

CIVIL
ENGINEERING
REFRESHER
SERIES

MATHEMATICS, SURVEYING
AND TRANSPORTATION
ENGINEERING

ALGEBRA REFRESHER MODULE SET

Find the number of terms 5 , 8 , 11 ... of which sum is 1025.

- a. 20 b. 22 c. 24 d. 25

An engineering component has a mass of 400 g. If each of its dimensions are reduced by 30% , determine the new mass.

- a. 125.6 g b. 115.8 c. 158.7 d. 137.2

Twelve workmen employed on a building site earn between them, a total of P 2415 per week. Laborers are paid P 175 per week and craftsmen earn P 220 per week. How many craftsmen are employed?

- a. 5 b. 7 c. 6 d. 8

At what time after 12 noon will the minute hand and hour hand of a clock be on a straight line for the first time?

- a. 12:40.5 b. 12:27.8 c. 12:32.7 d. 12:16.1

The geometric mean of two numbers is 6 while the arithmetic mean is 4. Find the product of geometric and harmonic means.

- a. 24 b. 54 c. 16 d. 36

One liter of a 25% solution is mixed with 3 liters of a 40% solution. What is the percentage of sugar in the new mixture?

- a. 13.75% b. 36.25% c. 23.55% d. 44.35%

A is 8% taller than B , while B is 9% taller than C. By how much percent is A taller than C?

- a. 12.22% b. 13.86% c. 17.72% d. 19.04%

What is the sum of the roots of the equation $3x^2 - 4x + 6 = 0$?

- a. -4 b. 4 c. 4/3 d. -4/3

Find the 5th term of the expansion $(2 - x)^6$?

- a. $60x^5$ b. $12x^4$ c. $60x^4$ d. $12x^5$

Calculate the following sum:

$$\sum_{j=1}^5 [(j+1)^2 - 1]$$

- a. 76 b. 85 c. 90 d. 80

Find the nth term of the series 1, 4 , 7 , 10 , 13...

- a. $3n - 2$ b. $3n + 2$ c. $2n + 2$ d. $n + 2$

Solve for x: $7x = 4x + 12$

- a. 3 b. 4 c. 7 d. 10

The length of a triangle exceeds twice its width by 3 inches. If the area of the rectangle is 10 , calculate the measure of the width.

- a. 2.4 b. 2.1 c. 1.6 d. 1.3

One number is more than the another and the sum is 71. Find the larger number.

- a. 36 b. 31 c. 34 d. 38

The sum of the ages of the two brothers is 20. In five years, one is twice the another. Find the present ages of the two brothers.

- a. 5,15 b. 14,24 c. 8,18 d. 11,21

Simplify this radical:

$$\sqrt{\sqrt{16x^2}}$$

- a. 4x b. $2\sqrt{x}$ c. 2x d. $4\sqrt{x}$

Which of the following is NOT a perfect number?

- a. 6 b. 28 c. 496 d. 1000

Given that $x < y < 0 < w < z$, what is the sign of xyz/w ?

- a. Negative b. Positive c. Imaginary d. Cannot determine

Solve for x and y:

$$\frac{3}{x} - \frac{2}{y} = 14$$

$$\frac{6}{x} + \frac{3}{y} = -7$$

- a. $x = 3/4, y = 1/5$ b. $x = -3/4, y = 1/5$ c. $x = 3/4, y = -1/5$ d. $x = -3/4, y = -1/5$

The following are the zeros of this equation $x^3 - 3x^2 - 10x + 24$ EXCEPT:

- a. 2 b. 4 c. 3 d. -3

Solve for x:

$$\log_{0.2} x = -1$$

- a. 5 b. -5 c. 1/5 d. -1/5

Divide 60 into two parts with the ratio of 2:3.

- a. 30,30 b. 36,24 c. 15,45 d. 10,50

Find the value of x in $(3^5)(9^6) = 3^{2x}$

- a. 8.5 b. 9 c. 9.5 d. 8

Find the 2017th digit in the decimal equivalent of $2017/9999$.

- a. 2 b. 0 c. 1 d. 7

If $d = 1000 - 200q$ and $c = 4000 + 20d$, find c as a function of q.

- a. $24000 + 4000q$ b. $24000 - 4000q$ c. $-24000 + 4000q$ d. $-24000 - 4000q$

Eleven men can finish the job in 15 days. Five men were working at the start and after six days four men were added. How many days will it take to finish the job?

- a. 30 days b. 25 c. 21 d. 17

A grocer bought a number of items for P 1440. Later the price increased by P 2.00 per item and as a result he received 24 fewer items for the same amount. Find the number of items bought first.

- a. 150 b. 135 c. 162 d. 144

Every student at a particular technological institute is required to take preboard exams. A student who passes it will take Design and the other one who fails will take Hydraulics. In a batch of 1240 students there are more students took Hydraulics than Design. However if there are 30 more students who passed the preboard, each subject would have the same enrolment. How many students took Hydraulics?

- a. 700 b. 650 c. 600 d. 550

$\log M + \log N$ is equal to:

- a. $\log MN$ b. same c. $\log M/N$ d. $\log_m N$

Find the value of k so that the equation $4x^2 + kx + 9 = 0$ has one root equal to -3

- a. $k = 12$ b. $k = 15$ c. $k = 20$ d. $k = 24$

Find the constant term of the third term in the expansion of $(2x + y)^6$.

- a. 180 b. 225 c. 240 d. 300

Evaluate: $1/2 * 2/3 * \dots 2016/2017$

- a. 1 b. 0 c. $1/2017$ d. 2017

The value of e that is 2.71828... is called:

- a. Briggs' Number b. Pi c. Fermat's Number d. Napierian Number

Factor the following: $ax + ay - bx - by$

- a. (a+b)(x-y) b. (a-b)(x+y) c. (b-a)(x+y) d. (y-x)(a+b)

Which of the following is a palindromic number?

- a. 2017 b. 2002 c. 2010 d. 2000

Solve for x: $10^x + 10^{x+1} = 5^x + 5^{x+1} + 5^{x+2}$

- a. 1.2169 b. 1.3185 c. 1.4468 d. 1.4947

For a given function $f(t) = f(-t)$. What type of symmetry does $f(t)$ have?

- a. odd b. even c. rotational d. quarter-wave

Simplify: $(-54s)(-4/9)$

- a. $3s/2$ b. 24s c. 168s d. $9s/4$

Solve for x: $|x - 2| + 1 = x$

- a. $1/4$ b. $2/5$ c. $3/2$ d. $4/7$

The diameter of a tumor D in mm, t in days after diagnosis is given by

$$D(t) = 10e^{0.0277t}$$

How long until the diameter is doubled?

- a. 30 days b. 27 c. 25 d. 21

Klay Thompson left from Warriors game at past 3:00 pm as indicated in his watch. Between two to three hours later, he returned at Oracle Arena and he noticed that the hands of the watch interchanged. At what time did he left his home?

- a. 3:25.9 b. 3:27.6 c. 3:28.2 d. 3:31.5

SITUATION 1: Resolve into partial fraction of the following:

$$\frac{10x^2 + 9x - 7}{(x+2)(x^2-1)} = \frac{A}{x+2} + \frac{B}{x+1} + \frac{C}{x-1}$$

Compute the value of B.

- a. 5 b. 3 c. 2 d. 0

Compute the value of A.

- a. 5 b. 3 c. 2 d. 0

Compute the value of C.

- a. 5 b. 3 c. 2 d. 0

Find the remainder of $3x^3 - x^2 - 8x + 5$ when divided by $x + 2$

- a. 3 b. 6 7 d. -7

Find the summation of $(5K - 3)$ from $K = 1$ to $K = 16$.

- a. 632 b. 705 c. 790 d. 847

The power is required to operate a turbine varies directly as the cube of the speed. If $\frac{1}{2}$ horsepower will operate at a speed of 100 rev/min, how fast will 4 horsepower operate it?

- a. 125 rpm b. 200 c. 300 d. 450

Find the remainder if $5x^2 - 2x^3 + 3$ is divided by $x^2 - 4 - 2x$

- a. $6x + 7$ b. -7 c. 7 d. $-6x + 7$

Simplify: $(a-x)(b-x)\dots(z-x)$

- a. 1 b. ∞ c. 0 d. $a-z$

Consider the sequence 9, -3, 1... which term is $-1/243$?

- a. 7 b. 8 c. 9 d. None

PLANE AND SPHERICAL TRIGONOMETRY REFRESHER MODULE

The sum of the sides of the triangle ABC is equal to 400 m. $A = 38^\circ$, $B = 58^\circ$. Find the side AC in meters.

- a. 150 b. 123 c. 113 d. 138

A ship P sails at a steady speed of 45 kph in a W 32° N from a point. At the same time, another ship Q leaves the port at a steady speed of 35 kph in a direction N 15° E. Determine their distance apart after 4 hours.

- a. 193 km b. 205 c. 235 d. 176

What is the equivalent value of 630 degrees in centesimal system.

- a. 650 grads b. 630 c. 700 d. 315

SITUATION 1: The sides of the triangle are $a = 23.9$ m , $b = 36.3$ m. The angle opposite b is 102.7° .

Calculate the angle A.

- a. 32.55° b. 35.96° c. 41.05° d. 44.74°

Find the angle C.

- a. 37.34° b. 38.71° c. 33.19° d. 35.19°

Find the length of the side c in meters.

- a. 22.6 b. 37.5 c. 28.1 d. 30.2

Find the period of the function $y = 3 \cot \frac{1}{2} t$.

- a. π b. $\frac{1}{2} \pi$ c. 2π d. 0

In triangle DEF , $DE = 18$, $EF = 6$. The length FD must be:

- a. 12 b. 24 c. 13 d. None

SITUATION 2: You are given the trigonometric function $y = -2\sin(\pi t/4 + \pi/2)$,

Find the maximum displacement.

- a. 0.25 b. 2 c. π d. 0

Calculate the time required for one cycle.

- a. 2 b. 8 c. 0.5 d. 0.125

Calculate the phase shift of the function.

- a. 2 b. 8 c. -2 d. -8

If $\tan B = x / \sqrt{1-x^2}$, what is $\cos B$?

- a. 1 b. x c. $\sqrt{1-x^2}$ d. $1/x$

The perimeter of a triangle is 84 m while its area is 102 m^2 . Determine the diameter of the circle that may be inscribed in this triangle.

- a. 7.49 m b. 8.66 c. 4.86 d. 5.21

A car travels northward from point D for one hour, then northward for 30 mins., then shifted N 30° E. the bus constant speed is 64.7 km. directly away from D. how long in hours has it travelled?

- a. 30 mins b. 60 c. 120 d. 180

The angles of elevation of the top of the tower at two points 30 m and 80 from the foot of the tower, on a horizontal line, are complimentary. What is the height of the tower?

- a. 49 m b. 60 c. 55 d. 32

The perimeter of triangle ABC is 300 m , $A = 36^\circ$, $B = 58^\circ$ and $C = 86^\circ$. Determine the side opposite the biggest angle.

- a. 115 b. 107 c. 112 d. 123

The A-frame cabin is below 35 feet wide. The roof of the cabin makes a 55° angle with the cabin's base. Find the length of one side of the roof from its ground level.

- a. 30 feet b. 35 c. 50 d. 60

Solve this trigonometric equation: $2\cos x + \sec x = 3$.

- a. $\pi/2$ b. $3\pi/2$ c. $\pi/3$ d. $5\pi/4$

A river flows due south at 125 ft/min. A motorboat, moving at 475 ft/min in still water, is headed due east across the river. Find the direction in which the boat moves and its speed.

- a. N $75^\circ 20'$ E a. N $75^\circ 20'$ W a. S $75^\circ 20'$ E a. S $75^\circ 20'$ W

It is usually defined as the angle made by the ray drawn and it can be read from north or south.

- a. Depression b. Elevation c. Bearing d. None of these

SITUATION 3: Answer the following by converting from degrees to radians.

25°

- a. 1.3177 b. 0.3201 c. 0.2130 d. 0.4363

112° 40'
a. 1.9664 b. 0.3201 c. 2.7952 d. 1.6848

12° 12' 20"
a. 0.2130 b. 2.7925 c. 0.4520 d. 0.5423

How many triangles can be formed given $a = 31.5$, $b = 51.8$, and $A = 33^\circ 40'$.
a. 0 b. 1 c. 2 c. Cannot be determined

SITUATION 4: Two sides of the triangle are 50 and 60. The angle included is 30° .

Find the third side.
a. 21.75 b. 29.22 c. 30.06 d. 41.31

What is the interior angle opposite the longest side?
a. 84.33° b. 87.33° c. 90.16° d. 93.75°

If $\cot 2A = \tan 3A$, find the value of A in degrees.
a. 95 b. 18 c. 32 d. 64

SITUATION 5: Identify the quadrants of the following:

$\sin A < 0$ and $\tan A > 0$
a. I b. II c. III d. IV

$\sin A > 0$ and $\cot A > 0$
a. I b. II c. III d. IV

$\sec A < 0$ and $\csc A > 0$
a. I b. II c. III d. IV

Find the trigonometric function asked of certain angles in standard position of the given points are on the terminal side of the angles. The tangent function at (0,4).
a. 4 b. 0 c. infty c. -4

SITUATION 6: Given the cosine function equal to 60/61 ,

Find $\sin \theta$.
a. 61/11 b. 11/60 c. 61/60 d. 11/61

Find $\tan \theta$.
a. 61/11 b. 11/60 c. 61/60 d. 11/61

Find $\csc \theta$.
a. 61/11 b. 11/60 c. 61/60 d. 11/61

SITUATION 7: Solve the right spherical triangle given $c = 112^\circ 48'$ and $A = 56^\circ 11' 56''$.

Find the side a.
a. 40° b. 50° c. 75° d. 85°

Find the side b.
a. $127^\circ 4' 30''$ b. $147^\circ 30' 7'$ c. $177^\circ 7' 27''$ d. $137^\circ 3' 40''$

Find the angle B.
a. $115^\circ 33' 2''$ b. $133^\circ 50''$ c. $120^\circ 3' 50''$ d. $105^\circ 13' 20''$

At a certain place the sun is observed to rise exactly in the northeast point on the longest day of the year. Find the latitude of the place. Hint: When the sun rises in the northeast on the longest day of the year, $a = 45^\circ$ and $d = 23^\circ 27'$
a. 15° b. 32° c. 48° d. 56°

The principal value of the equation $\sin x = \cos x$ is:
a. 30° b. 45° c. 60° d. 90°

An isosceles triangle has an area of 46 m^2 . One side of the equal interior angle is 65.5° What is the perimeter of the triangle in meters?
a. 31.24 m b. 30.79 c. 28.66 d. 26.16

The Greenwich mean time of Manila is +8. What is the GMT of Tokyo?
a. -8 b. +8 c. -9 d. +9

These are angles whose sum is 360°

ANALYTIC GEOMETRY REFRESHER SET

Find the distance of the vertex curve $(x-2)^2 = 4y$ to the line $2x - 3y - 8 = 0$.

- a. 1.10 b. 1.35 c. 1.60 d. 1.95

There is a fixed circle having a radius of 5 with center at (4,8). Find the equation of the curve connecting the centers of all circles that are tangent to this fixed circle and the x-axis.

- a. $x^2 + 8x - 26y = 55$ c. $x^2 - 8x - 26y = 55$
b. $x^2 + 8x + 26y = 55$ d. $x^2 - 8x + 26y = 55$

What kind of symmetry, if any, does the graph of $y = x^2 - 16$ have?

- a. It is symmetrical with respect to x-axis.
b. It does not have any symmetry.
c. It is symmetrical with respect to y-axis
d. It is symmetrical with respect to both axes.

Compute the distance between the directrices of the curve $9x^2 - 25y^2 - 54x - 250y + 481 = 0$.

- a. 15 b. 12.5 c. 10 d. 7.5

A hyperbola has the equation $x^2 - 8x - 4y^2 + 64y = 256$, find the center of hyperbola.

- a. (8,4) b. (-8,4) c. (4,8) d. (-4,8)

Two lines are represented by the equations $-1/2 y = 6x + 10$ and $y = mx$. Find the value of m such that the lines will be parallel.

- a. 12 b. -12 c. 6 d. -6

Find the locus of a point the sum of the squares of whose distances from (2,3) and (-1,-2) is 34.

- a. $x^2 + y^2 - x - y - 8 = 0$ c. $x^2 + y^2 + x + y - 8 = 0$
b. $x^2 + y^2 + x - y - 8 = 0$ d. $x^2 + y^2 - x + y - 8 = 0$

Find the radius of the circle passing through the points (3,8) , (9,6) , and (13,-2)

- a. 9 b. 10 c. 12 d. 6

An ellipse has an equation of $9x^2 + 16y^2 = 144$.

- a. 1.01 b. 1.11 c. 1.18 d. 1.27

In a three dimensional space using an xyz coordinate system, a line is connected between (0,0,7) and (4,1,0). Determine the length of the line.

- a. 8.12 b. 9.27 c. 6.30 d. 7.42

What is the equation of the line passing through the points of intersection of the curves $x^2 + y^2 + 12x + 6y + 9 = 0$ and $x^2 + y^2 + 18x - 4y + 21 = 0$?

- a. $-3x + 5y + 6 = 0$ c. $3x - 5y + 6 = 0$
b. $3x - 5y + 6 = 0$ d. $-3x - 5y + 6 = 0$

Using polar coordinates, a point is at $(7, 38^\circ)$. Find the rectangular coordinates.

- a. (4.7, 5.2) b. (6.4, 3.9) c. (5.5, 4.3) d. (6.2, 4.0)

*ECE BOARD Determine B such that $3x + 2y - 7 = 0$ is perpendicular to $2x - By + 2 = 0$.

- a. 5 b. 4 c. 3 d. 2

Find the area of the triangle which the line $2x - 3y + 6 = 0$ forms with the coordinate axis.

- a. 3 b. 4 c. 5 d. 2

What is the slope of the line which is defined by the equation $4y = 3x + 16$.

- a. 16 b. 0.75 c. 3 d. 4

Find the equation of the plane through (2,1,-3) parallel to the plane $3x+4y+z=4$?

- a. $3x - 4y - z = 2$ b. $3x + 4y + z = 7$ c. $3x + 4y + z = -7$ d. $3x + 4y + z = 2$

SITUATION 1: The equation of the plane passing thru points (5,4,1) , (4,-2,-3) and (0,6,5) is expressed as $x/A + y/B + z/C = 1$.

Find the value of B.

- a. -2/3 b. -1/3 c. 2/3 d. 1/3

Find the value of C.

- a. 1/2 b. 1/3 c. -1/2 d. -1/3

Find the equation of the plane.

- a. $2x - 3y + 4z = -2$ b. $-2x + 3y + 4z = -2$ c. $2x - 3y + 4z = 2$ d. $2x + 3y - 4z = 2$

Find the circumference bounded by the curve $x^2 - 10x + y^2 + 10y + 25 = 0$

- a. 10π b. 25π c. 5π d. 125π

He completed the solution of the locus of a circle.

- a. Hipparchus b. Euclid c. Appolonius d. Pythagoras

How many points of intersection between the curve $x^2 - 4y^2 + 2x + 8y + 1 = 0$ and the line $2y = x + 3$.

- a. 0 b. 1 c. 2 d. Cannot be determined

SITUATION 2: For the curve $4x^2 - 4y^2 - 32x + 16y + 39 = 0$,

Find the center.

- a. (4,1) b. (4,2) c. (2,4) d. (1,4)

Find the equation of the principal axis.

- a. $x = 2$ b. $y = 2$ c. $x = -2$ d. $y = -2$

The following curve is classified as:

- a. Hyperbola b. Ellipse c. Parabola d. Circle

The points (3,1), (5,2), (15,5), and (17,6) is formed in a shape of :

- a. Parallelogram b. Trapezoid c. Rectangle d. Kite

Find the y coordinate of latus rectum points of the curve $x = y^2 - 8y$.

- a. $7/2$ b. $9/2$ c. Both d. None

Find the x-coordinate of the focus of the curve $x^2 = -12y$.

- a. 0 b. 12 c. 3 d. -4

Determine the length of the latus rectum of the curve $r = 4/(1-\sin\theta)$.

- a. 4 b. 16 c. 0 d. 8

A surface whose equation is of the second degree is called:

- a. Plane Surface b. Linear Surface c. Quadric Surface d. Polar Surface

A moving point is equidistant from the point (a,0,0) and the line $x + a = 0, y = 0$. Find the value of z^2 .

- a. 0 b. $4ay$ c. $4ax$ d. $4az$

The following possible parametric equations EXCEPT:

- a. $x = t$ b. $y = t + 6$ c. $x = t + 1$ d. $y = t^2 + 2t + 7$

Find the line tangent of $y^2 = -3x$ at P(-1,-2).

- a. $x - 2y = 3$ b. $3x - y = 2$ c. $2x + 3y = -1$ d. $x + 2y = 3$

State the quadrant in which the coordinate (15,-2) lies.

- a. I b. II c. III d. IV

Given the equation of the parabola $y^2 - 8x - 4y - 20 = 0$, Find the length of latus rectum.

- a. 2 b. 4 c. 6 d. 8

If the distance between points (2,9,4) and (2,9,z) is 10, what is the value of z?

- a. -6 b. 6 c. ± 6 d. None

If two points in the single dimensional coordinate have coordinates 1 and 7, what is the coordinate of a point on the line in which is twice as far as 1 as from 7?

- a. 3 b. 4 c. 5 d. 6

Find the eccentricity of the ellipse having an equation of $4x^2 + 9y^2 = 13$.

- a. 2 b. 3 c. 0.75 d. 0.55

Find the equation of the diameter of the ellipse $4x^2 + y^2 = 16$ which all bisects all chords having equal slope of $1/2$.

- a. $8x + y = 0$ b. $x + 8y = 0$ c. Both d. None

What is the angle in degrees between the line $3x - 2y - 4 = 0$ and the x-axis?

- a. 22.5° b. 38.7° c. 56.3° d. 74.5°

What is the center of the conic in the curve $xy - x + 2y + 3 = 0$?

- a. (2,1) b. (-2,1) c. (2,-1) d. (-1,-2)

Find the equation of the asymptote in the curve $2xy = x^2 + 3$.

- a. $x = 2$ b. $y = 2$ c. $x = 0$ d. $y = 0$

Determine the cylindrical coordinates of the point whose rectangular coordinate is $(16/5, 12/5, 3)$.

- a. $(-4, -36.87^\circ, 3)$ b. $(4, 36.87^\circ, 3)$ c. $(5, 53.13^\circ, 4)$ d. $(5, 53.13^\circ, 4)$

How far from the x-axis is the focus of the hyperbola $x^2 - 2y^2 + 4x + 4y + 4 = 0$?

- a. 1.57 b. 2.73 c. 3.12 d. 5.01

The corners of a quadrilateral are $(4,0)$, $(12,4)$, $(10,8)$ and $(4,4)$. How far is the centroid from the y-axis?

- a. 6.22 b. 6.87 c. 7.26 d. 7.68

The segment from $(-1,4)$ to $(2,-2)$ is extended three times its own length. Determine the terminal point?

- a. $(11, -20)$ b. $(-18, 12)$ c. $(-16, -8)$ d. $(7, 19)$

Find the distance from the point $(2,3)$ to the line $3x + 4y + 9 = 0$.

- a. 2.7 b. 2.4 c. 5.4 d. 6.8

SITUATION 3: A circle is described algebraically by the equation $x^2 + y^2 - 6x + 8y + 21 = 0$.

Determine the center of the circle.

- a. $(3, -4)$ b. $(-4, 3)$ c. $(-3, 4)$ d. $(-3, -4)$

Find the perimeter of the circle.

- a. 2π b. 3π c. 6π d. 4π

Find the area of the circle.

- a. 2π b. 3π c. 6π d. 4π

PLANE AND SOLID GEOMETRY REFRESHER SET

The surface area of an open cylinder tank is 68 sq m. If the diameter is $\frac{2}{3}$ of its height, compute the height of the tank.

- a. 5.58 m b. 5.28 c. 5.15 d. 4.97

Find the volume of a cone to be constructed from a sector having a diameter of 72 cm and a central angle of 210°

- a. 11450 b. 13500 c. 15510 d. 12270

A 4.2 by 4.2 square pyramid with a lateral edge of 15 cm. What is the volume?

- a. 86.44 sq cm b. 87.17 c. 90.64 d. 93.78

A sphere has a volume of 2000 cu m. There exist a small circle of the sphere, the plane of which is 6.5 m from the center. Calculate the area of the small circle in m sq.

- a. 52 b. 59 c. 63 d. 68

A man cycles 24 km due south and then 20 km due east. Another man, standing at the same time as the first man cycles 32 km due east and 7 km due south. Find the distance between the two men.

- a. 20.81 km b. 25.12 c. 22.12 d. 16.57

One edge of regular hexahedron is 24 cm long. Find the ratio of its volume to its surface area.

- a. 0.5 b. 4 c. 0.125 d. 2

Find the volume of the regular polyhedron with an edge of 3 m.

- a. 5.74 m^3 b. 6.18 c. 3.18 d. 7.33

Star shaped figures are known as :

- a. Polygon b. Polyhedron c. Stars d. Polygrams

A piece of thin card board in the form of a sector of a circle of radius 36 cm is rolled into a cone. Find the volume of the cone if the angle of the sector is 45° .

- a. 780.45 b. 764.19 c. 757.50 d. 742.13

A right circular cone has a base radius of x and altitude of $3x$, what is the slant height?

- a. $3.16x$ b. $2.57x$ c. $6.19x$ d. $4.89x$

A spherical ball with a radius of 14 cm was dropped on a cone with a depth of 20 cm. Find the height from the base of the cone to the point of tangency of the ball and the cone.

- a. 16.31 cm b. 15.74 c. 14.55 d. 13.84

SITUATION 1: Imagine a cube to measure 5 units per edge and to have its total surface area painted yellow.

How many times you must cut completely through the cube to make cubes which measure 1 unit on an edge?

- a. 15 b. 25 c. 12 d. 125

How many cubes have one yellow face?

- a. 8 b. 36 c. 54 d. 27

How many cube are in all?

- a. 125 b. 75 c. 25 d. 100

A light is placed 5 m from the center of a giant globe 3 m in diameter, what will be the length of the wire?

- a. 9 m b. 10 c. 12 d. 15

An angle included by a tangent and a chord drawn from the point of contact is measured by _____ the intercepted arc?

- a. doubled b. same c. third d. half

A place hillside is inclined at an angle of 28° with the horizontal. A man wearing skis can climb hillside by following a straight path inclined at an angle of 12° to the horizontal, but one without skis must follow a path inclined with the horizontal. Find the angle between the directions of the two paths.

- a. $19^\circ 48'$ b. $11^\circ 16'$ c. $15^\circ 35'$ d. $17^\circ 46'$

A large steel buoy consists of a spherical segment and a cone having a common base of 3 m. The altitude of the segment is 2 m and that of the cone is 6 m. Find the total surface of the buoy.

- a. 114.91 sq m b. 104.06 c. 115.71 d. 100.32

What is the area of the decagon inscribed in a circle that has an area of 412 sq m.

- a. 385.4 sq m b. 406.12 c. 371.18 d. 421.15

A pyramid 20 cm high is divided into three parts by two planes parallel to the base. These planes are at distances 4 and 12 cm from the vertex. Determine the ratio of the smallest part to the largest part.
a. 0.102 b. 0.265 c. 0.038 d. 0.037

The areas of the faces of the rectangular box are 8, 12, and 16. Determine the volume.
a. 42.12 b. 39.19 c. 16.72 d. 54.33

In 2014, Ms Sisippi bought two lots at P9.6 million each. One lot contains 40 sq m more than the other but costs P 12,000 per sq m. Find the area of the smaller lot.
a. 140 b. 160 c. 180 d. 200

The sides of a rectangle are in the ratio 3:5. Given that the area of the rectangle is 60 sq units, what is the length of the diagonal of the rectangle?
a. 6 b. 5 c. 8 d. 7

The lateral area of the right circular cone is 40π sq cm. The base radius is 4 m. What is the slant height?
a. 15 b. 20 c. 10 d. 5

A trough having an equilateral triangle end sections has sides equal to 0.45 m. If the trough is full of water with a volume of 1 m^3 , find the length of the trough?
a. 12.15 b. 13.81 c. 10.66 d. 11.40

Find the number of sides a polygon has if the sum of the measures of the interior angle is 3600° ?
a. 20 b. 22 c. 19 d. 15

Points A, B, and P are points on a circle. TA and TB are tangents to the circle with A and B as points of tangency. The angle between the tangents angle $ATB = 50^\circ$. Find the angle APB if P is farther from the point T than A and B.
a. 65° b. 130° c. 50° d. 25°

For any cyclic quadrilateral, the product of the diagonals equals the sum of the products of the opposite sides.
a. British Flag Theorem c. Pythagorean Theorem
b. Vieta's Theorem d. Ptolemy's Theorem

A rectangular parallelepiped whose length is 4 m and 5 m and the altitude is 6 m. What is the area of the cross section of the opposite edges of the parallelepiped?
a. 39.77 b. 38.42 c. 30.16 d. 34.54

The difference between the radii of the circumscribing and the inscribed circle of a hexagon is 1.60 cm. Determine the area of the hexagon.
a. 370.41 b. 380.52 c. 390.64 d. 400.77

Three identical circles are tangent to one another. The radius is 20 cm. Find the area enclosed by the three circles but outside each of the three circles in sq cm.
a. 74.3 b. 82.1 c. 64.5 d. 50.7

SITUATION 2: Identify the number of sides if it is a polygon and the number of faces if it is a polyhedron.

Triskaidecagon
a. 15 b. 30 c. 13 d. 17

Hexahedron
a. 6 b. 12 c. 60 d. 24

Chilliagon
a. 10 b. 10,000 c. 1,000 d. 100

A conoid has a circular base of radius 25 cm and an altitude of 30 cm. Find the volume.
a. 32,457 cc b. 29452 c. 24,486 d. 18,453

A lateral edge of the frustum of a regular pyramid is 1.8 m long. The upper base is a square 1 m x 1 m and the lower base 2.4 m x 2.4 m square. Determine the volume of the frustum in cu m.
a. 4.6 b. 3.3 c. 5.7 d. 6.5

A circle has a circumference that is numerically equal to the area. If a certain square has the same area as the circle, what would be the length of the side?
a. $3\sqrt{\pi}$ b. $\pi\sqrt{3}$ c. $\pi\sqrt{2}$ d. $2\sqrt{\pi}$

What is the area of the rhombus whose diagonals are 12 and 24?
a. 144 b. 164 c. 108 d. 132

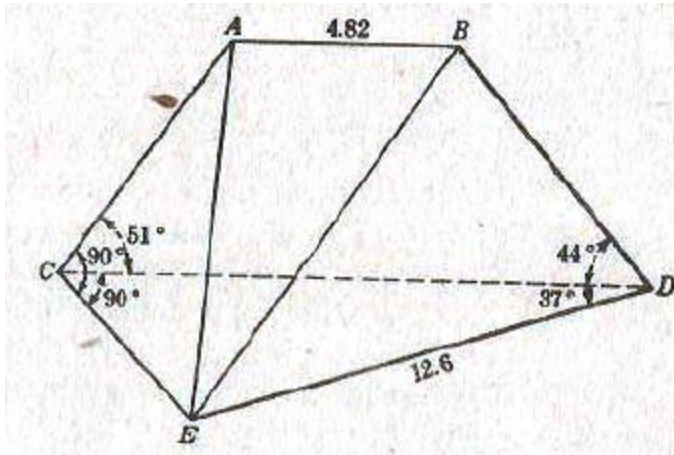
Three circles of radii 110, 140, and 220 are tangent to one another. What is the area of the triangle formed by joining the centers of the circles?

- a. 39,904 b. 25,476 c. 32,804 d. 47,124

Christmas balls $1\frac{1}{2}$ cm in diameter are packed in a box measuring 6 cm by 3 cm by 3 cm. If as many balls as possible are packed in the box, how much free space remained?

- a. 34.18 cc b. 21.34 c. 25.73 d. 18.85

The big block of granite shown in the figure has as lower base the horizontal triangle CDE. The upper edge AB is horizontal and point D lies in the plane ABC. Find the volume.



- a. 39.60 cu m b. 44.72 c. 53.5 d. 80.71

A cube of iceberg is 2 m by 2 m by 2 m. On a summer day, ice melts until it becomes a cube which is one half as heavy as the original. Calculate the edge of the new cube.

- 1.8425 m b. 1.9213 c. 1.7655 d. 1.5874

How long a wire 0.1 inch in diameter can be drawn from a block of copper $2 \times 4 \times 6$ in?

- a. 357.16 ft b. 509.30 c. 618.64 d. 472.39

A swimming pool is constructed in the shape of two partially overlapping identical circles. Each of the circles has a radius of 9 m and each circle passes through the center of the other. Find the area of the pool.

- a. 380 sq m b. 390 c. 400 d. 410

The angle subtended by an arc is 24° . If the radius of the circle is 45 cm, find the length of the arc.

- a. 19.33 b. 18.85 c. 17.54 d. 21.32

An ice cream cone is filled with ice cream and a surmounted ice cream in the form of a hemisphere on top of the cone. If the hemispherical surface is equal to the lateral area of the cone, find the total volume in cu in of ice cream if the radius of the hemisphere is equal to 1 inch and assuming the diameter of the hemisphere is equal to the diameter of the cone.

- a. 3.45 b. 3.91 c. 4.12 d. 4.25

Each side of the cube is increased by 1%. By what percent is the volume of the cube increased?

- a. 1.21 b. 2.8 c. 3.03 d. 3.5

SITUATION 3: An upper spherical segment with single base has a height of 2 cm. If the base radius is 4 cm,

Find the radius of the sphere.

- a. 7 cm b. 11 c. 5 d. 9

Compute the surface area of the spherical segment.

- a. 77.34 b. 80.16 c. 62.83 d. 80.59

Find the volume of the lower spherical segment.

- a. 447.83 b. 388.17 c. 409.12 d. 469.14

DIFFERENTIAL CALCULUS REFRESHER SET

A water tank has the form of a frustum of a cone with diameters of 2 m at the bottom , 3 m at the top and a height of 2 m. With a constant rate of inflow of water it was observed that when water was 20 cm deep , water was rising at the rate of 15mm/min. Find the rate of flow in L/min?

a. 1.75 b. 1.95 c. 2.15 d. 2.25

A body is projected vertically upward such that its height from the ground in feet is $h = 50t - 16.1t^2$ where t = time in flight in seconds. After how many seconds will the velocity be 12 fps?

a. 1.18 b. 0.88 c. 0.75 d. 1.16

Find the derivative of 3^{3x} .

a. $-\ln 3x$ c. $3\ln 3 \cdot 3^{3x}$
b. $\ln 3x$ d. $-3\ln 3 \cdot 3^{3x}$

Find the derivative of $2 \cos (2 + x^3)$

a. $6 \sin (2 + x^3)$ c. $-6x^2 \sin (2 + x^3)$
b. $-6 \sin (2 + x^3)$ d. $6x^2 \sin (2 + x^3)$

A ferris wheel has a radius of 10 m. Its center is 12 m above the ground. When a passenger is 17 m above the ground he is moving vertically at the rate of 1.81 m/s. What is the speed of the rotation of the wheel in rpm?

a. 5 b. 7 c. 4 d. 2

Find the limit of $\sin \phi / \phi$ as ϕ approaches 0° .

a. ∞ b. 1 c. 0 d. -1

What is the slope of the curve at $y = e^{4x}$ at the point when $x = 0$?

a. 4 b. 0 c. 1 d. -4

What is the curvature of curve $y^2 = 16x$ at the point (4,8)?

a. -0.029 b. -0.044 c. -0.057 d. -0.064

The sum of the two numbers is S. What is the maximum value of the sum of their cubes?

a. $3S/4$ b. $S^4/3$ c. $S^3/4$ d. $4S/3$

Determine the slope of the curve $y = (1-2x)^2/x$ at (1,1).

a. -2 b. 2 c. -3 d. 3

SITUATION 1: Let $y = \sqrt{1 + 3x}$.

Determine the value of x on the graph where the normal line is parallel to the line $4x + 3y = 1$

a. -1 b. 3 c. 0 d. 1

Determine the value of y on the graph where the normal line is parallel to the line $4x + 3y = 1$

a. 2 b. -1/3 c. -2 d. -1

Find the absolute extrema on $y = e^{\sin x}$ on $[-\pi, \pi]$

a. e b. -e c. π d. $-\pi$

Determine the slope of $y = x + 1/x$ at $x = 2$.

a. 0.65 b. 0.81 c. 0.75 d. 0.40

The following are transcendental functions EXCEPT:

a. Exponential b. Hyperbolic c. Trigonometric d. Algebraic

If $f(x,y) = (x - y)/(x + y)$, find $\partial f / \partial x$ at (2,1) using partial differentiation.

a. 5 b. -2 c. 0 d. 3

SITUATION 2: Compute the value of x using Newton's Approximation.

$x^3 - 2x^2 - 2x - 7 = 0$

a. 4.479 b. 1.044 c. 3.981 d. 3.268

$5\sin x = 4x$

a. 0.654 b. 1.687 c. 1.131 d. 1.322

Find the equation of the normal line to the graph $y = x \ln x$ that is perpendicular to the line $x - y + 7 = 0$.

a. $x + y = 1$ b. $x - y = 1$ c. $x + y = -1$ d. $x - y = -1$

SITUATION 3: A square of side x cm has area $A(x)$ cm^2 .

Find the rate of change of A as x changes from 4 to 4.6.

- a. 6.4 b. 8.6 c. 7.5 d. 6.0

Find the rate of change of A as x changes from 4 to 4.05.

- a. 8.32 b. 8.25 c. 8.10 d. 8.05

Find the instantaneous rate of change when $x = 4$.

- a. 12 b. 10 c. 8 d. 6

A cardboard poster containing 32 cm^2 of printed region is to have a margin of 2 cm at the top and bottom and 1.333 cm at the sides. Find the length of the smallest piece of cardboard that can be used to make the poster.

- a. 15.7 cm b. 12.4 c. 10.9 d. 8.8

The perimeter of a triangle is 15.96 cm. Find the maximum area of the triangle in sq cm.

- a. 17.1 b. 12.3 c. 12.6 d. 14.8

Find the point of inflection of the curve $y = x^3 - 6x^2 - x + 12$.

- a. (2,6) b. (-2,6) c. (2,-6) d. (-2,-6)

A cylindrical steam boiler is to have a volume of 1340 cu ft. The cost of the metal sheets to make boiler should be a minimum. What is the required base diameter in feet?

- a. 13.64 b. 18.46 c. 12.31 d. 11.95

SITUATION 4: A closed cylindrical tank has a capacity of 576.56 cu m.

Determine the required radius of the tank.

- a. 8.77 b. 7.12 c. 4.51 d. 6.54

Determine the required height of the tank.

- a. 9.02 b. 4.79 c. 11.64 d. 10.78

Determine the surface area at a minimum.

- a. 396.12 b. 478.64 c. 219.97 d. 383.40

If $f(x) = x(2^x)$, then $f'(x)$ is equal to:

- a. $2^x (\ln 2 + 1)$ c. $2^x (x \ln 2 + 1)$
b. $2^x (2 \ln 2 + x)$ d. $2^x (2x \ln x + 1)$

A point moves in the plane according to equations $x = t^3 + 2t$ and $y = 2t^3 - 6t$. Find dy/dx at $t = 0$.

- a. 6 b. -6 c. 3 d. -3

The time rate of change of the radius is constant for a given sphere. The time rate of change of the volume is:

- a. increasing
b. decreasing
c. increasing when $r > 1$ and decreasing when $r < 1$
d. decreasing when $r > 1$ and increasing when $r < 1$

What is the first derivative with respect to x of the function $g(x) = 4\sqrt[3]{x}$?

- a. 0 b. $4/9$ c. 4 d. 12

SITUATION 5: The sum of the two nonnegative numbers is 36.

Find the difference of their square roots is to be as large as possible.

- 18 b. 0 c. 36 d. 25

Find the sum of their square roots is to be as large as possible.

- a. 18 b. 0 c. 36 d. 25

SITUATION 6: Suppose that the cost of producing x washing machines is $c(x) = 2000 + 100x - 0.1x^2$.

Find the average cost per washing machine of producing the first 100 washing machines.

- a. 125 b. 110 c. 150 d. 175

Find the marginal cost when 100 washing machines are produced.

- a. 100 b. 90 c. 80 d. 70

Find the cost of producing the 101st washing machine.

- a. 81.20 b. 80.60 c. 79.90 d. 75.60

Find the function $f(x)$ whose derivatives is $\sin x$ and whose graph passes through the point (0,2).

- a. $f(x) = \cos x + 3$ c. $f(x) = \cos x - 3$
c. $f(x) = -\cos x - 3$ d. $f(x) = -\cos x + 3$

Which of the following is a solution of the equation $x^4 + x - 3 = 0$ using Newton's approximation.
a. 1.8659 b. -1.8659 c. 1.6452 d. -1.645

SITUATION 7: Given the curve $y = x^3 - 4x + 1$,

Find the equation of the line perpendicular to that curve at (2,1)
a. $8y = x + 10$ b. $8y = -x + 10$ c. $8y = x - 10$ d. $8y = -x - 10$

At what point on the curve have the smallest slope?
a. (0,1) b. (1,0) c. (-4,0) d. (0,4)

Find the equation of the tangent at the points where the slope of the curve is 8.
a. $y = -8x + 17$ b. $y = -8x - 17$ c. $y = 8x + 17$ d. $y = 8x - 17$

Find the derivative of $y = \log_a 4x$.
a. $y' = \log_a e / x$ b. $y' = \cos e/x$ c. $y' = \sin e/x$ d. $\tan e/x$

A spherical balloon is inflated with gas at the rate of 20 cu m per min. How fast is the radius of the balloon changing at the instant if the radius is 2 cm?
a. 0.633 b. 0.398 c. 0.517 d. 0.314

Find the y coordinate of the center of curvature of the parabola at (2,2).
a. 7 b. -7 c. -6 d. 6

Find dy/dx using implicit differentiation at (0,-2) if $x^3 - xy + y^2 = 4$.
a. 0.667 b. 0.8 c. -0.333 d. 0.5

An MRT train 6 m above the ground crosses Quezon Avenue at a speed of 9 m/s, at the instant that a car approaching at a speed of 4 m/s is 12 m up the street. Find the rate of the MRT train and the car are separating one second later.
a. 9.85 m/s b. 4.17 c. 3.64 d. 4.18

What is the allowable error in measuring the edge of the cube that is intended to hold 8 cu m if the error of the computed volume is not to exceed 0.03 cu m?
a. 0.002 b. 0.003 c. 0.0025 d. 0.001

A man 1.8 m tall walks away from a lamp post 4 m high at a speed of 1.5 m/s. How fast in m/s does his shadow lengthen ?
a. 1.17 b. 1.23 c. 1.64 d. 1.07

INTEGRAL CALCULUS REFRESHER SET

Find the area bounded by the curves $x^2 = y$ and $y^2 = x$.

