to be treated is surface water, there will need to be a treatment station for disinfection at the end of the turbidity treatment.

Before coagulation, there will be screens of varying sizes to help in removing any larger particles or solids in the water. Coagulation will be the first part of the treatment process that will allow for the suspended solids from the water to eventually be removed while also treating for turbidity and the color of the water for aesthetic purposes. This process alone was greatly increasing the water quality, and the importance of this process allows for the water to be ready for other stages of treatment. The coagulation process is first determined by measuring the amount of alum that should be used.

The rapid mixing tank is the first chamber in which the water will be entering for the water treatment process. The rapid mixing tank provides an aggressive mixing to ensure a uniform distribution of the coagulant used, which in this treatment will be alum. For a rapid mixing tank, there are certain design criteria that is required from the Texas Administrative Code requiring the



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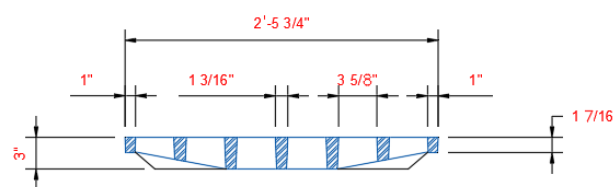
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volume of a tank not to exceed eight (8) cubic meters. The detention time for the tank is also required to be in a range of twenty (20) to sixty (60) seconds with G values ranging from seven hundred and fifty to one thousand (750 – 1000) per second units ( $s^{-1}$ ).

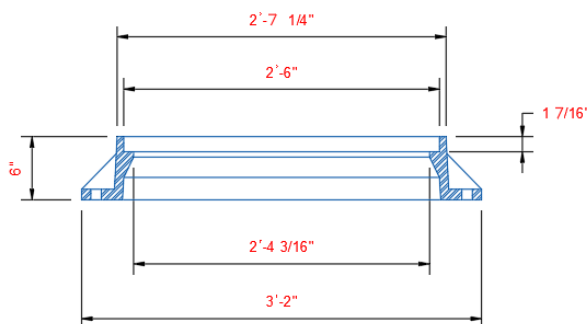
The flocculation chamber is a necessary part of the water treatment for the water to reduce its turbulence for its flow to the sedimentation tank. The flocculation segment of the treatment will be divided into three separate chambers for the reduction of turbulence. For the design criteria, the length of the chamber and the depth will be kept the same as the baffles that will be providing mixing will need to have the necessary space to provide the uniform mixing required.

The sedimentation tank will receive the flow of water from containing the suspended solids for them to settle. The water will entire the sedimentation at the inlet zone proceeding into the settling zone where the suspended solids will settle to the bottom. The water will then proceed through the outlet zone while the suspended solids, which are formed floc, will settle and go to the sludge zone. The necessary design criteria for the sedimentation tank will be as follows.

The filtration process will allow for the water to be passed through a variety of different granular objects, which can be either sand or produced plastics. For this water treatment plan there will be the use of rapid sand filters for optimal filtration due to the tight pores the sand can produce.

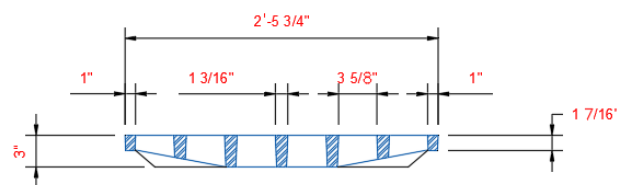


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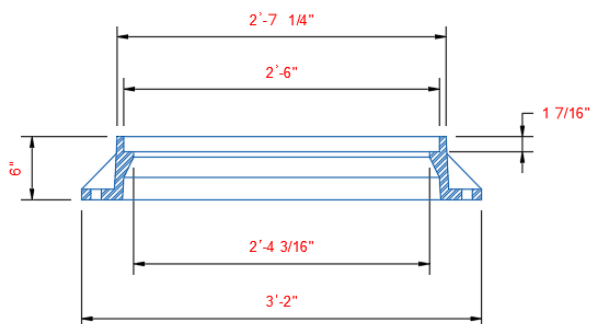


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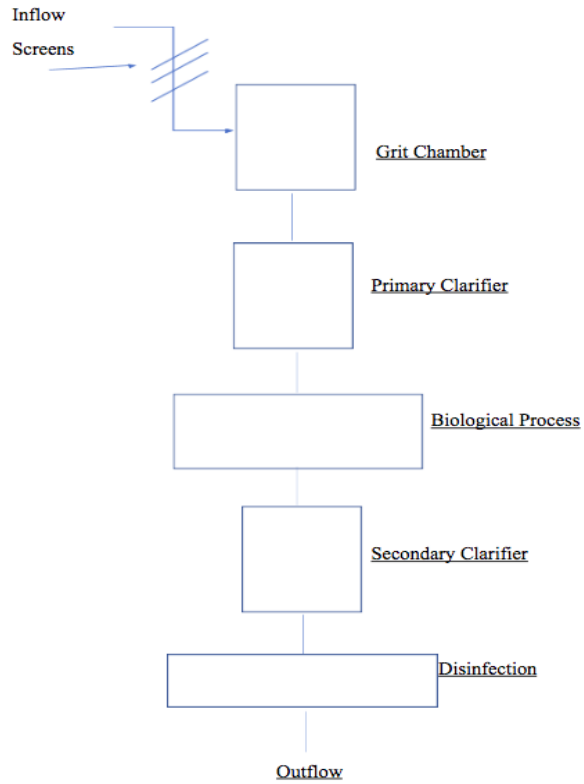
Microorganisms can be found in raw water from rivers, lakes and groundwater. While not all microorganisms are harmful to human health, there are some that may cause diseases in humans. These are called pathogens. Pathogens present in water can be transmitted through a drinking water distribution system, causing water-borne disease in those who consume it. Chlorination is one of many methods that can be used to disinfect water. This method was first used over a century ago, and is still used today. It is a chemical disinfection method that uses various types of chlorine or chlorine-containing substances for the oxidation and disinfection of what will be the potable water source.



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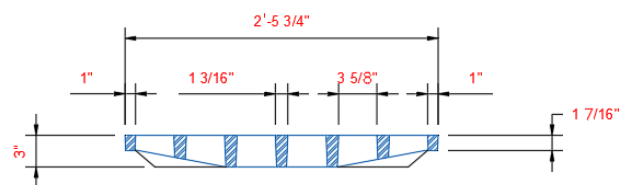


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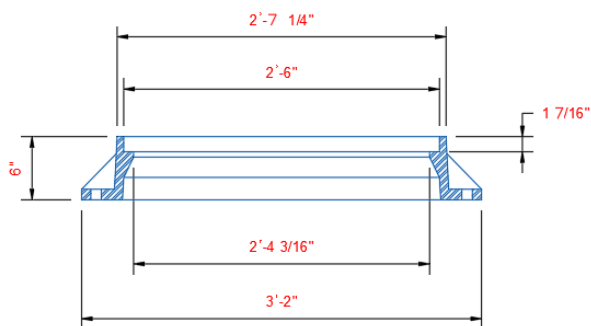


**Figure 15: Wastewater Treatment Schematic**

The design criteria for a wastewater treatment plant is shown in the Texas administrative code chapter 30 subchapter B for the estimated organic loading rates and flow rates for a new



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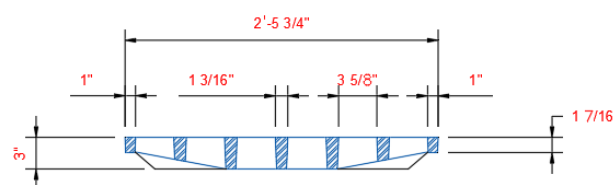
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wastewater treatment facility. There are different design criteria for different sources of wastewater to be treated. The wastewater facility is to design for a residential municipality.

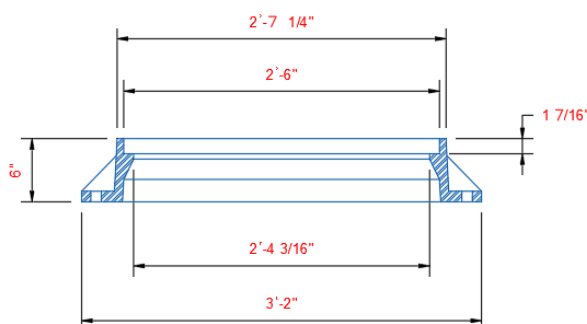
Wastewater Screening is the principal unit activity in all wastewater treatment plants. The screen is the gadget used to hold solids found in the influent wastewater to the treatment plant. The main purpose of screening is to remove solid materials that could. Cause damage to other process equipment. Cause reduction in efficiency of the whole system Contaminate waterways. There are three distinct kinds of screenings: coarse screens, Fine screens, and Micro-screens.

The design of the wastewater treatment plant is being designed for peak flow to maximize the capacity of the plant can operate and treat efficiently. The grit chamber design criteria is expressed in the Texas administrative code, and the specifications are to provide two chambers that will operate at peak flow.

The primary clarifier will begin the wastewater treatment with the design criteria being established for the peak flow for the facility. The detention time specified by the Texas administrative code recommends 0.9 hours for a primary clarifier operating at peak flow. The detention time for normal flow is set to 1.8 hours, but that will only be a periodic detention time since the plant in being designed for the most extreme case at peak flow. The primary clarifier is expected to reduce the day five biological oxygen demand by 35 percent. The overflow rate for a primary clarifier is in the range of 30 to 50 cubic meters per day meters square but in the case for



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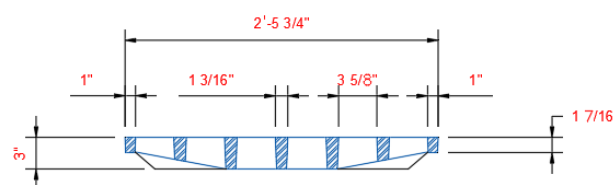
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peak flow the overflow rate at a much higher rate.

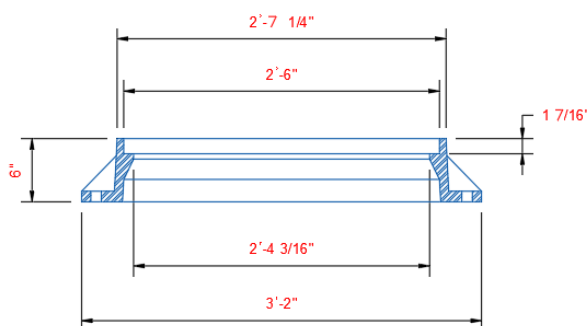
The biological process that will be established in this wastewater treatment plant will be a single stage trickling filter. The single stage trickling filter will allow the wastewater to increase in suspended solids to prepare for the further treatment of the secondary clarifier. As the suspended solids pass through the trickling filter medium, which can be a variety of materials ranging from gravel to engineered plastics, create spaces for the suspended solids to attach themselves. As the layers on the filter medium increase the organic matter is unable to obtain oxygen resulting in the detachment of the solids and filtered water flowing to the secondary clarifier.

The secondary clarifier will be designed using the higher of the two flow rate being the average flow rate and the peak flow design flow rate. The larger of the values will offer a larger and more capable sedimentation tank that can allow for the maximum quantity of water to be processed.

The impact of untreated domestic wastewater on community reservoirs has raised several health and safety concerns. The organisms of concern in domestic wastewater include: enteric bacteria, viruses, and protozoan cysts. In response to these concerns, disinfection is vital in the inactivation/destruction of pathogenic organisms. Many pathogens can be transmitted by waters contaminated by wastewater effluents, which should be disinfected to prevent the spread of pathogenic microorganisms, particularly when the wastewater is used for watering, drinking or



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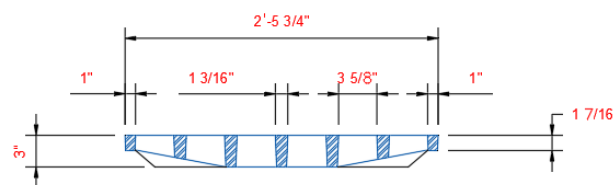
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bathing purposes. Wastewater disinfection is applied to provide protection to humans against exposure to waterborne pathogenic microorganisms. In order for disinfection to be effective, wastewater must be adequately treated.

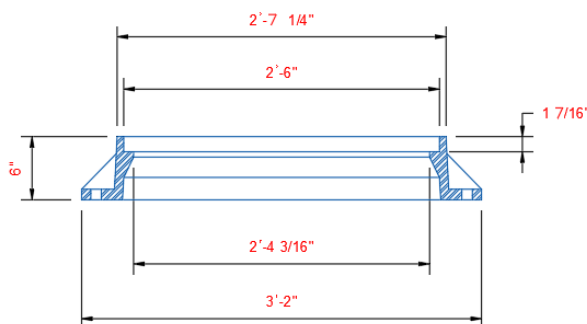
Chlorine is the most widely used disinfectant for municipal wastewater because it destroys target organisms by oxidizing cellular material. Chlorine can be supplied in many forms, which include: chlorine gas, hypochlorite solutions, and other chlorine compounds in solid or liquid form. Some alternative disinfectants include ozonation and ultraviolet (UV) disinfection. Choosing a suitable disinfectant for a treatment facility is dependent on the following criteria: ability to penetrate and destroy infectious agents under normal operating conditions; safe and easy handling, storage and shipping; absence of toxic residuals and mutagenic or carcinogenic compounds after disinfection; affordable capital and operation maintenance costs.

## 7. STRUCTURAL

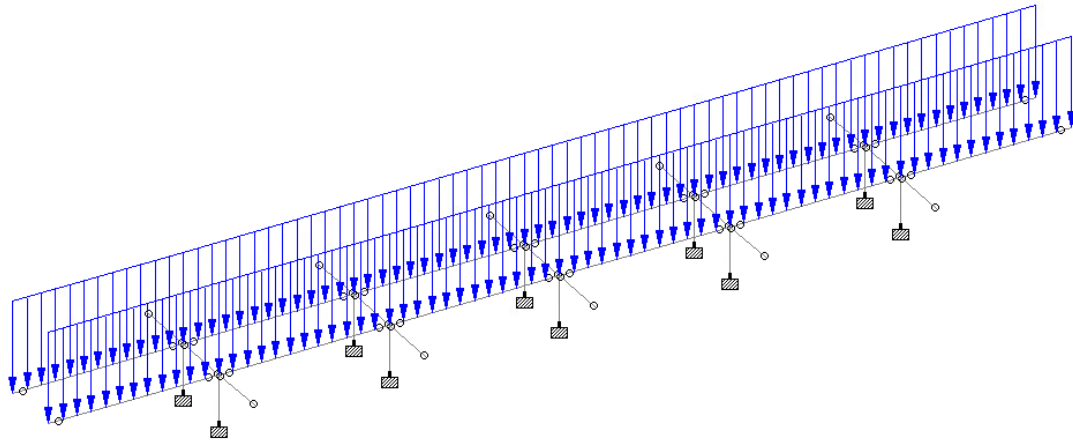
For this project, the structural layout including all beams and columns needed to be designed for the gas station canopy. There are 3 loads acting on the structure which include: dead, live, and wind load. The dead load is 20 psf which is found from building codes in the AISC manual.



GRATE SECTION A-A



FRAME SECTION A-A



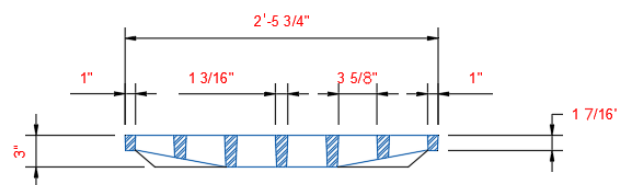
**Figure 16:** Dead Load Distribution

- The wind load was found by using the guidelines set forth in the ASCE 7-10 Chapter 30.

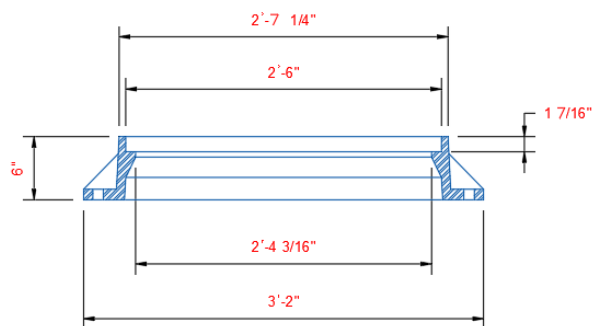
Basic Wind Speed is 160 mph.

Wind directionality factor ( $K_d$ ) is 0.85.

Exposure category is B.



GRATE SECTION A-A



FRAME SECTION A-A



Enclosure classification is open

Risk Category 3 (Table 1.5-1)

Using Chapter 30

Wind Figure 30.8-3

Roof Angle=0 degrees

Wind Area  $0.4(15\text{ft})=6\text{ ft}$

$C_n = (1.2-1.1)$  figure 30.8-2

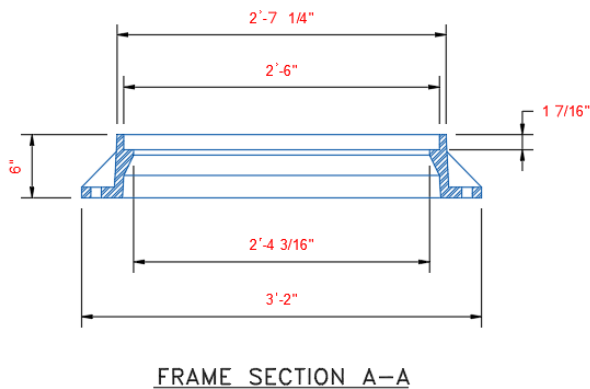
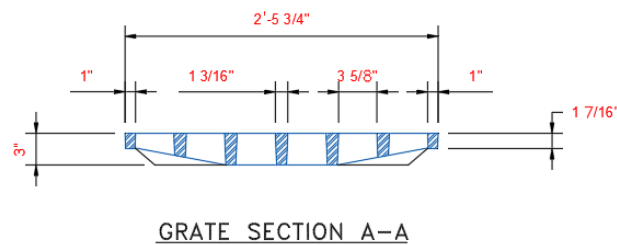
Rigid Building

$G=0.85$

$K_z=0.7$  table 30.3-1

$$Q_z = 0.00256(0.70)(1)(0.85)(160)^2 = 38.99 \text{ lb/ft}^2$$

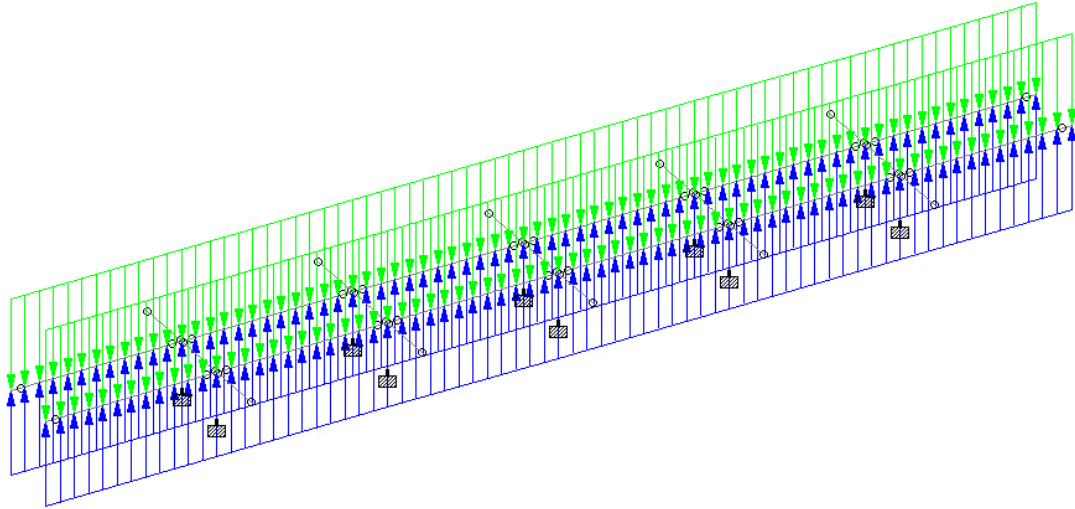
$$P = Q_z h G C_n$$



$$=38.99 \text{ lb/ft}^2(0.85)(1.2)=39.76$$

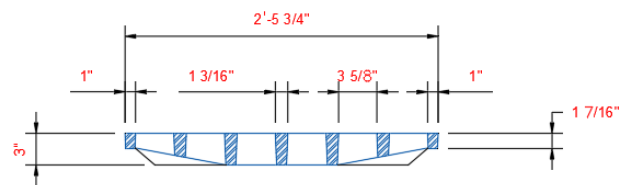
$$=38.99 \text{ lb/ft}^2(0.85)(-1.1)=-36.45$$

Below are the wind load calculations implemented into STAAD PRO in order to represent the proper loads on the canopy.

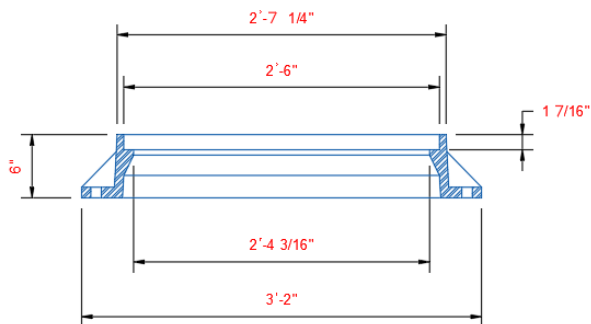


**Figure 17: Wind Load Distribution**

The columns and beams for the canopy framing were determined using STAAD PRO and



**GRATE SECTION A-A**



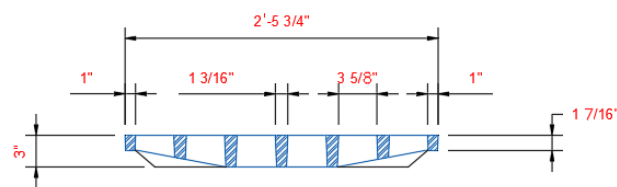
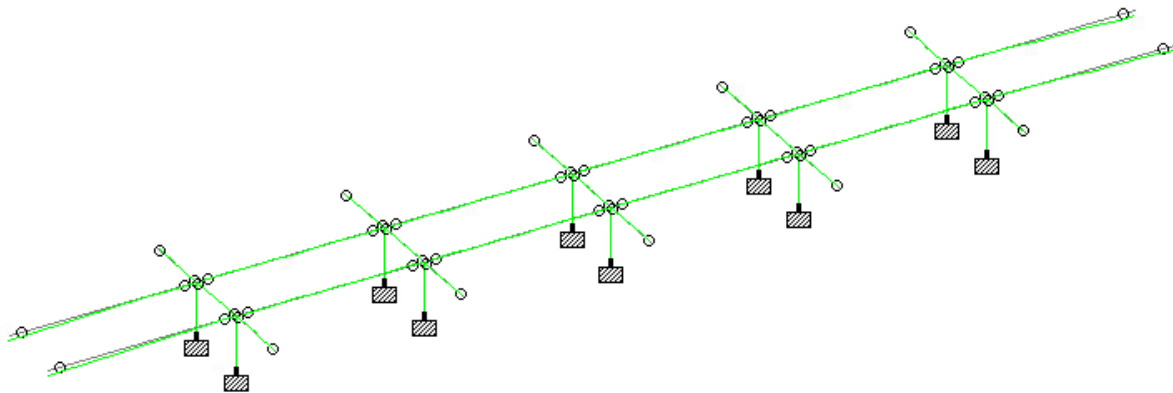
**FRAME SECTION A-A**

AISC's Steel Construction Manual. It is known that W shaped beams needed to be chosen and done by designing for the weakest member. Using knowledge from the steel design course, to find the most useful steel member we need to know the required moment strength.

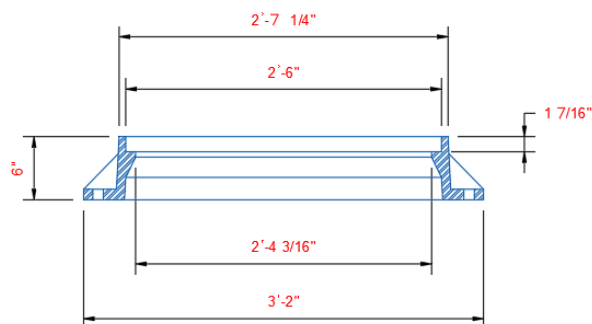
$M_u$  = required moment strength

$\phi$  = resistance factor for bending

$M_n$  = nominal moment strength

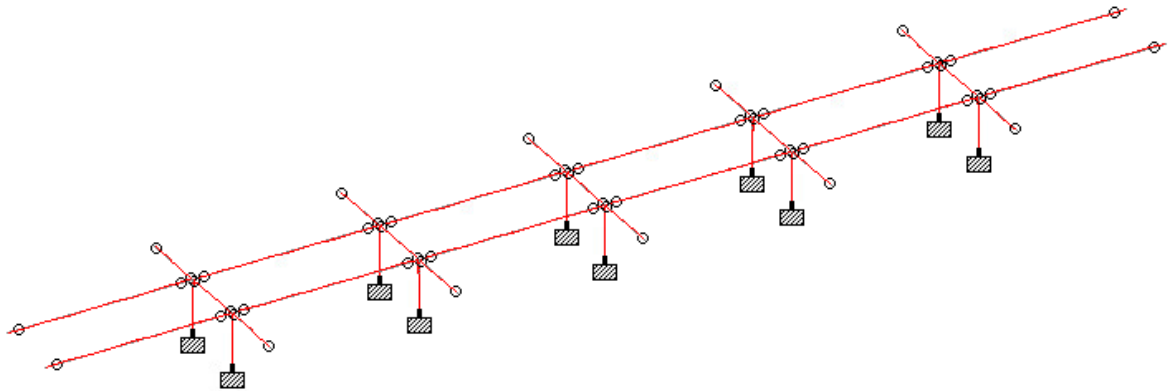


GRATE SECTION A-A



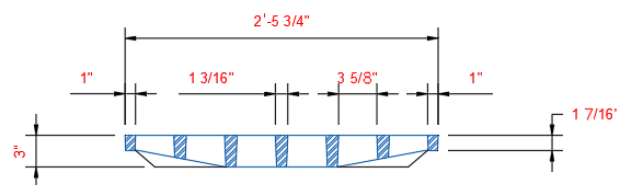
FRAME SECTION A-A

**Figure 18: STAAD PRO Displacement Results**

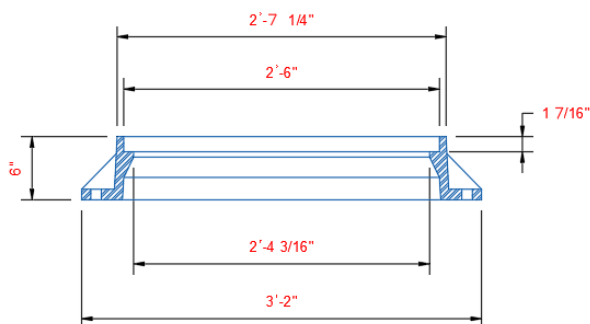


**Figure 19: STAAD PRO Beam Results**

For the column design, a combination of Staad Pro and the Steel Construction Manual from the American Institute of Steel Construction was used. A standard W-shape column was chosen by designing for the columns with the highest stresses. The following calculations were then completed to prove the chosen column met the standard requirements for compressive



GRATE SECTION A-A



FRAME SECTION A-A

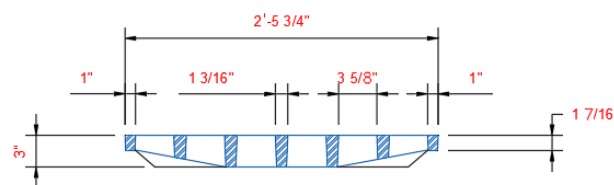
strength. The steel component that was chosen is W12x22. It is best for deflection and beam support. This beam was considered and implemented into STAAD PRO which gave the previous results outlined in the report.

## 7.1 Canopy Columns

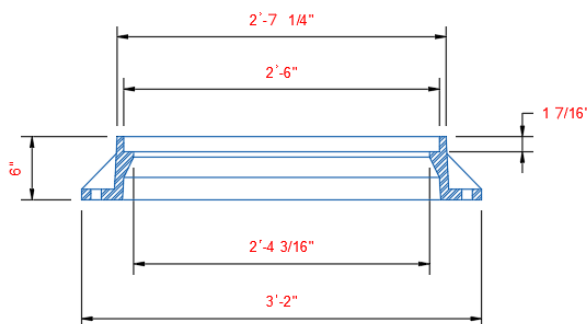
For the column design, a combination of Staad Pro and the Steel Construction Manual from the American Institute of Steel Construction was used. A standard W-shape column was chosen by designing for the columns with the highest stresses. The following calculations were then completed to prove the chosen column met the standard requirements for compressive strength.

## 8. GEOTECHNICAL

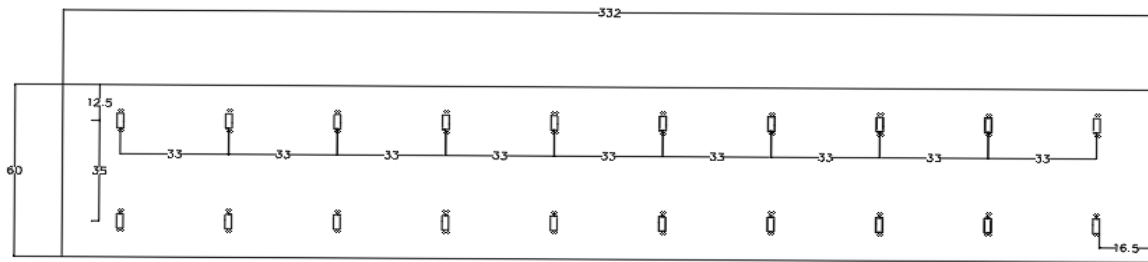
For the gas canopy, a foundation size must be chosen based on the dimensions. The gas station canopy is 332 feet long and 60 feet wide with ten 15 foot columns. The footing used had a thickness of 15 inches. The concrete footing is a square footing with grade 60 steel used and the standard weight concrete of 150 pounds per cubic foot. A 4x4 ft square footing was chosen based on our number of columns and steel design layout.



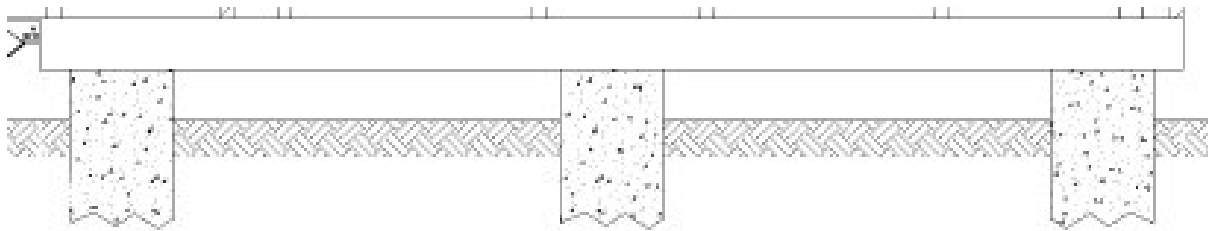
GRATE SECTION A-A



FRAME SECTION A-A

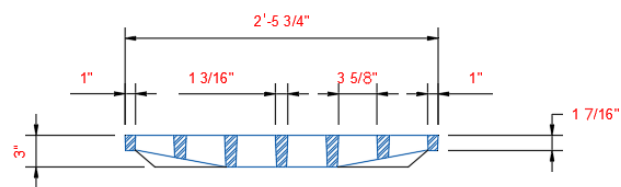


**Figure 20: Gas Canopy Layout**

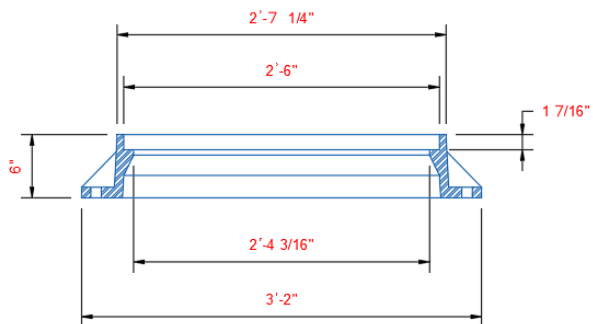


**Figure 21: Gas Canopy Foundation Layout**

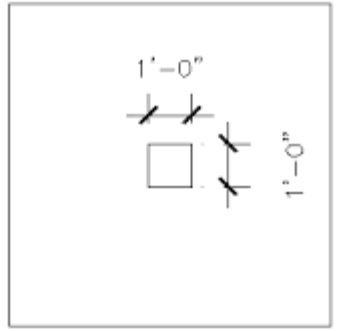
4' x 4'



GRATE SECTION A-A



FRAME SECTION A-A



**Figure 22: Gas Canopy Square Footing**

Using the equation,

$$Q_u = c N_c + g D N_q + 0.5 g B N_g$$

$$\phi=0$$

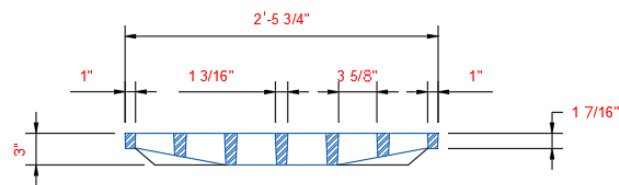
$$N_q=5.14$$

$$N_c=1.0$$

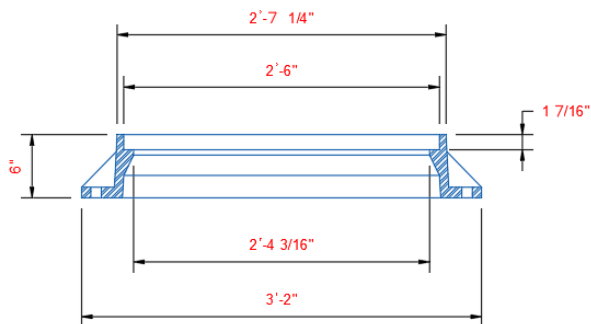
$$N_g=0$$

$$D=4.5 \text{ ft}$$

$$Q_u = 8.62 \text{ ksf}$$



**GRATE SECTION A-A**

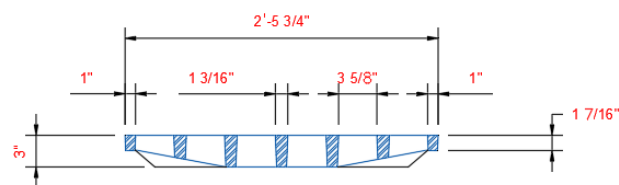


**FRAME SECTION A-A**

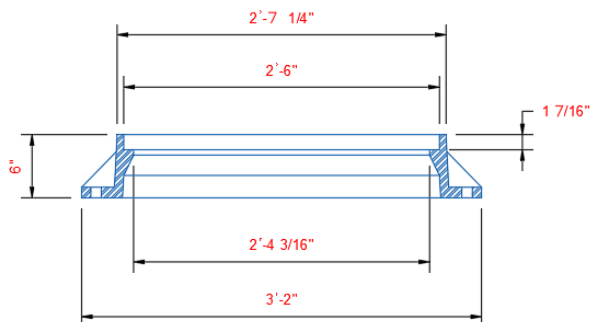
## 9. COST ESTIMATION

Below is the table used to find the cost of the materials used for this project. After quantities and unit costs were found, a total sum was found for the entire project. It should be noted that the cost of the individual businesses and stores are “all-inclusive.”

**Table 6:** Project Cost Estimation



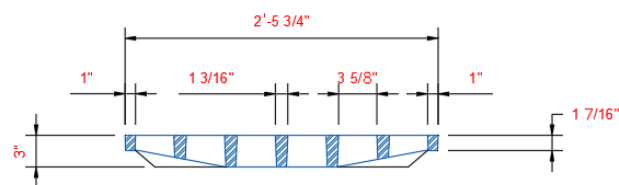
GRATE SECTION A-A



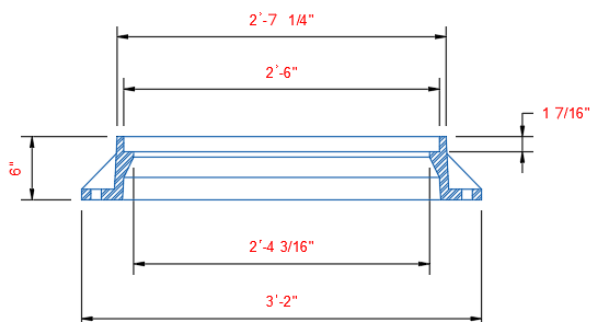
FRAME SECTION A-A



|                                            |             |                   |                 |                       |
|--------------------------------------------|-------------|-------------------|-----------------|-----------------------|
| Project Lead: Black Onyx Engineering Firm  |             |                   |                 |                       |
| Place of Project: Waller County            |             |                   |                 |                       |
| Limits of Project: FM 2020 & Collector Rd. |             |                   |                 |                       |
|                                            |             |                   |                 |                       |
| <b>Building &amp; Structural Cost</b>      | <b>Unit</b> | <b>Unit Price</b> | <b>Quantity</b> | <b>Extended Price</b> |
| Walmart                                    | EA          | \$ 20,000,000.00  | 1               | \$ 20,000,000.00      |
| CVS                                        | EA          | \$ 4,600,000.00   | 1               | \$ 4,600,000.00       |
| Walgreens                                  | EA          | \$ 5,800,000.00   | 1               | \$ 5,800,000.00       |
| Car Wash                                   | EA          | \$ 250,000.00     | 1               | \$ 250,000.00         |
| Kroger                                     | EA          | \$ 406,000.00     | 1               | \$ 406,000.00         |
| Whataburger                                | EA          | \$ 1,200,000.00   | 1               | \$ 1,200,000.00       |
| Chase Bank                                 | EA          | \$ 900,000.00     | 1               | \$ 900,000.00         |
| Shell Gas Station                          | EA          | \$ 1,000,000.00   | 1               | \$ 1,000,000.00       |
| 24-Hour Fitness                            | EA          | \$ 500,000.00     | 1               | \$ 500,000.00         |
|                                            |             |                   |                 |                       |
| <b>Roadway &amp; Intersection Pavement</b> | <b>Unit</b> | <b>Unit Price</b> | <b>Quantity</b> | <b>Extended Price</b> |
| Flatwork Sidewalks and Driveways           | SF          | \$ 1.50           | 486,910         | \$ 730,365.00         |
| Grading Cut                                | CF          | \$ 10.00          | 2,921,460       | \$ 29,214,600.00      |
|                                            |             |                   |                 |                       |
| <b>Water Resources</b>                     | <b>Unit</b> | <b>Unit Price</b> | <b>Quantity</b> | <b>Extended Price</b> |
| Grading Cut                                | CF          | \$ 10.00          | 380,061         | \$ 3,800,610.00       |
| Detention Pond                             | CF          | \$ 0.15           | 770,312         | \$ 115,546.80         |
| Storm Water Inlet/Catch Basins             | EA          | \$ 2,500.00       | 19              | \$ 47,500.00          |
| Trench Safety                              | LF          | \$ 1.00           | 1               | \$ 1.00               |
|                                            |             |                   |                 |                       |
| <b>Environmental</b>                       | <b>Unit</b> | <b>Unit Price</b> | <b>Quantity</b> | <b>Extended Price</b> |
| Water Treatment Plant                      | EA          | \$ 2,000,000.00   | 1               | \$ 2,000,000.00       |
| Wastewater Treatment Plant                 | EA          | \$ 1,000,000.00   | 1               | \$ 1,000,000.00       |
|                                            |             |                   |                 |                       |
|                                            |             |                   |                 | <b>Total Price</b>    |
|                                            |             |                   |                 | \$ 71,564,622.80      |



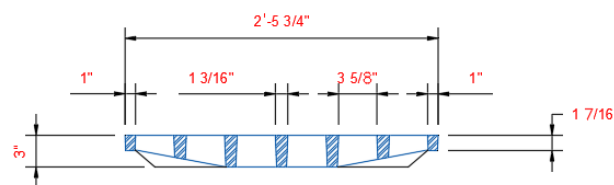
GRATE SECTION A-A



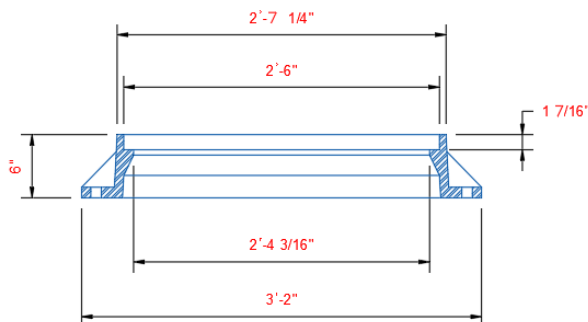
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## CONCLUSION AND RECOMMENDATIONS

Overall Black Onyx faced several challenges such as with calculations and in STAAD Pro software errors. A trial and error approach was taken and ultimately was corrected with the support of team members. Other challenges that were faced include the COVID-19 pandemic that caused all courses to be administered online. This affected us in many ways including technology issues, communication issues, and access to proper software and a good working environment. Our group was able to overcome many hurdles with the use of group chats and other means of communication but it was certainly difficult. In addition all five aspects of civil are covered throughout the duration of this project and we realize that there is so much that goes into each discipline. There is so much that can be said for each discipline, and this report entails a synopsis of technical details required to complete the given task.



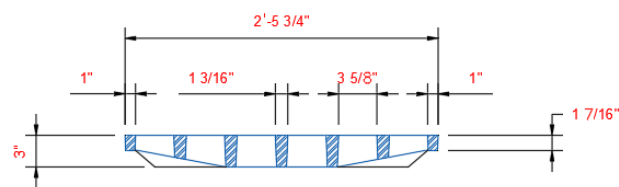
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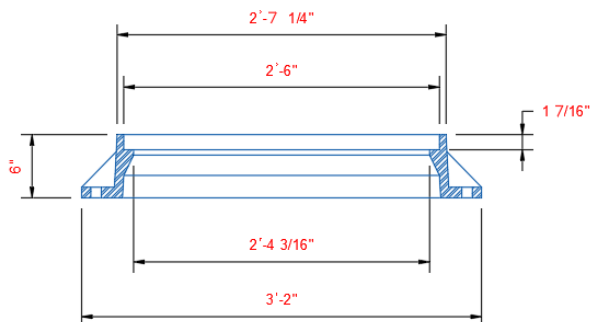
FRAME SECTION A-A

## LIST OF REFERENCES

- ICC. 2012 *International Building Code*. International Code Council, 2014, [codes.iccsafe.org/content/IBC2012?site\\_type=public](http://codes.iccsafe.org/content/IBC2012?site_type=public).

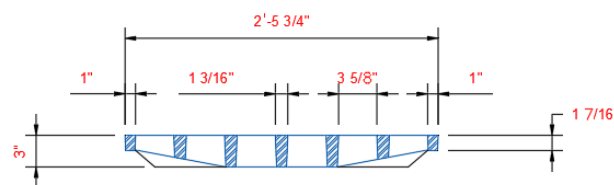


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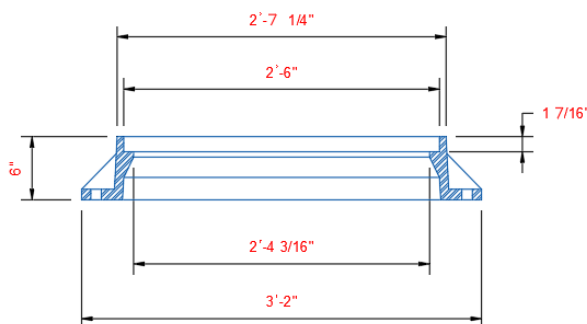


FRAME SECTION A-A

- *Minimum Design Loads for Buildings and Other Structures*. ASCE 7-10 ed., American Society of Civil Engineers, 2010.
- “Engineering Dept > Consultants > Standards & Specifications > Standard Civil Drawings.” *Engineering Dept*,
- [www.eng.hctx.net/Consultants/Standards-Specifications/Standard-Civil-Drawings](http://www.eng.hctx.net/Consultants/Standards-Specifications/Standard-Civil-Drawings).
- Yanchulis, Dave. “Home.” *Chapter 5: Parking Spaces*, [www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/guide-to-the-ada-standards/chapter-5-parking](http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/guide-to-the-ada-standards/chapter-5-parking).
- “Accessible Parking.” *ADA National Network*, 22 Apr. 2020, [adata.org/factsheet/parking](http://adata.org/factsheet/parking).
- Federal Highway Administration. *Manual on Uniform Traffic Control Devices*. 2009th ed., US Department of Transportation, 2009.

