UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO

FACULTAD DE INGENIERIA

"DISEÑO DE TRABES DE CONCRETO REFORZADO UTILIZANDO TABLAS ELABORADAS EN MICROCOMPUTADORAS".

T E S I S

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P R E S E N T A :

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MEXICO, D. F. 1988

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C A P I T U L O S .

I. INTRODUCCION.

En la actualidad, el diseño de las estructuras de concreto reforzado requiere de un mejor conocimiento de la física, las matemáticas, la economía, e inclusive de la sociología en algunas ocasiones, pero sobre todo de la tecnología disponible. Por tal motivo, el ingeniero diseñador se ha visto motivado a utilizar esa gran herramienta moderna que es la computadora, ya que su correcto aprovechamiento puede significar una verdadera simplificación para la metodología del diseño. Este razonamiento es válido al considerar lo práctico de un diseño en el que se puede reducir el tiempo empleado para su elaboración.

Así mismo y teniendo como premisa fundamental el hacer más expedito el proceso del diseño, la presente tesis pretende aportar una ayuda que consiste en un "paquete" de computadora y un catálogo de tablas que buscan facilitar la labor de aquellos profesionales relacionados con el diseño y construcción de estructuras

de concreto reforzado. Y más específicamente en cuanto a trabes de concreto reforzado, las cuales debido a su importancia se consideran como estructuras típicas.

Se hace hincapié en que dentro de las posibilidades del diseño se debe considerar, no la opción "perfecta y única" ya que ésta no existe por diversas razones, sino la opción adecuada y más realista atendiendo a los aspectos más fundamentales del diseño, que son:

- La seguridad.
- La resistencia adecuada (la cual es una consecuencia de la seguridad).
- El comportamiento satisfactorio en condiciones de servicio.
- El costo (aspecto económico).
- La vida útil de la estructura.
- La geometría (dimensiones y estética).

El material de este trabajo contiene un soporte teórico actualizado tomando en cuenta el comportamiento básico de las estructuras que trabajan a la flexión, y esta completamente de acuerdo con las especificaciones vigentes de las "NORMAS TECNICAS COMPLEMENTARIAS", que son la base técnica del reglamento de construcciones para el Distrito Federal, siguiendo su nomenclatura y simbolismo.

Asi pues es válido enfatizar que el enfoque empleado esta basado en el criterio de "DISEÑO POR RESISTENCIA ULTIMA", considerándolo como el más práctico (en terminos generales) y con las ventajas que supone el mismo, como son:

I. La resistencia a la flexión de un miembro se alcanza en condiciones últimas.

2. Las secciones de concreto reforzado se comportan inelásticamente bajo cargas elevadas, en consecuencia, la teoría elástica no puede dar

una predicción segura de la resistencia máxima de los miembros, ya que las deformaciones inelásticas no se toman en consideración: en consecuencia para las estructuras diseñadas por el método del esfuerzo de trabajo, se desconoce el factor exacto de carga(Carga Máxima/ Carga de Servicio), el cual varía de estructura a estructura.

3. El diseño por resistencia última permite una selección mas racional de los factores de carga.

4. El diseño por resistencia última utiliza reservas de resistencia resultantes de una distribución más eficiente de los esfuerzos permitidos por las deformaciones inelásticas, y en ocaciones indica que el método elástico es muy conservador.

5. El diseño por resistencia última permite al diseñador evaluar la ductilidad de la estructura en el rango inelástico.

6. Es posible diseñar vigas simplemente armadas mucho menos peraltadas al utilizar el método de resistencia última a diferencia del diseño elástico basado en esfuerzos permisibles. En consecuencia, existe un buen rango de libertad al elegir el tamaño de las secciones simplemente reforzadas en el diseño por resistencia última.

7. Se puede considerar, en general, que al utilizar el diseño plástico en lugar del elástico, hay un ahorro en acero y concreto de aproximadamente un 25% o más, lo cual es muy importante, teniendo en cuenta que no se compromete la seguridad de la estructura, ni los estados límite de servicio.

El empleo de las tablas de este trabajo permite que, únicamente con conocer los datos geométricos de la sección, y considerando las características de resistencia de los materiales (f'c y fy) se puedan conocer los elementos mecánicos de flexión (momento resisten

te) y de fuerza transversal (cortante resistente) que - resiste cada viga en particular, así mismo, el procedi -- miento anterior se podrá realizar de manera inversa.

Se elaboró para cada sección propuesta un - juego de cinco tablas que se podrán utilizar de la manera siguiente:

La primera tabla (p vs. MR), permite conocer - TODO EL RANGO de momentos resistentes para cada sección conforme a la cuantía de acero (p) que debe tener la viga según el procedimiento de diseño.

La segunda tabla (As vs. MR), asigna a cada - área de acero su correspondiente momento resistente considerando una gama de barras, que va desde 1 hasta 10 varillas para cada diámetro comercial de mayor uso en la - práctica constructiva.

La tercer tabla (Av vs. VR), permite conocer el diámetro de estribos así como su separación práctica -

para resistir fuerzas cortantes que deberá resistir la viga que se quiera diseñar.

La tabla 3 (Av vs. VR), se subdivide en tres, que son: la 3.A, la 3.B y la 3.C. Las cuales se deberán utilizar como se indica a continuación:

Si partiendo de la tabla 1. sabemos que el valor de "p" (cuantía de acero) resultó ser mayor o igual que 0.01, se utilizará la tabla 3.A; para cuando "p" toma un valor intermedio entre 0.01 y el valor de "p mín" se usará la tabla 3.B, y por último se cuenta con otro conjunto de valores, que son la tabla 3.C para cuando "p" es igual a "p mín". De tal forma que se podrán interpolar fácilmente aquellos valores que no sean exactamente los que se encuentran registrados en estas subtablas (3.A, 3.B y 3.C) que conforman de concepto a la "tabla 3".

NOTAS ADICIONALES DE LAS NORMAS TECNICAS COMPLEMENTARIAS DE REGLAMENTO DE CONSTRUCCIONES VIGENTE (1987).

Las siguientes notas y comentarios deberán tomarse en cuenta, para no perder el contexto reglamentario del diseño de trabes o vigas, que es como las llama el reglamento.

Los diseños aqui presentados son para vigas -- normales, esto es, con una relación L/H mayor que cinco, ya que de otra manera se trataría de vigas diafragma, que deberán tener un tratamiento aparte, ya que la contribución al cortante es diferente.

Siendo Q (factor de comportamiento sísmico, al que antiguamente se denominaba como factor de ductilidad), una cantidad adimensional definido en las normas técnicas complementarias para el diseño por sismo, los marcos de concreto reforzado de peso normal con elementos colados en el lugar, que cumplan con los requisitos generales de estas normas, se diseñarán por sismo aplicando un factor Q igual a 2.

El concreto empleado para fines estructurales puede ser de dos clases: clase 1, con un peso volumétrico en estado fresco superior a 2.2 T/m^3, y el concreto clase 2, con un peso volumétrico en estado fresco comprendido entre 1.9 y 2.2 T/m^3.

Los concretos clase 1 tendrán una resistencia especificada, f'c igual o mayor que 250 kg/cm^2. Así mismo la resistencia especificada de los concretos clase 2 será inferior a 250 kg/cm^2. El valor nominal de resistencia para efectos de diseño se calculará en ambos casos - con la expresión:

$$f^*_c = 0.8 f'_c$$

Para las obras clasificadas como del grupo A, o B1, según se definen en el articulo 174 del Reglamento, se usará concreto de clase 1. El corresponsable en seguridad estructural podrá permitir el uso de concreto clase 2 para dichas obras, si demuestra que el comportamiento estructural será satisfactorio.

El Reglamento conserva los mismos factores de resistencia que en su version anterior, que son para flexión de 0.9, y para cortante de 0.8.

Las expresiones consideradas para Vcr siempre que el peralte no sea mayor que 70 cm., son las generales, y para cuando el peralte resulta mayor se tendrá que hacer una reducción del 30%. Lo cual ya esta incluído en todas - las tablas correspondientes. No así para cuando la relación H/B sea mayor que 6, en donde también se tendrá que reducir el valor de Vcr; esta última condición no está conside

rada en el diseño de las tablas presentadas en este trabajo, ya que se utilizaron secciones con H/B igual a 2, por ser estas las más comunes.

En tramos comprendidos a un peralte efectivo de las secciones donde, en zonas de tensión, se interrumpa - más del 33% o se traslape mas del 50% del refuerzo longitudinal, se hará la reducción del párrafo anterior.

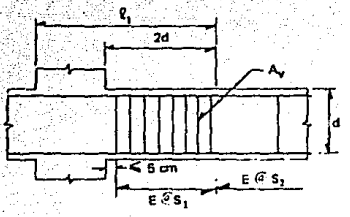
La separación de los estribos no deberá ser menor que 5 cm.

Las barras longitudinales pueden agruparse con un máximo de tres barras, con la salvedad de que en toda - sección se dispondrá de refuerzo tanto en el lecho inferior como en el superior. En cada lecho el área de refuerzo no - será menor que:

$$A_{s\,mín} = \frac{0.7\sqrt{f'_c}}{f_y} b d$$

y constará de por lo menos dos barras corridas de 12.7 mm. de diámetro (#4), para marcos dúctiles con Q igual 3 o 4. Además en estos casos los paquetes sólo podrán tener 2 barras cada uno.

Cabe hacer mención de otra restricción que puede influir de manera importante en el diseño, ésta es el anclaje, y los requisitos complementarios se mencionan en el punto 3 de las normas técnicas complementarias del reglamento.



$A_v f_{yv} \geq 0.06 A_b f_y$

$A_v \geq \#2.5$

$S_2 \leq d/2$

A_v, f_{yv} área y esfuerzo de fluencia del estribo

A_b, f_y área y esfuerzo de fluencia de la barra longitudinal de mayor diámetro

$$S_1 \leq \begin{cases} 425\, d_b/\sqrt{f_y} \\ 20 \text{ cm} \\ 24 \text{ diámetros del estribo} \\ d/4 \end{cases}$$

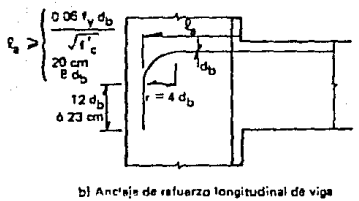
Para dimensionamiento por cortante en ℓ_1

$V_c = 0$

$F_c = 1.4$

No se traslapará refuerzo longitudinal en ℓ_1

a) Refuerzo longitudinal y transversal



b) Anclaje de refuerzo longitudinal de viga

Requisitos de armado para - articulaciones plásticas.

Requisitos de refuerzo en vigas.

II. TEORIA FUNDAMENTAL.

II.I FLEXION.