- a. 0.5 b. 0.667 c. 0.25 d. 0.333

Determine the radius of gyration of the area into the first quadrant bounded by the line $y = 0$, $x = 3$ and the curve $x^2 = 3y$ with respect to y axis.

- a. 4.77 b. 3.88 c. 3.07 d. 2.32

Evaluate the following:

$$\int_0^2 \int_0^{2y} x^2 dx dy$$

- a. 15.7 b. 10.7 c. 11.6 d. 9.8

Evaluate the integral of $24 dx / (5 + 3x^2)$ from $x = 0$ to $x = 1$.

- a. 21.27 b. 19.65 c. 31.18 d. 44.72

A plate in the form of a parabolic segment of base 12 m and a height of 4 m so that the base is in the surface of the liquid. Find the force on a face of the plate.

- a. 566.9 kN b. 318.6 c. 447.6 d. 502.2

Calculate the definite integral of $x^2 + 4x$ as x approaches from 1 to 3.

- a. 74/5 b. 74/3 c. 74/7 d. 74/9

Calculate the area of the region to the left of parabola $x = 2y^2$, to the right of the y - axis , and between $y = 1$ and $y = 3$.

- a. 54/7 b. 55/6 c. 52/3 d. 50/11

The solid has a base which is a circle of radius r . Each cross section perpendicular to a fixed diameter of the circle is an isosceles triangle with altitude equal to one half of its base. Determine the volume of the given solid using cross section method.

- a. $4r^3/3$ b. $4r/3$ c. $4r^3$ d. $4\pi r^3$

Find the area under the arch of $y = \sin x$ between $x = 0$ and $x = \pi$.

- a. -1 b. 0 c. π d. 2

Evaluate this following integral:

$$\int_1^2 \frac{x}{3x^2 - 2} dx.$$

- a. 0.188 b. 0.384 c. 0.447 d. 0.516

Find the Archimedean spiral $r = \theta$ from $\theta = 0$ and $\theta = 2\pi$.

- a. $4\pi/3$ b. $4\pi^3$ c. $4\pi^3 / 3$ d. $4/3\pi$

Determine the following definite integral:

$$\int_0^1 \frac{x}{(2x^2 + 1)^3} dx$$

- a. 1/7 b. 2/5 c. 3/8 d. 1/9

Let R be the region bounded by the curve $y = \ln x / x$, the x - axis , and the line $x = e$. Find the area of this region.

- a. 0.8 b. 0.5 c. 1.0 d. 0

This method is used in calculating volume generated by the function using the cylindrical nature of the vertical lines of revolution.

- a. Pappus 2nd Theorem b. Disk Method c. Shell Method d. None

Evaluate the following integral:

$$\int_0^{\pi} \sin \phi \, d\phi$$

- a. 2 b. 0 c. -1 d. $\sqrt{3}/2$

A one horsepower motor can do 550 ft lb of work per second. If a 0.1 hp motor is used to pump water from a full tank in the shape of a rectangular parallelepiped 2 ft deep, 2 feet wide, and 6 ft long to a point 5 ft above the top of the tank, how long will it take in terms of ω sec? Omega indicates unit weight of water.

- a. 0.185 b. 0.262 c. 0.344 d. 0.418

Evaluate this definite integral:

$$\int_{-1}^7 \frac{x^2 \, dx}{\sqrt{x+2}}$$

- a. 652/15 b. 661/17 c. 640/21 d. 598/12

Find the area bounded by the curves $y^2 = x$ and $x + y = 2$.

- a. 3.6 b. 4.0 c. 4.5 d. 5.0

Find the integral of $x \sin 2x \, dx$.

- a. $-x/4 \cos 2x + 1/2 \sin 2x + C$ c. $x/4 \cos 2x - 1/2 \sin 2x + C$
b. $-x/2 \cos 2x - 1/4 \sin 2x + C$ d. $-x/2 \cos 2x + 1/4 \sin 2x + C$

Find the surface area generated by rotating the first quadrant portion of the curve $x^2 = 16 - 8y$ about the y-axis.

- a. 58.41 b. 64.25 c. 61.27 d. 66.38

Evaluate the integral of $\cos^7 3x \, dx$ with limits from 0 to $\pi/6$.

- a. 0.417 b. 0.304 c. 0.152 d. 0.218

The marginal cost function for a particular commodity is given by $C'(x) = 6x - 17$. If the cost of producing 2 units is P 25, find the total cost function using second fundamental theorem of calculus.

- a. $C = 3x^2 + 17x + 47$ c. $C = -3x^2 + 17x - 47$
b. $C = 3x^2 + 17$ d. $C = 3x^2 - 17x + 47$

The region bounded by the curve $y = \tan x$, the line $x = 1/3 \pi$, and the x-axis is revolved about the x axis. Find the volume of the solid generated.

- a. 2.655 b. 2.152 c. 3.074 d. 2.899

Calculate this integral:

$$\int_1^2 \frac{x+2}{(x+1)^2} \, dx$$

- a. 0.572 b. 0.886 c. 0.611 d. 0.478

A force of 500 lb is required to compress a spring whose natural length is 10 in to a length of 9 in. Find the work done to compress the spring to a length of 8 in.

- a. 900 in-lb b. 1000 c. 1500 d. 1800

Evaluate this indefinite integral:

$$\int \frac{dx}{x^2 - 4}$$

- a. $1/4 \ln [(x-2)/(x-4)] + C$ c. $1/4 \ln [(x+2)/(x-4)] + C$
b. $1/4 \ln [(x+2)/(x-2)] + C$ d. $1/4 \ln [(x-2)/(x+2)] + C$

Find the area bounded by $y = 2/(x-2)$, the x axis, $x = 4$, and $x = 5$.

- a. 1.677 b. 1.120 c. 1.386 d. 1.519

SITUATION 1: The expressions below are the components of the acceleration from $t = 0$ to $t = 10$ seconds.

$$a_x = 0.8t$$

$$a_y = 2 - 0.3t$$

$$a_z = 5$$

Compute the distance along x component.

a. 200 m

b. 133.33

c. 169.50

d. 233.33

Compute the velocity along y component.

a. 5 m/s

b. 6.67

c. 10

d. 12

Compute the magnitude of the distance travelled.

a. 312.65

b. 318.54

c. 244.25

d. 287.71

Evaluate this integral:

$$\int_0^{\frac{\pi}{2}} \frac{\cos \theta d\theta}{1 + \sin^2 \theta}$$

a. 2

b. 0

c. 1/2

d. $\pi/4$

A point describes a plane curve, the components of its velocity at the time being $v_x = 5$, $v_y = 24 - 32t$. Find the distance of the point from its original position at the end of 2 seconds.

a. 11.9 ft

b. 18.9

c. 15.7

d. 13.6

Evaluate the integral of $x dx / \sqrt{3+x}$ with the limits from 1 to 6.

a. 20/3

b. 21/5

c. 17/9

d. 12/7

Find the smallest area bounded by the curves $y = \sin x$, $\sin(x/2)$ on the first quadrant only.

a. 1.5

b. 1.2

c. 1.7

d. 2.4

SITUATION 2: Using integration,

Find the moment of inertia with respect to x axis of the area bounded in the first quadrant bounded by the parabola $y^2 = 4x$, the line $x = 1$ and the x axis.

a. 1.15

b. 1.07

c. 0.89

d. 0.76

Find the moment of inertia with respect to y axis of the area bounded in the first quadrant bounded by the parabola $y^2 = 4x$, the line $x = 1$ and the x axis.

a. 0.19

b. 0.33

c. 0.40

d. 0.57

Find the integral of $\cos(\ln x) dx/x$ from $x = 0$ to $x = 3$.

a. 0.55

b. 0.71

c. 0.89

d. 1.07

It is known when $f(x) = 4$ when $x = 2$. What is the value of $f(x)$ when $x = 0$?

a. 2

b. 8

c. 6

d. 0

Determine the area bounded by the curve $y^2 = 9x/5$ and the line $y = x - 2$.

a. 6.86

b. 5.75

c. 9.39

d. 8.78

Find the area bounded by the curves $y = 3x^2 - 2x$ and $y = 1 - 4x$.

a. 55/16

b. 32/27

c. 34/19

d. 44/23

Find the area bounded by the curve $y = 4 / (x^2 + 4)$, the x axis, the vertical line $x = -2$ and $x = 2$.

a. 2

b. 0

c. 4

d. π

Find the volume of the first octant, bounded by the surface $x = 1$ and $x^2 = y + 2z$.

a. 0.07

b. 0.05

c. 0.10

d. 0.03

Evaluate the integral of $x dx / (x^2 + 2)$ as with the limits from 0 to 1.

a. 0.718

b. 0.518

c. 0.203

d. 0.645

Evaluate the integral:

$$\frac{x}{(x-1)(x-2)}$$

a. \ln of $(x+2)^2 / (x-1) + C$

b. \ln of $(x+2) / (x-1)^2 + C$

c. \ln of $(x-2)^2 / (x-1) + C$

d. \ln of $(x-2) / (x-1)^2 + C$

Find the area of the region bounded by $r^2 = a^2 \cos 2\theta$.

- a. π b. a c. a^2 d. 0

Evaluate the indefinite integral:

$$\int e^x \cdot \frac{1 - \sin x}{1 - \cos x} dx$$

- a. $e^2 \tan x/2$ b. $-e^x \cot x/2$ c. $e^x \cot x/2$ d. $-e^x \tan x/2$

Evaluate the indefinite integral: $dx/\sqrt{a^2 + x^2}$

- a. $\operatorname{arc} \cosh x/a$ b. $\operatorname{arc} \tanh x/a$ c. $\operatorname{arc} \sinh x/a$ d. Not integrable

Find the length of the arc of the curve $24xy = x^4 + 48$ from $x = 2$ to $x = 4$.

- a. $18/5$ b. $21/8$ c. $19/3$ d. $17/6$

Find the volume of the region bounded by $x^2 = 4y$ and $y = 1/2 x$ about the y axis.

- a. $6/\pi$ b. $2\pi/3$ c. $\pi/2$ d. $3\pi/2$

The following methods in evaluating definite integrals EXCEPT:

- a. Rectangular Rule b. Trapezoidal Rule c. Simpson's Rule d. All can be used.

ADVANCED MATH REFRESHER SET

Evaluate the following complex number: $7i^{3i}$

- a. $\cos(3\ln 7) + i\sin(7\ln 3)$ c. $\frac{\cos(3\ln 7) + i\sin(3\ln 7)}{d. \cos(3\ln 7) - i\sin(3\ln 7)}$
 b. $\cos(3\ln 7) - i\sin(7\ln 3)$

A spring is stretched by a 2 lb weight. Let the weight be pushed up 3 in above the E and then released. Describe the motion as a function of x.

- a. $-1/4 \cos 16t$ b. $x = 1/4 \cos 16t$ c. $4 \cos 16t$ d. $-4 \cos 16t$

The temperature of a body changes at a rate that is proportional to the difference in temperature between the outside medium and the body.

- a. Charles' Law c. Gay-Lussac's Law
 c. Simple chemical conversion d. Newton's Law of Cooling

Find the general solution of this linear differential equation: $(x^4 + 2y) dx - x dy = 0$

- a. $cy = x^4 + x^2$ b. $2y = x^4 + cx^2$ c. $y = cx^4 + 2x^2$ d. $2y = cx^4 + 2x^2$

Compute the inverse Laplace transform: $1/(s^2 + 2s + 10)$.

- a. $1/3 e^{t} \sin 3t$ b. $1/3 e^{-t} \sin 3t$ c. $3e^{t} \sin 3t$ d. $-3e^{t} \sin 3t$

An object moves along the x axis in such a way that its position $t > 0$ is $dx/dt + (t - t^{-1})x = t^2$. If the object was at position $x = 2$ at time $t = 1$, where will it be at time $t = 3$?

- a. 2.915 b. 3.055 c. 3.125 d. 3.285

Find the magnitude of the vector $4i + 7j - 5k$.

- a. 9.487 b. 10.377 c. 11.637 d. 17.418

The determinant of a matrix is _____ calculated from a square matrix.

- a. Vector b. Real c. Scalar d. Imaginary

What is the product AB of the following complex numbers in polar form? $A = 3 + 4i$ $B = 8 + 6i$

- a. $50\angle 90^\circ$ b. $50\angle 30^\circ$ c. $50\angle 45^\circ$ d. $50\angle 60^\circ$

He devised the fundamentals of matrices.

- a. Avogadro b. Euler c. Cauchy d. Cayley

Given the following series:

$$\begin{aligned}\sin x &= x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots \\ \cos x &= 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots \\ e^x &= 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots\end{aligned}$$

What relation can you draw from these series?

- a. $e^x = \cos x + \sin x$ c. $e^{ix} = i\cos x + \sin x$
 b. $e^{ix} = \cos x + i\sin x$ d. $ie^x = i\cos x + i\sin x$

Given the following matrices, determine the product BC.

$$B = \begin{bmatrix} 1 & 2 \\ 0 & -5 \end{bmatrix} \quad C = \begin{bmatrix} 3 & 6 \\ 4 & 1 \end{bmatrix}$$

a. $\begin{bmatrix} 15 & 7 \\ -18 & -5 \end{bmatrix}$ b. $\begin{bmatrix} 11 & 8 \\ -20 & -5 \end{bmatrix}$ c. $\begin{bmatrix} -11 & 8 \\ -20 & 5 \end{bmatrix}$ d. $\begin{bmatrix} 15 & -7 \\ 18 & 4 \end{bmatrix}$

Determine the absolute value: $z = -3 - 4i$

- a. 4 b. 3 c. 5 d. 6

In the fourth principal of a complex number is equal to $1.495\text{cis } 13.28^\circ$, what is the complex number in $a + bi$ form?

- a. $7 + 9i$ b. $5 + 2i$ c. $3 + 4i$ d. $5 + 8i$

Simplify the following determinant:

$$\begin{vmatrix} 1 & 2 & 3 & 4 \\ 4 & 5 & 6 & -2 \\ 7 & 8 & 9 & 1 \\ 8 & -1 & 0 & 3 \end{vmatrix}$$

- a. 195 b. 270 c. 300 d. 1000

Compute the gradient given the function $f(x,y,z) = xyz$ at $(1,1,1)$.

- a. $\sqrt{3}$ b. 0 c. 3 d. 1

Solve the initial value problem: $y'' + 3y' = 0$; $y(0) = 3$ and $y'(0) = 6$.

- a. $y = 5 - 2e^{-3x}$ b. $y = -5 + 2e$ c. $y = 5 + 2e^{3x}$ d. $y = 5 - 2e$

SITUATION 1: Two perpendicular vectors are given in terms of their component by $U = A\mathbf{j} + 4\mathbf{j} + 6\mathbf{k}$ and $V = 2\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$.

Use the dot product to determine the value of A

- a. 18 b. 20 c. 13 d. 11

Find the magnitude of U.

- a. 12.16 b. 14.87 c. 16.89 d. 22.78

Determine the cross product of U and V.

- a. $84\mathbf{j} + 37\mathbf{k}$ b. $51\mathbf{j} + 44\mathbf{k}$ c. $22\mathbf{j} + 18\mathbf{k}$ d. $44\mathbf{j} + 50\mathbf{k}$

Find the vector from the point $(1,-2)$ to the point $(3,7)$.

- a. $(4,11)$ b. $(2,9)$ c. $(-2,11)$ d. $(-2,-9)$

Find the differential equations of a family of circles through the origin.

- a. $x \, dx - y \, dy = 0$ b. $y \, dx - x \, dy = 0$ c. $x \, dy + y \, dx = 0$ d. $x \, dx + y \, dy = 0$

Solve the differential equation using variable separable: $dy/dx = 5x/7y$.

- a. $y^2 = 5/7 x^2 + C$ b. $y = 5/7 x^2 + C$ c. $y^2 = x^2 + C$ d. $y = x + C$

Determine the orthogonal trajectory of $x^2 + y^2 = C$.

- a. $y = xy$ b. $y = x$ c. $y = kx$ d. $y = 1/x$

Find the interval of convergence of the given power series x^n/n using ratio test method.

- a. $x > 0$ b. $-1 \leq x \leq 1$ c. $e > 0$ d. $x < -1$

SITUATION 2: Given the equation $(x + yi)(1 - 2i) = 7 - 4i$

Find x.

- a. 2 b. 4 c. 3 d. 0

Find y.

- a. 2 b. 4 c. 3 d. 0

These consists of the exponential derivatives that is " y' , y'' " in a differential equation.

- a. Degree b. Dependence c. Radical d. Order

Find the differential equation of the family of curves of straight lines through the origin.

- a. $x \, dx - y \, dy = 0$ b. $y \, dx - x \, dy = 0$ c. $x \, dy + y \, dx = 0$ d. $x \, dx + y \, dy = 0$

Eliminate the arbitrary constant: $ax^2 + bx + c$.

- a. $y = 0$ b. $y' = 0$ c. $y'' = 0$ d. $y''' = 0$

Find the least square vector for the given system.

$$\begin{pmatrix} 1 & 1 \\ -2 & 3 \end{pmatrix} \mathbf{X} = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$$

- a. $[-13/5, 7]$ b. $[13/5, 7/5]$ c. $[-13, 7/5]$ d. $[13, -7]$

The Laplace transform of $\cos wt$ is:

- a. $s/[s^2 + w^2]$ b. $w/[s^2 + w^2]$ c. $w/(s + w)$ d. $s/(s + w)$

SITUATION 2: A unit vector has direction cosines

$$\cos \theta_x = -0.5 \quad \cos \theta_y = 0.2.$$

Assuming that the z axis is positive,

Compute the z component of direction cosine.

- a. 0.789 b. 0.816 c. 0.843 d. 0.954

If the magnitude of the unit vector is 250, what is the value of the unit vector?

- a. $125i + 50j - 210.75k$ c. $125i - 50j - 210.75k$
b. $-125i + 50j - 210.75k$ d. $-125i + 50j + 210.75k$

Simplify the following complex number: $(6 + 7i) \div (4 - 3i)$

- a. $(-3 + 46i)/25$ b. $(3 + 46i)/25$ c. $-(3 + 46i)/25$ d. $(3 - 46i)/25$

Assume three force vectors intersect at a single point

$$F_1 = i + 3j + 4k$$

$$F_2 = 2i + 7j - k$$

$$F_3 = -i + 4j + 2k$$

What is the magnitude of the resultant force vector, R ?

- a. 15 b. 13.23 c. 14.73 d. 16.16

In an oil refinery, a storage tank contains 2000 gallons of gasoline that initially has 100 lb of an additive dissolve in it. In preparation for winter weather, gasoline containing 2 lb of additive per gallon is pumped into the tank at a rate of 40 gal/min. The well mixed solution is pumped out at a rate of 45 gal/min. How much of the additive is in the tank 20 min after the pumping process begins?

- a. 1277 lb b. 1342 c. 1579 d. 1680

These are curves that intersects each curve of the family perpendicularly.

- a. Projectile b. Orthogonal c. Homogeneous d. Intersecting

What is the value of $\ln(-1)$?

- a. $-\pi$ b. πi c. i d. Undefined

A cup of coffee at 180°F is placed in a room whose temperature is 70°C . After 5 minutes, the temperature of the coffee has dropped to 160°F . How many more minutes must elapse before the coffee's temperature drops to 130°F ?

- a. 9 mins b. 15 c. 10 d. 12

Obtain a general solution: $2(2x^2 + y^2)dx - xy dy = 0$. Assume that equation is homogenous.

- a. $x^4 = c(4x^2 + y^2)$ c. $cx^4 = (4x^2 + y^2)$
b. $x^4 = c(4x^2 - y^2)$ d. $cx^4 = (4x^2 - y^2)$

Solve for the particular solution: $2xyy' = 1 + y^2$ at $(2,3)$.

- a. $\sqrt{x + 5}$ b. $\sqrt{x - 5}$ c. $\sqrt{5x + 1}$ d. $\sqrt{5x - 1}$

Given the determinant, find the minor of -4.

$$\begin{vmatrix} 1 & 2 & 4 \\ 2 & 1 & -1 \\ -4 & 3 & 2 \end{vmatrix}$$

- a. 4 b. -4 c. -6 d. 6

Find the particular solution given $(y'' - 2y' - 3)y = 0$ at $x = 0$, $y = 4$ and $y' = 0$. Test $x = 1$.

- a. 15.9 b. 23.8 c. 17.4 d. 21.2

Evaluate $\sqrt{-9} \cdot \text{cube rt of } -343$.

- a. 21 b. $21i$ c. $-21i$ d. 21

SITUATION 3: Given the relationship of the matrix:

$$\begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

Solve for x .

a. -2

b. 2

c. 0

d. 1

Solve for y.

a. 6

b. -6

c. 3

d. -3

Calculate the dot product of the following vector pairs: $A = 2i + 3j$, $B = 5i - 2j$

a. 2

b. 3

c. 4

d. 5

An array of $m \times n$ quantities which represent a single number system composed of elements of rows and column is known as:

a. transpose of matrix

c. co-factor of a matrix

b. determinant

d. matrix

Solve the general solution of the following exact DE: $(\cos x \cos y - \cot x)dx - \sin x \sin y dy = 0$.

a. $\sin x \cos x = \ln|c \sin y|$

c. $\sin x \cos y = \ln|c \sin x|$

b. $c \sin y \cos y = \ln|\cos y|$

d. $\sin y \cos x = \ln|c \cos y|$

SURVEYING REFRESHER SET

SITUATION 1: A four cornered lot has the following azimuth and distances with unknown non-adjacent sides.

BOUNDARY	AZIMUTH	DISTANCE
1-2	12°	300 m
2-3	128°	-----
3-4	192°	150 m
4-1	260°	-----

Compute the missing side 4-1.

- a. 181.42 m b. 116.79 c. 191.83 d. 147.54

Compute the area of the lot in acres.

- a. 12.55 acres b. 9.35 c. 11.56 d. 18.31

If the lot is to be subdivided in to two lots having a ratio of 2:3, the smaller lot being on the southeast portion, compute the dividing line.

- a. 347 m b. 479 c. 198 d. 251

SITUATION 2: Answer the following terms in surveying.

These are long sights that can be taken with greater accuracy than using the stadia method.

- a. Intercept b. Merits c. Precision d. Subtends

It is the difference between the most probable value of the quantity and its observed value.

- a. Normal Error b. Mistakes c. Most probable error d. Residual Error

The following are used for base line measurements EXCEPT:

- a. Straining device b. Thermometer c. Stakes d. Vernier

SITUATION 3: The first branch of reverse curve has a radius of 200 m. If the distance between the tangent points is 110 m assuming the reverse curves are in parallel,

What is the radius of the second curve?

- a. 174.89 b. 194.20 c. 136.11 d. 155.84

Find the length of the first curve.

- a. 84.57 b. 90.16 c. 65.75 d. 98.18

Find the total length of the cruve.

- a. 113.36 b. 110.50 c. 124.57 d. 106.50

SITUATION 4: A line of levels is run from BM1 to BM2 which is 12 km long. Elevation of BM1 was found out to be 100 m and that of the BM2 is 125.382 m. Backsight and foresight distances were 150 m and 100 m respectively.

Calculate the number of set-ups to be used.

- a. 21 b. 20 c. 48 d. 35

Determine the corrected elevation of BM2 considering the effect of curvature and refraction.

- a. 129.55 b. 125.34 c. 117.83 d. 113.97

If during the levelling process the line of sight is inclined downward by 0.004 m in a distance of 10 m ,what would be the corrected elevation of BM2?

- a. 117.55 b. 133.19 c. 126.34 d. 184.22

A survey line was measured on sloping ground and recorded as 117.84 m. The difference between the ends was 5.88 m. The tape used was later found to be 30.66 m when compared with a standard of 30.48 m. Calculate the horizontal length of line.

- a. 118.38 m b. 154.79 c. 134.48 d. 121.76

SITUATION 5: The coordinates of two points B and C with respect to A are the following:

B - 536.23 m N	449.95 m E
C - 692.34 m N	1336.28 m E

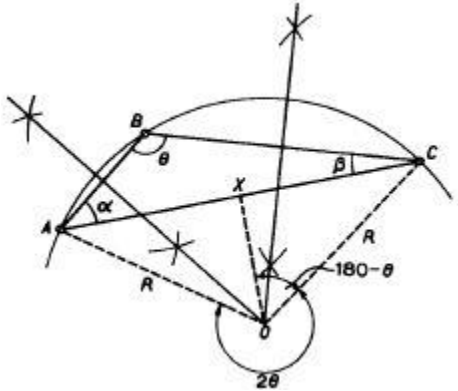
Calculate the bearing at AB.

- a. S 40° W b. S 40° E c. N 40° W d. N 40° E

Calculate the bearing at BC.

- a. S 80° W b. N 80° W c. S 80° E d. N 80° E

Find the stationing at PT if PC is 1+500. Assume that the radius of the circular curve is passing through three points.



- a. 2+170.7 b. 2+670.7 c. 2+770.7 d. 2+917.0

SITUATION 6: A circular curve having an azimuth of back tangent equal to 205° and the azimuth of the forward tangent equal to 262° . If the middle ordinate is 5.8 m,

Compute the angle of intersection.

- a. 42° b. 51° c. 57° d. 61°

Compute the radius of the curve.

- a. 84.27 m b. 54.19 c. 49.88 d. 42.06

Compute the length of the tangent.

- a. 34.77 b. 22.83 c. 55.19 d. 60.19

SITUATION 7: A steel tape with coefficient of linear expansion of 0.0000116 per $^\circ\text{C}$ is known to be 50 m long at 20°C . The tape was used to measure a line which was found to be 532.28 m long and when the temperature was 35°C .

Find the temperature correction per tape length

- a. 0.0055 b. 0.0044 c. 0.0078 d. 0.0021

Find the temperature correction for the measured line.

- a. 0.0816 b. 0.0926 c. 0.0718 d. 0.0619

Find the correct length of the line.

- a. 532.62 b. 532.86 c. 532.29 d. 532.37

A line level was run from point 5 to 6, 8 km apart. The average BS and also FS distance was 100 m. At every turning point, the rod settles by 3 cm. Find the total error in the recorded elevation of point 6.

- a. 1.79 m b. 1.44 c. 1.22 d. 1.17

Using 50 m tape that is 0.02 too long, the measured distance from A to B is 160.42 m. What is the correct distance from A to B?

- a. 170.466 b. 160.484 c. 161.279 d. 162.011

Which of the following is a common mistake in levelling?

- a. Faulty additions and subtractions
b. Variation in temperature
c. Bubble not exactly centered at the instant of sighting
d. Rod not held plumb

A $3^\circ 30'$ simple curve connects two tangents that intersect at an angle of 38° . If the center of curvature is moved 6 m away from the vertex and the direction of the tangents remain the same, determine the new radius of the curve.

- a. 274.84 m b. 246.61 c. 346.22 d. 333.08

SITUATION 8: The following are the observations made on the same angle:

47°26'13"
47°26'10"
47°26'16"
47°26'09"
47°26'18"

47°26'18"
47°26'15"
47°26'12"
47°26'15"
47°26'14"

Determine the most probable value.

- a. 47° 26' 09'' b. 47° 26' 12'' c. 47° 26' 14'' d. 47° 26' 18''

Determine the standard deviation.

- a. 2.5" b. 2.9" c. 3.1" d. 3.7"

Find the standard error of the mean.

- a. 1.0" b. 1.6" c. 2.3" d. 2.5"

SITUATION 9: Answer the following situations in surveying.

Accuracy is the term which indicates the degree of conformity of a measurement to its:

- a. most probable value c. true value
b. mean value d. standard error

Theory of errors is applied to minimize:

- a. gross errors b. systematic errors c. random errors d. all of these

Hydrographic surveys is an art of delineating the following EXCEPT:

- a. submarine levels b. dams c. contours d. features of seas

Two parallel railway 200 m apart were to be connected by equal turnouts. If the intermediate tangent is 400 m and the radius of the curve is 1100 m. Determine the central angle of the reverse curve.

- a. 18° 54' b. 18° 9' c. 17° 32' d. 16° 16'

Two tangents having azimuths 240° and 282° are connected by an 80 m spiral curve with a 6° circular curve. The width of the roadway is If the design velocity is 60 kph, determine the super-elevation at quarter points

- a. 0.144 b. 0.149 c. 0.152 d. 0.160

It is an imaginary line passing through places having the same magnetic declination.

- a. Isotropic b. Isogenic c. Isogonic d. Isoclinic

The point of intersection of two tangents is at 1+080 and the angle between the back and forward tangents is 120°. The radius of a circular curve to be set out is 570 m. Determine the station PT using arc basis.

- a. 1+268.54 b. 1+327.81 c. 1+257.18 d. 1+342.72

The DMD of the line BC is equal to 426.20. The departure of the previous line AB is 117.56. What is then the departure of the line BC?

- a. 191.08 b. 200.56 c. 171.82 d. 213.25

It is the great circle on the celestial sphere cut by a plane through the earth's center at right angles to the vertical.

- Horizon b. Ecliptic c. Zenith d. Equinox

SITUATION 10: A symmetrical parabolic curve passes through point A whose elevation is 23.23 m at a distance of 54 m from the PC. The elevation of the PC at station 4 + 100 is 22.56 m. The grade of the back tangent is +2% and the length of the curve is 120 m.

What is the grade of the back tangent?

- a. -1.9% b. +1.9% c. -1.4% d. +1.4%

What is the distance from PC locates the highest point?

- a. 64.83 m b. 71.55 c. 58.87 d. 70.59

What is the elevation of the highest point of the curve?

- a. 27.960 b. 23.267 c. 24.887 d. 27.022

SITUATION 11: From the given tract of land having the following data:

LINES	LATITUDE	DEPARTURE
A-B	+40	-80
B-C	+80	-40
C-D	-30	+70
D-A	-90	+50

Compute the DMD of line CD.

- a. +170 b. -170 c. +40 d. -40

Compute the DMD of line AB.

- a. -80 b. +80 c. -40 d. +40

Compute the double area of the lot.

- a. 4800 b. 2500 c. 9600 d. 6000

SITUATION 12: In the two peg test of a dumpy level using alternate method, the following observations were taken. Point M is equidistant from both A and B while P is 2.50 m away from A along the extension of line AB and 79.27 m from B.

Instrum. Set up near M

Instrum. Set up near P

Rod reading on A 0.296 m 1.563 m

Rod reading on B 0.910 m 2.140 m

Find the true difference in elevation bet. A and B.

- a. 0.991 b. 0.755 c. 0.841 d. 0.614

Find the error in the rod reading at B w/ the instrument still at P.

- a. 0.105 b. 0.076 c. 0.055 d. 0.038

Find the correct reading rod on B for a horizontal line of sight with the instrument still at P.

- a. 2.178 m b. 2.155 c. 2.147 d. 2.121

SITUATION 13: Two straights AB and BC falling to the right at gradients 10% and 5% respectively, are to be connected by a parabolic curve 200 m long. Design the vertical curve for chainage and reduce level of B as 2527.00 m and 56.46 m respectively. Take peg interval as 20 m.

Find the number of stations at 20 m interval.

- a. 5 b. 8 c. 10 d. 11

Find the elevation at the end of the spiral curve.

- a. 59.33 m b. 51.46 c. 50.77 d. 48.32

Find the elevation at the beginning of the spiral curve.

- a. 82.01 m b. 74.33 c. 70.57 d. 66.46

HIGHWAY AND TRANSPORTATION ENGINEERING REFRESHER MODULE

SITUATION 1: The heel spread of a frog of a turnout is 320 mm long with a frog number 10. If a length of toe is 1840 mm,

Find the heel length.

- a. 340 mm b. 1000 c. 310 d. 3200

Find the total length of the railroad track.

- a. 1840 mm b. 5040 c. 2460 d. 2280

This refers to the vertical distance of the wave crest and the wave trough.

- a. crest b. trough c. height d. length

For Phil. National roads, the maximum grade permitted on curves is:

- a. 4% b. 5% c. 6% d. 7%

The following points of view in analyzing impact of any highway projects EXCEPT:

- a. Transportation system c. Social and economic
b. Design specifications d. Environmental

It is the number of parked vehicles in a study area at any specified time.

- a. Parking accumulation c. Parking duration
b. Parking turnover d. Parking load

In tree planting along highways, bracing stakes of the rough wood shall be:

- a. 50 x 75 mm b. 75 x 75 c. 50 x 50 d. 100 x 75

SITUATION 2: The data below shows the result of the flow of traffic at a certain part of a highway by observing the arrival times for four vehicles at two sections A and B that are 150 m apart. The total observation time at section A is 15 secs.

VEHICLE	SECTION A	SECTION B
1	T	T + 7.58
2	T + 3	T + 9.18
3	T + 6	T + 12.36
4	T + 12	T + 21.74

Determine the mean speed in kph.

- a. 84.74 b. 80.56 c. 77.21 d. 74.74

Determine the space mean speed.

- a. 51.25 b. 60.77 d. 88.20 d. 80.20

Compute the flow at section A in vehicles per hour.

- a. 960 b. 1000 c. 1050 d. 1120

For sampling purposes of preparation of thermoplastic materials, the minimum weight should be:

- a. 1 kg b. 5 c. 10 d. 25

Given the following cross section notes for a road grading work:

<u>-3.2</u>	<u>1.2</u>	<u>1.2</u>	<u>2.8</u>
x ₁	0	3.5	x ₂

The road bed is 9 m wide and the side slope for cut is 1:1 and for fill is 1.5:1. Determine the area of cut of the section.

- a. 8.514 m² b. 9.404 c. 9.788 d. 10.347

The guide sign carry not more than ____ lines of legend.

- a. 5 b. 6 c. 3 d. 4

The design speed of a vertical sag parabolic curve is 100 kph. The tangent grades of the curve are -2.2% and +2.8% respectively. Determine the length of the curve.

- a. 126.58 m b. 130.16 c. 148.37 d. 164.29

The average spacing of vehicles in a single highway is 50 m center to center. The volume of traffic is 600 vehicles per hour. Determine the density of traffic in that highway.

- a. 15 b. 25 c. 30 d. 20

A highway curve having a radius of 121.95 m is banked so that there will no lateral pressure on car's wheel at a speed of 48 kph. What is the angle of elevation of the embankment?

- a. 5.78° b. 6.66° c. 8.45° d. 9.54°

Which of the following messages when painted on pavement is not allowed?

- a. In case of emergency turn left
- b. Keep clear
- c. No right turn
- d. Stop

SITUATION 3: The width of the expansion joint gap is 24 mm in a concrete pavement. If the laying temperature is 12°C and the maximum slab temperature is 50°C ,

Calculate the expansion in concrete between the expansion joints in mm assuming the gaps are twice the allowable expansion in concrete.

- a. 6
- b. 8
- c. 10
- d. 12

Calculate the spacing between joints using $K = 0.0000095/^\circ\text{C}$.

- a. 29.61 m
- b. 33.24
- c. 38.18
- d. 44.21

It refers to the increase in volume of earth work after excavation.

- a. Borrow pitting
- b. Hauling
- c. Shrinking
- d. Bulking

From station 0 + 040 with center height of 1.2 m in fill , the ground line makes a uniform slope of 6.5% to station 0 + 100, whose center height in cut is 3.5 m. Find the grade of the finished roadway.

- a. 0.88%
- b. 1.33%
- c. 1.87%
- d. 2.15%

A mass haul diagram indicates fill if the curve

- a. rises
- b. falls
- c. constant
- d. none

SITUATION 4: The design speed of a sag parabolic curve is 100 kph. The downward tangent grade is -2%. The length of the curve is 126 m.

Compute the upward tangent grade of the parabolic sag curve.

- a. 5%
- b. 4%
- c. 3%
- d. 2%

Compute the length of the sight distance.

- a. 115.32 m
- b. 131.55
- c. 147.84
- d. 156.21

At what distance from the PC is the lowest point of the curve?

- a. 50.60 m
- b. 55.18
- c. 60.24
- d. 56.21

For protection of untreated timber trestle piles, the sawed surface shall be coated with:

- a. Macadam oil
- b. Anti-pest oil
- c. Tack coatings
- d. Creosote oil

Centerline shall be established from instrument control points. The maximum spacing between centreline points shall be ____ meters when the centreline horizontal curve radius is less than or equal to 150 meters.

- a. 15
- b. 10
- c. 20
- d. 30

If 2340 vehicles pass a certain lane of road with an average speed of 52 kph, determine the appropriate spacing of the vehicles.

- a. 19.88 m/veh
- b. 26.54
- c. 22.22
- d. 28.59

SITUATION 5: An old dilapidated road having a curve portion is to be improved to accommodate a design speed of 90 kph. Super elevation is to be 0.08 and skid resistance is 0.10.

Compute the radius curve to accommodate the design speed of 90 kph.

- a. 307.21 m
- b. 354.33
- c. 388.44
- d. 429.91

Determine the degree of curve

- a. 3.23°
- b. 5.81°
- c. 6.89°
- d. 11.31°

Determine the impact factor due to this speed.

- a. 0.55
- b. 0.47
- c. 0.64
- d. 0.18

SITUATION 6: Determine the following movements by ships caused by sea waves.

The horizontal motion of the ship along its longitudinal axis of the boat, which is caused by seawater waves.

- a. Yawning
- b. Pitching
- c. Surging
- d. Heaving

The motion of the ship, which tends to rotate the ship about its traverse axis caused by seawater waves is known as:

- a. Yawning
- b. Pitching
- c. Swaying
- d. Heaving

The motion of the ship, which tends to move horizontally on its sides caused by seawater waves.

- a. Yawning
- b. Pitching
- c. Swaying
- d. Heaving

These shall be used for field riveting excluding hand tools to be permitted by the engineer.

- a. Pneumatic hammers b. Rollers c. Crane d. Vibrator

Determine the thickness of a rigid pavement of proposed highway to carry a max. wheel load of 60 kN. Neglect the effect of dowels. Use $f'c = 20$ MPa. Allowable tensile stress of concrete pavement is $0.60 f'c$.

- a. 350 b. 380 c. 390 d. 410

A highway curve has radius of 122 m. Find the angle of super elevation in degrees so that there will be no lateral pressure between the tires and the roadway at a speed of 30 mph.

- a. 8.92° b. 10.05° c. 6.54° d. 13.55°

SITUATION 7: Six vehicles are observed in a 200 m section of a highway. Average time headway is 4 s.

Determine the density in vehicles per km.

- a. 50 b. 30 c. 40 d. 60

Determine the traffic flow in vehicles per hr.

- a. 900 b. 1150 c. 1060 d. 870

Determine the space mean speed.

- a. 55 kph b. 60 kph c. 30 kph d. 75 kph

This is similar to passenger planning in that both may be used to satisfy policy goals in transportation that includes forecast demand, economic competition, etc...

- a. Logistic planning c. Freight planning
b. Environmental planning d. Accessibility planning

Data on a traffic accident recorded on a certain intersection for the past 4 years has an accident rate of 9200 per million entering vehicles. If the total number of accidents is 802, find the average daily traffic entering the intersection during the 4 year period.

- a. 55.25 b. 59.71 c. 66.87 d. 81.75

The following data of a particular asphalt concrete mixture. Compute the voids in the laboratory molded specimen.

Materials	Sp gr	% by wt
Limestone dust	2.80	17
Sand	2.60	73
Asphalt cement	1.02	10

A cylindrical specimen of the mixture was molded in the laboratory and weighed in air and water as follows:

Wt of dry specimen in air = 110 grams

Wt of saturated surface dry specimen in air = 114 grams

Wt of saturated specimen in water = 60 grams

- a. 9.77% b. 13.88% c. 10.53% d. 12.265

Determine the pavement thickness in cm using an expansion pressure of 0.15 kg/cm^2 and a pavement density of 0.0025 kg/cm^3 . Use expansion pressure method.

- a. 45 b. 100 c. 80 d. 60

SITUATION 8: Identify the following parts in railroads.

It refers to the fixed rail in a railway track which is part of a switch.

- a. stock rail b. wing rail c. check rail d. tongue rail

These members laid transversely under the rails for supporting them are called:

- a. Fish plate b. Ballast c. Bearing plates d. Sleepers

The fittings used to fix the rails to the wooden sleeper is called:

- a. Fish plates b. Clip c. Spikes d. Chair

SITUATION 9: The superhighway is designed to have a roadway capacity of 100 vpm. But due to some resurfacing portion of the highway, the roadway capacity is reduced to 30 vpm. The traffic arrival rate is 60 vpm and then resume after 40 mins.

Compute the maximum length of the queue.

- a. 1150 b. 1200 c. 1500 d. 1000

What is the average delay per vehicle due to some resurfacing of the portion of the highway.

- a. 15 mins b. 10 c. 8 d. 5

What is the longest time any vehicle spent in the queue?

a. 15 mins

b. 50

c. 60

d. 20

ENGINEERING ECONOMY REFRESHER SET

Compute the number of tons that the multinational ice plant company must be able to sell per year to break even based on the following data:

Cost of electricity = P 20,000.00
Tax to be paid per ton = P 2,000
Real estate tax per year = P 3.5 million
Salaries and wages = P 25 million
Other expenses = P 12 million
Selling price of ice = P 55 per kg.

- a. 1228 b. 1140 c. 986 d. 1420

A certain water works system in Singapore costs P 600 million and in 20 years it will have depreciated P 400 million in value. If the annual interest on bond is 5% and the local interest is fixed at 8% yearly and if the annual operating expenses amounted to P 80 million, what must be the charge per million cu m per year. The sinking fund is deposited annually and the capacity of water supply in Singapore is 3.5 billion.

- a. P 33.93 b. P 34.45 c. 35.20 d. 31.70

Find the nominal rate which if compounded quarterly is equivalent to 6.5% compounded semi annually.

- a. 4.39% b. 6.448% c. 5.31% d. 7.43%

An engineer promised to pay P 36,000 at the end of 90 days. He was offered 10% discount if he pays in 30 days. Find the rate of interest.

- a. 82.1% b. 34.7% c. 51.6% d. 66.6%

The pensionnaire will receive P 5,000 per week at the rest of his/her life. If the social security agency has a contribution of 6.5% per year and compounded weekly, what is the present worth of that financial benefit?

- a. P 1 million b. P 4 million c. P 10 million d. P 6.5 million

An urban bank has a mortgage offers of 12% compounded continuously. What is the effective annual interest?

- a. 12.36% b. 12.55% c. 12.75% d. 12.68%

Which of the following is not described by the bond value?