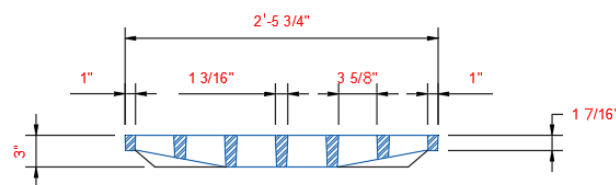


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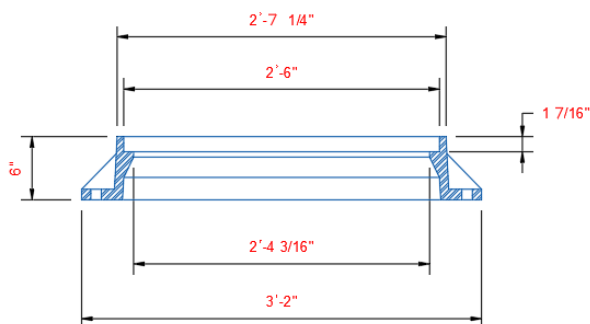


FRAME SECTION A-A

- “Design Manual.” *Design and Construction Standards*, City of Houston, 2020, [www.houstonpermittingcenter.org/office-city-engineer/design-and-construction-standards](http://www.houstonpermittingcenter.org/office-city-engineer/design-and-construction-standards)
- Harris County. “2018 *POLICY, CRITERIA & PROCEDURE MANUAL (PCPM)*.” HCFCFCD PCPM, Harris County Flood Control District, 2018, [www.hcfcd.org/About/Technical-Manuals/2018-Policy-Criteria-Procedure-Manual-PCPM?folderId=8626&view=gridview&pageSize=10](http://www.hcfcd.org/About/Technical-Manuals/2018-Policy-Criteria-Procedure-Manual-PCPM?folderId=8626&view=gridview&pageSize=10).
- “Source Water Assessment & Protection Viewer.” TCEQ, <https://www.tceq.texas.gov/gis/swaview>.
- “Wastewater Technology Fact Sheet: Chlorine Disinfection.” <https://www.3.epa.gov/npdes/pubs/chlo.pdf>
- “UV vs. Chlorine for Wastewater Disinfection.” *Treatment Plant Operator*, 30 Aug.



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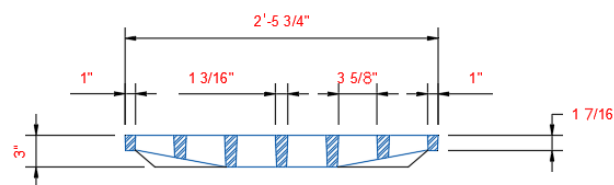


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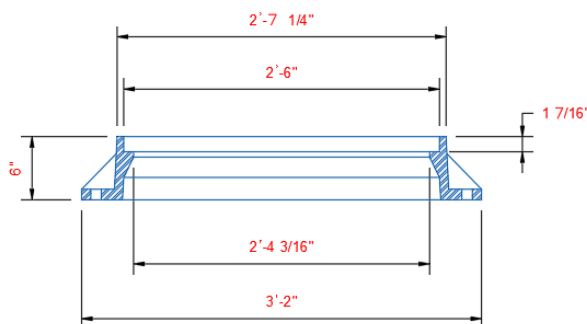
2018,

[https://www.tpomag.com/blog/2018/09/uv-vs-chlorine-for-wastewater-disinfection\\_sc\\_0039e](https://www.tpomag.com/blog/2018/09/uv-vs-chlorine-for-wastewater-disinfection_sc_0039e).

- Hancock, Nicole. “What Is Chlorination?” *Safe Drinking Water Foundation*, Safe Drinking Water Foundation, 27 Nov. 2016, <https://www.safewater.org/fact-sheets-1/2017/1/23/what-is-chlorination>.
- Adams, Tony. “Cost for Land, Construction of Wal-Mart Neighborhood Market on Buena Vista Road Tops \$7 Million.” *Ledger*, Columbus Ledger-Enquirer, 20 Dec. 2015, [www.ledger-enquirer.com/news/local/article50852335.html](http://www.ledger-enquirer.com/news/local/article50852335.html).
- “CVS Pharmacy TENANT OVERVIEW.” *Net Lease Advisor*, [www.netleaseadvisor.com/tenant/cvs-pharmacy/](http://www.netleaseadvisor.com/tenant/cvs-pharmacy/).
- “Everything You Need to Know About Starting A Car Wash From Your Chemical Experts.” *JBS Industries*, 16 Oct. 2019, [www.jbsindustries.com/blog/starting-car-wash/](http://www.jbsindustries.com/blog/starting-car-wash/).
- Guillen, Darla, and Houston Chronicle. “What Does It Cost to Start Your Own Franchise?” *Houston Chronicle*, Houston Chronicle, 1 Oct. 2019, [www.chron.com/business/article/Retail-development-in-2015-will-be-led-by-grocery-](http://www.chron.com/business/article/Retail-development-in-2015-will-be-led-by-grocery-)



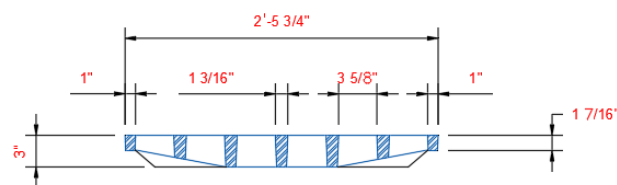
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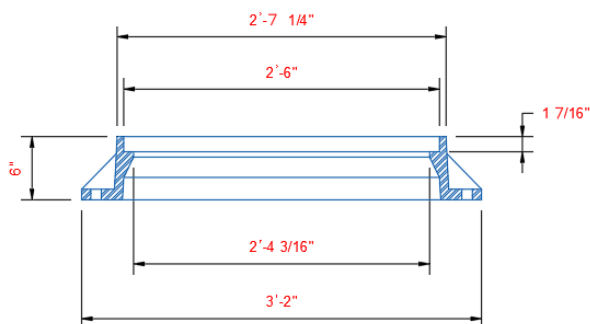
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6032378.php.

- “Whataburger.” *Whataburger Franchise Cost & Opportunities 2020* | *Franchise Help*, [www.franchisehelp.com/franchises/whataburger/](http://www.franchisehelp.com/franchises/whataburger/).
- Pickard-Whitehead, Gabrielle. “16 Gas Station Franchise Businesses.” *Small Business Trends*, 16 Dec. 2019, [smallbiztrends.com/2017/06/gas-station-franchise.html](http://smallbiztrends.com/2017/06/gas-station-franchise.html).
- “How Much Does It Cost to Open a Gym?: Sage US.” *Gym*, [www.sage.com/en-us/accounting-software/startup-costs/gym/](http://www.sage.com/en-us/accounting-software/startup-costs/gym/).
- “Figure 2f from: Irimia R, Gottschling M (2016) Taxonomic Revision of Rochefortia Sw. (Ehretiaceae, Boraginales). *Biodiversity Data Journal* 4: e7720. <https://doi.org/10.3897/BDJ.4.e7720>.” doi:10.3897/bdj.4.e7720.figure2f.
- Loehman, Edna Tusak. “Pricing for Water Conservation with Cost Recovery.” *Water Resources Research*, vol. 44, no. 8, 2008, doi:10.1029/2008wr006866.

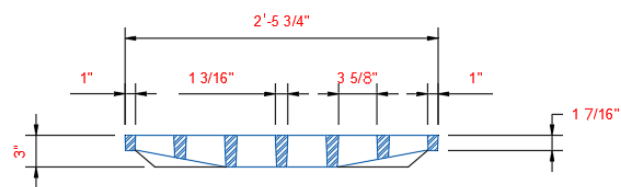


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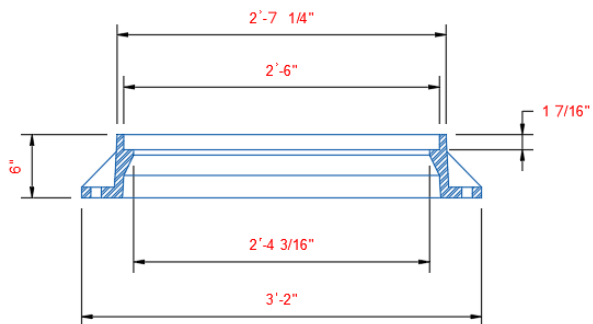


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## APPENDIX

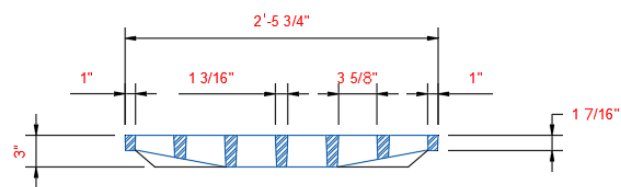


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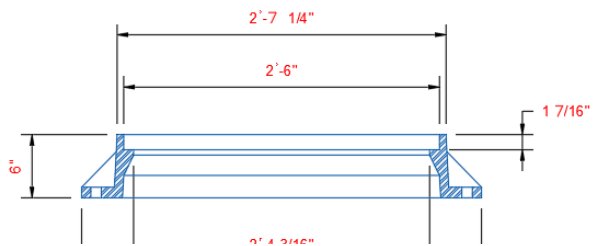


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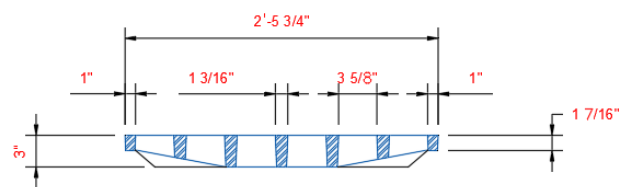
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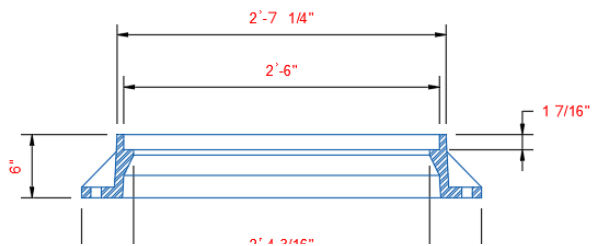
### Drainage Calculation Sample

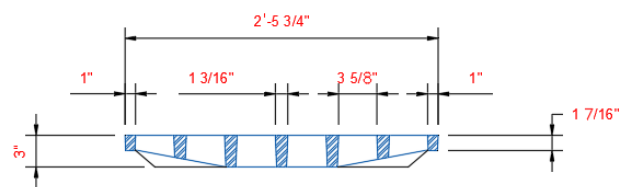
Inlet 1

$$Area (A) = 166399.2 \text{ ft}^2 \times 43560$$

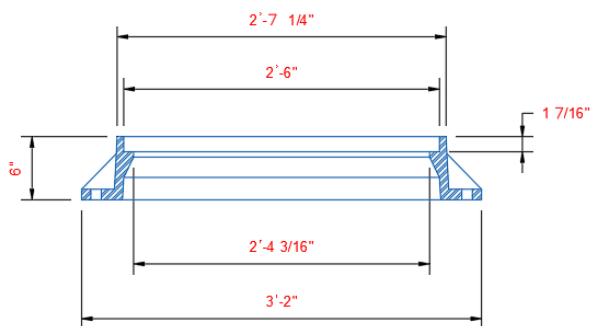


GRATE SECTION A-A





GRATE SECTION A-A



FRAME SECTION A-A

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**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**SENIOR DESIGN AND PROFESSIONALISM II**

**Instructor: Dr. Radha**

**Title of Assignment**

Final Report

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**Brief Description of the suitability of this assignment for the outcome**

Public health, safety, environmental aspects, transportation and flooding prevention and cost effects were addressed. The report shows how contemporary issues concerns were considered during the design phase. References used by students show the adherence to codes and acceptable practices to ensure public safety.

**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING  
CVEG 4482 Senior Design and Professionalism II  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

**Spring 2021**

**Instructor: Dr. R. Radha**

**Title of Assignment**

**Assignment and test to understand professional and ethical responsibility**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Check the ethical dimensions related to this assignment**

| Requires students to |                                                                                                                                               |                       |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>X</b>             | Recognize ethical and professional responsibilities in engineering situations involving global, and societal contexts                         |                       |
| <b>X</b>             | Make informed judgements on ethical and professional responsibilities in engineering while considering the impact of engineering solutions in |                       |
|                      | x                                                                                                                                             | global context        |
|                      | x                                                                                                                                             | economic context      |
|                      | x                                                                                                                                             | and societal context. |

**Brief justification of the suitability of assignment for the outcome**

**The report giving engineering reasons for decisions made relating to project design, demonstration of the use of codes and standards, and design results and details are the indicators of the professional responsibilities.**

**CVEG 4482 Senior Design and Professionalism II  
Spring 2021**

**ASSIGNMENT STATEMENT/QUESTIONS  
GRADING SCHEME FOR ASSIGNMENT**

|                |                   |
|----------------|-------------------|
| Report         | 50 points         |
| Design Results | 50 points         |
| <b>Total:</b>  | <b>100 points</b> |

**See below Student Sample for Crit. 4**

**INSTRUCTOR'S COMMENTS:**

1. Report Section justifies the project from an environmental and societal standpoint, including public health and safety.
2. The report shows how the public safety and the environment will be protected.
3. Cost effective materials were used.
4. Class average score for this criterion is 77 for 100.

**Sample student work is provided in the following pages**

**INSERT**



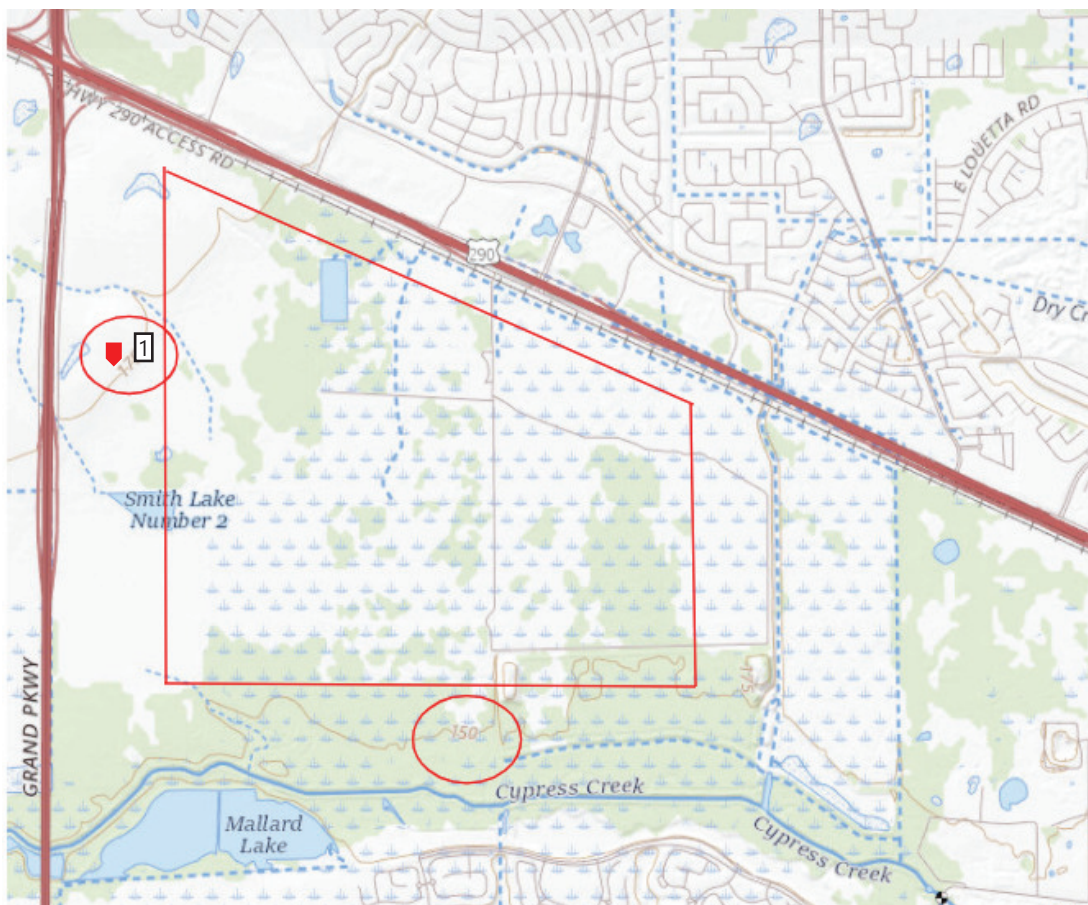
**SAMPLE 1**

## Geotechnical

As the geotechnical engineer for the area, I was tasked with several objectives such as site and soil analysis, improvement of the soil condition as needed, analyze the site for any cut/fill that will be needed, if there will be any potential vertical rise and if-so how can it be combatted and the foundation design type along with the allowable bearing capacity. Making sure that all risk factors if the surrounding soil and the immediate soil are addressed and the soil itself will be able to deal with the load it will be put under by the designs the client tasked us to complete.

## Site Assessment

Referencing the topographic map shown below, The red border represents the site area and the elevations of the site are circled in red. It is seen that the elevation of the site remains constant for most of the area based on the topographic map for most of the area with that being 150 feet. There is a slight change in elevation that occurs at the intersection of Highway 290 and South Highway 99, the elevation changes from 150 feet to 175 feet.

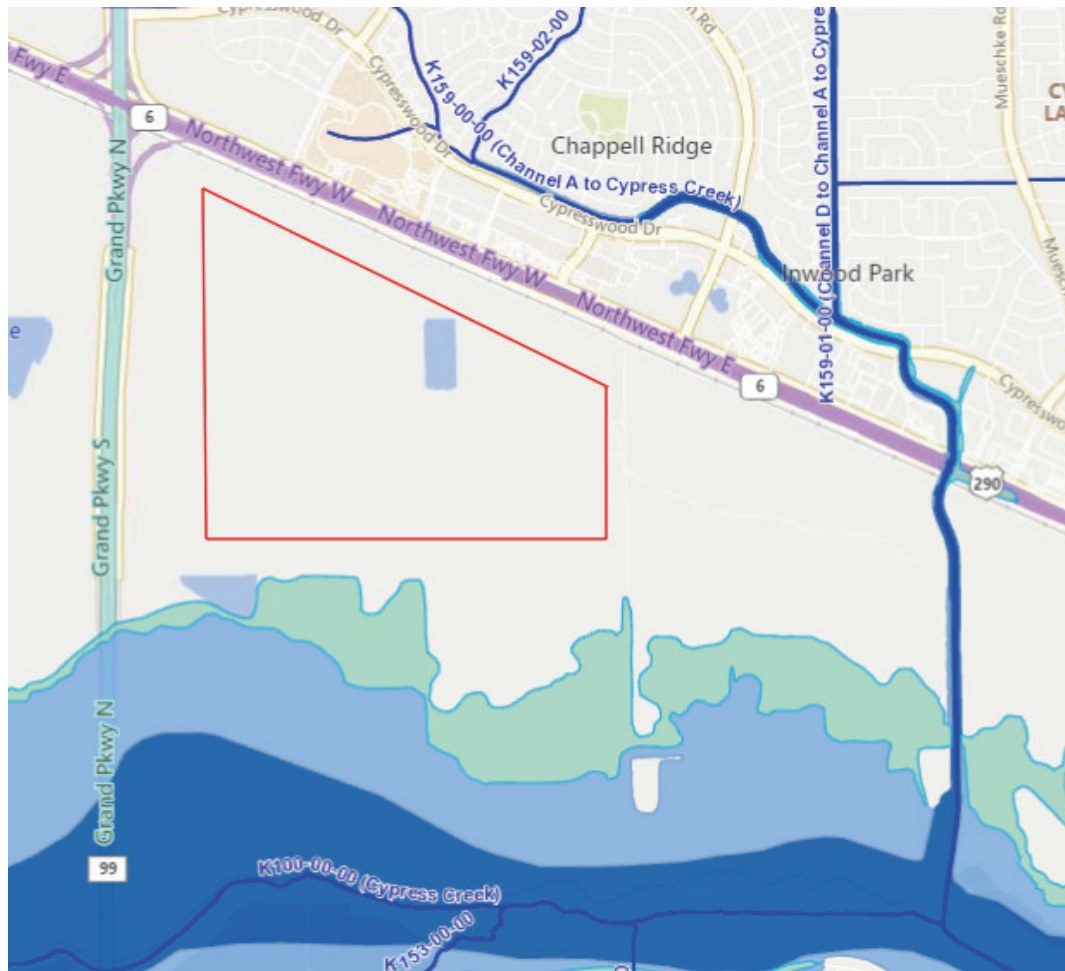


**Figure 7: Site Topographic Map**

A site flood assessment was conducted using a site flood map obtained from the Harris County Flood Control District's website with the shades of blue representing different floodplains and



the red boarded area representing the site. The dark blue is a regular flood plain, the cyan color is a 100-year floodplain and the light shade of green represents a 500-year floodplain and the map of this is shown below.

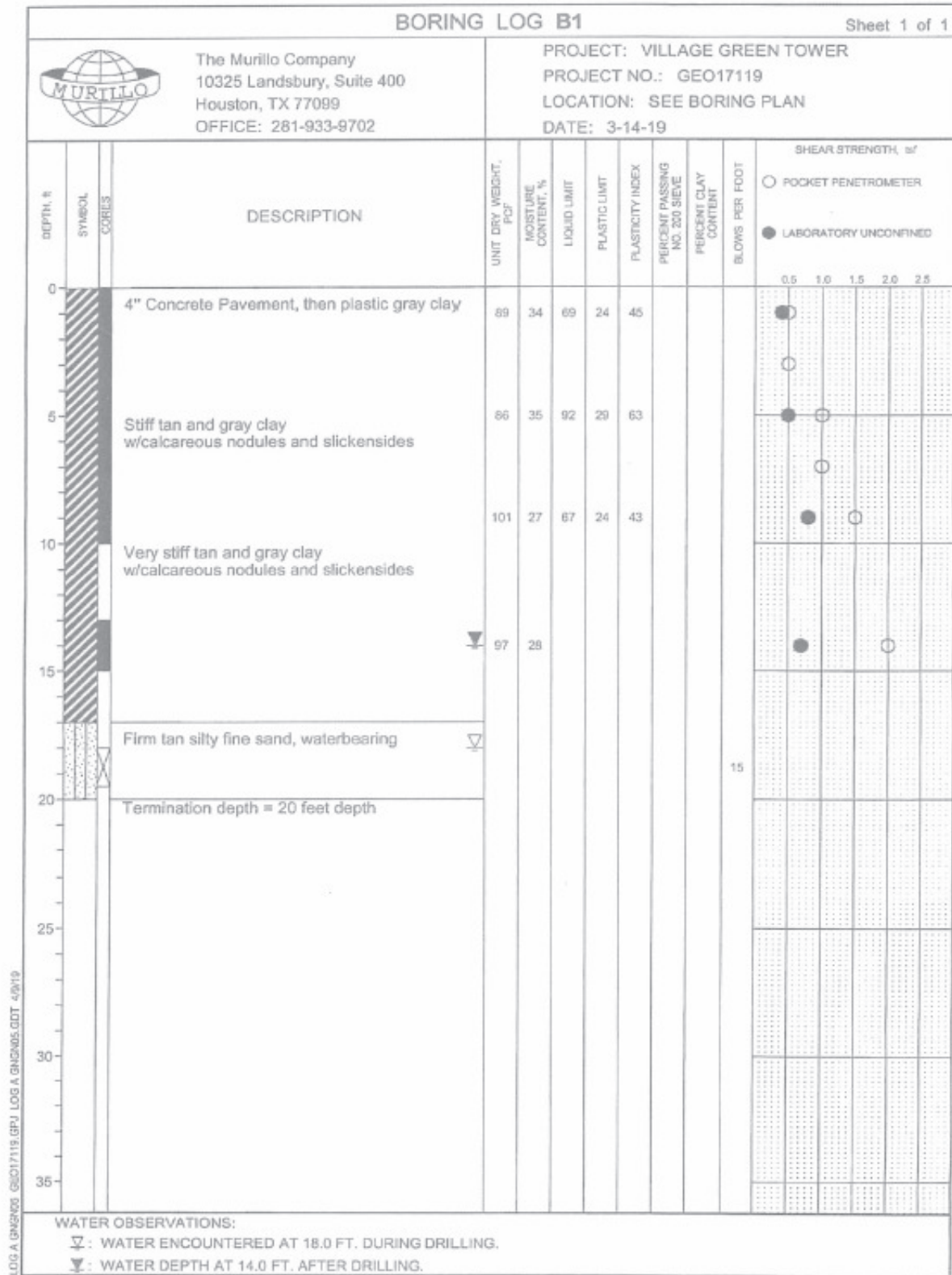


**Figure 8: Site Flood Map**

As seen in the area shown in the Figure 7 above, the site is not in the immediate flood plain of the area but it is very close to the 100-year and 500-year floodplains which have a 1% and 0.2% chance of occurring respectively. This will have to be taken into account when designing the area of the drainage systems. An open channel also does run south to the east of the site and the curves and continues west, and is at risk for flooding.

### **Soil Analysis**

To complete the soil analysis of the site the boring log that was provided to us by The Murillo Company was used and it is provided on the next page for reference.

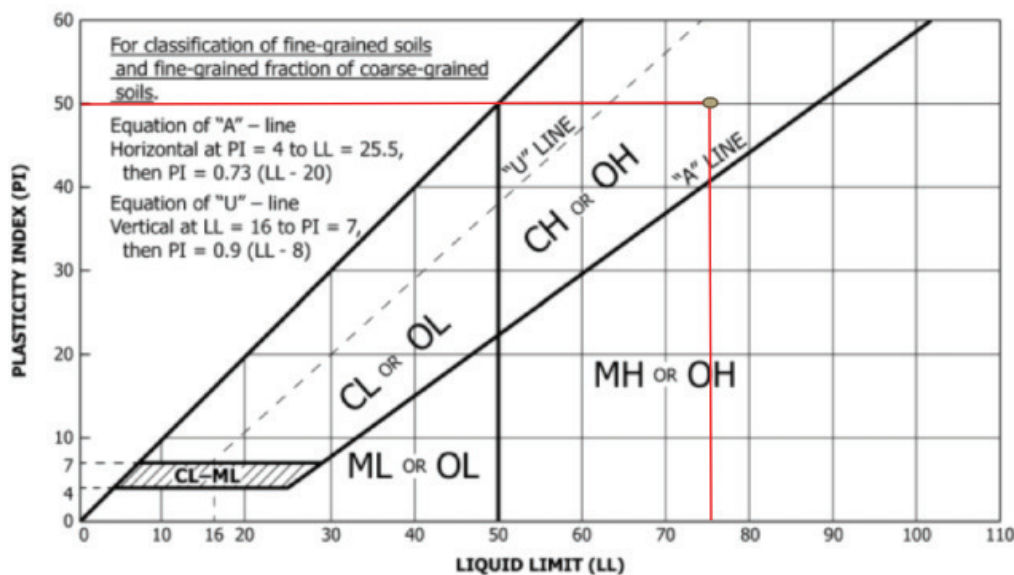


13  
**Figure 9: Boring Log**



Using the provided boring log the soil was analyzed and shown to carry the following characteristic; The number of blows were at 15 meaning the soil provided was stiff, the unconfined compressive strength of the soil is between 1.00 - 2.00 TSF, the moisture content ranges from between 27% - 35% with the average being 31%, the plastic limit and liquid limit are 25.6% and 76% respectively and show that the soil lies in a plastic state, the plasticity index ranges from 43% - 63% with an average of 50% showing that the soil is high in clay content as well as being cohesive and compressible. Using all of the findings we were able to determine several characteristics of the soil as well as the type of soil that it is.

The soil is a high plastic clay or fat clay which is represented with the initials CH for the first 17 feet and to confirm that the USCS Plasticity Chart was used and is also shown below. The liquid limit was 76% and the Plasticity Index was 50% as stated earlier. The rest of the soil is silty sand which is represented by SM.



**Figure 10: USCS Plasticity Chart**

With continuing analysis of the findings from the boring log, the high plasticity index shows that the soil may be expansive under wet conditions or exhibit shrinkage in dry conditions. A shear strength test was also completed using a pocket penetrometer and the unconfined compression test. The results from the pocket penetrometer test show that the average shear test was about 0.575 TSF while for the unconfined compression test the shear strength was on average roughly about 1.08 TSF. The results from the unconfined compression test represent the maximum axial compressive stress that a specimen can bear under zero confining stress. Based on all the analysis it would be feasible to use either a Drill Pier or Slab-on-grade foundation since both are good foundations to use with soils of high clay content. An example of each is also shown below.

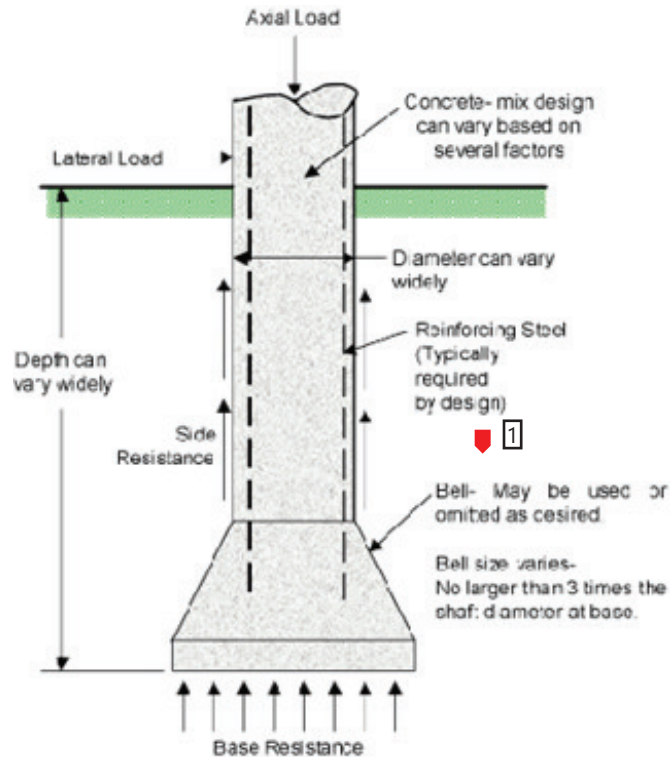
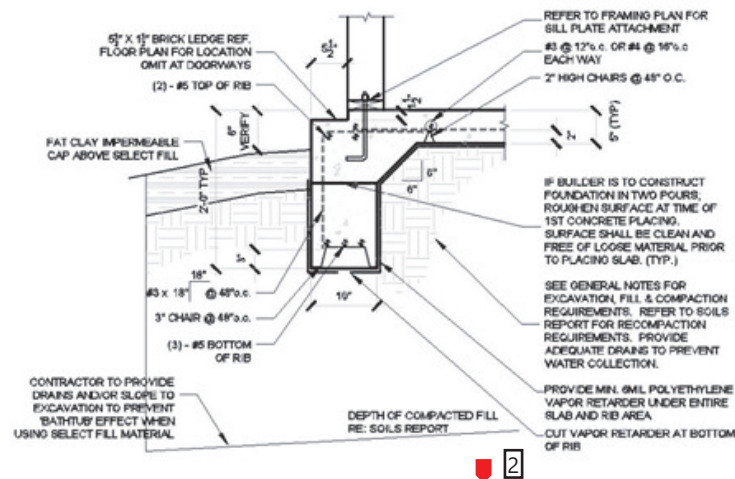


Figure 11: Drilled-Piers Foundation



## TYP. EXTERIOR RIB

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SCALE: 3/4" = 1'-0"

Figure 12: Grade-on-Slab Foundation

When looking over which foundation would be more feasible to use for the task given to use by the client the pros and cons were first assessed of each foundation. Looking over the pros for the

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This is example; need to design with respect to your project.

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same as comment given above



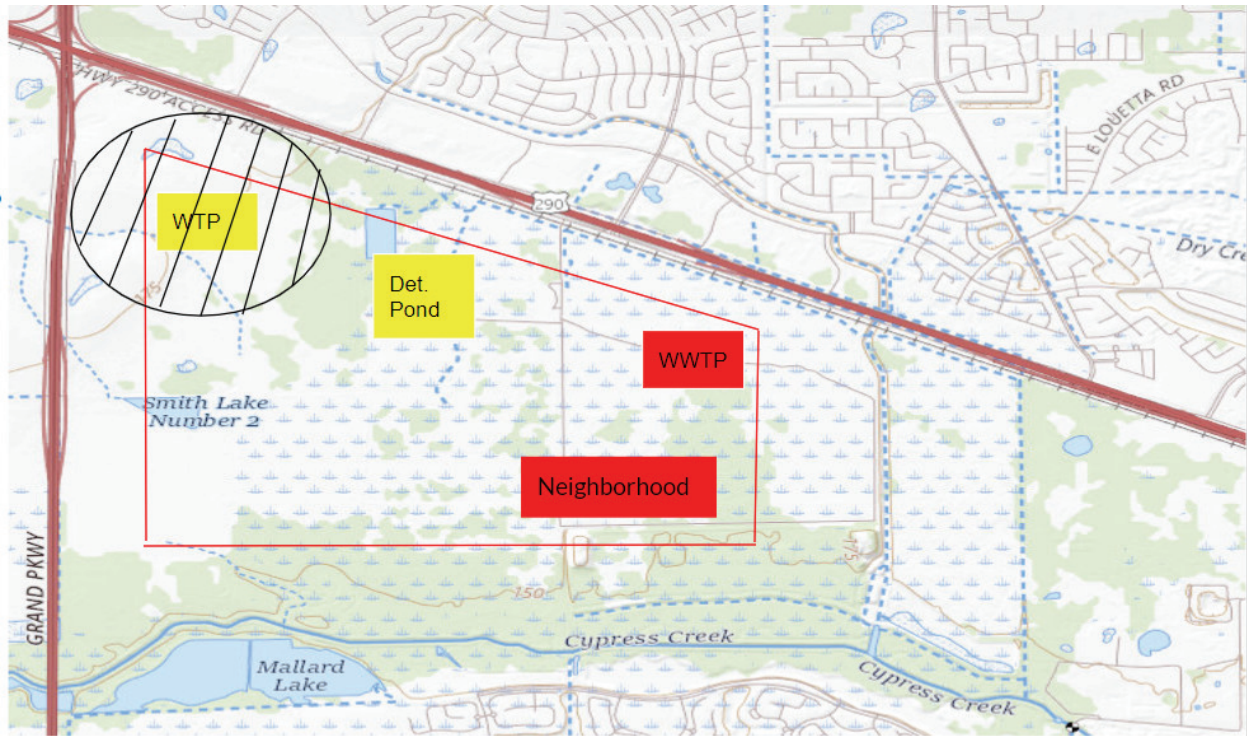
Drilled-Pier foundation, it is known to be a deep foundation which would mean it is better for soils that are more unstable and it will also combat any potential vertical rise that may be present. The foundation itself is also at very low risk for moving and narrower foundation walls can be constructed since they do not have continuous bearing. The cons are that it tends to be a lot more expensive due to the fact that deep drilling is being done which means more equipment and workers are needed and a structural floor will not be designed and constructed for this foundation. When looking at a Slab-on-Grade foundation, the fact that it is a shallow foundation means that it will be considerably less expensive than the Drilled-Piers foundation. This foundation also requires the removal of usually 3 to 6 feet of topsoil which can combat any sort of potential vertical rise than may arise from expansive soils. Some of the cons of the foundation are that there is risk of potential foundation movement, the foundation walls may also need to be built wider to ensure bearing pressures are adequate, and this foundation also requires mild reinforcement since loads are directly transmitted to the soils. There also will be added cost due to the soil importation, placement and compaction but it is still less expensive than the Drilled-Piers foundation. After reviewing all the pros and cons it was determined to go with the Slab-on-Grade foundation because of its cost effectiveness.

### **Earthwork (Cut/Fill)**

Cut and fill is the process of constructing a railway, road or canal whereby the amount of material from cuts roughly matches the amount of fill needed to make nearby embankments, so minimizing the amount of construction labor. The cut and fill was calculated using the grid method. The method is done by taking the average existing elevations (in feet) and having them be subtracted by the averaged proposed elevations (in feet). Once that value is obtained, multiplication of the value in feet found previously with the area (in ft<sup>2</sup>) which needs to be cut and filled. The calculated value will be the volume (in ft<sup>3</sup>) that needs to be implemented with a positive value being filled and negative value being cut.

The areas requiring cut/fill are shown in the figure below and the site area being bordered with red lines, yellow areas representing areas that need to be cut, the black gridded circle represents an area where cut can be taken and red areas represent areas that need to be filled





**Figure 13: Location of Cut/Fill Areas**

The completed and calculated earthwork is shown on the two tables below.

**Table 1: Earthwork Calculations**

| Building  1 | Average Existing Elevation of Area(ft) | Cut or Fill | Average Proposed Elevation of Area (ft) |
|------------------------------------------------------------------------------------------------|----------------------------------------|-------------|-----------------------------------------|
| Water Treatment Plant                                                                          | 275                                    | Cut         | 253                                     |
| Waste Water Treatment Plant                                                                    | 251                                    | Fill        | 254                                     |
| Neighborhood/Community Center                                                                  | 250                                    | Fill        | 253                                     |
| Office Building                                                                                | 250                                    | Fill        | 253                                     |
| Detention Basin                                                                                | 250                                    | Cut         | 238                                     |

**Table 2: Earthwork Calculations Continued**

| Building                      | Area of Building (ft <sup>2</sup> ) | Average Existing Elevation of Area(ft) | Average Proposed Elevation of Area (ft) | Volume (ft <sup>3</sup> ) | Cut or Fill |
|-------------------------------|-------------------------------------|----------------------------------------|-----------------------------------------|---------------------------|-------------|
| Water Treatment Plant         | 213,516                             | 275                                    | 253                                     | 640,548                   | Fill        |
| Waste Water Treatment Plant   | 218,546                             | 251                                    | 254                                     | 655,638                   | Fill        |
| Neighborhood/Community Center | 2,395,800                           | 250                                    | 253                                     | 7,187,400                 | Fill        |
| Office Building               | 9,600                               | 250                                    | 253                                     | 28,800                    | Fill        |

### **Potential Vertical Rise (PVR) 2**

Potential Vertical Rise (PVR) is expressed in either inches or millimeters and is the potential of a soil to swell at a given density, moisture, and loading condition when exposed to capillary or surface water, and thereby increase the elevation of its upper surface along with anything resting on it. The Potential Vertical Rise was calculated using *TxDOT's Tex-124-E Potential Vertical Rise (PVR) Excel Workbook* which is available through TxDOT's website. The results are shown on the figure on the following page.

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|                                                                                                        |                                  |                            |                             |
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| PVR Data BH                                                                                                                                       |                    |                                    |             |              |                  |             |               |                                  |                      |                    |                       |                          |                         |                       |                         |                    |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------------------|-------------|--------------|------------------|-------------|---------------|----------------------------------|----------------------|--------------------|-----------------------|--------------------------|-------------------------|-----------------------|-------------------------|--------------------|----------------|
| Depth to Bottom of Layer [ft]                                                                                                                     | Average Load [psi] | Liquid Limit (LL)                  | Dry 0.2LL+9 | Wet 0.47LL+2 | Percent Moisture | Dry Avg Wet | Percent No.40 | Plasticity Index (PI)            | Percent Volume Swell | Percent Free Swell | PVR [in] Top of Layer | PVR [in] Bottom of Layer | Differential Swell [in] | Modified No.40 Factor | Modified Density Factor | PVR in Layers [in] | Total PVR [in] |
| 0.00                                                                                                                                              | 0.0                | -                                  | -           | -            | -                | -           | -             | -                                | -                    | -                  | -                     | -                        | -                       | -                     | -                       | -                  | 4.20           |
| 2.00                                                                                                                                              | 1.0                | 69                                 | 22.8        | 34.4         | 34.0             | Wet         | 100.0         | 45                               | 6.9                  | 9.9                | 0.00                  | 0.43                     | 0.43                    | 1.00                  | 1.00                    | 0.43               | 3.78           |
| 4.00                                                                                                                                              | 3.0                | 69                                 | 22.8        | 34.4         | 34.0             | Wet         | 100.0         | 45                               | 6.9                  | 9.9                | 0.43                  | 1.05                     | 0.63                    | 1.00                  | 1.00                    | 0.63               | 3.15           |
| 6.00                                                                                                                                              | 5.0                | 92                                 | 27.4        | 45.2         | 35.0             | Avg         | 100.0         | 63                               | 16.0                 | 19.7               | 2.16                  | 3.31                     | 1.15                    | 1.00                  | 1.00                    | 1.15               | 2.00           |
| 8.00                                                                                                                                              | 7.0                | 92                                 | 27.4        | 45.2         | 35.0             | Avg         | 100.0         | 63                               | 16.0                 | 19.7               | 3.31                  | 4.26                     | 0.96                    | 1.00                  | 1.00                    | 0.96               | 1.04           |
| 10.00                                                                                                                                             | 9.0                | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 2.38                  | 2.69                     | 0.30                    | 1.00                  | 1.00                    | 0.30               | 0.74           |
| 12.00                                                                                                                                             | 11.0               | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 2.69                  | 2.91                     | 0.22                    | 1.00                  | 1.00                    | 0.22               | 0.52           |
| 14.00                                                                                                                                             | 13.0               | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 2.91                  | 3.08                     | 0.17                    | 1.00                  | 1.00                    | 0.17               | 0.35           |
| 16.00                                                                                                                                             | 15.0               | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 3.08                  | 3.22                     | 0.14                    | 1.00                  | 1.00                    | 0.14               | 0.21           |
| 18.00                                                                                                                                             | 17.0               | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 3.22                  | 3.34                     | 0.12                    | 1.00                  | 1.00                    | 0.12               | 0.09           |
| 20.00                                                                                                                                             | 19.0               | 67                                 | 22.4        | 33.5         | 27.0             | Avg         | 100.0         | 43                               | 9.7                  | 13.0               | 3.34                  | 3.43                     | 0.09                    | 1.00                  | 1.00                    | 0.09               | 0.00           |
| Fields are chart inputs                                                                                                                           |                    | Fields are final answers per layer |             |              |                  |             |               | Final Total PVR for the borehole |                      |                    |                       |                          |                         |                       |                         |                    |                |
| Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values. |                    |                                    |             |              |                  |             |               |                                  |                      |                    |                       |                          |                         |                       |                         |                    |                |

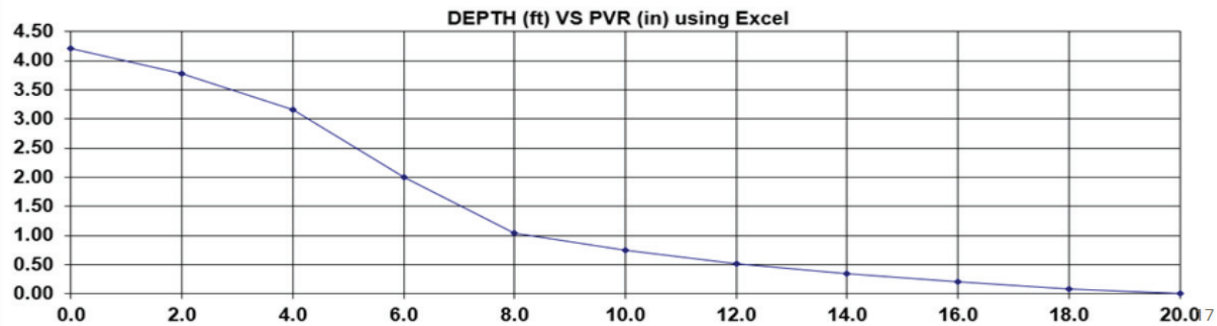


Figure 14: PVR Results and Graph

As seen in the figure the total PVR is shown to be 4.20 inches which is not acceptable, the PVR needs to be less than 1 inch. To deal with this a few options were proposed this were; to remove the topsoil and replace it with granular material, pond the soil with water for thirty of more days to bring drier clays toward optimum conditions, stabilize the soil using lime, calcium chloride, sodium carbonate, sodium sulphate, or fly ash, or use either a Drilled-Pier or Slab-on-Grade foundation. It was decided that along with the Slab-on-Grade foundation that will be used, using lime to stabilize the soil will lower the potential vertical rise to less than 1 inch.

### Shallow Foundation (Bearing Capacity) of the Community Center

To calculate the bearing capacity the General Terzaghi Equation was used and is shown below.

$$q_{\text{ultimate}} = c' N_c + \gamma D_f N_q + .5 \gamma B N_\gamma$$

Where,

$Q_{\text{ultimate}}$  = The Ultimate Bearing Capacity

$c'$  = cohesion

$\gamma$  = unit weight of soil

$D_f$  = depth of footings

$B$  = base

$N_c, N_q, N_\gamma$  = bearing capacity factors

The table below represents the values for all the factors in the formula and the finals values

**Table 3: Values of Factors**

| Variable                         | Value   |
|----------------------------------|---------|
| $\Phi$                           | 25°     |
| C'                               | 232 psf |
| $\gamma$                         | 89 pcf  |
| D <sub>f</sub>                   | 3 ft    |
| B                                | 5 ft    |
| N <sub>c</sub>                   | 25.13   |
| N <sub>q</sub>                   | 12.72   |
| N <sub><math>\gamma</math></sub> | 8.34    |

After calculation, the ultimate bearing capacity ( $q_{ultimate}$ ) of the soil under the community center came out to be 11.08 kips per square feet. We know the factor of safety is equal to 3, and to calculate allowable bearing capacity the division of the ultimate bearing capacity by the factor of safety is done as shown in the formula below.

$$q_{allowable} = \frac{q_{ultimate}}{\text{Factor of Safety}}$$

When using the formula provided above we find that the allowable bearing capacity is 3.69 kips per square feet.