LA SECCION HOMOGENEA. (Obtención de la Fórmula de la Escuadría).

Considérese una viga prismática de sección rectangular, hecha de un material homogéneo, libremente apoyada en sus extremos y sujeta a una carga uniformemente repartida en todo su claro, Fig. 1.

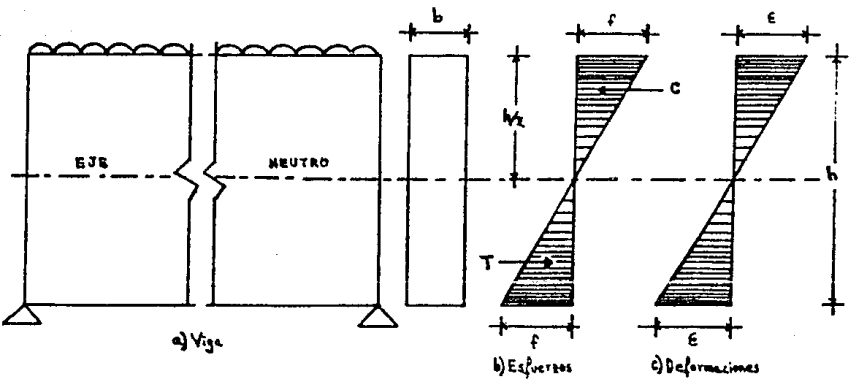


Figura 1.

La hipótesis de este análisis es la de las secciones planas de Bernoulli, cuya actualidad avala el reglamento, pues la menciona en primer lugar en el grupo que prescribe para la obtención de las resistencias de diseño, Artículos 2.1.1 y 3.2.

a)La distribución de deformaciones unitarias longitudinales en la sección transversal de un elemento, es plana.

Otra interpretación de esta hipótesis, es que los esfuerzos longitudinales de una sección transversal, son directamente proporcionales a su distancia al eje neutro de la sección.

La acción flexionante externa mostrada en la figura 1.a, provoca los esfuerzos ilustrados en el diagrama, Fig. 1.b, compresión en las fibras superiores y tensión en las inferiores, pasando por un punto de esfuerzo nulo, llamado eje neutro de la sección. Los esfuerzos actúan en forma de cuñas triangulares sobre un área de ancho b y altura h/2, cuyas resultantes son C y T, iguales y de sentido contrario y que, a una distancia en

tre sí de 2h/3, integran el momento resistente de la sección. Como la altura de las cuñas es igual, los esfuerzos máximos de las mismas son iguales y pueden llamarse simplemente f. De igual manera, las deformaciones unitarias superior e inferior de la sección, son iguales y pueden llamarse simplemente ϵ, Fig.1c.

Se tendrá por equilibrio que:

$$C = T = \frac{fbh}{2 \times 2} = \frac{fbh}{4}$$

y el momento resistente, es:

$$M = \frac{C \times 2h}{3} = \frac{fbh^2 \times 2}{3 \times 4} = \frac{fbh^2}{6}$$

que se puede escribir como:

$$\frac{M}{f} = \frac{bh^2}{6}$$

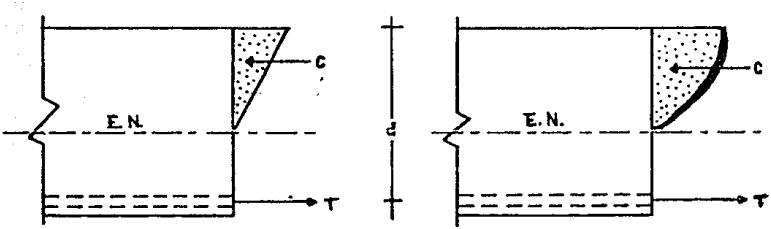
Que es la fórmula de una sección rectangular homogénea sujeta a flexión, en donde:

$$S = \frac{bh^2}{6}$$

es el módulo de sección de la misma, f en este caso no debe sobrepasar los valores de esfuerzo admisibles para el material del que se considera hecha la sección.

LA SECCION NO HOMOGENEA. Diseño por resistencia Ultima.

Numerosos investigadores, de entre los cuales sobresalió Charles Whitney, hicieron especial hincapié, en el hecho de que conforme se sobrecargaba la sección de concreto reforzado, es decir, que si se rebasaban los valores dados de trabajo en los esfuerzos admisibles, se alteraba el diagrama de esfuerzos correspondiente, creciendo la cuña que operaba arriba del eje neutro, hasta una forma parcialmente parabólica, que incrementando bastante la fuerza compresiva resultante en el concreto elevaba sustancialmente el momento resistente de la sección a la falla.



a) Sección Original

b) Al incrementar los esfuerzos

Figura 2.
(1ª Parte)

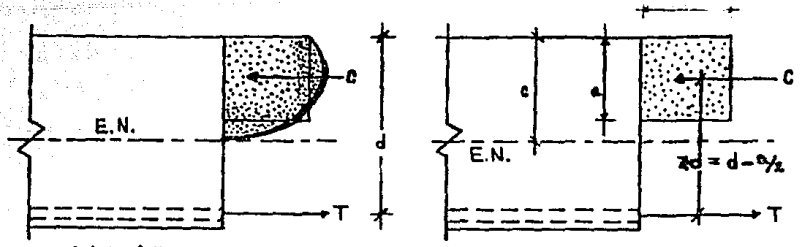


Figura 2.
(2ª Parte)

La figura 2. muestra esta variación al incrementar el esfuerzo, mostrando finalmente la llamada : "zona equivalente de esfuerzo de compresión" y el esfuerzo del concreto que opera en ella.

Por tanto, hubo en todo esto un cambio grande y positivo en lo concerniente al diseño: sin cambiar sustancialmente el concepto y el valor del factor de seguridad a la falla del concreto, se incrementó el momento resistente de la sección por medio de una utilización más racional de la capacidad del concreto. El factor de seguridad se obtiene ahora por medio de factores de carga y coeficientes reductivos.

Como ahora los esfuerzos salen de la zona de esfuerzos admisibles, que se encontraban dentro de la zona elástica de los diagramas de esfuerzo-deformacion unitaria, para caer en la zona inelástica o plástica de los mismos, este tipo de diseño se ha llamado "Diseño por Resistencia Ultima".

FORMULAS DE FLEXION

La figura 3. muestra el diagrama de esfuerzos - a la falla de una viga, incluyendo la zona equivalente - de Whitney y el diagrama correspondiente de deformaciones unitarias para una sección sujeta al diseño plástico. Las hipótesis dadas por el reglamento para este criterio de - diseño, Articulo 2.1.1, son:

a) La distribución de deformaciones unitarias longitudinales en la sección transversal - de un elemento, es plana.

b) Existe adherencia entre el concreto y el acero de tal manera que la deformación uni

taria del acero es igual a la del concreto adyacente.

c) El concreto no resiste esfuerzos de ten -- sión.

d) La deformación unitaria del concreto cuando alcanza su resistencia es de 0.003.

e) La distribución de esfuerzos de compresión en el concreto cuando alcanza la resistencia es uniforme en una zona cuya profundidad es de 0.8 veces la del eje neutro, definido este de acuerdo con las hipótesis anteriores. El esfuerzo uniforme se tomará igual a 0.85 f*c, si f*c es menor o igual que 250 Kg/cm^2 (caso usual) e igual a : (1.05— (f*c/1250))• f'c, si f*c es mayor que 250 Kg/cm^2.

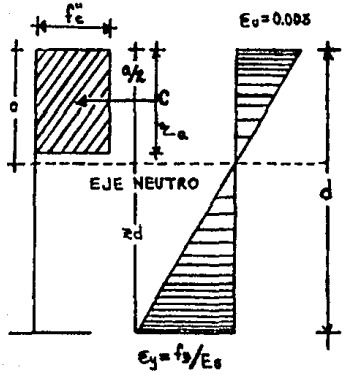


Figura 3.

El Reglamento define a $0.85f^*c = f''c$ y este es el valor que aparece en las figuras 2 y 3, y en las deducciones que siguen, ya que como se dijo antes, éste es el valor correspondiente al caso usual, donde f^*c es igual a 0.8 de $f'c$.

Si se llama c a la profundidad del eje neutro segun la hipótesis (e) anterior, la profundidad de la zona equivalente será " $a = 0.8c$ ", ecuación que dividida entre el peralte efectivo "d", hace:

$$q=\frac{a}{d}=0.8\frac{c}{d}$$

El brazo del par resistente de la sección vale:

$$zd=d-\frac{a}{2}=d\left(1-\frac{a}{2d}\right)$$

$$zd=d(1-0.5q)$$

La fuerza interna de compresión, vale:

$$C=f''_c\,ba$$

Y el momento resistente de la sección con respecto al concreto, es :

$$\begin{aligned}M_R=F_R\cdot C\cdot zd &= F_R f''_c\,bad(1-0.5q)\\ &= F_R f''_c\,b\left(\frac{a}{d}\right)d^2(1-0.5q)\\ &= F_R f''_c\,b\,d^2 q(1-0.5q)\end{aligned}$$

Si se llama Ku al coeficiente de flexión,

$$K_u=F_R f''_c\,q(1-0.5q)$$

Se tiene finalmente:

$$M_R = K_u b d^2 \Longrightarrow d = \sqrt{\frac{M_R}{K_u b}} \quad ;$$

$$b = \frac{M_R}{K_u d^2} \quad ; \quad K_u = \frac{M_R}{b d^2}$$

El momento resistente con respecto al acero, ya que la tensión en el acero es " $T = A_s \cdot f_y$ ", vale:

$$M_R = F_R T \not{=} d = F_R A_s f_y d (1 - 0.5q)$$

Llamando:

$$a_u = F_R f_y (1 - 0.5q)$$

Se tiene:

$$A_s = \frac{M_R}{a_u \cdot d}$$

Ahora bien, el equilibrio de la sección exije que:

$$C = T$$

$$f_c'' \cdot b \cdot a = A_s \cdot f_y$$

Y entonces: $$A_s = \frac{f_c''}{f_y} \cdot ba$$

Si se define al porcentaje de acero como:

$$p = \frac{A_s}{bd} = \frac{f''_c\, ba}{f_y\, bd} = \frac{f''_c}{f_y} \cdot q$$

De donde:

$$q = p \frac{f_y}{f''_c}$$

Remplazando a "q" por su valor en las ecuaciones obtenidas para MF con respecto al concreto, se tiene:

$$M_R = F_R\, bd^2 f_y \cdot p\,(1 - 0.5\, p \frac{f_y}{f''_c})$$

Ecuacion cuadrática en p que sirve para conocer el porcentaje de acero de la sección a partir del momento resistente y sus dimensiones b y d. Operando la ecuación cuadrática e igualando a cero, se tiene:

$$F_R\, bd^2 \frac{f_y}{2f''_c} \cdot p^2 - F_R\, bd^2 f_y \cdot p + M_R = 0$$

Se pueden resumir las ecuaciones de flexión para una sección rectangular reforzada a la tensión (o simplemente reforzada) que será el prototipo de las secciones consideradas en esta tesis, de acuerdo con el criterio de diseño por resistencia última en la siguiente manera:

Resumen.