- a. agrees to lend the bond issuer money c. maximizes the economic well-being
b. receives periodic interest payments d. provides excellent commercial value

SITUATION 1: For a nominal rate of 6% compounded semi-quarterly for 8 years in an ordinary annuity,

Compute the sinking fund factor.

- a. 0.0078 b. 0.0011 c. 0.0122 d. 0.0089

Compute the present worth factor.

- a. 44.71 b. 50.68 c. 71.55 d. 64.78

Compute the capital recovery factor.

- a. 0.0155 b. 0.0197 c. 0.0216 d. 0.0318

A parent on the day of the child is born wishes to determine what lump sum would have to be paid into an account annually, in order to withdraw P 20,000.00 each on the child's 18th, 19th, 20th, and 21st birthdays?

- a. P 35,941.73 b. P 33,941.73 c. 30,941.73 d. P 25,941.73

The profit on a product selling for P 82.00 is 10% of the selling price. What percentage increase in production cost will reduce the profit by 60%?

- a. 6.67% b. 6.76% c. 7.66% d. 7.76%

An engineering firm purchased a second hand truck for P 530,000 and paid P 15,000 for freight and taxes to the job site. The equipment has a normal life of 10 years with a trade in value of P 50,000 against the purchase of a new equipment at the end of the life. Determine the annual depreciation cost by the straight line method.

- a. P 50,900 b. P 61 300 c. 49 500 d. 48 980

The paper currency issued by the Central Bank which forms part of the country's money supply.

- a. Treasury bills b. Bank note c. Check d. Coupon

An item is purchased for P 100,000. Annual cost is P 18,000. Using interest rate of 8%, what is the capitalized cost of the perpetual service?

- a. P 310,000 b. P 315,000 c. P320,000 d. P 325,000

SITUATION 2: A German dentist bought a machine 10 years ago for P 9 million with an expected life of 20 years. The new assistant anticipated how that the machine will serve well for another 6 years only and purchase a new apparatus at P 12 million with an expected life of 16 years. The old machine is depreciated as anticipated and can be sold now at P 6 million. Operating cost of the old machine is P 100,000 and the new machine is P 50,000 per year. Salvage value is 10% of the initial value for both machines regardless of length of the time to be used. If money is worth 10% to the company,

Compute the annual cost of the old machine.

- a. P 1 million b. P 1.4 million c. P 2.1 million d. P 3.0 million

Compute the annual cost of the new machine.

- a. 1.56 million b. P 1.70 million c. P 1.88 million d. P 2.12 million

Compute the difference in cost to prevent replacement.

- a. P 126,777 b. P 131,384 c. P 141,256 d. P 150,539

SITUATION 3: Define the following terms in engineering economics.

These are the additional costs of producing one more unit of a product.

- a. Marginal cost b. Sunk cost c. Increment cost d. Fixed cost

These involve with the values for all attributes must be converted into a common measurement scales in every economic alternative.

- a. Taxation scale b. Compensatory models c. Dimensional model d. Cash flow

It refers to the period of time in years that results in the minimum equivalent annual cost.

- a. Ownership life b. Physical life c. Useful life d. Economic life

A bank loan of P 2,000 was made at 8 % simple interest. How long would take in yaers for the amount of the loan and interest equal to P 3,280.00?

- a. 6 b. 7 c. 8 d. 5

A man paid P 110,000 for a P 100,000 bond that pays P 4000 per year. In 20 years, the bond will be redeemed for P 105,000. What net rate of interest will the man obtain on his investment?

- a. 3.37% b. 3.47% c. 3.56% d. 3.40%

Which of the following is NOT a common factor for break even analysis?

- a. Capacity utilization c. Rate of return
b. Annual revenue and expenses d. Interest rates

SITUATION 4: The original cost of a certain machine is P 150,000 has a life of 8 years with a salvage value of P 9,000.

Determine the declining balance factor K.

- a. 0.1755 b. 0.2127 c. 0.2965 d. 0.3476

How much is the depreciation on the 5th year , if the constant percentage of declining value is used?

- a. P 10,893.62 b. P 23813.02 c. 44,325.86 d. 32425.20

A machine costing P 45,000 is estimated to have a salvage value of P 4,350 when retired at the end of 6 years. Depreciation cost is computed using a constant percentage of the declining book value. What is the annual rate of depreciation in percent?

- a. 33.25% b. 32.25% c. 35.25% d. 21.15%

A loan of P 2,000 is made for a period of 13 months, from July 1 to July 31 the following year, at a simple interest of 20%. What is the future amount is due at the end of the loan period?

- a. P 2276 b. P 2850 c. P 2433 d. P 2371

A telecoms firm purchased infrared equipment for P 6 million. Freight and installation charges amounted to 3% of the purchased price. If the equipment shall be depreciated over a period of 8 years with a salvage value of 5%, determine the depreciation using sum of years digit method.

- P 618,125 b. P 557,423 c. P 684,701 d. P 652,333

How long will it take money to quadruple if it earns 7% compounded semi-annually?

- a. 26.55 years b. 20.15 c. 33.16 d. 27.86

SIUTATION 3: A utility company is considering the following plans to provide a certain service required by resent demand and the respective growth of demand for the coming 18 years.

Plan R requires an immediate investment of 500,000 in property that has an estimated life of 18 years and with 20% terminal salvage value. Annual disbursements for operation and maintenance will be 50,000. Annual property taxes will be 2% of the first cost.

Plan S requires an immediate investment of 300,000 in property that has an estimated life of 18 years with 20% terminal salvage value. Annual disbursements for its operation and maintenance during the first 6 years will be 40,000. After 6 years, an additional investment of 400,000 will be required having an

estimated life of 12 years with 40% terminal salvage value. After this additional property is installed, annual disbursements for operation and maintenance of the combined property will be 60,000. Annual property taxes will be 2% of the first cost of property in service at any time. Money is worth 12%.

Determine the annual cost after 6 years for plan S?

- a. P 84k b. P 55k c. P 66k d. P 93k

Find the present worth cost for plan R.

- a. P 922k b. P 1.2 million c. P 875k d. P 916k

Compute the equivalent uniform annual cost.

- a. P 133,900 b. P 164,700 c. P 212,300 d. 300,100

An android phone costs P 2,000 today. If inflation is 6% per year and interest is 10% per year, what will be the appropriate future value of the machine adjusted for inflation in 5 years?

- a. P 3,630 b. P 4,200 c. P 2,850 d. P 4,310

An asset was purchased for P 100,000 and retired at the end of 15 years with a salvage value of P 4,000. The annual operating cost was P 18,000. Determine the capitalized cost of the asset based on an interest rate of 8%.

- a. P 369,195 b. P 380,230 c. P 411, 321 d. P 370,452

The official currency of the following countries is "pesos" EXCEPT:

- a. Philippines b. Spain c. Mexico d. Argentina

The cost to equip a condo unit with CCTV cameras is P 50,000. If the interest rate is 15% per year and it has a life of 6 years, find the equivalent annual cost.

- a. P 18,150 b. P 13650 c. P 13,210 d. P 18,110

Which of the following products is not considered as sales tax?

- a. Books b. Meals c. Groceries d. Cinema tickets

An oil refinery has decided to purchase new drilling equipment for P 550,000. The equipment will be kept for 10 years before being sold. The estimated SV for depreciation purposes is to be \$25,000. If Straight Line depreciation is used and the equipment is sold for P 35,000 at the end of 10 years, the taxable gain on the disposal of the equipment is

- a. P 35,000 b. P 25,000 c. P 15,000 d. P 10,000

The fixed costs incurred by a small genetics research lab are P 200,000 per year. Variable costs are 60% of the annual revenue. If annual revenue is P 300,000, the annual profit/loss is most nearly which answer below?

- a. P 66,000 profit b. P 66,000 loss c. P 80,000 profit d. P 80,000 loss

A nominal interest of 3% compounded continuously is given on the account. What is the accumulated amount of P 10,000 after 10 years?

- a. P 13,498.60 b. P 13,620.10 c. P 13,500.10 d. P 13,439.16

A firm is considering a capital investment. The risk premium is 0.04, and it is considered to be constant through time. Riskless investments may now be purchased to yield 0.06 (6%). If the project's beta (β) is 1.5, what is the expected return for this investment?

- a. 0.15 b. 0.10 c. 0.08 d. 0.024

A fund for replacement of a machinery in a plant must have P 3 million at the end of 9 years. An equal deposit of P 296,500 was made on the fund at the end of each 6 months for 4 years only. How much is the rate of the fund invested if it is compounded semi-annually?

- a. 3.5% b. 4.5% c. 5.5% d. 6.0%

A sum of P1,000.00 is invested now and left for 8 years, at which time the principal is withdrawn. The interest has accrued is left for another 8 years. If the effective annual interest rate is 5 %, what will be the withdrawn amount at the end of the 16th year?

- a. P 665.80 b. P 705.42 c. P 819.57 d. 655.49

If a sum of money triples in a certain period of time at a given rate of interest, compute the value of the single payment present worth factor.

- a. 0.333 b. 3 c. 0.292 d. 1.962

A bank is advertising 9.5% accounts that yield 9.84 annually. How often is the interest compounded?

- a. monthly b. bi-monthly c. quarterly d. daily

P 500 is deposited each year into a savings bank account that pays 5% nominal interest, compounded continuously. How much will be the account at the end of 5 years?

- a. P 2769.59 b. P 2448.64 c. P 2849.65 d. P 2347.96

SITUATION 4: An oil company is being offered a special coating for the gasoline underground tank installation in its service stations which will increase the life of the tank from the usual 10 years to 15 years. The cost of the special coating will increase the cost of the 40,000-tank to 58,000. Cost of installation for either of the tanks is P24,000. If the salvage value for both is zero, and interest rate is 26%,

	Machine w/o coating	Machine w/ special coating
First Cost	40,000	58,000
Installation	24,000	24,000
Salvage Value	0	0
Estimated Life	10 years	15 years

Compute the depreciation for machine without coating.

- a. P 1556.23 b. 1831.45 c. 1630.16 d. 2077.59

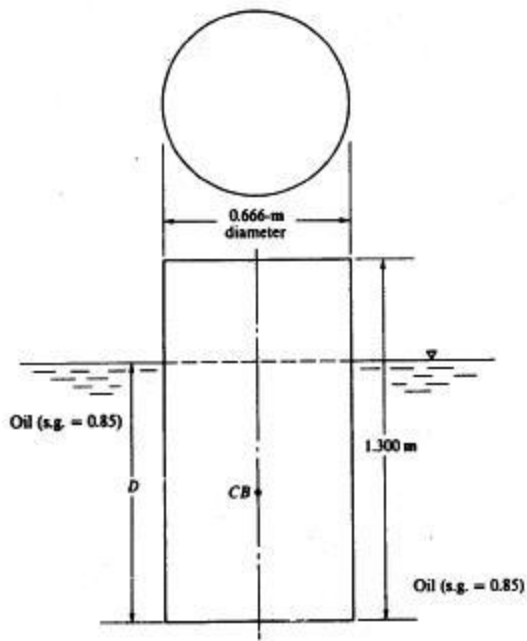
Compute the depreciation for machine with coating.

- a. P 557.80 b. P 827.23 c. 687.08 d. 751.24

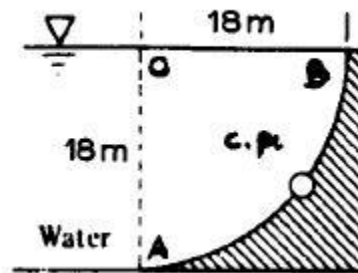
Compute the rate of return on additional investment on machine with special coating.

- a. 5.18% b. 4.75% c. 3.36% d. 8.81%

HYDRAULICS AND GEOTECHNICAL ENGINEERING



SITUATION 5: The canal shown in cross section in the figure runs 40 m into the paper.

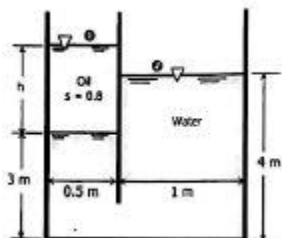


Determine the horizontal hydrostatic force. Use unit weight = 9.79 kN/cu m
a. 65,112 kN b. 63,439 c. 61,127 d. 58,786

Determine the magnitude of the hydrostatic force.
a. 175,002 kN b. 118,130 c. 154,207 d. 131,284

Find the vertical location of the center of pressure from A.
a. 8.33 m b. 9.54 c. 11.55 d. 9.07

SITUATION 6: A rectangular tank of internal width of 5 m as shown in the figure, contains oil of sp gr = 0.8 and water.



Find the depth of oil, h .
a. 1.75 m b. 1.55 c. 1.30 d. 1.25

Find the volume displaced by the block if a 1000 N block of wood is floated in the oil.

Determine the height of the tank so that no water will spill out.

- a. 2.44 m b. 1.26 c. 1.82 d. 2.05

If the acceleration is increased by 4 m/s^2 , how much water will be spilled out?

- a. 7.25 m^3 b. 6.15 c. 4.92 d. 3.25

SITUATION 11: Describe the following terms as follows:

A ship floating in seawater is stable if the metacentric height is:

- a. below the center of gravity
b. above the center of gravity
 c. coincides with the center of gravity
 d. the draft of the ship causes a buoyant force equal to the weight of the ship and its cargo.

A device used to measure pressure heads in pipes where the liquid is in motion.

- a. U tube b. Barometer c. Piezometer d. Manometer

It refers to the pressures that are above or below the atmosphere and can be measured by pressure gages or manometers.

- a. Atmospheric pressure c. Barometric pressure
 c. Absolute pressure d. Relative pressure

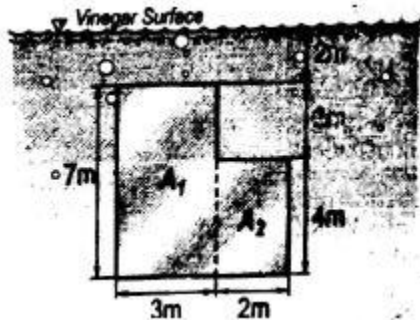
A gage pressure at elevation 6 m at the side of a tank containing a liquid reads 80 kPa. Another gage at elevation 4 m reads 100 kPa. What is the specific gravity of the liquid?

- a. 1.02 b. 1.04 c. 1.21 d. 1.14

Piston A has a cross section of 1200 sq cm while that of piston B is 950 sq cm with the latter higher than piston A by 1.75 m. If the intervening passages are filled with oil whose specific gravity is 0.8, what is the difference in pressure between A and B?

- a. 19.55 kPa b. 13.73 c. 18.44 d. 16.23

SITUATION 12: A vertical plate shown is submerged in vinegar ($\text{sg} = 0.80$). Assume unit weight of water is 9.79 kN/cu m .



Find the depth of the center of pressure of section A1 from the liquid surface.

- a. 5.56 m b. 6.24 c. 4.79 d. 7.11

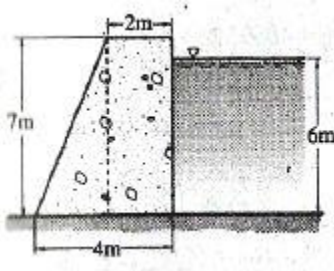
Find the magnitude of the hydrostatic force on one side of the plate.

- a. 1344 kN b. 1479 c. 905 d. 1134

Find the depth of the center of pressure of the whole section from the liquid surface.

- a. 7.23 m b. 4.19 c. 6.55 d. 9.18

SITUATION 13: A concrete dam retaining water is shown. If unit weight of concrete is 23.5 kN/cu m ,



Calculate the hydrostatic force.

- a. 184.75 b. 176.20 c. 155.26 d. 194.17

Calculate the factor of safety against overturning. Use $\mu = 0.48$

- a. 3.42 b. 2.75 c. 1.86 d. 1.54

Calculate the minimum pressure intensity.

- a. 56.9 kPa b. 64.7 c. 73.4 d. 82.6

SITUATION 14: A cylindrical container 8 m long high and 3 m in diameter is reinforced with two hoops 1 m from each end.

Determine the hydrostatic force.

- a. 960.18 kN b. 941.76 c. 855.79 d. 820.06

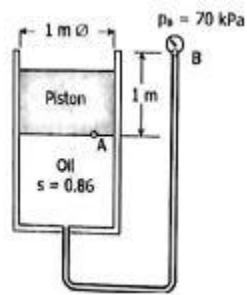
Determine the tension at the upper end.

- a. 164.9 kN b. 141.6 c. 135.3 d. 130.8

Determine the tension at the lower end.

- a. 475.59 kN b. 340.08 c. 256.64 d. 483.37

For the configuration shown, calculate the weight of the piston if the pressure gage reading is 70 kPa.



- a. 84.77 kN b. 56.56 c. 61.61 d. 39.15

Calculate the density of nitrogen at an absolute pressure of 1 MPa at 40°C.

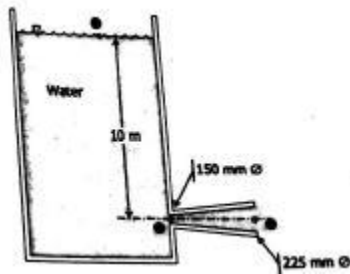
- a. 15.55 kg/m³ b. 13.35 c. 12.05 d. 10.75

A block of wood requires a force of 40 N to keep it immersed in water and force of 100 N to keep it immersed in glycerin ($s = 1.3$). Find the weight of the wood.

- a. 185 N b. 160 c. 135 d. 120

HYDRAULICS AND WATER RESOURCES ENGINEERING REFERSHER MODULE

SITUATION 1: A diverging tube discharges water from a reservoir at a depth of 10 m below the water surface. The diameter of the tube gradually increases from 150 mm at the throat to 225 mm at the outlet as shown in the figure.



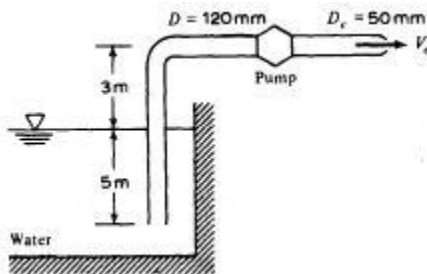
Neglecting friction, determine the maximum possible rate of discharge through this tube.

- a. $0.775 \text{ m}^3/\text{s}$ b. 0.618 c. 0.557 d. 0.481

Determine the corresponding pressure at the throat.

- a. -618.04 kPa b. -398.75 c. -188.15 d. -97.16

SITUATION 2: For the pump shown in the figure, the total friction head loss is 6 m. If the pump delivers 40 kW of power to the water,



Determine the exit velocity of the water.

- a. 32.7 m/s b. 51.4 c. 66.8 d. 18.3

Determine the flow rate.

- a. 48.1 L/s b. 48.5 c. 69.6 d. 64.2

Benzene flows through a 100 mm pipe at a mean velocity of 3 m/s. Find the volume flow rate.

- a. 1844 L/s b. 1416 c. 1233 d. 1655

SITUATION 3: A 25 mm long smooth brass pipe 300 m long drains an open 1.2 m cylindrical tank which contains oil having density = 950 kg/m^3 and dynamic viscosity of $0.03 \text{ N}\cdot\text{s/m}^2$. The pipe discharges at elevation 30 m. The liquid surface of oil is at elevation of 36 m.

Find Reynold's number for oil.

- a. 88.4 b. 96.1 c. 112.7 d. 144.8

Determine the velocity of flow.

- a. 0.1174 m/s b. 0.1488 c. 0.1213 d. 0.1459

Determine the time required in hours for the oil level to drop from elevation 36 to elevation 32.5 m.

- a. 29.6 hours b. 20.4 c. 22.9 d. 27.7

These are the causes of minor losses EXCEPT:

- a. Sudden contraction b. Bends c. Valves d. Changes in water flow

An orifice has a coefficient of discharge of 0.62 and a coefficient of contraction of 0.63. Find the coefficient of velocity for the discharge.

- a. 0.884 b. 0.984 c. 0.655 d. 0.800

This formula in pipes is most commonly used in waterworks.

- a. Darcy-Weisbach b. Manning c. Hazen-Williams d. Chezy

This refers to the overflowing stream in a weir.

- a. Suppressed b. Nappe c. Head d. Contracted

SITUATION 4: The head loss in 74 m of 150 mm diameter pipe is known to be 9 m when oil ($s = 0.90$) flows at $0.057 \text{ m}^3/\text{s}$. Assume viscosity of oil is $0.0389 \text{ Pa}\cdot\text{s}$

Determine the Reynolds number.

- a. 11210 b. 13170 c. 15140 d. 19830

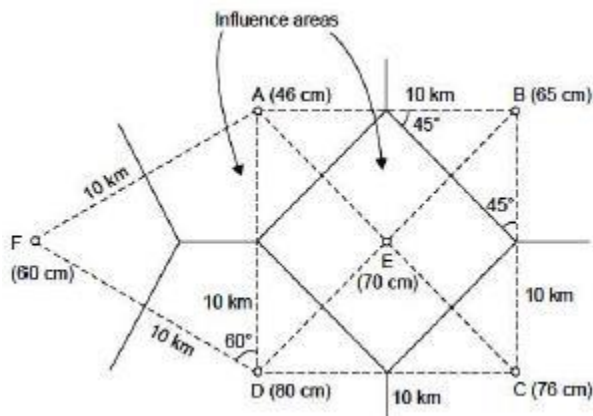
Determine the friction factor " f ".

- a. 0.019 b. 0.034 c. 0.044 d. 0.078

Find the shear stress at the wall of pipe.

- a. 39.91 N/m^2 b. 48.19 c. 56.23 d. 60.18

The area shown in the figure is composed of a square plus an equilateral triangular plot of side 10 km. The annual precipitations at the rain gauge stations located at the four corners and center of the square plot and apex of the triangular plot are indicated in the figure. Find the mean precipitation over the area using Thiessen polygon method.



- a. 84.11 cm b. 76.18 c. 70.59 d. 66.17

SITUATION 5: A 600 mm pipe connects two reservoir whose difference in water surface elevation 48 m. The pipe is 3500 m long and has the following pipe fittings: 2 globe valves, 4 short radius elbows, 2 long radius elbows, and one gate valve half open. The values of loss factors for pipe fittings are given (see Gillesania's Fluid Mechanics and Hydraulics).

Using the equivalent length method, assuming $f = 0.015$, calculate the actual length of the pipe.

- a. 4483 m b. 4064 c. 4199 d. 4318

Determine the head loss of the pipe.

- a. 55 m b. 51 c. 48 d. 40

Calculate the flow of the entire pipe system.

- a. 861 L/s b. 918 c. 648 d. 744

SITUATION 6: A rectangular irrigation canal 6 m wide contains water 1 m deep. It has a hydraulic slope of 0.001 and a roughness coefficient of 0.013.

Evaluate the mean velocity of the water in the canal in m/s.

- a. 6.11 m/s b. 2.01 c. 4.66 d. 1.99

Evaluate the discharge in the canal m^3/s .

- a. $15.55 \text{ m}^3/\text{s}$ b. 18.34 c. 14.15 d. 12.06

What would be the depth of the canal in meters using the more economical proportions but adhering to the same discharge and slope.

- a. 1.89 m b. 1.55 c. 1.67 d. 1.38

Water from a reservoir through a non-rigid 600 mm pipe with a velocity of 2.5 m/s is completely stopped by a closure of a valve situated 200 m from the reservoir. Assume that the pressure increases at a uniform rate and that there is no damping of the pressure wave. The pipe has a thickness of 20 mm, bulk modulus of water is $2.2 \times 10^9 \text{ Pa}$ and modulus of elasticity of steel is $1.4 \times 10^{11} \text{ Pa}$. Compute the celerity of pressure wave.

- a. 1885 m/s b. 1544 c. 1618 d. 1223

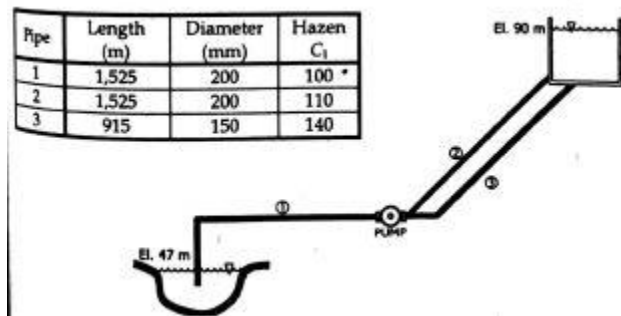
Water flows through an orifice at the vertical side of a large tank under a constant head of 2.4 m. How far horizontally from the vena contracta will the jet strikes the ground 1.5 below the orifice?

- a. 3.88 m b. 3.79 m c. 3.45 d. 3.08

During a test on a 2.4 m suppressed weir 900 mm high, the head was maintained constant at 300 mm. In 38 seconds, 28,800 liters of water were collected. What is the weir factor, C_w ?

- a. 1.044 b. 1.518 c. 1.891 d. 2.055

SITUATION 7: In the figure and the table shown, it is desired to pump 3,411,000 L/day of water from a stream to a pool. If the combined pump and motor efficiency is 70% ,



Determine the total pumping head in meters.

- a. 55.7 b. 69.8 c. 81.6 d. 101.9

Determine the power required by the pump.

- a. 38.614 kW b. 41.554 c. 56.212 d. 61.001

If the electricity is P 6.00 per kW-hr, and operating for 24 hr , assuming 1 month = 30 days, compute the monthly power cost.

- a. P 98,445.19 b. 112,273.15 c. 133,218.85 d. 166,812.48

SITUATION 8: Answer the following terms in Hydraulics and Water Resources Engineering.

In precipitation , these consist of tiny liquid droplets, usually with diameters between 0.1 and 0.5 mm, with such slow settling rates that they occasionally appear to float.

- a. Rain b. Hail c. Snow d. Drizzle

These are the sections which the parameters of channel flow will give maximum discharge.

- a. Normal Depth c. Most Efficient Section
b. Critical Flow d. Hydraulic Grade Line

The first "S" in MWSS stands for:

- a. System b. Sewerage c. Stock d. Society

SITUATION 9: Two pipes are connected in parallel between two reservoirs $L_1 = 2600$ m, $D_1 = 1.3$ m, $C = 90$; $L_2 = 2400$ m, $D_2 = 0.9$ m, $C = 100$. For a difference in elevation of 3.8 m,

Determine the velocity in pipe 1.

- a. 1.218 m/s b. 1.318 c. 1.109 d. 1.213

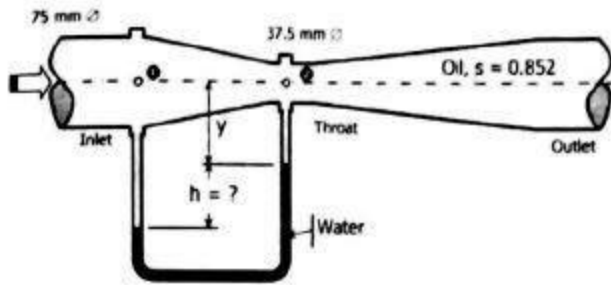
Determine the velocity in pipe 2.

- a. 1.020 m/s b. 1.116 c. 1.307 d. 1.064

Determine the total flow of water.

- a. 4.77 m/s b. 3.64 c. 2.91 d. 2.12

SITUATION 10: In the venture meter shown in the figure, $C = 0.957$, the recorded flow in the meter is 1.5 L/s ,



Determine the theoretical discharge.

- a. $0.001814 \text{ m}^3/\text{s}$ b. 0.001567 c. 0.00214 d. 0.001956

Calculate the difference in pressure heads in the venturimeter.

- a. 0.045 m b. 0.068 c. 0.096 d. 0.111

Determine the deflection of water, h in the differential manometer connected between the inlet and the throat?

- a. 695 mm b. 475 c. 554 d. 318

There are four commonly used methods for the base flow separation EXCEPT:

- a. Straight Line b. Fixed base length c. Chow's d. Constant slope

SITUATION 11: A jet of water 250 mm in diameter impinges normally on a flat steel plate. If the discharge is 0.491 cu m/s ,

Find the force exerted by the jet on the stationary plate.

- a. 6.33 kN b. 4.91 c. 3.64 d. 2.79

If the flat plate is moving at 2 m/s in the same direction as that of the jet, find the force exerted by the jet on the plate.

- a. 3.142 kN b. 2.216 c. 1.977 d. 1.425

If the flat plate is moving at 4 m/s in the same direction as that of the jet, find the work done on the plate per second.

- a. 7525 N.m/s b. 8419 c. 7068 d. 6619

SITUATION 12: Reservoir B shown in the figure receives $0.06 \text{ m}^3/\text{s}$ of flow.

Determine the flow in line AD.

- a. 0.219 cu m/s b. 0.203 c. 0.233 d. 0.173

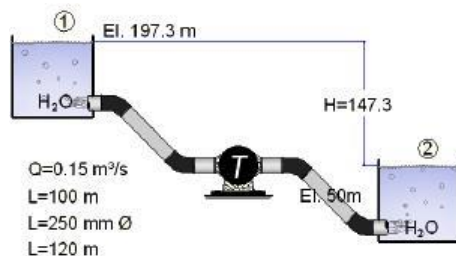
Determine the flow in line DC.

- a. 0.143 cu m/s b. 0.113 c. 0.159 d. 0.173

Find the elevation of reservoir B.

- a. 92.76 m b. 90.07 c. 91.06 d. 89.09

SITUATION 13: Water flows from an upper reservoir to lower one while passing through a turbine as shown in the figure.



Find the velocity of water.

- a. 3.66 m/s b. 3.06 c. 4.79 d. 5.19

Find the head loss due to friction.

- a. 4.77 m b. 3.18 c. 3.53 d. 3.87

Find the power generated by the turbine

- a. 211 kW b. 264 c. 313 d. 327

A sewage pipe carries:

- a. storm water b. potable water c. fatal materials d. sewage

A 20 cm diameter pipe length of 100 m with $z = 60$ m, $f = 0.02$ m and loss of head due to entrance coefficient $k = 0.5$. What is the flow rate?

- a. 11.48 m/s b. 10.12 c. 15.55 d. 18.79

A discharge of 750 L/s flows through a pipe having diameter of 400 mm, 85 m long. Using Hazen-Williams formula, compute the head loss.

- a. 5 m b. 7 c. 13 d. 4

GEOTECHNICAL ENGINEERING MODULE

SITUATION 1: A uniform soil deposit has a dry unit weight of 15.6 kN/m^3 and a saturated unit weight of 17.2 kN/m^3 . The ground water table is at a distance of 4 m below the ground surface. Point A is at depth of 6 m below the ground surface.

Compute the effective stress at A.

- a. 51.02 kPa b. 48.45 kPa c. 54.27 d. 42.39

If the water table goes up by 3.5 m find the effective stress at A.

- a. 44.34 kPa b. 41.02 c. 47.46 d. 48.12

In comparison to 1 and 2, what will happen to the effective stresses at A if the ground water surface will rise up the ground surface?

- a. Increase b. Remain c. Decrease d. Cannot be determined

SITUATION 2: A soil sample was determined in the laboratory to have a liquid limit of 41% and a plastic limit of 21.1%. If the water content is 30%,

Determine the plasticity index.

- a. 21.1 b. 19.9 c. 9.9 d. 11.1

Determine the liquidity index.

- a. 0.507 b. 0.608 c. 0.394 d. 0.447

What is the characteristic of soil?

- a. Brittle b. Liquid c. Dense d. Plastic

SITUATION 3: A consolidated drained tri-axial test was conducted on a normally consolidated clay. The results as follows:

Chamber confining pressure: 138 kPa

Deviator Stress = 258 kPa

Compute the friction angle of the soil.

- a. 32.55° b. 21.07° c. 28.89° d. 35.15°

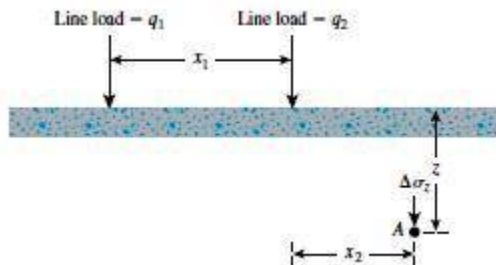
Compute the normal stress at failure.

- a. 204.68 kPa b. 212.59 c. 278.87 d. 255.15

Compute the shear stress at failure.

- a. 137.15 kPa b. 112.95 c. 108.53 d. 111.31

SITUATION 4: Refer to the figure. Given $q_1 = 300 \text{ kN/m}$, $q_2 = 260 \text{ kN/m}$, $x_1 = 4 \text{ m}$, $x_2 = 3 \text{ m}$ and $z = 3 \text{ m}$.



Find the vertical stress increase at point A due to first line load.

- a. 1.75 kPa b. 1.61 c. 1.53 d. 1.44

Find the vertical stress increase at point A due to the second line load.

- a. 13.79 kPa b. 14.44 c. 16.78 d. 12.31

Find the total vertical stress at point A.

- a. 15.54 kPa b. 18.39 c. 15.32 d. 13.75

SITUATION 5: A certain soil deposit has a liquid limit of 47% and a plastic limit of 24%.

Compute the coefficient of earth pressure at rest of this soil deposit. Hint: $K_0 = 0.19 + 0.223\log(PI)$

- a. 0.507 b. 0.447 c. 0.239 d. 0.319

Compute the total stress at rest lateral earth pressure a depth of 5 m. in a dense sand deposit where this soil was obtained. Unit weight of sand is 18.4 kN/m^3 .

- a. 45.33 kPa b. 46.64 c. 48.33 d. 50.01

Compute the total stress at rest lateral earth pressure at a depth of 5 m in the same sand deposit but a water table is located at a ground surface. Saturated unit weight of sand is 20.5 kN/m^3 .

- a. 84.31 kPa b. 80.64 c. 76.15 d. 72.21

SITUATION 6: Specifications on a job required a fill using borrowed soil to be compacted at 95% of its standard Proctor maximum dry density. Tests indicate that the maximum is 19.5 kN/m^3 with 12% moisture. The borrow material has a void ratio of 0.60 and a solid specific gravity of 2.65.

Compute the dry unit weight of the compacted soil.

- a. 17.216 kN/m^3 b. 18.525 c. 15.132 d. 19.761

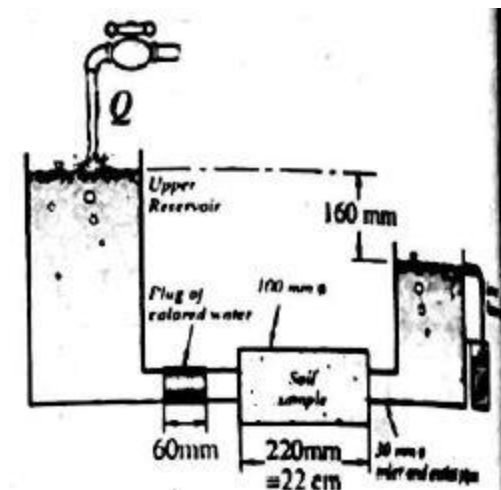
Compute the wet unit weight of the compacted soil.

- a. 21.2 kN/m^3 b. 20.7 c. 19.6 d. 18.5

Find the required minimum volume of borrow soil required to fill one cubic meter.

- a. 1.38 m^3 b. 1.65 c. 1.14 d. 1.29

SITUATION 7: The laboratory apparatus shown in the figure maintains a constant head in both the upper and lower reservoirs. The soil sample is a silty sand with hydraulic conductivity of $K = 5 \times 10^{-3} \text{ cm/s}$ and a moisture content of 18.5%. The specific gravity of the soil is 2.70.



Compute the void ratio.

- a. 0.40 b. 0.50 c. 0.65 d. 0.90

Compute the seepage velocity.

- a. 0.011 cm/s b. 0.007 c. 0.026 d. 0.034

Compute the discharge.

- a. $0.353 \text{ m}^3/\text{s}$ b. 0.215 c. 0.247 d. 0.287

SITUATION 8: Answer the following terms in Geotechnical Engineering.

Rocks can be classified in three basic categories EXCEPT:

- a. atmospheric b. sedimentary c. metamorphic d. igneous

It is a line along which a water particle will travel from upstream to the downstream side in the permeable soil medium.

- a. Stress line b. equipotential c. impervious line d. flow line

SITUATION 9: Results from liquid and plastic limit tests conducted on a soil are given in the table.

Number of blows, N	Moisture content (%)
14	38.4
16	36.5
20	33.1
28	27.0

Assuming the plastic limit is at 13.4% , determine the plasticity index of the soil.

- a. 13.7 b. 15.6 c. 16.6 d. 18.3

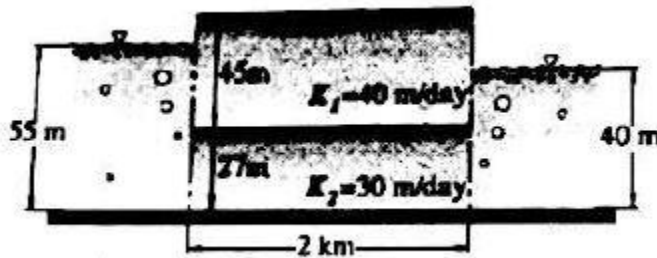
Determine the liquid limit of the soil sample.

- a. 32 b. 29 c. 25 d. 19

Determine the liquidity index if the water content is 32%.

- a. 1.54 b. 1.66 c. 1.19 d. 1.05

SITUATION 10: A confined aquifer underlies an unconfined aquifer as shown in the figure.



Compute the equivalent horizontal coefficient of permeability.

- a. 34.17 m/day b. 36.25 c. 38.19 d. 40.01

Compute the hydraulic gradient.

- a. 0.0075 b. 0.0080 c. 0.0100 d. 0.0075

Compute the flow rate in cu m per day per meter.

- a. 13.76 b. 11.65 c. 10.83 d. 12.91

SITUATION 11: A saturated clay layer has a thickness of 8 m with a water content of 50% and a specific gravity of 2.78.

Compute the saturated unit weight of the clay.

- a. 17.12 kN/m³ b. 15.69 c. 18.37 d. 20.45

Determine the total stress at the bottom.

- a. 157.44 kPa b. 136.96 c. 141.27 d. 147.84

Find the effective stress at the bottom.

- a. 64.19 kPa b. 58.48 c. 39.12 d. 46.79

SITUATION 12: A dense silt layer has the following properties:

Void ratio $e = 0.40$

Effective diameter $d_{10} = 10$ micrometers

Capillary constant $C = 0.20$ sq cm

Free ground water level is 8.0 m below the ground surface.

Find the height of the capillary rise in the soil.

- a. 4 m b. 7 c. 5 d. 8

Find the vertical effective stress in kPa at 5 m depth. Assume $\gamma_{sat} = 26.5$ kN/m³ and that the soil above the capillary action rise and ground surface is partially saturated at 50%.

- a. 134 kPa b. 150 c. 162 d. 177

Find the vertical effective stress at 10 depth. Assume unit weight of saturated soil and capillary rise in (34).

- a. 277.55 b. 261.18 c. 239.46 d. 205.29

SITUATION 13: Answer the following terms for the geotechnical engineering instruments.

This test is described as follows: "The water supply at the inlet is adjusted in such a way that the difference of head between the inlet and the outlet remains constant during the test period."

- a. Falling head b. Vane Shear c. Constant Head d. Pumping Head

It is a device by which a 60° cone that is used to allow independent determination of the cone resistance and frictional resistance of the soil above the ground.

- a. Sand cone b. Pycnometer c. Penetrometer d. Rubber balloon

These are pushed or driven into the soil that can be used in permeability tests.

- a. Porous probes b. Permeameter c. Pump well d. Head pump

SITUATION 14: A sample of sand above the water table was found to have a natural moisture content of 15% and a unit weight of 120 pcf. Laboratory tests on a dried sample indicated values of $e_{min} = 0.50$ and $e_{max} = 0.85$ for the densest and loosest states respectively.

Find the void ratio.

- a. 0.587 b. 0.609 c. 0.645 d. 0.788

Find the degree of saturation.

- a. 67.7 b. 70.4 c. 77.6 d. 81.5

Find the density index.

- a. 0.50 b. 1.00 c. 0.60 d. 0.75

SITUATION 15: For a normally consolidated clay, it has an angle of friction of 25° . In a drained tri-axial test, the specimen failed at a deviator stress of 180 kPa.

Compute the chamber confining pressure.

- a. 176.54 kPa b. 186.17 c. 144.66 d. 122.96

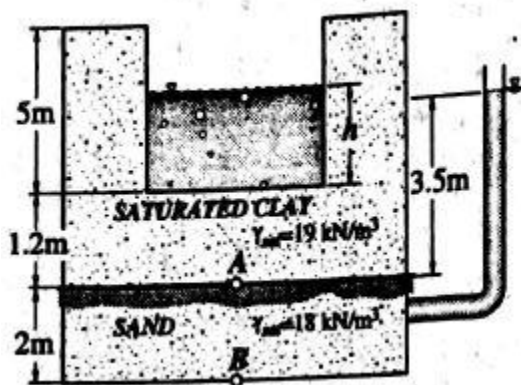
Compute the max. stress of failure.

- a. 296.96 kPa b. 302.96 c. 312.47 d. 318.39

Compute the shear stress at failure.

- a. 88.79 kPa b. 85.29 c. 81.57 d. 80.16

SITUATION 16: A cut is made in a stiff, saturated clay that is underlain by a layer of sand. The saturated unit weight of clay is 19 kN/m^3 and that of sand is 18 kN/m^3 .



What should be the height of the water "h" in the cut so that the stability of the saturated clay is not lost?

- a. 1.75 m b. 1.26 c. 1.18 d. 1.09

What would be the total stress at A.

- a. 37.33 kPa b. 34.38 c. 35.59 d. 32.74

What is the effective stress at B?

- a. 11.71 kPa b. 15.44 c. 13.29 d. 16.38

SITUATION 17: A liquid limit test conducted on a soil sample in the cup device, gave the following results:

Number of blows	10	19	23	27	40
Water content (%)	60.0	45.2	39.8	36.5	25.2

Two determinations for the plastic limit gave water contents of 20.3% and 20.8%. Determine the liquidity index if the natural water content is 27.4%.

- a. 0.76 b. 0.57 c. 0.39 d. 0.50

Determine the void ratio if the sp gr is 2.70.

- a. 1.03 b. 1.17 c. 1.21 d. 1.31

What is the characteristic of soil?

- a. Brittle b. Dense c. Liquid d. Plastic

FOUNDATION ENGINEERING REFRESHER MODULE

SITUATION 1: Two footings rest in a layer of sand 2.7 m thick. The bottom of the footings are 0.90 m below the ground surface. Beneath the sand layer is a 1.8 m clay layer. Beneath the clay layer is a hard pan. The water table is at a depth of 1.8 m below the ground surface.

Compute the stress increase at the center of the clay layer assume that the pressure beneath the footing is spread at an angle of 2 vertical to 1 horizontal.