## **Environmental - Water Treatment**

The purpose of this project is to design a water treatment plan to service a population of 10,000 persons residing at PVHB Residential and Office Facility while also taking into account future community/population growth. Different sources of water will be proposed and one will be thoroughly explained and chosen and using environmental codes and standards. Also, a treatment method will be proposed for the water before it is distributed. Then using the TAC (Texas Administrative Code) standards, design a sedimentation tank that will meet all the requirements.

In designing a Water Treatment Facility the preliminary steps are to identify the various components involved to maintain and run a successful Water treatment Plant. The municipal water usage has an assortment of applications in the domestic, non-domestic, public service, and leakage category. There are many factors to take into consideration when evaluating what may affect water usage. Through extensive research these factors are obtained. Water pressure, type of community, population, economic status of community, geographic location, cost, need of

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Check the numbers; may be correct; seems a little high.

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**SAMPLE 2**



# CSR ENGINEERING INC.

December 3, 2020

Dear Judges,

The attached report contains the detailed plans for a newly constructed subdivision and community center in northwest Harris County, Texas. This report includes the scope of work, the main components of each project and visual aids. A few main components include:

- 2D Office Building Conceptual Design
- 2D Housing Floor Plan
- Soil Analysis
- Subdivision Roadway Layout
- Water & Wastewater Treatment Plant
- Recreational Lake Design

CSR Engineering Inc. is available to answer any questions that you may have concerning this report or the project. You can contact our team lead Chantice Redeau at (phone number: 210-849-0082 or email: [credeau@student.pvamu.edu](mailto:credeau@student.pvamu.edu))

Sincerely,

Jamal Baker  
Marshall Green  
Randelle Jones  
Nykea Keitt  
Chantice Redeau  
Trevon Rogers



# **College of Engineering**

# **Senior Design Project**



**Jamal Baker**  
**Marshall Green**  
**Randelle Jones**  
**Nykea Keitt**  
**Chantice Redeau**  
**Trevon Rogers**

**Prairie View A&M University**  
**Prairie View, Texas 77446**

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## **ACKNOWLEDGEMENT**

The entire project was prepared by Jamal Baker, Marshall Green, Randelle Jones, Nykea Keitt, Chantice Redeau and Trevon Rogers collectively . It would not have been a success without the hard work and productivity from each team member. We were able to learn a lot during this process of research, technical applications and teamwork. Also a special thanks to Dr. Radha and the entire Civil & Environmental Engineering Department for providing resources and guidance throughout our collegiate careers. Prior knowledge from each design course allowed us to have a boost in creating a well planned out project.

## **INTRODUCTION**

The proposed subdivision, located in northwest Harris County, has been designed based on the provided design data, environment, and the future needs for the public. CSR Engineering Inc. has decided to name the proposed subdivision, The Gateway. The area is northwest of Houston near the US 290 & SH 99 Grand Parkway Interchange. The 359 acre property is located south of US 290 and west of SH 99. The main entrance of the subdivision will be signalized and located at the Bauer Rd. & US 290 intersection. Within the subdivision, Water & Wastewater Treatment Plants will be designed to serve 10,000 people. Landscaping will also be considered to not only enhance the area, but to help with drainage. Placed in the center of the residential area, will be a recreational lake to serve as a detention pond and resident's leisure.

Additionally, the community center & office building are located within the 359 acres of land. The community center will be a 9600 square foot building that will provide residents with a place to host events. The office building will be 28,800 square feet and will be the headquarters of a major company.

# **CHAPTER 1: PROJECT SCOPE**

## **1.1 Problem Statement**

To design a subdivision which includes a community center and office building with a 30-year design period.

## **1.2 Project Goals & Objective**

The project team is required to perform Civil Engineering Site Development, and Design services and address all aspects outlined in the reporting requirements and deliverable items of this project description. The purpose of this project is to provide an AutoCAD geometric design that includes a subdivision roadway layout and location of the recreational lake. Water & Wastewater Treatment plants are needed to serve 10,000 people for the subdivision and surrounding area.

In addition, a 2D conceptual layout design of the community center and office building are needed. Also in the area, parking facilities will be designed for each building. It is required to add a 5 foot sidewalk to the main road and near the community center and office buildings.

# CHAPTER 2: PRELIMINARY DESIGN

## 2.1 Structural Engineering

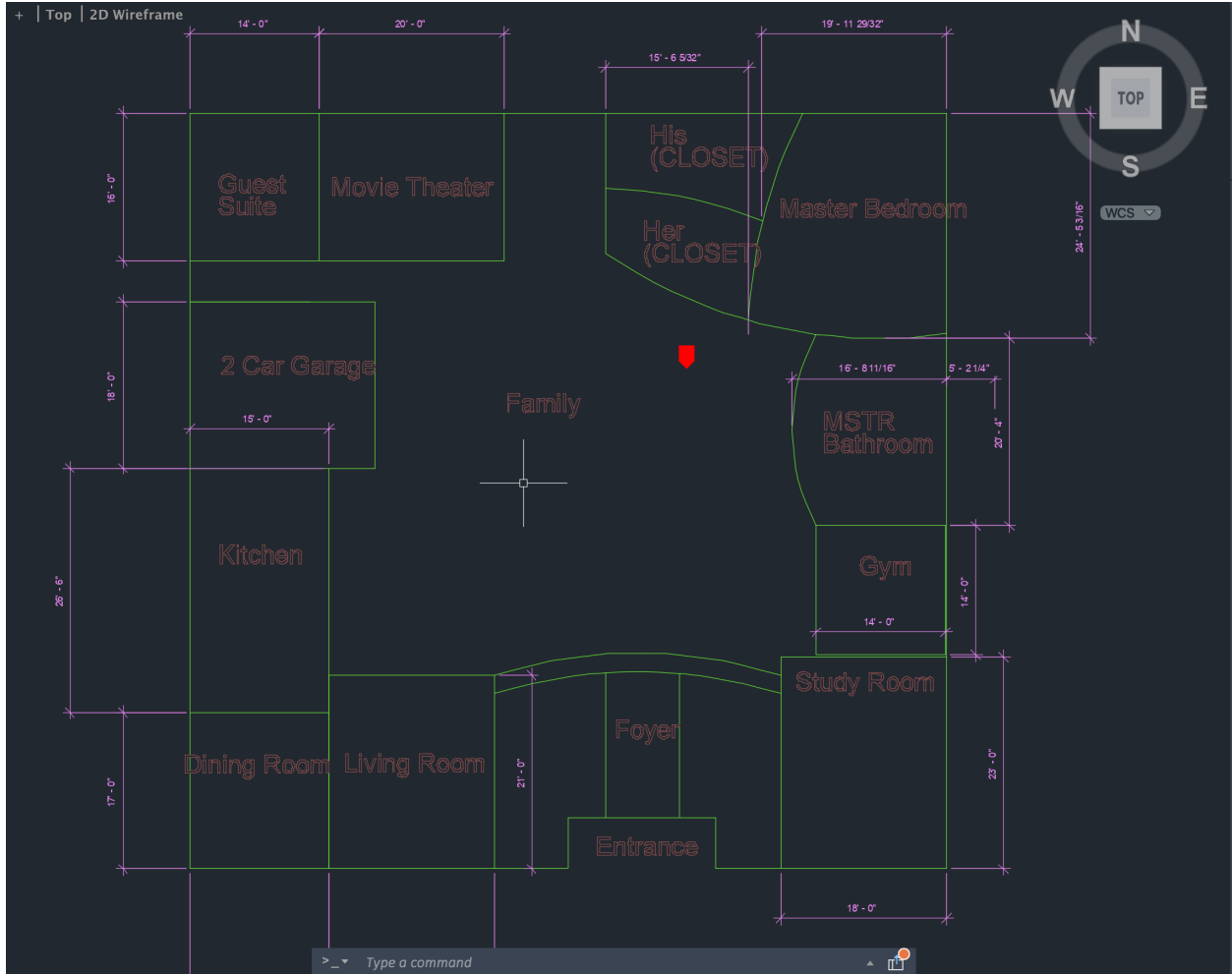
### 2.1.1 Design of Homes

The homes in our subdivision measure 82 ft x 82 ft. and the entire area each home will be built on totals 13,000 square feet. The homes feature many luxury amenities including an in-home theatre, exercise room, and guest suite. STAAD Pro is a software that will be utilized to provide an illustrative model of the steel frame, by featuring maximum loadings based on beam self-weight and the calculated loads established. Each represents environmental sustainability due the versatility and reusability of the materials used. There are various live loads that are subjected to the overall structure, and to the floor of the steel frame. Live loads are forces that vary in location and magnitude of each load. They are a gravitational force that can be moved and placed based on the criteria and prior history of installation.

When it comes to the structural aspects of projects there are several softwares that aid in the design of steel structures. STAAD Pro is one of those softwares, STAAD or is a structural analysis and design software application originally developed by Research Engineers International. It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis) or a buckling analysis. When choosing the proper number steel beam and column multiple tests are run in the Staad Pro software until the displacement of the structure is a perfect match to the outline of the Steel frame .







**Figure 2.1.1 Home Floor Plan (AutoCad)**

## 2.2 Geotechnical Engineering

### 2.2.1 Site Assessment

The picture below is a topography map that shows the location of the site. The location of the site is south of 290, and west of 99. The size of the site is 2700 acres. The elevation of the site

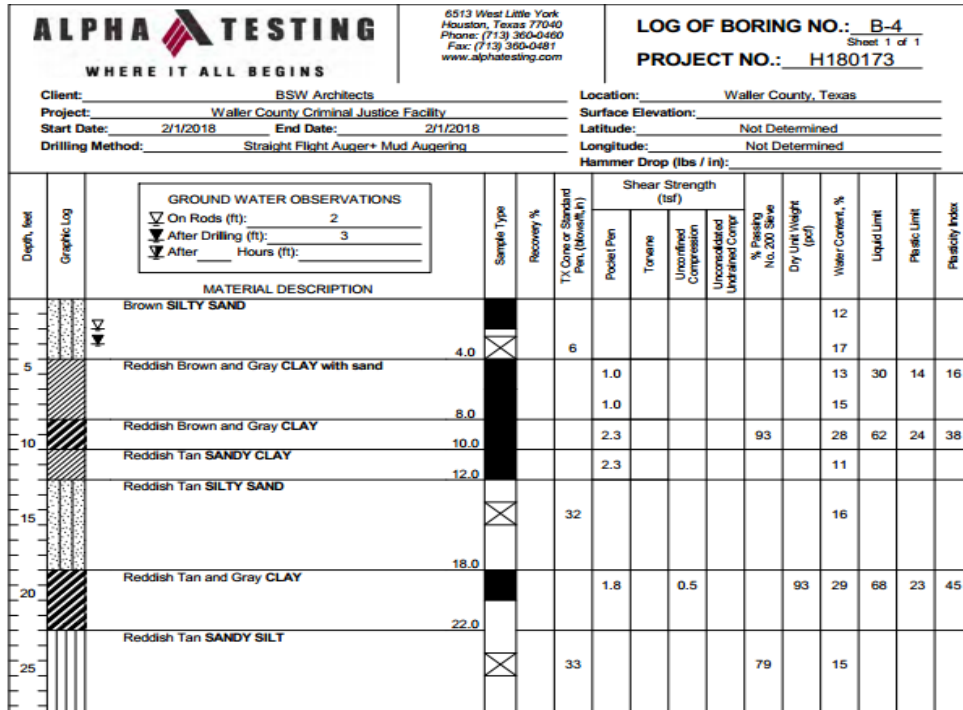
goes into a downwards slope from 195 to 190 feet above sea level. Therefore the average elevation of the site is 192.5 feet above sea level.



**Figure 2.2.1 Site Location**

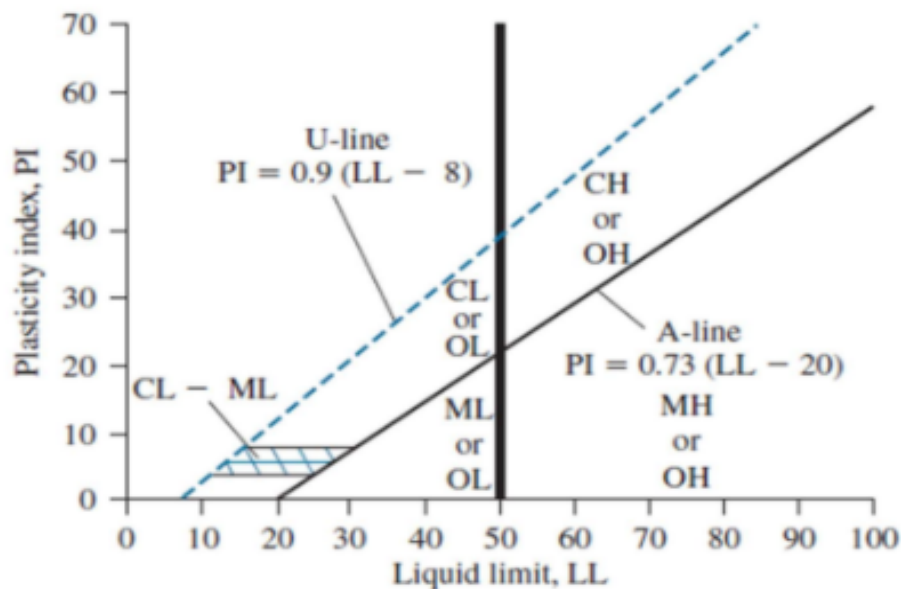
### **2.2.2 Soil Properties**

The boring log data that was given for the location of the site is located below. This boring log displays the testing of the soil in order to classify the type of soil it is, the amount of stress it can take, as well as other properties of the soil that will make a difference when designing a structure on it.



**Figure 2.2.2 Boring Log Data of Site**

The boring log tells the engineer the results from various tests of the soil within the site location. The log shows the depth of each kind of soil down to 22 feet. Based on the boring log data, the soil is classified as an A-6 Organic Sandy Clay. This was found by using the Liquid Limit (30), Plastic Limit (14), and Plasticity Index (16) shown on the boring log, and the use of the table and chart below to classify the soil of the site



**Figure 2.2.2A Plasticity Chart**

| Granular materials         |                                                     |        |            |                                 |        |        |        |
|----------------------------|-----------------------------------------------------|--------|------------|---------------------------------|--------|--------|--------|
| General classification     | (35% or less of total sample passing No. 200 sieve) |        |            |                                 |        |        |        |
| Group classification       | A-1                                                 |        | A-3        | A-2                             |        |        |        |
|                            | A-1-a                                               | A-1-b  |            | A-2-4                           | A-2-5  | A-2-6  | A-2-7  |
| Sieve analysis (% passing) |                                                     |        |            |                                 |        |        |        |
| No. 10 sieve               | 50 max                                              |        |            |                                 |        |        |        |
| No. 40 sieve               | 30 max                                              | 50 max | 51 min     |                                 |        |        |        |
| No. 200 sieve              | 15 max                                              | 25 max | 10 max     | 35 max                          | 35 max | 35 max | 35 max |
| For fraction passing       |                                                     |        |            |                                 |        |        |        |
| No. 40 sieve               |                                                     |        |            |                                 |        |        |        |
| Liquid limit (LL)          |                                                     |        |            | 40 max                          | 41 min | 40 max | 41 min |
| Plasticity index (PI)      |                                                     | 6 max  | Nonplastic | 10 max                          | 10 max | 11 min | 11 min |
| Usual type of material     | Stone fragments,<br>gravel, and sand                |        | Fine sand  | Silty or clayey gravel and sand |        |        |        |
| Subgrade rating            | Excellent to good                                   |        |            |                                 |        |        |        |

| Silt-clay materials        |                                                       |        |                    |                                          |
|----------------------------|-------------------------------------------------------|--------|--------------------|------------------------------------------|
| General classification     | (More than 35% of total sample passing No. 200 sieve) |        |                    |                                          |
| Group classification       | A-4                                                   | A-5    | A-6                | A-7                                      |
|                            |                                                       |        |                    | A-7-5 <sup>a</sup><br>A-7-6 <sup>b</sup> |
| Sieve analysis (% passing) |                                                       |        |                    |                                          |
| No. 10 sieve               |                                                       |        |                    |                                          |
| No. 40 sieve               |                                                       |        |                    |                                          |
| No. 200 sieve              | 36 min                                                | 36 min | 36 min             | 36 min                                   |
| For fraction passing       |                                                       |        |                    |                                          |
| No. 40 sieve               |                                                       |        |                    |                                          |
| Liquid limit (LL)          | 40 max                                                | 41 min | 40 max             | 41 min                                   |
| Plasticity index (PI)      | 10 max                                                | 10 max | 11 min             | 11 min                                   |
| Usual types of material    | Mostly silty soil                                     |        | Mostly clayey soil |                                          |
| Subgrade rating            | Fair to poor                                          |        |                    |                                          |

<sup>a</sup>If  $PI \leq LL - 30$ , the classification is A-7-5.

<sup>b</sup>If  $PI > LL - 30$ , the classification is A-7-6.

**Figure 2.2.2B AASHTO Soil Classification System**

### 2.2.3 Soil Bearing Capacity

The bearing capacity of the soil within the site, can be calculated by using Terzaghi's Equation:

$$Q_{ult} = cN_c + (\gamma_1) D_f N_q + 0.5 (\gamma_2) B N_\gamma$$

**Figure 2.2.3 Terzaghi's Equation**

Based on the number of blows (6) provided by the boring log data, the angle of friction (31 degrees) and unconfined compressive strength ( $S_u = 0.75$  tons/ft) can be found using the guide for grain soil table. The angle of friction was then used to find the  $N_c$ ,  $N_q$ , and  $N_\gamma$  values of Terzaghi's equation. The values of  $N_c$ ,  $N_q$ , and  $N_\gamma$  can be found using Terzaghi's Table of Bearing capacity factors.

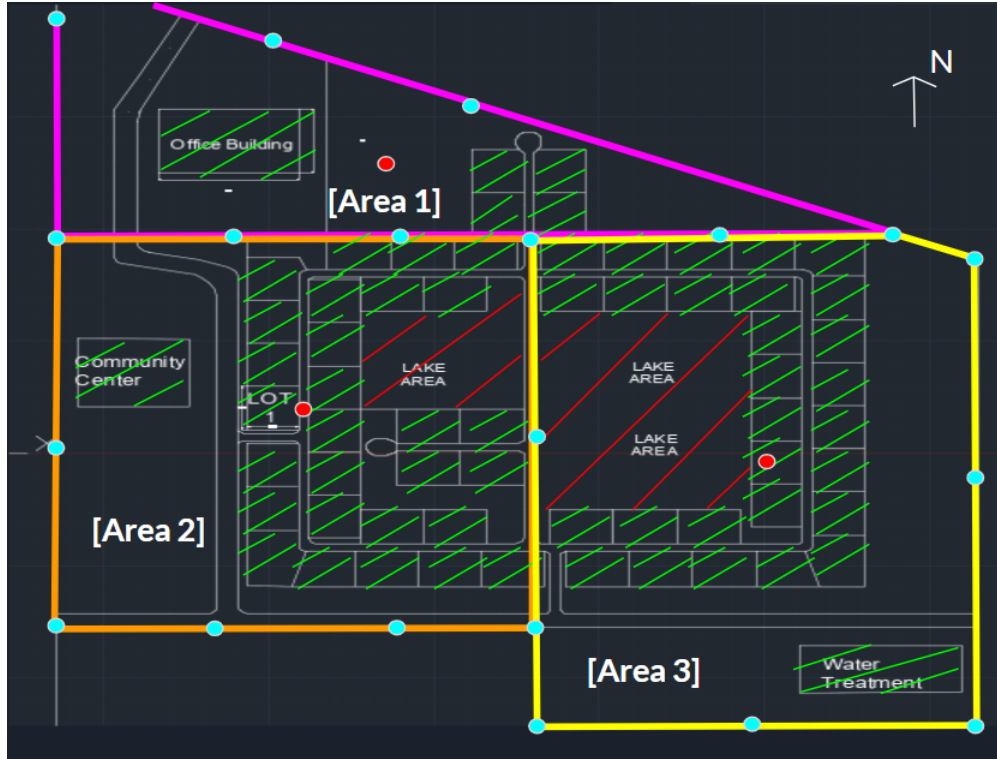
|          |       |
|----------|-------|
| Nc value | 40.41 |
| Nq value | 25.28 |
| Ny value | 22.65 |

**Table 2.2.3a Terzaghi's Bearing Capacity Factors**

The thickness of the slab (B) will be 4 feet thick, based on the slab to grade foundation that the structures will be designed for. The depth of the soil, Df will be assumed to be 6 foot. The cohesion value in Terzaghi's equation is found dividing the unconfined compressive strength by two, equating to 750 pounds per square feet. This cohesion value shows that the soil is stiff, and is possibly a good depth to build a slab foundation on. The saturated weight of the soil (gamma) is given by the boring log data (15 kilo-newtons per cubic meter = 3.37 pounds per cubic feet). Now solving for the bearing capacity, the total ultimate bearing capacity is calculated to be 12,971 pounds per cubic feet. Using a factor of safety of three, the allowable bearing capacity of the soil is calculated by dividing the ultimate bearing capacity by three. Thus equating an allowable bearing capacity of 4,324 pounds per cubic feet. (See appendix for hand calculations.)

#### **2.2.4 Site Plan**

The site plan of the subdivision is shown below, this site plan shows the sections within the subdivision where the individual sections (Area 1, Area 2, Area 3) are analyzed using the grid method for developing the earthwork (cut and fill) of the site.



**Figure 2.2.4 Site Division of Subdivision**

### **2.2.5 Sub Division Areas**

The center and existing ground elevations are set at 195 feet above sea level. However, because this area is mostly flat, the area where the office building as well as residential housing will be filled 3 feet (to 198 feet above sea level) for drainage purposes. The green lines on the picture below indicate places that will be filled on the site, and lines that a red indicated places where the soil will be excavated. The red dot indicates the center ground elevation of the area.



**Figure 2.2.5a Area 1 of Subdivision**

The second area of the subdivision has a center elevation set at 195 feet above sea level. The average Existing Ground Elevations are 192.5 feet above sea level.

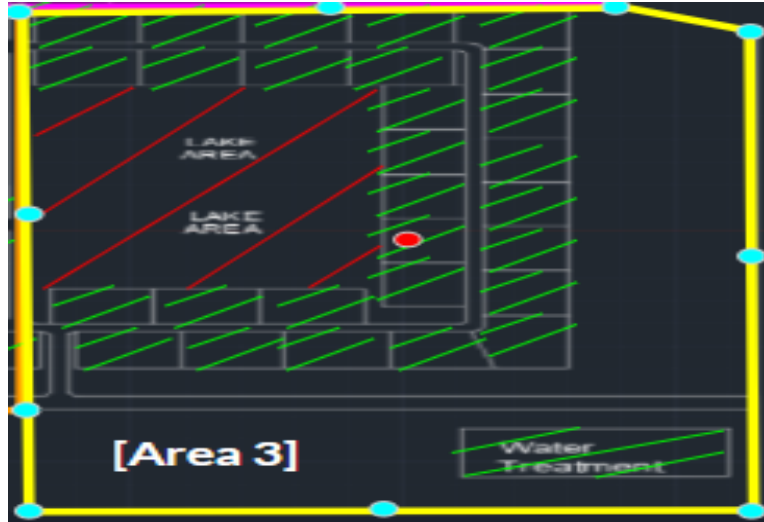
Again, this area is mostly flat, the area where the community center of the subdivision as well as residential housing will be elevated by 3 feet (198 feet above sea level) for drainage purposes. However, toward the bottom of area 2, the elevation is 190, therefore the residential housing in this area will need to be filled an additional 4 feet to be consistent with the other housing within the subdivision.



**Figure 2.2.5b Area 2 of Subdivision**

The third area of the subdivision has a Center Elevation set at 195 feet above sea level. The average Existing Ground Elevations are 192.5 feet above sea level.

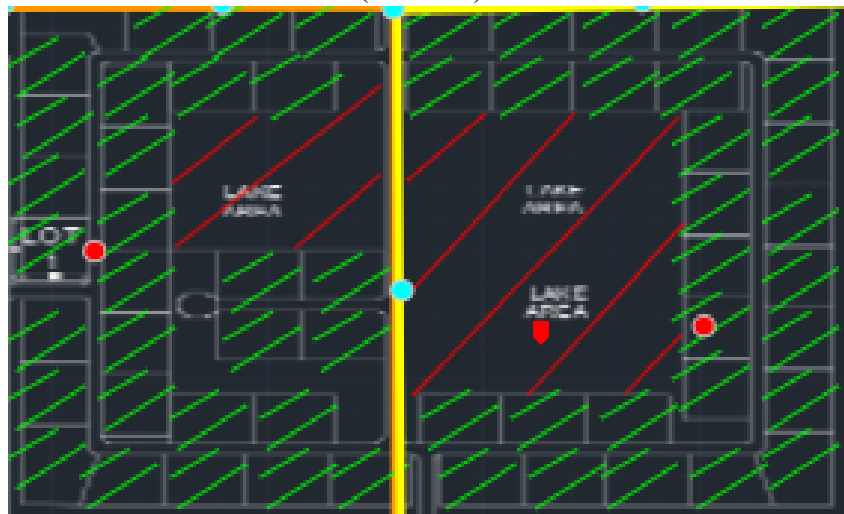
Again, this area is going down slope. The area where the water treatment facility is located as well as the lower half of residential housing will be filled 7 feet, while the rest of the residential housing within the subdivision will be elevated 3 feet (198 feet above sea level) for drainage purposes. However, toward the bottom of area 2, the elevation is 190, therefore the housing in this area will need to be filled an additional 4 feet.



**Figure 2.2.5c Area 3 of Subdivision**

The lake area is approximately 15,250,000 sq. feet.

The depth of the lake will be 12 feet. This means that the amount of Cut that is needed for the lake is 12 feet below the flat 195 elevation (183 feet).



**Figure 2.2.5d Lake Area of Subdivision**

### **2.2.6 Cut and Fill Volumes**

Cut and Fill Volumes determine the volume of soils needed to be either added or removed to make the elevation of a project sub area or of a proposed building level. The method used to calculate cut and fill is the grid method. The average existing elevations are subtracted from the



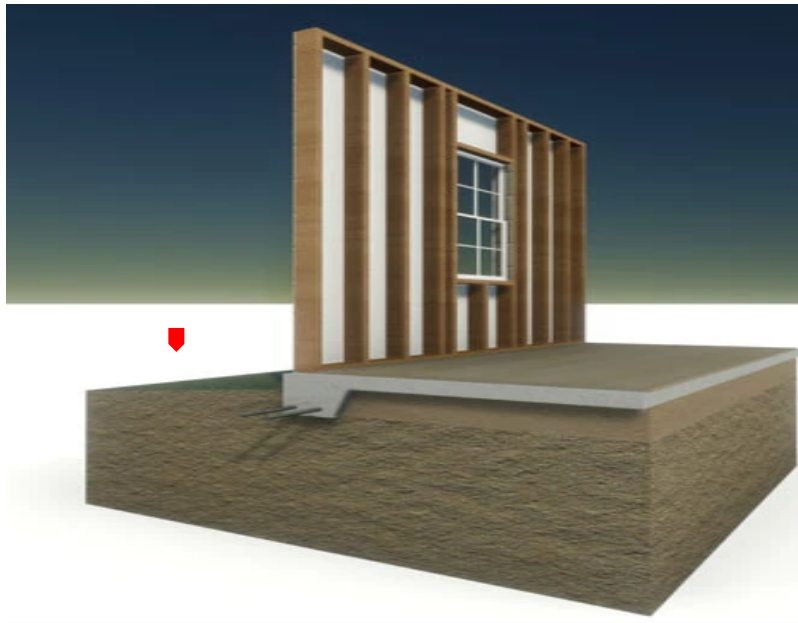
average proposed elevations. The result is multiplied by the area of either a building or a subarea to give the volume of cut-and-fill. A negative result indicates cut, and a positive result indicates fill. According to the TxDOT Specification Standards, the shrinkage/swelling factors are not needed to calculate the cut and fill volumes. Since the lake will cause a significant amount of excavation, the soil excavated will be used to fill the areas needing soil thus cutting cost down from the hauling process from an off site location.

| <b>Type of Building</b> | <b>Area of Building (sq. ft)</b> | <b>Average Existing Elevation (ft)</b> | <b>Proposed Elevation (ft)</b> | <b>Volume (cubic feet)</b> | <b>Cut or Fill</b> |
|-------------------------|----------------------------------|----------------------------------------|--------------------------------|----------------------------|--------------------|
| <b>Office Building</b>  | 9,600                            | 195                                    | 198                            | 19,200                     | Fill               |
| <b>Residential Home</b> | 6,800                            | 192.5                                  | 198                            | 81,600                     | Fill               |
| <b>Community Center</b> | 2,475                            | 195                                    | 198                            |                            | Fill               |
| <b>Lake</b>             | 15,250,000                       | 195                                    | 183                            | 183,000,000                | Cut                |

**Table 2.2.6 Calculated Cut and Fill Volumes of Subdivision**

### **2.2.7 Residential & Community Center Foundation Design**

The foundation that will be provided for the community center, as well as the residential homes will be a slab-on-grade foundation. This foundation type is the most popular type of foundation for such type structures. The slab-on-grade foundation has many advantages and disadvantages. The advantages include: less expensive to construct, effective process, simplest foundation to construct, free from mold and mildew issues, and it allows a wide range of flooring options. The disadvantages included that it offers minimum protection to the home, potentially expensive repairs, and cracks can become an issue. Nonetheless the slab-on-grade foundation was chosen because of its cost effectiveness. An example of a slab-on-grade foundation is shown below.



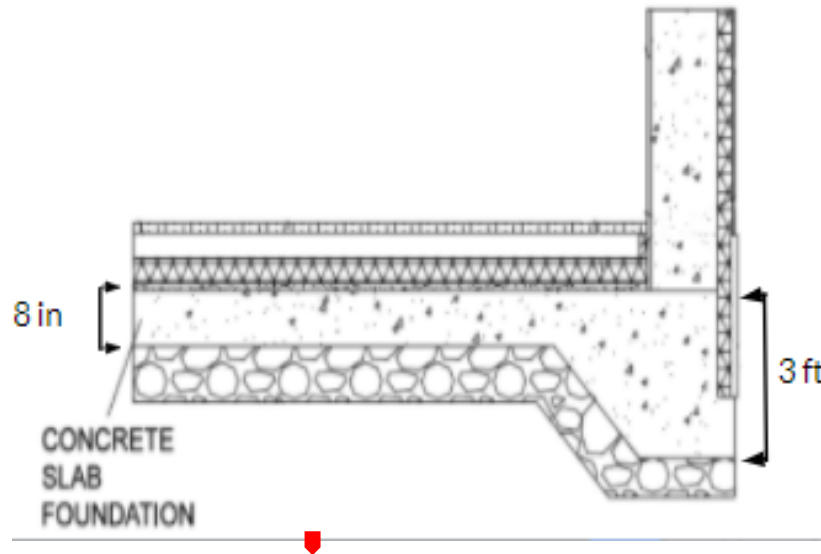
**Figure 2.2.7a Slab on Grade Foundation Type**



**Figure 2.2.7b Slab on Grade Foundation Type**

The foundation will have a depth of three feet. The foundation will also have a design period of 80-100 years. The foundation will have a thickness of 6 inch due to the normal standards of a

residential home with a slab foundation, as well as to ensure that the foundation can endure more strength. Similarly, the foundation will be concrete material, with no reinforcing bars/steel. The design drawing of the foundation is shown below.



**Figure 2.2.7c Slab to Grade Foundation Design Drawing**

## **2.3 Transportation Engineering**

### **2.3.1 Subdivision Roadway Layout**

The subdivision roadway layout is designed to ensure every section has a calm traffic flow. As designed, the Office Building is located near the main entrance. The Community Center is located on the far west side of the property. Both buildings have access via the main road, Gateway Blvd. Gateway Blvd. travels north to south and terminates at the City of Houston ETJ proposed Mound Rd and is classified as a collector road. All residential properties are located east of Gateway Blvd. Located in the residential area are local roads and two cul-de-sacs. In addition, a secondary entrance to the subdivision will be at the proposed Mound Rd and SH 99 intersection. A typical one span bridge will travel across portions of the recreational lake located at the center of the residential section.

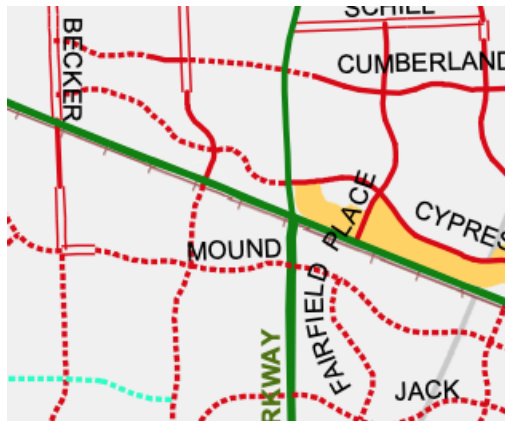


**Figure 2.3.1 Subdivision Roadway Layout**

Figure 2.3.1 displays the AutoCAD design of the roadway layout. All roadways were designed based on the Harris County Engineering Department Standards and Texas Department of Transportation Roadway Design Manual.

### **2.3.2 Gateway Boulevard Road Design (Main Rd.)**

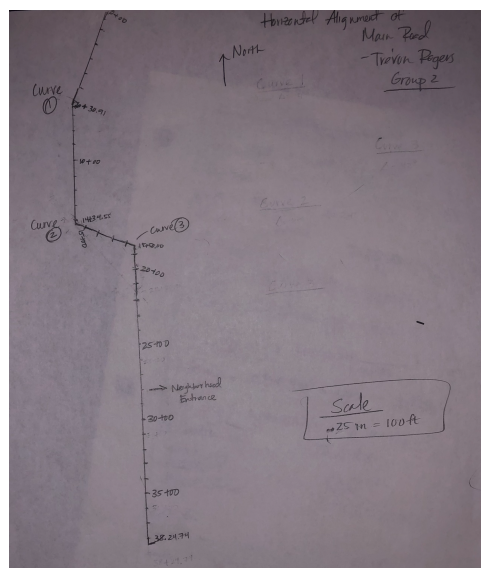
Gateway Blvd. is a .72 mile collector road that travels in a northward and southward direction. The road begins at the US 290 and Bauer Rd. intersection and terminates at the City of Houston ETJ proposed Mound Rd. CSR Engineering plans to partner with the City of Houston to construct Gateway Blvd. within the proposed right of way for Bauer Rd., shown in the figure below.



**Figure 2.3.2 City of Houston Proposed Mound Rd.**

Figure 2.3.2 shows the location of the proposed Mound Rd. The figure is a small display from the City of Houston's 2019 Major Thoroughfare and Freeway Plan. The dotted red line signifies a proposed major thoroughfare and the solid green line signifies a freeway or expressway.

The road will be widened from two lanes to four lanes to accommodate future traffic in the development. For the horizontal alignment, the centerline was first determined. Using the Google Maps, Point A was established at the intersection of US 290 & Bauer Road. as Station 0+00. The alignment terminates at Point B, Mound Road. The ending station of the alignment is 38+24.74. There are a total of 3 curves that make up .72 miles. The entrance to the residential neighborhood is at Station 28+00. In Figure 2.2.3, the horizontal alignment is drawn with the centerline and horizontal curve data. All curve data calculations can be found in the appendix.



**Figure 2.3.3 Horizontal Alignment of Gateway Blvd.**

Table 2.3.1 consists of the data for each curve along the horizontal alignment. Curves are numbered in numerical order from north to south. The delta values are computed and tabulated in the table.



**Table 2.3.1 Curve Data**

| Curve | Station  | Delta (degrees) |
|-------|----------|-----------------|
| 1     | 6+30.91  | 24              |
| 2     | 14+34.55 | 15              |
| 3     | 18+50.00 | 18              |

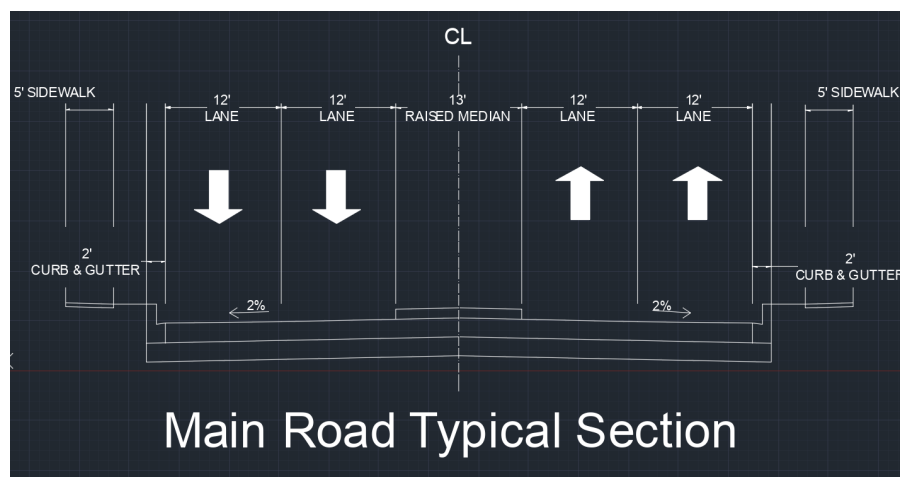
The vertical alignment is currently still in development. The profile view will provide information to help determine the design speed and posted speed. Based on the contour map, the area is mostly flat at an elevation of 195 feet.

The widened four lane Gateway Blvd. will have a 84 feet right of way. Each lane will be 12 feet wide and a raised median width of 13 feet. 2 feet curb & gutters will be considered on both sides of the road, to help with drainage in addition to a 2 percent slope. All design standards were followed based on the Harris County Engineering Department. Table 2.3.2 shows the standard design values provided.

**Table 2.3.2 Collector/Major Thoroughfare Roadway Design Standards**

| ROADWAY CLASSIFICATION          | ROW (1) | 4 LANES      | 4 LANES      | 4 LANES      | 6 LANES      |                     |
|---------------------------------|---------|--------------|--------------|--------------|--------------|---------------------|
|                                 |         | 80 FT.       | 90 FT.       | 100 FT.      | 100 FT.      |                     |
| COLLECTOR OR MAJOR THOROUGHFARE | W       | 25 FT. (B-B) | 25 FT. (B-B) | 25 FT. (B-B) | 34 FT. (B-B) | SEE COUNTY ENGINEER |
|                                 | M       | 13 FT.       | 21 FT.       | 31 FT.       | 12 FT.       |                     |
|                                 | S       | 8.5 FT.      | 9.5 FT.      | 9.5 FT.      | 9.5 FT.      |                     |

Below is Figure 2.3.4 is an AutoCAD cross-typical section for Gateway Blvd. All drawings include 5 feet wide sidewalks on both sides. In the drawings, the dimensions are shown.



**Figure 2.3.4 Main Road Typical Section**

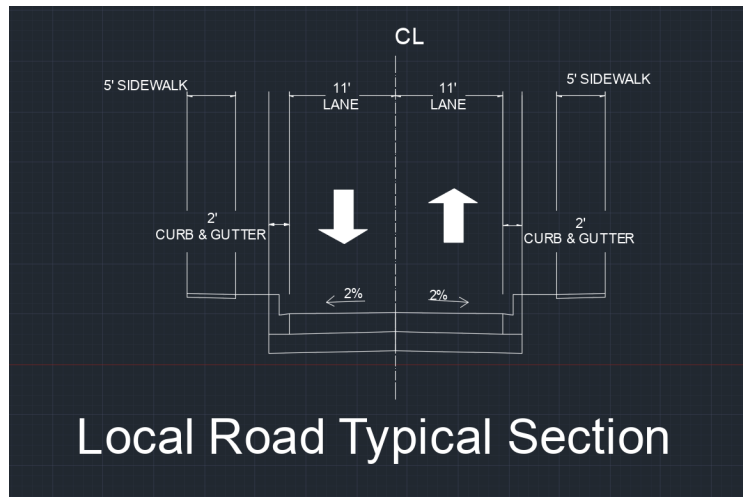
### **2.3.4 Local Residential Road Design**

Local roads will be designed under Harris County Engineering Department design standards. Roads will have two 12 ft lanes and two cul-de-sacs with a 50 ft radius will be placed in the residential section of the subdivision. Table 2.3.3 provides the standard design dimensions. In addition, Figure 2.3.5 and 2.3.6 are cross-sectional sketches of a typical local road and bridge. Figure 2.3.7 displays the typical sketch of a cul-de-sac.

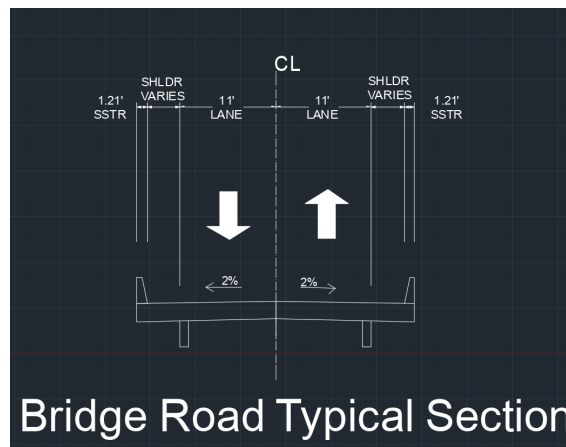
**Table 2.3.3 Local Roadway Design Standards**

| ROADWAY CLASSIFICATION | SINGLE PAVING SECTION (W) | DOUBLE PAVING SECTION (W) | SINGLE PAVING SECTION WITH ROADSIDE DITCHES (W) | DOUBLE PAVING SECTION WITH ROADSIDE DITCHES (W) |
|------------------------|---------------------------|---------------------------|-------------------------------------------------|-------------------------------------------------|
| LOCAL                  | 28 FT. (B-B)              | 2/25 FT. (B-B)            | 22 FT. (E-E) WITH 6 FT. SHOULDERS               | 2/24 FT. (E-E) WITH 6 FT. SHOULDERS             |
| COLLECTOR              | 41 FT. (B-B)              | 2/25 FT. (B-B)            | 41 FT. (E-E) WITH 6 FT. SHOULDERS               | 2/24 FT. (E-E) WITH 6 FT. SHOULDERS             |

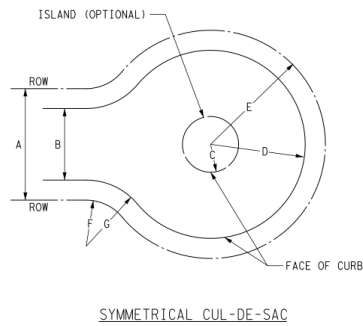
B-B: BACK TO BACK  
E-E: EDGE TO EDGE



**Figure 2.3.5 Local Road Typical Section**



**Figure 2.3.6 Bridge Road Typical Section**



**Figure 2.3.7 Symmetrical Cul-De-Sac Design**

### **2.3.5 Pavement Design**

Each road within the subdivision will consist of a rigid pavement design. All Texas Department of Transportation design standards will be followed to determine the needed base-course, subbase-course and how to treat the subgrade. A 10 inch concrete slab will top the pavement design.

### **2.3.6 Traffic Signal Location**

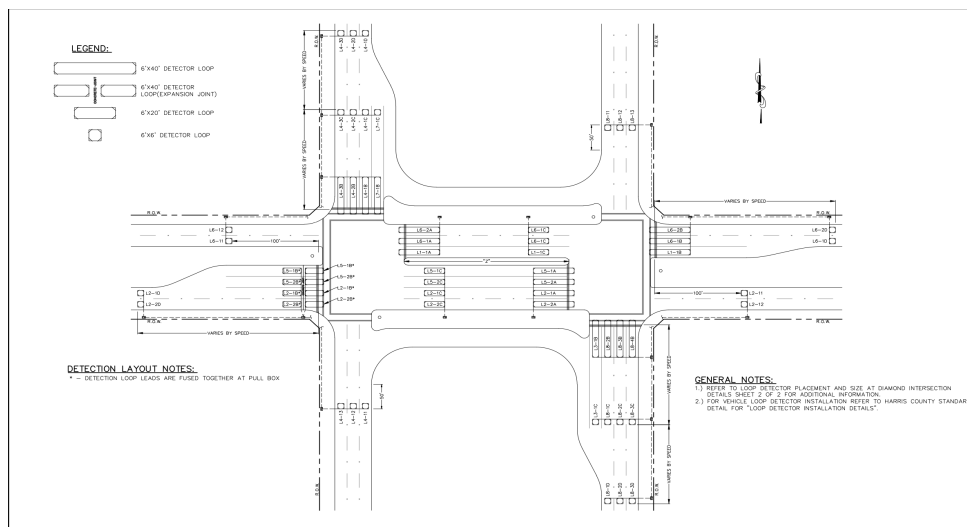
Future design traffic data was calculated based on the current data obtained from the Harris County Engineering Department and the Texas Department of Transportation. The traffic signal will be located at the intersection of Gateway Blvd. and US 290. Future AADT was determined by assuming 40% of intersection traffic would travel onto Gateway Blvd. 2050 AADT was calculated to be 11936 vpd and 250 ADT was determined to be 20236 vpd. Figure 2.3.7 shows the current condition of the non-signalized intersection from Google Maps.