1) $\frac{a}{d} = 0.8\frac{c}{d} = q$

2) $C = T = F_R A_s f_y = f_c'' b a$

3) $z = (1 - 0.5q)$

4) $K_u = F_R f_c'' q(1-0.5q) = \frac{M_R}{bd^2}$

5) $A_s = \frac{M_R}{a_u d}$

6) $a_u = F_R f_y z$

7) $M_R = F_R b d^2 f_y \cdot p\left(1 - 0.5\, p \frac{f_y}{f_c''}\right)$

8) $p = \frac{A_s}{bd} = q\frac{f_c''}{f_y}$

9) $F_R = 0.9$, para flexión según el reglamento.

MECANISMO DE FALLA.

Ya que el diseño por resistencia última está basado en la falla compresiva del concreto y la fluencia del acero, como extremos de esforzamiento para los materiales, es importante conocer que tipos de falla pueden ocurrir y entonces, preveer que estos sean lo más adecuado para la seguridad de la pieza.

LA SECCION BALANCEADA.

La sección o falla balanceada ocurre cuando ambos materiales (concreto y acero) simultáneamente, alcanzan los esfuerzos máximos previstos, o sea, los que provocan sus deformaciones unitarias máximas. Para el concreto se ha fijado esta deformación unitaria como : $\epsilon_u = 0.003$ y para el acero $\epsilon_y = fy/Fs$. La figura 4. muestra los tres tipos de falla que pueden ocurrir a la sección teniendo a la balanceada como intermedia.

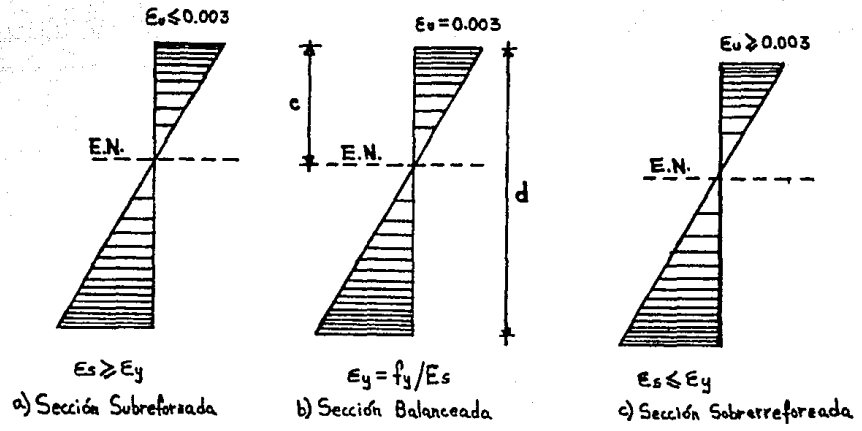


Figura 4.

En las fallas balanceada y subreforzada ocurren en la forma siguiente: al incrementar la carga, el acero tiende a sobrepasar la deformación unitaria de fluencia, presentando deformaciones relativamente grandes, lo que hace que se eleve el eje neutro: esto hace que la zona equivalente de compresión se reduzca, provocandose el colapso de la viga por aplastamiento del concreto. Sin que el acero se rompa. El colapso es, en este caso, siempre advertido por signos que indican que va a

ocurrir: demasiado crecimiento de las grietas de tensión (en tamaño y número), al que se acompaña un flechamiento excesivo, etc. A este tipo de falla se le conoce como falla dúctil.

En la falla sobrereforzada, los signos previos anteriores no existen. La mayor cuantía en acero apenas lo hace alargarse para un par mecánico interno que puede estar poniendo en peligro la estabilidad de la pieza, -- por el aplastamiento súbito del concreto. Esta falla es de tipo frágil. Es por esto que en general los reglamentos de construcción prohiben este tipo de sección para - el diseño. El Reglamento del Distrito Federal no es una excepción, puesto que en su Artículo 2.1.2.b prescribe - como refuerzo máximo al de la sección balanceada para -- cargas muertas y vivas usuales, y 0.75p·bal cuando se incluyen las accidentales (viento o sismo). Es decir, se - preveé una falla de tipo dúctil.

Existe un tercer tipo de falla que ocurre para secciones deshusadamente poco reforzadas, en las que incluso no se ha cumplido con la cuantía mínima de acer-

prescrita por el Reglamento a un elemento reforzado a la flexión o por temperatura. Aquí, la cantidad de acero -- puede no ser apta para resistir ni los momentos provocados en la pieza por la temperatura o el peso propio. Al menor esfuerzo extra el acero se rompe y sobreviene el - colapso de la pieza. Se le puede considerar como una sección sumamente subreforzada y ocurre generalmente por -- error.

Otra forma de nombrar a una sección subreforzada puede ser el llamarla "sección aperaltada", ya que si a una sección dada se le disminuye el acero de refuerzo sin disminuirle las cargas, es decir, el par mecánico interno, habrá que aperaltarla para satisfacer la resistencia que requiere dicho momento.

Por otra parte, en la Figura 4. inciso (b), por geometría se tiene:

$$\frac{C}{0.003} = \frac{d}{(f_y/E_s) + 0.003} \Longrightarrow \frac{C}{d} = \frac{0.003}{(f_y/E_s) + 0.003}$$

El valor del porcentaje balanceado, a partir de la fórmula ya obtenida para "p", queda:

$$p = q\frac{f''_c}{f_y} = 0.8\frac{c}{d}\frac{f''_c}{f_y} = \frac{f''_c}{f_y} \times 0.8 \times \frac{0.003}{(f_y/E_s)+0.003}$$

Dando para Es. el valor de 2×10^6, se tiene:

$$p_{bal} = \frac{f''_c}{f_y} \cdot \frac{4800}{f_y+6000}$$

Que es el valor dado por el Reglamento.

II.2 CORTANTE.

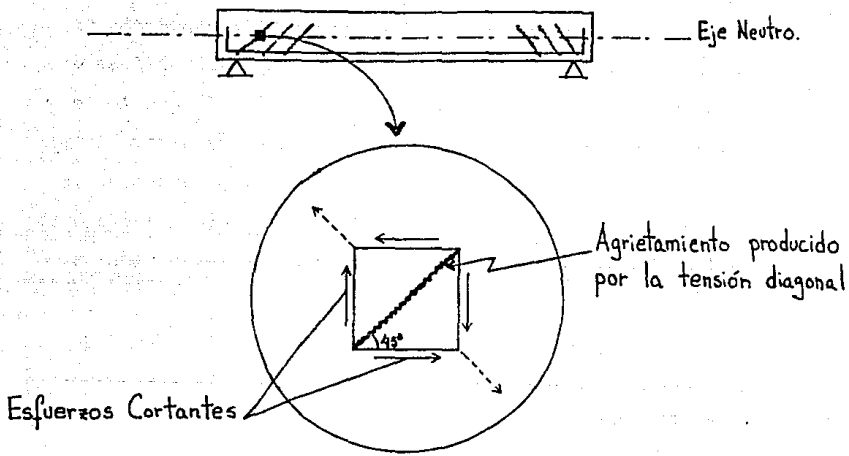
Los experimentos con vigas de concreto reforzado normal con refuerzo adecuado en el alma indican que la fuerza cortante no tiene influencia patente en el desarrollo de la capacidad a flexión, lo que permite al diseñador ignorar la interacción y manejar por separado la flexión y el cortante. Sin embargo los estudios sobre la distribución de los esfuerzos en un material compuesto - como lo es el concreto reforzado, muestran que existe una relacion íntima entre la flexión, cortante, adherencia y anclaje en el claro sometido a cortante de una viga. Cuando se requiere transmitir grandes fuerzas cortantes a través de una sección en momento último, se puede afectar la distribución de las deformaciones por flexión en el concreto y el acero. Las fuerzas cortantes en las vigas de gran peralte también pueden ser tan dominantes que gobiernen la resistencia del miembro, inhibiendo el desarrollo de toda la capacidad flexión, que se obtiene de los principios presentados en el desarrollo de la teoría de flexión. lo cual se menciona en los comentarios adicionales de las normas técnicas, respecto a las secciones de peralte mayor o igual a 70 cm.

Una muestra del criterio anterior se observa en los diseños permitidos por el reglamento del D.D.F.

Para cuando se presentan cargas accidentales, sismo o viento, se tiene especial cuidado en realizar un diseño en el que se anule toda posibilidad de que los elementos estructurales fallen por cortante, es decir, de manera frágil. En el caso de las vigas se debe asegurar la ductilidad del elemento para que la resistencia a cortante del mismo sea mayor que la resistencia máxima a flexión.

Los esfuerzos cortantes, en especial para el caso de las vigas, pueden ser verticales y horizontales. Los primeros se producen como resultado de las cargas verticales principalmente, la fuerza de gravedad y la geometría del elemento, y los segundos producidos por los efectos de tensión y compresión producidos por la flexión del elemento.

La combinación de dichos esfuerzos producen fuerzas resultantes en un plano principal a 45^{o} (generalmente) respecto al eje neutro, produciendo agrietamiento bajo cargas relativamente bajas. La siguiente figura ejemplifica dicho fenómeno, llamado también de Tensión Diagonal.



Cabe aclarar que las expresiones que calculan el diseño por cortante para vigas de concreto reforzado, reflejan los efectos de las variables principales dentro de los límites de la información experimental.

MIEMBROS SIN REFUERZO TRANSVERSAL.

El efecto de la fuerza cortante en un elemento se puede calcular (medir) obteniendo el esfuerzo cortante nominal (vu).

$$vu = \frac{Vu}{bd}$$

Donde: vu: esfuerzo cortante nominal en una seccion transversal.

Vu: fuerza cortante externa en la sección considerada, correspondiente a la carga de diseño.

b: ancho de la sección.

d: peralte efectivo.

Para Vcr: Esfuerzo cortante <u>total</u> que resiste el concreto. se tiene que:

$V_{CR} = (0.2 + 30\,p)\,FR\,b\,d\sqrt{f^*c}$, si $p < 0.01$

$V_{CR} = 0.5\,FR\,b\,d\sqrt{f^*c}$, si $p \geq 0.01$

Siendo F.R.: factor de resistencia 0.8

MIEMBROS CON REFUERZO TRANSVERSAL.

Por lo general se considera que cuando la resistencia a cortente que puede soportar el concreto es menor que la fuerza cortante que debe resistir la viga, se necesitará de la utilización de estribos, lo anterior es cierto mas no limitativo, ya que existen otras dos razones para la colocación de estribos:

a) Por el procedimiento constructivo (facilidad en el habilitado).