- a. 36.55 kPa b. 21.18 c. 25.51 d. 30.18

Determine the size of footing B so that the settlement in the clay layer is the same beneath footings A and B. Footing A is 1.5 m square.

- a. 3.24 m b. 4.18 c. 3.78 d. 4.77

Determine the settlement beneath footing A.

- a. 82.11 mm b. 46.65 c. 54.18 d. 56.75

SITUATION 2: A concrete pile having a diameter of 0.30 m is to be driven into a loose sand having a unit weight of 20 kN/ cu m. The pile has a length of 12 m. Coefficient of friction between the sand and pile is 0.4. Bearing capacity factor $N_q = 80$. The shaft lateral pressure factor K is equal to 0.90. Allowable load of the pile is 170 kN.

Compute the ultimate bearing capacity of the pile.

- a. 345.9 kN b. 339.3 c. 321.2 d. 315.6

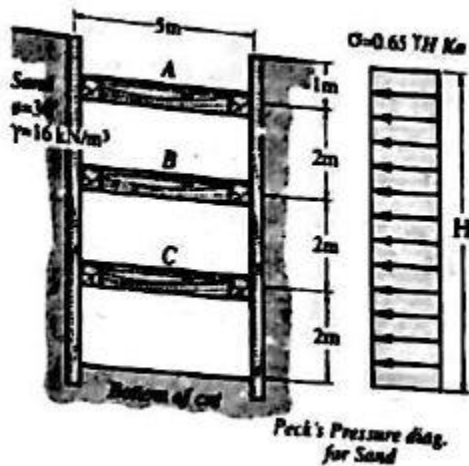
Compute the ultimate frictional capacity.

- a. 211.7 b. 213.8 c. 216.8 d. 220.

Find the factor of safety.

- a. 4.79 b. 4.02 c. 3.25 d. 3.11

SITUATION 3: A 7 m deep braced cut in sand is shown in the figure. In the plan the struts are placed at a spacing of 2 m center to center. Using Peck's empirical pressure diagram,



Compute the strut load at level A.

- a. 116.18 kN b. 154.77 c. 109.22 d. 128.77

Compute the strut load at level B.

- a. 477.54 kN b. 382.53 c. 356.74 d. 339.78

Compute the strut load at level C.

- a. 247.83 kN b. 194.16 c. 221.89 d. 203.15

SITUATION 4: A retaining wall 7 m high is supporting a horizontal backfill having a dry unit weight of 1570 kg/m³. The cohesionless soil has an angle of friction of 34° and a void ratio of 0.68.

Compute the Rankine active force on the wall.

- a. 113.87 kN b. 110.65 c. 106.77 d. 101.53

Compute the Rankine active force on the wall if water logging occurs at a depth of 3 m from the ground surface.

- a. 172 kN b. 166 c. 184 d. 153

Compute the location of the resultant active force from the bottom.

- a. 1.88 m b. 1.95 c. 2.02 d. 2.18

SITUATION 5: A cantilever sheet pile is 8.2 m long with a depth of embedment of 3.2 m. Angle of friction of the soil supported by the sheet pile is 34° and has a unit weight of 1.91 g/cc. There is water table below the base of the sheet pile. Use $\gamma_{\text{water}} = 9.81 \text{ kN/m}^3$.

Compute the active force acting on the sheet pile.

- a. 181.2 kN/m b. 155.8 c. 178.3 d. 164.7

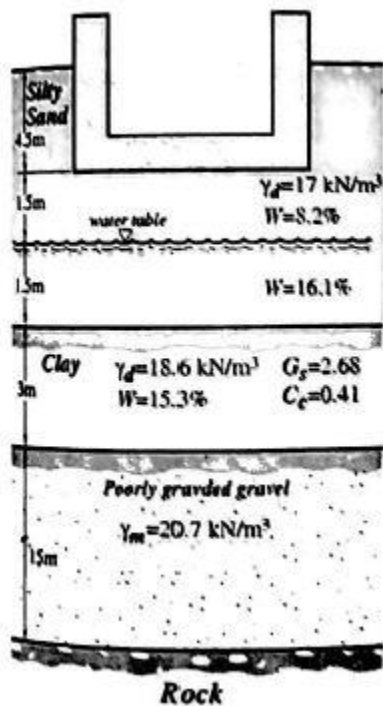
Compute the passive force acting on the sheet pile.

- a. 373.6 kN/m b. 338.7 c. 326.9 d. 350.8

Compute the theoretical passive force that must be mobilized to ensure stability.

- a. 477.9 kN/m b. 505.8 c. 488.3 d. 456.9

SITUATION 6: In the soil profile shown, the clay layer is normally consolidated and the ground water location maybe assumed to remain constant. The raft foundation is 15 m x 15 m with a uniform loading of 192 kPa.



Compute the initial effective stress at the midpoint location of clay layer.

- a. 142.47 kPa b. 161.85 c. 196.03 d. 207.10

Find the change in stress at mid point of clay?

- a. 88.15 kPa b. 90.16 c. 92.17 d. 98.30

Find the settlement due to placement of the raft foundation.

- a. 186 mm b. 199 c. 202 d. 209

It is the direct result of the decrease in the soil volume.

- a. Consolidation b. Settlement c. Compressibility d. Transmissibility

He proposed a method based on pressuremeter tests from which the load-settlement diagrams of foundations can be derived.

- a. Meyerhof b. Boussinesq c. Briaud d. Westergaard

A vertical cut is to be made through a soil mass. The soil to be cut has the following properties:

$\gamma_{\text{soil}} = 16.5 \text{ kN/m}^3$, cohesion = 24 kPa, angle of internal friction = 21° ,
Use Culman's method with a factor of safety of 2. Compute the value of the developed cohesion.

- a. 18 kPa b. 12 c. 48 d. 26

These consists of four equal sized thin steel plates welded to a steel torque.

- a. Sieve b. Pressuremeter c. Sand cone d. Shear vane

It is usually done during drilling on rock formations.

- a. Borrow pit b. Test pit c. Core Boring d. Auger boring

SITUATION 7: A cantilevered retaining wall was originally designed with a base width of 3 m but it was actually constructed with a base width of 1.8 m. The original design incorporated a factor of safety of 2 and ignored passive pressure.

Compute the total lateral force acting on the wall.

- a. 124.33 kN b. 154.29 c. 187.66 d. 221.78

Compute the location of the resultant lateral force from the bottom of the wall footing.

- a. 1.47 m b. 1.77 c. 1.96 d. 2.13

Compute the new factor of safety against overturning moment about the toe.

- a. 1.25 b. 1.37 c. 1.50 d. 1.63

SITUATION 8: A concrete pile 12 m long having cross section of 0.30 m x 0.30 m is fully embedded into a layer of sand assuming $C = 0$. Frictional resistance of pile at working condition is 200 kN and 100 kN is the point load capacity at working condition. Allowable working load is 340 kN.

Compute the elastic settlement of the pile.

- a. 1.89 mm b. 1.55 c. 1.37 d. 1.29

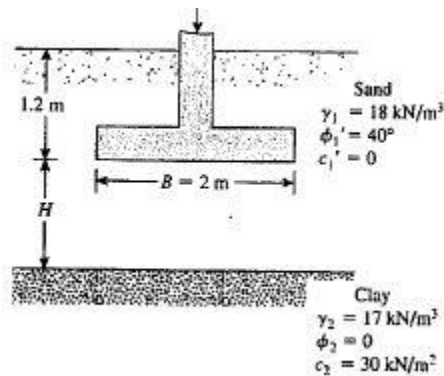
Compute the settlement caused by the load transmitted along the pile shaft.

- a. 0.577 mm b. 0.601 c. 0.389 d. 0.638

A square column foundation has to carry a gross allowable load of 1805 kN, $FS = 3$, $d_f = 1.5$ m, $\gamma = 15.9$ kN/m³, $\phi = 34^\circ$, and $c = 0$. Compute the width of the footing.

- a. 3 m b. 4.5 c. 2 d. 1.75

SITUATION 9: This figure shown is a continuous foundation,



If $H = 1.5$ m, determine the ultimate bearing capacity, q_u ?

- a. 315.5 kPa b. 306.9 c. 286.3 d. 278.1

At what minimum height H will the clay layer not have any effect on the ultimate bearing capacity of the foundation?

- a. 10 m b. 11 c. 12 d. 13

SITUATION 10: A mat foundation having dimensions of 100 x 32 ft carries a total weight of structure plus live load of 5200 tons. The mat foundation is supported by sand underneath. Unit weight of sand is 125 pcf. The N value from the standard penetration test is equal to 18 with a correction factor $C_n = 0.62$. If the base of the footing is 8 ft below the ground level,

Compute the overburden pressure 8 ft below the ground in tons per sq ft.

- a. 0.48 b. 0.56 c. 0.61 d. 0.68

Find the allowable net soil pressure. Hint: use $P_{allow} = 0.22N$.

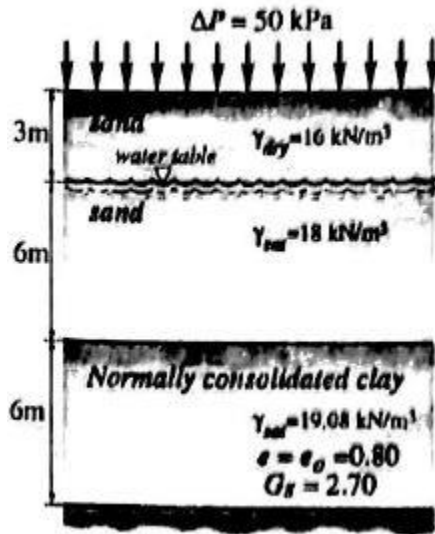
- a. 4.74 tons/ft² b. 4.90 c. 3.64 d. 3.96

Determine the factor of safety against bearing capacity failure. Note: Because the differential settlement of a mat foundation are less than those of an individual footing foundation designed for the

same soil pressure, it is reasonable soil pressures approximately two times as great as that allowed for individual footings maybe used because it does not lead to detrimental differential settlements.

- a. 7.71 b. 5.57 c. 6.15 d. 6.92

SITUATION 11: A soil profile shown in the figure. A uniformly distributed load of 50 kPa is applied at the ground surface. The clay is normally consolidated.



Compute the compression index.

- a. 0.272 b. 0.332 c. 0.418 d. 0.554

Compute the primary consolidation settlement.

- a. 159 mm b. 280 c. 94 d. 226

Compute the secondary settlement 8 years after the completion of primary consolidation settlement. Time for completion of primary settlement is two years. Assume that secondary compression index is 0.025.

- a. 24 mm b. 48 c. 52 d. 35

For timber piles, the Class A types have the minimum diameter of its butt of:

- a. 305 mm b. 330 c. 320 d. 356

A vertical retaining wall 4 m high with a cohesionless horizontal soil backfill with a unit weight of 15.5 kN/m^3 , angle of internal friction = 30° , angle of friction between soil and the wall is 15° . Compute the active earth pressure coefficient for static condition.

- a. 0.2866 b. 0.3014 c. 0.3255 d. 0.3656

SITUATION 12: Define the following terms in foundation engineering.

This is also called skin friction.

- a. Rear shear b. Back shear c. Side shear d. Upper shear

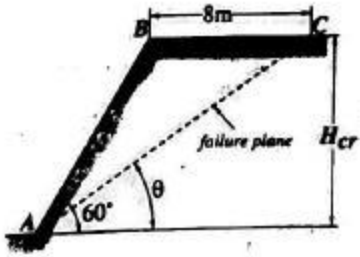
It is the slope of the normal consolidation line in a plot of void ratio against the natural logarithm of mean effective stress.

- a. Plasticity index b. Consolidation index c. Liquidity index d. Compression index

In slope stability, it refers to the surface of sliding

- a. Failure plane b. Bearing plane c. Consolidation plane d. Slip plane

SITUATION 13: From the figure shown, the soil has a unit weight of 17 kN/m^3 and undrained shear strength of $c_u = 20 \text{ kPa}$. The slope makes an angle of 60° with the horizontal. Assume stability number $m = 0.185$.



Compute the stability factor.

- a. 4.77 b. 5.41 c. 6.18 d. 6.56

Compute the maximum depth up to which the cut could be made.

- a. 8.54 m b. 6.36 c. 7.11 d. 6.05

Compute the angle that the failure plane makes with the horizontal if $BC = 8$ m.

- a. 28.59° b. 31.56° c. 34.55° d. 38.13°

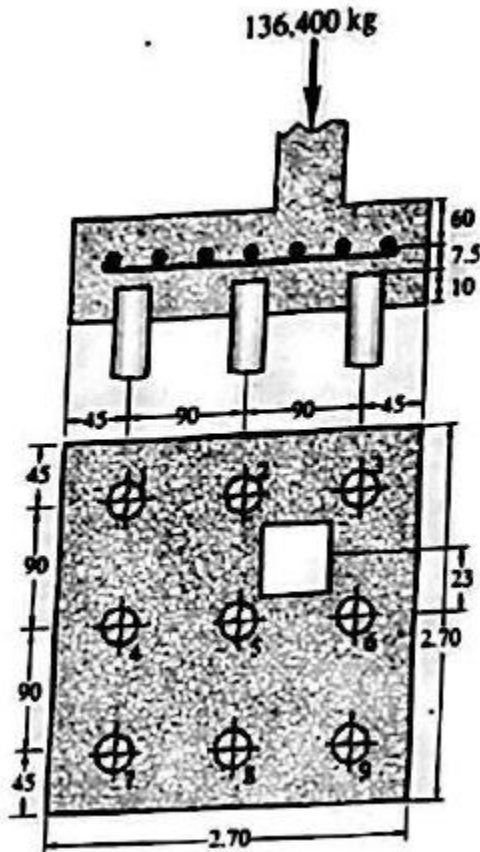
A retaining wall 6 m high is supporting a horizontal backfill having dry unit weight of 1600 kg/m^3 . The cohesionless soil has an angle of friction of 32° and a void ratio of 0.68. Compute the Rankine active force of the wall.

- a. 91.55 kN b. 64.07 c. 78.55 d. 86.76

A 0.3×0.3 concrete pile is driven into a clayey soil having a unconfined strength of 110 kPa. The pile has a length of 10 m. Unit weight of clay is 18 kN/m^3 . Compute the ultimate frictional capacity using alpha method with $\alpha = 0.50$.

- a. 210 kN b. 350 c. 270 d. 400

SITUATION 14: The footing shown carries a column load of 136,400 kg on a column section 60×60 cm. neglecting the weight of the footing.



Compute the maximum load of the piles.

- a. 24778 kg b. 30564 c. 33718 d. 38184

Compute the minimum load of the piles.

a. 6588 kg

b. 5078

c. 5557

d. 5385

Compute the pile load on lowermost left corner (pile 7).

a. -178.85 kg

b. -212.56

c. -252.60

d. -318.41

STRUCTURAL ENGINEERING AND CONSTRUCTION

ENGINEERING MECHANICS REFRESHER SET

SITUATION 1: The mass of the boat and its passengers is 1180 kg. The boat moves on a circular path of $R = 24$ m. at a constant speed of 6 m/s.

What is the tangent component of the total force acting on the boat?

- a. 6 kN b. 3.5 c. 2.5 d. 0

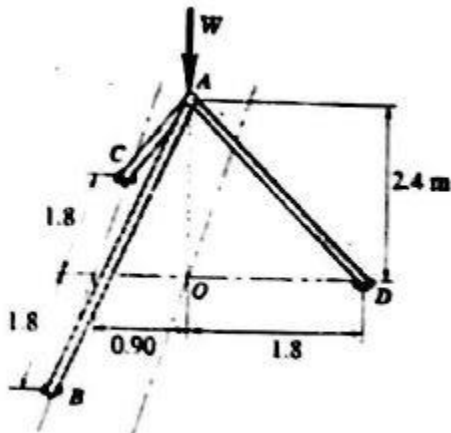
What if the normal component of total force acting on the boat?

- a. 1.77 kN b. 2.35 c. 3.7 d. 0.98

If the boat is moving at a speed of 6 m/s at current instant and is increasing its speed at 2 m/s^2 , what is the magnitude of the sum of the external forces acting on the boat that includes its weight?

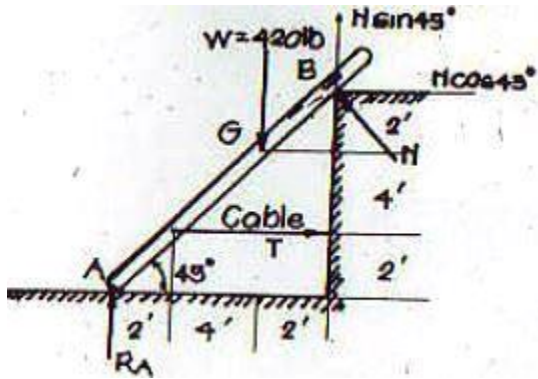
- a. 2.84 kN b. 2.95 c. 3.17 d. 1.48

The tripod supports the load W as shown in the figure. Determine the maximum load " W " that can be supported by the tripod if the capacity of each leg is limited to 10 kN.



- a. 45 kN b. 30 c. 23 d. 3.33

SITUATION 2: The uniform rod shown in the figure weighs 420 N and has its center of gravity at G .



Determine the tension of the rod.

- a. 180 N b. 254.56 c. 240 d. 1260

Determine the normal force above the rod.

- a. 180 N b. 254.56 c. 240 d. 1260

Determine the reaction at the bottom of the rod.

- a. 180 N b. 254.56 c. 240 d. 1260

SITUATION 3: Answer the following terms in engineering mechanics.

What is the branch of engineering mechanics which refers to the study of stationary rigid body?

- a. Statics b. Kinetics c. Kinematics d. Dynamics

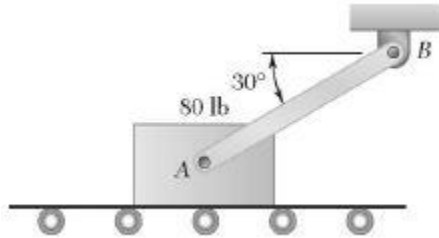
What refers to the force that holds part of the rigid body together?

- a. Natural Force b. External Force c. Internal Force d. Concentrated Force

"Two forces acting on a particle may be replaced by a single force called resultant which can be obtained by drawing diagonal of parallelogram which has the sides equal to the given forces". This statement is known as:

- a. Pappus Propositions
- b. Principle of Transmissibility
- c. Parallelogram Law
- d. Varignon's Theorem

SITUATION 4: The 80 lb block is attached to link AB and rests on a moving belt. Knowing that $\mu_s = 0.25$ and $\mu_k = 0.20$,



Calculate the reaction R that should be applied to the belt to maintain its motion to the right.

- a. 75.54 lb
- b. 95.23
- c. 100.78
- d. 56.18

Calculate the reaction R that should be applied to the belt to maintain its motion to the left.

- a. 55.75 lb
- b. 64.43
- c. 74.14
- d. 81.23

Calculate the horizontal force P that should be applied to the belt to maintain its motion to the left?

- a. 14.34 lb
- b. 18.72
- c. 20.06
- d. 21.35

SITUATION 5: The 10 m ladder weighing 35 kg is resting on a horizontal floor at A and on the wall at B making an angle of 60° from the horizontal. The coefficient of friction of all surfaces is 0.25.

Determine the distance "x" to which the 72 kg man can climb the ladder without causing the ladder to slip at its lower end A.

- a. 3.5 m
- b. 4.5
- c. 6
- d. 10

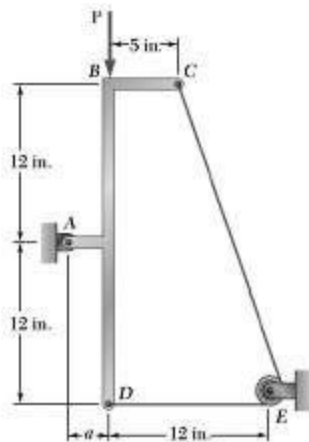
Determine the reaction at the wall at B.

- a. 212.7 N
- b. 254.6
- c. 280.7
- d. 312.5

Determine the reaction at the horizontal floor at A.

- a. 1157.5 N
- b. 1230.6
- c. 954.9
- d. 1018.5

SITUATION 6: A force P of magnitude 280 N is applied to member ABCD, which is supported by a frictionless pin at A and by the cable CED. Since the cable passes over a small pulley at E, the tension may be assumed to be the same portions CE and ED of the cable. For the case when $a = 3$ m,



Determine the tension in the cable.

- a. 900 N
- b. 875
- c. 860
- d. 850

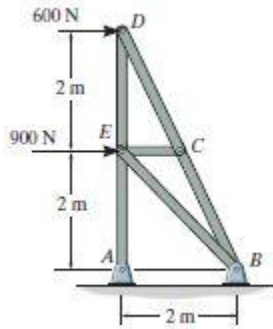
Determine the vertical reaction at A.

- a. 1850 N
- b. 1720
- c. 1460
- d. 1120

Determine the angle of the reaction.

- a. 60°
- b. 36.87°
- c. 45°
- d. 53.13°

SITUATION 7: In the truss shown,



Determine the force DE.

- a. 1.20 kN(T) b. 1.2 (C) c. 1.34 kN (T) d. 1.34 (C)

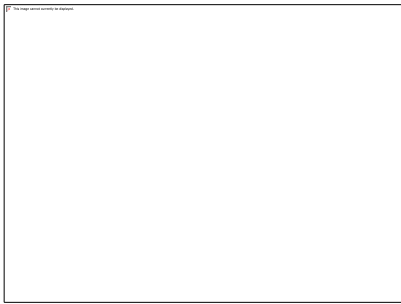
Determine the force CE.

- a. 1.34 kN (T) b. 2.10 (C) c. 0 d. 1.27 (T)

Determine the force EB.

- a. 1.34 kN (C) b. 1.27 (C) c. 0 d. 2.1 (C)

SITUATION 8: Spring CD remains in the horizontal position at all times due to the roller at D. If the spring is unstretched when $\theta = 0^\circ$ and the bracket achieves its equilibrium position when $\theta = 30^\circ$,



Determine the stiffness k of the spring.

- a. 1.75 kN/m b. 1.33 c. 1.87 d. 1.16

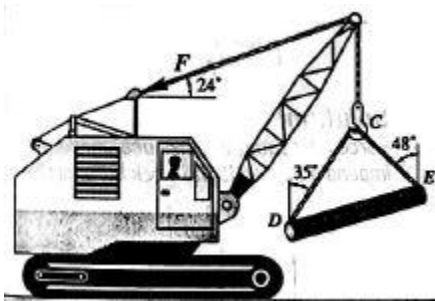
Determine the vertical component at A.

- a. 250 N b. 285 c. 290 d. 300

Determine the horizontal component at A.

- a. 374.15 N b. 384.27 c. 398.21 d. 412.29

SITUATION 9: A crane cable is supporting a 100 kN load as shown below:



Find the tension in cable CD.

- a. 74.87 kN b. 53.84 c. 91.65 d. 86.78

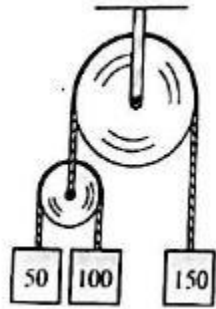
Find the tension in cable CE.

- a. 53.44 b. 61.84 c. 57.79 d. 77.61

Find the force F.

- a. 250 kN b. 100 c. 83.56 d. 91.79

SITUATION 10: The three bodies A, B, and C weighs 50 N, 100 N, and 150 N respectively. If they are supported in the position shown and then released simultaneously, neglecting mass of chords and pulleys.



Calculate the acceleration of block A.

- a. 3.462 m/s^2 b. 0.576 c. 4.038 d. 9.81

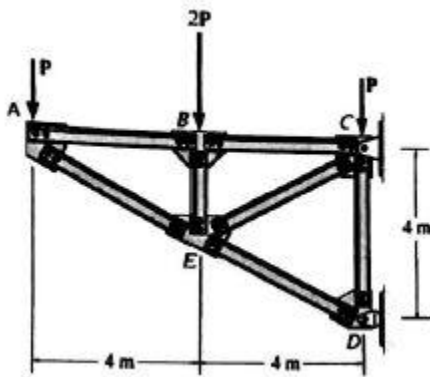
Calculate the acceleration at block B.

- a. 2.886 m/s^2 b. 2 c. 3 d. 0.576

Calculate the acceleration at block C.

- a. 4.038 m/s^2 b. 6 c. 2.886 d. 0.576

SITUATION 11: Assume that each member of the truss is made of steel having a mass per length of 4 kg/m . Set $P = 0$, neglect the weight of the gusset plates and assume each joint is a pin.



Find member AE.

- a. 414 N T b. 226 C c. 411 T d. 372 C

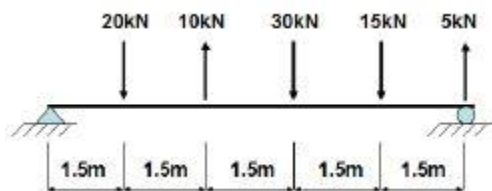
Find member AB.

- a. 332 N T b. 196 C c. 226 T d. 332 C

Find member BE.

- a. 411 C b. 226 T c. 196 C d. 414 T

SITUATION 12: A beam is loaded shown in the figure.



Determine the resultant load.

- a. 30 kN b. 45 c. 50 d. 65

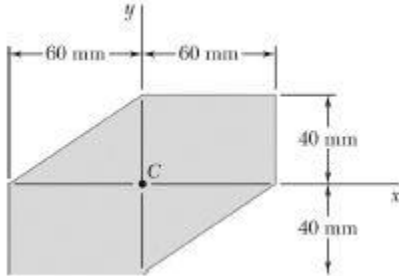
Determine the location of the resultant load from the left support.

- a. 3.75 m b. 4.20 c. 4.5 d. 3.5

Determine the reaction at the left support.

- a. 45 kN b. 35 c. 25 d. 50

In the figure shown, compute the product moment of inertia.



- a. $3.2 \times 10^6 \text{ mm}^4$ b. 2.4×10^6 c. 4.7×10^6 d. 6.0×10^6

SITUATION 13: Name the Physicists on the principles of mechanics as stated.

He studied the effects of dry friction which occurs between the contacting surfaces of bodies when there is no fabricating fluid.

- a. Newton b. Varignon c. Coulomb d. Bernoulli

He is a Swiss mathematician known for restating Pappus' Theorems

- a. Newton b. Einstein c. Descartes d. Guldinus

He devised the principle of resultant of the external forces applied to a body which is equal to the vector summation of the effective forces acting on all particles.

- a. Galilei b. Pascal c. Archimedes d. D'Alembert

SITUATION 14: A 4 kg ball and a 3 kg ball move on a smooth horizontal plane along a straight line path with speeds of +6 and -8 m/s, respectively.

Determine the speed of the 3 kg ball after impact if the impact is inelastic or plastic.

- a. 0.5 m/s b. 2.5 c. 0 d. 3

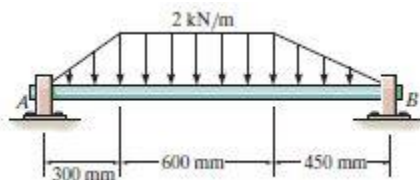
Determine the speed of the 3 kg ball after impact if the impact is elastic.

- a. -8 m/s b. +8 c. +6 d. -6

Determine the speed of the 3 kg ball after impact if the coefficient of restitution is 0.5.

- a. +3 b. -3 c. +4 d. -4

SITUATION 15: In the figure shown,



Calculate the reaction at A.

- a. 1315.7 N b. 1022.2 c. 957.8 d. 1160.8

Calculate the location of the maximum moment from the left support.

- a. 0.3 m b. 0.9 c. 0.661 d. 0.479

Calculate the maximum moment.

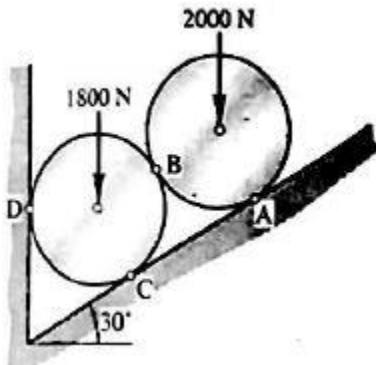
a. 277 kN.m

b. 0

c. 684

d. 577

SITUATION 16: The cylinder shown are equal in diameter and have weights as indicated in the figure.



Calculate the reaction between the two cylinders.

a. 900 N

b. 1500

c. 1000

d. 3800

Calculate the reaction at A.

a. 900 N

b. 2656

c. 2000

d. 1732

What is the reaction at D?

a. 2000 N

b. 4732

c. 2194

d. 1000

STRENGTH OF MATERIALS REFRESH SET

Steel rails 10 m long are laid with a clearance of 3 mm at a temperature of 15°C. Use $\alpha = 11.7 \times 10^{-6}$ per degree centigrade and modulus of elasticity of steel is 200000 MPa. Determine the temperature of steel so that rails will just touch.

- a. 31.55°C b. 40.44°C c. 40.64°C d. 38.57°C

A cubical section has $E = 200000$ MPa and Poissons ratio = 0.30. Determine the compressive stress acting on each side of its faces if the volume of the cube is reduced by 0.15%.

- a. 275 MPa b. 315 c. 250 d. 200

A thin walled cylinder shell has an internal diameter of 2 m is fabricated from plates 20 mm thick. Which of the following gives the ratio of the hoop stresses over the longitudinal stress of the cylinder?

- a. 2 b. 10 c. 1 d. 3

A cantilever beam, 60 mm wide by 200 mm high and 6 m long, carries a load that varies uniformly from zero at the free end to 1000 N/m at the wall. Calculate the maximum flexural stress.

- a. 20 MPa b. 15 c. 18 d. 22.5

SITUATION 1: A rigid plate of negligible mass rests on a central spring which is 20 mm higher than the symmetrically located outer springs. Each of the outer springs consists of 18 turns of 10 mm wire on a mean diameter of 100 mm. The central spring has 24 turns of 20 mm wire on a mean diameter of 150 mm. if a load $P = 5$ kN is now applied to the plate, use $G = 83000$ MPa.

Determine the load carried by the central spring.

- a. 3754 kN b. 4031 c. 3573 d. 3348

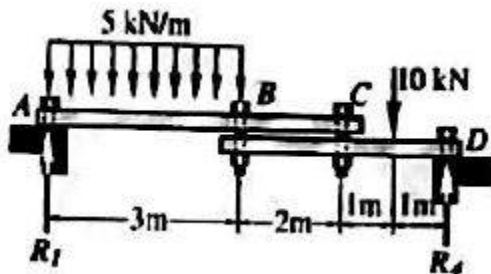
Determine the shearing stress of the central spring.

- a. 115.8 MPa b. 170.5 c. 156.4 d. 137.9

Determine the shearing stress of the outer spring.

- a. 318.7 b. 220.9 c. 196.4 d. 234.7

SITUATION 2: The boards ABC and BCD are loosely bolted together as shown. The bolts exert only vertical reactions on the boards.



Find the max. shear for board ABC.

- a. 17.65 kN b. 10.38 c. 13.21 d. 19.12

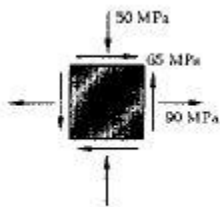
Find the location of the maximum shear from left support on board ABC.

- a. 2.642 m b. 3.065 c. 1.854 d. 2.631

Find the Maximum moment of the board BCD.

- a. 17.34 kN m b. 21.57 c. 16.33 d. 13.55

SITUATION 3: The state of plane stress shown is expected in a cast iron base. Using Mohr's circle,



Determine the maximum shear stress.

- a. 87.3 MPa b. 95.5 c. 84.6 d. 106.7

Determine the minimum normal stress.

- a. 64.6 MPa b. 88.7 c. 95.5 d. 103.7

Determine the maximum normal stress.

- a. 115.5 MPa b. 120.7 c. 134.1 d. 145.0

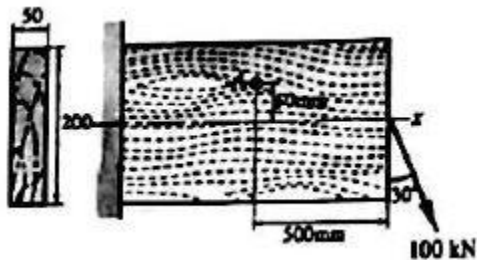
It refers to the deformation of the member per unit length.

- a. Stress b. Strain c. Torsion d. Shear

This refers to the stresses much lower than the static breaking strength.

- a. Rupture b. Deformation c. Deflection d. Fatigue

SITUATION 4: The cross section shown in the figure is 50 x 200 mm and point A is 50 mm above the center of the beam. Assume the 100 kN load acts at the centroid of the cross section. Hint: Be sure to include the shearing stresses caused by the applied load.



Compute the normal stress at A.

- a. 75 MPa b. 70 c. 50 d. 85

Compute the shearing stress at A.

- a. 11.39 b. 15.60 c. 9.74 d. 8.57

Compute the principal stresses direction from x-y plane that makes with the horizontal.

- a. 7.78° b. 9.61° c. 8.51° d. 10.99°

Which of the following is NOT an assumption in deriving a formula $\delta = PL/AE$?

- a. constant cross sectional area
b. material is linearly elastic
c. small strain
d. stresses must be tensile

A welded steel cylindrical drum made of a 10 mm plate has an internal diameter of 1.20 m. It is filled with gas producing an internal pressure of 1.5 MPa. Assume that Poisson's ratio is 0.30 and $E = 200$ GPa. Determine the tangential stress developed in the thin walled cylinder.

- a. 90 MPa b. 70 c. 50 d. 35

A cantilever hollow cylinder bar is 1.5 m long, 5 mm thick and with outside diameter of 75 mm. it is subjected to a torque of 3 kN m at its free end. What is the resulting angle of twist of the bar? Use $G = 78\,000$ MPa

- a. 5.6° b. 2.4° c. 3.7° d. 4.8°

SITUATION 5: A 2 m length of an aluminium pipe of 240 mm outer diameter and 10 mm wall thickness is used as a short column and carries a centric axial load of 640 kN. Knowing that $E = 73$ GPa and $\nu = 0.33$,

Determine the change in length of the pipe.

- a. 2.77 mm b. 2.43 c. 3.48 d. 3.64

Determine the change in its outer diameter.

- a. 0.0961 mm b. 0.0475 c. 0.0764 d. 0.0823

Determine the change in its wall thickness.

- a. 0.004 mm b. 0.007 c. 0.001 d. 0.010

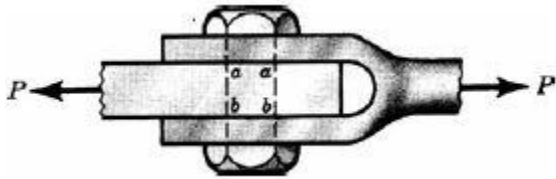
Is is determined merely by dividing either the stress at yield or the ultimate stress by a number termed the safety factor.

- a. Normal stress b. Shear Stress c. Flexural stress d. Working stress

Laboratory tests on human teeth indicate that the area effective during chewing is 0.25 sq cm and that the tooth length is about 1.1 cm. If the applied load in the vertical direction is 880 N and the measured shortening is 0.004 cm, determine Young's modulus.

- a. 9000 MPa b. 8800 c. 8000 d. 7700

SITUATION 6: Consider the bolted joint shown in the figure. The force P is 30 kN and the diameter of the bolt is 10 mm.



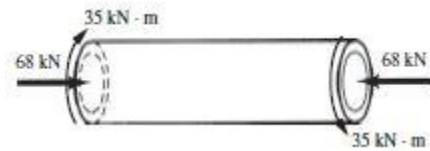
Determine the average value of the shearing stress existing across either of the planes a-a or b-b.

- a. 175 MPa b. 191 c. 203 d. 216

If the maximum allowable working stress in shear is 93 MPa, determine the required diameter of the bolt.

- a. 20 mm b. 22 c. 25 d. 16

SITUATION 7: A hollow shaft of outer radius 140 mm and inner radius 125 mm is subjected to an axial force and a torque as shown in the figure.



Determine the torsion in the shaft.

- a. 29.8 MPa b. 26.1 c. 22.3 d. 20.6

Calculate the axial stress in the shaft.

- a. 8.38 MPa b. 6.16 c. 10.31 d. 5.44

Calculate the maximum shear stress in the shaft.

- a. 19.75 MPa b. 22.47 c. 25.2 d. 22.3

It is the angular change between two perpendicular faces of a differential element.

- a. Modulus of rigidity c. Shearing strain
b. Allowable stress d. Rupture strength

A simply supported beam 10 m long carries a uniformly distributed load of 20 kN/m. What is the value of the maximum moment of the beam due to this load?

- a. 10000 kN m b. 5000 c. 2000 d. 250

SITUATION 8: A 10 m long simply supported beam carries a uniform load of 8 kN/m for 6 meters from the left support and a concentrated load of 15 kN 2 meters from the right support.

Which of the following gives the maximum shear?

- a. 36.6 kN b. 41.8 c. 33.2 d. 31.3

Which of the following gives the maximum moment?

- a. 92.23 kN m b. 83.72 c. 81.74 d. 85.92

It occurs whenever there is a discontinuity or nonuniformity of a material.

- a. Strain c. Shearing rupture
b. Stress failure d. Stress concentration

SITUATION 9: A truck with axle loads of 40 kN and 60 kN on a wheel base of 5 m rolls across a 10 m span.

Calculate the maximum bending moment.

- a. 175 kN m b. 160 c. 155 d. 120

Calculate the maximum shearing force.

- a. 95 kN b. 110 c. 80 d. 125

Determine the location of 40 kN load from the left support when maximum moment occurs.

- a. 9 m b. 5 c. 7.5 d. 4

STRUCTURAL THEORY REFRESHER SET

SITUATION 1: A 9 m high retaining wall is laterally supported at the top and fixed at the base. The wall resists active earth pressure increasing from 0 at the top to 52 kN/m at the base of the per meter length along the longitudinal axis.

Determine the design moment at the base. Apply the fixed end moment equation $wL^2/30$ at the top and $wL^2/20$ at the base. Assume the EI is constant.

- a. 315.9 kN m b. 280.8 c. 164.9 d. 204.6

The lateral support at the top of the wall was removed, determine the design moment at the base.

- a. 567 kN m b. 854 c. 702 d. 66

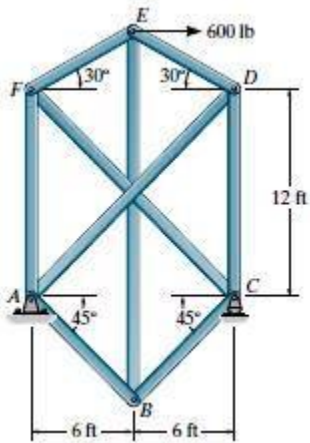
Determine the resulting base shear if the wall is free at the top.

- a. 234 kN b. 316 c. 481 d. 607

Which of the following that is not described for wind loads?

- a. When structures block the flow of wind, its kinetic energy is converted to potential energy of pressure.
 b. The effect of wind on a structure depends upon the density and velocity of the air.
c. For high rise buildings, static approach is used to determine wind loadings.
 d. The pressure effects of the wind on the building can be determined from pressure transducers attached to the model.

SITUATION 2: In the complex truss shown in the figure, (Hint: Substitute member AD with one placed between E and C)



Determine the force AF.

- a. 1428 lb (C) b. 1166 (C) c. 646 (C) d. 580 (C)

Determine the force CD.

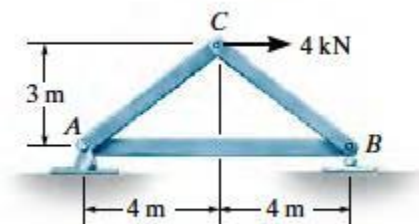
- a. 1593 lb (C) b. 820 (T) c. 1593 (T) d. 473 (T)

Determine the force EF.

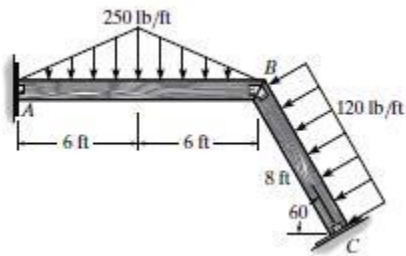
- a. 473 lb (T) b. 473 (C) c. 1166 (T) d. 1166 (C)

The cross sectional area of each member of the truss shown in the figure is 400 sq mm and $E = 200$ GPa. Determine the vertical displacement of joint C if a 4 kN force is applied to the truss at C.

- a. 0.205 mm b. 0.079 c. 0.186 d. 0.133



SITUATION 3: In this determinate frame shown,



Determine the maximum shear of the entire structure.

- a. 825 lb b. 750 c. 765 d. 805

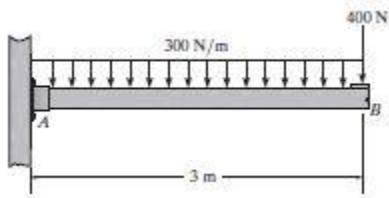
Determine the maximum shear of member BC.

- a. 290 lb b. 320 c. 350 d. 480

Find the maximum moment of member AB.

- a. 2500 lb ft b. 3000 c. 3100 d. 4400

SITUATION 4: In the given cantilever beam shown,



Determine the moment reaction of this beam.

- a. 3150 N m b. 2750 c. 3680 d. 2250

Determine the slope at point B in $\text{N m}^2 / EI$.

- a. 3150 b. 2750 c. 3680 d. 2250

Determine the deflection at point B $\text{N m}^3 / EI$.

- a. 6437.5 b. 5844.1 c. 6637.5 d. 5478.6

SITUATION 5: Answer the following terms in structural theory.

This method relates the moments at the ends of a member to the rotations and displacements of its ends and the external loads applied to the member.

- a. Virtual Work b. Slope Deflection c. Three Moment d. Conjugate Beam

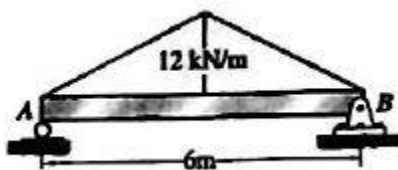
It refers to loading that is congruent to an axis in its plane if the deflection of the loading about the axis is identical to the loading itself.

- a. Indeterminate b. Prismatic c. Symmetric d. Unsymmetric

These are points that undergo unknown displacements of the structure.

- a. Determinancy b. Joints c. Nodes d. Sections\

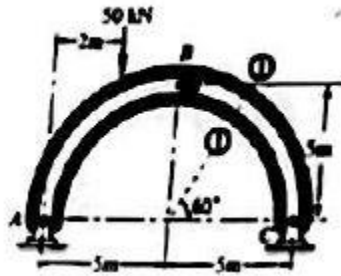
SITUATION 6: A simply supported beam having a span of 6 m carries a triangular load which varies at 12 kN/m at the center to zero at the supports.