**Figure 2.3.8 Gateway Blvd. & US 290 Intersection**



The signalized intersection will be known as a Diamond Signalized Intersection. This is due to the intersection's conflict points and design. The intersection consists of the four lane Gateway Blvd. and two-three lane one way feeder roads. In order to ensure traffic flow is smooth, detection loops will be installed. Figure 2.3.8 is a design rendering from the Harris County Engineering Department of a diamond signalized intersection.



**Figure 2.3.9 Diamond Intersection Design Rendering**

### **2.3.7 Parking Facilities & Driveway Design**

Parking facilities will be major components for the community center, office building and treatment plants. Off-street parking will help accommodate all parking needs within the subdivision. Parking data followed the American Disability Act Design Standards and City of Houston Municipal Parking Standards. In addition, building occupancies were determined using the International Fire Code by the Structural Engineer. Parking stalls will be 90 degrees and be 9 ft wide and 18 ft long. Table 2.3.4 includes the total number of parking stalls for each building within the subdivision.

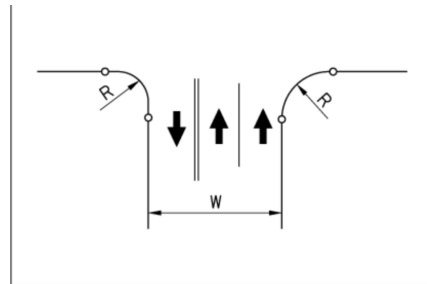
**Table 2.3.4 Parking Stall Count**

| <b>Building</b>                    | <b>Parking Stall Count (stalls)</b> | <b>ADA (stalls)</b> |
|------------------------------------|-------------------------------------|---------------------|
| Community Center                   | 180                                 | 6                   |
| Office Building                    | 196                                 | 6                   |
| Water & Wastewater Treatment Plant | 34                                  | 1                   |

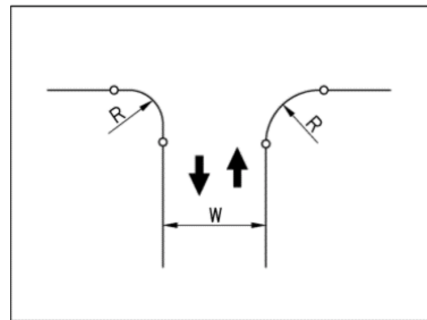
Parking for the community center will be located at the front and rear of the building. Regular visitor parking will be in the front and 6 bus & van parking stalls will be at the rear. Office

building parking will be located near the front entrance of the building. Lastly, Water & Wastewater Treatment Plant parking will be in between both treatment plants. This will help accommodate the 500 ft separation requirement for the treatment plants.

Driveways for the parking facilities will adhere to the TxDOT Roadway Design Manual. Each building will have commercial driveways. The community center will have one entry lane and two exit lanes for the parking lot main entrance. There will be a 25 ft driveway radius and 40 ft throat width with 12 ft lanes. For the bus and van rear entrance, there will be a 30 ft driveway radius and 30 ft throat width with two 12 ft lanes. Figure 2.3.9 and 2.3.10 is a design rendering of both driveway designs.

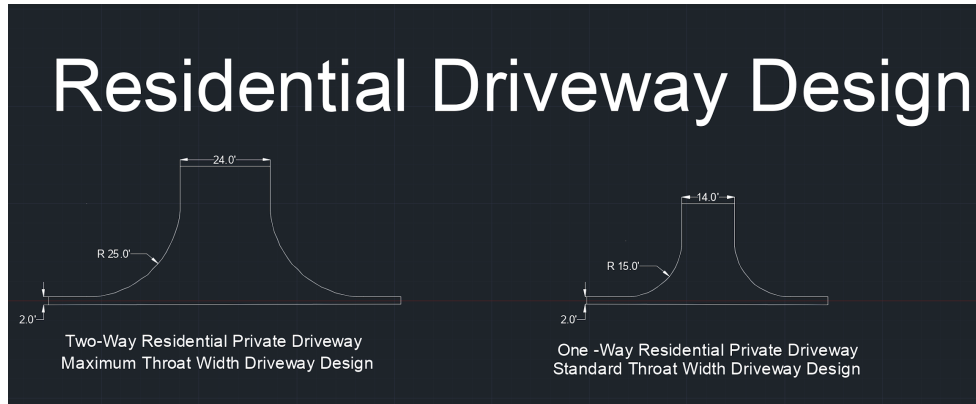


**Figure 2.3.10 Commercial Three Lane Driveway Design**



**Figure 2.3.11 Commercial Two Lane Driveway Design**

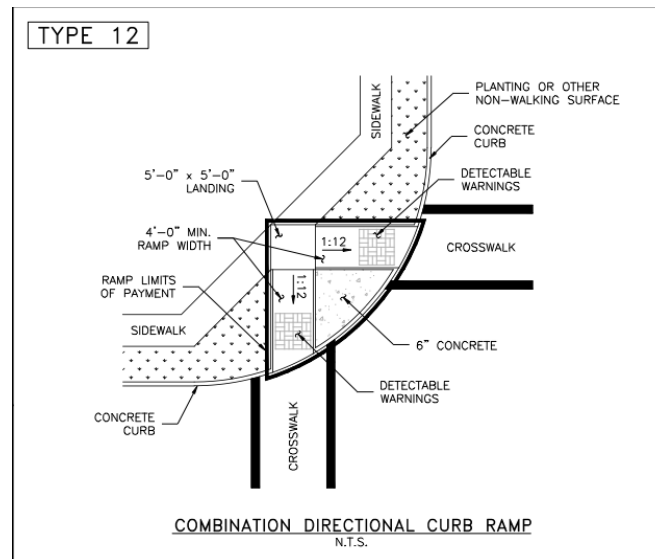
Residents will have two options for residential driveways. There can be a two-way or one-way driveway design. Two-way driveways will have a 24 ft throat width and 25 ft radius. One-way driveways will have a 14 ft throat width and 15 ft radius. Both will have a 2 ft curb offset to help with drainage. Figures 2.3.11 is an AutoCAD drawing of both residential driveways for the subdivision.



**Figure 2.3.12 Residential Two-Way & One-Way Driveway Design**

### **2.3.8 Sidewalks**

Sidewalks will be around the subdivision to promote a pedestrian friendly area. All design standards were based on TxDOT Roadway Design Manual and the Harris County Engineering Department. Sidewalks will be 5 ft wide, 4.5 in thick, a 2% slope and 4 ft buffer zone from the curb. Figure 2.3.13 is a design rendering a typical sidewalk at crosswalk design.

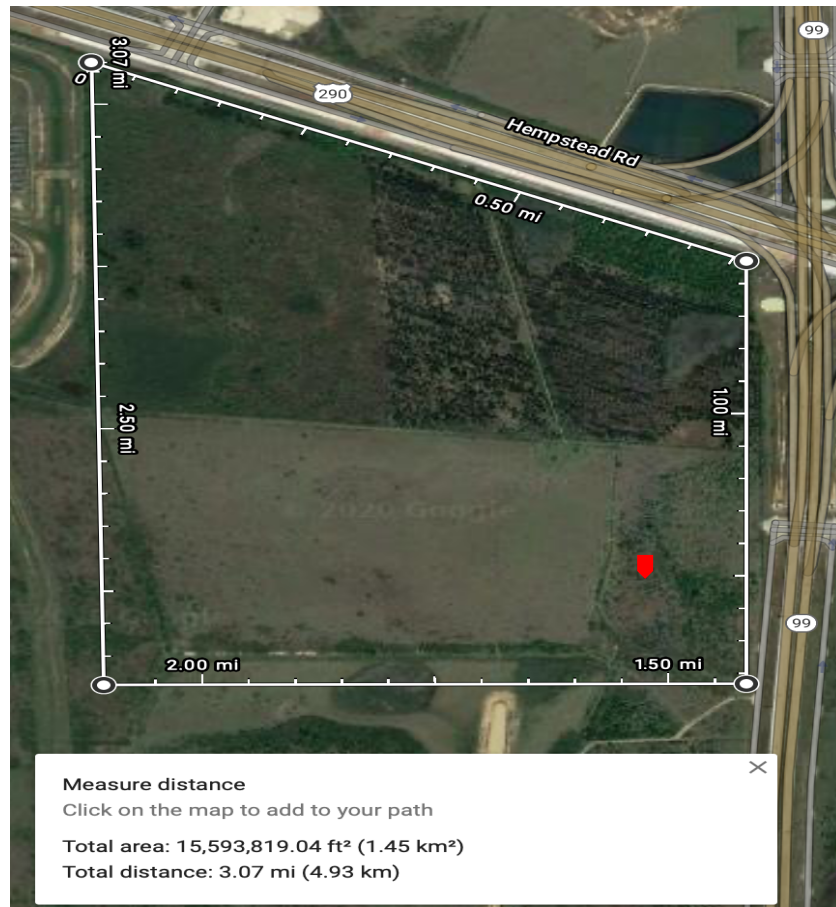


**Figure 2.3.13 Sidewalk at Intersection Design**

## **2.4 Environmental Engineering: Water Treatment**

The proposed subdivision, located in northwest Harris County, has been designed based on the provided design data, environment, and the future needs for the public. CSR Engineering Inc. has decided to name the proposed subdivision, The Gateway. The area is northwest of Houston near the US 290 & SH 99 Grand Parkway Interchange. The 359 acre property is located south of US 290 and west of SH 99. Within the subdivision, Water & Wastewater Treatment Plants will be

designed to serve 10,000 people. Additionally, the community center & office building are located within the 359 acres of land. The community center will be a 9,600 square foot building that will provide residents with a place to host events. The office building will be 28,800 square feet and will be the headquarters of a major company.



**Figure 1. Site Map of PVHB Residential and Office Facility Development**

#### **2.4.1 Problem Statement**

CRS Engineering Inc. has been asked to design a Water Treatment Plant for the PVHB Residential and Office facilities; it must be designed to supply the development to serve a population of 10,000 persons – including design and specifications for the plant. The report will discuss all aspects of water and wastewater treatment design. All guidelines will be followed based on the Texas Administrative Code (TAC).

#### **2.4.2 Project Goals and Objective**

The project team is required to perform Civil Engineering Site Development, and Design Services and address all aspects outlined in the reporting requirements and deliverable items of this project description. Some of the goals include design and specifications for the water treatment plant: Site Plan, Building footprint, Minimal parking, Water quantity calculations, supply lines, and pump station (water source from stream outside close and adjacent to boundary line), Details of treatment systems from beginning to end.

### **2.4.3 Site Assessments**

CRS Engineering Inc. has been tasked with developing a new site for the public of the Greater Houston Area. The new PVHB Residential and Office Facility Project is along US 290 & SH 99 Grand Parkway Interchange. With every project, an Environmental Site Assessment (ESA) is needed to determine if an environmental impact was made. ESA's ensure that the surrounding area will not be disrupted negatively in any way. This includes checking for endangered & threatened species, noise pollution, odor pollution, risk management, and etc. The PVHB Residential and Office Facility Site is located in Harris County, and my team will be using the guidelines, regulations, and data of the Texas Administrative Code (TAC) & Texas Parks & Wildlife Department to ensure the proposed site is suitable for the given area.

### **2.4.4 Endangered Species**

All proposed sites must consider rare, threatened, and endangered species before construction. If there is any species that meets this criteria in the area, either another location must be considered or proper measurements must be taken to reallocate the species. Attached below is a table of all the threatened and endangered species of Harris County, provided by The Texas Parks & Wildlife Department.

- [Site Assessment Species](#)

### **2.4.5 Noise Pollution**

Noise pollution from water treatment plants is caused due to the machinery, which includes pump stations, fans, compressors, and etc. Effective noise control engineering can provide a wide range of solutions, but the two most effective are: Equipment/Site Location & Facility Ventilation. The Texas Administrative Code (Chapter 309, Subchapter B: Location Standards) states, “(c) A wastewater treatment plant unit may not be located closer than 500 feet from a public water well as provided by §290.41(c)(1)(B) of this title (relating to Water Sources) nor 250 feet from a private water well”. The distance given is just a minimum of what Texas Standards are; The TAC never gives a specific distance that would help eliminate noise control, but CRS Engineering will be using a distance of \_\_\_\_\_. This was determined using a similar distance of an actual Water Treatment Plant with some of the same requirements we were given. By locating the noisiest equipment as far from neighboring residential properties, the noise pollution is reduced significantly. Another tactic used to reduce noise pollution is Facility Ventilation. Although not necessary in water treatment plants in Texas, it is an effective solution to the noise produced. Facility Ventilation is the process of enclosing the Water Treatment Plant with fabricated materials that can reduce noise levels at neighboring areas.

### **2.4.6 Odor Pollution**

Common odors lingering in and around treatment plants smell like rotten eggs, ammonia, or garlic, among other things. Sometimes the odor is described as earthy or organic. This can be a common problem around surrounding neighborhoods. Although we are designing a Water Treatment Plant, we will be using Wastewater Treatment Plant specifications given by the TAC to determine how to deal with odor pollution. Effective odor control engineering can provide a wide range of solutions, but the three most effective are: Site Location, Deodorizing Misting Systems, and Powder Activated Carbon. As stated above, when it comes to location of a site, we

have to ensure that the noise and odor are at a minimum. The distance of \_\_\_\_\_ will be used because this gives enough space to decimate the odor as well as noise. The next two tactics are not required by the TAC, but have been very effective in studies across the country. Deodorizing Misting Systems can be used to target airborne volatilized odor compounds by saturating outdoor facility air with sprayed deodorizing mists delivered through a network of pumps, filters, injectors, and hose-lines. Powdered Activated Carbon is a high performance absorbent engineered to remove harmful contaminants in the air, gas, and liquid phases. The potable water industry has long used this product to effectively remove taste and odor compounds, and provide clean water that is safe to drink.

#### 2.4.7 Population Estimation

The second step for designing Water/Wastewater Plants is determining the future population. With the future population calculated, the correct water demand can be calculated when we multiply our population with the Average Annual Daily Flow (AADF). The PVHB Residential and Office Facility Site will have a future population of 10,000 people as given in the scope of work.

#### 2.4.8 Water Demand

The average American family uses more than 300 gallons of water per day at home. Roughly 70 percent of this use occurs indoors. Nationally, outdoor water use accounts for 30 percent of household use yet can be much higher in drier parts of the country and in more water-intensive landscapes.

#### 2.4.9 Water Demand

$$\begin{aligned} Q_{Average} &= (\text{Population}) \times (\text{AADF or Demand}) \\ &= (10,000 \text{ persons}) \times (180 \text{ gpcd}) \\ &= 1,800,000 \text{ gpd or } 1.8 \text{ MGD} \end{aligned}$$

$$\begin{aligned} Q_{Max \text{ Daily}} &= (Q_{Average}) \times (F) \\ &= (1,800,000 \text{ gpd}) \times (2.4) \\ &= 4,320,000 \text{ gpd or } 4.32 \text{ MGD} \end{aligned}$$

**Note: No Seasonal Correction Factor Needed**

$$\begin{aligned} Q_{Design} &= (Q_{Max \text{ Daily}}) \times (F_{\text{peak hourly}}) \\ &= (4,320,000 \text{ gpd}) \times (1.25) \\ &= 5,400,000 \text{ gpd or } 5.4 \text{ MGD} \end{aligned}$$

#### 2.4.10 Fire Demand

American Insurance Association Formula

$$\begin{aligned} Q(\text{gpm}) &= 1020\sqrt{P}(1 - 0.01\sqrt{P}) \\ &= 1020\sqrt{10}(1 - 0.01\sqrt{10}) = 3,123.52 \text{ gpm} \\ &= (3,123.52 \text{ gpm}) \times (1440 \text{ min/d}) = 4,497,868.8 \text{ gpd or } 4.50 \text{ MGD} \end{aligned}$$

**Note: Not Used for Treatment Design**

#### 2.4.11 Total Water for Distribution

$$\begin{aligned}Q_{Total} &= 5,400,000 \text{ gpd} + 4,497,868.8 \text{ gpd} = 9,897,868.8 \text{ gpd} \\&= (.15)(9,897,868.8 \text{ gpd}) = 1,484,680.32 \text{ gpd} \\Q_{Total} &= 8,413,188.48 \text{ gpd or } 8.4 \text{ MGD}\end{aligned}$$

#### 2.4.12 Acquisition of Water

[https://www.publicworks.houstontx.gov/sites/default/files/assets/003-regional\\_water\\_supply\\_map.pdf](https://www.publicworks.houstontx.gov/sites/default/files/assets/003-regional_water_supply_map.pdf)

#### 2.4.13 General Water Treatment Methods

##### i. Screening Treatment

Screening is mostly the first step in purifying surface water (water from lakes and rivers), which often has large debris, such as sticks, leaves, fish, trash, and other large particles. This may interfere with subsequent purification steps. These objects can clog the water-treatment system and must be removed before the water enters the treatment plant. Screening is a separation of particles on the basis of physical characteristics like size in water.

Screening is commonly categorized into either coarse screening or fine screening. Screens may be physically or mechanically cleaned, with only the older and smaller treatment facilities using physically cleaned screens as their primary or only screening device. Coarse screens are naturally used as primary preventive devices, and usually have openings of 10mm or larger. Fine screens are used to remove material that may cause operation & maintenance problems in the treatment process. Typical opening sizes for fine screens are 3 to 10mm. With science improving everyday advances with openings of less than 3mm are now being used to reduce material that may enter the water treatment process.

##### ii. Coagulation and Flocculation Treatment

The second water treatment method is coagulation. By adding ferric sulfate and polyelectrolyte, this starts the purification process of the water coming from the Mississippi River. The chemicals are added at precise dosage and mixed with the river water to ensure complete coagulation. Ferric sulfate is the primary coagulant and polyelectrolyte is a coagulant aide. Coagulant chemicals cause the very fine particles that make up the suspended solids present in the river water to clump together, or coagulate.

The third water treatment is flocculation. This is another mixing treatment just like coagulation, but without the chemicals. The mixing will make the particles appear larger than the particles that came out of the coagulation treatment.

##### iii. Sedimentation

In the water treatment process, sedimentation is the process of removal of suspended particles that are heavier than water by gravitational settling. Most raw water will contain mineral and organic particles. During the sedimentation stage, water slowly courses through large tanks, commonly called primary sedimentation tanks". These tanks hold large volumes of water and are designed to allow water to have a smooth, even flow at a velocity and turbulence of the water to be decreased to the point that the water will no longer transport the flocculated solids and they will settle to the bottom of the basin. The main purpose of the sedimentation stage is to remove turbidity, suspended and dissolved solids by allowing them the time to settle out of the water into a sludge that can be separately processed. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank from where it can be pumped to possible further sludge treatment stages. At the end of the settling basin, hydrated lime,  $\text{Ca}(\text{OH})_2$ , is added to the water to increase its pH. This is necessary because the alum that is added during the coagulation/flocculation process is acidic. After pH adjustment, chlorine is added for disinfection and to prevent aquatic growth on the filters during the next treatment process.

**iv. Filtration and Disinfection**

This part of the filtration process is normally used to remove the passing of particulate and other impurities, including floc, from the water being treated. These impurities consist of suspended particles, fine, silts, and clays. The material used in filters for public water supply is normally a bed of sand, coal, or other granular substance. Filtration processes can generally be classified as being either slow or rapid. The majority of municipal plants treat the settled water liquid using filtration and disinfection.

The water will course from the sedimentation tanks into the filter bed. Filters contain material of graduated size in layers that remove solids from the water. The first layer of a filter will usually be anthracite coal and the second layer is sand. Underneath the sand is a layer of stone or plastic composite. At the bottom of the filter is an under-drain system that supports the filter. Water is pumped onto the filters. As the water is being pumped into the filters, suspended matter is left on the filters. Floc, that is larger than the openings on the filter, are captured. Some suspended matter sticks to the surface of the filter or the previously deposited material. After the water is passed through the filter, the disinfectant is applied. During the disinfection, disease-causing organisms are destroyed or disabled. Chlorine is the most common disinfectant used in the United States because it is practical, effective, and economical. Chlorine dissipates rapidly. It is important to add the right amount of chlorine at the water treatment plant to make sure disinfection continues while the water is flowing through the distribution system. After a certain period of time, the filter will get clogged by excess floc and need to be cleaned and backwashed. Backwashing is the reversal of the direction of the water flow through the filter. A rapid upward flow lifts the particles and keeps them in suspension until they can be washed out.

**v. Storage**



Although the water is now consumable, it must be stored and transferred properly. Stabilization is a protective measure that reduces corrosion in water lines. Polyphosphate, a chemical that prevents corrosion, is added to the finished water as a preventive measure. Corrosive waters can cause problems related to public health, aesthetics, and economics. The water flows to the fluoridation, which is a safe and economical process that is endorsed by public health groups worldwide to reduce tooth decay. Fluoride is added to the line leaving the storage tank, so the fluoride dosage can be very precisely controlled. In designing, it's commonly forgotten to leave a sufficient amount of sodium hypochlorite, essentially a strong bleach. That is added to the finished water. This is done, so that a minimum amount of chlorine remains in the water until it reaches the customer's tap. Finally, pumping is necessary. Pumping systems include electric as well as diesel pumps to ensure continuous water service, even during power outages.



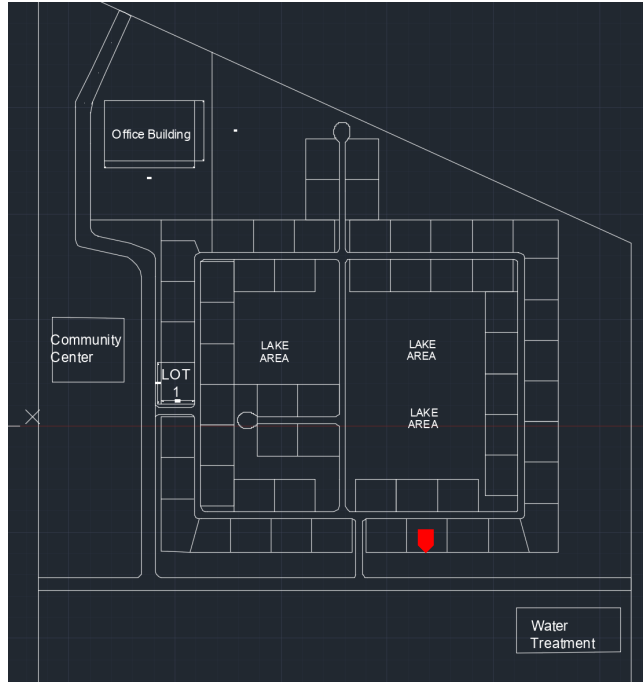
## **2.5 Water Resources Engineering**

The main goal is to design the rainwater drainage system and utility pipelines designed for water distribution and wastewater collection. The preliminary design consist of:

- Determining the location of the lake
- Finding the rainfall intensity of where the site is located
- Determining the quantity of water
- Determining the direction of the water flow
- Designing stormwater runoff, to avoid flooding risks and property damage
- Providing a profile and cross-section of the drainage
- Providing a profile and cross-section of the rainwater detention center
- Preparing plans and drawings showing utility lines, water lines, and storm sewer lines

### **2.5.1 Location of the Lake**

The location of the lake will be in the middle of the subdivision, so that the residents can enjoy it. The lake will occupy 350 acres of the site. The quantity of the water in the lake will be 7,623,000 ft<sup>3</sup>.



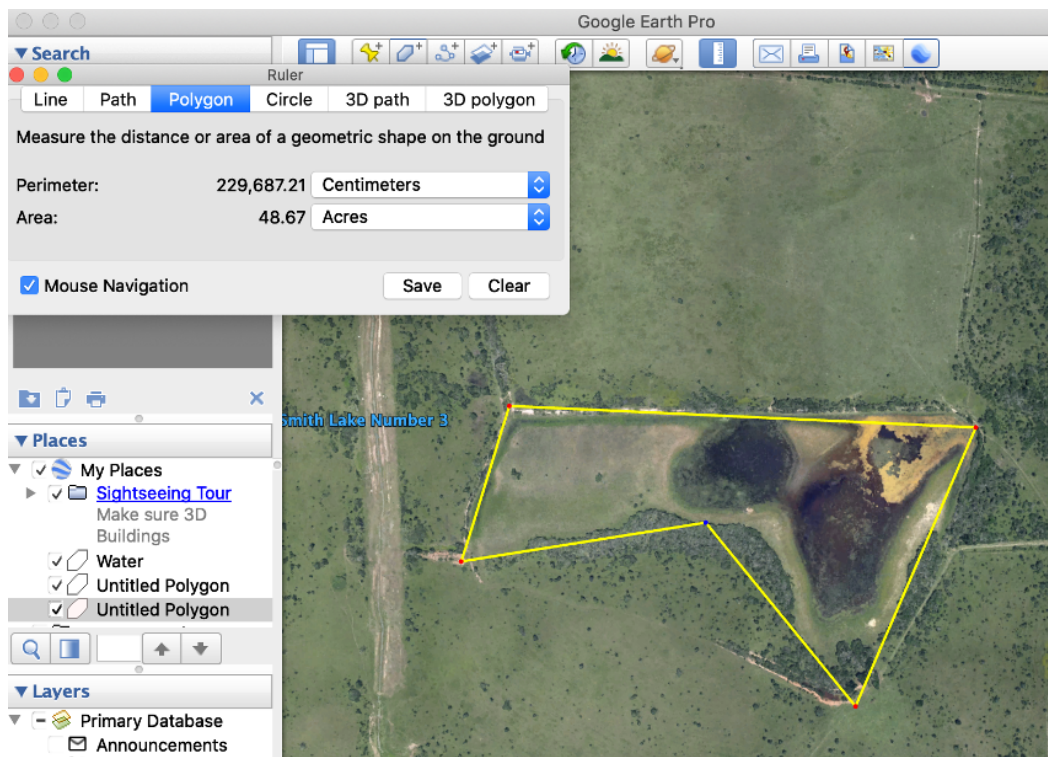
**Figure. 2.5.1 Location of the Lake**

### 2.5.2 Rainfall Intensity

The rainfall intensity can be found from Harris County Flood Control Sector. In this case, the rainfall intensity is very low. Since the rainfall intensity is very low, the detention pond will not be as huge. The location of the subdivision is not in a flood zone.

### 2.5.3 Quantity of Water

The quantity of water can be determined by multiplying the direct runoff by the drainage area. The direct runoff is 15.1 inches and the drainage area is 48.67 acres.



## Figure 2.5.2 Drainage Area

### 2.5.4 Stormwater Detention Basin

The peak discharge is found from an equation given in the Harris County Flood Control Manual. The peak discharge came out to be 205.57 cfs.

The dimensions of the basin is determined by creating a hydrograph to determine the outflow of the basin. The next step will be to route this inflow hydrograph to get the outflow of the basin. The peak discharge is also determined from the inflow hydrograph and a set of equations given in the Harris County Flood Control Manual. The equations used to formulate the hydrograph are:



## Hydrograph of the Area

### 2.5.5 Projections

The next things that need to be done in the Water Resources Area are to route the inflow hydrograph, determine the dimensions of the detention basin, and figure out the drainage part of the project. Utility plans will be the next thing going forward.

## 2.6 Wastewater Management

### 2.6.1 Wastewater Treatment

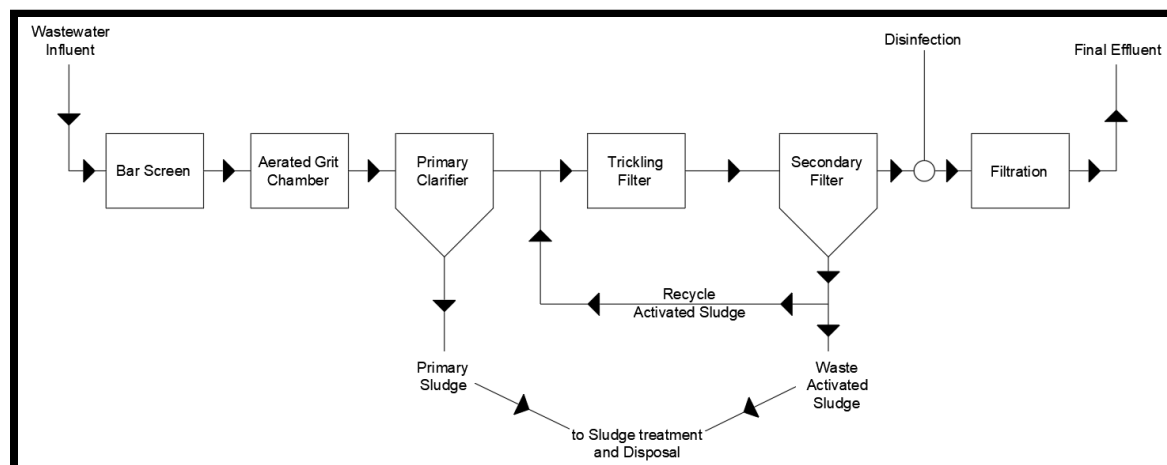
The objective of a wastewater treatment is to produce an effluent that can be discharged without causing serious environmental impacts. The processes for wastewater and water treatment plants are similar except, the biological methods are different. The treatment required for a wastewater treatment plant will depend on the effluent discharge requirements. There are three different types of treatment identifications. They are identified as primary, secondary, and advanced. The primary treatment involves sedimentation of solid waste within the water, which occurs after filtering out large contaminants and solids. The secondary treatment utilizes oxidation to further purify wastewater. This is done by three different ways which are biofiltration, aeration, and oxidation ponds. The advanced treatment is normally used for removing phosphates and nitrates from the water supply. The most commonly used materials that assist in this process are substances like activated carbon and sand.

Standards from the Texas Administrative Code (TAC) and the Texas Commission on Environmental Quality (TCEQ) will be utilized when designing the wastewater treatment plant. Some assumptions must be made in order to design, such as the quality of wastewater, the flow through the plant, and the total waste being produced. The treatments that will be designed are: screening, grit chambers, primary clarifiers, trickling filters, secondary clarifiers, and disinfection methods. Below is a table provided by TCEQ of standards to follow for wastewater characteristics, along with a diagram showing the treatment processes.

**Table 2.6.1 - Major Constituent of Typical Domestic Wastewater**

| Constituent     | concentration in mg/l |
|-----------------|-----------------------|
| Total Solids    | 1200                  |
| Dissolved Solid | 850                   |

|                     |     |
|---------------------|-----|
| Suspended Solid     | 350 |
| Nitrogen            | 85  |
| Phosphorus          | 20  |
| Chloride            | 100 |
| Alkalinity as Caco3 | 200 |
| Grease              | 150 |
| BOD5                | 400 |



**Figure 2.6.1. Diagram of Wastewater Treatment Facility Layout**

**Table 2.6.2 - The Wastewater Flow from TAC Title 30**

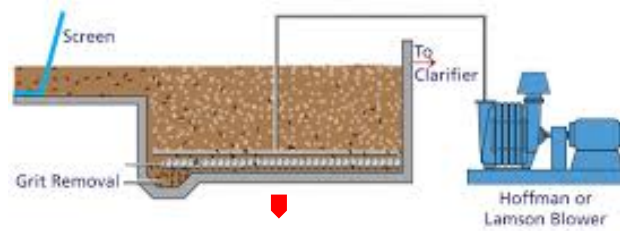
| Source                                                        | Remarks                                           | Daily Wastewater Flow (gallons/person) | Wastewater Strength (mg/l BOD <sub>5</sub> ) | Wastewater Strength (mg/l NH <sub>3</sub> -N) |
|---------------------------------------------------------------|---------------------------------------------------|----------------------------------------|----------------------------------------------|-----------------------------------------------|
| Municipality                                                  | Residential                                       | 75-100                                 | 250-400                                      | 15-75                                         |
| Subdivision                                                   | Residential                                       | 75-100                                 | 250-400                                      | 15-75                                         |
| Trailer Park (Transient)                                      | 2½ Individuals per Trailer                        | 50-60                                  | 250-350                                      | 15-75                                         |
| Mobile Home Park                                              | 3 Individuals per Trailer                         | 50-75                                  | 300                                          | 15-75                                         |
| School                                                        | Cafeteria & Showers                               | 20                                     | 300                                          | 15-75                                         |
|                                                               | Cafeteria/No Showers                              | 15                                     | 300                                          | 15-75                                         |
| Recreational Parks                                            | Overnight User                                    | 30                                     | 200                                          | 15-75                                         |
|                                                               | Day User                                          | 5                                      | 100                                          | 15-75                                         |
| Office Building or Factory                                    | A facility must be designed for the largest shift | 20                                     | 300                                          | 15-75                                         |
| Hotel/Motel                                                   | Per Bed                                           | 50-75                                  | 300                                          | 15-75                                         |
| Restaurant                                                    | Per Meal                                          | 7-10                                   | 1000*                                        | 15-75                                         |
| Restaurant with bar or cocktail lounge                        | Per Meal                                          | 9-12                                   | 1000*                                        | 15-75                                         |
| Hospital                                                      | Per Bed                                           | 200                                    | 300                                          | 15-75                                         |
| Nursing Home                                                  | Per Bed                                           | 75-100                                 | 300                                          | 15-75                                         |
| Alternative Collection Systems (Subchapter D of this chapter) | Per Capita                                        | 75                                     | N/A                                          | N/A                                           |
| *Based on a restaurant with a grease trap                     |                                                   |                                        |                                              |                                               |

Hempstead , Tx Wastewater Estimations:

The wastewater usage for 2050 was obtained by the assumption that 80% of the water that will be provided to the forecast population will come back as wastewater. It was obtained by getting 80% of 35.4 MGD which is 28.32 MGD. The wastewater per gal/capita\*day came out to be 102.4 gal/capita\*day which is out the range provided by TAC title 30 chapter 2.17 (75-100 gal/capita\*day).

## 2.6.2 Aerated Grit Chamber

An aerated grit chamber removes grit from wastewater streams. As shown in Figure 1, grit is removed by causing the wastewater to flow in a spiral pattern. Air is introduced in the grit chamber along one side, causing a perpendicular spiral velocity pattern to flow through the tank. Heavier particles are accelerated and diverged from the streamlines, dropping to the bottom of the tank, while lighter organic particles are suspended and eventually carried out of the tank.



**Figure 2.6.2. Aerated Grit Chamber**

Using a detention time of 3 minutes, a peak flow of 238.4 MGD, and a depth of 10 feet. The dimensions of the grit chamber were found by using the following equation:

$$V = Q * \theta$$

Where,

V = Volume

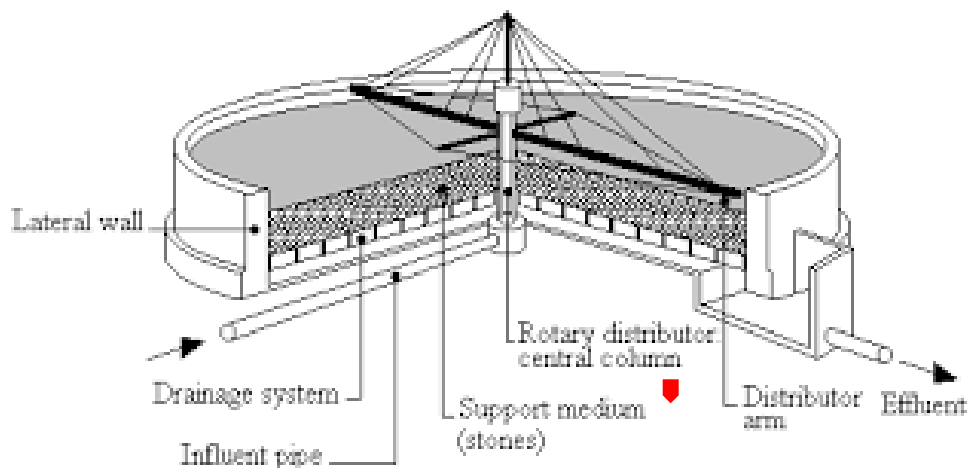
Q = Flow

$\theta$  = Detention Time

### 2.6.3 Trickling Filter

Trickling filters are utilized to eliminate organic matter from the wastewater after it has gone through the essential clarifier. The trickling channel is a high-impact treatment framework that uses microorganisms joined to a medium to eliminate organic matter from wastewater. It

empowers natural material in the wastewater to be consumed by a huge number of microorganisms joined to the medium as an organic film or sludge layer approximately 0.1 to 0.2 mm thick. Water streams in a meager film throughout the medium to permit time for treatment. As the layer thickens, on account of the microorganisms bit by bit connecting themselves to the medium, oxygen can't enter the medium face, and anaerobic life forms create. As the natural film continues developing, the microorganisms close to the surface begin to kick the bucket and accordingly lose their capacity to stick to the medium and a part of the sludge layer tumbles off the channel. This cycle is known as sloughing. The sloughed solids are then moved to the secondary clarifier for expulsion from the waste water. The trickling Filter is intended to give a last emanating of 20 mg/l, with the essential settling tank eliminating 45% of BOD and 65% of Total Suspended solids. There will stream channels for this wastewater treatment plant. The expulsion proficiency is roughly 90.9% with each channel seeing about 17.8 MGD. The influent solids stacking rate was resolved to be 32,659.44 lb. /day. Each channel will have measurements of 6 ft depth and a diameter of 62 ft and will have the option to hold a volume of 21,410 ft<sup>3</sup>.



**Figure 2.6.3 - Cross-Section of a Trickling Filter**

#### **2.6.4 Secondary Clarifier**

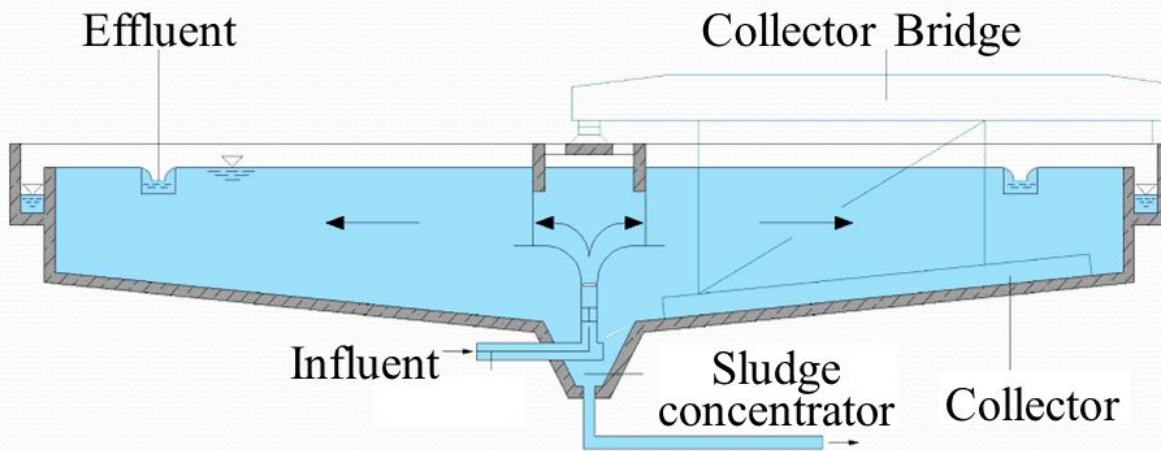


The secondary clarifier is a basic part of the wastewater treatment plant. Its key capacities are to isolate the organic floc from the treated fluid waste stream and the thickening and capacity of the slope from the natural treatment measure. The secondary clarifier works in a similar way as the essential clarifier portrayed already. A portion of the solids gathered in the secondary clarifier are sent back to the trickling filter to experience a similar cycle once more. Aerobic natural treatment is acted within the sight of oxygen by aerobic microorganisms that utilize the natural issue in the wastewater, along these lines creating more microorganisms and inorganic finished results.

**Table 2.6.3 - Secondary Clarifier Tank Dimensions**

| Design          | Dimension                   |
|-----------------|-----------------------------|
| Number of tanks | 2                           |
| Diameter        | 86.67ft                     |
| Depth           | 4.18 ft                     |
| Weir Length     | 272.28 ft                   |
| Weir Loading    | $17382.84 \frac{ft^2}{day}$ |
| Free board      | 2ft                         |

## Circular Secondary Clarifier (2)



5

Figure 2.6.4 - Secondary Clarifier Design

## CHAPTER 3: CONCLUSION

### 3.1 Conclusion

In conclusion, The Gateway subdivision preliminary design includes all major components to accommodate the future growth of northwest Harris County and Cypress area. The Greater Houston Metropolitan Area is continuously growing and the Grand Parkway at US 290 intersection will allow the subdivision to thrive. All structural, geotechnical, transportation,

environmental and water resources designs were developed to guarantee and sustainable subdivision for the future.

## **CHAPTER 4: REFERENCES**

### **4.1 References**

U.S. Department of Transportation, Federal Highway (FHWA) Manual on Uniform Traffic Control Devices 2009 Edition, January 2010.

American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, 6th Edition, 2011.

Texas Department of Transportation, Roadway Design Manual 2020 Edition, July 2020

Engineering Dept Consultants Transportation & Planning Resources. (n.d.). Retrieved December 08, 2020, from <https://www.eng.hctx.net/Consultants/Transportation-Planning/Resources>

“Rules in PDF.” Texas Commission on Environmental Quality, 2010, [www.tceq.texas.gov/rules/indxpdx.html](http://www.tceq.texas.gov/rules/indxpdx.html).

“Texas Administrative Code.” Welcome to the Texas Administrative Code, [www.sos.state.tx.us/tac/index.shtml](http://www.sos.state.tx.us/tac/index.shtml).

Waller County, Texas, [www.co.waller.tx.us/page/environment](http://www.co.waller.tx.us/page/environment).