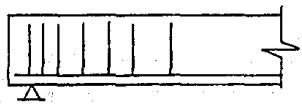
b) Por Reglamento, ya que especifica una cantidad mínima de acero transversal.

El refuerzo transversal mas común es, como ya se sabe, el formado por un conjunto de estribos, ya sean inclinados o verticales que por facilidad constructiva son los más usados, el reglamento actual también considera que se puede utilizar malla electrosoldada.

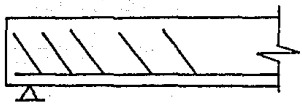
También se pueden utilizar como refuerzo transversal el refuerzo longitudinal, prolongandolo mas allá de donde deja de ser necesario por flexión y doblándolo de ma-

nera que atraviese la zona de tensiones diagonales mas significativas. Además hay que aclarar que para que sea efectivo este último procedimiento hay que anclar dichas barras longitudinales en la zona de compresión.

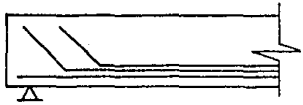
La siguiente figura representa el refuerzo transversal:



Estribos Verticales

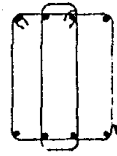


Estribos Inclinados



Refuerzo Longitudinal Doblado

Estribo de dos ramas



Estribo de cuatro ramas

La naturaleza relativamente compleja de una falla por cortante comparada con una falla dúctil a flexión determina la conveniencia de diseñar los elementos de manera que su resistencia a cortante sea igual o mayor que su resistencia a flexión.

Para asegurar una falla dúctil a flexión, el Reglamento contiene criterios de esta naturaleza así como restricciones que al cumplirse aseguran un diseño adecuado. La determinación de la cantidad de refuerzo por cortante se basa en una forma modificada de la analogía de la armadura, la cual establece que el refuerzo por cortante resiste la totalidad del cortante transversal. Numerosas investigaciones indican que se puede suponer que la resistencia a cortante proporcionada por el concreto es igual al cortante que produce el agrietamiento inclinado; por consiguiente, es posible diseñar el refuerzo por cortante en tal forma que soporte el exceso de cortante que no resiste el concreto.

Solamente será necesario considerar algunas secciones de control (críticas) a lo largo del elemento; la separación requerida del refuerzo por cortante en los puntos intermedios generalmente es evidente a partir de los valores calculados en los puntos de control.

Con el fin de evitar que el ancho de las grietas que aparecen como señal de un esfuerzo cortante alto sea excesivo, el reglamento indica que el acero transversal tenga un esfuerzo de fluencia máximo de 4,200 kg/cm^2..

Se debe tener en cuenta que, para que el refuerzo transversal sea realmente efectivo debe colocarse con separaciones tales que cualquier grieta inclinada potencial que pudiera formarse sea cruzada cuando menos por un estribo.

La ductilidad de la viga se incrementa al proporcionar confinamiento lateral al concreto sujeto a compresión. Además de lo anterior el refuerzo transversal realiza la importante función de mejorar la capacidad por adherencia del elemento.

Cuando la fuerza cortante Vu sobrepasa la resistencia del concreto es preciso suministrar refuerzo por cortante para soportar dicho esfuerzo de cortante.

El cortante se calcula con la ecuación que da el Reglamento, y que es la siguiente:

$$S = \frac{FR\ A_v\ f_y\ d\ (\operatorname{sen}\theta + \cos\theta)}{V_u - V_{CR}}$$

Donde:

s: separación en cm.

FR: factor de resistencia.

Av: area transversal de acero (cm^2).

fy: esfuerzo de fluencia del acero (kg/cm^2).

d: peralte efectivo de la sección encm.

θ: ángulo del refuerzo con respecto al eje de la pza.

Vu: fuerza cortante de diseño en kg.

Vcr: contribución del concreto en kg.

Si se utilizan estribos verticales $\Rightarrow \theta = 90°$

Si $\theta = 90° \Rightarrow S = \frac{F_R\ A_v\ f_y\ d}{V_u - V_{CR}} \Rightarrow V_u - V_{CR} = \frac{F_R\ A_v\ f_y\ d}{S}$

Por lo tanto queda finalmente:

$$V_U = \frac{F_R\ A_v\ f_y\ d}{S} + V_{CR}$$

Para calcular Vcr hay que saber que cantidad de acero axial (para tensión) existe, esto es:

Si $p < 0.01 \Rightarrow V_{CR} = F_R\, b d\, (0.2 + 30\, p) \sqrt{f^*_c}$

Si $p > 0.01 \Rightarrow V_{CR} = 0.5\, F_R\, b d \sqrt{f^*_c}$

Pero para completar el cálculo Hay que revisar que se cumplan las siguientes restricciones que marca el Reglamento, de tal forma que podrán restringir los valores ya calculados con las formulas o expresiones anteriores:

1) $V_U \leq 2\, F_R\, b d \sqrt{f^*_c}$

2) $V_{CR} < V_U \leq 1.5\, F_R\, b d \sqrt{f^*_c} \Rightarrow S \leq 0.5d$

3) $V_U > 1.5\, F_R\, b d \sqrt{f^*_c} \Rightarrow S \leq 0.25d$

4) $S \leq \dfrac{F_R\, A_V\, f_y}{3.5\, b}$

5) Si $h \geq 70$ cm $\Rightarrow V_{CR} = 0.70 V_{CR}$

6) Si $h/b > 6 \Rightarrow V_{CR} = 0.70 V_{CR}$

7) $L/h > 5 \Rightarrow$ si no se cumple se tratará de una viga Diafragma.

III. PROGRAMAS DE COMPUTADORA.

Las siguientes son de manera sucinta las principales razones por las que se realizaron los programas en lenguaje COBOL:

1. COBOL es un lenguaje fácil, claro y explícito, debido a su estructura, que consta principalmente de:

a) División de identificación.

b) División de ambiente (archivos, hardware, etc.).

c) División de datos.

d) División de procedimientos.

Esta estructura permite tener programas muy bien documentados.

2. COBOL permite dar mantenimiento al programa sin necesidad de reescribir el mismo desde en principio, lo cual no se da normalmente en otros lenguajes como FORTRAN, C, PASCAL O BASIC.

3. COBOL permite que los nombres de las variables y las rutinas sean largos y lógicos, ademas realiza el manejo vectorial de una forma más sencilla que la que ofrecen otros lenguajes. Por lo tanto los programas que se generan no resultan criptográficos, es decir de difícil interpretación.

4. Muchas versiones de COBOL, incluyendo la que se utilizó en los programas presentados, manejan funciones matemáticas de alto nivel (circulares, logarítmicas, etc).