Which of the following gives the reaction at B?

- a. 24 kN b. 20 c. 36 d. 18

SITUATION 9: A pin connected circular arch supports a 50 kN vertical load as shown in the figure. Neglect the weights of the members.



Compute the bending moment that act on the cross section at 1-1.

- a. 17.8 kN m b. 18.4 c. 21.9 d. 22.6

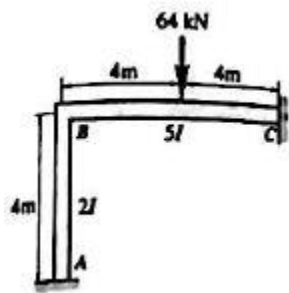
What is the shear force that act on the cross section at 1-1?

- a. 5.11 kN b. 9.84 c. 6.23 d. 3.66

What is the axial force that act on the cross section at 1-1?

- a. 13.66 kN b. 14.04 c. 18.47 d. 16.23

SITUATION 10: From the given frame shown, with different moment of inertias, has fixed supports at A and C. Use three moment equation.



Compute the moment at A.

- a. 17.89 kN m b. -17.89 c. 14.22 d. -14.22

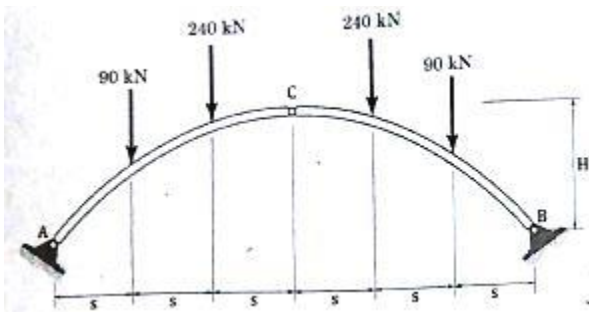
Compute the moment at B.

- a. 28.44 kN m b. -28.44 c. 36.16 d. -36.16

Compute the moment at C

- a. 59.26 kN m b. -59.26 c. 81.80 d. -81.80

SITUATION 11: The three hinged arch shown in the figure is loaded with vertical loads only. Distance $H = 12$ m and $s = 4$ m.



Determine the horizontal reaction at A.

- a. 210 kN b. 170 c. 180 d. 190

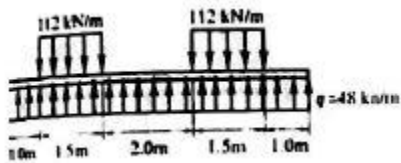
Determine the vertical reaction at B.

- a. 330 kN b. 90 c. 190 d. 240

Determine the vertical reaction at C.

- a. 0 c. 330 kN d. 240 d. 90

SITUATION 12: In the figure shown, a uniform load of 12 kN/m is acting downward and supported by an upward uniform pressure of $q = 48$ kN/m.



Calculate the maximum shear.

- a. 112 kN b. 48 c. 85 d. 96

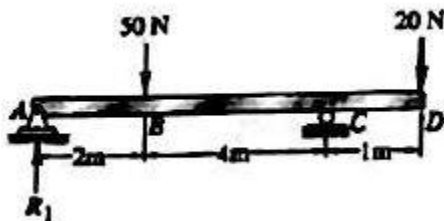
Calculate the maximum moment.

- a. 84 kN m b. 75 c. 66 d. 42

Determine the distance from the left where the flexural stress is zero.

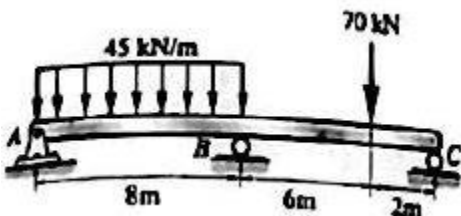
- a. 1.75 m b. 2.25 c. 3.0 d. 3.5

From the beam shown in the figure, determine the deflection at D.



- a. 55.91/EI b. 46.81/EI c. 42.21/EI d. 39.74/EI

SITUATION 13: The continuous beam A, B, and C have different moment of inertias. BC is twice that of AB.



Determine the value of $6A_1a/I_1L_1$ in kN m^2 due to the contribution of the uniform load acting on span AB to be used in the three moment equation.

- a. 4920 b. 5060 c. 5310 d. 5760

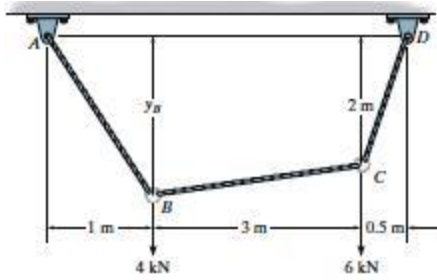
Determine the value of $6A_2b/I_2L_2$ in kN m^2 due to the contribution of the concentrated load acting on span BC to be used in the three moment equation.

- a. 615 b. 525 c. 450 d. 370

Find the moment at B.

- a. -289.15 kN m b. -261.88 c. -220.16 d. -195.32

SITUATION 14: In the figure shown,



Compute the maximum tension in the cable.

- a. 5.48 kN b. 6.41 kN c. 5.79 d. 3.88

Compute the tension at member BC.

- a. 2.55 kN b. 1.57 kN c. 1.00 d. 2.33

Compute the sag at point B.

- a. 2.43 m b. 2.11 c. 1.77 d. 1.59

REINFORCED CONCRETE REFRESHER SET

NOTE: For code provisions, prefer to NSCP 2010 and some review books.

SITUATION 1: A 450 mm square interior column carries a dead load of 825 kN and a live load of 668 kN. A rectangular footing is required to carry the column loads such that the length of the long side must be equal to twice the width of the short side. Assume base of footing is 1.5 m below the ground surface. Allowable bearing pressure is 192 kPa. $f_c' = 27.6$ MPa, $f_y = 415$ MPa, $\gamma_{\text{soil}} = 15.74$ kN/m³, $\gamma_{\text{conc}} = 23.5$ MPa and thickness of footing is 0.60 m.

Calculate the ultimate upward soil pressure.

- a. 224.76 MPa b. 196 c. 207.78 d. 245.51

Calculate the ultimate punching shear.

- a. 1533 kN b. 1845 c. 1988 d. 2157

Determine the dimensions of the footing in meters.

- a. 2.44 x 1.22 x 0.6 b. 2.14 x 4.28 x 0.60 c. 2.00 x 4.00 x 0.60 d. 2.57 x 5.14 x 0.60

SITUATION 2: A doubly reinforced concrete beam section has an effective depth of 625 mm and a width of 350 mm. It is reinforced with a compressive bars at the top having an area of 1500 sq mm and 4970 sq mm tension bars at the bottom with a steel covering of 62.5 mm both on top and bottom bars. Balanced steel ratio = 0.0285, $f_c' = 27.58$ MPa and $f_y = 413.4$ MPa.

Compute the compression block.

- 188.64 mm b. 181.35 c. 174.83 d. 190.55

Compute the ultimate moment capacity of the beam.

- a. 908 b. 935 c. 988 d. 1008

Compute the safe concentrated live load that the beam could carry at its midspan if it has a service dead load of 30 kN/m on a span of 6 m.

- a. 244.7 kN b. 352.5 c. 281.3 d. 300.2

According to NSCP, the development length of the individual bars within a bundle, tension, or compression shall be that for individual bar and increased by how much for 3 bar bundles?

- a. 20% b. 25% c. 33% d. 40%

A rectangular beam has a width of 300 mm and an effective depth of 437.50 mm. It is reinforced with 4 - 28 ϕ bars. $f_c' = 41.47$ MPa and $f_y = 414.70$ MPa. Determine the tension reinforcement index.

- a. 0.218 b. 0.157 c. 0.188 d. 0.255

SITUATION 3: Define the following terms in reinforced concrete.

These are the slabs are suitable for spans 9 to 15 meters and live loads of 3.84 to 5.8 kPa but expensive due to addition of formworks.

- One way b. Flat c. Two way d. Waffle

These are cracks that are too fine and seen by the naked eye.

- a. Microcrack b. Honeycomb c. Swelling d. Creep

It refers to the protective layer of concrete over reinforcing bars to protect them from fire and corrosion.

- a. Cover b. Mortar c. Filler d. Grout

SITUATION 4: A reinforced concrete beam had a width of 280 mm and an effective depth of 520 mm. It is reinforced with 4 - 28 ϕ bars at the bottom. If $f_c' = 21$ MPa and $f_s = 140$ MPa, $n = 9$.

Which of the following gives the distance from neutral axis to the top of the beam?

- a. 318.45 b. 218.49 c. 177.84 d. 211.58

Which of the following gives the moment of inertia of the beam.

- a. $2988.7 \times 10^6 \text{ mm}^4$ b. 3158.19×10^6 c. 3564.79×10^6 d. 2568.99×10^6

Which of the following gives the moment carried by the beam.

- a. 184.9 kN m b. 212.47 c. 129.3 d. 110.76

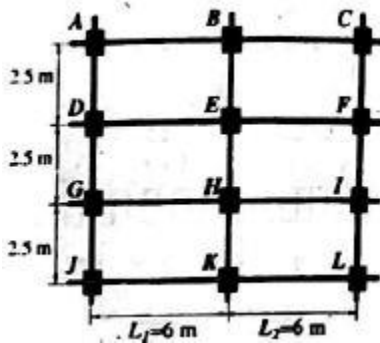
Determine the effective flange width for a symmetrical T beam with a span of 6 m. the width of the web is 250 mm. the slab thickness is 120 mm, and the clear distance to adjacent beams is 3 m

- a. 2170 mm b. 1200 c. 2150 d. 1500

The nominal maximum size of coarse aggregate specified in NSCP should be ____ of the depth of slabs.

- a. 1/4 b. 2/5 c. 1/3 d. 1/2

SITUATION 5: A reinforced concrete beam having a width of 300 mm and an overall depth of 600 mm has a spacing of 2.5 m on centers supports a slab 100 mm in thickness. The super imposed dead load = 3 kPa (includes floor finish, ceiling, fixtures, etc...) Live load = 4.8 kPa. Columns E and H are omitted such that the girder BEHK support beams DEF at E and GHI at H. Use NSCP 2001 Specs.



Compute the ultimate load in kN at E induced by the beam DEF.

- a. 288.77 kN b. 264.51 c. 308.75 d. 313.53

Compute the ultimate load in kN at H induced by the beam GHI.

- a. 288.77 b. 264.51 c. 308.75 d. 313.53

Compute the maximum positive moment of girder BK assuming full fixity at B and K. use $FEM = \frac{Pab^2}{L^2}$.

- a. 279.56 kN m b. 220.43 c. 256.18 d. 249.16

SITUATION 6: A decorative tubular concrete beam is simply supported on a span of 4.5 m. Concrete weighs 24 kN/m.

Compute the cracking moment of the tubular section if it has an outside diameter of 600 mm and an inside diameter of 300 mm if its allowable cracking stress is 3.22 MPa.

- a. 69.11 kN.m b. 66.18 c. 64.01 d. 62.16

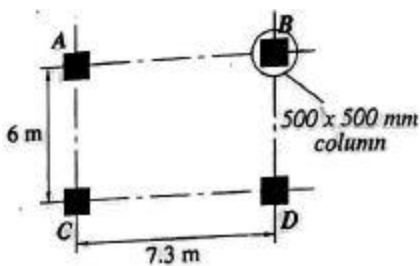
In addition to its own weight, what concentrated load at midspan can the beam safely carry before it cracks.

- a. 45.4 kN b. 55.7 c. 61.7 d. 68.3

If the 300 mm diameter hollow core was replaced by the 300 mm hollow square section, calculate the cracking moment.

- a. 56.32 kN m b. 61.04 c. 45.79 d. 60.18

SITUATION 7: A typical flat - plate panel is shown in the figure. The four system consists of four panels in each direction with a panel size of 7.3 m by 6 m. All panels are supported by 500 x 500 mm column, 3.6 long. The slab without beams carries a service live load of 3.84 kPa and a service dead load that consists of 1.15 kPa of floor finish in addition to the slab weight. Thickness of slab = 225 mm. $F_c' = 27.6$ MPa and $f_y = 414.7$ MPa.



Determine the spacing of 16 mm ϕ bars at the column strip in the long direction with a static moment of $M_o = 485.52$ kN m

- a. 165 mm b. 180 c. 160 d. 150

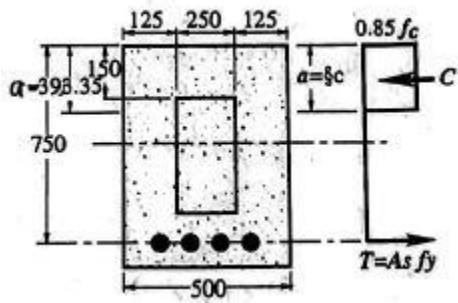
Determine the number of 12 mm ϕ bars required at the column strip in the long direction with a static moment of 485.52 kN m.

- a. 15 b. 11 c. 10 d. 18

Determine the spacing of 12 mm ϕ bars required at the column strip in the long direction with a static moment of 485.52 kN m.

- a. 275 b. 300 c. 200 d. 175

SITUATION 8: The hollow box beam in the figure must carry a factored moment of 540 kN m. $f'_c = 28$ MPa, $f_y = 345$ MPa, and $E_s = 200000$ MPa.



Calculate the location of the neutral axis from the top of the beam for a balanced condition.

- a. 488.19 mm b. 512.64 c. 429.56 d. 462.77

Calculate the balanced steel area A_{s_b} .

- a. 9471 sq mm b. 10073 c. 11257 d. 13101

Which of the following gives the maximum area permitted by the code?

- a. 7028.25 sq mm b. 9825.75 c. 7554.75 d. 8442.75

SITUATION 9: A rectangular concrete beam and an effective depth of 600 mm. It is reinforced for compression at the top with two 25 mm ϕ bars placed of 62.5 mm from the compression face of the beam. $f'_c = 34.6$ MPa, $f_y = 414.6$ MPa.

Compute the factor β based on NSCP 2010 specs.

- a. 0.85 b. 0.836 c. 0.817 d. 0.802

Compute the depth of compression block for a balanced condition.

- a. 279.18 b. 289.89 c. 280.77 d. 246.23

Determine the resisting moment using the maximum steel required for a balanced condition.

- a. 680.2 kN m b. 655.9 c. 678.1 d. 690.3

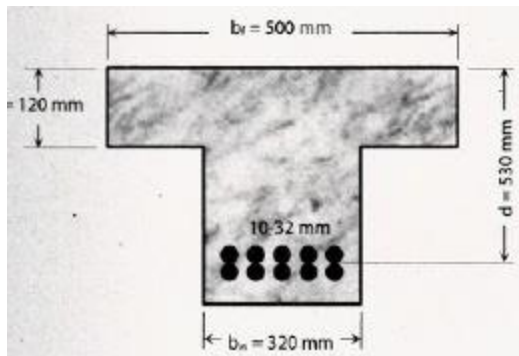
This method is used to control the deflection of reinforced concrete with long span members.

- a. Curing b. Steel Reinforcing c. Cambering d. Reducing dimensions

He was able to analyse correctly the stresses in a reinforced concrete beam

- a. William Ward b. Thaddeus Hyatt c. E.L. Ransome d. Joseph Monier

SITUATION 10: The section of a reinforced concrete T beam is shown in the figure. The beam is reinforced with 10 - 32 ϕ tension bars with $f_y = 415$ MPa. Concrete strength $f'_c = 32$ MPa. If the total service dead load moment on the beam is 330 kN-m,



Compute the factor β based on 2010 NSCP.

- a. 0.821 b. 0.845 c. 0.810 d. 0.85

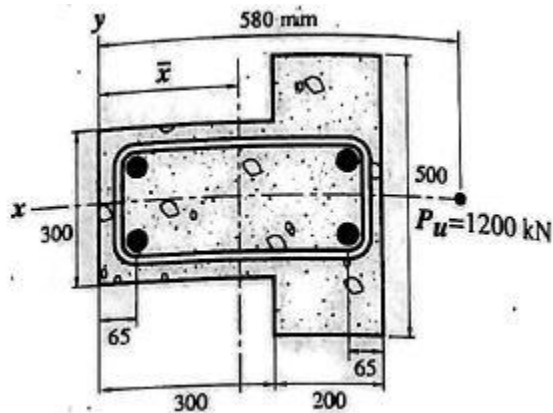
Determine the area of steel reinforcement in sq mm.

- a. 7018 b. 6645 c. 6212 d. 6813

Calculate the moment live load carried by the T beam

- a. 242.33 kN m b. 218.65 c. 223.57 d. 244.20

SITUATION 11: For the column section shown, $f_c' = 21$ MPa, $f_y = 275$ MPa, the column is reinforced with 4 - 28 mm ϕ and 10 mm ϕ tie wires.



Find the nominal strength of the column at zero eccentricity.

- a. 3655 kN b. 3874 c. 4025 d. 4144

Find the location of plastic centroid.

- a. 242.18 b. 276.60 c. 288.16 d. 300.15

Find the moment due to load $P_u = 1200$ kN at (580,0).

- a. 313 kN m b. 364 c. 477 d. 515

SITUATION 12: A reinforced concrete beam has a width of 300 mm and an effective depth of 600 mm. Compression reinforcement if needed will be placed at a depth of 60 mm below the top. If $f_c' = 30$ MPa, $f_y = 414$ MPa, If the beam is to resist an ultimate moment of 650 kN m,

Compute the maximum steel ratio using 2001 NSCP.

- a. 0.01877 b. 0.02323 c. 0.02178 d. 0.01677

Compute the minimum steel ratio using 2001 NSCP.

- a. 0.00418 b. 0.00392 c. 0.00338 d. 0.00277

Determine the steel area reinforcement.

- a. 3442 sq mm b. 3178 c. 3077 d. 2956

The minimum floor live load for the ground floor in a residential unit is:

- a. 4.8 kPa b. 2.9 c. 1.9 d. 6.0

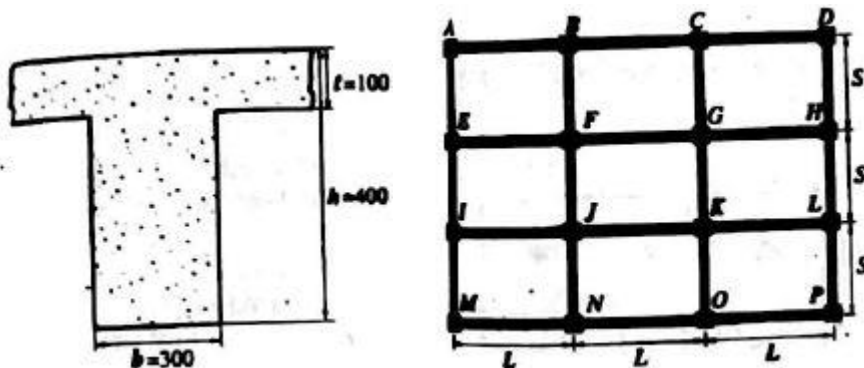
SITUATION 13: From the given floor plan, the following data are obtained:

DL = 4.8 kPa (service dead load), LL = 2.9 kPa, $u = 1.4D + 1.7L$

Dimensions and stresses:

Beam = 300 x 400 mm ; Clear cover to slab = 20 mm ; Slab reinforcement = 10 mm bars

Slab thickness = 100 mm ; S = 2.8 m ; L = 6.0 m



Determine the ultimate negative moment of the slab at the span bounded by FGJK.

- a. 5.59 kN m b. 6.07 c. 5.75 d. 6.43

Determine the ultimate positive moment of the slab at the span bounded by FGJK.

- a. 4.02 kN m b. 5.18 c. 4.55 d. 4.89

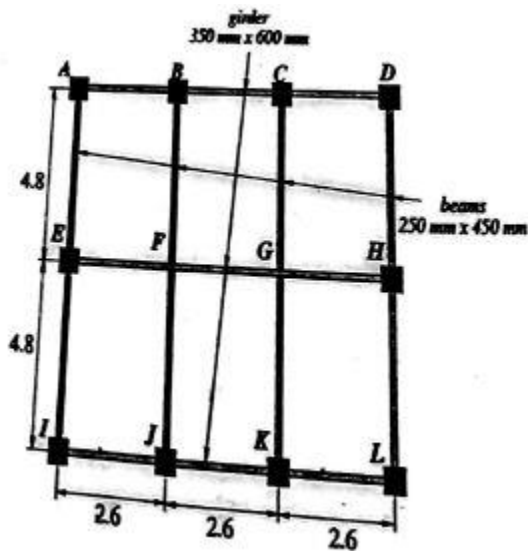
Determine the maximum spacing of the 10 mm ϕ bars as prescribed by design codes.

- a. 150 mm b. 300 c. 450 d. 225

In NSCP, the area of the longitudinal reinforcement for non-composite compression members shall not be less than 0.01 nor _____ times the gross area of the section.

- a. 0.08 b. 0.11 c. 0.15 d. None

SITUATION 14: The concrete frame is used to support the concrete deck for a commercial building. The frame carries a service dead load of 2.2 kPa and a service live load of 4.8 kPa. The slab thickness is 125 mm. Beams AH, BG, CF, and DE has a cross section of 250 x 250 mm while girder ABCD has a cross section of 350 x 750 mm. Weight of concrete is 24 kN/m.



Compute the total factored uniform load in kN/m supported by beam BJ.

- a. 39.418 b. 33.864 c. 35.319 d. 37.745

Compute the reaction at G.

- a. 177.59 kN b. 164.53 c. 162.55 d. 156.18

Compute the reaction at A.

- a. 184.57 kN b. 122.19 c. 141.89 d. 150.27

STEEL DESIGN REFERSHER COURSE

NOTE: For the code provisions refer to NSCP 2001/2010.

SITUATION 1: A W 420x85 steel beam is fully restrained with a uniformly distributed super imposed load of 25 kN/m. The beam has a span of 10 m.

Properties of W 420 x 85:

A = 10839 sq mm bf = 180 mm tf = 18 mm
Tw = 11 mm d = 420 mm Ix = $310 \times 10^6 \text{ mm}^4$

Compute the bearing stress in MPa.

- a. 188.64 MPa b. 116.54 c. 145.83 d. 136.29

Compute the maximum web shear stress in MPa.

- a. 12.88 b. 16.77 c. 15.79 d. 18.26

Compute the maximum horizontal shearing stress in MPa.

- a. 19.41 b. 22.56 c. 25.76 d. 28.10

SITUATION 2: A W 8 x 27 steel column 6 m long is connected at the top and the bottom and is part of a frame subjected to joint translation (side sway). It carries an axial load of 800 kN and a counter clockwise moment at the top and a clockwise moment at the bottom which is only 90% of the moment at top.

Properties of W 8 x 27:

A = 0.013 m² r = 194 mm Sx = 0.00099 m³
Fy = 248 MPa Es = 200000 MPa K = 1.0

Which of the following gives the total axial compressive stress if axial load existed?

- a. 61.54 MPa b. 44.47 c. 54.81 d. 77.05

Find the allowable axial compressive stress.

- a. 155.48 MPa b. 117.53 c. 91.69 d. 121.84

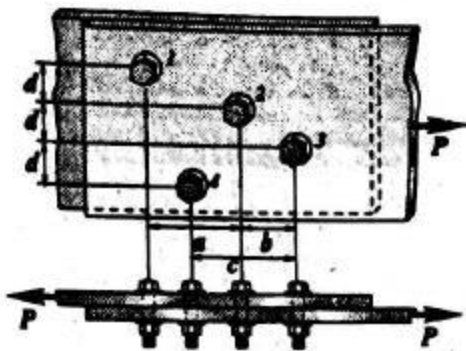
If the allowable bending stress is 149 MPa, what is the value of the moment at the top?

- a. 66.49 kN m b. 86.91 c. 62.52 d. 77.48

For a transverse shear, there is a tendency of the left section of the beam to _____ with respect to the right section of the beam.

- a. Crack downwards b. crack upwards c. slide downwards d. slide upwards

SITUATION 3: The figure shows a plate having a width of 400 mm and thickness of 12 mm is to be connected to another plate 34 mm ϕ bolts as shown in the figure. Assume that diameter of holes to be 2 mm larger than the diameter of the bolts. Use A 36 steel plate with yield strength of Fy = 248 MPa and a minimum tensile strength Fu = 400 MPa. If a = 60 mm, c = 150 mm, and d = 100 mm,



Find the nearest value of b so that the net width along the bolts 1-2-3-4 is equal to the net width of the bolts 1-2-4.

- a. 15.55 mm b. 19.71 c. 22.56 d. 28.16

Find the nearest net area for tension in the plates.

- a. 3318.48 m² b. 3815.99 c. 3107.54 d. 3623.65

Find the value of P so that the allowable tensile stresses will not be exceeded.

- a. 724.73 kN b. 776.55 c. 844.56 d. 853.68

SITUATION 4: A built up beam is made up of 1250 mm x 9 mm web section and two flange sections of 620 x 20 mm plate. It has a span of 14 m and carries a uniform load of 40 kN/m including the self weight. Use A 36 steel $F_y = 248$ MPa.

Compute the section modulus of the given beam.

- a. 12188.6 mm³ b. 18195.31 c. 17776.7 d. 19145.9

Compute the allowable bending stress using NSCP Specifications

- a. 188.45 MPa b. 124.66 c. 159.45 d. 138.15

Compute the safe concentrated load that it could carry at its mid span besides the uniform load.

- a. 353.14 kN b. 381.79 c. 366.20 d. 321.37

SITUATION 5: The propped cantilever beam is 10 m long is required to carry a load of 100 kN at midspan. If the yield stress of mild steel is 300 MPa,

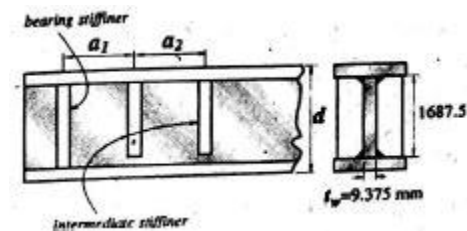
Compute the plastic section modulus.

- a. 80000 mm³ b. 75318 c. 64248 d. 83333

Compute the elastic section modulus of the beam given that the shape factor is equal to 1.69.

- a. 52217.6 b. 49309.5 c. 54616.0 d. 43217.8

SITUATION 6: A plate girder shown in the figure is made up of an A 572 Grade 50 ($F_y = 345$ MPa). Assuming tension field action is included.



Determine the adequacy of the web depth to thickness ratio of the plate girder.

- a. 279.55 b. 286.23 c. 222.16 d. 242.21

Compute the stiffener spacing required in the end panel if it has a shear stress of 83 MPa.

- a. 816 mm b. 844 c. 890 d. 935

Compute the allowable panel aspect ratio. Hint: $APAR = (260t_w/h)^2$

- a. 1.79 b. 1.86 c. 2.12 d. 2.09

The minimum tensile strength for the electrodes of E 70 is:

- a. 248 MPa b. 345 c. 485 d. 520

For the pure compression member, the axial load at which the column begins to bow outward is called:

- a. Ultimate Load c. Allowable Load
b. Flexural Load d. Euler's Critical Buckling Load

SITUATION 7: A steel plate is 360 mm wide and 20 mm thick with four bolt holes 25 mm ϕ cut into the plate as shown in the figure.

Determine the net area considering the route ABCFG.

- a. 5561 mm² b. 5925 c. 5415 d. 5837

Determine the net area considering route ABCFDE.

- a. 5018 b. 5625 c. 5318 d. 5275

Determine the critical net area of the section.

- a. 5018 b. 5625 c. 5476 d. 5223

SITUATION 8: A circular shaft having a radius of 30 mm is welded by a fillet weld at its fixed end and is subjected to an eccentric load of $P = 20$ kN and $e = 100$ mm.

Determine the size of the fillet weld so that it will not exceed a cross shear stress of 18 MPa.

- a. 10 mm b. 12 c. 9 d. 15

Compute the moment reaction of the fillet weld so as to not exceed a torsional shear stress of 80 MPa.

- a. 353.68 N mm b. 475.59 c. 518.24 d. 218.23

Compute the maximum shearing stress of the weld using $t = 8$ mm.

- a. 55.26 MPa b. 64.13 c. 81.29 d. 55.18

SITUATION 9: Define the following terms in steel design.

It is generally used for the members carrying tensile, compressive or bending stresses for welds.

- a. Base plate b. Groove welds c. Fillet welds d. Slot welds

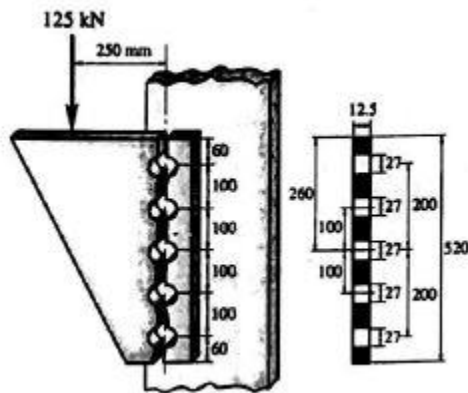
The failure of the members may occur along a path involving tension on one plane and shear on a perpendicular plane is also known as:

- a. Net force b. Gross force c. Block shear d. None of these

Which of the following rivets have bearing areas to develop sufficient strength?

- a. Countersunk b. Chipped flush c. Button heads d. All of these

SITUATION 10: An eccentrically loaded connection shown in the figure has an eccentric load of 180 kN. A 325 bolts is used with threads excluded from shear planes. Using elastic method,



Compute the resultant load on the most stressed bolt in the eccentrically loaded connection.

- a. 118.67 kN b. 234.79 c. 312.15 d. 121.49

Compute the diameter of the A 325 bolts for a bearing type connection having an allowable shear stress of 207 MPa.

- a. 22 mm b. 16 c. 20 d. 28

Compute the shearing stress of bolt A.

- a. 137.80 b. 151.25 c. 167.40 d. 160.88

SITUATION 11: A W 610 x 113 is to be supported on a 300 mm concrete wall such that there is a bearing 200 mm wide. Use A 36 steel $F_y = 250$ MPa, $f'_c = 20.7$ MPa.

Properties of W 610 x 113

$d = 608$ mm $t_f = 17.3$ mm $K = 35.94$ mm
 $b_f = 228$ mm $t_w = 11.9$ mm

Determine the maximum end reaction due to bearing on wall.

- a. 385.26 kN b. 417.31 c. 355.66 d. 401.28

Determine the maximum end reaction due to web yielding.

- a. 477.89 b. 505.23 c. 569.12 d. 677.48

Determine the maximum reaction due to bending stress of the flange.

- a. 140 kN b. 175 c. 210 d. 230

In design of columns, the modification factor for the compression members in frames subject to translation when there is sidesway is:

- a. 1.00 b. 0.90 c. 0.85 d. 0.65

SITUATION 12: Light grade steel channel was used as a purlin of a truss. The top chord of the truss is inclined 1 V : 4 H and distance between trusses is 6 m. The purlin has a weight of 79 N/m and spaced 1.2 m apart on centers. The dead load including the roof materials is 720 Pa, live load of 1000 Pa and wind load of 1440 Pa. Assume all loads passes through the centroid of the section. Use C 200 x 76 with $S_x = 6.19 \times 10^4$ mm³, $S_y = 1.38 \times 10^4$ mm³ and allowable bending stresses $F_{bx} = F_{by} = 207$ MPa.

Compute the leeward suction of the roofing.

- a. 1115.9 N/m b. 1036.8 c. 1218.5 d. 1315.7

Compute the bending stress f_{bx} for $D + L$.

- a. 166.18 b. 108.54 c. 151.14 d. 137.63

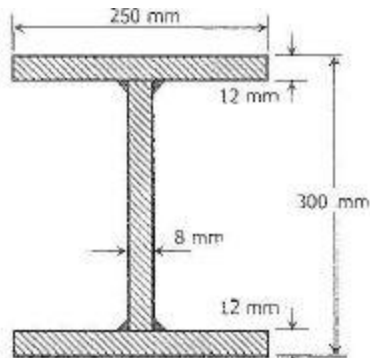
Calculate the maximum ratio of actual to the allowable bending stress for load combination $0.75(D + L + W)$ at the windward side.

- a. 1.54 b. 1.18 c. 0.89 d. 1.25

The effective net area factor for at least three fasteners per line of all tees is:

- a. 0.85 b. 0.90 c. 0.75 d. 1.00

SITUATION 13: In the figure shown using effective length of 3.5 m and $F_y = 248$ MPa,



Determine the radius of gyration on x direction.

- a. 130 mm b. 135 c. 150 d. 165

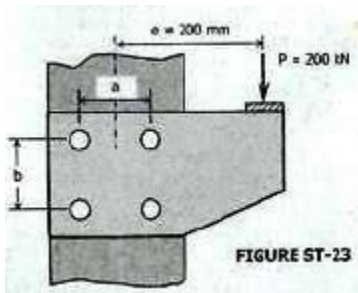
Compute the allowable buckling stress, F_a .

- a. 107.18 MPa b. 112.45 c. 137.18 d. 151.23

Compute the allowable axial load.

- a. 923 kN b. 956 c. 1008 d. 1076

SITUATION 14: In the connection shown in the figure, a load transmits 200 kN load acting at $e = 200$ mm. Use $a = b = 250$ mm. The load is transmitted to the column by the plates and 8 22 mm ϕ rivets. The plates are adequate to transmit the load to the rivets. The connection can be analysed by replacing the given load with an equivalent loading composed of a vertical force alone acting through the centroid of the rivets and a moment.



Which of the following most nearly gives the maximum shear stress in the rivets in MPa for equivalent vertical force alone acting on the centroid.

- 90 b. 140 c. 120 d. 70

Which of the following most nearly gives the maximum shear stress in the rivets in MPa for the equivalent moment alone?

- a. 700 b. 740 c. 720 d. 760

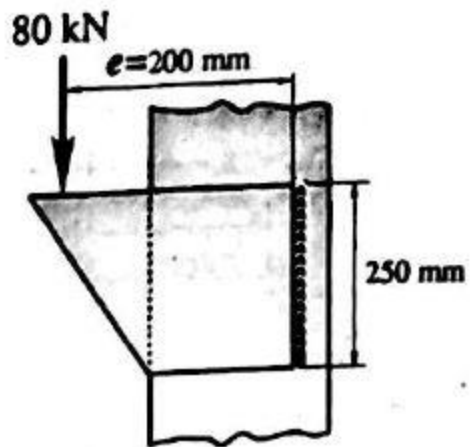
Which of the following most nearly gives the maximum shear stress in the rivets in MPa?

- a. 170 b. 160 c. 110 d. 130

Which of the following characteristics is considered in web crippling?

- a. can be stiffened near the loads c. The toe of fillet is most dangerous for failure
b. arises high compressive stresses d. its compressive force applied can be buckled.

SITUATION 15: A bracket shown in the figure is welded by a fillet to a column section. It carries an eccentric load of 80 kN acting at 200 mm from the fillet weld shown.



Compute the maximum bending moment per mm of fillet weld.

- a. 1536 N mm b. 1720 c. 1880 d. 2016

Using elastic method, determine the maximum force per mm to be resisted by the fillet weld shown.

- a. 1217 N/mm b. 1569 c. 1630 d. 1754

Determine the size of the fillet weld to carry the load using E 70 electrodes with $F_u = 485$ MPa.

- a. 19 mm b. 10 c. 16 d. 20

STRUCTURAL ENGINEERING AND CONSTRUCTION MISCELLANEOUS REFRESHER

Note: For code provisions in timber design refer to 2001/2010 NSCP.

What type of damages is awarded, usually for fraud cases, to punish and make an example of the defendant to deter other from doing the same thing?

- a. Punitive damages
b. Liquidated damages
c. Nominal damages
d. Consequential damages

SITUATION 1: A 140 x 140 mm Apitong 3 m long is used as a column. The column hinged at both ends with $K = 1.0$. The properties of some Philippine Woods at 80% stress grade as follows:

Species	80% Stress Grade				
	Bending and tension parallel to grain	Modulus of elasticity in bending	Compression parallel to grain	Compression perpendicular to grain	Shear parallel to grain
	MPa	1000 MPa	MPa	MPa	MPa
Apitong	16.5	7.31	9.56	2.20	1.73
Bagtikan	16.6	6.48	9.89	2.33	1.82
Lauan	13.9	5.83	8.18	1.72	1.48
Palosapis	13.8	5.98	8.38	2.73	1.68

Which of the following gives the classification of the column?

- a. Long
b. Intermediate
c. Short
d. None

Determine the allowable unit stress in compression parallel to grain adjusted for L/d ratio.

- a. 5.64 MPa
b. 7.54
c. 3.21
d. 4.78

Compute the axial load capacity of the column.

- a. 76.5 kN
b. 103.2
c. 93.6
d. 83.3

SITUATION 2: A prestressed concrete beam is 250 x 450 mm. The initial prestressing force is 600 kN. Assume that there is loss of prestress of 15% at service loads.

Find the final compressive stress in the beam if the prestressing force is applied at the centroid of the beam?

- a. -5.33 MPa
b. -4.53
c. -4.8
d. -5.65

Compute the final compressive stress in the beam if the prestressing force is applied at 100 mm below the centroid of the beam?

- a. -1.51 MPa
b. -12.44
c. -11.2
d. -10.58

Find the maximum eccentricity at which the prestressing force can be applied without producing tensile stress of the beam?

- a. 100 mm
b. 125
c. 150
d. 75

It is one of the first seismic scales to reflect earthquake intensities.

- a. Mercalli
b. Richter
c. Rossi-Forel
d. MSK

SITUATION 3: A concrete mix has a ratio of 1:2:4 by mass the properties of the materials to be used are tabulated below:

Materials	Specific gravity
Cement	3.33
Sand	2.65
Gravel	2.67

* Cement weighs 40 kg per bag. Use 24 liters of water per bag of cement.

Find the volume of cement solids per bag of cement?

- a. 0.0240 m³
b. 0.0210
c. 0.0420
d. 0.0120

Find the required volume of sand solids per bag of cement?

- a. 0.0203 m³
b. 0.0302
c. 0.0401
d. 0.0104

Find the volume need for concrete that can be produced per bag of cement?

- a. 0.1061 m³
b. 0.0661
c. 0.1261
d. 0.1461

These involves determination of project scope and economic and technical evaluation of feasible alternatives as an civil engineer.

- a. Study and Report Phase
c. Preliminary Design

c. Construction Phase

d. Operation Phase

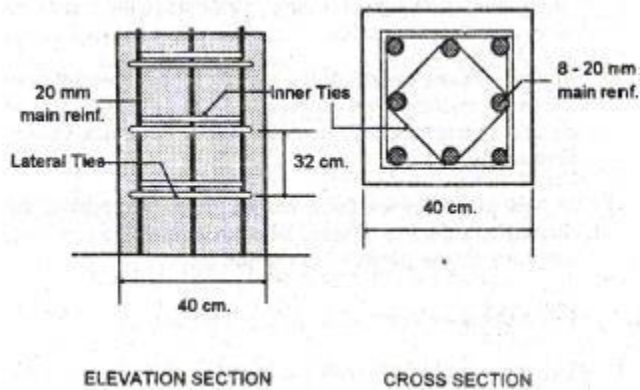
The minimum age for joining as a board member of civil engineering is :

- a. 18 b. 21 c. 30 d. No limit

The bids and awards committee under Implementing Rules and Regulations shall have :

- a. 5-7 members b. 6-8 c. at least 5 d. no limit

SITUATION 4: In the figure shown, if there are 30 columns at 8 meters high,



Determine the spacing of the lateral ties.

- a. 320 mm b. 500 mm c. 300 d. 450

Find the total lateral ties considering the inner ties.

- a. 1.00 m b. 1.25 c. 1.4 d. 1.8

Compute the total length of the tie wire.

- a. 2284 m b. 2496 c. 2307 d. 2554

In roof accessories, the effective length of the gutter is:

- a. 2.30 m b. 2.20 c. 2.50 d. 2.35

Quality control testing in DPWH project is the responsibility of the :

- a. DPWH b. Contractor c. Both A and B d. None

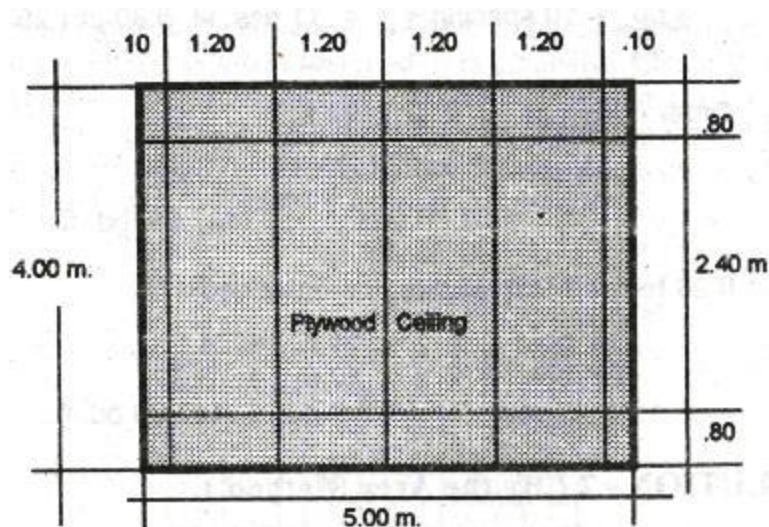
Prestressed concrete requires use of Class:

- a. A b. C c. E d. P

He/she is the in charge of the quality control and assurance of all government infrastructure projects.

- a. Civil Engineer b. Materials Engineer c. Master Plumber d. Highway Engineer

SITUATION 5: A bedroom with dimensions of 4 x 5 m specify the use of 1/4" x 4" x 8" plywood ceiling on a 2" x 2" ceiling joist spaced at 400 x 600 mm as shown in the figure.



Determine the amount of lumber used by using effective coverage method. (Refer to Max Fajardo's Estimate)

- a. 479.3 bd ft b. 537.3 c. 518.2 d. 684.5

Determine the no. of 1/4" x 4' x 8' plywood to be used.

- a. 27 b. 30 c. 35 d. 44

SITUATION 6: Identify the following specifications in engineering materials

How many samples should be taken for every 75 cu.m fresh concrete?

- a. 7 b. 3 c. 10 d. 1

How long does a vibrator be inserted in a concrete mix?

- a. ≤ 15 secs b. ≥ 15 c. Unlimited d. None

How many compaction tests shall be conducted for Item 201 having a volume of 8250 m³?