# APPENDIX

## Transportation Design Calculations

Trevon Rogers

Main Road Horizontal Alignment

Curve 1

$D_a = 60^\circ$   $\theta = 1.15$   $\Delta = 24^\circ$   
 degrees radians

$R = \frac{180 \cdot 30}{\pi D^\circ} = \frac{180 \cdot 30}{\pi (60^\circ)} = 1492.18 \text{ ft}$

$L = \frac{R \Delta \pi}{180} = \frac{(1492.18 \text{ ft})(24) \pi}{180} = 624.97 \text{ ft}$

$T = R \tan \frac{\Delta}{2} = (1492.18 \text{ ft}) \tan \left( \frac{24}{2} \right) = 317.17 \text{ ft}$

$E = R \left[ \frac{1}{\cos \left( \frac{\Delta}{2} \right)} - 1 \right] = (1492.18 \text{ ft}) \left[ \frac{1}{\cos \left( \frac{24}{2} \right)} - 1 \right] = 33.34 \text{ ft}$

$LC = 2R \sin \frac{\Delta}{2} = 2(1492.18 \text{ ft}) \sin \left( \frac{24}{2} \right) = 620.48 \text{ ft}$

$M = R(1 - \cos \frac{\Delta}{2}) = (1492.18 \text{ ft}) \left( 1 - \cos \frac{24}{2} \right) = 32.61 \text{ ft}$

|                           |                              |              |
|---------------------------|------------------------------|--------------|
| <u>PC Station</u>         | <u>PT Station</u>            |              |
| 630.91 PI                 | 313.02 PC                    | PC = 3+13.02 |
| - 317.17 -T               | + 624.97 L                   | PT = 9+37.99 |
| 313.02 PC <sub>stat</sub> | 937.99 PT <sub>station</sub> |              |

Curve 2

$D_a = 75^\circ$   $\theta = \dots$   $\Delta = 15^\circ$   
 degree radian

$R = \frac{180 \cdot 30}{\pi (75)} = 1313.12 \text{ ft}$   $L = \frac{(1313.12 \text{ ft})(15^\circ) \pi}{180} = 343.77 \text{ ft}$

$T = (1313.12 \text{ ft}) \tan \left( \frac{15}{2} \right) = 172.88 \text{ ft}$   $E = (1313.12 \text{ ft}) \left[ \frac{1}{\cos \left( \frac{15}{2} \right)} - 1 \right] = 11.33 \text{ ft}$

$LC = 2(1313.12 \text{ ft}) \sin \left( \frac{15}{2} \right) = 342.79 \text{ ft}$   $M = (1313.12 \text{ ft}) \left[ 1 - \cos \left( \frac{15}{2} \right) \right] = 11.23 \text{ ft}$

↓

TreVon Rogers

Curve 2 cont'd

PC Station

$$\begin{array}{r} 1424.55 \text{ PI} \\ - 172.88 \text{ -T} \\ \hline 1251.67 \text{ PC station} \end{array}$$

L

PT Station

$$\begin{array}{r} 1251.67 \text{ PC} \\ + 343.77 \text{ L} \\ \hline 1595.44 \text{ PT station} \end{array}$$

$$PC = 12 + 51.67$$

$$PT = 15 + 95.44$$

Curve 3

$$D_a = 72^\circ$$

$$\Delta = 18^\circ$$

$$R = \frac{180 \cdot 36}{\pi(72)} = 1367.84 \text{ ft} \quad L = \frac{(1367.84 \text{ ft})(18^\circ)\pi}{180} = 429.72 \text{ ft}$$

$$T = (1367.84 \text{ ft}) \tan\left(\frac{18^\circ}{2}\right) = 216.61 \text{ ft} \quad E = (1367.84 \text{ ft}) \left[ \frac{1}{\cos \frac{18^\circ}{2}} - 1 \right] = 17.05 \text{ ft}$$

$$LC = 2(1367.84 \text{ ft}) \sin\left(\frac{18^\circ}{2}\right) = 427.95 \text{ ft} \quad M = (1367.84 \text{ ft}) \left(1 - \cos \frac{18^\circ}{2}\right) = 16.84 \text{ ft}$$

PC Station

$$\begin{array}{r} 1850.00 \text{ PI} \\ - 216.61 \text{ -T} \\ \hline 1633.36 \text{ PC} \end{array}$$

PT Station

$$\begin{array}{r} 1633.36 \text{ PC} \\ + 429.72 \text{ L} \\ \hline 2063.08 \text{ PT} \end{array}$$

$$PC_{\text{station}} = 16 + 33.36$$

$$PT_{\text{station}} = 20 + 63.08$$



## # of Parking Stalls (90 Degree Parking)

Regular Stall

$$9 \text{ ft} \times 18 \text{ ft} \\ 162 \text{ ft}^2$$

Total Property Size

$$200 \text{ ft} \times 200 \text{ ft} \\ 40,000 \text{ ft}^2$$

Bus Stall

$$15 \text{ ft} \times 40 \text{ ft} \\ 600 \text{ ft}^2$$

Building Size

$$9,000 \text{ ft}^2$$

International Fire Code

$$50 \text{ ft}^2/\text{person}$$



$$\frac{9,000 \text{ ft}^2}{50 \text{ ft}^2/\text{person}}$$

$$180 \text{ people}$$

↑  
Max Occupancy

$$\begin{array}{rcl} 40,000 \text{ ft}^2 & \text{total area} & \\ - 9,000 \text{ ft}^2 & \text{building area} & \\ \hline 30,400 \text{ ft}^2 & \text{remaining area} & \\ - 2,1060 \text{ ft}^2 & \text{total reg. area} & \\ \hline 9,340 \text{ ft}^2 & & \\ - 1,800 \text{ ft}^2 & \text{total bus area} & \\ \hline 7,540 \text{ ft}^2 & \text{remaining} & \end{array}$$

3 Bus Spots

$$3(600 \text{ ft}^2) = 1,800 \text{ ft}^2$$

130 Reg. Spots

$$130(162 \text{ ft}^2) = 21,060 \text{ ft}^2$$

3 Aisles

$$22 \text{ ft} \times 40 \text{ ft}$$

$$3(880 \text{ ft}^2) = 2,640 \text{ ft}^2$$

Lane Width (Entrance/Exit)

- 12 ft Lanes

Entrance (Main)

- 25 ft Driveway Radius
- 40 ft Throat width

Trucks/Bus Entrance/Exit

- 30 ft Driveway Radius
- 30 ft Throat width

TXDOT  
Roadway Design  
Manual

## WASTEWATER DEMAND

(All calculations are rounded to the nearest whole number)

$$Q_{2050} = \text{Average Wastewater Daily Flow per capita} * P_{2050}$$

$$= 100 \text{ gal/capita*day} * 1,192,744 \text{ persons}$$

$$119.2 \text{ MGD} * 0.003785 \frac{m^3}{d} = 451,453 \frac{m^3}{d}$$

The Average peak factor is 2. It is necessary to calculate the average peak flow

$$Q_{\text{peak}} = 119.2 \text{ MGD} * 2 = 238.4 \text{ MGD} * 0.003785 \text{ m}^3/\text{d} = 902,344 \text{ m}^3/\text{d}$$

**Distribution System - Total Max Daily Demand = Fire Demand + Max Daily Demand**

- Future Population - 10,0000 people
- AADF - 180 gal/dayperson (From Table 1.9)
- Peak Correction Factor,  $F_p = 1.75$  (From \_\_\_\_)

**Fire Demand =  $1020\sqrt{P}(1 - 0.01\sqrt{P})$  (American Insurance Association Formula)**

- P - Population (in thousands)
- **Fire Demand =  $1020\sqrt{10}(1 - 0.01\sqrt{10}) = 3124 \text{ gal/min}$**
- **Fire Demand = 3124 gal/min**

**Max Daily Demand = (Qmax daily)(Population)(Fp)(Fs)**

- **Qmax daily = (AADF)(Population)**
  - AADF - Average Annual Daily Flow
- **Fp - Peak Correction Factor**
- **Fs - Seasonal Correction Factor (NO SEASONAL FACTOR NEEDED)**
- **Max Daily Demand = (180 gal/dayperson)(10,000 people)(1 day/ 1440 min)(1.75) = 2188 gal/min**

**Distribution System - Total Max Daily Demand = 3124 gal/min + 2188 gal/min = 5312gal/min**

**Mostly leakage within the distribution system - 15%**

$$(.15)(5311.02 \text{ gal/min}) = 797 \text{ gal/min}$$

$$(5311.02 - 796.65) \text{ gal/min} = \underline{4515 \text{ gal/min}}$$

## WASTEWATER PIPELINES



- Material of Pipes: Polyvinyl Chloride
- Number of Pipes :
- Placement and Layout of the Pipes
- Water Demand for the Community:
  - $2.79 \times 10^9$  gal/ year
  - $7.64 \times 10^6$  gal/day
- Pipe Dimensions : 24in at a downward slope of 1.3% with capacity 50% filled

## SECONDARY CLARIFIER TANK DIMENSIONS

$$Total\ Area\ Required = \frac{Q}{SLR}$$

Where:

Q (peak) = 36 MGD

Q (avg.) = 18MGD

SLR= surface loading rate (1500 gal/ft<sup>2</sup>-day)

Total area required was found 23,600ft<sup>2</sup>

Next, the number of tanks was calculated:

$$A = \frac{\pi d^2}{4}$$

Assuming 2 tanks, and using a max diameter of 100 ft.

$$Area_{new} = 23,600\ ft^2 / 2 = 11,800\ ft^2$$

$$d = \sqrt{\frac{4 \cdot A}{\pi}}$$

$$d = 123\ ft > 100\ ft\ (DOES\ NOT\ WORK!)$$

Assuming 3 tanks, and using a max diameter of 100 ft.

$$Area_{new} = 23,600\ ft^2 / 3 = 7,866.67\ ft^2$$

$$d = \sqrt{\frac{4 \cdot A}{\pi}}$$

$$d = 100.08 \text{ ft} > 100 \text{ ft (DOES NOT WORK!)}$$

Assuming 4 tanks, and using a max diameter of 100 ft.

$$Area_{new} = 23,600 \text{ ft}^2 / 4 = 5900 \text{ ft}^2$$

$$d = \sqrt{\frac{4 \cdot A}{\pi}}$$

$$d = 86.67 \text{ ft} < 100 \text{ ft (WORKS!!)}$$

Therefore, 4 tanks with a diameter of 86.67ft will be used. And the depth is calculated to be:

$$V = Q \cdot \phi$$

$$V = 4733000 \text{ ft}^3/\text{day} \cdot 2 \text{ hrs} \cdot \frac{1 \text{ day}}{24 \text{ hrs}} = 394,416.67 \text{ ft}^3$$

$$V = A \cdot \text{Depth}$$

$$\text{Depth} = \frac{V}{A} = \frac{394,416.67 \text{ ft}^3}{23,600 \text{ ft}^2} = 16.71 \text{ ft} / 4 = 4.18 \text{ ft}$$

The weir length is calculated,

$$\text{Weir length for a circular basin} = \pi \cdot d = \pi \cdot 86.67 \text{ ft} = 272.28 \text{ ft}$$

And the Weir loading,

$$WLR = \frac{Q}{L_w} = \frac{4733000 \text{ ft}^3/\text{day}}{272.28 \text{ ft}} = 17,382.84 \frac{\text{ft}^2}{\text{day}}$$

## TRICKLING FILTER CALCULATIONS

$$\text{BOD} = 400 \text{ mg/L} \quad \text{BOD eff} = 20 \text{ mg/L} \quad \text{Depth} = 6 \text{ ft}$$

$$\text{TSS} = 90 \text{ mg/L} \quad R = 2 \quad Q = 35.4 \text{ MGD}$$

( 45 % BOD removal )

$$1 - 0.45 = 0.55$$

$$C_m = 0.55 \cdot (400 \text{ mg/L}) = 220 \text{ mg/L}$$

$$S_{eff} = 20 \text{ mg/L}$$

$$E = (220-20)/220=0.909*100=90.9\%$$

$$(2 \text{ filters}) Q/2 = 35.4 \text{ MGD} / 2 = 17.8 \text{ MGD}$$

$$W = 220 \text{ mg/l} * 17.8 \text{ MGD} * 8.34 = 32,659.44 \text{ lb/day}$$

$$F = 1 + R / (1 + 0.1R)^2 = 2.083$$

$$90.9 = \frac{100}{1 + 0.0561 \left( \frac{28,577.01}{V^{2.083}} \right)^{1/2}}$$

$$V = 56,717 \text{ ft}^3 \quad A = 9453 \text{ ft}^2 \quad \text{Diameter} = 109.7 \text{ ft}$$

### **ASSIGNMENTS FOR OUTCOME “4”**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**

**CVEG 4201 Senior Design and Professionalism II  
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

**SPRING 2022**

**Instructor: Dr. Md Jobair Bin Alam**

**Title of Assignment**

**Sample from the Final Report (Ethics)**

**Outcome Measured Using this Assignment**

**Outcome 4**

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**Brief Description of the suitability of this assignment for the outcome**

Public health, safety, environmental aspects, transportation, and water resources management were addressed. The report shows how contemporary issues and concerns were considered during the design phase of the project. References used by students show the adherence to codes and acceptable practices to ensure public safety. In addition to the final report which contains the students' professional and ethical responsibilities for the design project, they were tasked to evaluate critical ethical case studies to understand the students' ability to handle critical conditions that may occur in any project.

**CIVIL ENGINEERING DEPARTMENT**

**PRAIRIE VIEW A&M UNIVERSITY**



**CVEG 4201 – Senior Design and Professionalism II**

**Assignment 1**

**Submitted by**

**Perla Zaldivar**

**Date Given: 3/24/22**

**Date Due: 4/1/22**

## **Problem 1**

The code of ethics can be implemented for the senior project as the project consist of designing buildings for the public and working in a group setting. The project will be design with safety and the welfare of the public in mind since that is the number one priority. Each aspect of the project will ensure that the design is up to standards. When designing we must consider the impact the development will make in the environment. The development will be designed to prevent risk to the surrounding environment and economic impact. The code of ethics mentions how as an engineer one should mentor or share knowledge to current and future engineer. If a group member doesn't recollect something another member can help the individual if they are more knowledgeable in the subject. It is expected to communicate and complete the project according to the deadlines from the client. We are also expected to do so by following the gantt chart created, each person is responsible to do their part. The code of ethics also mentions the engineer can only take credit for what they did.

To be a successful engineer, I need to keep the code of ethics in mind throughout my whole career. I must ensure everything I do is up to code and standards within the county, city, or state. I also need to double check my work to make sure I did the work correctly as the design will be used by the public. I also need to report anything unethical that is happening in the work environment to the American Society of Engineers. Another important responsibility is ensuring people are treated fairly and ensure there is no discrimination, and no one is making any decisions based on that. The code of ethics ensures that all engineers are on the same page when working in a professional environment.

## **Problem 2**

### **Case 1:**

Engineer A should not sign and or seal any drawings created for Agency B. As mentioned Engineer A was never informed about any data that Agency B conducted. All drawings done by Engineer A were done in accordance to the parameter and recommendations given. If any mistakes were made Agency B would inform Engineer A to adjust the drawing, that reflects the correct recommendation. Therefore, Engineer A should not sign any documents since they only did the CAD drawing. The code of ethics states that “approve, sign, or seal only work products that have been prepared or reviewed by them or under their responsible charge.” It is the responsibility of Agency B to seal the documents. The code of ethics also mentions that a person should only take credit for their work, Engineer A is only allowed to take credit for the CAD drawings. Engineer A should inform Agency B that it is unethical for him to seal the drawings. The engineer can elaborate that by him sealing it opens him up to legal consequences and potentially losing his license.

### **Case 2:**

The engineer is the one who determined all the necessary calculations for the structure that follow the states standards. As an engineer the most important thing is the safety of the public. The engineer is aware of the changes that are occurring to his drawing therefore it is the engineer's duty to report his findings. Although it seems like nothing can happen there is always a possibility of people getting hurt which is all under Engineer A's name. Although the engineer did not seal anything it is the individual's duty to report the violations to the American Society of Civil Engineers. Engineer A is the engineer-in-charge listed by the firm, if something was to occur the engineer would be held responsible. Furthermore, if it was determined that Engineer A became aware of changes were made by the other



managers. The state would potentially revoke the engineers license and could be in legal trouble. The code of ethics also state that any misconduct needs to be reported to the authorities in order to protect the health, safety and welfare of the public.

**Prairie View A&M University  
Roy G. Perry College of Engineering  
Civil & Environmental Engineering Department**



**CVEG 4201: Senior Design II**

**Section: P01**

**Course Number: 21299**

**Title: Assignment 1 Ethics**

**Submitted By: Armando Gomez**

**Submitted To: Md Jobair Bin Alam**

**Date Assigned: March 24, 2022**

**Due Date: April 01, 2022 – 11:59PM**

Civil engineering has been around since recorded history. Without them roads, buildings or bridges would not be made. When becoming an engineer, it is important to have a moral compass to point you in the right direction. The code of ethics as outlined from the American Society of Civil Engineers (ASCE) is such a compass that needs to be engrained in one's engineering career as a road map to success. It is important not only to have the knowledge that we have learned but to apply these codes of ethics as well. This should be applied in all aspects of our senior design project. As these codes of ethics will be part of our civil engineering career which bears a large responsibility not only for the safety of the community but to be the example for those civil engineers that are to follow. Providing our newfound skill and professionalism for the upcoming civil engineers and be able to be of civic service.

Our senior design had to encompass so many different disciplines of civil engineering that in each discipline safety and the welfare of the public needs to be at the forefront of the design. Taking the design parameters then applying all local code, standards, and guidelines to provide a safe environment for the community. This is an important part of the project in the transportation as there is an existing city adjacent to the new Amazon location and to provide a minimum adverse effect on the local community due to the new development being proposed. Planning for future issues and describing them in detail give for a better understanding in the design process and the community it will affect. In moving forward, it would be important documenting and advising the effects to the local communities. As engineers we are to take what we have learned and apply it in a way to make the lives of the citizens of the society we live in better.

Throughout my senior design I have attained a better understanding of working with other students in a collaborative process and finding equitable time to discuss the project. Having a good honest communication and providing a collaborative approach when discussing the project has been a key component in having a successful group project. As well as keeping each other accountable in all aspects of the project. Being able to discuss any issue that we may have come across or direct each other to which professor to communicate to and be able to get our answers to any question we may have. Working with my peers and staying vigilant in respects to each other's progress and giving credit where credit is due. Having integrity in the work that we do as to not do any plagiarism of other people's work without

giving credit. Sourcing such people is important as to maintain ethical standards in the development of civil engineering field. Treating our group members with respect to be able to have a healthy work environment without any issues that would affect our communication.

The code of ethics presented by the ASCE is important to have a successful professional career as a civil engineer. Having good ethical values would provide good foundation for a fundamental character development in our professional careers. Working for an engineering company that provides a service to a client would require to be presented in a professional manner. Having clients as well as the society's wellbeing at the forefront of any project. Making the correct decision when addressing design issues that would affect the safety of those that would use for or accrue additional cost to the project. Having good communication skills is of paramount importance in this career. Things can not be assumed to be known and should be communicated in a manner that would be understood by those who might not know some of the common language for engineers. Getting things accomplished and done in advance requires scheduling. Having a set progress schedule with milestones is an effective way to promote completion in a timely manner or address foreseeable changes to the schedule that would need to be provided. As it is important that any economic impact it would have on the client to be addressed as they arise. As an engineer we hold the responsibility to provide a service to the client and act as faithful agents to the client throughout the project. Advise of any potential health hazard or health risk that presents itself should be addressed to the employer and the client soon as possible.

In the professional career as a civil engineer, one needs to have honor, integrity, and dignity. These are good qualities to have when joining the workforce. Always taking consideration of the surroundings for the safety of the those you work for and the public affected. There are no shortcuts throughout the design process. It is important that any misconduct should be taken very seriously and be reported immediately. As this is part of the professionalism of conducting oneself in a professional manner and being competent in the work that is to be done. The cost of the client and liability of the engineers working to meet all regulations to provide a great service to the client and will serve the community.

## Problem 01

What the Agency A is requesting of Agency B is not ethical to go through with the PE engineering seal. What engineering firm A is requesting of Agency B is first and foremost putting the health and safety of the public at risk. As all that the Agency has provided is drafting of a set of plans. Without all the relevant data to be provided to the Agency B from Agency A they should not be able to provide the engineering seal for the plans that were drafted. As this would be not in the best interest of the public to do so or for Agency B. As they would be held liable for any injuries or monetary issues that could crop up due to the lack of data that was reviewed and implemented in the design of the project.

If Agency B would decide to move forward with that seal that would be negligible in their end by providing the seal. This again would not be in the best interest of the health and safety of the public in which they are entrusted to protect. This would be fraud in their part if they were to move forward as they did not have access to the relevant information that is available but not yet reviewed. In this type of work is being conducted they should be reported to the proper authorities. As this is not ethical behavior in conducting business as Agency B also needs to watch the best interest of Agency A even if it means from themselves. This will cost Agency A quite a substantial sum of money if issues arise due to poorly provided design. As an Agency B need conduct itself at a higher standard as they are the engineering firm with the PE license. They bear the responsibility of taking into consideration the Agencies involved as well as the public.

The drawings were produced by Agency A from the recommendations that Agency B provided (Agency B requested conditional data from Agency A but was not received), the as-buils and GIS mapping that was produced by Agency B. As agency A was hired by Agency B to provide a design it should have been discussed who would be providing the final seal of approval for the final construction set of plans. It is important that they should have been very clear from the beginning of the design what responsibility fell over who at the end. As this would solve many issues that they are dealing with now on who should be responsible for sealing of the plans. Ultimately it is in the best interest of both parties to come up with a solution on who will be providing the seal for the construction plans. Agency A should provide the information required to Agency B as their recommendation would have a full scope of work that will be required and needed to be done for the safe completion of the

project. This provided a professionalism between the two Agencies in dealing with the project as they are both practicing PE firms.

It is important that both firms continue to act in a professional manner in dealing with each other. Agency A should provide the seal as they were hired to draft the drawings for Agency B underground utility lines. In doing so this burden should be the responsibility of Agency A to provide the service that was expected from Agency B.

## Problem 02:

The ethical responsibility for Engineer A in this circumstance is that he is the license professional engineer while others are not. Engineer A is responsible that this project is built the way he engineered it to be built. The company that Engineers A works for was hired by a coal mining company provide a turnkey system for construction of a conveying system, Screen and crushing buildings, preparation plants and stacking tubes. This is a tall order that should not be taken lightly. As he is the practicing PE in that state all responsibility falls under him. It is understood that the state does not require signed or seal documents in the state they are working on and have limited inspections it is the ethical responsibility of the engineer A that the facility is built per his design. The most important is that the health, safety and welfare of the public or for whom the facility is to be used by are safe. That the facility is safe for the employees that will be working there as well as being responsible for the as-build company is works for and their interest. Changes that are being without discussing with Engineer A should not be tolerated and should be brought up to the VP of construction boss as well as the engineer A boss. Letting the correct parties know is holding them accountable. In doing so saving all parties from any damage or harm that a faulty constructed facility could cause.

Acting as a faithful agent not only to the client but also to the engineer A employer is of paramount importance. It is the expertise of engineer A that the coal mining company hired them for in the design of their coal mining facility. The professionalism that comes with having technical and knowledgeable PE provide a reliable and safe design. Engineers A is the professional engineer all design changes should be discussed with Engineer A. Just because the VP for construction has 35 years of experience dose not supersede the expertise that come with Engineer A. Making clear that any of these changes would not be acceptable without prior approval by Engineer A would not be acceptable. As there is to much at risk for the safety and monetary problems this could cause if it were to fail . This is not ethical responsible if the Engineer A does not make this clear and takes the proper measurements to remedy the changes. Not taking part in negligent behavior should be avoided and reported to the superior. Keeping silent and not addressing these issues is not acceptable behavior. Relating this information to the client and superiors the engineer A in not being a faithful agent the client or Engineers A employer. Continued monitoring of the

construction and addressing the issues as they come up could save time and money in the long run for the project.

Working with others throughout the project is required in creating a healthy work environment. Getting to the point of changes being done without Engineers A knowing is not promoting an ethical and responsible behavior. Project managers, engineering managers and VP for construction are not professional engineers. They hired PE for the project for there expertise and should not be superseded by anybody else. Especially when managers or officers have no degrees or can't perform engineering calculations. This will provide for health and safety at the workplace.



**OUTCOME “4” SPECIFIC ASSIGNMENTS  
USED TO ASSESS THE OUTCOME IN**

**CVEG 4093  
SYSTEMS ENGINEERING**

**DEPARTMENT OF  
CIVIL & ENVIRONMENTAL ENGINEERING  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**CVEG 4093  
Systems Engineering**

**Fall 2020**

**Instructor: Dr. Emmanuel U. Nzewi, PE**

**Title of Assignment**

- 1] Taskstream – Classwork2020Nov51-
- 2] Final Exam - Problem 7

**Outcome 4**

***Ability to recognize ethical and professional responsibilities***

**Brief Description of the suitability of this assignment for the  
outcome**

This assignment focused on the ethical dimensions an engineer must consider in engineering design and concepts of sustainability in engineering design – in both problems

# ClassWork2020Nov05A

## (TaskStream)



PRAIRIE VIEW  
A&M UNIVERSITY

Department of Civil & Environmental Engineering

CVEG 4093

Systems Engineering

Fall 2020

Dr. Nzewi

Ethics Case Classwork2020Nov05A

Date: 11/05/2020

Due: 11/06/2020, 11 PM (Canvas)

Name [PRINT] \_\_\_\_\_

*This case will test your knowledge and ability to apply the NSPE Code of Ethics in making decisions.*

Simon deHolland, P.E. is a salaried structural engineer serving as a construction inspector on a new twenty-story Ajax Hotel building. Simon's employer, Village Engineering Co., holds the construction services contract with Ajax Hotels.

The general contractor on the job is Simon's former employer, Rise-High Construction Company. After leaving Rise-High as a full-time employee, Simon continued to perform occasional jobs for the contractor on a part-time basis. One such task was the preparation of shop drawings for the Ajax Hotel project.

Simon did not disclose the "moonlighting" relationship with Rise-High to his current employer, Village Engineering or to the client, Ajax.

200

**Does Simon deHolland's behavior in this case adhere to the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?**

**In your answer you MUST quote/cite the NSPE Code of Ethics section to support your answer.**

**A correct answer MUST also quote the the appropriate section(s) of NSPE Code of Ethics.**

**[A] Yes**, all aspects of this case adhere to ethical conduct as defined in the NSPE Code of Ethics for Engineers.

**[B] No**, Simon deHolland is not permitted to accept outside employment without disclosure to his employer nor is he permitted to accept compensation.

**[C] No**, it is a conflict of interest for an engineer to inspect the work of a former employer



# STUDENT #1 - High



PRAIRIE VIEW  
A&M UNIVERSITY

## Department of Civil & Environmental Engineering

CVEG 4093

Systems Engineering

Fall 2020

Dr. Nzewi

Ethics Case Classwork 2020 Nov 05A

Date: 11/05/2020

Due: 11/06/2020, 11 PM (Canvas)

Name [PRINT] Milton Cruz

This case will test your knowledge and ability to apply the NSPE Code of Ethics in making decisions.

200

200

Simon deHolland, P.E. is a salaried structural engineer serving as a construction inspector on a new twenty-story Ajax Hotel building. Simon's employer, Village Engineering Co., holds the construction services contract with Ajax Hotels.

The general contractor on the job is Simon's former employer, Rise-High Construction Company. After leaving Rise-High as a full-time employee, Simon continued to perform occasional jobs for the contractor on a part-time basis. One such task was the preparation of shop drawings for the Ajax Hotel project.

Simon did not disclose the "moonlighting" relationship with Rise-High to his current employer, Village Engineering or to the client, Ajax.

Does Simon deHolland's behavior in this case adhere to the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

In your answer you **MUST** quote/cite the NSPE Code of Ethics section to support your answer. A correct answer **MUST** also quote the the appropriate section(s) of NSPE Code of Ethics.

[A] Yes, all aspects of this case adhere to ethical conduct as defined in the NSPE Code of Ethics for Engineers.

[B] No, Simon deHolland is not permitted to accept outside employment without disclosure to his employer nor is he permitted to accept compensation.

From NSPE → III Professional Obligations

1.) Engineers shall be guided in all their relations by the highest standards of honesty and integrity.

c.) Engineers shall not accept outside employment to the detriment of their regular work. Before accepting any outside engineering employment, they will notify their employers.

[C] No, it is a conflict of interest for an engineer to inspect the work of a former employer

other codes  
on the  
back



From NSPE

I.) Fundamental Canons:

4.) Act for each employer or client as faithful agents or trustees.

From NSPE

II.) Rules of Practice

4.) Engineers shall act for each employer or client as faithful agent or trustees.

9.) Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgement or the quality of their service.



PRAIRIE VIEW  
A&M UNIVERSITY

## Department of Civil &amp; Environmental Engineering

CVEG 4093

Systems Engineering

Fall 2020

Dr. Nzewi

Ethics Case Classwork 2020 Nov 05A

Date: 11/05/2020

Due: 11/06/2020, 11 PM (Canvas)

Name [PRINT] ZAIN QURESHI

This case will test your knowledge and ability to apply the NSPE Code of Ethics in making decisions.

150

200

Simon deHolland, P.E. is a salaried structural engineer serving as a construction inspector on a new twenty-story Ajax Hotel building. Simon's employer, Village Engineering Co., holds the construction services contract with Ajax Hotels.

The general contractor on the job is Simon's former employer, Rise-High Construction Company. After leaving Rise-High as a full-time employee, Simon continued to perform occasional jobs for the contractor on a part-time basis. One such task was the preparation of shop drawings for the Ajax Hotel project.

Simon did not disclose the "moonlighting" relationship with Rise-High to his current employer, Village Engineering or to the client, Ajax.

Does Simon deHolland's behavior in this case adhere to the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

In your answer you MUST quote/cite the NSPE Code of Ethics section to support your answer.

A correct answer MUST also quote the the appropriate section(s) of NSPE Code of Ethics.

[A] Yes, all aspects of this case adhere to ethical conduct as defined in the NSPE Code of Ethics for Engineers.

[B] No, Simon deHolland is not permitted to accept outside employment without disclosure to his employer nor is he permitted to accept compensation.

"Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment they will notify their employers"

"Engineers shall not accept financial or other considerations including free engineering designs, from material or equipment suppliers for specifying their product."

-50  
Incomplete



# STUDENT #3 - Low



PRAIRIE VIEW  
A&M UNIVERSITY

## Department of Civil & Environmental Engineering

CVEG 4093

Systems Engineering

Fall 2020

Dr. Nzewi

Ethics Case Classwork2020Nov05A

Date: 11/05/2020

Name [PRINT] Scott Mcary

Due: 11/06/2020, 11 PM (Canvas)

This case will test your knowledge and ability to apply the NSPE Code of Ethics in making decisions.

100

200

Simon deHolland, P.E. is a salaried structural engineer serving as a construction inspector on a new twenty-story Ajax Hotel building. Simon's employer, Village Engineering Co., holds the construction services contract with Ajax Hotels.

The general contractor on the job is Simon's former employer, Rise-High Construction Company. After leaving Rise-High as a full-time employee, Simon continued to perform occasional jobs for the contractor on a part-time basis. One such task was the preparation of shop drawings for the Ajax Hotel project.

Simon did not disclose the "moonlighting" relationship with Rise-High to his current employer, Village Engineering or to the client, Ajax.

Does Simon deHolland's behavior in this case adhere to the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

In your answer you **MUST** quote/cite the NSPE Code of Ethics section to support your answer.

A correct answer **MUST** also quote the the appropriate section(s) of NSPE Code of Ethics.

[A] Yes, all aspects of this case adhere to ethical conduct as defined in the NSPE Code of Ethics for Engineers.

-100

Incomplete

[B] No, Simon deHolland is not permitted to accept outside employment without disclosure to his employer nor is he permitted to accept compensation. Section II "Rule of Practice" part 4a

"Engineers shall disclose all known conflicts of interest."

Section III part 1c "Engineers shall not accept outside employment to detriment of regular work"

Simon is required to notify employer and decline offer.

[C] No, it is a conflict of interest for an engineer to inspect the work of a former employer

Because of Simon's relationship with with the general contractor at his job he is not acting acting as a "faithful agent for the employer"

Part 4 of section II Rules and practice



# Final Exam

## (Problem 7)

## 7 [50]

NSPE Code of Ethics is a guide for making ethical decisions. Base your answers on the NSPE Code of Ethics.

**7(a) [14]** Winnie Gooding, PE, drafted the following certification for Mary Shriner, the owner of a 24-acre tract of land her client (Mary) was planning to sell to an upscale land developer: *"I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center subject to preserving the southerly 2 acres as wetlands."* Winnie signed, dated, and sealed the certification and delivered it to Mary. Mary insisted that Winnie change the document to remove the "subject to" phrase. Winnie Gooding resisted Mary's arm-twisting/coercion, but eventually relented. Winnie reissued the certificate with the following revised language: *"I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center."*

In this case, does Winnie Gooding's revised certification adhere to the principles of ethical conduct as provided in the NSPE Code of Ethics for Engineers?

Answer: **Yes NO** (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE – no justification, no points]:

**7 (b) [13]** David Oneheart, is a PE. He is a salaried environmental engineer serving as the inspector on a new water treatment plant being constructed by his company – CleanerOne, LLC. David's employer holds the construction services contract with the City of Georgetown, TX. David Oneheart had formerly worked for BuilditWell Construction as a full-time engineer. BuilditWell is the general contractor for the water treatment plant project. David continued to maintain a professional relationship with BuilditWell on a part-time basis after moving to work for CleanerOne fulltime. As such, he was tasked by BuilditWell to provide some drawings and other engineering services on the water treatment plant project. David did not inform CleanerOne about this relationship with BuilditWell.

Is David Oneheart's behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: **Yes NO** (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE – no justification, no points]:

**7 (c) [13]** A licensed traffic engineer, Fred Reames, PE, is an employee of the Gtowne Regional Planning Council. Fred's duties include analyzing the traffic reports and projections prepared by private traffic engineering consultants for commercial developers. When Fred reviewed the traffic report for a regional development project, he made a calculation error that made the difference between approval or rejection of the development project. Fred made the discovery only after approval of the plan, and too late to reverse the decision. Fred immediately disclosed the error to his supervisor, a non-engineer, public administrator, who strongly advised Fred to keep the matter under wraps and tell no one else about it. Fred ignored the supervisor's instructions and wrote a full disclosure memo to his supervisor and the Executive Director of Gtowne Regional Planning Council.

Is Fred Reames' behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: **Yes NO** (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE – no justification, no points]:

**7 (d) [10]** What is competitive bidding?

# STUDENT #1 - High

7 [50]

NSPE Code of Ethics is a guide for making ethical decisions. Base your answers on the NSPE Code of Ethics.

7(a) [14] Winnie Gooding, PE, drafted the following certification for Mary Shriner, the owner of a 24-acre tract of land her client (Mary) was planning to sell to an upscale land developer: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center subject to preserving the southerly 2 acres as wetlands." Winnie signed, dated, and sealed the certification and delivered it to Mary. Mary insisted that Winnie change the document to remove the "subject to" phrase. Winnie Gooding resisted Mary's arm-twisting/coercion, but eventually relented. Winnie reissued the certificate with the following revised language: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center."

In this case, does Winnie Gooding's revised certification adhere to the principles of ethical conduct as provided in the NSPE Code of Ethics for Engineers?

Answer: Yes ☒ NO (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:

Important info should properly be disclosed regarding project site to the public

7 (b) [13] David Oneheart, is a PE. He is a salaried environmental engineer serving as the inspector on a new water treatment plant being constructed by his company - CleanerOne, LLC. David's employer holds the construction services contract with the City of Georgetown, TX. David Oneheart had formerly worked for BuilditWell Construction as a full-time engineer. BuilditWell is the general contractor for the water treatment plant project. David continued to maintain a professional relationship with BuilditWell on a part-time basis after moving to work for CleanerOne fulltime. As such, he was tasked by BuilditWell to provide some drawings and other engineering services on the water treatment plant project. David did not inform CleanerOne about this relationship with BuilditWell.

Is David Oneheart's behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: Yes ☒ NO (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:

David did not inform the company of the work relationship between the entities involved, thus, this creates a conflict of interest

7 (c) [13] A licensed traffic engineer, Fred Reames, PE, is an employee of the Gtowne Regional Planning Council. Fred's duties include analyzing the traffic reports and projections prepared by private traffic engineering consultants for commercial developers. When Fred reviewed the traffic report for a regional development project, he made a calculation error that made the difference between approval or rejection of the development project. Fred made the discovery only after approval of the plan, and too late to reverse the decision. Fred immediately disclosed the error to his supervisor, a non-engineer, public administrator, who strongly advised Fred to keep the matter under wraps and tell no one else about it. Fred ignored the supervisor's instructions and wrote a full disclosure memo to his supervisor and the Executive Director of Gtowne Regional Planning Council.

Is Fred Reames' behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: Yes ☒ NO (Circle correct response)

WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:

Fred maintained his integrity and honesty being an engineer, regardless of being instructed to do otherwise, for the safety and public welfare.

7 (d) [10] What is competitive bidding?

Allowing for contractors to bid for being awarded a new project based on pricing and services.

Close



7 [50]

NSPE Code of Ethics is a guide for making ethical decisions. Base your answers on the NSPE Code of Ethics.

**7(a) [14]** Winnie Gooding, PE, drafted the following certification for Mary Shriner, the owner of a 24-acre tract of land her client (Mary) was planning to sell to an upscale land developer: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center subject to preserving the southerly 2 acres as wetlands." Winnie signed, dated, and sealed the certification and delivered it to Mary. Mary insisted that Winnie change the document to remove the "subject to" phrase. Winnie Gooding resisted Mary's arm-twisting/coercion, but eventually relented. Winnie reissued the certificate with the following revised language: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center."

In this case, does Winnie Gooding's revised certification adhere to the principles of ethical conduct as provided in the NSPE Code of Ethics for Engineers?

Answer: **Yes** **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:** No, because the phrase "subject to" is very important. Winnie's findings were initially explaining that conditions were good but subject to... The new statement implies that the project is 100% good to go without any additional constraints. The first should've been considered.

**7 (b) [13]** David Oneheart, is a PE. He is a salaried environmental engineer serving as the inspector on a new water treatment plant being constructed by his company - CleanerOne, LLC. David's employer holds the construction services contract with the City of Georgetown, TX. David Oneheart had formerly worked for BuilditWell Construction as a full-time engineer. BuilditWell is the general contractor for the water treatment plant project. David continued to maintain a professional relationship with BuilditWell on a part-time basis after moving to work for CleanerOne fulltime. As such, he was tasked by BuilditWell to provide some drawings and other engineering services on the water treatment plant project. David did not inform CleanerOne about this relationship with BuilditWell.

Is David Oneheart's behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: **Yes** **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:** David should've informed CleanerOne about his relationship with BuilditWell. This can cause a conflict of interest within the project. It would best if someone without a relationship.

**7 (c) [13]** A licensed traffic engineer, Fred Reames, PE, is an employee of the Gtowne Regional Planning Council. Fred's duties include analyzing the traffic reports and projections prepared by private traffic engineering consultants for commercial developers. When Fred reviewed the traffic report for a regional development project, he made a calculation error that made the difference between approval or rejection of the development project. Fred made the discovery only after approval of the plan, and too late to reverse the decision. Fred immediately disclosed the error to his supervisor, a non-engineer, public administrator, who strongly advised Fred to keep the matter under wraps and tell no one else about it. Fred ignored the supervisor's instructions and wrote a full disclosure memo to his supervisor and the Executive Director of Gtowne Regional Planning Council.

Is Fred Reames' behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: **Yes** **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:**

Yes, because even though Fred's supervisor wanted him to keep quiet, he did the ethical act by writing a full disclosure. Fred's action saved lives. He did the right thing by informing the Executive about the issue.

**7 (d) [10]** What is competitive bidding?

Competitive bidding is when companies are in a running to win a bid/job for a project. The best bidder is selected based on cost effectiveness and safety guidelines.

-5



## STUDENT #3- Low

7 [50]

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**7(a) [14]** Winnie Gooding, PE, drafted the following certification for Mary Shriner, the owner of a 24-acre tract of land her client (Mary) was planning to sell to an upscale land developer: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center subject to preserving the southerly 2 acres as wetlands." Winnie signed, dated, and sealed the certification and delivered it to Mary. Mary insisted that Winnie change the document to remove the "subject to" phrase. Winnie Gooding resisted Mary's arm-twisting/coercion, but eventually relented. Winnie reissued the certificate with the following revised language: "I have examined the terrain and subsoil conditions of the subject property and certify that it is suitable as a construction site for a one-story shopping center."

In this case, does Winnie Gooding's revised certification adhere to the principles of ethical conduct as provided in the NSPE Code of Ethics for Engineers?

Answer: ~~Yes~~ **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:**

No because he has to remain honest in a professional environment. He should have left it as is because he was doing his job.

**7 (b) [13]** David Oneheart, is a PE. He is a salaried environmental engineer serving as the inspector on a new water treatment plant being constructed by his company - CleanerOne, LLC. David's employer holds the construction services contract with the City of Georgetown, TX. David Oneheart had formerly worked for BuilditWell Construction as a full-time engineer. BuilditWell is the general contractor for the water treatment plant project. David continued to maintain a professional relationship with BuilditWell on a part-time basis after moving to work for CleanerOne fulltime. As such, he was tasked by BuilditWell to provide some drawings and other engineering services on the water treatment plant project. David did not inform CleanerOne about this relationship with BuilditWell.

Is David Oneheart's behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: ~~Yes~~ **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:**

Based on code of ethics he is required to mention it when there is a conflict of interest and working with another company.

**7 (c) [13]** A licensed traffic engineer, Fred Reames, PE, is an employee of the Gtowne Regional Planning Council. Fred's duties include analyzing the traffic reports and projections prepared by private traffic engineering consultants for commercial developers. When Fred reviewed the traffic report for a regional development project, he made a calculation error that made the difference between approval or rejection of the development project. Fred made the discovery only after approval of the plan, and too late to reverse the decision. Fred immediately disclosed the error to his supervisor, a non-engineer, public administrator, who strongly advised Fred to keep the matter under wraps and tell no one else about it. Fred ignored the supervisor's instructions and wrote a full disclosure memo to his supervisor and the Executive Director of Gtowne Regional Planning Council.

Is Fred Reames' behavior in this case in line (agree/congruent) with the principles of ethical conduct as defined in the NSPE Code of Ethics for Engineers?

Answer: ~~Yes~~ **NO** (Circle correct response)

**WHY? [YOU MUST FULLY JUSTIFY YOUR RESPONSE - no justification, no points]:**

Yes because he disclosed the mistake and it was ethical of him to involve executive workers because the others didn't care.

**7 (d) [10]** What is competitive bidding?

A competitive bidding is when a company discloses future project details to potential partners. This has to be done ethically because there can't be no favoritism.

-15

# **CVEG 2304: Global Development Issues**

## **ASSIGNMENTS FOR OUTCOME “4”**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**‘Test Performance Based Outcome Assessment Tools’**

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**Test 1**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Students were tested on the fundamentals of Global Studies topics as they pertain to global development issues. The topics included Population & Resources and Identity & Culture.



**CVEG 2304 (P01): Global Development Study**  
**Test 1: Face-to-Face (Multiple Choice and Written Response Type Questions)**  
**CLOSED BOOK/NOTES      Fall 2021/Dr. I. Ahmed**  
**September 30, 2021 (12:30 – 1:50 PM)**

**Multiple Choice Questions (25 Questions, 50 Points) – Circle the best answer**

1. One type of Culture-Driven Architecture looks at:

- (A) Values, Beliefs and Attitude to which a society subscribes and responds
- (B) Natural topography of land
- (C) Materials behavior
- (D) None of the above

2. Social Progress Index (SPI) measures a country's ability to provide:

- 2 X
- (A) Social, economic and environmental needs of its citizens
  - (B) Social and environmental needs of its citizens
  - (C) Opportunity to progress
  - (D) None of the above

3. On Maslow's pyramid of needs, engineers' role is most important in:

- 2 X
- (A) Physiological needs aspect
  - (B) Esteem related needs
  - (C) Safety needs aspect
  - (D) Self-actualization needs

4. Civil Engineers shall strive to comply with the principles of:

- 2 X
- (A) Design
  - (B) Safety, Health and Welfare of the public
  - (C) Sustainable development
  - (D) Creative arts

5. Engineers uphold and advance the **integrity, honor and dignity** of the engineering profession by:

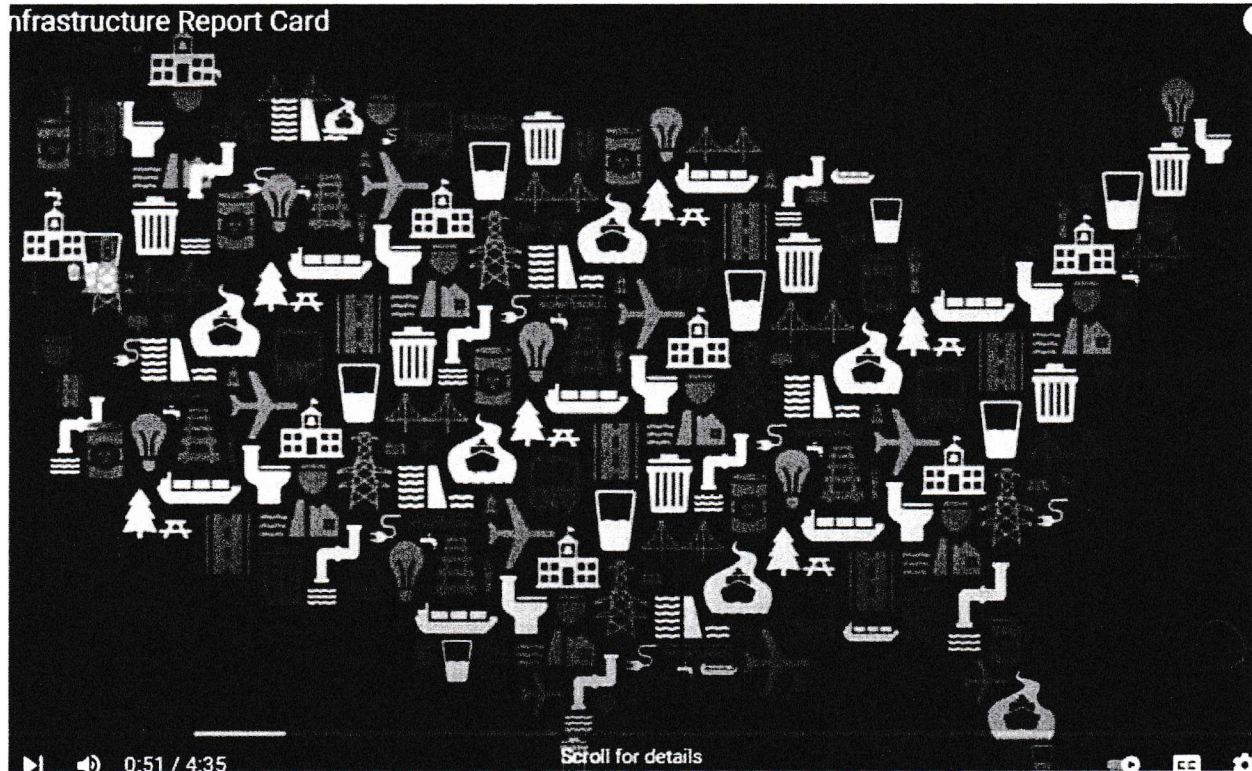
- (A) using their knowledge and skill for the enhancement of human welfare and the environment
- (B) being honest and impartial and serving with fidelity the public, their employers and clients
- (C) striving to increase the competence and prestige of the engineering profession
- (D) All of the above



6. Global studies can be defined as the study of the \_\_\_\_\_ of political, economic, social, cultural links between people, corporations and governments in different countries.