5. COBOL permite un diseño de reportes que son agradables a la vista, lo cual facilita su comprensión para el usuario.

```
1          IDENTIFICATION DIVISION.
2          PROGRAM-ID.    TABLA_1.
3          AUTHOR.        PABLO ROMO MICHAUD.
4          INSTALLATION.  UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO.
5          DATE-WRITTEN.  23/JUN/87.
6          DATE-COMPILED. 23/JUN/87.
7          *REMARKS.
8          *          ************************************************
9          *          * REPORTE DE TABLA 1                          *
10         *          ************************************************
11         SECURITY. ESTE PROGRAMA ES PROPIEDAD DE LA UNAM.
12         ENVIRONMENT DIVISION.
13         CONFIGURATION SECTION.
14         SOURCE-COMPUTER.  MICRO-VAX.
15         OBJECT-COMPUTER.  MICRO-VAX.
16         INPUT-OUTPUT SECTION.
17         FILE-CONTROL.
18             SELECT REPORTE ASSIGN TO TABLA_1.
19         *
20         DATA DIVISION.
21         *
22         FILE SECTION.
23         FD  REPORTE
24             LABEL RECORD IS STANDARD
25             RECORD CONTAINS 80 CHARACTERS
26             DATA RECORD IS LINEA.
27          01  LINEA              PIC X(80).
28         *
29         WORKING-STORAGE SECTION.
30         *
31          01  VARIABLES.
32              05 CONTADOR-LINEAS  PIC 9(03) VALUE ZEROES.
33              05 CONTADOR-PAGINAS PIC 9(03) VALUE ZEROES.
34              05 LINEA-TEMPORAL   PIC X(80) VALUE SPACES.
35              05 RESPUESTA        PIC X(01) VALUE SPACES.
36              05 F-PRIMA-C        PIC 9(03) VALUE ZEROES.
37              05 RAIZ-F-PRIMA-C   PIC S9(10)V9(8) VALUE ZEROES.
38              05 F-Y              PIC 9(04) VALUE ZEROES.
39              05 B                PIC 9(03) VALUE ZEROES.
40              05 H                PIC 9(03) VALUE ZEROES.
41              05 P-MIN            PIC S9(10)V9(8) VALUE ZEROES.
42              05 F-ASTERISCO      PIC S9(10)V9(8) VALUE ZEROES.
43              05 F-BIPRIMA-C      PIC S9(10)V9(8) VALUE ZEROES.
44              05 F-R              PIC S9(10)V9(8) VALUE ZEROES.
45              05 P-MAX            PIC S9(10)V9(8) VALUE ZEROES.
46              05 R                PIC S9(10)V9(8) VALUE 5.
47              05 DELTA            PIC S9(10)V9(8) VALUE ZEROES.
48              05 RANGO            PIC S9(10)V9(8) VALUE ZEROES.
49              05 PORCENTAJE-ACERO PIC S9(10)V9(8) VALUE ZEROES.
50              05 D                PIC S9(10)V9(8) VALUE ZEROES.
51              05 M-R              PIC S9(10)V9(8) VALUE ZEROES.
52              05 F-R              PIC S9(10)V9(8) VALUE .9.
53              05 I                PIC 9(05) VALUE ZEROES.
54              05 J                PIC 9(05) VALUE 1.
55              05 K                PIC 9(05) VALUE ZEROES.
56         *
57          01  FORMATO.
```

```
                03 ENC-1.
                   05 FILLER                PIC X(36) VALUE SPACES.
                   05 FILLER                PIC X(09) VALUE
                'TABLA #1'.
                03 ENC-2.
                   05 FILLER                PIC X(15) VALUE SPACES.
                   05 FILLER                PIC X(50) VALUE
                'P (Porcentaje de acero) vs MR (Momento Resistente)'.
                03 ENC-3.
                   05 FILLER                PIC X(21) VALUE SPACES.
                   05 FILLER                PIC X(39) VALUE
                'Vigas Rectangulares Simplemente Armadas'.
                03 ENC-4.
                   05 FILLER                PIC X(37) VALUE SPACES.
                   05 FILLER                PIC X(06) VALUE 'DATOS:'.
                03 ENC-5.
                   05 FILLER                PIC X(20) VALUE SPACES.
                   05 FILLER                PIC X(10) VALUE
                'Materiales'.
                   05 FILLER                PIC X(18) VALUE SPACES.
                   05 FILLER                PIC X(07) VALUE
                'Seccion'.
                03 ENC-6.
                   05 FILLER                PIC X(16) VALUE SPACES.
                   05 FILLER                PIC X(06) VALUE
                'f'c = '.
                   05 ENC-F-PRIMA-C         PIC ZZZZ.
                   05 FILLER                PIC X(09) VALUE
                ' Kg/cm2'.
                   05 FILLER                PIC X(11) VALUE SPACES.
                   05 FILLER                PIC X(04) VALUE
                'b = '.
                   05 ENC-B                 PIC ZZZ.
                   05 FILLER                PIC X(03) VALUE
                ' cm'.
                03 ENC-7.
                   05 FILLER                PIC X(16) VALUE SPACES.
                   05 FILLER                PIC X(06) VALUE
                'fy  = '.
                   05 ENC-F-Y               PIC ZZZZ.
                   05 FILLER                PIC X(09) VALUE
                ' Kg/cm2'.
                   05 FILLER                PIC X(11) VALUE SPACES.
                   05 FILLER                PIC X(04) VALUE
                'h = '.
                   05 ENC-H                 PIC ZZZ.
                   05 FILLER                PIC X(03) VALUE
                ' cm'.
                   05 BLANCOS               PIC X(80) VALUE ALL ' '.
                   05 GUIONES               PIC X(80) VALUE ALL '-'.
                03 ENC-8.
                   05 FILLER                PIC X(80) VALUE
                '| Porcentaje |   Momento  || Porcentaje |   Momento  || Porc
            -   'entaje |   Momento |'.
                03 ENC-9.
                   05 FILLER                PIC X(80) VALUE
                '|    De      | Resistente ||    De      | Resistente ||    D
```

```
115       -    'e      | Resistente|'.
116            03 ENC-10.
117               05 FILLER          PIC X(80) VALUE
118               '|   Acero    | C Kg x m 3 ||   Acero    | C Kg x m 3 ||   Ac
119       -    'ero    | C Kg x m 3|'.
120       *
121            01  DETALLE.
122               02 RENGLONES OCCURS 30 TIMES.
123                  03 CAMPOS OCCURS 3 TIMES.
124                     05 PALITO-0             PIC X(01).
125                     05 PALITO-1             PIC X(02).
126                     05 DET-PORCENTAJE-ACERO PIC 9,99999.
127                     05 PALITO-2             PIC X(05).
128                     05 DET-M-R              PIC ZZ,ZZZ,99.
129                     05 PALITO-3             PIC X(03).
130       *
131            PROCEDURE DIVISION.
132       *
133            RUTINA-CONTROL.
134                OPEN OUTPUT REPORTE
135                PERFORM GENERA-TABLA UNTIL RESPUESTA EQUAL 'N'
136                CLOSE REPORTE
137                STOP RUN.
138       *
139       *
140       *
141            GENERA-TABLA.
142                PERFORM PREGUNTA
143                PERFORM CALCULA
144                PERFORM IMPRIME
145                DISPLAY 'QUIERES QUE GENERE OTRA TABLA S/N '
146                        WITH NO ADVANCING
147                ACCEPT RESPUESTA.
148
149            PREGUNTA.
150                DISPLAY 'DAME F PRIMA c ' WITH NO ADVANCING
151                ACCEPT F-PRIMA-C
152                DISPLAY 'DAME Fy         ' WITH NO ADVANCING
153              ' ACCEPT F-Y
154                DISPLAY 'DAME b          ' WITH NO ADVANCING
155                ACCEPT B
156                DISPLAY 'DAME h          ' WITH NO ADVANCING
157                ACCEPT H
158                MOVE F-PRIMA-C TO ENC-F-PRIMA-C
159                MOVE F-Y       TO ENC-F-Y
160                MOVE B         TO ENC-B
161                MOVE H         TO ENC-H
162                MOVE ZEROES TO I
163                                .K
164                MOVE 1 TO J.
165       *
166            CALCULA.
167                COMPUTE RAIZ-F-PRIMA-C ROUNDED = F-PRIMA-C  ** .5.
168                COMPUTE P-MIN ROUNDED = ( RAIZ-F-PRIMA-C * .7 ) / F-Y.
169                COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
170                IF F-ASTERISCO NOT GREATER 250
171                   COMPUTE F-BIPRIMA-C ROUNDED = ( F-ASTERISCO * 0.85 )
```

```
                ELSE
                   COMPUTE F-BIPRIMA-C ROUNDED =
                     (1.05 - ( F-ASTERISCO / 1250)) * F-PRIMA-C.
                COMPUTE P-B ROUNDED =
                     ( F-BIPRIMA-C / F-Y ) * (4800 / (F-Y + 6000)).
                COMPUTE P-MAX ROUNDED = F-B * 0.75.
                COMPUTE RANGO ROUNDED = P-MAX - P-MIN.
                COMPUTE DELTA ROUNDED = RANGO / 89
                MOVE P-MIN TO PORCENTAJE-ACERO
                PERFORM LLENA-TABLA VARYING I
                        FROM 1 BY 1
                           UNTIL I > 90.
           *
            LLENA-TABLA.
                IF I EQUAL 31
                   MOVE ZEROES TO K
                   MOVE 2 TO J
                ELSE
                   IF I EQUAL 61
                      MOVE ZEROES TO K
                      MOVE 3 TO J.
                ADD 1 TO K
                MOVE '!' TO PALITO-0 ( K , J )
                MOVE '  ' TO PALITO-1 ( K , J )
                MOVE '  ' TO PALITO-2 ( K  , J )
                MOVE '  ' TO PALITO-3 ( K , J )
                COMPUTE D ROUNDED = H - R
                COMPUTE D ROUNDED = D ** 2
                COMPUTE M-R ROUNDED = F-R * B * D * F-Y *
                   PORCENTAJE-ACERO * (1 - 0.5 * PORCENTAJE-ACERO *
                                       ( F-Y / F-BIPRIMA-C))
                COMPUTE M-R ROUNDED = M-R / 100
                MOVE PORCENTAJE-ACERO TO DET-PORCENTAJE-ACERO ( K , J )
                MOVE M-R TO DET-M-R ( K , J )
                ADD DELTA TO PORCENTAJE-ACERO.
           *
            IMPRIME.
                MOVE 99 TO CONTADOR-LINEAS
                MOVE GUIONES TO LINEA
                PERFORM ESCRIBE
                PERFORM VACIA-TABLA VARYING I FROM 1 BY 1
                        UNTIL I > 30
                MOVE GUIONES TO LINEA
                PERFORM ESCRIBE.
           *
            VACIA-TABLA.
                MOVE ' ! ' TO PALITO-3 ( I , 3 )
                MOVE RENGLONES ( I ) TO LINEA
                PERFORM ESCRIBE.
           *
            ESCRIBE.
                ADD 1 TO CONTADOR-LINEAS
                IF CONTADOR-LINEAS > 56
                   MOVE ZEROES                TO CONTADOR-LINEAS
                   ADD 1 TO CONTADOR-PAGINAS
                   MOVE LINEA TO LINEA-TEMPORAL
                   WRITE LINEA FROM ENC-1 AFTER PAGE
```

```
229                 WRITE LINEA FROM ENC-2 AFTER 3
230                 WRITE LINEA FROM ENC-3 AFTER 3
231                 WRITE LINEA FROM ENC-4 AFTER 5
232                 WRITE LINEA FROM ENC-5 AFTER 2
233                 WRITE LINEA FROM ENC-6 AFTER 2
234                 WRITE LINEA FROM ENC-7 AFTER 1
235                 WRITE LINEA FROM GUIONES AFTER 5
236                 WRITE LINEA FROM ENC-8 AFTER 1
237                 WRITE LINEA FROM ENC-9 AFTER 1
238                 WRITE LINEA FROM ENC-10 AFTER 1
239                 WRITE LINEA FROM GUIONES AFTER 1
240                 MOVE LINEA-TEMPORAL TO LINEA.
241               WRITE LINEA AFTER 1
242               MOVE SPACES TO LINEA
243                             LINEA-TEMPORAL.
244           *
245           ************************************************************************
246           * FIN DEL PROGRAMA QUE EMITE LA TABLA 1                                *
247           ************************************************************************
248           *
249           *
250           *
```

TABLA_1 25-Jul-1988 18:18:14
Cross Reference in Alphabetical Order 25-Jul-1988 11:07:11