- a. 10 b. 5 c. 6 d. 1

SITUATION 7: PD 1594 states that an unbalanced bid as a bid containing one or more pay items that are 30% higher than the unit Allowable Government Estimate in respect to major items whereas other pay items are priced lower than the unit AGE. AGE = 1/2 the sum of the AAE and the average of all responsive bids, bids higher than 120% of the AAE or lower than 60% of the AAE shall be removed. Major items = at least 20% of the AAE or those indicated or specified in the instruction to bidders. The responsive bids for a government project with 8 bid items are as follows (per 1000 Php):

	Qty	AAE	Bid A	Bid B	Bid C
Item 1	100	1,000	1,000	1,250	750
Item 2	100	20,000	22,000	18,000	19,000
Item 3	500	5,000	4,000	6,100	5,100
Item 4	80	8,000	6,000	4,800	5,800
Item 5	1,000	3,000	2,900	3,300	2,800
Item 6	400	1,800	1,000	1,800	2,100
Item 7	3,000	3,000	2,500	2,400	3,200
Item 8	20	25,000	31,000	20,000	28,000

Find the total AAE in millions of Pesos.

- a. 64.4 b. 46.6 c. 64.6 d. 66.4

Which of the following is classified as major items?

- a. 2,8 b. 2,4 c. 2,4,8 d. 4,8

Determine the items that gives the complete list of unbalanced bids?

- a. A,B,C b. A,C c. B d. None

For earthquake prevention, these are mounted in structures to reduce the amplitude of mechanical vibrations.

- a. Rollers b. Dampers c. Base Isolation d. Retrofitting

It is the test to determine the consistency of concrete.

- a. Hardness b. Slump c. Flexure d. Shear

In occupational safety standards, those are the hazards that do not require technical devices to detect.

- a. Poisonous hazards c. Recognized hazards
c. Warning signs d. Precautionary measures

The following are the traits of being an effective leaders EXCEPT:

- a. self-confidence c. accuracy
b. creativity d. flexibility

For a project manager to achieve his given set of goals through other people, he must have good:

- a. interpersonal skills c. communication skills
b. leadership d. decision making skills

A material can fail after repeated stress loadings even if the stress level never exceeds the ultimate strength, a condition known as:

- a. yield point b. fatigue failure c. rupture d. ductility

A bituminous mix subjected to immersion-compression test yielded a dry stability of 2.0 kg. and wet stability of 1.5kg. The index of retained strength of the mix is:

- a. 0.5 b. 1.33 c. 33 d. 0.75

SITUATION 8: Identify the following in National Building Code.

The qualifications of a building official has a field experience of :

- a. 5 yrs b. 3 c. 1 d. None

In the use of occupancy, universities shall be classified as group:

- a. A b. B c. C d. D

RA 6541 was enacted in:

- a. 1950 b. 1977 c. 1992 d. 2010

The minimum basic fees for P 10 million or less projects is at:

- a. 5% b. 6% d. 4.5% d. 3.5%

SITUATION 9: A simply supported timber beam has a span of 6 m long and carries a uniformly distributed load of 25 kN/m over its entire span. This load already includes an allowance for beam weight. The timber is 80% stress grade Apitong. The allowable deflection is 1/240 of the span.

Find the smallest dimension of the beam such that allowable shear stress is not exceeded.

- a. 220 x 440 b. 150 x 300 c. 250 x 500 d. 200 x 400

Find the smallest dimension of the beam such that allowable bending stress is not exceeded.

- a. 220 x 440 b. 150 x 300 c. 250 x 500 d. 200 x 400

Which of the following gives the smallest dimension of the beam such that the maximum allowable deflection is not exceeded

- a. 220 x 440 b. 150 x 300 c. 250 x 500 d. 200 x 400

This portion of the wall between the ground level and the ground floor level is known as:

- a. Ceiling b. Plinth c. Pitch d. Beam

This type of concrete is made up by calcining of bauxite and lime.

- a. Blast Furnace b. High Alumina c. Portland d. Low Heat

What kind of paint has a reflectance or beads?

- a. Latex b. Enamel c. Reflectorized d. Silver Finish

Steel bar for concrete reinforced is tested for its:

- a. tensile b. compressive c. yield d. Both A and C

These are box shaped containers made of tough woven hexagonal netting strengthened by selvages of heavier wires.

- a. Mattress b. Gabions c. Culvert d. Fill

SITUATION 10: A 6 m span beam having a cross section of 200 mm x 500 mm carries a uniformly distributed load throughout its span. The wood used is 80% stress grade Apitong whose properties relevant to this problem depicted below:

Bending and tension parallel to grain = 16.5 MPa

Modulus of elasticity = 7,310 MPa

Shear parallel to grain = 1.73 MPa

Weight of wood = 7.5 kN/m³

Find the slenderness factor.

- a. 11.75 b. 12.00 c. 12.11 d. 12.37

Determine the maximum superimposed uniformly distributed load that the beam could carry?

- a. 29.07 kN/m b. 27.60 c. 27.00 d. 25.96

CE BOARD PRACTICE

SET 1

CE GREAT MINDS DIAGNOSTIC EXAM

MATHEMATICS, SURVEYING, AND TRANSPORTATION ENGINEERING

INSTRUCTION: Select the best answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

- What is the lateral area of the frustum of a right circular cone whose base diameters are 2 and 4 m. if its altitude is 5 m?
a. 44.06 m² **b. 48.06** c. 52.06 d. 56.06
- Determine the limit of $\lim_{x \rightarrow 0} \frac{\csc x - \cot x}{x}$
a. 0.25 b. 0 c. Undefined **d. 0.5**
- By the condition of a will sum of P 25000 is left to be held in trust by her guard amounts to P 45000. When will the lady receive the money if the fund is invested compounded quarterly?
a. 7 years, 5 months b. 5 years, 7 months c. 12 years d. 6 years
- Compute the sinking fund factor of a return rate of 3% in 8 years.
a. 0.142 **b. 0.112** c. 7.020 d. 8.892
- In the two peg test with the level at B, the instrument is to be 1.40 m above B, and the rod held at 7.12 m with the instrument at A, the rod reading at A and B are 4.73 m and 1.6 m respectively. Determine the difference in elevation between A and B.
a. 5.092 m **b. 3.965 m** c. 4.694 d. 4.425
- Using the following notes, determine the elevation of BM₁₄?

STATION	BS	FS	ELEVATION
BM ₁₂	4.64		209.65
1	5.80	5.06	
2	2.25	5.02	
BM ₁₃	6.02	5.85	
3	8.96	4.94	
4	8.06	3.22	
5	9.45	3.71	
6	12.32	2.02	
BM ₁₄		1.96	

- a. 183.95 b. 234.27 **c. 235.35** d. 235.26
- Find the volume of the largest right circular cylinder that can be circumscribed about a rectangular parallelepiped of dimensions 2 ft by 3 ft by 4 ft.
a. 121.54 cu in b. 112.45 c. 145.52 d. 154.11
- The tangent to the curve $y = xe^x$ at $x = 0.8$ is:
a. 1.8 b. 3.6 **c. 4** d. 5.2
- The cross-sectional area of a road with width of 10 m is 42.9 sq m. The cross sectional area is as follows:
$$\frac{9.8}{2.4} \quad \frac{0}{x} \quad \frac{7.4}{1.2}$$

Determine the value of x.
a. 3.94 b. 2.45 c. 3.70 d. 3.45
- A sight is taken with a engineer's level at rod held 100 m away and an initial reading of 1.83 m was observed. The bubble is then level through six spaces on level tube and the rod reading is 1.91 m. What is the sensitivity of the bubble tube in seconds of arc?
a. 29" b. 24" c. 28.5" **d. 27.5"**

SITUATION 1: A model rocket is launched from point A with an initial velocity of 85 m/s. If the rocket's descent parachute does not deploy and the rocket lands 100 m from A,

- Determine the angle the forms with the vertical.

- a. 3.90 b. 2.35 c. 2.25 d. 5.25
12. Determine the maximum height reached by the rocket.
a. 815 m b. 366 c. 129 d. 194
13. Determine the duration of the flight.
a. 13.4 s b. 17.3 c. 11.6 d. 10.4
14. The distance from the midpoint of the curve to the midpoint of the chord of a simple curve is 8.12 m. If the central angle is 40° , find the radius.
a. 134.64 m b. 124.63 c. 186.41 d. 115.52
15. It is the degree of peakedness of a statistical distribution usually taken relative to normal distribution.
a. Skewness b. Hypotheses c. Kurtosis d. ANOVA
16. The revenue R from selling x number of computer boards is given by $C = 50x + 5000$. Find how many boards must be sold to break even?
a. 300 b. 400 c. 500 d. 600
17. A swimming pool is constructed in the shape of two overlapping identical circles having a radius of 9 m. and each circle passes through center of each other. Find the area common to the two circles
a. 103 b. 102 c. 101 d. 100
18. Tickets to a benefit concert cost either P 12 or P 15. A total of 300 tickets are sold, and the total receipts were P4140.00. How many P 12 tickets were sold?
a. 120 b. 180 c. 150 d. 200
19. Calculate the following definite integral: $\int_0^3 (x^2 + 4x) dx$
a. 74/5 b. 74/3 c. 74/7 d. 74/9
20. A German silver alloy consists of 60% copper, 25% zinc and 15% nickel. Determine the mass of copper in a 10 kg sample.
a. 2.5 b. 1.5 c. 6 d. None
21. Determine the determinant of this matrix:
- $$\begin{bmatrix} 8 & 2 & 0 & 0 \\ 2 & 8 & 2 & 0 \\ 0 & 2 & 8 & 2 \\ 0 & 0 & 2 & 4 \end{bmatrix}$$
- a. 1552 b. 1542 c. 1526 d. 1569
22. The color of curb markings for parking restrictions shall be of _____ covering the face of the curb.
a. solid red color
b. solid yellow color
c. solid white color
d. solid red and yellow color
23. A certain operation is now performed by hand, the labor cost per unit is P 0.54 and the annual fixed charge for tool used is P 100 per year. A machine that is being considered for this job will cost P 2500 , have a salvage value of P 100 at any time and a fixed annual cost of P 300. With the machine, the labor cost is P 0.22 per unit. Use straight line method of depreciation. For what number of units of product per year at zero interest and life of 6 years for the machine will the annual cost of the two methods break even?
a. 1775 b. 1875 c. 1975 d. 2075
24. An experiment consists of selecting three items from a box of several items. The three items are classified defective (D) or non-defective (N) as they are selected. Give the sample space for this experiment. Which outcomes are in the events A ,B, and C where A exactly one defective?
a. (NNN, NND, DNN) b. (DNN, NDN, NND) c. (DDD, DNN, NDD) d. (NDD, DND, DDN)
25. Find the 25th term of an AP 5,8,11,14...
a. 81 b. 79 c. 77 d. 75
26. A mixture compound from equal parts of two, liquids, one water and the other oil was placed in a hemispherical bowl. The bowl depth of the two liquids is 3 cm. After standing for a short time the mixture separated , the oil settling above the water. If the thickness of the segment of the oil is 1 cm, find the radius of the bowl.

- SITUATION 2: The tangents of a spiral curve forms an angle of intersection of 25° at station 2 + 058. Design speed is 60 km/hr. For a radius of central curve of 300 m and a length of spiral of 52.10 m.

- SITUATION 3: China, United States, and Russia are the countries with the most cellular subscribers in the world. Together, three countries have 34.8% of the world cellular subscribers. If the percent of the world subscribers in China is 3.1% less than 4 times the percent of the world subscribers in Russia and the percent of the world subscribers in United States is 4.3% more than the percent of the world's subscribers in Russia,

37. Calculate the percentage for Russia.
a. 5.6% b. 19.3 c. 9.9 d. 65.2
38. Calculate the percentage for United States.
a. 5.6% b. 19.3 c. 9.9 d. 65.2
39. Calculate the percentage for China.
a. 5.6% b. 19.3 c. 9.9 d. 65.2
40. If the sum of the first 13 terms of two AP are in the ratio of 7:3 , what is the ratio of their corresponding seventh terms?
a. 7/4 b. 4/7 c. 7/3 d. 4/7
41. These are cheaper variety of paints in which chalk is used as base and water is used as a carrier.
a. Bitumen b. Plasters c. Distempers d. Pigments
42. Two points lie in a horizontal line directly north of a building 50 m high. The angles of depression to the points are 24° and 52° . The distance between the points is closest to:
a. 85.5 m b. 78.8 c. 96.3 d. 73.2
43. It is a relatively thin deposit of mineral between definite boundaries.
a. Vein b. Strike c. Dip d. Drift
44. Determine the gradient of the function $x^2 + y^2 + z^2$ at points P(1,2,3)
a. 7.48 b. 8.25 c. 6.00 d. 7.21

45. In a bowling game, how many ways can the 10 pins fall in the first throw?
 a. 1023 b. 3628800 c. 1 d. 2024
46. Eleven workers of the same skill were on a job that could be finish in 15 days. After 10 days, 5 workers quit. How many days more would it take the remaining workers to finish the job?
 a. 6.79 b. 9.33 c. 9.17 d. 5.57
47. If $\tan B = \frac{x}{\sqrt{1-x^2}}$, find $\cos B$.
 a. x b. $\sqrt{1-x^2}$ c. $\sqrt{x^2 - 1}$ d. 1
48. Find the differential equations of a family of circles through the origin.
 a. $x \, dx + y \, dy = 0$ b. $x \, dy + y \, dx = 0$ c. $x \, dx - y \, dy = 0$ d. $x \, dy - y \, dx = 0$
49. Find the integral of $\int_0^2 \int_0^{2y} x^2 \, dx \, dy$
 a. 22.5 b. 16.3 c. 10.7 d. 9.5
50. A turnout has a frog number of 9 with a length of heel spread equal to 336.11 mm. Compute the length of heel. Hint: FN = L of heel / L of spread
 a. 3205 b. 3305 c. 3025 d. 3195
51. Mr. Curry can finish a job in 6 days and Mr. Thompson can finish the same job in 12 days. How many days the job will be done if both of them will work together?
 a. 3 b. 4 c. 5 d. 2
52. A curve has an equation $r^2 \sin 2\theta = 6$. Transform to rectangular coordinates.
 a. $xy = 3$ b. $xy = 6$ c. $x/y = 3$ d. $x/y = 6$
53. The interior angles of a quadrilateral are as follows:

Angles	Value	No. of Measurements
A	92	2
B	88	4
C	71	3
D	110	6

- Compute the corrected value of angle C.
 a. $91^\circ 36'$ b. $87^\circ 48'$ c. $70^\circ 44'$ d. $108^\circ 27'$
54. It is a device which determines one's direction with reference to magnetic north.
 a. compass b. map c. level d. odometer
55. A box having a square base and open top is to be made with the least material to be used. What should be the base edge in meters if the volume is to be $32 \, \text{m}^3$.
 a. 8 b. 4 c. 6 d. 9
56. The datum line for design of port facilities in accordance with charts which is being used by the Phil. Ports Authority
 a. Low Water Level c. High Water Level
 b. Residual Water Level d. Mean Low Water Level
57. A machine costing P 45000 is estimated to have a salvage value of P4350 when retired at the end of 6 years. Depreciation cost is computed using a constant percentage of the declining book value. What is the annual depreciation in percent?
 a. 23.66% b. 32.25% c. 40.27% d. 16.85%
58. If a sum of money triples in a certain period of time at a given rate of interest, compute the value of the single payment present worth factor.
 a. 0.25 b. 0.5 c. 0.333 d. 0.75
59. Solve for x that satisfy $x^2 + 36 = 9 - 2x^2$
 a. $\pm 6i$ b. $\pm 3i$ c. 9i d. -9i
60. A series of numbers which are perfect square numbers is known as _____ Series
 a. Fibonacci b. Fourier c. Fermat d. Euler
61. Integrate $\tan (\ln x) / x \, dx$
 a. $\ln \cos (\ln x) + C$ c. $\frac{1}{2} \tan^2 (\ln x) + C$

$$b. \ln \sec(\ln x) + C$$

$$d. \tan (\ln x)^2 + C$$

62. Data on traffic accident recorded on a certain intersection for the past 5 years has an accident rate of 4160 per million entering vehicles. If the average daily traffic entering the intersection is 504 , find the total number of accidents during the 5 year period.
a. 4472 b. 3826 c. 5031 d. 6027
63. The deflection angles of two intermediate points A and B on a circular curve are $3^{\circ}05'$ and $8^{\circ}15'$ respectively. If the chord distance AB is 40 m , compute the length of the curve from PC to A.
a. 26.57 b. 23.90 c. 22.57 d. 24.06
64. Boyle's law states that for a gas of constant temperature, the volume of a fixed mass is inversely proportional to its absolute pressure. If a gas occupies a volume of 1.5 m^3 at a pressure of 200000 Pascals. Determine the volume when the pressure is 800×10^3 Pascals.
a. 0.375 m^3 b. 0.558 c. 0.235 d. 0.878
65. An airplane flew from Manila ($14^{\circ}36' \text{ N}$, $121^{\circ}05' \text{ E}$) at a course of $S 30^{\circ} \text{ E}$ maintaining a certain altitude and following a great circle path. If its groundspeed is 350 knots, after how many hours will it cross the equator?
a. 2.87 hrs b. 2.27 c. 3.17 d. 3.97

SITUATION 4: A line 100 m long was paced by a surveyor for four times with the following data: 142 , 145 , 145.5 , and 146. Then, another line was paced for four times again with the following results: 893 , 893.5 , 891 , and 895.5.

66. Determine the pace factor.
a. 0.701 b. 0.685 c. 0.691 d. 0.722
67. Determine the no. of paces for the new line.
a. 893.25 b. 893.61 c. 893.56 d. 893.77
68. Compute the distance of the new line.
a. 617.54 b. 617.24 c. 617.44 d. 617.34
69. Find the Laplace transform of $f(t) = 3t \cos (2t)$.
a. $3(s^2 + 4)/(s^2+4)^2$ c. $3(s^2 - 4)/(s^2 +4)$
b. $3(s^2 - 4)^2/(s^2 -4)^2$ d. $3(s^2 - 4)/(s^2+4)^2$
70. Convert to Arabic Number system: MCMXCIII.
a. 1993 b. 1893 c. 2113 d. 2093
71. Find the perimeter of the ellipse given $e = 0.75$ and distance between the foci is 6.
a. 24.88 b. 28.45 c. 32.65 d. 25.41
72. With interest rate of 9% compounded continuously, what is the present worth of a perpetuity of P 8000 payable monthly?
a. P 1254253 b. P1153256 c. P 1062699 d. P 1546320
73. A parabolic curve has a descending grade of -0.8% which meets at an ascending grade of 0.4% at Sta. 10+020. The max. allowable change of grade per 20 m station is 0.15. Elevation of 10+020 is 240.60 m. What is the length of the curve.
a. 120 b. 160 c. 150 d. 140

SITUATION 5: Answer the following terms in Analytic Geometry.

74. It is a locus of points in which every point therein is equidistant to a fixed point.
a. circle b. parabola c. ellipse d. hyperbola
75. It is a chord passing through the focus and parallel to the directrix of a conic section.
a. major axis b. eccentricity c. latus rectum d. vertex

CE GREAT MINDS

HYDRAULICS AND GEOTECHNICAL ENGINEERING

INSTRUCTION: Select the best answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

CONCEPTUAL AND PROBLEM SOLVING

1. An 8 m. thick layer of clay under a surcharge loading underwent 80% primary consolidation in 70 days. The clay layer is drained both top and bottom. Find the coefficient of consolidation of clay for the pressure range. Use $T_v = 0.567$ Hint: use the formula:

$$t = \frac{T_v(H_{dr})^2}{C_v}$$

Where: t = time corresponding to degree of consolidation
 C_v = coefficient of consolidation
 H_{dr} = half the thickness of the sample drained on both sides.
 T_v = time factor

- a. 0.1365 m²/day b. 0.1296 c. 0.1477 d. 0.2592
2. It is used in drilling operations to determine the *in situ* undrained shear strength of clay soils particularly soft clays.
 a. triaxial test b. nuclear method c. rubber balloon d. vane shear
3. A rectangular block of wood, floats with one face horizontal in a fluid ($S = 0.9$). The wood density is 750 kg/m³. Determine the percentage of wood, which is floated.
a. 17% b. 21% c. 27% d. 24%
4. Water is supplied to a 90 mm nozzle under a head of 300 m. If $C_v = 0.95$ and $C_c = 1$, calculate the velocity of the jet.
 a. 63.45 m/s b. 72.88 c. 76.72 d. 59.20
5. In engineering practice the highest altitude in an atmospheric condition is :
 a. 10000 m b. 8500 c. 8225 d. 9250

SITUATIONAL

SITUATION 1: A rectangular scow is 9 m wide , 15 m long, and 3.6 m high has a draft in sea water of 2.4 m. Its center of gravity is 2.7 m above the bottom of the scow.

6. Calculate MB_0 .
 a. 2.7135 m b. 2.8125 c. 3.125 d. 1.8125
7. Calculate the initial metacentric height.
 a. 1.7135 b. 1.9185 c. 1.6555 d. 1.3125
8. Compute the righting or overturning moment when the scow tilts until one side is just at the point of submergence in kN.m .
 a. 3273.8 RM b. 3273.8 OM c. 1189.3 RM d. 1189.3 OM

SITUATION 2: For sandy soil, $e_{max} = 0.86$, $e_{min} = 0.43$ and $G_s = 2.66$.

9. Find the void ratio at $D_r = 0.56$.
 a. 0.75 b. 0.62 c. 0.83 d. 0.54
10. Find the moist unit weight of soil when the water content is 0.07.
a. 17.24 kN/m³ b. 15.56 c. 18.75 d. 19.03
11. Find the degree of saturation.
 a. 0.4 b. 0.35 c. 0.3 d. 0.25

SITUATION 3: A soil sample was determined in the laboratory to have a liquid limit of 41% and a plastic limit of 21.1 %. If the water content is 30%, the following characteristics of soil as follows:

LI < 0 - brittle solid
 LI < 1 - plastic
 LI > 1 - liquid

12. Calculate the plasticity index.

- a. 21.1 b. 20 c. 19.9 d. 18.7
13. Calculate the liquidity index.
a. 0.447 b. 0.472 c. 0.506 d. 0.538
14. Determine the characteristic of soil.
a. liquid b. plastic c. dense d. brittle

SITUATION 4: The submerged, curved surface AB in Figure FM1-MG is one-quarter of a circle of radius 4 ft. The tank's length (distance perpendicular to the plane of the figure) is 6 ft.

15. Calculate the horizontal component of the hydrostatic force.
a. 15620 lb b. 13985 c. 14980 d. 14220
16. Calculate the vertical component of the hydrostatic force.
a. 17625 lb b. 16690 c. 17225 d. 18000
17. Calculate the location of the horizontal force from the water surface.
a. 10.13 ft b. 9.76 c. 10.27 d. 9.56

SITUATION 5: In a tri-axial test for a normally consolidated soil, the normal stress at failure is equal to 450 kPa and the shear stress at failure equal to 300 kPa.

18. Compute the angle of friction.
a. 27.56° b. 28.57° c. 33.69° d. 30.62°
19. Compute the angle of the failure plane with the major principal axis.
a. 60.33° b. 61.07° c. 60.84° d. 61.85°
20. Compute the maximum principal stress at failure.
a. 957.25 kPa b. 984.26 kPa c. 1013.03 kPa d. 1056.84 kPa

SITUATION 6: Pipes from three reservoirs that meet at point C which is at elevation 366 m. is shown in the Figure H13R-JCB. With C = 150 and pressure at point C is 18.3 psi.

21. Compute the pressure head at C in m.
a. 13.57 b. 12.66 c. 9.54 d. 11.47
22. Compute the elevation at D.
a. 378.66 b. 380.67 c. 377.59 d. 376.76
23. Compute the head loss at pipe line x.
a. 33.77 b. 38.94 c. 35.50 d. 32.94

SITUATION 7: A 4.2 m thick layer of sand is underlain by a layer of clay. The water table is 2 below the ground or sand surface. For sand, $G_s = 2.65$ and the average void ratio is 0.52. The sand above water table has a degree of saturation of 0.37. The saturated unit weight of the clay layer is 20.2 kN/m³.

24. Determine the unit weight of sand above the water table.
a. 17.86 b. 20.46 c. 10.65 d. 18.35
25. Determine the total stress at a point 10 m below the ground.
a. 199 kPa b. 123 c. 232 d. 167
26. Determine the effective stress at a point 10 m below the ground.
a. 134.5 kPa b. 120.4 c. 156.9 d. 111.1

SITUATION 8: Identify the following terms in soils.

27. It has particle size greater than 2 mm.
a. Gravel b. Sand c. Silt d. Clay
28. The US Sieve size of 0.074 mm opening is:
a. 4 b. 10 c. 40 d. 200
29. It is used in scaling the natural water content of a soil sample.
a. Plastic Limit b. Compression Index c. Liquidity Index d. Liquid Limit

SITUATION 9: A 0.36 m square prestressed concrete pile is to be driven in a clayey soil with unconfined compressive stress of 110 kN/m². If the design capacity of the pile is 360 kN, with a factor of safety of 2 , $N_c = 9$, and the unit weight of soil is 18.1 kN/m³.

30. Find the end bearing capacity of the soil.
a. 66.26 kN b. 64.15 c. 68.26 c. 62.70
31. Find the skin friction force.
a. 705.33kN b. 668.26 c. 655.85 d. 720.56
32. Find the length of the pile.
a. 11.01 b. 11.22 c. 10.90 d. 12.37

SITUATION 10: A 4 m cylindrical tank 10 m high , contains oil at a depth of 6 m and water at a depth of 4 m. A 100 mm orifice located at the bottom of the tank. Use $C_c = 0.9$, $C_v = 0.98$ and $S_{oil} = 0.90$.

33. Compute the coefficient of discharge.
a. 0.9 b. 0.98 c. 0.88 d. 0.80
34. Compute the time to remove the water.
a. 608 s b. 752 c. 345 d. 489
35. Find the total time required to drain all liquids.
a. 33 mins b. 44 c. 55 d. 66

SITUATION 11: An open cylindrical tank 30 cm in diameter and 80 cm high partially filled with water is rotated about its vertical axis at a speed of 240 rpm

36. What would be the depth of water in the tank if the cylindrical tank is brought to rest so that no water will be spilled out?
a. 0.56 m b. 0.44 c. 0.72 m d. 0.36 m
37. At what speed would it be rotated so that 1.40 liters of water will be spilled out?
a. 225.60 rpm b. 285.75 c. 245.80 d. 252.22
38. Calculate the speed so that the pressure at the center of the bottom of the tank is zero.
a. 225.60 rpm b. 285.75 c. 245.80 d. 252.22

SITUATION 12: Given the soil profile in which the water table is 3 m below the ground. Also 3 m below the ground is the clay layer. For the sand, the void ratio is 0.65 , $G_s = 2.66$. For a clay layer, $e = 0.90$, $G_s = 2.75$ $LI = 0.24$,and $PL = 20\%$.

39. Compute the compression index.
a. 0.64 b. 0.77 c. 0.45 d. 0.36
40. Compute the effective stress increase with the water table lowered with the water table lowered by 5 m.
a. 97.15 kPa b. 198.47 c. 282.59 d. 101.32
41. Compute the settlement.
a. 647 mm b. 764 c. 822 d. 612

SITUATION 13: A 50 mm. diameter siphon is drawing oil ($S = 0.82$) from an oil reservoir as shown on the Figure H2BT - JS. The head loss from point 1 to point 2 is 150 m and from point 2 to 3 is 2.40 m. Use $\gamma_{water} = 9.79$ kN/m³ .

42. If the total length of the 50 mm diameter siphon, compute the friction factor f .
a. 0.056 b. 0.022 c. 0.035 d. 0.015
43. Compute the discharge of oil from the siphon.
a. 10.11 L/s b. 7.88 c. 9.12 d. 6.55
44. Compute the lowest vacuum pressure of the siphon.
a. -55.12 kPa b. -69.62 c. -47.38 d. -36.9

SITUATION 14: A braced sheet pile for an open cut in a stiff clay is shown in the Figure F1SL - ABM. The struts are spaced longitudinally at 4 m center to center.

45. Compute the loads on strut at A.
a. 525.18 kN b. 367.63 c. 137.81 d. 262.59
46. Compute the loads on strut at B.

a. 525.18 kN b. 367.63 c. 137.81 d. 262.59

47. Compute the loads on strut at C.

a. 525.18 kN b. 367.63 c. 137.81 d. 262.59

SITUATION 15: The Figure G1SS - JSJ shows a layer of granular soil in a tank with an upward seepage by applying water through the valve at the bottom. The loss of head caused by upward seepage between the levels A and B is 0.70 m and between levels A and B is 0.28 m. The void ratio is 0.52 and its specific gravity is 2.72.

48. Compute the effective stress at C.

a. 19.45 kN/m² b. 18.87 c. 20.34 d. 17.35

49. Calculate the critical hydraulic gradient.

a. 1.45 b. 1.13 c. 1.37 d. 1.64

50. Calculate the upward seepage force per unit volume.

a. 1.45 b. 1.13 c. 1.37 d. 1.64

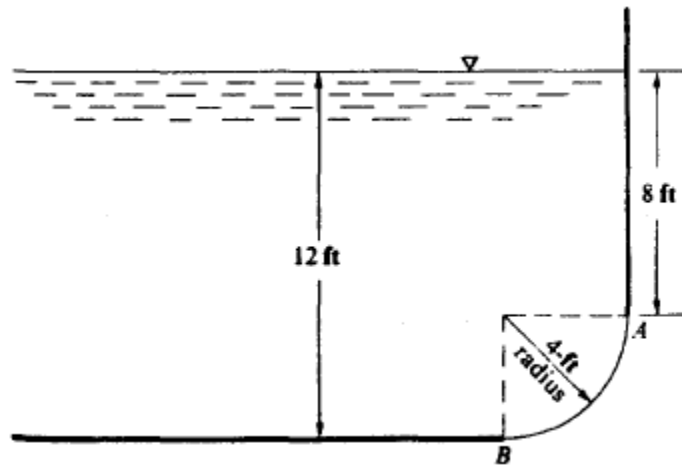


Figure FM1- MG

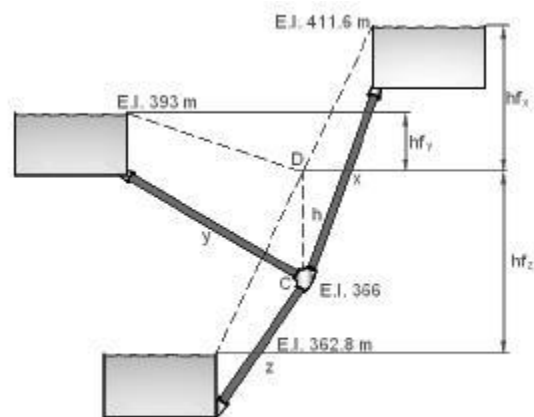


Figure H13R - JCB

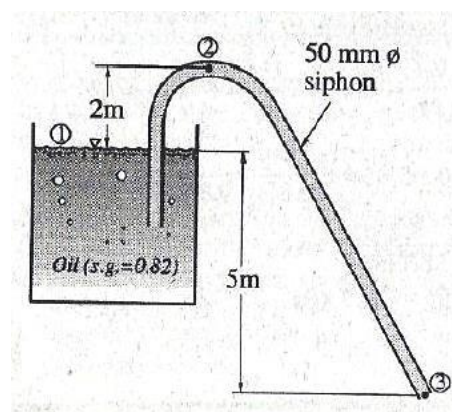


Figure H2BT - JS

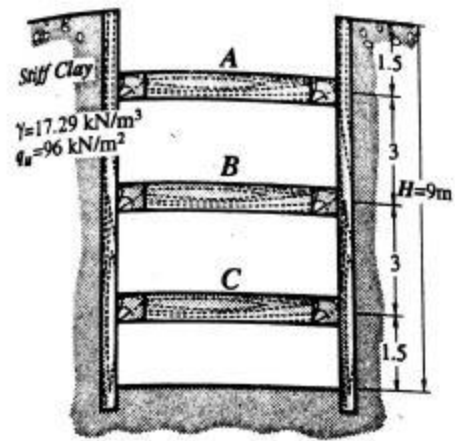


Figure F1SL - ABM

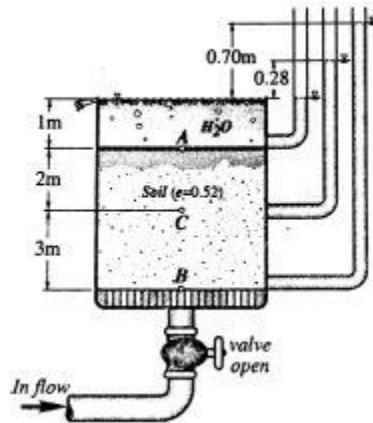


Figure G1SS - JSJ

CE GREAT MINDS

STRUCTURAL ENGINEERING AND CONSTRUCTION

INSTRUCTION: Select the correct answer for each of the following questions. Mark only one answer for each item by shading the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

SITUATIONAL

SITUATION 1: The actual detail section of a concrete beam designed for positive bending is as shown in Figure RC1B - RKCT . If $f'_c = 21$ MPa and $F_y = 276$ MPa.

1. Which of the following gives the design classification of the cross section?
 a. Under reinforced , singly
 b. Over reinforced , singly
 c. Doubly, compression steel yield
 d. Doubly, lower the compression steel strength
2. Which of the following gives the nominal strength of the section?
 a. 211 kNm b. 280 c. 320 d. 362
3. Which of the following gives the ultimate strength of the section?
 a. 190 kNm b. 252 c. 288 d. 326

SITUATION 2: The implementing rules and regulations of PD 1594 states that the for a unit-price contract, quantity overruns or under runs of not more than 15% of the estimates per major pay item (i.e. pay items which represents at least 20% of the total estimated cost) and 25% per minor pay item in the bill of quantities need not be covered by change order provided that the same is authorized by the Approving Authority for the contract. The quantities and contract prices for a government project as shown in Figure CELCO - JRMM.

4. Which of the following most nearly gives the Approved Agency Estimate?
 a. P 13.95 M b. 14.34 c. 15.39 d. 13.44
5. Which of the following gives the complete list of major items?
 a. 2,5,7 b. 5,7 c. 2,7 d. 8
6. Which of the following need not be covered by a Change Order?
 a. Decrease in quantity from 50 to 37 for item 2
 b. Decrease in quantity from 1000 to 750 in item 5
c. Increase in quantity from 500 to 625 for item 3
 d. Increase in quantity from 20 to 26 for item 8

SITUATION 3: Answer the following problems in thin walled pressure vessels problems.

7. A 20 m diameter cylindrical tank is to be used to store gas. The shell plating is 10 mm thick and the working stress of the material is 125 MPa. Calculate the maximum permissible gas pressure?
 a. 0.75 MPa b. 0.5 c. 0.25 d. 0.33
8. One proposed design for an energy-efficient automobile involves an on-board tank storing hydrogen which would be released to a fuel cell. The tank is be cylindrical, 0.4 m in diameter , made of type 302 stainless steel having a working stress in tension of 290 MPa and closed by hemispherical end caps. The hydrogen would be pressurized to 15 MPa, when the tank is initially filled. Determine the required wall thickness of the tank.
a. 5.2 mm b. 6.6 c. 7.4 d. 8.1
9. A steel tank made from 8 mm thick plate has an outer diameter of 500 mm. The tank is used as storage of gas under a pressure of 2.2 MPa. Determine the longitudinal stress.
 a. 62.1 b. 64.4 c. 66.6 d. 68.8

SITUATION 4: A 10 m long ladder which weighs 300N is leaning on a wall at an angle of 60° with the horizontal. A horizontal force P is applied 2 meters measured vertically from the bottom of the ladder. The coefficient of friction at all surfaces is 0.25.

10. Calculate the smallest value of P that will move the ladder.
 a. 170.29 N b. 255.93 c. 342.57 d. 150.64
11. Determine the reaction at the contact between the ladder and the ground surface.
 a. 170.29 N b. 255.93 c. 342.57 d. 150.64
12. Determine the reaction at the contact between the ladder and the wall.
 a. 170.29 N b. 255.93 c. 342.57 d. 150.64

SITUATION 5: In the Figure STCA - HAS shown,

13. Calculate the force BC.
a. 83 lb b. 46.7 c. 88.1 d. 72.9
14. Calculate the force CD.
a. 83 lb b. 46.7 c. 88.1 d. 72.9
15. Find the total length of the cable.
a. 13.7 ft b. 16.8 c. 19.3 d. 20.2

SITUATION 6: A 572 Grade 65 steel with $F_y = 448$ MPa is used as a simple beam to carry a concentrated load P at the center of its span on a 6 m simply supported span. The beam is a W 12 x 14 section. Refer to Figure SDSB - JCW.

Properties of W 12 x 14:

Weight of beam - 204.76 N/m	Flange thickness - 5.690 mm
Area - 2658 sq mm	Web thickness - 5.029 mm
Depth - 302.514 mm	Section modulus - 242529 mm ³
Flange width 100.787 mm	

16. Compute the allowable bending stress if the compression flange of the beam is fully supported against the lateral movement.
a. 276.58 MPa b. 289.90 c. 256.75 d. 262.84
17. Determine the value of the concentrated load P that the beam could support safely.
a. 47.88 kN b. 49.94 c. 44.55 d. 46.26
18. Compute the allowable bending stress if the compression flange has lateral support only at its ends and at the mid-span.
a. 52.28 MPa b. 77.41 MPa c. 268.8 MPa d. 248 MPa

SITUATION 7: The resultant of the concurrent forces has a magnitude of 1000 kN and acts through the origin and points $x = 2$, $y = 3$, and $z = 4$.

19. Which of the following gives the x component.
a. 371.06 kN b. 370.06 kN c. 376.06 kN d. 317.06 kN
20. Which of the following gives the y component.
a. 536.95 kN b. 550.59 c. 556.59 d. 565.59
21. Which of the following gives the z component.
a. 738.12 kN b. 740.10 kN c. 741.12 kN d. 742.12 kN

SITUATION 8: A batter hits a baseball so that it leaves the bat at speed of $v_0 = 37$ m/s at an angle of $\theta = 53.1^\circ$.

22. Find the time when the ball reaches the highest point of its flight.
a. 2 s b. 3.02 c. 4.57 d. 1.89
23. Calculate the maximum height reached.
a. 45.9 m b. 56.3 c. 44.7 d. 39.8
24. Determine the horizontal range from the starting point as the ball hits the ground.
a. 144 m b. 164 m c. 184 m d. 134 m

SITUATION 9: A component of power generator consists of a torus supported by six tie rods from an overhead central point shown in Figure SMSS - LADC. The weight of the torus is 2000 N per meter of circumferential length. The point of attachment is 1.25 m above the plane of the torus. The radius of the middle line of the torus is 0.5 m. Each tie rod has a cross sectional area of 25 sq mm.

25. Determine the tensile force of each rod.
a. 1097 N b. 1164 N c. 1056 N d. 1120 N
26. Determine the deformation of the rod.
a. 0.55 mm b. 0.5 c. 0.45 d. 0.4
27. Determine the vertical displacement of the rod.
a. 0.54 mm b. 0.32 mm c. 0.47 mm d. 0.35 mm

SITUATION 10: A 2.4 m square footing is 450 mm thick. Its supports a 400 mm column at its center. $F'_c = 28$ MPa, $F_y = 415$ MPa. Concrete cover to bar centroid is 100 mm.

28. Determine the maximum ultimate load the footing can sustain based on two way shear.
a. 1535 kN b. 1740 c. 2325 d. 2522
29. Determine the maximum ultimate load based on the wide beam shear.
a. 1535 kN b. 1740 c. 2325 d. 2522
30. Determine the maximum ultimate load the footing can sustain based on the flexure if the slab is reinforced with 8-20 mm ϕ bars on both ways.
a. 1535 kN b. 1740 c. 2325 d. 2522

SITUATION 11: A reinforced concrete beam having a width of 300 mm and overall depth of 600 mm has a spacing of 2.5 m on centers supports a slab 100 mm in thickness. The super imposed dead load is 3 kPa and live load is 4.8 kPa. Columns E and H are omitted such that the girder BEHK support beams, DEF at E and GHI at H. Refer to Figure RC2LDB - SAS.

31. Compute the ultimate load at E induced by the beam DEF
a. 225 kN b. 264 kN c. 237 kN d. 252 kN
32. Compute the ultimate load at H induced by the beam GHI.
a. 225 kN b. 264 kN c. 237 kN d. 252 kN
33. Compute the maximum positive moment of girder BK assuming full fixity at B and K. Use $FEM = Pab^2 / L^2$.
a. 197.5 kN.m b. 185.5 kN c. 202.5 d. 191.5

SITUATION 12: A concrete mix has a ratio of 1:2:4 by mass. The properties of the materials to be used are tabulated below.

Materials	Specific Gravity
Cement	3.33
Sand	2.65
Gravel	2.67

34. Which of the following most nearly gives the volume of cement solids per bag of cement?
a. 0.0240 m³ b. 0.0210 c. 0.0420 d. 0.0120
35. Which of the following most nearly gives the required volume of sand solids per bag of cement?
a. 0.0203 m³ b. 0.0302 m³ c. 0.0401 m³ d. 0.0104 m³
36. Which of the following most nearly gives the volume of concrete that can be produced per bag of cement?
a. 0.1061 m³ b. 0.0661 m³ c. 0.1261 m³ d. 0.1461 m³

SITUATION 13: The truss in the Figure TBT - CB is made up of Guijo 100 mm x 150 mm. It is loaded with a downward load of 20 kN at its apex.

Shear parallel to grain	=	1.00 MPa
Shear longitudinal for joints	=	1.45 MPa
Compression parallel to grain	=	11 MPa
Compression perpendicular to grain	=	5 Mpa

37. Which of the following gives the axial stress on member AC?
a. 1.26 MPa b. 1.19 MPa c. 1.14 MPa d. 1.07 MPa
38. Which of the following gives the value of x?
a. 160 mm b. 117.03 c. 130.12 d. 104.60
39. Which of the following gives the value of y?
a. 22.94 mm b. 17.08 c. 14.55 d. 19.45 mm

SITUATION 14: The beam shown in Figure RC3CS - ROS has a width of 300 mm, overall depth of 600 mm and an effective depth of 520 mm. The beam is simply supported over a span of 9 meters and carries superimposed dead load of 8 kN/m and live load of 20 kN/m. Use $\gamma_{conc} = 24$ kN/m³, $F'_c = 21$ MPa and $F_y = 345$ MPa. For code provisions see Figure RCSCP - LKET.

40. Calculate the ultimate shear strength of concrete. Use $1.2D + 1.6L$.
a. 186.2 kN b. 157.75 c. 188.10 d. 191.4

41. Calculate the shear strength of stirrups.
 a. 133.75 kN b. 126.74 c. 142.11 d. 139.83
42. Determine the spacing of stirrups.
 a. 260 mm b. 200 mm c. 300 mm d. 180 mm

SITUATION 15: A steel shaft 3 ft long has a diameter of 4 inches is subjected to a torque of 15 kip ft.