- (A) Interaction  
 (B) Comparison  
 (C) Disaggregation  
 (D) Integration

7. The map of USA in the figure shows the \_\_\_\_\_ of U.S. infrastructure.

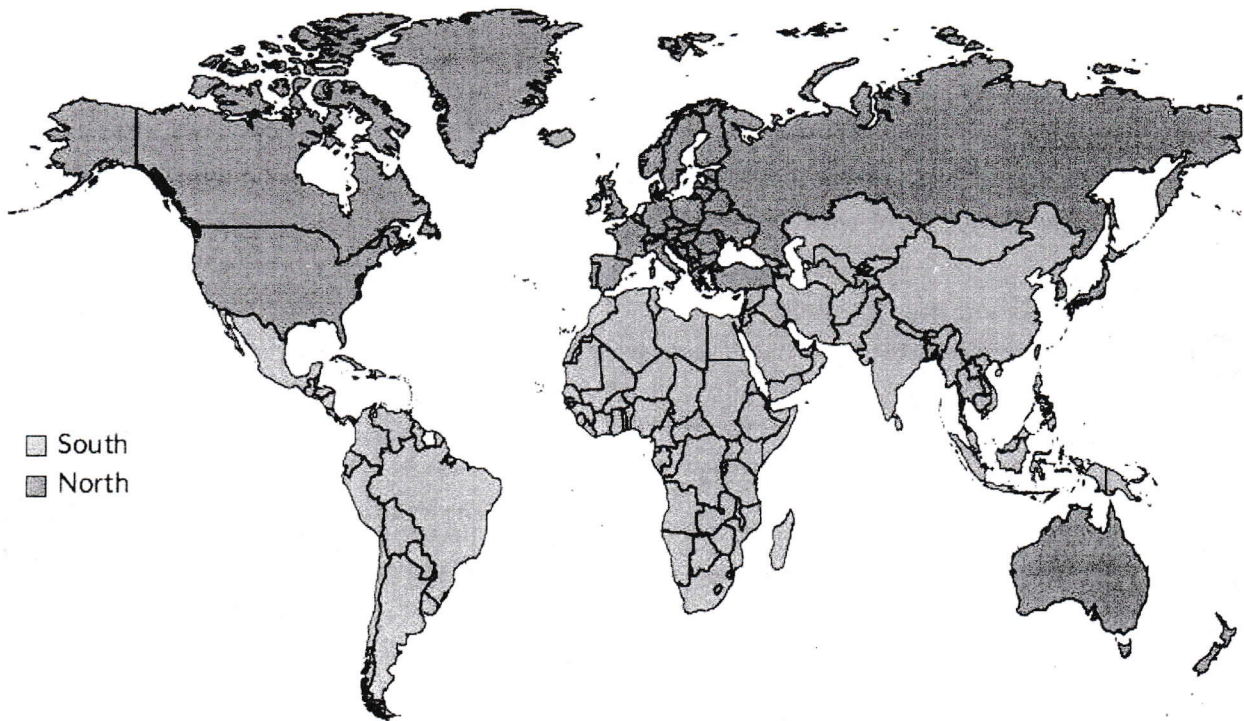


- (A) Components  
 (B) Gross Domestic Product components of the USA  
 (C) Density  
 (D) None of the above

8. Resources can be divided into:

- (A) Private, public and common goods  
 (B) Natural and man-made kinds  
 (C) Earthly and non-earthly goods  
 (D) None of the above

9. The world map shown below depicts the Global \_\_\_\_\_ and \_\_\_\_\_ .



- (A) Northern hemisphere and Southern hemisphere
- (B) Magnetic North, Magnetic South
- ☒ (C) North, South
- (D) None of the above

10. New awareness of the effects of human actions on the natural world is a trend, seen in the case of:

- ☒ (A) Environment
- (B) Mobility
- ☒ (C) Security
- (D) Globalization

11. BRIC is a collective acronym for:

- (A) Brussels, Reykjavik, Indore and Chicago
- (B) Botswana, Rhodesia, India and Chad
- ☒ (C) Brazil, Russia, India and China
- (D) None of the above

12. Globalization supports the idea that global and local changes can occur \_\_\_\_\_.

- ☒ (A) Simultaneously
- ☐ (B) Separately

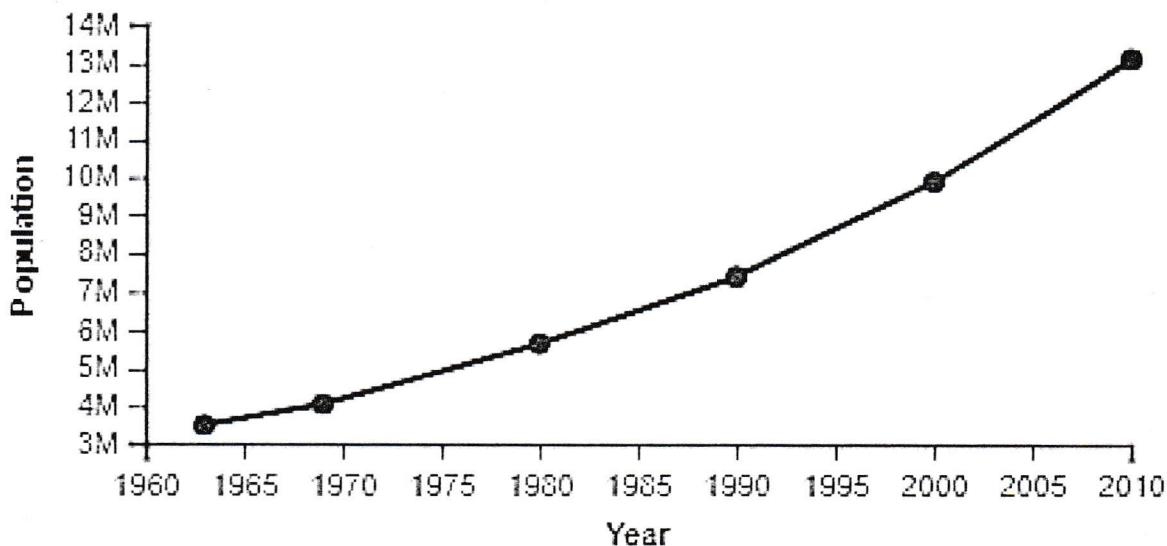
13. While globalization has encouraged international peace by tightening economic links among countries and broadening cultural understanding, it has promoted international tensions through \_\_\_\_\_ in trade, income and opportunity.

- ☐ (A) separation
- ☐ (B) equalities
- ☒ (C) inequalities
- ☐ (D) None of the above

14. *Demographic transition* is a model that is used to explain:

- ☐ (A) how fertility numbers change under changes in social and economic patterns
- ☒ (B) how population numbers change under changes in social and economic patterns
- ☐ (C) how mortality numbers change under changes in social and economic patterns
- ☐ (D) None of the above

15. The population chart of Zambia below is:



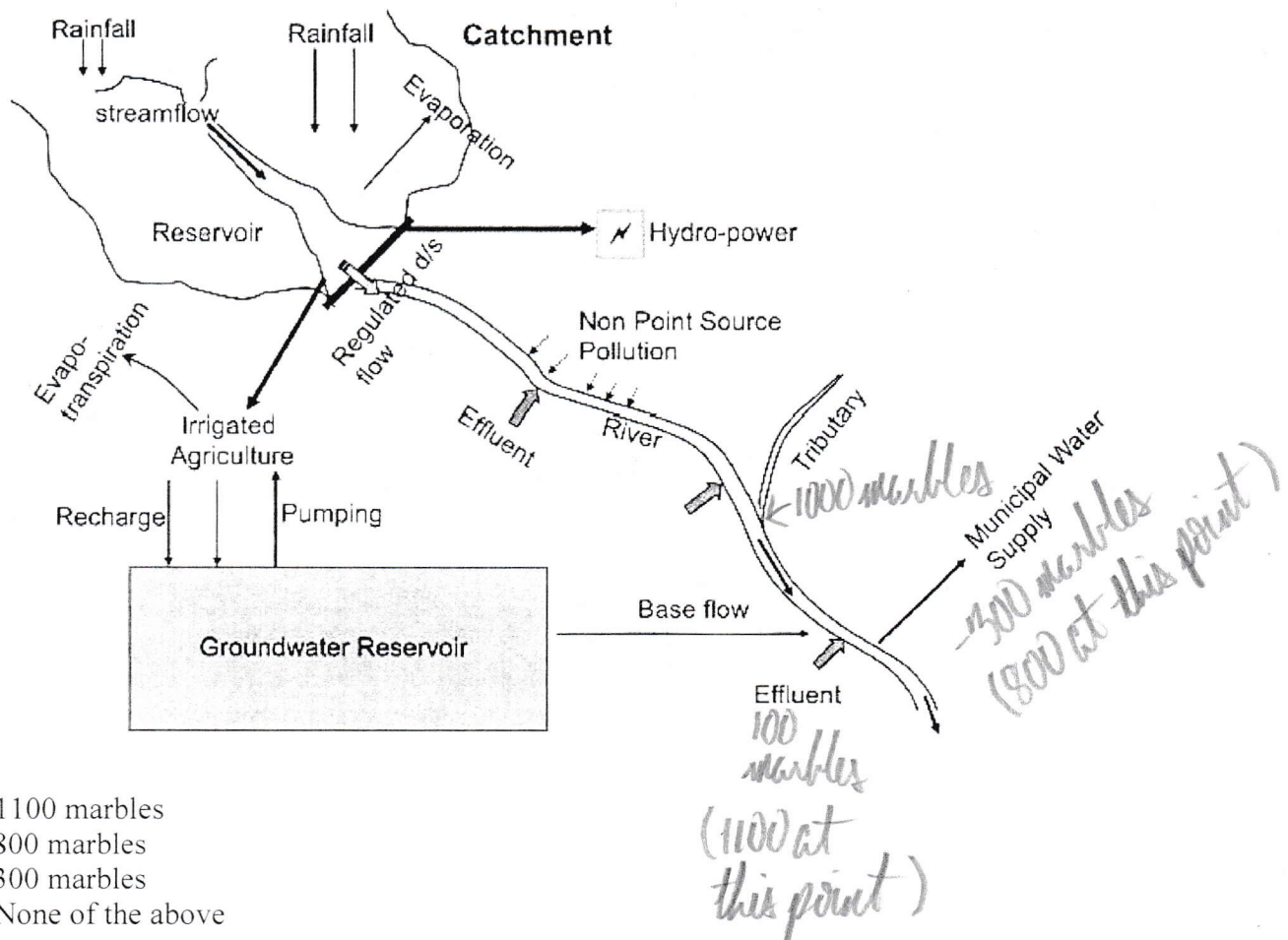
- ☒ (A) an Exponential growth function
- ☐ (B) an Exponential decay function
- ☐ (C) a polynomial function of the second order
- ☐ (D) None of the above



16. A brick wants to be:

- (A) an Arch
- (B) a lintel
- (C) a wall
- (D) None of the above

17. Consider water flow in the river shown is treated by flow of marbles. 1000 marbles flow in the river (main channel) below the tributary. The effluent *downstream of the tributary* brings in 100 marbles into the river. The municipal water supply takes out 300 marbles from the river. How many marbles are left flowing in the river downstream of the municipal flow diversion point?



- (A) 1100 marbles
- (B) 800 marbles
- (C) 300 marbles
- (D) None of the above

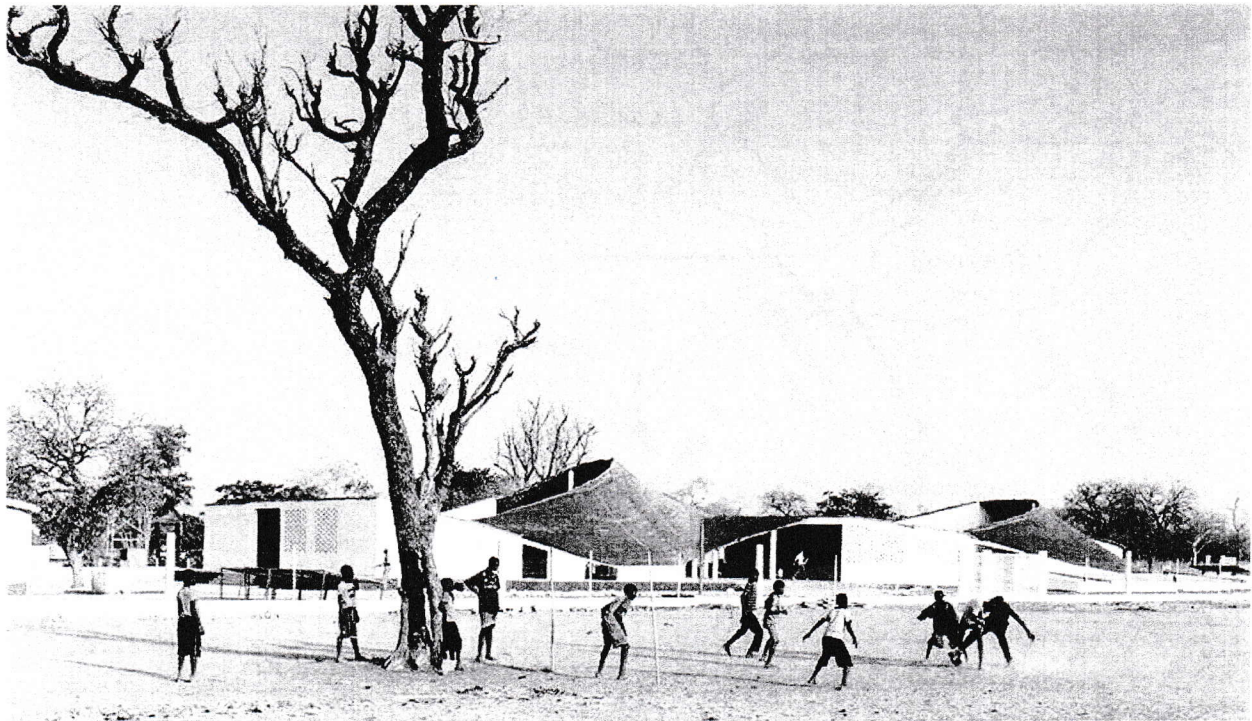
18. Investments in water, food and energy nexus lead to:

- ☒ (A) National independence and economic growth
- (B) National dependence and economic downfall

19. Even a room that needs to be dark needs a crack of light to:

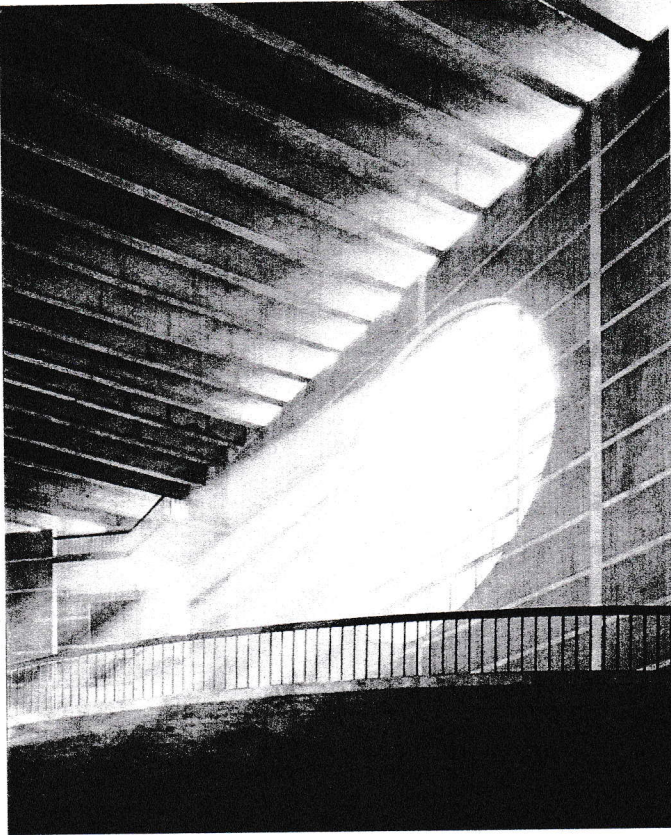
- (A) process photo films
- ☒ (B) tell how dark it is
- (C) tell your sensitivity to light
- (D) None of the above

20. The funnel shaped roof in the photo from Senegal, West Africa, is utilized to blend the structure to the natural topography and:



- ☒ (A) to harvest rain water
- (B) to allow children use it as slide for playing
- (C) to bring in natural light
- (D) None of the above

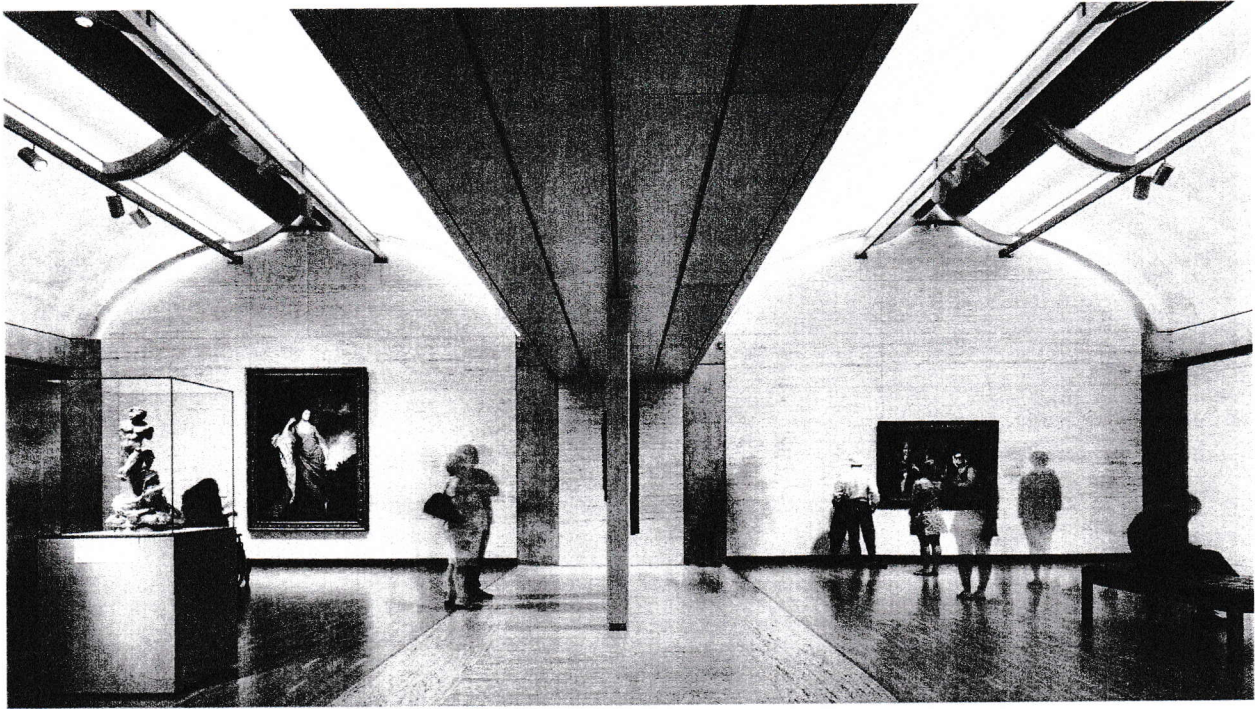
21. The photo of an interior corner of the Parliament Building in Dhaka, Bangladesh, illustrates the interaction between:



- 2 X (A) Light and space  
(B) Light and shadow  
(C) Concrete and Steel  
(D) None of the above

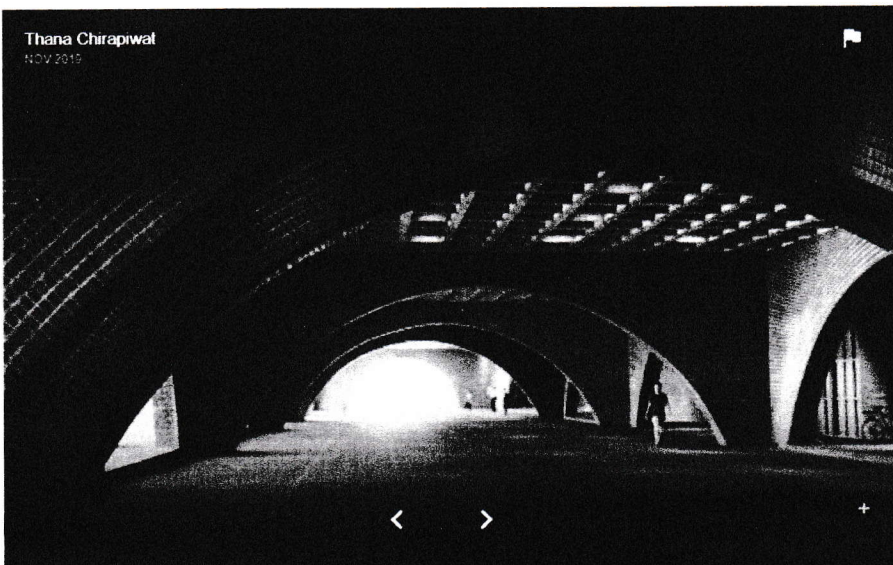


22. The photo illustrates the natural light through the thin concrete arch roofs of Architect Louis Kahn's:



- (A) House of the Nation, Dhaka, Bangladesh
- (B) Kimbell Art Museum, Fort Worth, Texas
- (C) Salk Institute, La Jolla, CA.
- (D) Exeter Library, Exeter, NH

23. The type of ceiling shown in between two arches is best known as:



- ☒ (A) Honeycomb structure
- ☐ (B) Square pants structure
- ☐ (C) Hollow pane structure
- ☐ (D) None of the above

24. \_\_\_\_\_ refers to the belief in the separation of religion and State.

- ☐ (A) Glocalization
- ☐ (B) Peculiarism
- ☒ (C) Secularism
- ☐ (D) None of the above

25. The spread of religion has long been tied to:

- ☐ (A) Glocalization
- ☒ (B) Globalization
- ☐ (C) Secularism
- ☐ (D) None of the above

## Clean, Legible Hand-written Answers Please: 50 Points

1. Define **Globalization**.

*"Globalization" is the spread of a culture (or its ideas) worldwide. Many of those ideas are derived from Western culture, namely from Europe.*



## 2. Define Culture.

(-3) In simple terms, culture is the way of life for any group of people, usually influenced by location and religion, and expressed through ideas, food, architecture, and the arts.

3. In brief, explain how you would *begin* to develop the following infrastructures from scratch:

a) Water infrastructure (you can use bulleted lines to explain your steps)

My ideal water infrastructure would be...

same { derived from a river  
considerate of availability and accessibility

(-4) = ? ?

b) Roadway infrastructure (you can use bulleted lines to explain your steps)

It would be best to survey the land to gain insight on where the roads would fit, and then consider connections to cities.

(-3) how?? write more----

4. Mention two methods for **rain water harvesting**. Expand your response with reasoning on how your method might work? No sketches required. You can use bulleted lines.

a) Dams and Reservoirs

- Collect water and rainwater

- act as storage

- Can provide enough water to power a region and serve its water needs

- requires the dam to be hydroelectric

} not relevant to the question!

b) Watersheds

- collect water for future use

- Can prevent flooding

- absorb (but only if natural)

how?

Watersheds do not collect water automatically!!

} not relevant!

5. What is organic architecture to you? Explain.

"Organic Architecture" is such that is built with its surroundings in mind. This form of architecture can draw natural resources from nearby (ideally water) with intent to serve itself, occupants, or even its community.

good

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**Test 2**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Students were tested on the fundamentals of Global Studies topics as they pertain to global development issues. The topics included Culture, Science & Technology, Economy, Trade, Migration and Environment.

67/100

**CVEG 2304 (P01): Global Development Study**  
**Test 2: Face-to-Face (Multiple Choice and Written Response Type Questions)**  
**CLOSED BOOK/NOTES      Fall 2021/Dr. I. Ahmed**  
**November 18, 2021 (12:30 – 1:50 PM)**

**Multiple Choice Questions (15 Questions, 75 Points) – Circle the best answer**

1.  $\text{CO}_2$  + \_\_\_\_\_ -----> Underground, hard rock

- (A)  $\text{O}_2$   
 (B)  $\text{N}_2$   
 (C)  $\text{H}_2\text{O}$   
 (D) None of the above

2. Carbon capture represents:

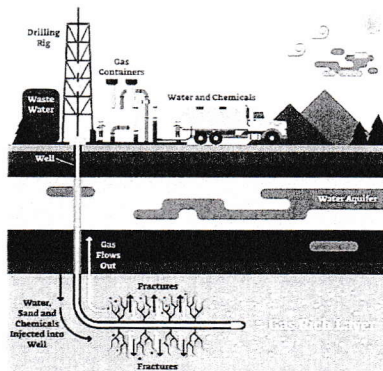
- (A) Capturing emitted carbon at the source (like factories, vehicle emission)  
 (B) Capturing carbon from the air in the form of  $\text{CO}_2$   
 (C) None of the above

3. Direct air capture represents:

- (A) Capture  $\text{CO}_2$  in the air by commercial level air suction technology  
 (B) Capture emitted carbon at the source (like factories, vehicle emission)  
 (C) None of the above

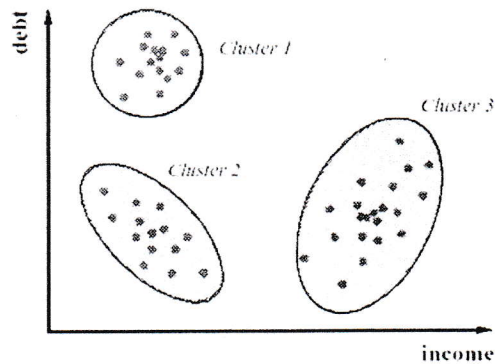
4. The figure illustrates:

- (A) Carbon capture technology used in Iceland  
 (B) Hydraulic fracturing or fracturing technology  
 (C) Creative arts  
 (D) Water extraction at a well



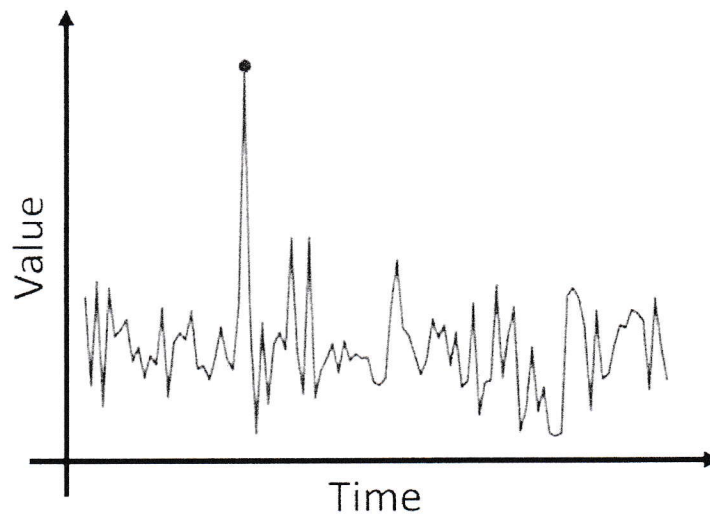
5. Data Mining: A *positive* correlation (debt increases with income increase) between debt and income is seen in the figure, in:

- (A) Cluster 1
- (B) Cluster 2
- ☒ (C) Cluster 3
- (D) In all of the above



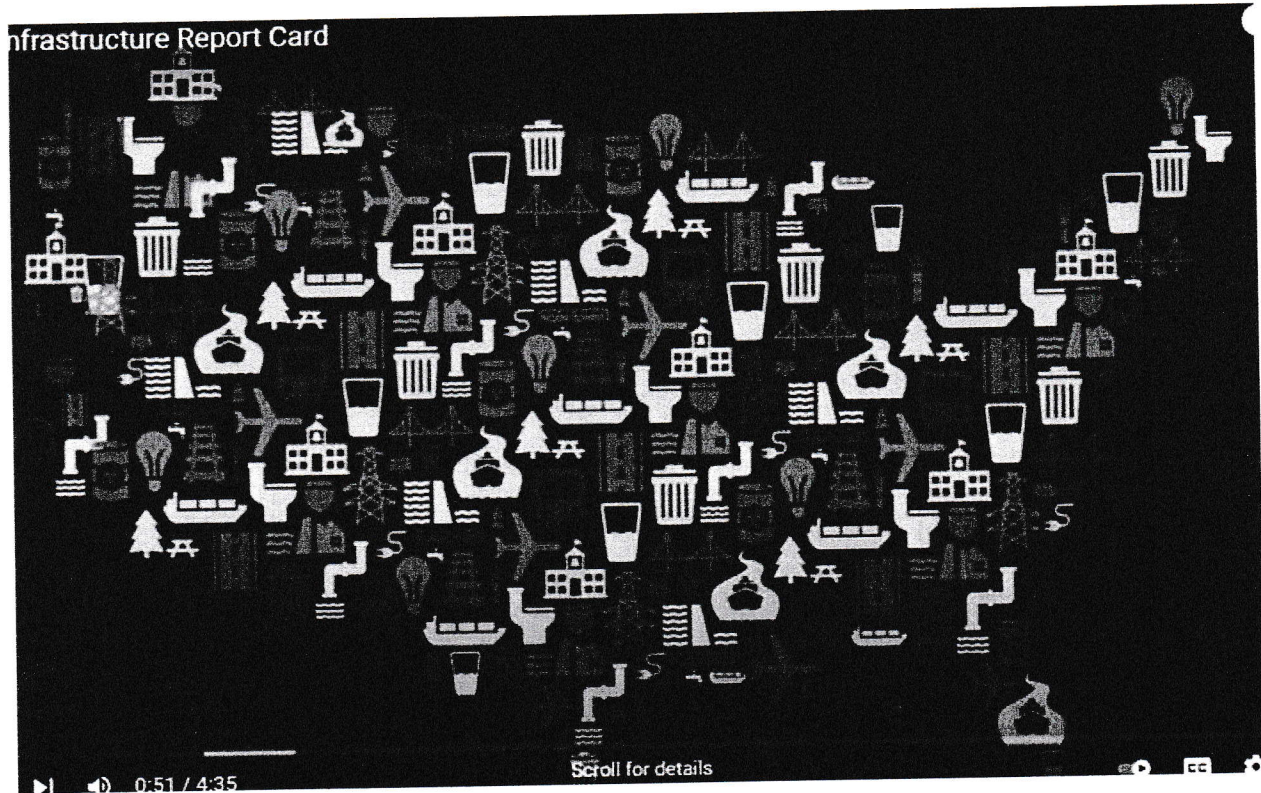
6. Data Mining: The spike in the figure represents:

- (A) A Dirac Delta Function found in Math
- ☒ (B) Anomaly
- (C) Global optimum value
- (D) None of the above





7. The map of USA in the figure shows the \_\_\_\_\_ of U.S. infrastructure.

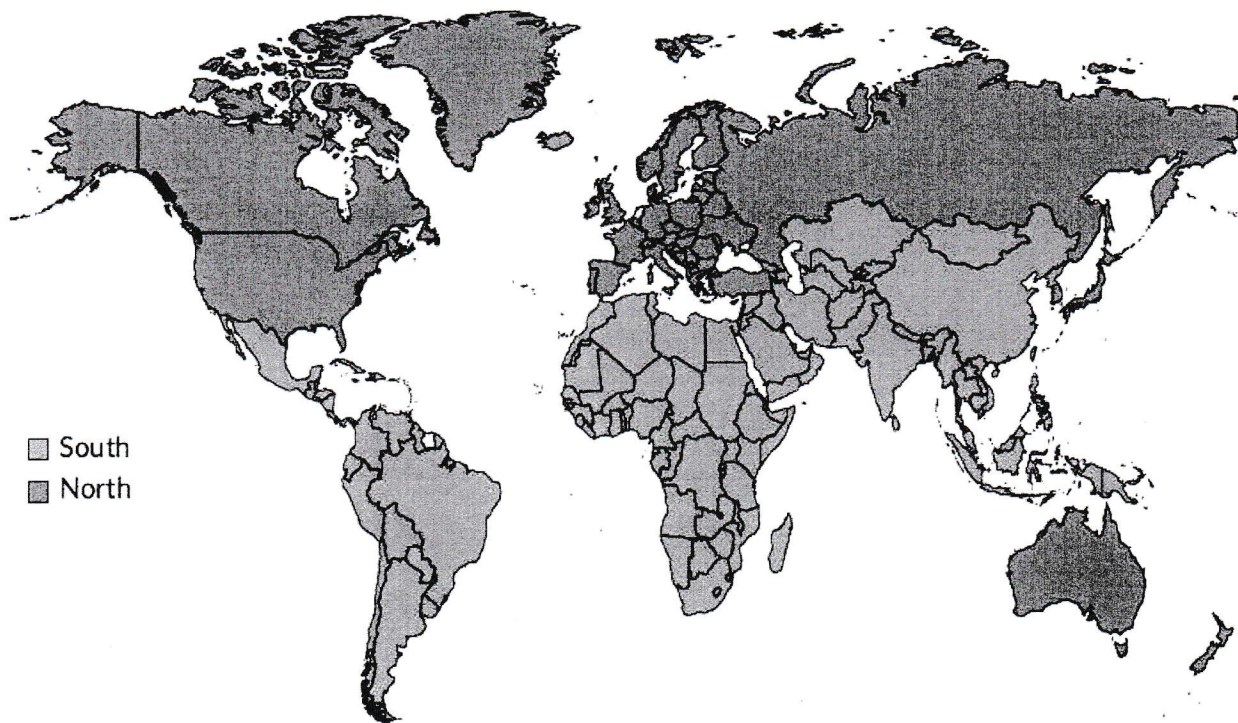


- ☒ (A) Components
- (B) Gross Domestic Product components of the USA
- (C) Density
- (D) None of the above

8. Resources can be divided into:

- (A) Private, public and common goods
- ☒ (B) Natural and man-made kinds
- (C) Earthly and non-earthly goods
- (D) None of the above

9. The world map shown below depicts the Global \_\_\_\_\_ and \_\_\_\_\_.



- (A) Northern hemisphere and Southern hemisphere
- (B) Magnetic North, Magnetic South
- ☒ (C) North, South
- (D) None of the above

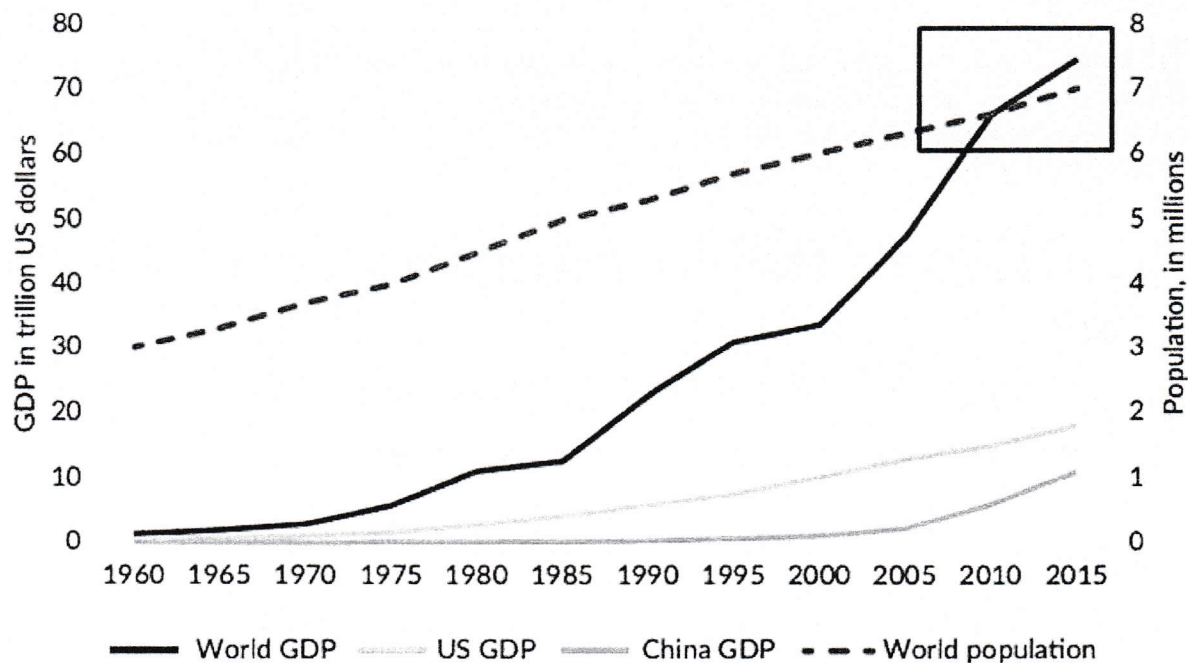
10. Chance =

- (A) Probability / 100 %
- (B) Probability + 100
- ☒ (C) Probability x 100%
- (D) Probability



11. The situation shown in the **inset** of the figure best represents:

- (A) World population growth rate surpassed world GDP growth rate in circa 2010
- ☒ (B) World GDP growth rate surpassed world population growth rate in circa 2010
- (C) U.S. GDP is greater than China GDP but China GDP is rising from circa 2010
- (D) None of the above



The growing global economy

Source: Based on data in World Bank Economic Indicators (2018).

12. Barter is:

- (A) Exchange of goods using gold
- ☒ (B) Exchange of goods with goods with no money exchanged

13. World Trade Organization was created in 1995 to:

- ☒ (A) Manage trade disputes
- (B) Make US and China global trade profitable
- (C) Monitor human rights violation in workplace
- (D) None of the above

14. *In Free Trade:*

- ☒ (A) All barriers to trade are removed
- (B) Some barriers to trade are removed
- (C) All barriers to trade are removed between two countries
- (D) None of the above

15. *Fair trade:*

- ☒ (A) Ensures farmers a pre-set value on their goods when price fluctuates in the market
- (B) Guarantees business for farmers in rural settings
- (C) Encourages foreign direct investment
- (D) None of the above

## **Clean, Legible Hand-written Answers Please: 30 Points**

1. Define the *theory* best known as the **Comparative Advantage** of Trade

The Comparative Advantage of Trade is a theory that some countries possess an innate advantage in trade over others, and thus fare better over it.

2. Define **Culture**.

Culture is a set way of life for a group of individuals, driven by location, traditions, and history, influenced by trade, and expressed through art, food, and architecture, among others.

3. Assume, you wish to invest in a Free Trade business (could be produce hauling between U.S. and Mexico). Name up to two **degrees of trade cooperation** benefits you would like to tap into and how. List them **and** write about them, in brief.

-10  
BUNK-

4. Explain, in brief, the three qualities that lead to success in business and trade, mentioned below:

a) Creativity:

- ideas for business and trade
- focus is given on what goods to sell and what services to provide based on needs

Did not ask for definition

(-3)

b) Infrastructure:

- anything that drives business and trade and keeps a steady flow thereof, namely transportation and movement of goods

Roads  
Navigable waterways  
etc. ---

(-1)

(-2)

c) Survival:

- All efforts put in place to preserve successful business/trade
- includes agreements

(-3)

## **ASSIGNMENTS FOR OUTCOME “4”**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**‘Project Performance Based Outcome Assessment Tools’**

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**MINI PROJECT #1**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Students were tasked with a research and development study project on the state of Water, Energy, Agriculture (food) and Transportation infrastructure of Gabon, a country in Western Africa with access to ocean, and the Republic of Congo and Equatorial Guinea as its neighbors. Students reported on what has been done since Gabon's independence from colonialism and what are the future development directions for the country.

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**MINI PROJECT #2**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

The tasks involved data analysis and plotting in Microsoft Excel to extract information from given set of river discharge data. Students worked to create normal and log-transformed data based probability (flood frequency) plots. This was a task under Science & Technology side of Global Studies as it pertains in hydrologic sciences and in many other data intensive areas. Students were offered an Excel tutorial in class.

Daniel Grant  
CVEG 2304 P01

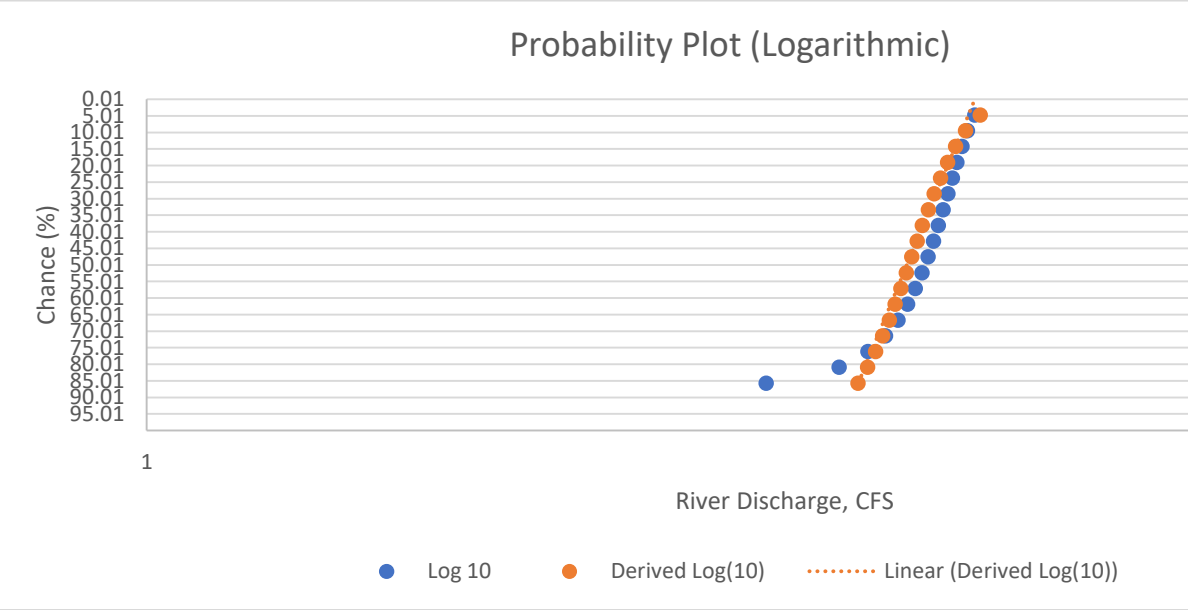
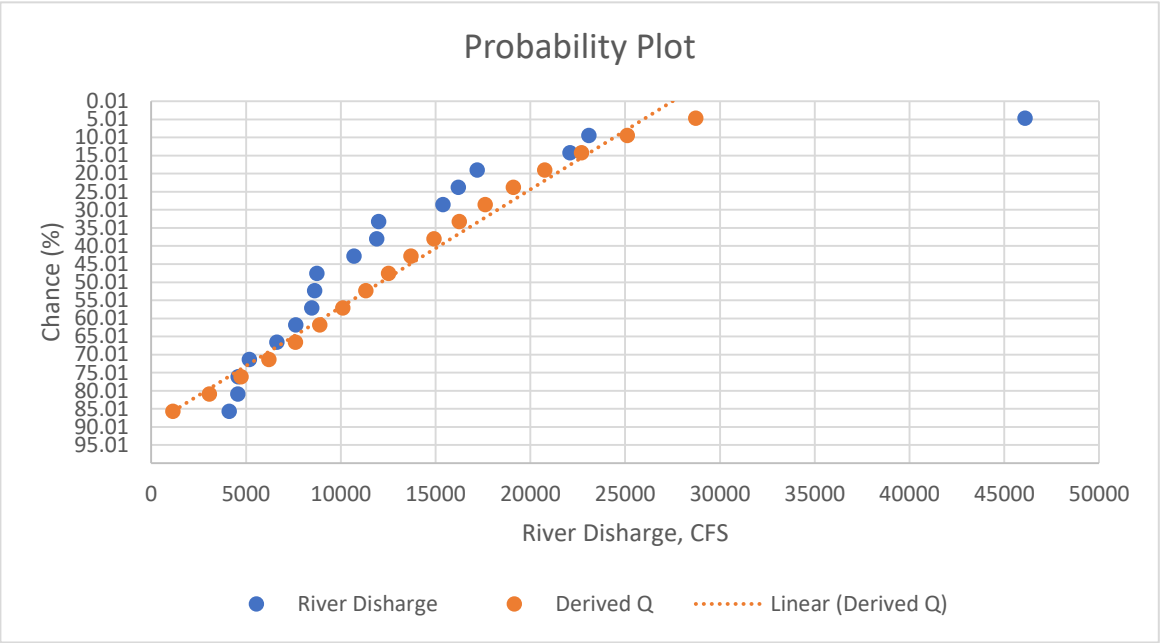
21-Oct-21  
Dr. I. Ahmed  
CVEG 2304  
Mini Project 2  
Data File

Show Formula  
for Log Q in cell

| Discharge, Q<br>(cfs) | Chance<br>(%) | Derived Normal, Q<br>(cfs) | LOG 10      | Derived log Q<br>- |
|-----------------------|---------------|----------------------------|-------------|--------------------|
| 46100                 | 4.76          | 28728                      | 4.458305392 | 4.502              |
| 23100                 | 9.52          | 25125                      | 4.40010607  | 4.385              |
| 22100                 | 14.29         | 22701                      | 4.356044989 | 4.307              |
| 17200                 | 19.05         | 20767                      | 4.317373763 | 4.245              |
| 16200                 | 23.81         | 19108                      | 4.281215233 | 4.191              |
| 15400                 | 28.57         | 17627                      | 4.246178405 | 4.143              |
| 12000                 | 33.33         | 16264                      | 4.211227366 | 4.099              |
| 11900                 | 38.1          | 14932                      | 4.174117981 | 4.056              |
| 10700                 | 42.86         | 13711                      | 4.137069131 | 4.017              |
| 8740                  | 47.62         | 12523                      | 4.097708381 | 3.978              |
| 8620                  | 52.38         | 11321                      | 4.05388479  | 3.94               |
| 8470                  | 57.14         | 10114                      | 4.004922949 | 3.901              |
| 7630                  | 61.9          | 8892                       | 3.948999454 | 3.861              |
| 6630                  | 66.67         | 7608                       | 3.881270504 | 3.82               |
| 5190                  | 71.43         | 6222                       | 3.793930007 | 3.775              |
| 4600                  | 76.19         | 4741                       | 3.675869955 | 3.727              |
| 4580                  | 80.95         | 3082                       | 3.488832634 | 3.674              |
| 4120                  | 85.71         | 1148                       | 3.059941888 | 3.611              |

The two charts can compare as for both charts on the x-axis, the River Discharge CFS is steadily increasing. For both plots as you can see the number maybe somewhat a little different but as you can see here both the River Discharge are still increasing.





ing as along with Chance (%).  
n the Chance (%) and

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**MINI PROJECT #3**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Students were tasked with a *research and reporting assignment* on the state of **Fair Trade and The Global Cocoa Growers' Industry**. They were specifically asked to create a *synced* set of presentation slides that report on in-depth, researched, state of *a few specific aspects* of the issue at hand.