REPORTE	18#	23#	134	136
RESPUESTA	35#	135	147#	
RUTINA-CONTROL	133#			
TABLA_1	2#			
VACIA-TABLA	217#	212		
VARIABLES	31#			

```
TABLA_1                                                  25-Jul-1988 18:18:14
Compilation Summary                                      25-Jul-1988 11:07:11

PROGRAM SECTIONS

    Name                                  Bytes   Attributes

  0 $CODE                                  3156     PIC   CON   REL   LCL    SHR    EXE
  1 $LOCAL                                 4252     PIC   CON   REL   LCL  NOSHR  NOEXE
  2 $PDATA                                 1332     PIC   CON   REL   LCL    SHR  NOEXE
  3 COB$NAMES_____2                          24     PIC   CON   REL   LCL    SHR  NOEXE
  4 COB$NAMES_____4                          16     PIC   CON   REL   LCL    SHR  NOEXE

DIAGNOSTICS

    Informational:      50 (suppressed by command qualifier)

COMMAND QUALIFIERS

    COBOL  TABLA_1.COB/ANSI/CROSS/COPY/LIST=TABLA_1.LIS

    /COPY_LIST  /NOMACHINE_CODE  /CROSS_REFERENCE=ALPHABETICAL
    /ANSI_FORMAT  /NOSEQUENCE_CHECK  /NOMAP
    /NOTRUNCATE  /NOAUDIT  /NOCONDITIONALS
    /CHECK=(NOPERFORM,NOBOUNDS)  /DEBUG=(NOSYMBOLS,TRACEBACK)
    /WARNINGS=(NOSTANDARD,OTHER,NOINFORMATION)
    /STANDARD=(NOSYNTAX,NOPDP11)  /NOFIPS

STATISTICS

    Run Time:           7.65 seconds
    Elapsed Time:       35.26 seconds
    Page Faults:        615
    Dynamic Memory:     467 pages
```

```
1         IDENTIFICATION DIVISION.
2         PROGRAM-ID.     TABLA_2.
3         AUTHOR.         PABLO ROMO MICHAUD.
4         INSTALLATION.   UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO.
5         DATE-WRITTEN.   23/JUN/87.
6         DATE-COMPILED.  23/JUN/87.
7        *REMARKS.
8        *          ************************************************************
9        *          * REPORTE DE TABLA 2                                       *
10       *          ************************************************************
11        SECURITY. ESTE PROGRAMA ES PROPIEDAD DE LA UNAM.
12        ENVIRONMENT DIVISION.
13        CONFIGURATION SECTION.
14        SOURCE-COMPUTER.  MICRO-VAX.
15        OBJECT-COMPUTER.  MICRO-VAX.
16        INPUT-OUTPUT SECTION.
17        FILE-CONTROL.
18            SELECT REPORTE ASSIGN TO TABLA_2.
19       *
20        DATA DIVISION.
21       *
22        FILE SECTION.
23        FD  REPORTE
24            LABEL RECORD IS STANDARD
25            RECORD CONTAINS 132 CHARACTERS
26            DATA RECORD IS LINEA.
27        01  LINEA              PIC X(132).
28       *
29        WORKING-STORAGE SECTION.
30       *
31        01  VARIABLES.
32            03 NUMEROS.
33               05 CONTADOR-LINEAS  PIC 9(03) VALUE ZEROES.
34               05 CONTADOR-PAGINAS PIC 9(03) VALUE ZEROES.
35               05 RESPUESTA        PIC X(01) VALUE SPACES.
36               05 F-PRIMA-C        PIC 9(03) VALUE ZEROES.
37               05 RAIZ-F-PRIMA-C   PIC S9(10)V9(08) VALUE ZEROES.
38               05 F-Y              PIC 9(04) VALUE ZEROES.
39               05 B                PIC 9(03) VALUE ZEROES.
40               05 H                PIC 9(03) VALUE ZEROES.
41               05 F-MIN            PIC S9(10)V9(08) VALUE ZEROES.
42               05 F-ASTERISCO      PIC S9(10)V9(08) VALUE ZEROES.
43               05 F-BIPRIMA-C      PIC S9(10)V9(08) VALUE ZEROES.
44               05 P-B              PIC S9(10)V9(08) VALUE ZEROES.
45               05 P-MAX            PIC S9(10)V9(08) VALUE ZEROES.
46               05 R                PIC S9(10)V9(08) VALUE 5.
47               05 PORCENTAJE-ACERO PIC S9(10)V9(08) VALUE ZEROES.
48               05 A-S-VARIADA      PIC S9(10)V9(08) VALUE ZEROES.
49               05 PORCENTAJE-TABLA-2 PIC S9(10)V9(08) VALUE ZEROES.
50               05 D                PIC S9(10)V9(08) VALUE ZEROES.
51               05 M-R              PIC S9(10)V9(02) VALUE ZEROES.
52               05 F-R              PIC S9(10)V9(08) VALUE .9.
53               05 I                PIC 9(05) VALUE ZEROES.
54               05 J                PIC 9(05) VALUE 1.
55               05 K                PIC 9(05) VALUE ZEROES.
56               05 L                PIC 9(05) VALUE ZEROES.
57            03 ALFANUMERICOS.
```

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                05 LINEA-TEMPORAL    PIC X(132) VALUE ZEROES.
      *
       01  FORMATO.
           03 ENC-1.
              05 FILLER              PIC X(61) VALUE SPACES.
              05 FILLER              PIC X(09) VALUE
           'TABLA #2'.
           03 ENC-2.
              05 FILLER              PIC X(42) VALUE SPACES.
              05 FILLER              PIC X(50) VALUE
           'As (Area de Acero) vs MR (Momento Resistente)'.
           03 ENC-3.
              05 FILLER              PIC X(47) VALUE SPACES.
              05 FILLER              PIC X(39) VALUE
           'Vigas Rectangulares Simplemente Armadas'.
           03 ENC-4.
              05 FILLER              PIC X(07) VALUE SPACES.
              05 FILLER              PIC X(36) VALUE 'DATOS:'.
           03 ENC-5.
              05 FILLER              PIC X(50) VALUE SPACES.
              05 FILLER              PIC X(10) VALUE
           'Materiales'.
              05 FILLER              PIC X(18) VALUE SPACES.
              05 FILLER              PIC X(07) VALUE
           'Seccion'.
           03 ENC-6.
              05 FILLER              PIC X(46) VALUE SPACES.
              05 FILLER              PIC X(06) VALUE
           'f'c = '.
              05 ENC-F-PRIMA-C       PIC ZZZZ.
              05 FILLER              PIC X(09) VALUE
           ' Ks/cm2'.
              05 FILLER              PIC X(11) VALUE SPACES.
              05 FILLER              PIC X(04) VALUE
           'b = '.
              05 ENC-B               PIC ZZZ.
              05 FILLER              PIC X(03) VALUE
           ' cm'.
           03 ENC-7.
              05 FILLER              PIC X(46) VALUE SPACES.
              05 FILLER              PIC X(06) VALUE
           'fy  = '.
              05 ENC-F-Y             PIC ZZZZ.
              05 FILLER              PIC X(09) VALUE
           ' Ks/cm2'.
              05 FILLER              PIC X(11) VALUE SPACES.
              05 FILLER              PIC X(04) VALUE
           'h = '.
              05 ENC-H               PIC ZZZ.
              05 FILLER              PIC X(03) VALUE
           ' cm'.
              05 BLANCOS             PIC X(132) VALUE ALL ' '.
              05 GUIONES             PIC X(129) VALUE ALL '-'.
           03 ENC-8.
              05 FILLER              PIC X(132) VALUE
           '| # Barras => |          1          ||          2
      -    ||          3          ||          4          ||
```

```
          -    '5          |'.
               03 ENC-9.
                  05 FILLER              PIC X(132) VALUE
               '| No. de      |     cm2    Ton.m     ||       cm2    Ton.m
          -    '  ||      cm2    Ton.m     ||      cm2     Ton.m    ||     cm2
          -    ' Ton.m     |'.
               03 ENC-10.
                  05 FILLER              PIC X(132) VALUE
               '| Designacion |     As        MR        ||      As       MR        |
          -    '|      As       MR       ||      As       MR      ||      As
          -    '    MR       |'.
               03 ENC-11.
                  05 FILLER              PIC X(132) VALUE
               '| # Barras => |          6               ||           7
          -    '  ||            8              ||             9          ||
          -    ' 10            |'.
          *
           01  VECTOR-1.
               03 RENGLON-1 OCCURS 8 TIMES.
                  05 DET-NUMERO-DESIGNACION-1   PIC 9(05)V99.
                  05 VALORES-A-S-MR-1 OCCURS 5 TIMES.
                     07 DET-A-S-VARIADA-1        PIC 9(09)V99.
                     07 DET-M-R-1                PIC 9(09)V99.
          *
           01  VECTOR-2.
               03 RENGLON-2 OCCURS 8 TIMES.
                  05 DET-NUMERO-DESIGNACION-2   PIC 9(05)V99.
                  05 VALORES-A-S-MR-2 OCCURS 5 TIMES.
                     07 DET-A-S-VARIADA-2        PIC 9(09)V99.
                     07 DET-M-R-2                PIC 9(09)V99.