43. Determine the maximum shearing stress of the shaft.
 a. 12.5 ksi b. 11.7 c. 18.8 d. 14.3
44. Determine the angle of twist in radians.
 a. 0.0117 b. 0.0157 c. 0.0215 d. 0.0207
45. Determine the angle of twist in degrees.
 a. 0.90 b. 0.6704 c. 1.186 d. 1.2319

SITUATION 16: A W x 35 steel column has an unsupported length of 6 m. Using A 26 steel with $F_y = 248$ MPa and $E_s = 200000$ MPa assuming both ends are fixed and $K = 0.65$. Refer to Figure SDSCP - PRRD for the provisions and properties of this section.

46. Compute the slenderness ratio.
 a. 117.85 b. 126.17 c. 105.88 d. 112.77
47. Compute the value of FS.
 a. 1.79 b. 1.73 c. 1.86 d. 1.92
48. Determine the axial load.
a. 726.8 kN b. 829.7 c. 800.6 d. 794.3

SITUATION 17: Using portal method of analysis for the building frame shown in Figure STPM - ARDR.

49. Compute the shear force on member JF.
 a. 7 kN b. 1.2 c. 3 d. 7.5
50. Compute the axial force on member IJ.
 a. 7 kN b. 1.2 c. 3 d. 7.5
51. Compute the shear force on member JK.
 a. 7 kN b. 1.2 c. 3 d. 7.5

SITUATION 18: Light grade steel channel was used as a purlin of a truss. The top chord of the truss is inclined 1 V: 3 H and distance between trusses is equal to 3 m. The purlin has a weight of 71 N/m and spaced 1.2 m on centers. The dead load including roof materials is 1200 Pa live load of 1000 Pa and wind load is 1440 Pa. Coefficient of pressure at leeward is 0.6 and at the windward side is 0.2. Sag rods are placed at the middle thirds. $F_{bx} = F_{by} = 138$ MPa.

$$S_x = 4.48 \times 10^4 \text{ mm}^3$$

$$S_y = 1.18 \times 10^4 \text{ mm}^3$$

52. Calculate the maximum ratio of actual to allowable bending stress for combination (D + L) load.
 a. 0.66 b. 0.80 c. 1.00 d. 0.85
53. Calculate the maximum ratio of actual to allowable bending stress for combination 0.75(D + L + W) load.
a. 0.66 b. 0.80 c. 1.00 d. 0.85
54. Calculate the maximum ratio of actual to allowable bending stress for combination (D + L) load if one line of sag rod was placed at the midpoint.
 a. 0.66 b. 0.80 c. 1.00 d. 0.85

SITUATION 19: The section of a column shown in figure RCCC - LGR. For this problem, $b_1 = 300$ mm, $b_2 = 180$ mm, $d_1 = 250$ mm, $d_2 = 350$ mm, $f'_c = 28$ MPa, $f_y = 414$ MPa.

55. Determine the location of the geometric centroid.
 a. 272 mm b. 262 mm c. 256 mm d. 248 mm
56. Determine the location of the plastic centroid.
 a. 287 mm b. 291 mm c. 280 mm d. 296 mm
57. If $P_u = 3200$ kN applied 400 mm from y axis, calculate the moment produced.
 a. 392.5 kN.m b. 348.8 kN.m c. 362.7 kN.m d. 399.11 kN.m

SITUATION 20: A beam width $b = 300$ mm and depth $d = 600$ mm is to be prestressed.

58. Find the prestressing force if the compressive stress is 21 MPa.
a. 3780 kN b. 900 kN c. 1440 kN d. 3280 kN
59. Find the eccentricity of the force if the compressive stress at the bottom fiber is 12 MPa and tensile stress at the top fiber is 2 MPa.
a. 160 mm b. 125 mm c. 140 mm d. 110 mm
60. Find the prestressing force if the compressive stress at the bottom fiber is 12 MPa and tensile stress at the top fiber is 2 MPa.
a. 3780 kN b. 900 kN c. 1440 kN d. 3280 kN

CONCEPTUAL AND PROBLEM SOLVING

61. The relationship of E , ν , and G in Poisson's ratio upon solving for G is:
a. $2(1+E)/\nu$ b. $\nu/2(1+E)$ c. $E/2(1+\nu)$ d. $2(1+\nu)/E$
62. Classify the determinacy of the beam as shown in Figure STDS - AMDC.
a. unstable b. determinate c. 1° indeterminate d. 2° indeterminate
63. At least how many pre-bid conference shall be conducted for each procurement unless otherwise provided in the implementing rules and regulations?
a. 1 b. 2 c. 3 d. 4
64. An eccentrically loaded bolted connection is shown in Figure SDBBC - FLG. Diameter of A 325 bolts in standard holes is 19 mm. The applied load is 45 kN. Calculate the torsional force on the critical bolt.
a. 11.44 kN b. 6.66 c. 19.06 d. 15.25
65. A 40 kN axial load is applied to a short wooden post that is supported by a concrete footing resting on undistributed soil. If the bearing stress in the soil is 145 kPa, determine the area of the cross section.
a. 0.53 m^2 b. 0.46 c. 0.33 d. 0.28
66. For the propped beam (fixed-roller supports), what are the boundary conditions needed to solve for the support reactions using double integration method?
a. $y(0)=0$; $y(L)=0$ b. $y(0)=0$; $y'(L)=0$
c. $y(0)=0$; $y'(0)=0$; $y(L)=0$ d. $y(0)=0$; $y'(0)=0$; $y(L)=0$; $y'(L)=0$
67. Seismic body waves can be classified as :
a. P and S
b. Love and S
c. S and Rayleigh
d. Love and Rayleigh
68. The term PERT means:
a. Pessimistic Evaluation and Review Tool
b. Program Evaluation and Review Technique
c. Probable Easement Rehabilitation Theory
d. Programmable Evolution on Recording Timetable
69. A catapult is placed 100 feet from the castle wall which is 35 feet high. The soldier wants the burning bale of hay to clear the top of the wall and land 50 feet inside a castle wall. If the initial velocity of the bale is 70 feet per second, then what angle should the bale of hay be launched so that it travel 150 feet and pass over the castle wall?
a. 58.8° b. 53.8° c. 50.8° d. 54.8°
70. Determine the maximum moment of inertia in 10^6 mm^4 as a section having $I_x = 100 \cdot 10^6 \text{ mm}^4$, $I_y = 60 \cdot 10^6 \text{ mm}^4$ and $P_{xy} = 15 \cdot 10^6 \text{ mm}^4$
a. 115 b. 95 c. 145 d. 105
71. Determine the reaction at the right support on a simply supported beam as shown in Figure EME - CDDR.
a. 510 N b. 520 c. 530 d. 540

72. It is the slope of the stress-strain diagram at the origin of the curve.
a. Tangent modulus b. Initial modulus c. Secant Modulus d. Apparent modulus
73. A T-beam for a floor system has a slab thickness of 75 mm and a web thickness of 375 mm. It has an effective depth of 600 mm. It has a span of 5.4 m, assuming the spacing is center to center. Calculate the effective width of the flange based on NSCP Specs.
a. 1575 mm b. 1800 mm c. 1350 mm d. 1250 mm
74. For the forces shown in Figure EMF - JLCA, determine the resultant force.
a. 36.65 N b. 37.85 N c. 35.36 N d. 37.81 N
75. A decorative beam is simply supported over a span of 6 m. The beam weighs 4 kN/m. A concentrated load of 14 kN will produce initial cracking at the tension side. What is the cracking moment for the beam section?
a. 37 kN.m b. 38 c. 39 d. 40

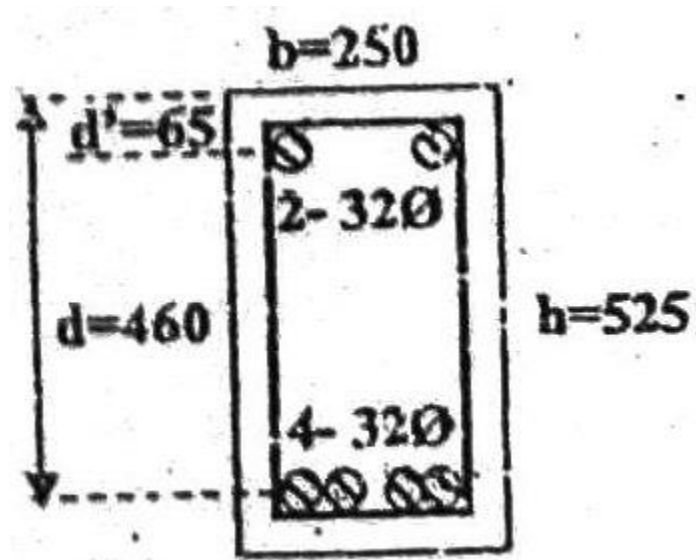


Figure RC1B - RKCT

Item	Quantity	Unit Price in PHP	
		AAE	Contract
1	100	900	1000
2	50	12000	10000
3	500	4000	5000
4	60	7500	6000
5	1000	2000	3000
6	400	2000	1500
7	3000	2100	2000
8	20	20000	25000

Figure CELCO - JRMM

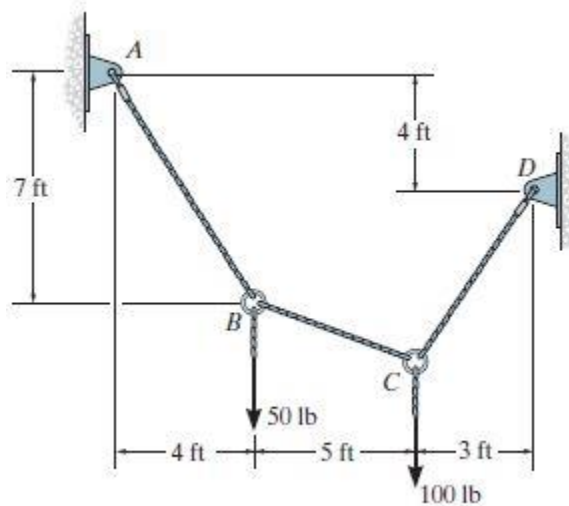


Figure STCA - HAS

Figure SDSB - JCW PROVISIONS FOR STEEL BEAMS

CASE 1: Allowable bending stresses for I-shaped members and channels bending about the strong axis.

$$F_b = 0.66F_y$$

$$\frac{b_f}{2t_f} \leq \frac{170}{\sqrt{F_y}}$$

$$\frac{d}{t_w} \leq \frac{1680}{\sqrt{F_y}}$$

$$L_1 = \frac{200b_f}{\sqrt{F_y}} \quad ; \quad L_2 = \frac{137900}{\frac{F_y d}{b_f t_f}}$$

CASE 2: For partially compact bending about strong axis

$$F_b = F_y \left[0.79 - 0.000762 \left(\frac{b_f}{2t_f} \right) \sqrt{F_y} \right]$$

$$\frac{170}{\sqrt{F_y}} \leq \frac{b_f}{2t_f} \leq \frac{250}{\sqrt{F_y}}$$

Allowable bending stresses for laterally unbraced beams

- A. When unbraced length $L_b < L_c$; $F_b = 0.66F_y$
- B. When unbraced length $L_u > L_b > L_c$; $F_b = 0.60F_y$
- C. When unbraced length $L_b > L_c$ and L_u ; $F_b < 0.60F_y$

Checking:

$$\sqrt{\frac{703270}{F_y}} < \frac{L_t}{r_t} < \sqrt{\frac{3516330}{F_y}}$$

$$F_b = F_y \left[\frac{2}{3} - \frac{F_y \left(\frac{L}{r_t} \right)^2}{10.55 * 10^6 C_b} \right] \quad \text{or} \quad \frac{82740 C_b}{\frac{L d}{b_f t_f}}$$

$$\sqrt{\frac{703270}{F_y}} < \frac{L_t}{r_t} > \sqrt{\frac{3516330}{F_y}}$$

$$\frac{1172100 C_b}{\left(\frac{L}{r_t} \right)^2} \quad \text{or} \quad \frac{82740 C_b}{\frac{L d}{b_f t_f}}$$

Note: For F_b = larger value governs.

If the beam is simple span, use $C_b = 1.0$.

For C_b with bending moments:

$$C_b = 1.75 + \frac{1.05 M_1}{M_2} + 0.3 \left(\frac{M_1}{M_2} \right)^2 \leq 2.3$$

Hint: Calculate the Area and moment of inertia of the section considering only the flange of to the 1/6 of the web depth.

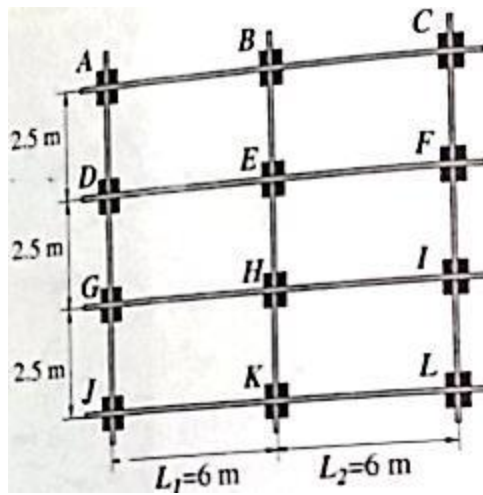


Figure RC2LDB - SAS

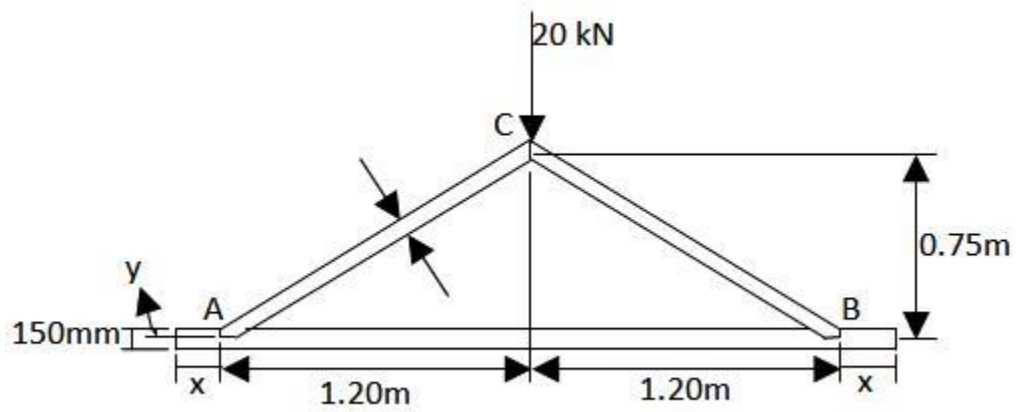


Figure TBT - CB

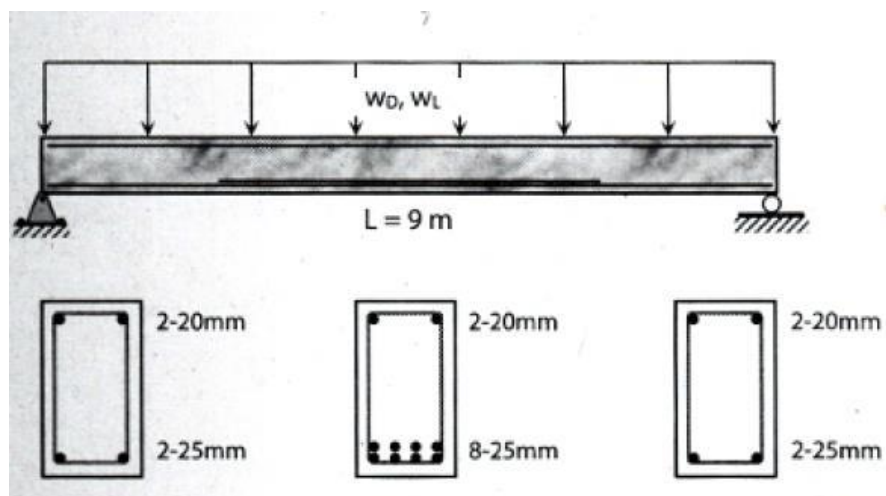


Figure RC3CS - ROS

Figure RCSCP - LKET

NSCP Provisions for Concrete Shear

BASIC CODE REQUIREMENTS

The basic Code requirement (Sec. 411.2) on shear strength is that the factored shear force V_u shall be equal or less than the design shear ϕV_n or

$$\text{Eq. 4-1} \quad V_u \leq \phi V_n$$

where $\phi = 0.75$ and

$$\text{Eq. 4-2} \quad V_n = V_c + V_s$$

For beams with no web reinforcement, the shearing force that causes the first diagonal cracking can be taken as the shear capacity of the beam. For beams that does contain web reinforcement, the concrete is assumed to carry a constant amount of shear force V_c , and the web reinforcement need only be designed for the shear force V_s in excess of that carried by the concrete, or

$$V_s = V_u - V_c \quad \text{Eq. 4-3}$$

Detailed calculation of V_c

- For members subject to shear and flexure only,

$$\text{Eq. 4-7} \quad V_c = \left(0.17 \lambda \sqrt{f'_c} + 17 \rho_w \frac{V_u d}{M_u} \right) b_w d$$

but not greater than $0.29 \sqrt{f'_c} b_w d$. Quantity $V_u d / M_u$ shall not be taken greater than 1.0 in computing V_c by Eq. 4-7, where M_u is factored moment occurring simultaneously with V_u at section considered.

- For members subject to axial compression, Eq. 4-7 may be used to compute V_c with M_u substituted for M_u and $V_u d / M_u$ not then limited to 1.0, where

$$\text{Eq. 4-9} \quad M_{in} = M_u - N_u \frac{4h - d}{8}$$

However, V_c shall not be taken greater than

$$\text{Eq. 4-10} \quad V_c = 0.29 \sqrt{1 + \frac{0.29 N_u}{A_g}} \lambda \sqrt{f'_c} b_w d \quad 2010 \text{ NSCP}$$

SHEAR STRENGTH PROVIDED BY REINFORCEMENT (411.6.6)

When factored shear force V_u exceeds strength ϕV_c , shear reinforcement shall be provided to satisfy Eq. 4-1 and Eq. 4-2. The shear strength provided by the stirrups is given by the following but shall not be taken greater than $0.66 \sqrt{f'_c} b_w d$.

SHEAR STRENGTH PROVIDED BY CONCRETE, V_c FOR NONPRESTRESSING MEMBERS (SECTION 411.4)

Simplified calculation of V_c

- For members subject to shear and flexure only,

$$\text{Eq. 4-5} \quad V_c = 0.17 \lambda \sqrt{f'_c} b_w d$$

- For members subject to axial compression

$$\text{Eq. 4-6} \quad V_c = 0.17 \left(1 + \frac{N_u}{14 A_g} \right) \lambda \sqrt{f'_c} b_w d$$

Spacing of Shear Reinforcement

If $V_u \leq \frac{\phi V_c}{2}$, no stirrups are required

If $\frac{\phi V_c}{2} \leq V_u \leq \phi V_c$, minimum stirrups required $s = \frac{3A_v f_y}{b_w}$

If $V_u \geq \phi V_c$, $s = \frac{A_v f_y d}{V_u} \rightarrow s_{min} \rightarrow 100$

Maximum Spacing

If $V_u < \frac{1}{3} \sqrt{f'_c} b_w d$, $s = \frac{d}{2}$

If $V_u > \frac{1}{3} \sqrt{f'_c} b_w d$, $s = \frac{d}{4}$

PROVISIONS FOR TORSIONAL ANALYSIS

Torsion effects can be neglected when

$$T_u < T_{cr} = \frac{\phi \sqrt{f'_c}}{12} \left(\frac{A_{cp}}{P_{cp}} \right)^2$$

Transverse reinforcement for is designed using

$$T_u < \frac{\phi 2 A_v A_t f_{yv} \cot \theta}{S}$$

Max. spacing for torsion $\frac{P_h}{8}$ or 300mm

Longitudinal reinforcement (in addition to flexure reinforcement)

$$A_l = P_h \frac{A_t f_{yv}}{S f_{cl}} \cot^2 \theta$$

Figure SDSCP - PRRD Provisions for steel columns

Case 1: If $KL/r < C_c$:

$$F_a = [1 - 0.5x^2] \left(\frac{F_y}{FS} \right)$$

$$x = \frac{KL/r}{C_c}$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$$

$$FS = \frac{5}{3} + \frac{3}{8}x - \frac{x^3}{8}$$

Case 2: If $KL/r > C_c$:

$$F_a = \frac{12\pi^2 E}{23 \left(\frac{KL}{r} \right)^2}$$

Properties of W x 35

Area = 6645.15 mm²
d = 206.25 mm
bf = 203.89 mm
tf = 12.52 mm
tw = 8.00 mm
Ix = 52.45 * 10⁶ mm⁴
Iy = 17.69 * 10⁶ mm⁴
Sx = 509.64 * 10³ mm³
Sy = 173.7 * 10³ mm³
Rx = 88.9 mm
Ry = 51.56 mm

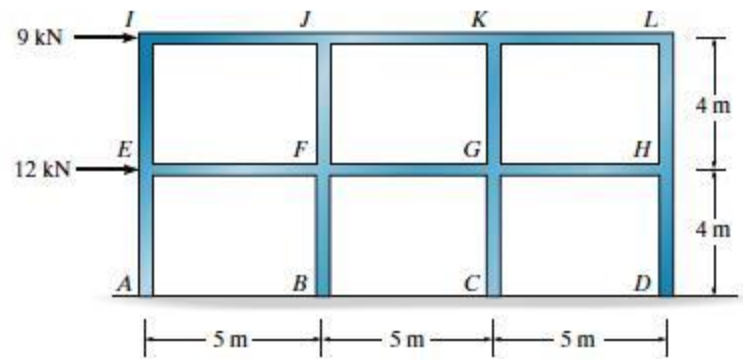


Figure STPM - ARDR

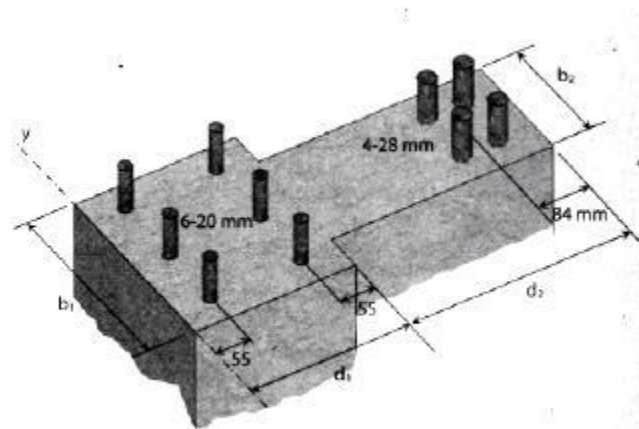


Figure RCCC - LGR

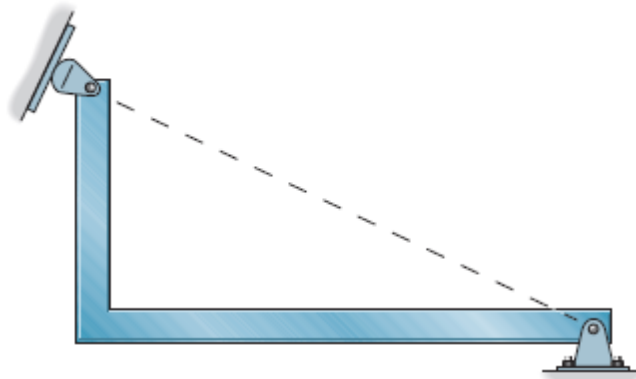


Figure STDS - AMDC

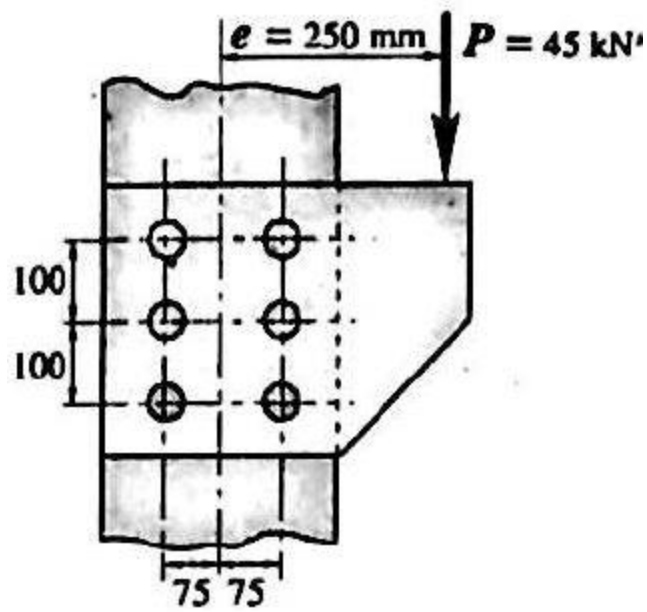


Figure SDBBC - FLG

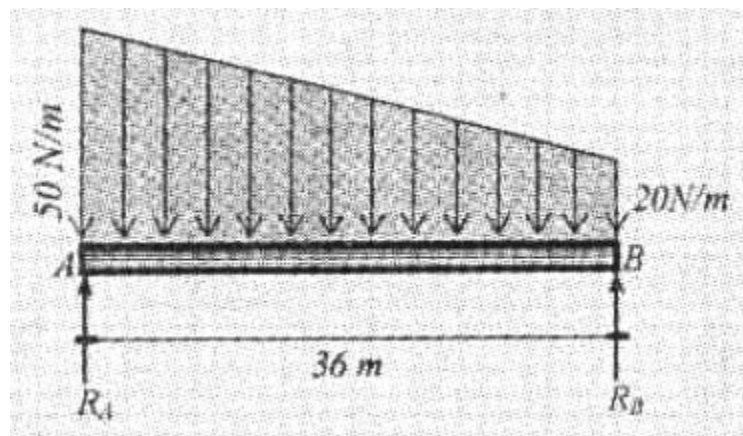


Figure EME - CDDR

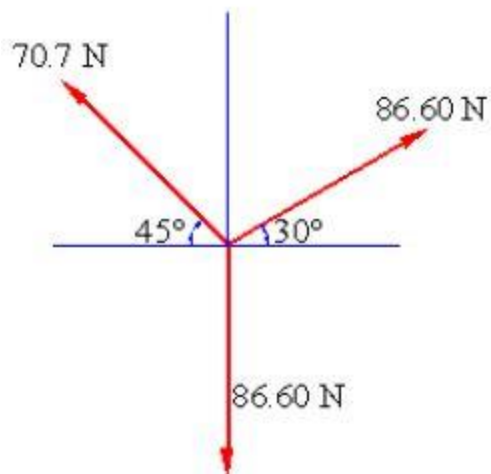


Figure EMF - JLCA

CE BOARD PRACTICE

SET 2

CE GREAT MINDS PREBOARD PRACTICE

MATHEMATICS, SURVEYING, AND TRANSPORTATION ENGINEERING

INSTRUCTION: Select the best answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

1. The bases of a right prism are pentagons with each side 6 cm long. The bases are 14 cm apart. What is the volume of the prism in cu. cm?
a. 574 b. 802 c. 785 d. 867
2. Find the area of the region bounded by the curves $y = 12x / (x^2 + 4)$, the x-axis, $x = 1$, and $x = 4$.
a. $4 \ln 6$ b. $\ln 24$ c. $6 \ln 15$ d. $6 \ln 4$
3. A reversed curve of equal radii connects two parallel tangents 12 meters apart. The length of the chords from PC to PT is 140 m. Determine the radius of the curve.
a. 427.6 m b. 408.3 m c. 438.5 d. 487.4
4. It is the study of a traffic behaviour near a certain section where demand exceeds demand capacity.
a. Queueing b. Estimating c. Characterizing d. Distributing
5. A spiral easement curve has a length of 80 m. and the radius of the central curve is 200 m. Determine the maximum velocity that a car could pass through the spiral easement curve.
a. 82.4 kph b. 76.3 c. 81.6 d. 79.6
6. P 200,000 was deposited on Jan 1, 1988 at the interest rate of 24% compounded semi-annually. How much would the sum be on Jan 1, 1993?
a. P 621,710.00 b. P 612,107 c. P 621 170 d. P 627 110
7. In how many ways can 10 objects be split into two groups containing 4 and 6 objects, respectively.
a. 225 b. 300 c. 270 d. 210

SITUATION 1: According to Consumer Digest, the probable location of personal computers in the home as follows:

Adult bedroom	0.03
Child bedroom	0.15
Office or den	0.40
Other bedrooms	0.14
Other rooms	0.28

8. What is the probability that a PC is in a bedroom?
a. 0.68 b. 0.32 c. 0.40 d. 0.42
9. What is the probability that a PC is not in the bedroom?
a. 0.68 b. 0.32 c. 0.40 d. 0.42
10. How many liters of pure alcohol must be added to 30 liters of 20% alcohol to obtain a mixture which is 40% alcohol solution?
a. 8 liters b. 6 c. 12 d. 10
11. River A flows at a rate of 3 kph and river B at 1 kph. It takes the boat to travel twice in river A for a distance of 18 km than it took the boat to travel 10 km in river B. Compute the speed of the boat in still water.
a. 25 kph b. 21 c. 18 d. 12
12. The sides of a square lot having an area of 2.25 hectares were measured using a 100 m tape that was 0.04 m too short. Compute the error in the area in sq m
a. 16 sq m b. 18 c. 20 d. 22
13. Four milk cans are bundled together using a piece of string. If you allow 5 cm for tying the knot, what is the shortest amount of string that you need if each can has a radius of 4 cm?
a. 62.12 cm b. 71.32 c. 84.55 d. 90.12
14. A rectangular bin, open at the top, is required to contain 128 cu m. If the bottom is to be a square at a cost of P 2.00 per square meter, what dimensions will minimize the cost?
a. $s = 4$, $h = 4$ b. $s = 8$, $h = 8$ c. $s = 8$, $h = 4$ d. $s = 4$, $h = 8$

15. Compute the braking distance for a car moving at an initial velocity of 60 kph and a final velocity of 40 kph. The slope of the roadway is +5% , Coefficient of friction bet. road pavement and tires = 0.15 , and Perception-reaction time is 0.75 s.
 a. 37.55 m b. 31.15 c. 39.33 d. 34.55
16. Find an equation of the line through (1, -1) perpendicular to the line $3x - 4y = 10$.
 a. $3y = -4x + 1$ b. $3y = 4x - 1$ c. $3y = -4x - 1$ d. $3y = 4x + 1$

SITUATION 2: For the ellipse $4x^2 + 9y^2 + 8x - 32 = 0$,

17. Find the distance focus from the center.
 a. 2.75 b. 2.24 c. 2.56 d. 2.18
18. Find the major axis , a.
a. 3 b. 4 c. 5 d. 2
19. Find the eccentricity of the ellipse.
 a. 1 b. 0.33 c. 0.75 d. 0.5
20. The number of accidents for 6 year period in a highway is 5432. If the average daily traffic is 476, Calculate the accident rate.
 a. 5402 b. 5355 c. 5312 d. 5211
21. A marksman fires at a target 350 meters away and hears the bullet hit the target 2 seconds after he pulled the trigger. An observer 400 meters away from the marksman and 420 meters from the target, hears the bullet hit the target 1 second after he hears the rifle report. Find the speed of the bullet.
 a. 330 m/s b. 372.58 c. 400 d. 385

SITUATION 3: A compound curve passes thru a common tangent AB having a length of 300 m. The radius of the first curve is equal to 290 m and a central angle of 42° . If the radius of the second curve is 740 m,

22. Find the tangent of the second curve.
 a. 178.23 m b. 188.68 c. 194.60 d. 205.37
23. Calculate the central angle of the second curve.
 a. $24^\circ 47'$ b. $28^\circ 36'$ c. $32^\circ 51'$ d. $36^\circ 12'$
24. What is the stationing of PT if PC is at $20 + 542.20$?
a. $21 + 124.16$ b. $26 + 624.11$ c. $21 + 426.12$ d. $22 + 116.41$
25. A telecoms company has a fixed cost of P 150,000,000 per month and a variable cost of P 2000 per month per subscriber. The company charges P 3995 per month to their subscribers. Find the number of users to make break even.
 a. 150 037 b. 121 319 c. 105 503 d. 94 288
26. You are given 8 numbers which add up to 168. One of the numbers is 28. Find the average of other 7 numbers.
 a. 25 b. 20 c. 15 d. 10
27. Find the latus rectum of the curve $x^2 = -12y$
 a. 12 b. -12 c. -6 d. 6
28. In a right spherical triangle ABC , $B = 37^\circ$ and $b = 31^\circ$. Find the value of A.
 a. 63° c. 59° c. 53° d. 69°
29. Find the number of terms of the series 5 , 8, 11 ... of which the sum is 1025.
 a. 20 b. 22 c. 24 d. 25
30. In a vector $2i + 3j + 6k$, compute the angle A which makes with x-axis.
 a. 64.62° b. 74.75° c. 73.4° d. 31°
31. Find the magnitude in (30).
 a. 6 b. 7 c. 8 d. 9
32. A series of numbers which are perfect squares is called:
 a. Fourier Series c. Euler's number
c. Fermat's number d. Fibonacci numbers
33. If a group of positive integers has a sum of 8 ,what is the greatest product the group can have?
 a. 16 b. 7 c. 18 d. 8
34. Convert $x^2 - 4y - 4$ into polar form.

- a. $r = 2/(1 - \sin\theta)$ b. $r = 2(1 - \sin\theta)$ c. $r = \cos\theta + \sin\theta$ d. $r = 1 + \sin\theta$
35. Find the radius of gyration of the area in the first quadrant bounded by the lines $x = 0$, $y = 4$ and the curve $y^2 = 8x$ with respect to x-axis.
a. 3.65 b. 3.10 c. 3.52 d. 3.77
36. In how many ways can 5 differently colored marbles be arranged in a row?
a. 120 b. 48 c. 3125 d. 24
37. The first cost of a machine is P 1,800,000 with a salvage value of P 300,000 at the end of the its life of 5 years. Determine the book value after 3 years using straight line method.
a. 1,000,000 b. 900,000 c. 500,000 d. 450,000
38. Find the area of the quadrilateral having sides of 10, 5, 14.14, and 15 and the sum of the opposite angles is 225° .
a. 115 b. 110 c. 105 d. 100
39. The sum of the nth term of a sequence is given by $S(n) = n(n - 3)$. Determine the nth term of the sequence.
a. $2n-2$ b. $2n-4$ c. $2n+2$ d. $2n+4$
40. A two digit number is chosen randomly. What is the probability that it is divisible by 7?
a. $7/50$ b. $13/90$ c. $1/7$ d. $7/45$
41. Find the volume of solid of revolution bounded by the curves $y^2 = x^3$, the x-axis and $x = 4$.
a. 32π b. 64π c. 96π d. 128π
42. A ladder is placed 50 m from a wall at an angle θ with the horizontal. Top of the ladder is x meters above the ground. If the bottom of the ladder is pushed toward the wall, find the rate of change of x with respect to θ when $\theta = 45^\circ$
a. 2.5 m/deg B. 1.90 C. 1.75 d. 1.50
43. If you are investing the money, which is better?
a. 9% compounded quarterly c. 9% compounded semi-annually
c. 9% compounded monthly d. 9% compounded continuously
44. A parabolic curve has a descending grade of -0.8% which meets an ascending grade of 0.4% at Sta. 10+020. The maximum allowable change of grade per 20 meter station is 0.15. Elevation of station 10 + 020 is 240.60 m. What is the length of the curve?
a. 180 m b. 160 c. 140 d. 120
45. A businessman borrowed P 300,000 and agrees to discharge his obligation by paying a series of 8 equal payments of P 57434.78 the first being due at the end of $5\frac{1}{2}$ years. Find the interest rate he is paying if it is compounded semi-annually.
a. 4% b. 5% c. 6% d. 7%
46. A series of perpendicular offsets were taken from a transit line to a curved boundary line. These offsets were taken 9 meters apart and were taken in the following order (in meters) : 2, 3.2, 4, 3.5, 5, 4.5, 6, 7. Compute the area using Simpson's One-Third Rule.
a. 270.90 m^2 b. 280.60 c. 290.5 d. 250.7
47. Given the equation of the parabola $y^2 - 8x - 4y - 20 = 0$, find the latus rectum.
a. 2 b. 4 c. 6 d. 8

SITUATION 4: From the following closed tranversed as follows:

LINES	BEARING	DISTANCES
1-2	N 30° E	120.20
2-3	N 78° E	90.20
3-4	S 32° E	88.40
4-1	-----	-----

48. Compute the bearing of line 4-1.
a. N $76^\circ 13'$ E b. N $76^\circ 13'$ W c. S $76^\circ 13'$ E d. S $76^\circ 13'$ W
49. Compute the distance of the line 4-1.
a. 206.90 b. 200.69 c. 200.96 d. 209.06
50. Compute the area in hectares.
a. 168.54 b. 186.45 c. 145.68 d. 156.84
51. Find the limit of the following:

$$\lim_{x \rightarrow \infty} \left(\frac{y^2 + 1}{y} \right)$$

- a. 0 b. ∞ c. 1 d. 2

52. Find the inverse matrix of the following:

$$\begin{bmatrix} 2 & 3 \\ 3 & 1 \end{bmatrix}$$

- a. $\begin{bmatrix} -1 & 3 \\ 1 & -2 \end{bmatrix}$ b. $\begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix}$ c. $\begin{bmatrix} 3 & 2 \\ -1 & 1 \end{bmatrix}$ d. $\begin{bmatrix} 2 & 1 \\ -1 & -3 \end{bmatrix}$

53. Which of the following statements is FALSE about the procedure of taping horizontal distances?
a. When a line is to be measured, both ends must first be marked.
b. A steady and firm pull is applied on one end of the tape during stretching depending on the weight of the tape.
c. During the measurement, it is important to determine in which the tape is held nearly horizontal.
d. In some instances, taping would be done on a hard surface such as concrete or asphalt or in steels of the railroad.
54. Two boats left the wharf at the same time. One sailed in the direction N 30° E at 40 mph. The other sailed due East at 25 mph. How fast were they separating at the end of one hour in mph?
a. 30 mph b. 35 c. 40 d. 45
55. Find the total length of the curve $r = 4(1 - \sin \theta)$.
a. 16 b. 32 c. 18 d. 20
56. The profit on a product selling for P 8.20 is 10% of the selling price. What percentage increase in production cost will reduce the profit by 60%?
a. 6.67 % b. 7% c. 8.55% d. 9.16%
57. It determines the value of a critical factor at which economic trade-offs area balanced.
a. Annuity b. Depreciation c. Perpetuity d. Break Even Analysis
58. The geometric mean and harmonic mean of two numbers are 12 and 7.2 , respectively. What is the larger number?
a. 12 b. 36 c. 24 d. 30
59. Find the remainder of $3x^4 + 5x^2 + x - 20$ when divided by $x + 2$.
a. 3 b. 4 c. 5 d. 6
60. It consists of authorized hauling in excess of the free-haul distance.
a. Limit of Economic Haul c. Overhaul
b. Compaction d. Subgrade
61. A civil engineer proceed to do the stadia survey to work to determine the topography of a certain area. The transit was set up at a point A, eith the line of sight horizontal, took rod readings from the rods placed at B and C which is 200 m and 60 m from A respectively. Compute the stadia interval factor.
a. 91.55 b. 94.77 c. 93.58 d. 99.93

SITUATION 5: Suppose that the distribution of monthly earnings for the underemployed workers in a certain city is known to be bell-shaped and symmetric with a mean of P 21160 and a standard deviation of P 4550.