# Fair Trade & The Cocoa Industry

Cote d'Ivoire & Oxfam

CVEG 2304: Global Development Issues

Instructed by Dr. I. Ahmed

Presented by Kristopher Green

November 17, 2021

# Key Words & Terms

- Fair Trade
- Cocoa
- Human Rights
- Trade Ethics
- Cote d'Ivoire

# About Oxfam (American Division)

- Founded in 1970 to respond to a humanitarian crisis in Bangladesh <sup>(3)</sup>
- Pushes to “[fight] inequality to end poverty and injustice” <sup>(1)</sup>
- Demands equal rights and equal treatment
- Their attention is paid towards the following: Economic Justice and Equal Rights, Gender Justice, Climate Action, and Humanitarian Response

# About Oxfam (UK Division)

- Founded in 1942 <sup>(4)</sup>
- Their founding was to combat a famine in Greece caused by the Nazi Regime <sup>(14)</sup>
- Similarly, they “[fight] inequality to end poverty and injustice” <sup>(1)</sup>

# Top Cocoa Producers <sup>(5)</sup>

1. Cote d'Ivoire (Ivory Coast)
2. Ghana
3. Indonesia
4. Brazil
5. Cameroon
6. Dominican Republic
7. Ecuador
8. Mexico
9. Nigeria
10. Peru

*Everyone thinks of Peru when they think about cocoa, but it's only tenth globally in cocoa production!*

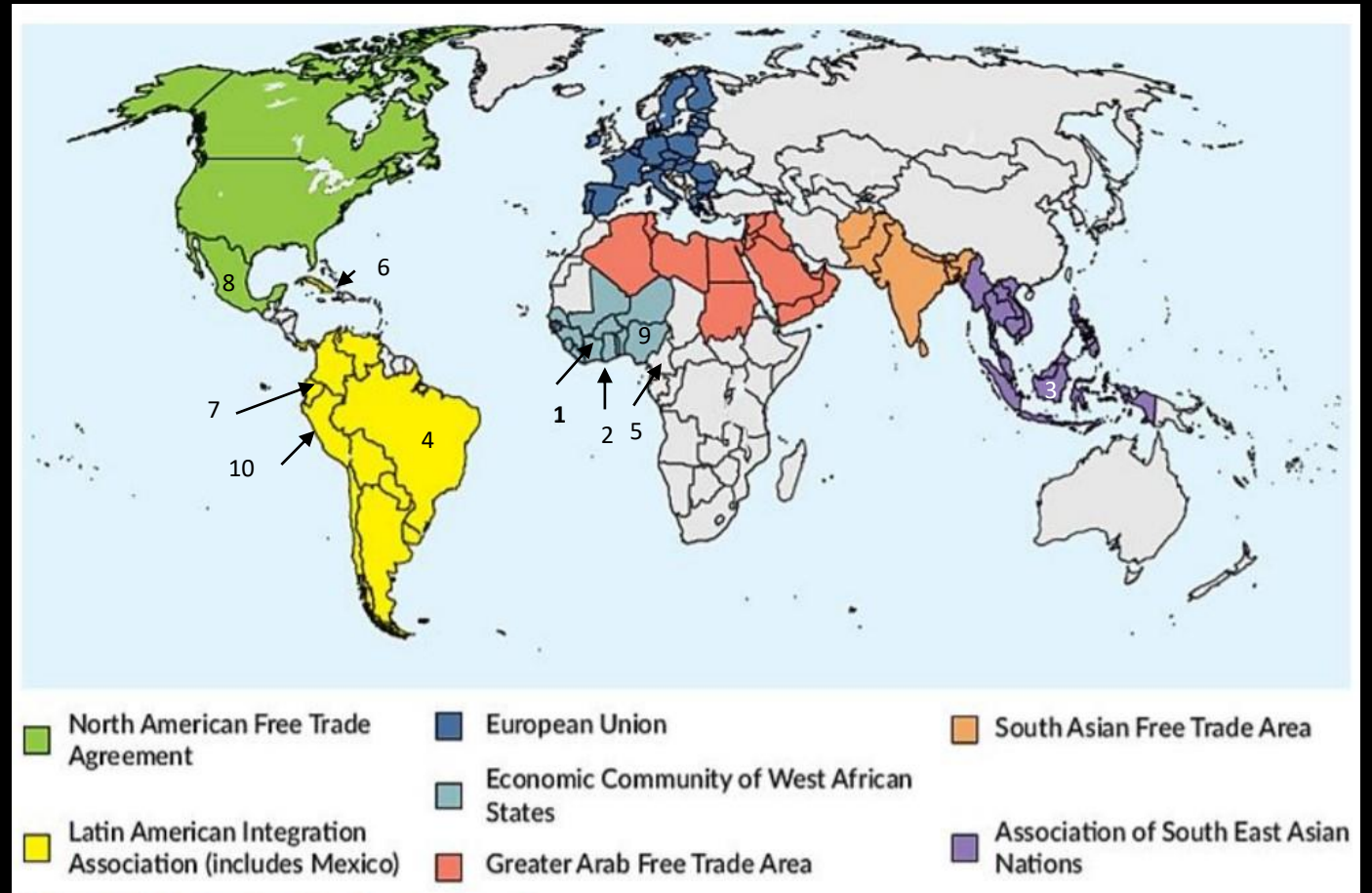
# Cocoa and Trade Agreements

Cote d'Ivoire, Ghana, Cameroon, and Nigeria are part of the Economic Community of West African States.

Indonesia is part of the Association of South East Asian Nations.

Brazil, Ecuador, Mexico, and Peru are part of the Latin American Integration Association.

Mexico is also a part of the North American Free Trade Agreement with the Dominican Republic.



(1) Cote d'Ivoire (Ivory Coast)

(2) Ghana

(3) Indonesia

(4) Brazil

(5) Cameroon

(6) Dominican Republic

(7) Ecuador

(8) Mexico

(9) Nigeria

(10) Peru



# West Africa and Cocoa

- Cote d'Ivoire produces 45% of the world's cocoa <sup>(10)</sup>
  - This makes it the world's largest producer of cocoa
- The country is part of the Economic Community of West African States (Abbreviated as ECOWAS), founded in 1975
  - The goal of joining ECOWAS was to promote economic cooperation and development, same as all other ECOWAS countries <sup>(6)</sup>
  - In full, Benin, Burkina Faso, Cabo Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo are all members of ECOWAS <sup>(6)</sup>
  - Much of the ECOWAS region grows cocoa and benefits from its production
- Companies like Nestle, Hershey, and Mars benefit from West African cocoa farming

# Oxfam America and Cote d'Ivoire <sup>(1/4)</sup>

In 2011, Oxfam America was involved in helping a humanitarian crisis in Cote d'Ivoire. Since then, Oxfam America has remained involved with the country. <sup>(8)</sup>

- They have focused on providing water and facilities to refugees who have fled to neighboring Liberia <sup>(8)</sup>
- Oxfam America acts as an advocate for farmers in countries like Cote d'Ivoire to provide them their trading needs

# Oxfam America and Cote d'Ivoire (2/4)

Cocoa production in Cote d'Ivoire has unfortunately relied on slavery.

- Women and children are treated like animals
  - As a violation in equality, this goes against Oxfam's mission
- The major chocolate companies (Mars, Nestle, and Hershey, two of which are American) were sued in 2020 for violations in child labor laws (10)
  - Workers report not being paid (or at least fed), being forced to work long hours, being isolated, or using dangerous materials (10)
  - All companies that were sued issued statements that denounced child labor and reassured their efforts to end it (10)

# Oxfam America and Cote d'Ivoire <sup>(3/4)</sup>

- In 2013, Oxfam launched a campaign—Behind The Brands—that recognizes women's contribution to the cocoa industry and advocates for their empowerment <sup>(17)</sup>
  - They saw a correlation between women's empowerment and the reduction of child labor and put their findings in a 2016 study <sup>(17)</sup>
  - Women with more say in household income were able to put more of the income towards their children's education, keeping them off the fields <sup>(17)</sup>

# Oxfam America and Cote d'Ivoire (4/4)

- As of 2019, Cote d'Ivoire still faces problems with child labor (17)
- Oxfam is now pushing for higher cocoa prices and has urged the Ivorian government to increase those prices (17)

# Fair Trade: Pros

- Fair trade in Cote d'Ivoire would be to benefit the farmers in the country (who otherwise don't receive anything) by giving them more sustainable wages
  - Farmers receive **3.2%** of the final value of a single chocolate bar <sup>(12)</sup>
- Fair trade would also combat child labor and help reform Ivorian cocoa industry
- In 2002, Oxfam launched a campaign—Make Trade Fair—that promotes fair trade through petition, advocacy, and rulemaking <sup>(15)</sup>

# Fair Trade: Cons

- The price of Ivorian cocoa could increase, which for consumers would be problematic
- Fair trade regulations may require a certificate, which is not easy for all companies to attain
- Any regulation made would require government approval, and the government is not obligated to adhere to them

# Fair Trade: Why it Doesn't Work

- Fair trade only benefits the farmers, not their workers <sup>(13)</sup>
  - If a farmer profits from cocoa production, they are **not** obligated to pay their workers, which is slavery
- “Fair Trade” is a certification; not many of Cote d'Ivoire's cocoa companies are “Fair Trade-certified”
  - Out of 50 Ivorian companies in 2019, only about half of them are certified <sup>(13)</sup>
- Even with a certificate, there exists disparities
  - Certified companies have reported lower average wages for workers <sup>(18)</sup>



# Fair Trade: Why it Won't Work

- Ivorian companies may not find a Fairtrade certification to be profitable
- Child labor problems still exist within the country, and that would have to be handled first

# Conclusions

- Fair trade is no good if it does not apply to all
- **WORKERS NEED TO GET PAID**
- The cocoa industry needs major reform to achieve better worldwide support.
- Oxfam is doing whatever it can, but change relies on the government recognizing the problem and doing their due diligence in fixing it.

# Summary

- Oxfam, which is a major advocate for fair trade and human rights, is doing what it can to support countries like Cote d'Ivoire
- Despite being part of a trade agreement, workers in Cote d'Ivoire still suffer from poor working conditions for cocoa production, and child labor remains a problem
- Fair trade is intended to benefit countries where workers and farmers would otherwise make nothing, but does not always work because it only benefits farmers
- Though Oxfam is trying to fight the human rights and fair trade violations in Cote d'Ivoire, time will tell how well their efforts paid off

# References

- (1) "Oxfam GB | about Us." 2021. Oxfam GB. 2021. <https://www.oxfam.org.uk/about-us/>.
- (2) "About Oxfam." 2020. Oxfamamerica.org. 2020. <https://www.oxfamamerica.org/about-us/>.
- (3) "Oxfam's History." 2010. Oxfamamerica.org. October 19, 2010. <https://www.oxfamamerica.org/about-us/our-history/>.
- (4) "Oxfam GB | History of Oxfam." 2011. Oxfam GB. 2011. <https://www.oxfam.org.uk/about-us/history-oxfam/>.
- (5) "Cocoa Producing Countries 2021." 2021. Worldpopulationreview.com. 2021. <https://worldpopulationreview.com/country-rankings/cocoa-producing-countries>.
- (6) Harouna MAYAKI. 2021. "Member States | Economic Community of West African States(ECOWAS)." Ecowas.int. November 13, 2021. <https://www.ecowas.int/member-states/>.
- (7) "How We Can Adapt Plants to Save Our Planet." 2021. @BBC\_Future. 2021. <https://www.bbc.com/future/bespoke/follow-the-food/how-we-can-adapt-plants-to-save-our-planet.html>.
- (8) "Oxfam Races to Avert Humanitarian Crisis in Cote d'Ivoire." 2021. Oxfamamerica.org. November 3, 2021. <https://www.oxfamamerica.org/press/oxfam-races-to-avert-humanitarian-crisis-in-ivory-coast/>.
- (9) "The 'Invisible' Women at the Heart of the Chocolate Industry." 2020. @BBC\_Future. 2020. <https://www.bbc.com/future/bespoke/follow-the-food/the-invisible-women-farmers-of-ivory-coast.html>.
- (10) Balch, Oliver. 2021. "Mars, Nestlé and Hershey to Face Child Slavery Lawsuit in US." The Guardian. The Guardian. February 12, 2021. <https://www.theguardian.com/global-development/2021/feb/12/mars-nestle-and-hershey-to-face-landmark-child-slavery-lawsuit-in-us#:~:text=Eight%20children%20who%20claim%20they,the%20world's%20biggest%20chocolate%20companies.&text=The%20production%20of%20cocoa%20in,low%20pay%20and%20child%20labour..>
- (11) "Cocoa Farmers - Fairtrade Foundation." 2021. Fairtrade Foundation. June 29, 2021. <https://www.fairtrade.org.uk/farmers-and-workers/cocoa/>.
- (12) "What Is Fair Trade Chocolate | Simply Chocolate." 2021. Simplychocolate.com. 2021. <https://www.simplychocolate.com/learn-what-is-fair-trade-chocolate>.
- (13) "Fair Trade Helps Farmers, but Not Their Hired Workers." 2019. NPR.org. July 2019. <https://www.npr.org/sections/thesalt/2019/07/01/736721302/fair-trade-helps-farmers-but-not-their-hired-workers#:~:text=More%20Podcasts%20%26%20Shows-,Fair%20Trade%20Helps%20Farmers%2C%20But%20Not%20Their%20Hired%20Workers%20%3A%20The,shared%20with%20their%20hired%20workers..>
- (14) Birchall, Guy. 2018. "When Was Oxfam Founded. How Did It Get Its Name and What Does Oxfam Stand For?..." The Sun. The Sun. July 31, 2018. <https://www.thesun.co.uk/news/5622623/oxfam-founded-name-meaning-date/#:~:text=Oxfam%20was%20started%20in%20Oxford,a%20group%20of%20concerned%20citizens..>
- (15) "Oxfam Exchange OXFAM LAUNCHES TRADE CAMPAIGN HOPE'S EDGE: THE next DIET for a SMALL PLANET ANNUAL REPORT 2001 -SUMMARY." n.d. Accessed November 18, 2021. <https://s3.amazonaws.com/oxfam-us/static/oa3/files/oxfam-exchange-spring-2002.pdf>.
- (16) Pike, John. 2021. "Economic Community of West African States (ECOWAS)." Globalsecurity.org. 2021. <https://www.globalsecurity.org/military/world/int/ecowas.htm>.
- (17) Uwe Gneiting. 2020. "The Cocoa Sector Still Has a Child Labor Problem. Can Higher Prices Help Solve It?" Oxfamamerica.org. 2020. <https://politicsofpoverty.oxfamamerica.org/the-cocoa-sector-child-labor-problem-higher-prices/>.
- (18) "Million Dollar Question: Does Fairtrade Work?" 2014. Center for Global Development. 2014. <https://www.cgdev.org/blog/million-dollar-question-does-fairtrade-work>.

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**GLOBAL DEVELOPMENT ISSUES**

**FALL 2021**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**MINI PROJECT #4**

**Outcome Measured Using this Assignment**

**Outcome 4**

**The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Students prepared a set of PowerPoint slides on **the Elements of Trade Ethics**. In particular, they conducted research on **Trade Ethics** topics assigned to them as individual slide headers; Students were asked to conduct internet (or any other source based) research and provide reference citation on the related slides.

# **Elements of Trade Ethics**

**Kimdrea Obey**

## **Mini Project #4**

**CVEG 2304: Global Development Issues**

**December 2, 2021**

# Guidelines to follow from Dr. Ahmed:

## Do not delete this slide

- Conduct research on **Trade Ethics TOPICS** given to you as individual Slide headers; provide reference citation on the related slides.
- Summarize and Briefly Explain with bullet items
- Use supporting information from any good case study you may find in your research (as asked)
- If not mentioned, prepare only one slide per topic header
- You may use any reference but a live one
- Complete the survey on the last slide

# Definition of Trade Ethics

- Ethical Trade: Addresses the ethical aspects of organizations including worker welfare, agricultural practice, natural resource conservation, and sustainability of the environment.



## Examples of Ethical Trade

### TENETS OF THE ETHICAL TRADING INITIATIVE

The Ethical Trading Initiative is based on work done by the International Labour Organization. Its tenets are intended to ensure that businesses and their partners protect the rights and well-being of workers.



Source: Ethical Trading Initiative

# How is staff loyalty and motivation maintained in ethical business place?

- Common law requirements.
- Non –compete agreements
- Employee required to act in a manner equal to or above their employer's interest.
- Benefit programs are in place for employees with tenure.
- Follow basic rules and receive recognition
- Employee must not create a conflict of interest with the employer
- Most states hold a general rule that, without employee consent, an employee cannot hold a second job that competes with or conflicts with the first job

## **Leadership Ethics: What is it and what are some of its properties? What does it take to be an ethical leader?**

- **Leadership ethics:** individuals behave according to a set of principals and values that are recognized by the majority as a sound basis for the common good.

### **Properties and Characteristics**

- Fair
- Honest
- Respectful
- Value Driven
- Encourages Initiative
- Leads By Example
- Kindness

# Why is 'fair trade' an ethical issue?

- Fair trade focuses on one group and is biased towards one party.
- Producers benefit but consumers do not.
- Fair trade does not showcase value towards workers or multinational companies.
- The priority is given to producers of organizations rather than employees or all moving parts in need.

# Difference between Fair Trade and Ethical Trade

## Fair Trade

- Originated in 1980s
- Protect poor developing country farmers from low international market prices of commodities like coffee, cocoa, and tea.
- Address the injustice of low prices and guarantee that the producers receive fair terms of trade and fair prices.
- Producers will receive funds for business or social development projects.

## Ethical Trade

- Originated in 1990s
- Improves conditions of the workers throughout their supply chain, wherever they are in the world.
- Involves workers producing clothes, shoes, toys, food and other consumables for multinational companies.

# **What is/are the argument(s) against Fair Trade, *on Ethical Basis*?**

- Bribing and brainwashing consumers to think they're helping producers/farmers.
- Little to no extra Fairtrade funds paid by consumers will reach farmers.
- Critics from the Utilitarian ethic argue that the system diverts profits from the poorest farmers/people to the quite poor, or the rich in result the profits are received by corporate firms.
- These results may cause “death and destitution.”

## Slide 9 continued....

- 70% of licensed income is spent on promoting the Fairtrade brand.
- They charge higher margins, expect higher turnover, and they can launder their image.
- Price commitments apply only to exporting cooperatives but not primary cooperatives or farmers.

## How do you rate this course?

A: Well presented, B: Somewhat well presented

- The Required Textbook: B
- Clarity of Lecture Slides: A
- Mini Project Topics (4): A
- Lecture Case Studies (2): A
- Major: Civil Engineering



# References

- <https://www.ethicaltrade.org/issues/ethical-trade-and-fairtrade>
- <https://opentextbc.ca/businessethicsopenstax/chapter/loyalty-to-the-company/>
- <https://online.maryville.edu/blog/ethics-in-international-business/>
- <https://www.360training.com/blog/8-characteristics-ethical-leader>
- <https://www.betterup.com/blog/the-importance-of-an-ethical-leader#:~:text=tools%20from%20BetterUp.-,What%20is%20ethical%20leadership%3F,fairness%2C%20transparency%2C%20and%20honesty.>
- <http://www.griffithsspeaker.com/Fairtrade/Ethical%20Objections%20to%20Fairtrade%20web.pdf>

# **CVEG 3102 Professional Engineering**

## **ASSIGNMENTS FOR OUTCOME “4”**

**Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**‘Performance Based Outcome Assessment Tools’**

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**PROFESSIONAL ENGINEERING I**

**SPRING 2022**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**Subject Test: Mechanics of Materials**

**Outcome Measured Using this Assignment**

**Outcome 3**

**Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

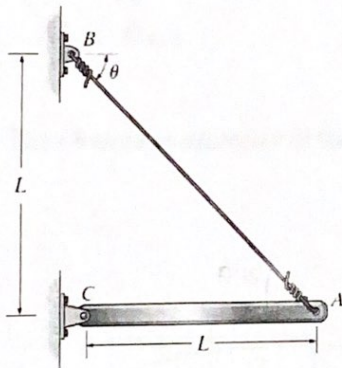
Through rigorous week long crash review of the NCEES FE-CIVIL topic, students take a 15-question multiple choice test covering the breadth and the depth of the fundamentals of Mechanics of Materials. Students take 12 more such subject tests to cover the entire spectrum of the FE-CIVIL examination topics.

12/15 P

Department of Civil & Environmental Engineering  
CVEG 3102: Professional Engineering I  
MECHANICS OF MATERIALS TEST  
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)  
February 8, 2022 (IN-CLASS 2-Hour Test)  
Dr. I. Ahmed

Name: Perla Zaldivar

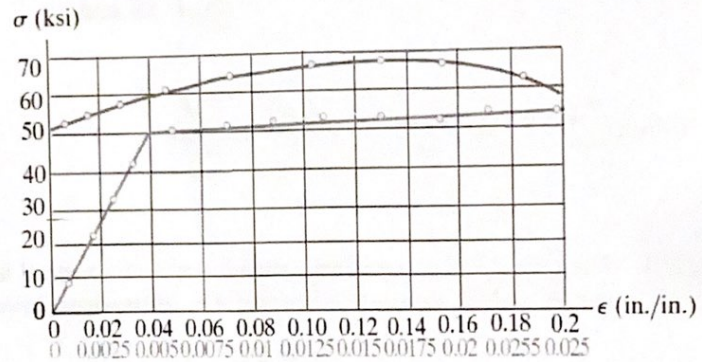
1. The wire  $AB$  is un-stretched when  $\theta = 45^\circ$ . If a vertical load is applied at point  $A$  of the bar  $AC$ , which causes  $\theta$  to become  $47^\circ$ , the normal strain in the wire is nearly:



- a. 0.0043  
b. 0.0343  
c. 0.0558  
d. 0.0032

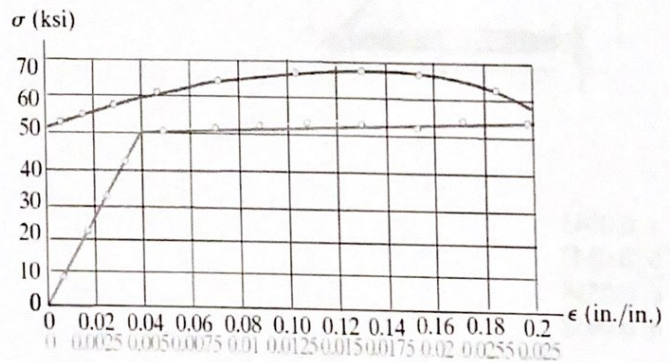
2. The stress-strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. The *modulus of elasticity* for the material approximately:

E



- a. 10.0 ( $10^3$ ) psi
- ☒ b. 10.0 ( $10^3$ ) ksi
- c. 14.0 ( $10^3$ ) psi
- d. 14.0 ( $10^3$ ) ksi

3. The yield stress for the situation in Problem #2 is exactly:



- ☒ a. 50 ksi
- b. 68 ksi
- c. 53 ksi
- d. None of the above



4. The acrylic plastic rod is 0.2 m long and 0.015 m in diameter. If an axial load of 300 N is applied to it, the *change in its length* is nearly:

$E_{\text{plastic}} = 2.70 \text{ GPa}$ ,  $\nu_{\text{plastic}} = 0.4$ .

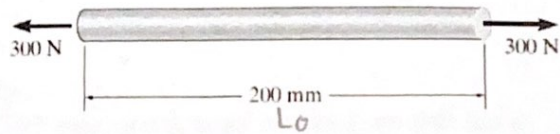
$$\epsilon_y = -\frac{\nu}{1+\nu} \epsilon_x$$

$$P = 300 \text{ N}$$

$$E = 2.70 \text{ GPa}$$

$$\nu = 0.4$$

$$\sigma = \frac{P}{A} = \frac{300 \text{ N}}{3000 \text{ mm}^2} = 0.1 \text{ N/mm}^2 \text{ or } 100,000 \text{ N/m}^2$$



$$E = \frac{\sigma}{\epsilon}$$

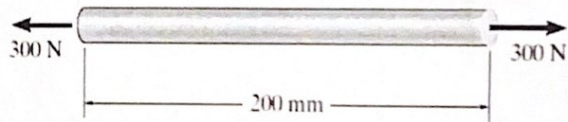
$$\epsilon = \frac{\sigma}{E} = \frac{100,000 \text{ Pa}}{2.7 \times 10^9 \text{ Pa}} =$$

- a. 0 mm
- b. 0.500 mm
- c. 0.350 mm
- ☒ d. 0.126 mm

$$\epsilon = \frac{\Delta L}{L_0}$$

$$\Delta L = \epsilon L_0$$

5. The *change in diameter* of the rod in Problem #4 is most nearly:



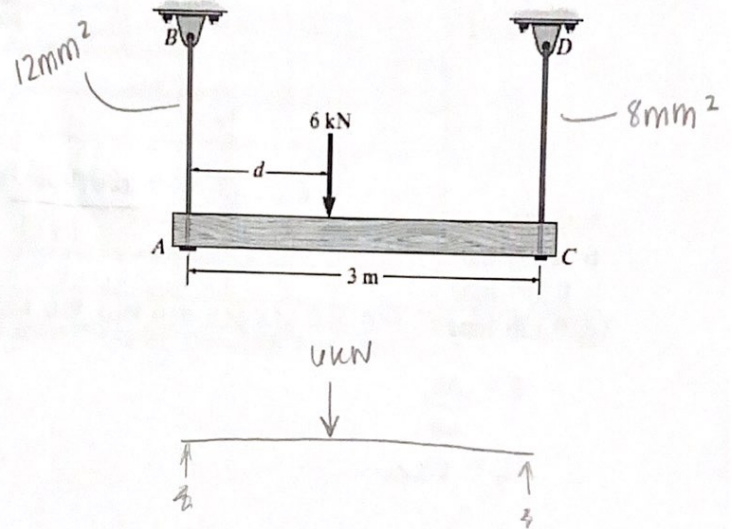
$$A = 0.3 \text{ m}^2 \text{ or } 3000 \text{ mm}^2$$

The acrylic plastic rod is 200 mm long and 15 mm in diameter. An axial load of 300 N is applied to it.  $E_{\text{plastic}} = 2.70 \text{ GPa}$ ,  $\nu_{\text{plastic}} = 0.4$ .

- ☒ a. 0.00377 mm (reduction)
- b. 0.00377 mm (increase)
- c. 0.04356 mm (reduction)
- d. 0.04356 mm (increase)

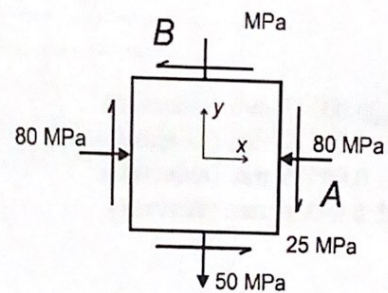
6. The beam is supported by two rods  $AB$  and  $CD$  that have cross-sectional areas of  $12 \text{ mm}^2$  and  $8 \text{ mm}^2$ , respectively. What is **position  $d$**  of the  $6\text{-kN}$  load so that the **normal stress** in each rod is the same? **[HINT: Free Body Diagram of the beam and Statics analysis will help]**

$$\sigma = \frac{P}{A}$$



- a. 2.2 m
- ☒ b. 1.2 m
- c. 3.0 m
- d. 3.1 m

7. The principal normal stresses on the element shown are:



- a.  $54.6 \text{ kPa}$ ;  $-84.6 \text{ kPa}$
- ☒ b.  $54.6 \text{ MPa}$ ;  $-84.6 \text{ MPa}$
- c.  $54.6 \text{ MPa}$ ;  $84.6 \text{ MPa}$
- d. None of the above



4 ft

$$24 \text{ in} = r$$



$$5/16 \text{ in} \rightarrow r = 0.3125 \text{ in}$$

8. The wall thickness of a 4-ft-diameter *spherical* tank is 5/16 inch. If the stress is limited to 8000 psi, the allowable internal pressure is most nearly:

- a. 608 psi
- b. 108 psi
- c. 300 psi
- ☒ d. 208 psi

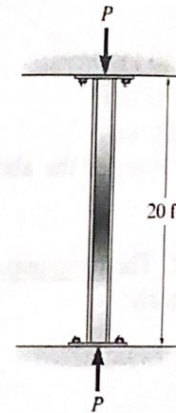
$$\sigma_r = P_i \left( \frac{24 \text{ in}^2 + 0.3125 \text{ in}^2}{24 \text{ in}^2 - 0.3125 \text{ in}^2} \right)$$

$$200.14 \text{ PSI}$$

9. The W12 x 50 structural member is made of A992 steel and is used as a *column* that has a length of 20 ft. If its *ends* are assumed **pin supported**, and it is subjected to an axial load of 150 kip, what is, most nearly, the critical normal stress if  $\sigma_{\text{Yield}} = 50 \text{ ksi}$ ?

$$P = 150 \text{ kip}$$

$$\sigma_{\text{actual}} = \sigma_{\text{Yield}} = 50 \text{ ksi}$$



- a. 19 ksi
- ☒ b. 25 ksi
- c. 55 ksi
- d. 66 ksi

10. The *factor of safety* for the situation in Problem #9 is most nearly:

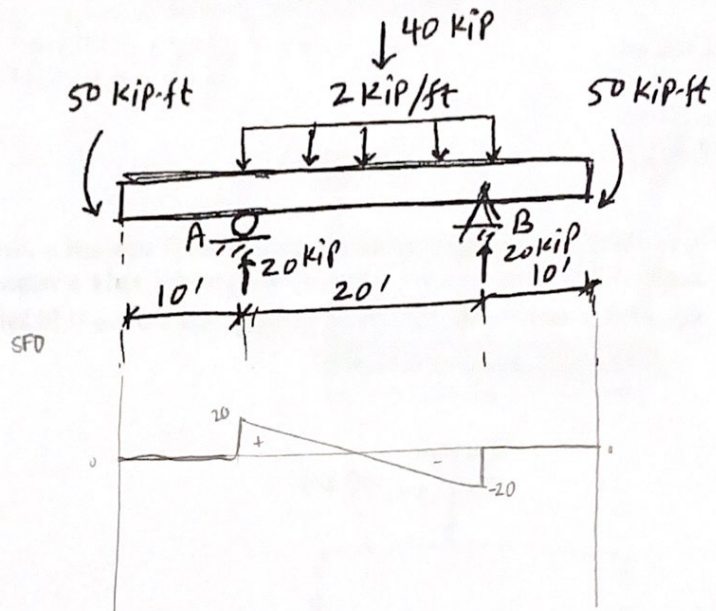
The W12 x 50 structural member is made of A992 steel and is used as a *column* that has a length of 20 ft. The *ends* are assumed **pin supported**, and it is subjected to an axial load of 150 kip,  $\sigma_{\text{Yield}} = 50 \text{ ksi}$ ?

- ☒ a. 2
- b. 3
- c. 1
- d. None of the above

$$FS = \frac{\sigma_a}{\sigma_y}$$

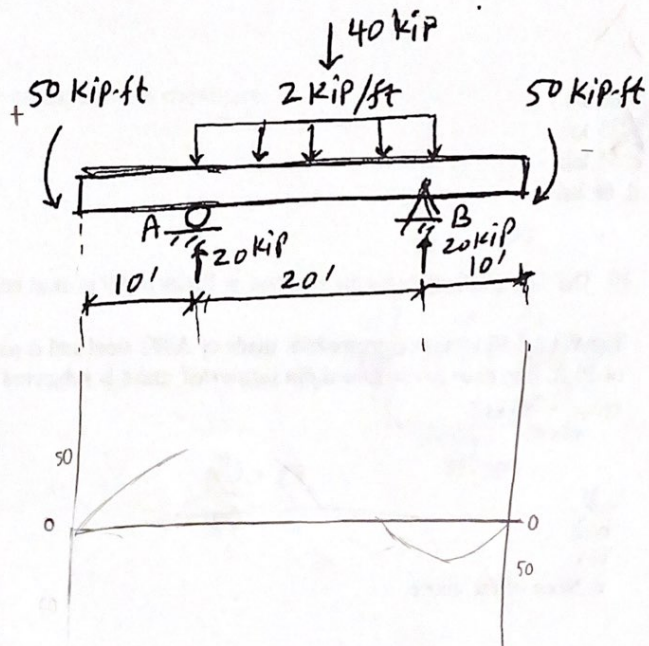


11. The maximum positive shear force anywhere on the beam is most nearly:



- a. 40 kip
- b. 30 kip
- c. 20 kip
- d. None of the above

12. The maximum negative bending moment anywhere in the beam of Problem #11 is most nearly:



- a. 20 kip-ft
- b. 50 kip-ft
- c. 30 kip-ft
- d. None of the above

13. A wood beam is reinforced with steel straps at its top and bottom as shown. Determine the **maximum bending stress developed in the steel** if the beam is subjected to a moment of  $M = 150 \text{ kN}\cdot\text{m}$ . Take  $E_w = 10 \text{ GPa}$ ,  $E_{st} = 200 \text{ GPa}$ . [Hints: Convert Wood to Steel; Note the Transformation Factor,  $n$ ]

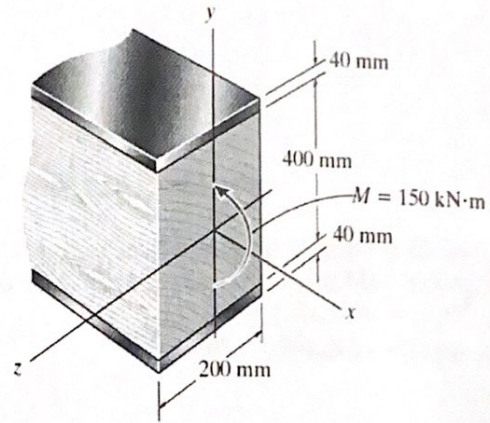
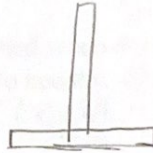
$$M = 150 \text{ kN}\cdot\text{m}$$

$$E_w = 10 \text{ GPa}$$

$$E_{st} = 200 \text{ GPa}$$

$$200 \text{ mm} (40 \text{ mm}) = 8000 \text{ mm}^2$$

$$I_1 = 1044$$



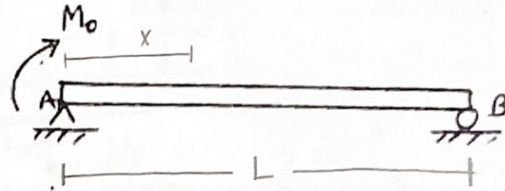
- a. 90 MPa
- b. 13 MPa
- ☒ c. 18 MPa
- d. 43 MPa

14. The **maximum bending stress developed in the wood** for Problem # 13 is *most nearly* (Remember, you have converted Wood to Steel in Problem #13):

- ☒ a. 2 MPa
- b. 4 MPa
- c. 6 MPa
- d. None of the above



15. The correct *bending moment equation* as a function of distance  $x$  along the beam (from left to right) is (Consider the beam is Horizontal):



- a.  $M(x) = M_0$
- b.  $M(x) = (M_0 x/L) + M_0$
- c.  $M(x) = - (M_0 x/L) + M_0$
- d.  $M(x) = - (M_0 x^2/L) + M_0 x$

$$\frac{M_0(x)}{L}$$

**CIVIL & ENVIRONMENTAL ENGINEERING  
DEPARTMENT  
OUTCOME SPECIFIC ASSIGNMENT  
COVER SHEET**

**PROFESSIONAL ENGINEERING I**

**SPRING 2022**

**Instructor: Dr. Iftekhar Ahmed, P.E.**

**Title of Assignment**

**MOCK FE EXAM**

**Outcome Measured Using this Assignment**

**Outcome 3**

**Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

**Brief Description of the suitability of this assignment for the outcome**

Through rigorous semester long crash review of all the NCEES FE-CIVIL topics, students take a 100-question multiple choice online MOCK FE test covering the breadth and the depth of the fundamentals of civil engineering, computers, math, engineering economics, ethics and contracts. A sample of that MOCK tests is presented here. No student work sample exists due to the online treatment. The MOCK exam statistics for Spring 2022 is included.

MOCK\_FE: Statistics

ecourses.pvamu.edu/courses/14655/quizzes/83076/statistics



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Quiz Summary

Section Filter

Student Analysis

Item Analysis

Average Score

85%

High Score

90%

Low Score

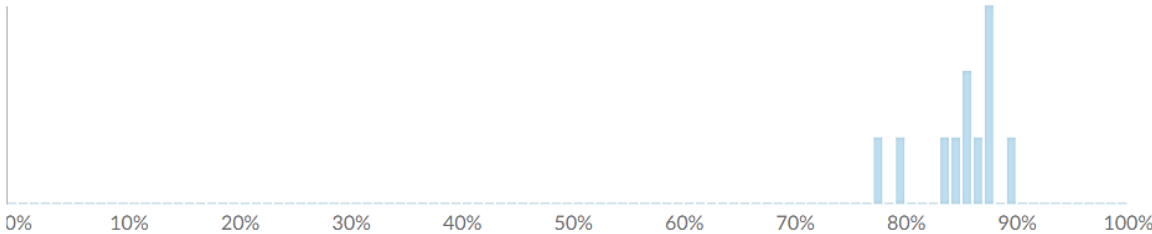
78%

Standard Deviation

3.45

Average Time

04:20:11

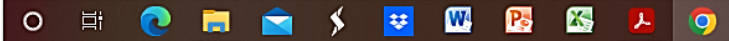


| Score Range (%) | Frequency |
|-----------------|-----------|
| 78-80           | 2         |
| 80-82           | 2         |
| 82-84           | 2         |
| 84-86           | 3         |
| 86-88           | 4         |
| 88-90           | 5         |
| 90-92           | 2         |

MOCK\_FE Quiz Ite....csv

Show all

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80°F

9:50 PM 5/19/2022

1. What is the distance between the points P (1, -3, 5) and Q (-3, 4, -2)?

- a.  $\sqrt{10}$
- b.  $\sqrt{14}$
- c. 8
- d.  $\sqrt{114}$

2. What is the determinant of the following matrix?

$$\begin{vmatrix} 2 & -3 & 9 \\ 2 & 0 & -1 \\ 1 & 4 & 5 \end{vmatrix}$$

- a. -113
- b. -7
- c. 49
- d. 73

3. The partial derivative  $\frac{\partial f}{\partial x}$  of  $x^2y^3$  is:

- a.  $2xy$
- b.  $3y^2x^2$
- c.  $2xy^3$
- d. None of the above

4. Find the critical points of the function  $f(x) = 3x^{5/3} - 15x^{2/3}$  where maxima or minima may be found.

- a.  $x = 0$  and  $x = 2$
- b.  $x = 2$
- c.  $x = 0$
- d. None of the above

5. Determine the (x,y) coordinates of the center of the circle defined by the following equation:

$$x^2 - 8x + y^2 - 10y + 25 = 0$$

- a. (3,2)
- b. (3,4)
- c. (4,5)
- d. (5,4)

6. The relative extrema of  $f(x) = x^3 - 3x^2 + 3x - 1$  is:

- a. 1
- b. 3
- c. No extrema exists
- d. None of the above

7.  $\int \cos 5x \, dx$  is:

- a.  $(1/5) \sin 5x + C$
- b.  $5 \sin 5x + C$
- c.  $(1/5) \sinh 5x + C$
- d. None of the above

8. The scores of a final exam are distributed according to the table shown. What are the approximate mode and arithmetic mean of the scores?

| Score | Frequency |
|-------|-----------|
| 38    | 5         |
| 45    | 2         |
| 69    | 7         |
| 76    | 10        |
| 82    | 12        |
| 90    | 8         |
| 91    | 19        |
| 95    | 15        |

- a. mode 79; mean 73
- b. mode 82; mean 79
- c. mode 85; mean 85
- d. mode 91; mean 82

9. Solve the system of equations:

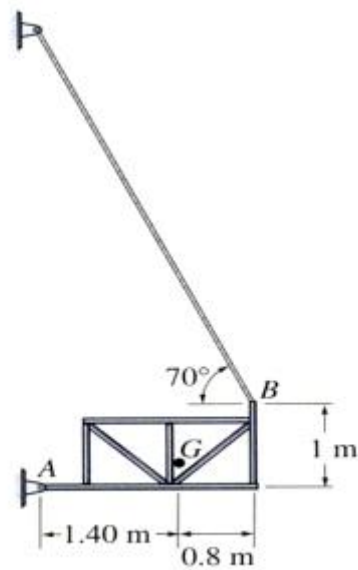
$$\begin{aligned}x - y + z &= -3 \\2x + y &= 1 \\y - 3z &= 7\end{aligned}$$

- a.  $x=0, y=1, z=-2$
- b.  $x=0, y=2, z=-2$
- c.  $x=0, y=-11, z=2$
- d.  $x=0, y=1, z=-6$

10. When a helicopter is 1.2 km above one end of an island, the angle of depression to the other end of the island is  $22.7^\circ$ . Find the approximate length of the island (rounded off to the nearest whole number).

- a. 10 km
- b. 3 km
- c. 5 km
- d. 2 km

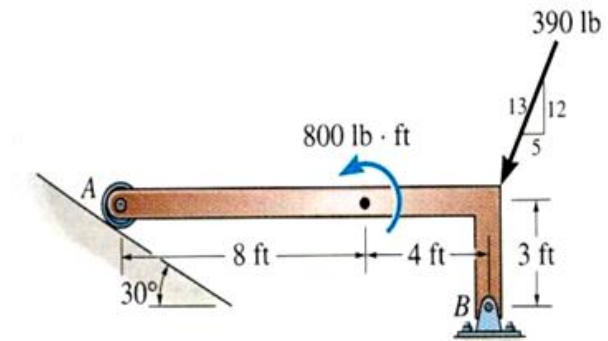
11. The structure (Weight = 1962 N) shown with its mass center at  $G$  is held in place by the pin at  $A$  and the cable at  $B$ . Determine the tension in the cable.



- a. 1035 N
- b. 900 N
- c. 1140 N
- d. 1300 N

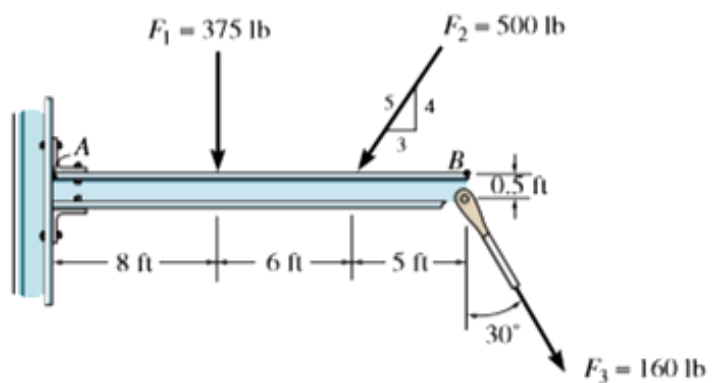


12. Find the support reaction at A.



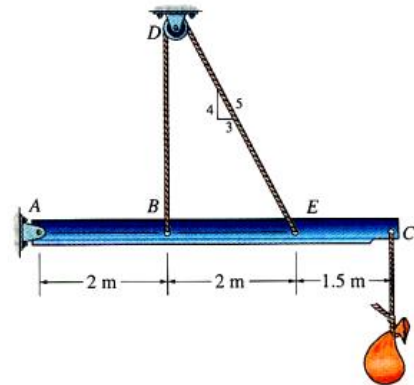
- a. 150 lb
- b. 200 lb
- c. 110 lb
- d. 105 lb

13. Find, nearly, the *resultant moment* about point A. Show



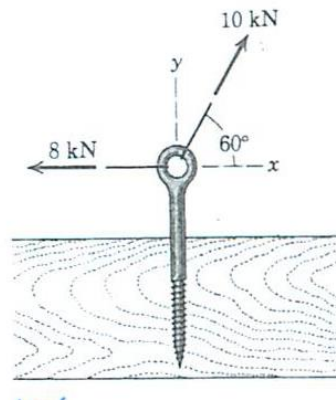
- a. 15,000 lb
- b. 20,140 lb
- c. 11,190 lb
- d. 11270 lb

14. The beam and the cable (with a *frictionless pulley* at *D*) support an 80-kg load at *C*. The cable extends half way into the beam's thickness. Determine the tension in the cable. [ $g = 9.81 \text{ m/s}^2$ ]



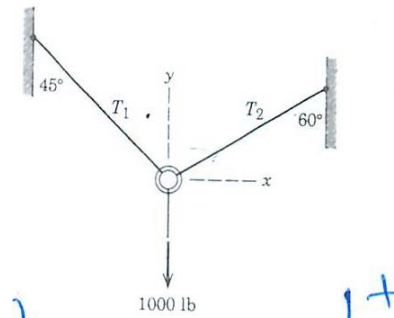
- a. 830 N
- b. 950 N
- c. 1,200 N
- d. 560 N

15. Determine, nearly, the magnitude of the resultant force vector for the situation shown.



- a. 9 N
- b. 5 N
- c. 112 N
- d. 60 N

16. The ring supports the 1000-lb load and is held in position by the two cables attached to vertical walls. Tension  $T_1$  is nearly:

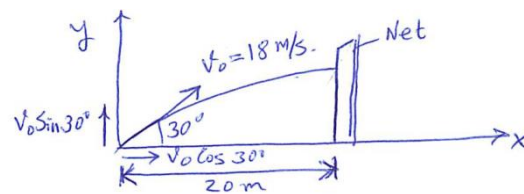


- a. 90 lb
- b. 515 lb
- c. 895 lb
- d. 400 lb

17. A boy throws a ball straight up from the top of a 12-m high tower. If the ball falls past him 0.75 seconds later, determine the velocity at which it was thrown.