          *
           01  DETALLE-1.
               03 FILLER                            PIC X(05) VALUE '|    '.
               03 DET-1-NUMERO-DESIGNACION-1          PIC ZZ.Z.
               03 FILLER                            PIC X(06) VALUE '     |'.
               03 FILLER                            PIC X(03) VALUE SPACES.
               03 DET-1-A-S-VARIADA-1-1                   PIC ZZ9.99.
               03 FILLER                            PIC X(03) VALUE SPACES.
               03 DET-1-M-R-1-1                       PIC ZZ9.99.
               03 FILLER                            PIC X(06) VALUE '   || '.
               03 DET-1-A-S-VARIADA-1-2                   PIC ZZ9.99.
               03 FILLER                            PIC X(05) VALUE SPACES.
               03 DET-1-M-R-1-2                       PIC ZZ9.99.
               03 FILLER                            PIC X(06) VALUE '   || '.
               03 DET-1-A-S-VARIADA-1-3                   PIC ZZ9.99.
               03 FILLER                            PIC X(05) VALUE SPACES.
               03 DET-1-M-R-1-3                       PIC ZZ9.99.
               03 FILLER                            PIC X(06) VALUE '   || '.
               03 DET-1-A-S-VARIADA-1-4                   PIC ZZ9.99.
               03 FILLER                            PIC X(05) VALUE SPACES.
               03 DET-1-M-R-1-4                       PIC ZZ9.99.
               03 FILLER                            PIC X(06) VALUE '   || '.
               03 DET-1-A-S-VARIADA-1-5                   PIC ZZ9.99.
               03 FILLER                            PIC X(05) VALUE SPACES.
               03 DET-1-M-R-1-5                       PIC ZZ9.99.
               03 FILLER                            PIC X(06) VALUE '   |  '.
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172         *
173          01  DETALLE-2.
174              03 FILLER                          PIC X(05) VALUE 'I    '.
175              03 DET-2-NUMERO-DESIGNACION-2        PIC ZZ.Z.
176              03 FILLER                          PIC X(06) VALUE '    I'.
177              03 FILLER                          PIC X(03) VALUE SPACES.
178              03 DET-2-A-S-VARIADA-2-1               PIC ZZ9.99.
179              03 FILLER                          PIC X(03) VALUE SPACES.
180              03 DET-2-M-R-2-1                     PIC ZZ9.99.
181              03 FILLER                          PIC X(06) VALUE '   II '.
182              03 DET-2-A-S-VARIADA-2-2               PIC ZZ9.99.
183              03 FILLER                          PIC X(05) VALUE SPACES.
184              03 DET-2-M-R-2-2                     PIC ZZ9.99.
185              03 FILLER                          PIC X(06) VALUE '   II '.
186              03 DET-2-A-S-VARIADA-2-3               PIC ZZ9.99.
187              03 FILLER                          PIC X(05) VALUE SPACES.
188              03 DET-2-M-R-2-3                     PIC ZZ9.99.
189              03 FILLER                          PIC X(06) VALUE '   II '.
190              03 DET-2-A-S-VARIADA-2-4               PIC ZZ9.99.
191              03 FILLER                          PIC X(05) VALUE SPACES.
192              03 DET-2-M-R-2-4                     PIC ZZ9.99.
193              03 FILLER                          PIC X(06) VALUE '   II '.
194              03 DET-2-A-S-VARIADA-2-5               PIC ZZ9.99.
195              03 FILLER                          PIC X(05) VALUE SPACES.
196              03 DET-2-M-R-2-5                     PIC ZZ9.99.
197              03 FILLER                          PIC X(06) VALUE '   I  '.
198         *
199          01  TABLA-A-S.
200              05 FILLER      PIC X(04) VALUE '0049'.
201              05 FILLER      PIC X(04) VALUE '0071'.
202              05 FILLER      PIC X(04) VALUE '0127'.
203              05 FILLER      PIC X(04) VALUE '0198'.
204              05 FILLER      PIC X(04) VALUE '0285'.
205              05 FILLER      PIC X(04) VALUE '0507'.
206              05 FILLER      PIC X(04) VALUE '0792'.
207              05 FILLER      PIC X(04) VALUE '1140'.
208         *
209          01  TABLA-A-S-R REDEFINES TABLA-A-S.
210              05 VALORES-A-S OCCURS 8 TIMES.
211                 07 A-S      PIC 9(02)V9(02).
212         *
213          PROCEDURE DIVISION.
214         *
215          RUTINA-CONTROL.
216              OPEN OUTPUT REPORTE
217              PERFORM GENERA-TABLA UNTIL RESPUESTA EQUAL 'N'
218              CLOSE REPORTE
219              STOP RUN.
220         *
221         *
222         *
223          GENERA-TABLA.
224              PERFORM PREGUNTA
225              PERFORM CALCULA VARYING L FROM 1 BY 1
226                      UNTIL L > 8
227              MOVE 99 TO CONTADOR-LINEAS
228              PERFORM IMPRIME-DETALLE-1 VARYING J FROM 1 BY 1 UNTIL J > 8
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229             WRITE LINEA FROM GUIONES AFTER 1
230             WRITE LINEA FROM GUIONES AFTER 5
231             WRITE LINEA FROM ENC-11 AFTER 1
232             WRITE LINEA FROM ENC-9 AFTER 1
233             WRITE LINEA FROM ENC-10 AFTER 1
234             WRITE LINEA FROM GUIONES AFTER 1
235             PERFORM IMPRIME-DETALLE-2 VARYING J FROM 1 BY 1 UNTIL J > 8
236             WRITE LINEA FROM GUIONES AFTER 1
237             DISPLAY '********** TABLA 2 ***************'
238             DISPLAY 'QUIERES QUE GENERE OTRA TABLA S/N '
239                     WITH NO ADVANCING
240             ACCEPT RESPUESTA.
241
242         PREGUNTA.
243             DISPLAY 'DAME F PRIMA c ' WITH NO ADVANCING
244             ACCEPT F-PRIMA-C
245             DISPLAY 'DAME Fy        ' WITH NO ADVANCING
246             ACCEPT F-Y
247             DISPLAY 'DAME b         ' WITH NO ADVANCING
248             ACCEPT B
249             DISPLAY 'DAME h         ' WITH NO ADVANCING
250             ACCEPT H
251             MOVE F-PRIMA-C TO ENC-F-PRIMA-C
252             MOVE F-Y       TO ENC-F-Y
253             MOVE B         TO ENC-B
254             MOVE H         TO ENC-H
255             MOVE ZEROES TO I.
256         *
257         CALCULA.
258             IF L EQUAL 1
259                MOVE 2.5 TO DET-NUMERO-DESIGNACION-1 ( L )
260                            DET-NUMERO-DESIGNACION-2 ( L )
261             ELSE
262                IF L EQUAL 2
263                   MOVE 3 TO DET-NUMERO-DESIGNACION-1 ( L )
264                             DET-NUMERO-DESIGNACION-2 ( L )
265                ELSE
266                   IF L EQUAL 3
267                      MOVE 4 TO DET-NUMERO-DESIGNACION-1 ( L )
268                                DET-NUMERO-DESIGNACION-2 ( L )
269                   ELSE
270                      IF L EQUAL 4
271                         MOVE 5 TO DET-NUMERO-DESIGNACION-1 ( L )
272                                   DET-NUMERO-DESIGNACION-2 ( L )
273                      ELSE
274                         IF L EQUAL 5
275                            MOVE 6 TO DET-NUMERO-DESIGNACION-1 ( L )
276                                      DET-NUMERO-DESIGNACION-2 ( L )
277                         ELSE
278                            IF L EQUAL 6
279                               MOVE 8 TO
280                               DET-NUMERO-DESIGNACION-1 ( L )
281                               DET-NUMERO-DESIGNACION-2 ( L )
282                            ELSE
283                               IF L EQUAL 7
284                                  MOVE 10 TO
285                                  DET-NUMERO-DESIGNACION-1 ( L )
```

```
                                    DET-NUMERO-DESIGNACION-2 ( L )
                                ELSE
                                    MOVE 12 TO
                                    DET-NUMERO-DESIGNACION-1 ( L )
                                    DET-NUMERO-DESIGNACION-2 ( L ).
           COMPUTE A-S-VARIADA ROUNDED =  A-S ( L ) * I
           MOVE ZEROES TO K
           COMPUTE D ROUNDED = H - R
           COMPUTE PORCENTAJE-TABLA-2 ROUNDED =
               A-S ( L ) / ( B * D )
           COMPUTE RAIZ-F-PRIMA-C ROUNDED = F-PRIMA-C  ** .5.
           COMPUTE P-MIN ROUNDED = ( RAIZ-F-PRIMA-C * .7 ) / F-Y.
           COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
           IF F-ASTERISCO NOT GREATER 250
              COMPUTE F-BIPRIMA-C ROUNDED = ( F-ASTERISCO * 0.85 )
           ELSE
              COMPUTE F-BIPRIMA-C ROUNDED =
                (1.05 - ( F-ASTERISCO / 1250)) * F-PRIMA-C.
           COMPUTE P-B ROUNDED =
               ( F-BIPRIMA-C / F-Y ) * (4800 / (F-Y + 6000)).
           COMPUTE P-MAX ROUNDED = P-B * 0.75.
           IF PORCENTAJE-TABLA-2 NOT GREATER P-MAX AND
              PORCENTAJE-TABLA-2 NOT LESS    P-MIN
              MOVE PORCENTAJE-TABLA-2 TO PORCENTAJE-ACERO
              COMPUTE D ROUNDED = D ** 2
              COMPUTE M-R ROUNDED = F-R * B * D * F-Y *
                  PORCENTAJE-ACERO * (1 - 0.5 * PORCENTAJE-ACERO *
                                     ( F-Y / F-BIPRIMA-C))
                  COMPUTE M-R ROUNDED = M-R / 100000
           ELSE
              MOVE ZEROES TO M-R.
           MOVE A-S-VARIADA TO DET-A-S-VARIADA-1 ( L , 1 )
           MOVE M-R TO DET-M-R-1 ( L , 1 )
           PERFORM DESPLIEGA VARYING I FROM 2 BY 1 UNTIL I > 10.
      *
       DESPLIEGA.
           COMPUTE D ROUNDED = H - R
           COMPUTE A-S-VARIADA ROUNDED =  A-S ( L ) * I
           COMPUTE PORCENTAJE-TABLA-2 ROUNDED =
              A-S-VARIADA / ( B * D )
           COMPUTE RAIZ-F-PRIMA-C ROUNDED = F-PRIMA-C  ** .5.
           COMPUTE P-MIN ROUNDED = ( RAIZ-F-PRIMA-C * .7 ) / F-Y.
           COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
           IF F-ASTERISCO NOT GREATER 250
              COMPUTE F-BIPRIMA-C ROUNDED = ( F-ASTERISCO * 0.85 )
           ELSE
              COMPUTE F-BIPRIMA-C ROUNDED =
                (1.05 - ( F-ASTERISCO / 1250)) * F-PRIMA-C.
           COMPUTE P-B ROUNDED =
               ( F-BIPRIMA-C / F-Y ) * (4800 / (F-Y + 6000)).
           COMPUTE P-MAX ROUNDED = P-B * 0.75.
           IF PORCENTAJE-TABLA-2 NOT GREATER P-MAX AND
              PORCENTAJE-TABLA-2 NOT LESS    P-MIN
              MOVE PORCENTAJE-TABLA-2 TO PORCENTAJE-ACERO
              COMPUTE D ROUNDED = D ** 2
              COMPUTE M-R ROUNDED = F-R * B * D * F-Y *
                  PORCENTAJE-ACERO * (1 - 0.5 * PORCENTAJE-ACERO *
```

```
                                ( F-Y / F-BIPRIMA-C))
                    COMPUTE M-R ROUNDED = M-R / 100000
            ELSE
                MOVE ZEROES TO M-R.
            IF I > 5
                ADD 1 TO K
                IF K = 1
                    MOVE A-S-VARIADA TO DET-A-S-VARIADA-2 ( L , K )
                    MOVE M-R         TO DET-M-R-2 ( L , K )
                ELSE
                    MOVE A-S-VARIADA TO DET-A-S-VARIADA-2 ( L , K )
                    MOVE M-R         TO DET-M-R-2 ( L , K )
            ELSE
                MOVE A-S-VARIADA TO DET-A-S-VARIADA-1 ( L , I )
                MOVE M-R         TO DET-M-R-1 ( L , I ).
      *
       IMPRIME-DETALLE-1.
           MOVE DET-NUMERO-DESIGNACION-1 ( J ) TO
                DET-1-NUMERO-DESIGNACION-1
           PERFORM MUEVE-VECTOR-1-A-DETALLE
           MOVE DETALLE-1 TO LINEA
           PERFORM ESCRIBE.
      *
       MUEVE-VECTOR-1-A-DETALLE.
           MOVE DET-A-S-VARIADA-1 ( J , 1 ) TO DET-1-A-S-VARIADA-1-1
           MOVE DET-M-R-1 ( J , 1 )         TO DET-1-M-R-1-1
           MOVE DET-A-S-VARIADA-1 ( J , 2 ) TO DET-1-A-S-VARIADA-1-2
           MOVE DET-M-R-1 ( J , 2 )         TO DET-1-M-R-1-2
           MOVE DET-A-S-VARIADA-1 ( J , 3 ) TO DET-1-A-S-VARIADA-1-3
           MOVE DET-M-R-1 ( J , 3 )         TO DET-1-M-R-1-3
           MOVE DET-A-S-VARIADA-1 ( J , 4 ) TO DET-1-A-S-VARIADA-1-4
           MOVE DET-M-R-1 ( J , 4 )         TO DET-1-M-R-1-4
           MOVE DET-A-S-VARIADA-1 ( J , 5 ) TO DET-1-A-S-VARIADA-1-5
           MOVE DET-M-R-1 ( J , 5 )         TO DET-1-M-R-1-5.
      *
       IMPRIME-DETALLE-2.
           MOVE DET-NUMERO-DESIGNACION-2 ( J ) TO
                DET-2-NUMERO-DESIGNACION-2
           PERFORM MUEVE-VECTOR-2-A-DETALLE
           MOVE DETALLE-2 TO LINEA
           PERFORM ESCRIBE.
      *
       MUEVE-VECTOR-2-A-DETALLE.
           MOVE DET-A-S-VARIADA-2 ( J , 1 ) TO DET-2-A-S-VARIADA-2-1
           MOVE DET-M-R-2 ( J, 1 )          TO DET-2-M-R-2-1
           MOVE DET-A-S-VARIADA-2 ( J , 2 ) TO DET-2-A-S-VARIADA-2-2
           MOVE DET-M-R-2 ( J , 2 )         TO DET-2-M-R-2-2
           MOVE DET-A-S-VARIADA-2 ( J , 3 ) TO DET-2-A-S-VARIADA-2-3
           MOVE DET-M-R-2 ( J , 3 )         TO DET-2-M-R-2-3
           MOVE DET-A-S-VARIADA-2 ( J , 4 ) TO DET-2-A-S-VARIADA-2-4
           MOVE DET-M-R-2 ( J , 4 )         TO DET-2-M-R-2-4
           MOVE DET-A-S-VARIADA-2 ( J , 5 ) TO DET-2-A-S-VARIADA-2-5
           MOVE DET-M-R-2 ( J , 5 )         TO DET-2-M-R-2-5.
      *
       ESCRIBE.
           ADD 1 TO CONTADOR-LINEAS
           IF CONTADOR-LINEAS > 56
```