62. What percentage of the workers earned less than P 16610 ?
a. 12% b. 16% c. 34% d. 95%
63. What percentage of the workers earn higher than P 12060?
a. 95% b. 96% c. 97% d. 98%
64. Find the equation of the perpendicular bisector of the line segment joining (2, 4) and (-1 ,6).
a. $6x - 4y = 17$ b. $-6x - 4y = 17$ c. $6x + 4y = 17$ d. $-6x + 4y = 17$
65. In fundamentals of accounting, which of the following is considered as current assets?
a. Taxes b. Mortgage c. Inventories d. Equipments
66. Find the laplace transform of $f(t) = t^2$
a. $3/s^2$ b. $3/s^3$ c. $2/s^3$ d. $2/s^2$
67. Find the numerical coefficient of the 7th term of $(3x - 2y)^{10}$.
a. 1,068,880 b. 1,088,640 c. 1,640,088 d. 1,880,460

68. The Golden State Warriors hits an average of 20 three point field goals made. What is the probability that the they will hit 17 vs the Cavs?
a. 0.076 b. 0.080 c. 0.088 d. 0.097
69. Messages when painted on pavement should be limited to a maximum of:
a. 5 words b. 4 c. 3 d. 6
70. If $\sec^2 A$ is $5/2$, the value of $\cos^2 A$ is:
a. 2.5 b. 0.6 c. 1.5 d. 0.4
71. The sum of the interior angles of a polygon is 540° . Find the number of sides.
a. 23 b. 24 c. 25 d. 26
72. What is the equation of the asymptote of the hyperbola $4x^2 - 9y^2 = 36$?
a. $2x - 3y = 0$ b. $3x - 2y = 0$ c. $2x - y = 0$ d. $2x + y = 0$
73. The weight of a mass of 10 kg using $g = 9.77 \text{ m/s}^2$ is:
a. 79.7 N b. 77.9 N c. 97.7 N d. 99.7 N
74. Locate the centroid of the area bounded by the parabola $y^2 = 4x$, the line $y = 4$ and the y-axis.
a. $6/5, 3$ b. $2/5, 3$ c. $7/4, 6/5$ d. $1/4, 9/5$
75. Duels in the town of Hathoria are rarely fatal. There, each warrior comes at a random moment between 5 am and 6 am on the appointed day and leaves exactly 5 mins later, honor served, unless the opponent Lirean arrives within the time interval and they kill each other. What fraction of duels lead to violence?
a. $1/4$ b. $1/12$ c. $23/144$ d. $11/54$

CE GREAT MINDS PREBOARD PRACTICE

HYDRAULICS AND GEOTECHNICAL ENGINEERING

INSTRUCTION: Select the best answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

CONCEPTUAL AND PROBLEM SOLVING

- The relative compaction of a sand in the field is 94%. The max and min dry unit weights of the sand are 16.2 kN/m^3 and 49.9 kN/m^3 respectively. Compute the dry unit weight in the field.
a. 14.92 b. 15.23 c. 16.77 d. 13.74
- A direct shear test was conducted on a specimen of dry sand and with normal stress of 142 kPa. Failure occurred at a shear stress of 96 kPa. The size of the specimen was 50 x 50 x 25 mm. Compute the shearing stress if the normal stress is 85 kPa.
a. 74.23 kPa b. 64.19 c. 49.22 d. 57.46
- A hydraulic jump occurs in a triangular flume having side slopes at 1:1. The flow rate is $0.45 \text{ m}^3/\text{s}$, depth before the jump is 0.30 m. Find the depth after the jump.
a. 0.858 m b. 0.874 c. 0.888 d. 0.893
- Which of the following is not one of the steps in soil exploration?
a. Boring b. Sieving c. Sampling d. Testing
- A soil sample has a unit weight of 105.7 pcf and a saturation of 50%. When its saturation is increased to 75%, its unit weight raises to 112.7 pcf. Determine the porosity of the soil sample in percent.
a. 40.70 b. 28.93 c. 44.87 d. 61.05
- Oil, with $\rho = 950 \text{ kg/m}^3$ and $\nu = 0.00002 \text{ m}^2/\text{s}$ flows through a 300 mm diameter pipe that is 100 m long with a head loss of 8 m. $\epsilon/D = 0.002$. Calculate the flow rate.
a. $0.294 \text{ m}^3/\text{s}$ b. 0.335 c. 0.344 d. 0.406
- The volume of the atmospheric water is 12900 km^3 . The evapotranspiration from land is $72000 \text{ km}^3/\text{yr}$ and that from the ocean is $505000 \text{ km}^3/\text{year}$. Estimate the residence time of water molecules in the atmosphere.
a. 7.6 days b. 7.9 c. 8.2 d. 8.5
- Determine the submerged depth of a cube of alloy steel 0.3 m on each side floating in mercury. The specific gravities of alloy and mercury are 7.8 and 13.6 respectively.
a. 0.172 m b. 0.185 c. 0.198 d. 0.211
- A rectangular footing shown in figure FEPC1 - DITG is acted by a vertical load of 8060 kN and two horizontal forces of 1500 kN in both long and the short directions with a distance of 0.6 m from the ground surface. Determine the largest base pressure at the four corners if the footing was on soil.
a. 551 kPa b. 329 c. 243 d. 20
- A 10 m high gravity type retaining wall is required to support a hard clay backfill having a level surface with a unit weight of 17 kN/m^3 . Cohesion of the hard clay is 45 kN/m^2 . Compute the total lateral force from the retained soil for the theoretical active pressure condition. Assume that the value of $K_a = 1.0$ for a hard clay backfill.
a. 176.32 kN b. 188.40 c. 194.55 d. 202.23
- Determine the allowable gross vertical load -bearing capacity of the foundation if $FS = 4$. The square footing with the width of 3 m, the depth is 2 meters, cohesion, $\phi = 30^\circ$ and the unit weight is 16.5 kN/m^3
a. 275 kN b. 277.5 c. 280 d. 282.5
- It is a process of removing suspended silt from the water which consists of earthly matter, fine sand or the like carried by running water and deposited as a sediment.
a. Filtration b. Evapotranspiration c. Erosion d. Desiltation
- It measures the buffering capacity of the water against changes in pH.
a. Salinity b. Acidity b. Alkalinity d. Fluidity
- Determine the weight W that can be equilibrated by the force acting on the piston of Figure FMFS - JMF15.
a. 53 kN b. 64 c. 95 d. 85

30. Find the horizontal force in terms of h .
a. $4.905h^2$ b. $9.81h^2$ c. $10h^2$ d. $5h^2$
31. Find the vertical force in terms of h .
a. $17.514h$ b. $15.711h$ c. $14.715h$ d. $11.574h$

32. Find h for the gate just to come up to the vertical position.
 a. 0.3715 m b. 0.4718 c. 0.2748 d. 0.5014

SITUATION 5: From the Figure GEHC - VL,

33. Find the equivalent coefficient of permeability in 10^{-4} cm/s.
 a. 8.055 b. 8.133 c. 8.025 d. 8.354
34. Find the total flow.
a. 6.741×10^{-5} m³/s b. 6.741×10^{-4} c. 6.741×10^{-3} d. 6.741×10^{-2}
35. Find the total flow liters/s.
 a. 6.741×10^{-5} m³/s b. 6.741×10^{-4} c. 6.741×10^{-3} d. 6.741×10^{-2}

SITUATION 6: A square footing 3 x 3 m carries a column load of 3500 kN resting on the sand layer as shown in Figure GECOS - JJJJ. Unit weight of sand above the water table is 17.31 kN/m³ and has a saturated unit weight of 18.10 kN/m³ below the water table. The sand overlies a clay layer 1.2 m thick having a saturated unit weight of 16.50 kN/m³ and a void ratio of 1.70.

Compression Index:

$C_s = 0.04$ due to preconsolidation pressure

$C_c = 0.35$ primary consolidation index

36. Compute the preconsolidation pressure P_c if the over consolidation ratio is 2.
a. 69.468 kPa b. 75.311 c. 80.625 d. 84.019
37. Find the total effective stress at the center of the clay.
 a. 159.315 b. 154.764 c. 147.208 d. 141.002
38. Determine the settlement due to consolidation due to overconsolidation.
 a. 55 mm b. 60 c. 75 d. 85

SITUATION 7: A 7 m deep braced cut in sand shown in Figure FEBS - LMP. In the plan the struts are placed at a spacing 2 m center to center.

39. Find the strut load at level A.
a. 109.22 b. 36.4 c. 0 d. 194.16
40. Find the strut load at level C.
 a. 109.22 b. 36.4 c. 0 d. 194.16
41. Find the strut load at level B.
 a. 109.22 b. 36.4 c. 0 d. 194.16

SITUATION 8: If an artificial atmosphere consists of 20% oxygen and 80% nitrogen by volume at 101.32 kPa at 20° C, $R(O_2) = 260$ and $R(N_2) = 297$

42. Find the partial pressure of oxygen.
a. 20.3 kPa b. 21.7 c. 22.5 d. 23.1
43. Find the specific weight of nitrogen.
 a. 9.07 N/m³ b. 9.14 c. 9.38 d. 9.51
44. Find the specific weight of the mixture.
 a. 9.81 kN/m³ b. 10.12 c. 11.75 d. 13.84

SITUATION 9: A open cylindrical tank, 2 m in diameter and 4 m high contains water to a depth of 3 m. it is rotated about its own vertical axis with a constant angular speed ω .

45. If $\omega = 100$ rpm, how much area at the bottom of the tank is uncovered?
 a. 0.7 m² b. 0.8 c. 0.9 d. 1.0
46. Determine the angular speed will just zero the depth of the water at the center of the tank?
 a. 80 rpm b. 85 c. 100 d. 110
47. If $\omega = 3$ rad/s, Find the value of h .
a. 0.23 b. 0.41 c. 0.55 d. 0.69

SITUATION 10: A fire pump delivers water through a 300 mm Φ main to a hydrant shown in Figure HDBE - JSC to which is connected to a rubber-line fire hose 100 mm in Φ terminating to a 25 mm Φ nozzle. The nozzle is 2.5 m above the hydrant and 16 m above the pump. Assuming frictional losses of 3 m from the pump to the hydrant, 2 m in the hydrant, 10 m from the hydrant to the base of the nozzle, and the loss in the nozzle of 4% of the velocity head in the jet. The gage pressure right after the pump is 550 kPa.

48. Determine the flow rate.
a. 0.011 m³/s b. 0.024 c. 0.038 d. 0.044
49. Determine the velocity of the nozzle.
a. 19.20 m/s b. 20.38 c. 21.74 d. 22.15
50. What vertical height can the jet be thrown?
a. 22 m b. 24 c. 27 d. 28

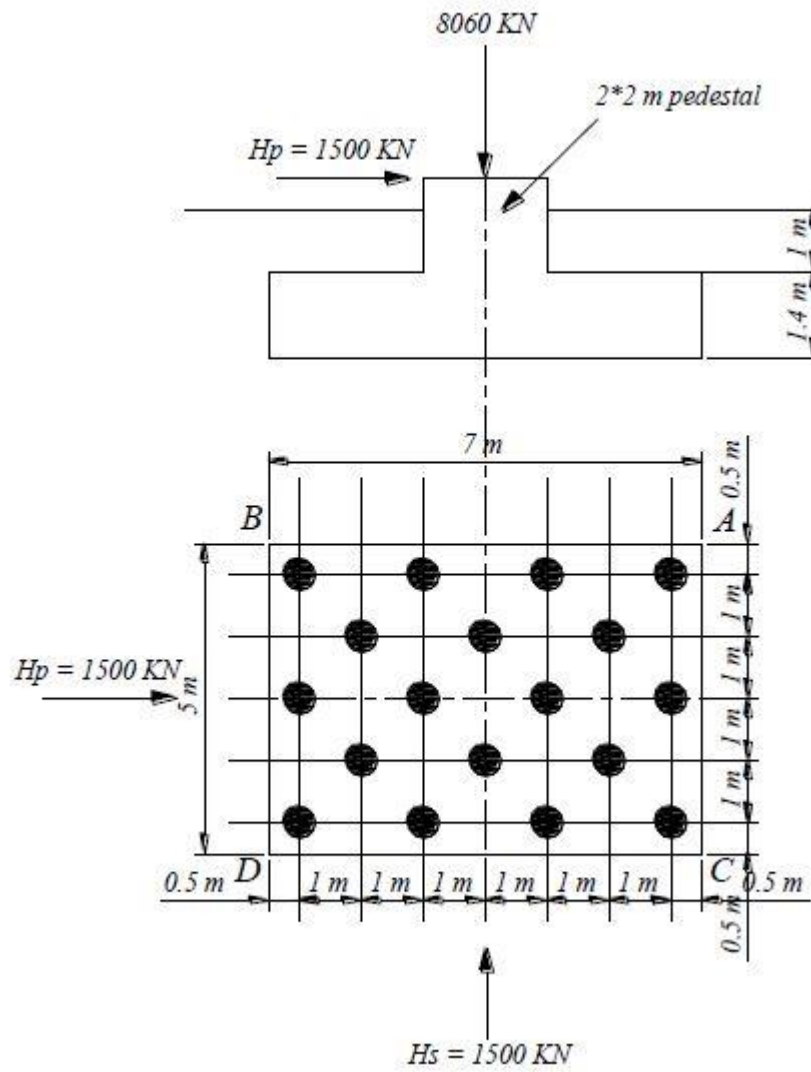


Figure FEPC1 - DITG

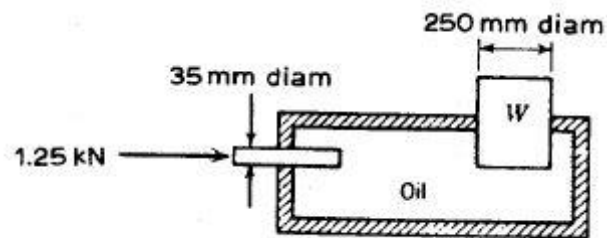


Figure FMFS - JMF15

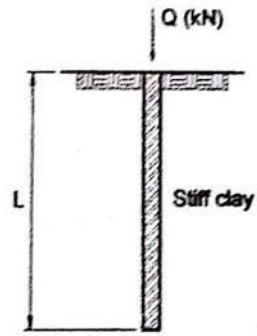


Figure FE2PC2 - MMC

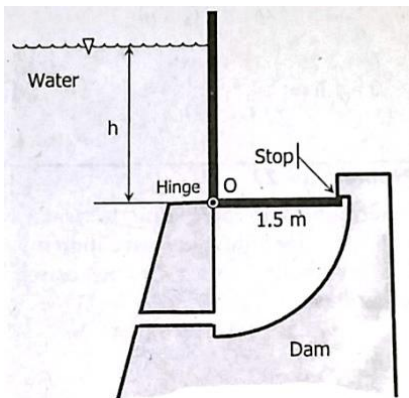


Figure FMCS - PGMA

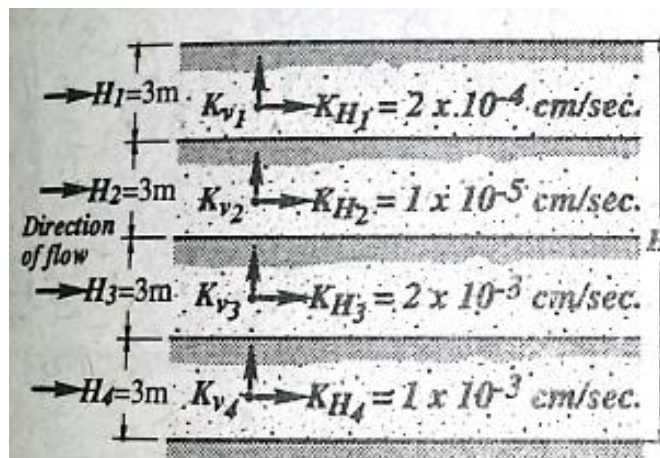


Figure GEHC - VL

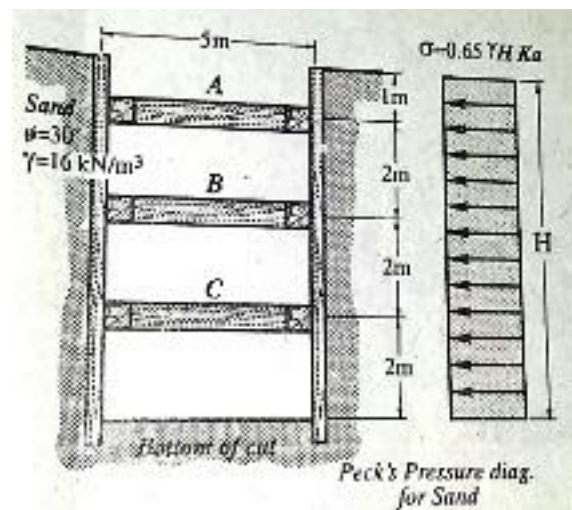


Figure FEBS - LMP

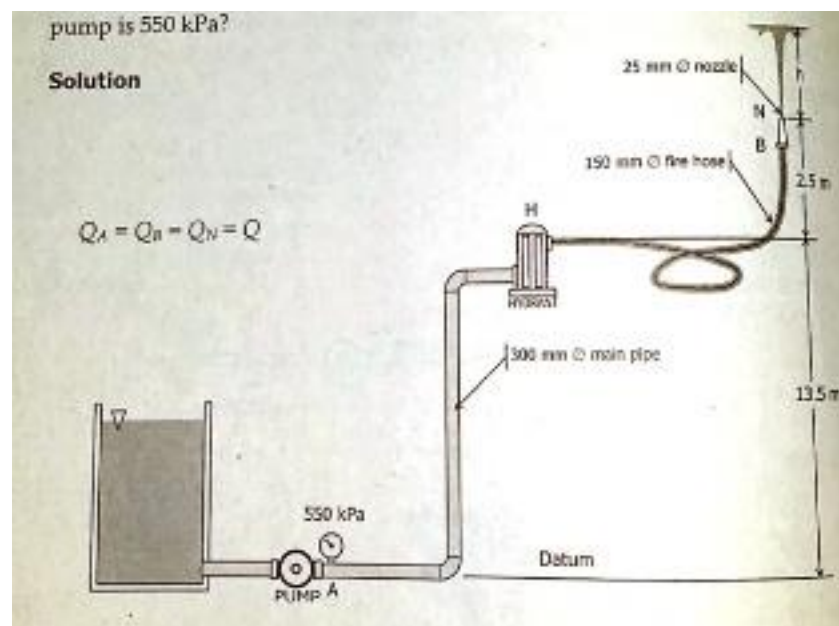


Figure HDBE - JSC

CE GREAT MINDS PREBOARD PRACTICE

STRUCTURAL ENGINEERING AND CONSTRUCTION

INSTRUCTION: Select the best answer for each of the following questions. Mark only one answer for each item by shading the box corresponding to the letter of your choice on the answer sheet provided. STRICTLY NO ERASURES ALLOWED. Use pencil no. 2 only.

SITUATION 1: A rectangular wooden beam has a span of 6 m and carries a total uniform load of 25 kN/m including its own weight. The beam is made up of 80% stress grade Apitong with allowable stresses of the following:

Allowable stresses for Apitong 80% stress grade:

Allowable bending = 16.5 MPa

Compression parallel to the grain = 9.56 MPa

Compression perpendicular to the grain = 2.20 MPa

Shear parallel to the grain = 1.73 MPa

Modulus of elasticity = 7310 MPa

1. Find the smallest dimension of the beam that will not exceed the allowable bending stress.
a. 220 x 440 b. 200 x 400 c. 225 x 375 d. 250 x 500
2. Find the smallest dimension of the beam that will not exceed the allowable shearing stress.
a. 220 x 440 b. 200 x 400 c. 225 x 375 d. 250 x 500
3. Find the smallest dimension of the beam that will not exceed the allowable shearing stress.
a. 220 x 440 b. 200 x 400 c. 225 x 375 d. 250 x 500

SITUATION 2: A particle moves along a horizontal straight line with acceleration of $a = 6 \sqrt{s}$, when $t = 2$ sec, its displacement is $S = 27$ m and its velocity is 27 m/s.

4. Which of the following gives the displacement when $t = 4$ sec?
a. 125 m b. 100 c. 75 d. 50
5. Which of the following gives the velocity of the point when $t = 4$ sec?
a. 80 m/s b. 75 c. 60 d. 55
6. What is the acceleration of the point when $t = 4$ sec?
a. 40 m/s² b. 30 c. 25 d. 15

SITUATION 3: In the figure shown in Figure STSDM - AFE, using slope deflection method,

7. Compute the fixed end moment at BC.
a. -12.79 b. 12.79 c. -13.5 d. 13.5
8. Find the slope at B.
a. 3.1765/EI b. 4.0283/EI c. 4.1775/EI d. 5.0830/EI
9. Find the vertical reaction at C.
a. 2.83 kip b. 4.56 c. 3.07 d. 7.52

SITUATION 4: A 300 mm concrete wall supports a dead load of 300 kN and a live load of 220 kN. The allowable bearing pressure is 240 kPa and the level of the bottom of the footing is 1.2 m below the ground surface. Assume concrete weighs 24 kN/m³ and that of soil is 16 kN/m³. Use $f'_c = 28$ MPa, f_y of 28 mm bars = 248 MPa, 600 mm, steel covering of 100 mm.

10. Determine the effective soil pressure.
a. 220 kPa b. 216 c. 210 d. 202
11. Calculate the ultimate moment produced.
a. 177.85 kN.m b. 166.20 c. 164.41 d. 157.25
12. Determine the area of bars as designed.
a. 2823 mm² b. 2745 c. 2874 d. 2799

SITUATION 5: A W 610 x 113 is to be supported on a 300 mm concrete wall such that there is a bearing 200 mm wide. Use A 36 steel $F_y = 250$ MPa and $f'_c = 20.7$ MPa.

Properties of W 610 x 113

$d = 6008$ mm, $bf = 228$ mm, $K = 35.94$ mm, $t_f = 17.3$ mm, $t_w = 11.9$ mm

13. Find the maximum end reaction due to bearing on the wall.
a. 456.2 kN b. 501.8 c. 385.9 d. 417.3
14. Which of the following gives the maximum end reaction due to web yielding?
a. 569 kN b. 487 c. 523 d. 511
15. Calculate the maximum end reaction due to bending stress of the flange.
a. 160 kN b. 145 c. 140 d. 125

SITUATION 6: Determine the determinacy of the following structures shown in the following figures. Take note the zero degree means determinate, X is unstable and n° means indeterminate.

16. Figure STDS - CEB
a. 1° b. 2° c. 0 d. X
17. Figure STDS - JST
a. 5° b. 3° c. X d. 2°
18. Figure STDS - ELS
a. X b. 0° c. 2° d. 3°

SITUATION 7: Three cylinders in Figure ESEF - KT have the indicated weights and dimensions. Assuming smooth contact surfaces,

19. Calculate the reaction at A.
a. 600 lb b. 400 c. 0 d. 346.41
20. Calculate the reaction at B.
a. 600 lb b. 400 c. 0 d. 346.41
21. Calculate the reaction at C.
a. 600 lb b. 400 c. 0 d. 346.41

SITUATION 8: A 250 x 300 mm concrete beam is prestressed with a prestressing force of 530 kN at an eccentricity of 60 mm. The beam carries a superimposed load of 50 kN/m.

22. Calculate the stress at the top.
a. 1.41 MPa b. 1.39 c. 1.34 d. 1.30
23. Calculate the stress at the bottom.
a. 15.23 MPa b. 15.55 c. 15.67 d. 15.78
24. Calculate the maximum span that can be carried by the beam.
a. 4 m b. 3 c. 6 d. 9

SITUATION 9: A reinforced concrete beam has a width of 280 mm an effective depth of 520 mm. It is reinforced with 4 - 28 mm Φ bars at the bottom. Using $f'_c = 21$ MPa, and $f_s = 140$ MPa with $n = 9$.

25. What is the location of the neutral axis from the bottom?
a. 301.51 mm b. 294.18 c. 311.50 d. 281.94
26. Find the moment of inertia in $\times 10^6 \text{ mm}^4$.
a. 3015.77 b. 2925.7 c. 2693.5 d. 2988.7
27. Find the moment that can be carried.
a. 122.6 kN m b. 129.3 c. 137.8 d. 140.1

SITUATION 10: In the Figure MMOI - JDJS,

28. Find the minimum moment of inertia.
a. 500 b. 640 c. 720 d. 780
29. Find the maximum moment of inertia.
a. 3000 b. 2560 c. 2200 d. 2080
30. Find the maximum product of inertia.
a. 900 b. 960 c. 1000 d. 1040

SITUATION 11: A model rocket is launched from point A with an initial velocity of 75 mps. If the rocket's descent parachute does not deploy and the rocket lands a distance of $d = 100$ m from the A,

31. Find the angle that V_0 forms with the vertical.
a. 3.59° b. 5.76° c. 2.12° d. 1.77°

48. Compute the vertical force P exerted by the balloon A.
 a. 240 N b. 540.20 c. 496.36 d. 956

SITUATION 17: Figure RCD - TRDDR shows floor framing plan of a reinforced concrete building. All beams are 300 mm x 500 mm. Use $1.2D + 1.6L$

49. Compute the uniform service dead load at beam DEF.
a. 17.1 kN/m b. 19.5 c. 20.7 d. 22.2
50. Compute the ultimate uniform load.
 a. 35.52 kN/m b. 39.72 c. 40.08 d. 41.43
51. Compute the total ultimate load concentrated at E induced by beam DEF using the tributary area method.
a. 238.32 kN b. 240.09 c. 245.56 d. 260.15

SITUATION 18: A national highway project 7.2 m wide by 1 km by 25 cm thick. Using class A mixture (multiplied by 9 for bags of cement, 0.5 for every cu m of sand and 1 for every cu m of gravel.)

52. Calculate the number of bags of cement required.
 a. 20000 cu m b. 19500 c. 18000 d. 16200
53. Calculate the volume of sand required.
 a. 1000 cu m b. 900 c. 1800 d. 2000
54. Calculate the volume required for gravel.
 a. 1000 cu m b. 900 c. 1800 d. 2000

SITUATION 19: Two plates each with thickness $t = 16$ mm are bolted together with 6 - 22 mm ϕ bolts forming a lap connection shown in Figure SDBC - HK. Bolt hole diameter = 25 mm.

Allowable stresses:

Tensile stress on gross area of the plate = $0.60F_y$

Tensile stress on net area of the plate = $0.50F_u$

Shear stress of the bolt: $F_v = 120$ MPa

Bearing stress of the bolt: $F_p = 1.2F_u$

55. Calculate the shear capacity of the bolts.
 a. 275.60 kN b. 274.56 c. 273.70 d. 270.40
56. Calculate the bearing capacity of the bolts.
 a. 1060.55 kN b. 1037.80 c. 1021.13 d. 1013.76
57. Calculate the block shear capacity.
 a. 592 kN b. 556 c. 520 d. 504

SITUATION 20: For the given state of stresses shown in Figure SMMC - ECS29,

58. Calculate the angle of failure plane.
 a. 35° b. 37° c. 40° d. 42°
59. Calculate the maximum stress exerted.
 a. 15.70 MPa b. 19.5 c. 13.6 d. 14.0
60. Calculate the maximum stress.
a. 86.4 MPa b. 88.8 c. 90.0 d. 92.6

SITUATION 21: A simply supported beam having a width of 350 mm and an effective depth of 520 mm carries a uniformly distributed factored load of 7 kN/m including the own weight and $P_u = 370$ kN acting 2 m from the left support. Use $f'_c = 20.7$ MPa, all steel including stirrups is 415 MPa. See Figure RDCS - AJMY.

61. Determine the ultimate shear force.
 a. 170.54 kN b. 165.50 c. 169.14 d. 235.86
62. Determine the shear force for concrete.
a. 140.77 kN b. 184.56 c. 164.76 d. 145.54
63. Determine the spacing required.
 a. 200 mm b. 190 c. 160 d. 140

SITUATION 22: A 300 mm x 500 mm is reinforced with 4 - 28 mm ϕ of area 615.75 sq mm each, one in each corner with a spacing of compression steel equal to 65 mm. Use $f'_c = 24.19$ MPa, $E_s = 2 \times 10^6$ MPa and $f_y = 345.58$ MPa.

64. Compute the ultimate load on balance failure.
a. 1456 kN b. 1582 c. 1677 d. 1862
65. Compute the ultimate moment on balance failure.
a. 400 kN m b. 375 c. 360 d. 350
66. Compute the eccentricity on balanced failure.
a. 250 mm b. 240 c. 225 d. 205

SITUATION 23: A W 460 x 177 column has a length of 8 m. Refer to the NSCP Specs at Figure SDSC - SLMY. Use $f_y = 380$ MPa, $A = 22600$ mm² and $r_{min} = 68.2$ mm. If the both ends are hinged, ($K = 1.00$)

67. Compute the slenderness ratio.
a. 56.30 b. 117.30 c. 78.35 d. 58.65
68. Find the value of limiting slenderness ratio, C_c .
a. 105.93 b. 115.68 c. 101.93 d. 95.68
69. Find the allowable load that could carry.
a. 1588 kN b. 1635 c. 1692 d. 1716

CONCEPTUAL AND PROBLEM SOLVING

70. Which of the following objects considered as machine parts in the necessary of stiffness?
a. connecting rod b. beams c. trusses d. purlins
71. Marble A is placed in a hollow tube, and the tube is swung in a horizontal plane, causing the marble to be thrown out. As viewed from the top, which of the following points best describes the path of the marble after leaving the tube. Refer to Figure EDRM - RCC1.
a. 1 b. 2 c. 3 d. 4
72. A 200 mm thick one way reinforced slab overhangs a simple support. The span of overhang is 2.4 m. Drawings called for the reinforcement to be placed with top cover of 25 mm. The steel was misplaced, however and later was found to be as much as 87.5 mm. below the top of the concrete. Use $f'_c = 27.6$ MPa, $f_y = 414.6$ MPa. Reinforcing bars is 22 mm ϕ spaced at 275 mm on cover. Find the Ultimate moment ϕM_n as built.
a. 78.75 kN.m b. 78.31 c. 76.55 d. 80.22
73. A wooden beam 150 x 300 mm is loaded at flexural strength of 8 MPa. Find the maximum moment that could carry.
a. 12 kN.m b. 18 c. 20 d. 25
74. These are the displays of cumulative costs, labor hours, or other quantities plotted against time.
a. Gantt chart b. PERT c. S Curve d. Primavera
75. A building in Manila is to be designed to have a base shear coefficient of 1.402 with a site coefficient if 1.2. Find the fundamental period of vibration.
Use the formula : $C = 1.25S / T^{(2/3)}$
a. 1.85 s b. 1.64 c. 1.11 d. 0.98

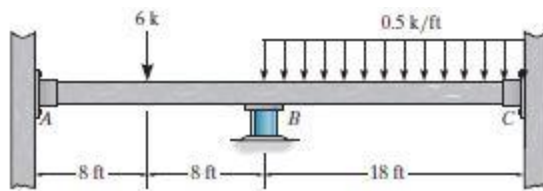


Figure STSDM - AFE



Figure STDS - CEB

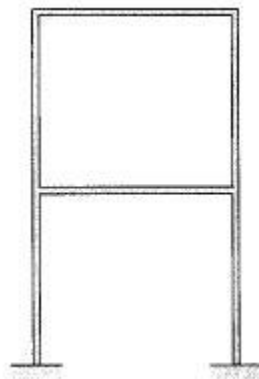


Figure STDS - JST

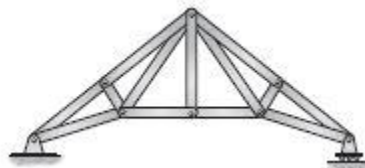


Figure STDS - ELS

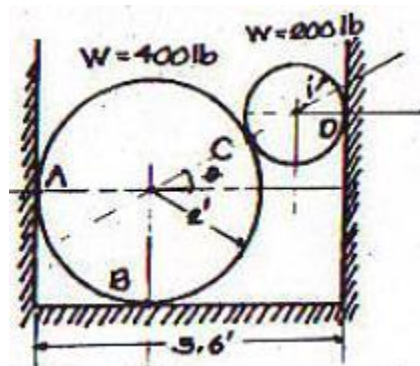


Figure ESEF - KT

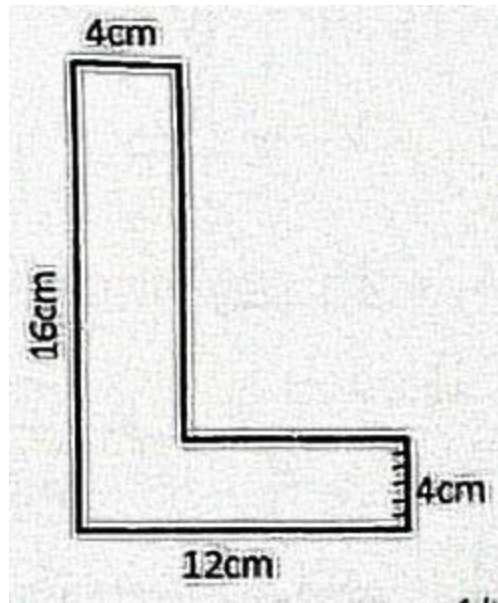


Figure SMMOI - JDJS

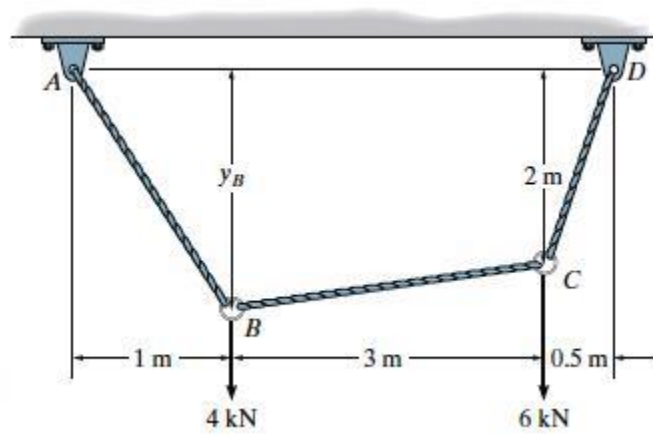


Figure STAS - 8080

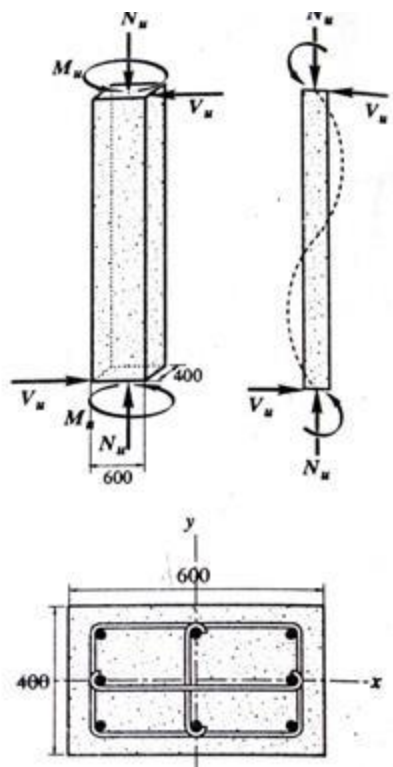


Figure RCCS - GSW31

- 3) For members subject to significant axial tension.

$$V_c = \frac{1}{6} \left[1 + \frac{0.3 N_u}{A_g} \right] \sqrt{f_c'} b_w d$$

- A) Allowable shear strength for simplified calculation.

- 1) For members subject to shear and flexure only.

$$V_c = \frac{1}{6} \sqrt{f_c'} b_w d$$

- 2) For members subject to an axial compression.

$$V_c = \frac{1}{6} \left[1 + \frac{N_u}{14 A_g} \right] \sqrt{f_c'} b_w d$$

- B) Allowable shear strength for detailed calculation.

- 1) For members subject to shear and flexure.

$$V_c = \frac{1}{7} \left[\sqrt{f_c'} + 120 \rho_w \frac{V_u d}{M_u} \right] b_w d < 0.3 \sqrt{f_c'} b_w d$$

$\frac{V_u d}{M_u}$ shall not be greater than 1.0

Min. area of shear reinforcement:

$$A_v = \frac{b_w S}{3 f_y}$$

When factored shear force V_u exceeds the shear strength ϕV_c , shear reinforcement shall be provided and the shear strength V_s shall be computed where shear reinforcement perpendicular to the axis member:

$$A_s = \frac{A_v f_y d}{S}$$

- ① Determine the concrete shear strength for the positive x-direction using simplified calculation.
- ② Determine the concrete shear strength for the negative x-direction using simplified calculation.
- ③ Determine the required spacing of shear reinforcement. Apply provisions on spacing limits of reinforcements when applicable.

Figure RCCS - CCLBJ

- ⑩ Average compressive strength f_c' for the design of concrete mix if the specified compressive strength $f_c' = 28$ MPa such that the record of prior cylinder test results are not available.

f_c' less than 21 MPa

$$f_c' = f_c' + 70$$

f_c' from 21 to 35 MPa

$$f_c' = f_c' + 8.5$$

f_c' over 35 MPa

$$f_c' = f_c' + 10$$

Figure MTACS - IJCS

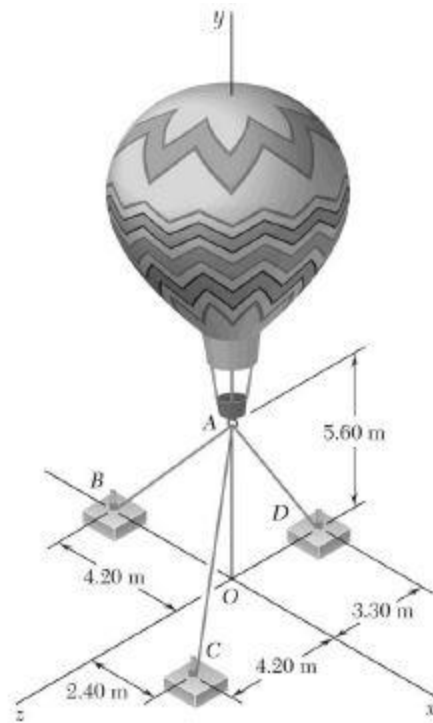


Figure EMTDF - KKVM

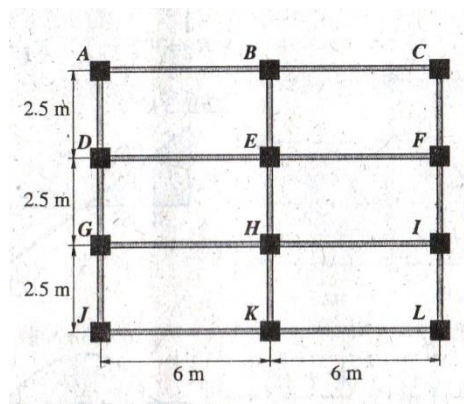


Figure RCDFFP - TRDDR

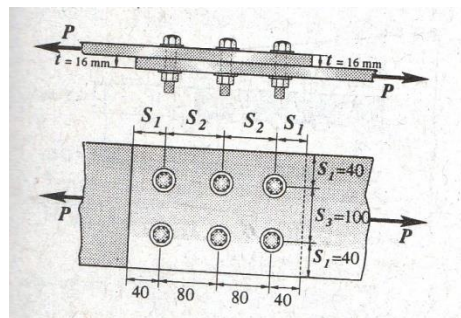


Figure SDBC - HK

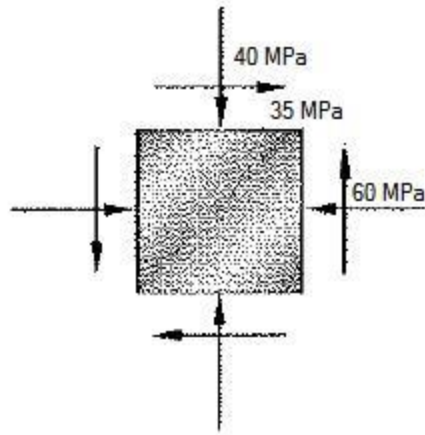


Figure SMMC - ECS29

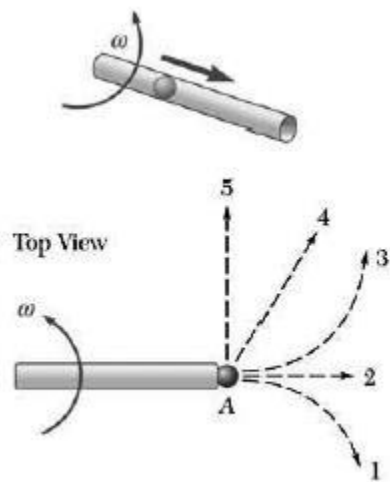


Figure EDRM - RCC1

Figure RDCS - AJMY

BASIC CODE REQUIREMENTS

The basic Code requirement (Sec. 411.2) on shear strength is that the factored shear force V_u shall be equal or less than the design shear ϕV_n , or

$$\text{Eq. 4-1} \quad V_u \leq \phi V_n$$

where $\phi = 0.75$ and

$$\text{Eq. 4-2} \quad V_n = V_c + V_s$$

For beams with no web reinforcement, the shearing force that causes the first diagonal cracking can be taken as the shear capacity of the beam. For beams that does contain web reinforcement, the concrete is assumed to carry a constant amount of shear force V_c , and the web reinforcement need only be designed for the shear force V_s in excess of that carried by the concrete, or

$$V_s = V_n - V_c$$

Eq. 4-3

Detailed calculation of V_c

- For members subject to shear and flexure only,

$$\text{Eq. 4-7} \quad V_c = \left(0.17\lambda\sqrt{f'_c} + 17\rho_w \frac{V_u d}{M_u} \right) b_w d$$

but not greater than $0.29\sqrt{f'_c} b_w d$. Quantity $V_u d/M_u$ shall not be taken greater than 1.0 in computing V_c by Eq. 4-7, where M_u is factored moment occurring simultaneously with V_u at section considered.

- For members subject to axial compression, Eq. 4-7 may be used to compute V_c with M_u substituted for M_u and $V_u d/M_u$ not then limited to 1.0, where

$$\text{Eq. 4-9} \quad M_w = M_u - N_u \frac{4h-d}{8}$$

However, V_c shall not be taken greater than

$$\text{Eq. 4-10} \quad V_c = 0.29 \sqrt{1 + \frac{0.29N_u}{A_c}} \lambda \sqrt{f'_c} b_w d \quad 2010 \text{ NSCP}$$

SHEAR STRENGTH PROVIDED BY REINFORCEMENT (411.6.6)

When factored shear force V_u exceeds strength ϕV_c , shear reinforcement shall be provided to satisfy Eq. 4-1 and Eq. 4-2. The shear strength provided by the stirrups is given by the following but shall not be taken greater than $0.66\sqrt{f'_c} b_w d$.

SHEAR STRENGTH PROVIDED BY CONCRETE, V_c FOR NONPRESTRESSING MEMBERS (SECTION 411.4)

Simplified calculation of V_c

- For members subject to shear and flexure only,

$$\text{Eq. 4-5} \quad V_c = 0.17\lambda\sqrt{f'_c} b_w d$$

- For members subject to axial compression

$$\text{Eq. 4-6} \quad V_c = 0.17 \left(1 + \frac{N_u}{14A_g} \right) \lambda \sqrt{f'_c} b_w d$$

Spacing of Shear Reinforcement

If $V_u \leq \frac{\phi V_c}{2}$, no stirrups are required

If $\frac{\phi V_c}{2} \leq V_u \leq \phi V_c$, minimum stirrups required $s = \frac{3A_v f_y}{b_w}$

If $V_u \geq \phi V_c$, $s = \frac{A_v f_y d}{V_u} \quad \left(3 \times 20 \rightarrow 20, 40 \right)$

Maximum Spacing

If $V_u < \frac{1}{3}\sqrt{f'_c} b_w d$, $s = \frac{d}{2}$

If $V_u > \frac{1}{3}\sqrt{f'_c} b_w d$, $s = \frac{d}{4}$

PROVISIONS FOR TORSIONAL ANALYSIS

Torsion effects can be neglected when

$$T_u < T_{cr} = \frac{\phi \sqrt{f'_c}}{12} \left(\frac{A_{cp}^2}{P_{cp}} \right)$$

Transverse reinforcement for is designed using

$$T_u < \frac{\phi 2A_o A_t f_{yv} \cot \theta}{S}$$

Max. spacing for torsion $\frac{P_h}{8}$ or 300mm

Longitudinal reinforcement (in addition to flexure reinforcement)

$$A_l = P_h \frac{A_t f_{yv}}{S f_{cl}} \cot^2 \theta$$

14 NSCP Formulas for Axially Loaded Columns

1. When $\frac{KL}{r} < C_c$ (Intermediate Column)

On the gross section of axially loaded compression members where cross sections meet with the provisions of the NSCP, when KL/r , the largest slenderness ratio of any unbraced segment is less than C_c , the allowable stress is:

$$F_a = \left[1 - \frac{(KL/r)^2}{2 C_c^2} \right] \frac{F_y}{F.S.} \quad \text{Equation 16.14.1}$$

$$F.S. = \frac{5}{3} + \frac{3 (KL/r)}{8 C_c} - \frac{(KL/r)^3}{8 C_c^3} \quad \text{Equation 16.14.2}$$

$$\text{Where: } C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$$

2. When $\frac{KL}{r} > C_c$ (Long Column)

On the gross section of axially loaded compression members, when KL/r exceeds C_c , the allowable stress is:

$$F_a = \frac{12 \pi^2 E}{23 (KL/r)^2} \quad \text{Equation 16.14.3}$$

F_a = allowable compressive stress

Note: This is Eulers formula with a factor of safety of $\frac{23}{12} = 1.92$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$$