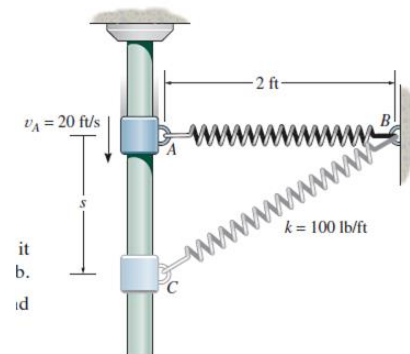
- a. 3.7 m/s
- b. 4.5 m/s
- c. 6.7 m/s
- d. None of the above

18. A daredevil is shot out of a canon at 18 m/s at an angle (with horizontal) of  $30^\circ$ . A vertical net is placed 20m away (horizontal distance) from the daredevil's starting point and safely catches him. How long is the daredevil in the air?



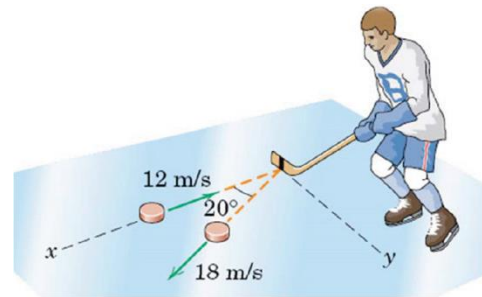
- a. 3.4 seconds
- b. 0.5 seconds
- c. 2.7 seconds
- d. 1.3 seconds

19. The 2-lb block is given an initial velocity of 20 ft/s when it is at A. If the spring has an unstretched length of 2 ft and a stiffness of  $k = 100$  lb/ft, determine, nearly, the *velocity of the block at C* when the vertical distance  $s = 1$  ft.



- a. 10 ft/s
- b. 23 ft/s
- c. 12 ft/s
- d. 19 ft/s

20. An ice-hockey puck with mass of 0.20 kg has a velocity of 12 m/s before being struck by the stick. After a *0.04 second* contact with the stick, the puck moves in the new direction shown with a velocity of 18 m/s. Determine the magnitude of average force  $F_{\text{avg}}$  exerted by the stick on the puck *during contact*.



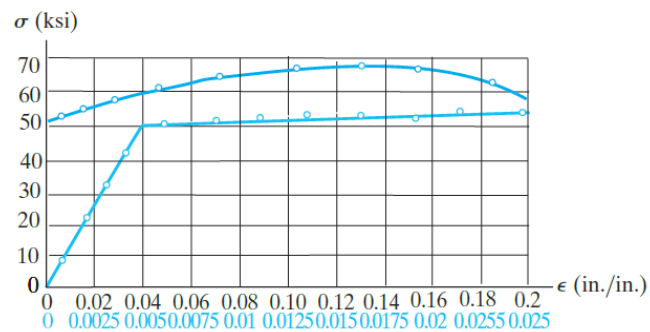
- a. 170 N
- b. 230 N
- c. 148 N
- d. 190 N

21. A jet fighter with a mass of 6450 kg requires 10 *seconds* from rest to reach its takeoff speed of 250 km/h under a constant thrust of  $T = 48$  kN. Determine the time average  $R$  of the combined air and ground resistance during takeoff. (**Assume:** the jet is a particle in the sky, flying high!)



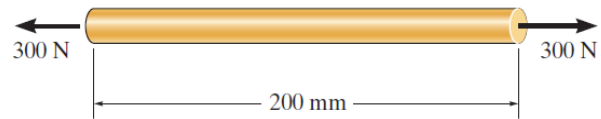
- a. 17 kN
- b. 3.21 kN
- c. 5.0 kN
- d. 1.9 kN

22. The stress–strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. Determine approximately, the modulus of elasticity for the material.



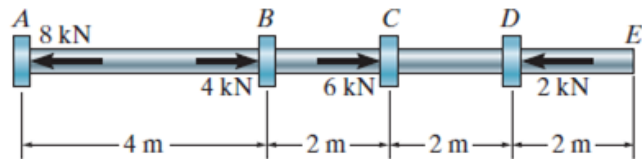
- a.  $10 \times 10^3$  ksi
- b.  $12 \times 10^4$  ksi
- c.  $15 \times 10^3$  ksi
- d. None of the above

23. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, determine the *change in its length*.  $E_{\text{plastic}} = 2.70 \text{ GPa}$ ,  $\nu_{\text{plastic}} = 0.4$ .



- a. 0.500 mm
- b. 0.430 mm
- c. 0.126 mm
- d. None of the above

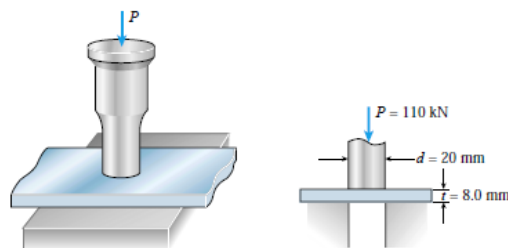
24. The 2014-T6 aluminum rod ( $E = 72.4 \text{ GPa}$ ) has a uniform diameter of 30 mm and supports the load shown. Determine, nearly, the displacement of end A with respect to end E. Neglect the size of the couplings.



- a. 0.50 mm
- b. 0.70 mm
- c. 0.90 mm
- d. None of the above

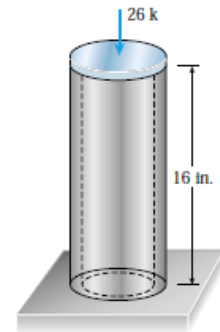
25. A punch for making holes in steel plates is shown in the figure. Assume that a punch having diameter  $d = 20 \text{ mm}$  is used to punch a hole in an 8-mm thick plate, as shown in the cross-sectional view. If a force  $P = 110 \text{ kN}$  is required to create the hole, **what is the average shear stress in the plate (nearly)?**

*The shear surface area in the plate =  $\pi dt$  (or, circumference times the thickness of the plate)*



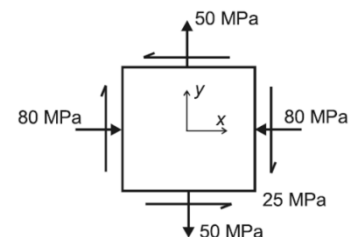
- a. 500 mm
- b. 220 mm
- c. 200 mm
- d. 319 mm

26. A short post constructed from a ***hollow circular tube*** of aluminum supports a *compressive* load of 26 kips. The inner and outer diameters of the tube are  $d_1 = 4.0$  in. and  $d_2 = 4.5$  in., respectively, and its length is 16 in. The *shortening* of the post due to the load is measured as 0.012 in. **Determine the compressive stress in the post.** (Disregard the weight of the post itself, and assume that the post does not buckle under the load.)



- a. 4500 psi
- b. 8080 psi
- c. 7790 psi
- d. 6500 psi

27. The principal normal stresses, respectively, are:

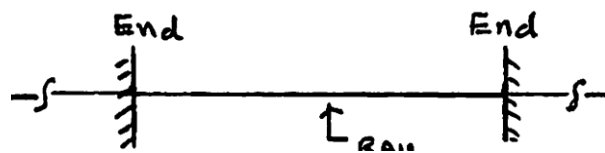


- a. 54.6 MPa; -84.6 MPa
- b. 65.9 MPa; -46.0 MPa
- c. -70.0 MPa; - 54.5 MPa
- d. 65.6 MPa; 46.4 MPa

28. The wall thickness of a 4-ft-diameter *spherical* thin vessel is 5/16 inch. The allowable internal pressure if the stress is limited to 8000 psi is nearly:

- a. 195 psi
- b. 440 psi
- c. 350 psi
- d. 208 psi

29. A 10-m section of steel [ $E = 200 \text{ GPa}$  and  $\alpha = 11.9(10^{-6})/^{\circ}\text{C}$ ] rail has a cross sectional area of  $7500 \text{ mm}^2$ . Both ends of the rail are tight against adjacent rails that can be assumed rigid for this problem. The rail is supported *against* lateral movement (in other words, no change in diameter allowed). For an increase in temperature of  $50^{\circ}\text{C}$ , determine the normal stress in the rail.

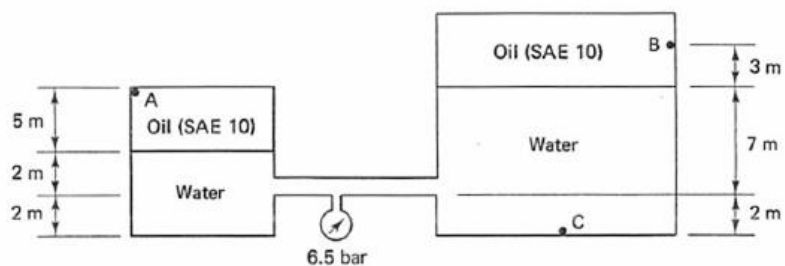


- a. 119 MPa
- b. 96 MPa
- c. 127 MPa
- d. None of the above

30. A well designed ship displaces  $130 \text{ m}^3$  of seawater. What is the *weight* of the ship? Density of seawater is  $1023 \text{ kg/m}^3$ . [ $g = 9.81 \text{ m/s}^2$ ]

- a. 2.4 Mega N
- b. 9.6 Mega N
- c. 12.7 Mega N
- d. 1.3 Mega N

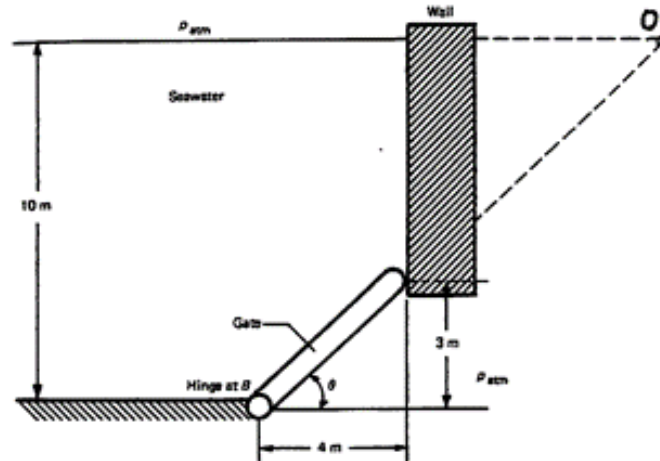
31. If the pressure gauge shown in the figure indicates a pressure of  $6.5 \times 10^5 \text{ N/m}^2$  (6.5 bar) estimate the pressure at point B. The unit weights of the oil and water are  $9016 \text{ N/m}^3$  and  $9790 \text{ N/m}^3$ , respectively.





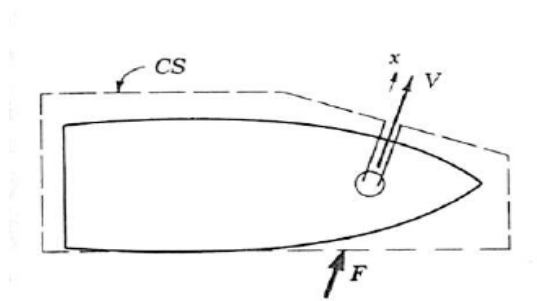
- a.  $3.4 \times 10^5 \text{ N/m}^2$
- b.  $4.6 \times 10^5 \text{ N/m}^2$
- c.  $5.5 \times 10^5 \text{ N/m}^2$
- d.  $6.5 \times 10^5 \text{ N/m}^2$

32. A rectangular gate, 2 m wide (into the paper), is hinged at point  $B$  and rests against a smooth wall at point  $A$ . Estimate the pressure force on the gate due to the seawater of density  $1000 \text{ kg/m}^3$  (neglect any effect of atmospheric pressure).



- a.  $8.3 \times 10^5 \text{ N}$
- b.  $10.3 \times 10^5 \text{ N}$
- c.  $4.5 \times 10^5 \text{ N}$
- d.  $6.3 \times 10^5 \text{ N}$

33. A jet of water 80 mm in diameter with a velocity of 40 m/s is discharged in a **horizontal x direction (as shown)** from a nozzle mounted on a boat. What force,  $F$ , is required to hold the boat stationary? Density of water is  $1000 \text{ kg/m}^3$ .



- a. 8090 N
- b. 8040 N
- c. 9600 N
- d. 5600 N

34. Assume that the *drag*,  $D$ , acting on a spherical particle that falls very slowly through a viscous fluid is a function of the particle diameter,  $d$ , the particle velocity,  $V$ , and the fluid viscosity,  $\mu$ . **How many  $\pi$  terms can be formed?**

- a. 2
- b. 3
- c. 1
- d. None

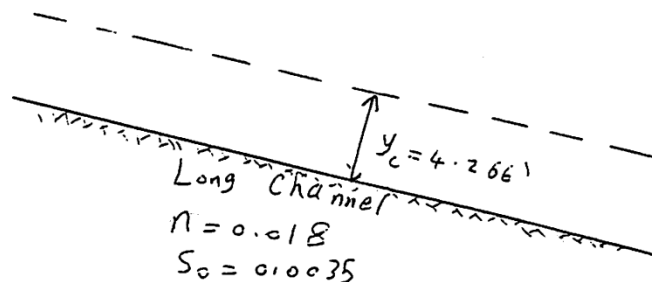
35. Water issues from a *large* tank through a circular 5-in-diameter orifice under a static head of 45 ft. If 534  $\text{ft}^3$  of water volume is discharged in 2 **minutes**, what is the *coefficient of discharge*? The *vena contracta* diameter is measured to be 3.93 inches.

- a. 0.560
- b. 0.406
- c. 0.500
- d. 0.606

36. Oil, with density  $\rho = 900 \text{ kg/m}^3$  and  $\nu = 0.00001 \text{ m}^2/\text{s}$ , flows steadily at  $0.2 \text{ m}^3/\text{s}$  through 500m length of a 200-mm diameter cast-iron pipe ( $e = 0.26 \text{ mm}$ ). *Determine, nearly, the head loss due to friction.*

- a. 115 m
- b. 90 m
- c. 230 m
- d. 45 m

37. The depth at some section of the given wide channel was reported to be 4.1 feet. The discharge per unit width is 50 cfs/ft;  $y_c = 4.266 \text{ ft}$ . The normal flow depth is nearly:



- a. 6 ft
- b. 5 ft
- c. 4 ft
- d. 2 ft

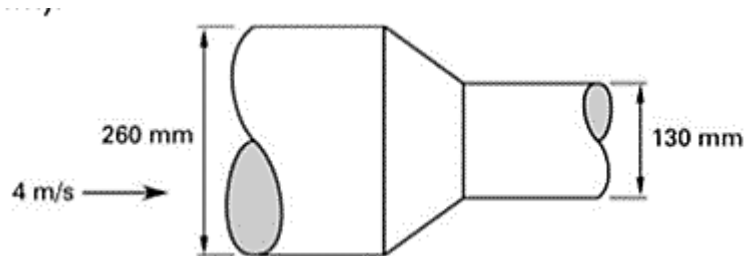
38. A trapezoidal channel has concrete side slopes at 1:1, and a gravel bottom. The average Manning's roughness coefficient for the entire channel cross section is 0.018. The channel bed slope is 0.0005 and the normal flow depth is 1 m. Because of the gravel bottom, the maximum flow velocity in the channel is limited to 0.75 m/s. The bottom width of the channel is nearly:

- a. 0.6 m
- b. 0.5 m
- c. 0.4 m
- d. 0.3 m

39. A 6-cm pipe carries water at 20°C ( $\nu = 1.007 \times 10^{-6} \text{ m}^2/\text{s}$ ) at the rate of 12 liters/s. The Reynolds number for this condition is nearly:

- a.  $6.3 \times 10^5$
- b.  $4.0 \times 10^5$
- c.  $3.0 \times 10^5$
- d.  $2.5 \times 10^5$

40. The speed of an incompressible fluid is 4 m/s entering the 260 mm pipe. The speed in the 130 mm pipe is most nearly:



- a. 40 m/s
- b. 9 m/s
- c. 12 m/s
- d. 16 m/s

41. A hydraulic jump occurs in a *wide rectangular* channel. The upstream depth and velocity are 0.4m, and 13 m/s, respectively. The downstream flow depth is nearly:  
[Specific weight of water =  $9810 \text{ N/m}^3$ ;  $g = 9.81 \text{ m/s}^2$ ]

- a. 3.5 m
- b. 4.8 m
- c. 2.9 m
- d. 6 m

42. A manufacturing facility is willing to accept only 1% risk of flooding during its 50-year design life. What is the annual *probability* that flooding *will* occur during the design life?

- a. 0.0002
- b. 0.007
- c. 0.01
- d. 0.05

43. The rank of a river discharge in an annual discharge series data is 11. The sample size is 53. The *return period* is best estimated to be:

- a. 3.86 years
- b. 54 years
- c. 2 years
- d. 4.91 years

44. A flood discharge has a return period of 100 years. The *probability* of it occurring *twice* during the next 10 years is:

- a. 0.00055
- b. 0.096
- c. 0.67
- d. 0.0092

45. Consider a return period of 100 years. The *probability* of it *not occurring* during the next 20 years is:

- a. 0.818
- b. 0.675
- c. 0.717
- d. 0.432

46. Which of the following terms is best defined as a formula or set of steps for solving a particular problem?

- a. program
- b. software

- c. firmware
- d. algorithm

47. The computer language that is executed within a computer's central processing unit is:

- a. DOS
- b. high-level language
- c. assembly language
- d. machine language

48. How many times will the second line be executed?

M = 42

LOOPSTART M = M - 1

P = INTEGER PART OF (M/2)

IF P > 15, THEN GO TO

LOOPSTART, OTHERWISE

GO TO END

END PRINT "DONE"

- a. 8
- b. 11
- c. 9
- d. 12

49. M = 5, P = M \* 2 + 6, THEN  $n = p^{0.5} =$

- a. 4
- b. 16
- c. 32
- d. 0

50. A computer structured programming program contains the following program segment. What is the value of X after the segment is executed?

**X = 0**

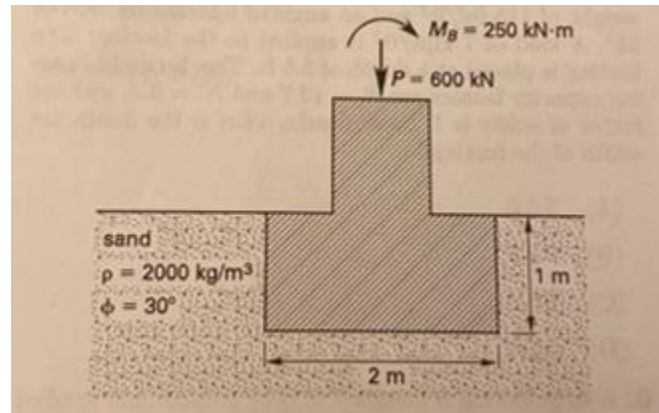
**FOR T = -1 TO 2**

**X = X + T**

**NEXT T**

- a. 6
- b. 4
- c. 3
- d. 2

51. A 2-m wide continuous wall footing is designed to support an axial column load of 600 kN (per meter wall length) and a moment of 250 kN.m (per meter wall length). The footing is placed 1 m into a sandy soil with a density of  $2000 \text{ kg/m}^3$ , cohesion of 0.5 Pa, and an angle of internal friction of  $30^\circ$ . Most nearly, the ultimate bearing capacity per meter of footing length is:



- a. 84 kPa
- b. 210 kPa
- c. 430 kPa
- d. 830 kPa

52. A soil has an angle of internal friction of  $25^\circ$ . The Rankine *active* earth pressure coefficient is nearly:

- a. 0.34
- b. 0.41
- c. 0.52
- d. 0.58

53. A soil has a void ratio of 0.41. The unit weight of the solids is  $33 \text{ kN/m}^3$ . The saturated unit weight of the soil is most nearly:

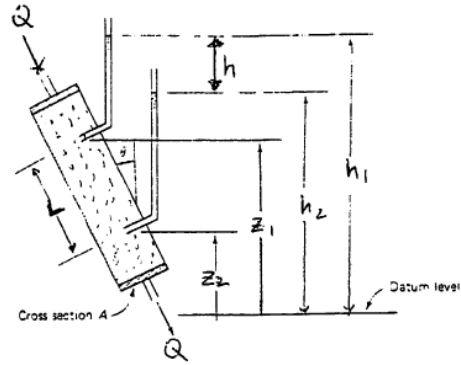
- a.  $26 \text{ kN/m}^3$
- b.  $29 \text{ kN/m}^3$
- c.  $33 \text{ kN/m}^3$
- d.  $37 \text{ kN/m}^3$

54. Soil directly below a footing experiences a total compressive stress of 52 kPa. The surface of the water (water table) is 2 m higher than the bottom of the footing. The *effective stress* under the footing is most nearly:

- a. 32 kPa
- b. 38 kPa
- c. 13 kPa

d. 19 kPa

55. Flow through an inclined soil column is shown. The mathematical expression for the *hydraulic gradient* is:



- a.  $h_1/L$
- b.  $h/L$
- c.  $(z_1 - z_2)/L$
- d. None of the above

56. A soil sample has a void ratio of 0.72, moisture content 12% and  $G_s = 2.72$ . Its dry unit weight is nearly:

- a.  $15 \text{ kN/m}^3$
- b.  $20 \text{ kN/m}^3$
- c.  $30 \text{ kN/m}^3$
- d.  $25 \text{ kN/m}^3$

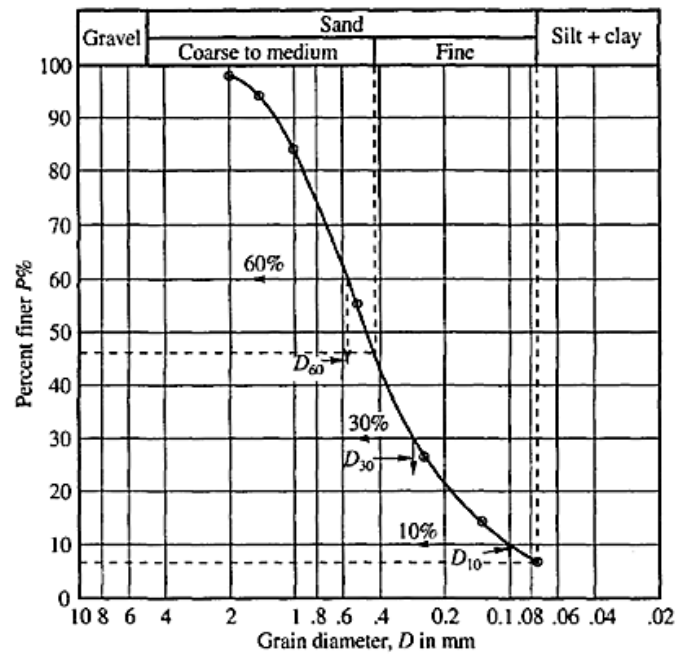
57. A retaining wall supports soil with a vertical height of 2 m. The soil has an angle of internal friction of  $32^\circ$  and a specific (unit) weight of  $25 \text{ kN/m}^3$ . The *active* lateral soil resultant *force* is most nearly:

- a. 5 kN/m
- b. 15 kN/m
- c. 46 kN/m
- d. 92 kN/m

58. A sample of *saturated* clay ( $S = 1$ ) from a consolidometer test has a total weight of 3.36 lb and a dry weight of 2.32 lb; the specific gravity of the solid particles is 2.7. For this sample, the total unit weight is nearly:

- a. 110 lb/ft<sup>3</sup>
- b. 290 lb/ft<sup>3</sup>
- c. 330 lb/ft<sup>3</sup>
- d. 96 lb/ft<sup>3</sup>

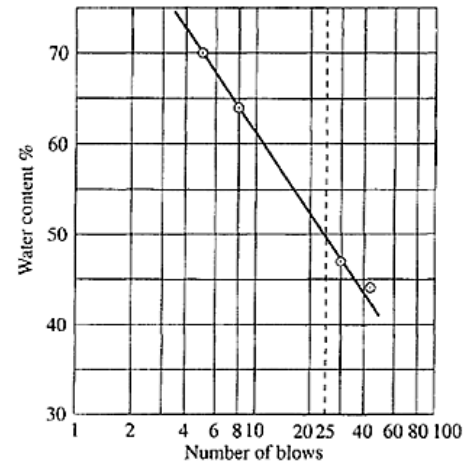
59. The *uniformity coefficient* for a dry sample based on the gradation plot shown is nearly:



- a. 2.4
- b. 2.9
- c. 5.9
- d. 3.4

60. The semi-log flow curve from a liquid limit test on a sample of clay is shown. According to the graph, the liquid limit is nearly:



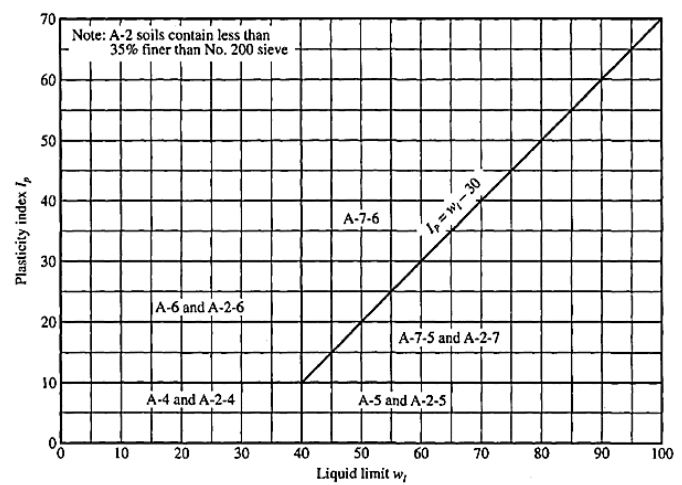


- a. 25%
- b. 30%
- c. 50%
- d. 60%

61. The natural moisture content of an excavated soil is 32%. Its liquid limit is 60% and plastic limit is 27%. The plasticity index of the soil is nearly:

- a. 33%
- b. 43%
- c. 52%
- d. 10%

62. The chart shown is used for:



- a. AASHTO Soil Classification System
- b. Unified Soil Classification System
- c. USDA Soil Classification System
- d. None of the above

63. Ethical behavior among professionals is established by:

- a. ASCE Code of Ethics
- b. Rules of play for professional sports
- c. Legal contracts
- d. Taxation regulations

64. Whistle blowing is best described as calling public attention to:

- a. Unethical behavior in a government agency you are monitoring as a private individual
- b. Secret illegal behavior by your employer
- c. Your own previous unethical behavior
- d. Unethical behavior of employees under your control

65. Why is a competitive bidding often considered to be counterproductive?

- a. The best design is not always the least expensive
- b. Competition among different design firms is unprofessional and unethical
- c. A design professional who reduces the final cost in order to be competitive may eliminate important design steps or features
- d. Competitive bidding may reduce the client's cost but will increase the design professional's cost

66. If a contract does not include the boilerplate cause, "Time is of the essence," which of the following is true?

- a. Damages for delay cannot be claimed
- b. Workers need to be paid for downtime in the project
- c. Standard industry time guideline apply
- d. It is difficult to recover losses for extra hours billed

67. Engineers are to uphold the health, safety, and public

- a. Welfare
- b. Trust
- c. Support
- d. Confidence

68. A “tort” is:

- a. A civil wrong committed against another person
- b. A section of a legal contract
- c. the breach of a contract
- d. None of the above

69. A registered engineer has applied for a promotion at a firm she has been working at for several years. During an interview for the new position, she is asked to contrast her qualifications with other registered engineers at the firm who have applied for the same position. She should

- a. Withdraw her application for the position
- b. Give a full accounting of all the ways her ability and experience are superior to those of the other applicants
- c. Demand to speak to the interviewer’s supervisor
- d. decline to compare her qualifications but offer to describe them

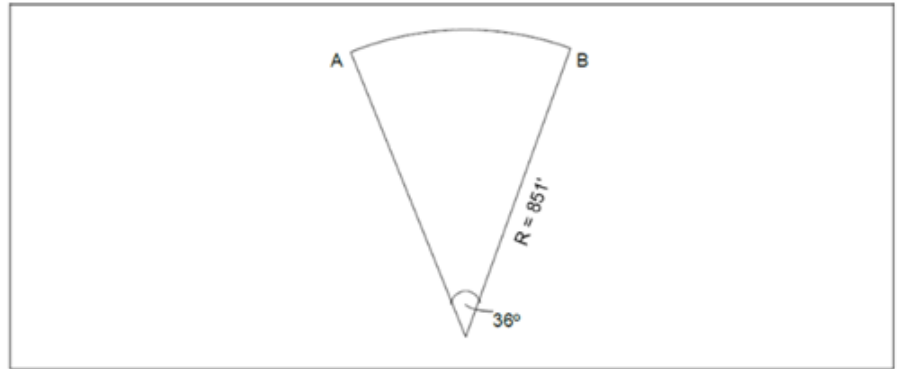
70. Registered engineers’ first obligation/consideration to society is

- a. Public welfare
- b. Public safety
- c. Steal cement and sale on Ebay
- d. To meet the needs of a particular enterprise

71. A horizontal curve for a section of a highway has a design speed of 60 mph. The terrain restricts the radius of the curve to 1200 ft, which therefore requires the super-elevation at the curve, in percent, to be most nearly:

- a. 8
- b. 6
- c. 4
- d. 10

72. A horizontal curve is defined by its radius of 851 feet, as shown below. The length of the chord AB, in feet, is most nearly:



- a. 515
- b. 525
- c. 535
- d. 525

73. A transition curve is to be used to implement a change in cross-section from a normally crowned section to a fully super-elevated section. The outer lane is to be gradually aligned from the normally crowned section to a straight level section at the Tangent-to-Spiral (T.S.) point. The full super-elevation is rotated about the centerline.

Degree of Curve ( $D$ ) =  $2.5^\circ$

Two 11-foot lanes

Design super-elevation =  $0.08 \text{ ft/ft}$

Grade =  $+1.50\%$

Crown =  $0.015 \text{ ft/ft}$

T.S. Station =  $100 + 00.00$

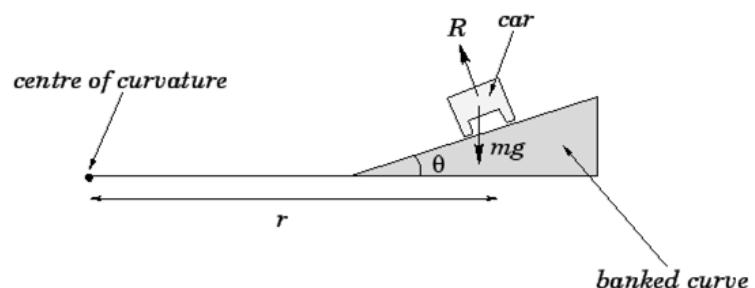
T.S. CL Elevation =  $2,500.00 \text{ ft}$ .

Length of spiral =  $230 \text{ ft}$

The station (feet) where full super-elevation is reached is most nearly:

- a.  $102 + 50$
- b.  $101 + 00$
- c.  $100 + 25$
- d.  $100 + 00$

74. The radius of curvature  $r = 60 \text{ m}$ . The recommended speed around a curve is  $40 \text{ km/h}$ . The bank angle of the curve is nearly:

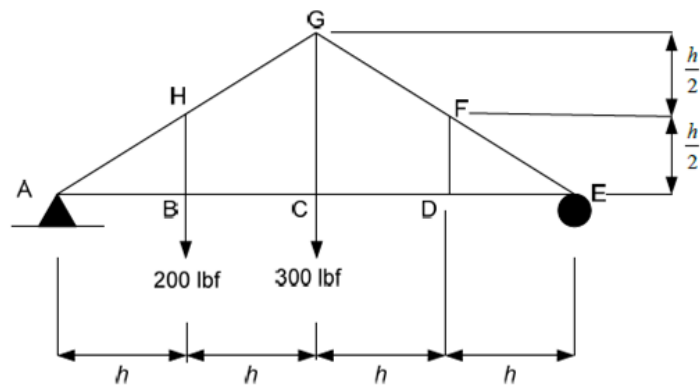


- a. 11.8 degrees
- b. 13.0 degrees
- c. 16.0 degrees
- d. 5.6 degrees

75. If you count 106 cars in 15 minutes in a suburban area (Area Multiplier,  $F = 33$ ), the daily traffic count is nearly:

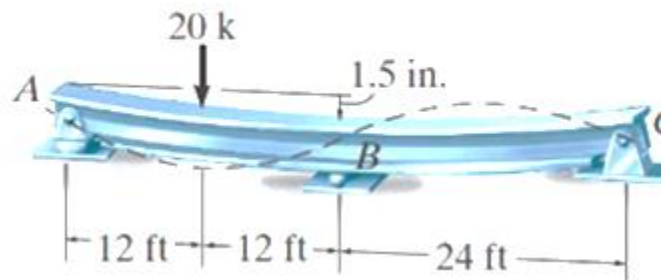
- a. 4500
- b. 3500
- c. 1600
- d. None of the above

76. The force in member  $AH$  is nearly:



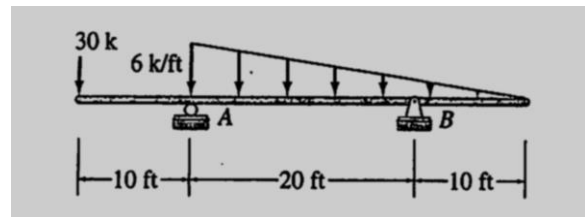
- a. 490 lb
- b. 350 lb
- c. 450 lb
- d. 670 lb

77. Support B settles by 1.5 in. The reaction at support B is most nearly:



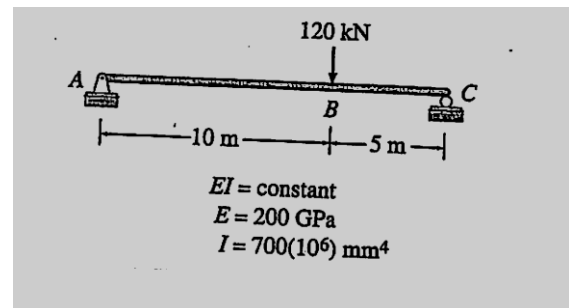
- a. 12.9 kip
- b. 9 kip
- c. 5.6 kip
- d. 6 kip

78. The support reactions for the beam shown are nearly:



- a.  $A_x = 0$ ;  $A_y = 90$ ;  $B_y = 30$
- b.  $A_x = 0$ ;  $A_y = 60$ ;  $B_y = 30$
- c.  $A_x = 0$ ;  $A_y = 94$ ;  $B_y = 50$
- d.  $A_x = 0$ ;  $A_y = 35$ ;  $B_y = 90$

79. The maximum deflection for the (horizontal) beam shown is nearly:



- a. 0.0517 m
- b. 0.0875 m
- c. 0.0659 m
- d. 0.0221 m

80. If a one-time amount of \$500 is invested at an annual interest rate of 8% (compounded annually), its future worth at the end of 30 years is nearly:

- a. \$5030
- b. \$7045
- c. \$8230
- d. \$9000

81. If you need to have \$800 in savings at the end of 4 years and your savings account yields 5% annual interest, the amount you need to deposit today is nearly:

- a. \$550
- b. \$660
- c. \$500
- d. None of the above

82. \$1000 is deposited in a savings account that pays 6% annual interest, and no money is withdrawn for three years. The account balance after three years is most nearly:

- a. \$1120
- b. \$1190
- c. \$1210
- d. 1280

83. A computer with a useful life of 12 years has an initial cost of \$2300 and a salvage value of \$350. The interest rate is 6%. Using straight line method, the total depreciation of the computer for the first five years is most nearly:

- a. \$760
- b. \$840
- c. \$920
- d. \$810

84. An asset is purchased for \$100,000. The estimated life is 7 years and the salvage value is \$15,000. Assuming a straight line depreciation method, the Book Value of the asset at the end of 3 years is most nearly:

- a. \$89,000
- b. \$110,000
- c. \$70,290
- d. \$63,570

85. The annual nominal interest rate on the unpaid portion of a contract is 17%. The effective annual interest rate, if the interest is compounded quarterly, is most nearly:

- a. 12%
- b. 9%
- c. 18%
- d. 12%

86. Sludge is digested after being removed from a secondary treatment tank. During the digestion process, the gas that is produced is mostly:

- a. Methane

- b. Butane
- c. Nitrogen oxide
- d. CO<sub>2</sub>

87. A sample of influent water has a sludge volume index of 65 mL/L. After 30 min of settling, the sludge volume is 260 mL/L. What is most nearly the concentration of mixed liquor suspended solids (MLSS) in the sample?

- a.  $4.0 \times 10^3$  mg/L
- b.  $2.0 \times 10^3$  mg/L
- c.  $3.0 \times 10^3$  mg/L
- d.  $5.0 \times 10^3$  mg/L

88. Bench studies have determined that aluminum sulfate (alum) promotes acceptable floc formation at a dose of 23 mg/L when applied to a surface water source. Design standards for chemical flocculation require flash mixing at a minimum velocity gradient (G) of 900/s for 120 seconds. Electrical power costs \$0.05/kWh. The water demand is 19,000 m<sup>3</sup>/d. The water temperature is 20°C. The total tank volume required for flash mixing is nearly:

- a. 45 m<sup>3</sup>
- b. 27 m<sup>3</sup>
- c. 30 m<sup>3</sup>
- d. 25 m<sup>3</sup>

89. A treatment plant upgrade calls for design of sedimentation basins to handle a flow rate of 8 MGD. The basins are of Type I suspension with an overflow rate ( $q_o$ ) of 650 gpd/ft<sup>2</sup>, a length to width ratio of 4:1, a weir overflow rate ( $q_w$ ) of 20,000 gpd/ft. The minimum settling zone depth is 10 ft and 1.5 ft is allowed for freeboard. If 3 tanks are chosen, the surface dimension (Length and Width) of each tank is most nearly:

- a. L = 128 ft; W = 32 ft
- b. L = 120 ft; W = 26 ft
- c. L = 90 ft; W = 18 ft
- d. None of the above

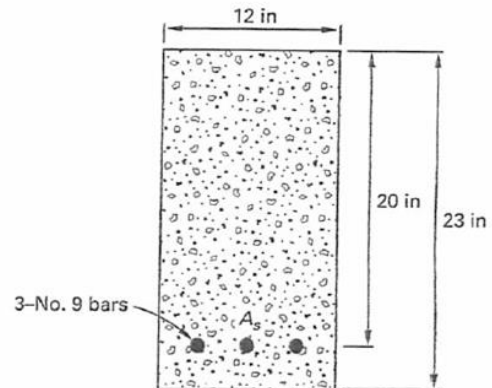
90. A secondary clarifier accepts effluent from a bioreactor at a flow rate of 8300 m<sup>3</sup>/d and total suspended solids of 1600 mg/L. The solids loading rate is 2.6 kg/m<sup>2</sup>.h, and the particle settling velocity is 1.29 m/h. The solids loading rate is most nearly:

- a. 16,000 kg/day
- b. 13,280 kg/day
- c. 17,300 kg/day
- d. None of the above



91. If the dead load shear force in the beam is 5 kips and the live load shear force in the beam is 15 kips, then the minimum amount of shear reinforcement needed for a center-to-center stirrup spacing of 8 inch based on ACI strength design is most nearly:

Given:  $f'_c = 3000 \text{ lb/in}^2$ ,  $f_y = 40,000 \text{ lb/in}^2$ ,  $A_s = 3 \text{ in}^2$  [3 #9 bars] and  $A_s' = 1 \text{ in}^2$   
Assume the beam is under-reinforced!



- a.  $0.1 \text{ in}^2$
- b.  $0.12 \text{ in}^2$
- c.  $0.14 \text{ in}^2$
- d.  $0.18 \text{ in}^2$

92. A floor system consists of 30 reinforced concrete beams and a continuous 4 inch deck slab. A typical section is shown for the deck and two of the beams. Assume the beams are under-reinforced. Assume the effective flange width for this beam is 40 inch. If the area of reinforcing steel per beam is  $6.00 \text{ in}^2$ , the nominal moment capacity of each beam based on ACI strength design is most nearly:

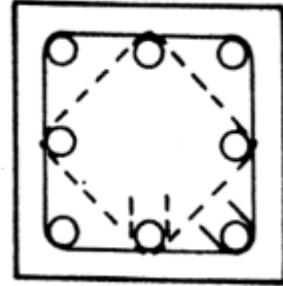
Given:  $f'_c = 2800 \text{ lb/in}^2$ ,  $f_y = 42,000 \text{ lb/in}^2$ ,  $L = 30 \text{ ft}$  (simple span length, into the paper)

- a. 150 kip-ft
- b. 160 kip-ft
- c. 520 kip-ft
- d. 650 kip-ft

93. The long (RC) column definition under braced (non-sway) conditions is given by which of the following if  $M_1$  and  $M_2$  are the smaller and larger end moments:

- a.  $(KL/r) > [34 - (12M_1/M_2)]$
- b.  $(KL/r) > [34 + (12M_1/M_2)]$
- c.  $(KL/r) > [34 - (20M_1/M_2)]$
- d.  $(KL/r) > [34 + (20M_1/M_2)]$

94. Determine the capacity of a 16" x 16" square column with 8- #10 bars, tied. Grade 40 steel and 4000 psi concrete.

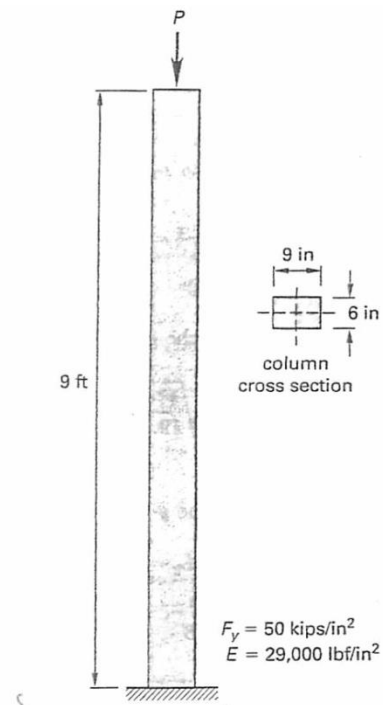


- a. 850 kips
- b. 900 kips
- c. 420 kips
- d. 646 kips

95. A short square tied column is to carry an axial dead load of 300 kip and a live load of 200 kip. The factored load is most nearly:

- a. 680 kips
- b. 400 kips
- c. 420 kips
- d. 390 kips

96. A solid **steel column** with a fixed bottom support and free upper end is concentrically loaded. Material and geometric properties are shown in the figure. The available axial compressive design stress is most nearly:



- a. 13 kips/in<sup>2</sup>
- b. 18 kips/in<sup>2</sup>
- c. 29 kips/in<sup>2</sup>
- d. 39 kips/in<sup>2</sup>

97. A steel column is built-in at one end and free to translate and rotate at the other end. The column uses a 12 ft long W12 X 45 beam. If the yield strength of the steel is 50 kips/in<sup>2</sup>, the available design stress in the column is most nearly:

- a. 7.3 kips/in<sup>2</sup>
- b. 9.7 kips/in<sup>2</sup>
- c. 10 kips/in<sup>2</sup>
- d. 9 kips/in<sup>2</sup>

98. **Using LRFD**, Select an ASTM A992 ( $F_y = 50$  ksi) W-shape column to carry an axial dead load of 140 kips and live load of 420 kips. The column is 30 ft long and is pinned top and bottom in both axes. Limit the column size to a nominal 14-in. shape.

- a. W14 X 132
- b. W 14 X 120
- c. W 14 X 110
- d. W14 X 90

99. Calculate the available strength of a W14×132 column with unbraced lengths of 30 ft in both axes. ASTM A992 ( $F_y = 50$  ksi;  $F_u = 65$  ksi;  $A_g = 38.8$  in<sup>2</sup>;  $r_x = 6.28$  in.;  $r_y = 3.76$  in.). To carry an axial dead load of 140 kips and live load of 420 kips. The column is 30 ft long and is pinned top and bottom in both axes. **Use LRFD.**

- a. 840 kips
- b. 750 kips
- c. 810 kips
- d. 892 kips

100. The available flexural strength of the W18 x 50 ASTM A992 beam **using LRFD** ( $F_y = 50$  ksi;  $F_u = 65$  ksi;  $Z_x = 101$  in<sup>3</sup>) is most nearly:

- a. 379 kip-ft
- b. 347 kip-ft
- c. 410 kip-ft
- d. 245 kip-ft