```
400                 MOVE ZEROES                 TO CONTADOR-LINEAS
401                 ADD 1 TO CONTADOR-PAGINAS
402                 MOVE LINEA TO LINEA-TEMPORAL
403                 WRITE LINEA FROM ENC-1 AFTER PAGE
404                 WRITE LINEA FROM ENC-2 AFTER 3
405                 WRITE LINEA FROM ENC-3 AFTER 3
406                 WRITE LINEA FROM ENC-4 AFTER 5
407                 WRITE LINEA FROM ENC-5 AFTER 2
408                 WRITE LINEA FROM ENC-6 AFTER 2
409                 WRITE LINEA FROM ENC-7 AFTER 1
410                 WRITE LINEA FROM GUIONES AFTER 5
411                 WRITE LINEA FROM ENC-8 AFTER 1
412                 WRITE LINEA FROM ENC-9 AFTER 1
413                 WRITE LINEA FROM ENC-10 AFTER 1
414                 WRITE LINEA FROM GUIONES AFTER 1
415                 MOVE LINEA-TEMPORAL TO LINEA.
416               WRITE LINEA AFTER 1
417               MOVE SPACES TO LINEA
418                           LINEA-TEMPORAL.
419           *
420           ***************************************************************
421           * FIN DEL PROGRAMA QUE EMITE LA TABLA 2                       *
422           ***************************************************************
423           *
424           *
425           *
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TABLA_2                                                  25-Jul-1988 18:21:14
Compilation Summary                                      25-Jul-1988 11:07:15

PROGRAM SECTIONS

    Name                          Bytes   Attributes

  0 $CODE                          6717     PIC   CON   REL   LCL    SHR    EXE
  1 $LOCAL                         4668     PIC   CON   REL   LCL NOSHR NOEXE
  2 $PDATA                         1543     PIC   CON   REL   LCL    SHR NOEXE
  3 COB$NAMES_____2                  24     PIC   CON   REL   LCL    SHR NOEXE
  4 COB$NAMES_____4                  16     PIC   CON   REL   LCL    SHR NOEXE


DIAGNOSTICS

    Informational:       108 (suppressed by command qualifier)


COMMAND QUALIFIERS

    COBOL  TABLA_2.COB/ANSI/CROSS/COPY/LIST=TABLA_2.LIS

    /COPY_LIST  /NOMACHINE_CODE  /CROSS_REFERENCE=ALPHABETICAL
    /ANSI_FORMAT  /NOSEQUENCE_CHECK  /NOMAP
    /NOTRUNCATE  /NOAUDIT  /NOCONDITIONALS
    /CHECK=(NOPERFORM,NOBOUNDS)  /DEBUG=(NOSYMBOLS,TRACEBACK)
    /WARNINGS=(NOSTANDARD,OTHER,NOINFORMATION)
    /STANDARD=(NOSYNTAX,NOPDP11)  /NOFIPS


STATISTICS

    Run Time:            14.39 seconds
    Elapsed Time:        164.00 seconds
    Page Faults:         634
    Dynamic Memory:      519 pages
```

```
      IDENTIFICATION DIVISION.
      PROGRAM-ID.    TABLA_3_A.
      AUTHOR.        PABLO ROMO MICHAUD.
      INSTALLATION.  UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO.
      DATE-WRITTEN.  16/AGO/87.
      DATE-COMPILED. 16/AGO/87.
     *REMARKS.
     *         ************************************************
     *         * REPORTE DE TABLA 3 A                        *
     *         ************************************************
      SECURITY. ESTE PROGRAMA ES PROPIEDAD DE LA UNAM.
      ENVIRONMENT DIVISION.
      CONFIGURATION SECTION.
      SOURCE-COMPUTER.  MICRO-VAX.
      OBJECT-COMPUTER.  MICRO-VAX.
      INPUT-OUTPUT SECTION.
      FILE-CONTROL.
          SELECT REPORTE ASSIGN TO TABLA_3A.
     *
      DATA DIVISION.
     *
      FILE SECTION.
      FD  REPORTE
          LABEL RECORD IS STANDARD
          RECORD CONTAINS 132 CHARACTERS
          DATA RECORD IS LINEA.
      01  LINEA              PIC X(132).
     *
      WORKING-STORAGE SECTION.
     *
      01  VARIABLES.
          03 NUMEROS.
             05 CONTADOR-LINEAS  PIC 9(03) VALUE ZEROES.
             05 CONTADOR-PAGINAS PIC 9(03) VALUE ZEROES.
             05 RESPUESTA        PIC X(01) VALUE SPACES.
             05 F-PRIMA-C        PIC 9(03) VALUE ZEROES.
             05 RAIZ-F-ASTERISCO PIC S9(10)V9(08) VALUE ZEROES.
             05 V-C-R            PIC S9(10)V9(08) VALUE ZEROES.
             05 VU-MAX           PIC S9(10)V9(08) VALUE ZEROES.
             05 VU-MIN           PIC S9(10)V9(08) VALUE ZEROES.
             05 VU               PIC S9(10)V9(08) VALUE ZEROES.
             05 SEPARACION-LIMITE-1 PIC S9(10)V9(08) VALUE ZEROES.
             05 SEPARACION-LIMITE-2 PIC S9(10)V9(08) VALUE ZEROES.
             05 VU-LIMITE-1      PIC S9(10)V9(08) VALUE ZEROES.
             05 VU-LIMITE-2      PIC S9(10)V9(08) VALUE ZEROES.
             05 F-Y              PIC S9(10)V9(08) VALUE ZEROES.
             05 B                PIC 9(03) VALUE ZEROES.
             05 H                PIC 9(03) VALUE ZEROES.
             05 F-ASTERISCO      PIC S9(10)V9(08) VALUE ZEROES.
             05 R                PIC S9(10)V9(08) VALUE 5.
             05 D                PIC S9(10)V9(08) VALUE ZEROES.
             05 F-R              PIC S9(10)V9(08) VALUE .3.
             05 SEPARACION       PIC S9(10)V9(08) VALUE ZEROES.
             05 I                PIC 9(05) VALUE ZEROES.
             05 J                PIC 9(05) VALUE 1.
             05 K                PIC 9(05) VALUE ZEROES.
             05 L                PIC 9(05) VALUE ZEROES.
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                03 ALFANUMERICOS.
                   05 LINEA-TEMPORAL   PIC X(132) VALUE SPACES.
      *
           01   FORMATO.
                03 ENC-1.
                   05 FILLER           PIC X(60) VALUE SPACES.
                   05 FILLER           PIC X(10) VALUE
                'TABLA 03.A'.
                   05 FILLER           PIC X(25) VALUE SPACES.
                03 ENC-2.
                   05 FILLER           PIC X(36) VALUE SPACES.
                   05 FILLER           PIC X(61) VALUE
                'S (Separacion de Estribos) vs VR (Cortante resistente total
           -    ')'.
                03 ENC-RESTRICCIONES.
                   05 FILLER           PIC X(01) VALUE
                   '|'.
                   05 FILLER           PIC X(54) VALUE SPACES.
                   05 FILLER           PIC X(13) VALUE
                'RESTRICCIONES'.
                   05 FILLER           PIC X(60) VALUE SPACES.
                   05 FILLER           PIC X(01) VALUE
                   '|'.
                03 ENC-RESTRICCION-1.
                   05 FILLER           PIC X(48) VALUE
                '|       Estribos       |      Separacion      |'.
                   05 FILLER           PIC X(80) VALUE SPACES.
                   05 FILLER           PIC X(01) VALUE '|'.
                03 ENC-RESTRICCION-2.
                   05 FILLER           PIC X(130) VALUE
                '|        No. de        |        Maxima        |
           -    'Valores de          Vu ( Limite max )            S ( Maxima
           -    ')       |'.
                03 ENC-RESTRICCION-3.
                   05 FILLER           PIC X(48) VALUE
                '|    Designacion      |       [ cm ]         |'.
                   05 FILLER           PIC X(80) VALUE SPACES.
                   05 FILLER           PIC X(01) VALUE '|'.
      *
                03 ENC-3.
                   05 FILLER           PIC X(47) VALUE SPACES.
                   05 FILLER           PIC X(39) VALUE
                'Vigas Rectangulares Simplemente Armadas'.
                03 ENC-4.
                   05 FILLER           PIC X(15) VALUE SPACES.
                   05 FILLER           PIC X(06) VALUE 'DATOS:'.
                   05 FILLER           PIC X(15) VALUE SPACES.
                   05 FILLER           PIC X(06) VALUE
                'f'c = '.
                   05 ENC-F-PRIMA-C    PIC Z29 VALUE ZEROES.
                   05 FILLER           PIC X(07) VALUE
                ' kg/cm2'.
                   05 FILLER           PIC X(18) VALUE SPACES.
                   05 FILLER           PIC X(09) VALUE
                'Seccion: '.
                   05 FILLER           PIC X(04) VALUE
                'b = '.
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               05 ENC-B              PIC ZZ9.
               05 FILLER             PIC X(08) VALUE
            ' cm  x  '.
               05 FILLER             PIC X(04) VALUE
            'h = '.
               05 ENC-H              PIC ZZ9.
               05 FILLER             PIC X(03) VALUE
            ' cm'.
            03 ENC-6.
               05 FILLER             PIC X(49) VALUE SPACES.
               05 FILLER             PIC X(22) VALUE
            '*** Para P >= 0.01 ***'.
            03 BLANCOS            PIC X(132) VALUE ALL ' '.
            03 GUIONES            PIC X(129) VALUE ALL '-'.
            03 ENC-8.
               05 FILLER             PIC X(130) VALUE
            '|  Estribos    |                          ||
       -    '||                   ||                          ||
       -    '              |'.
            03 ENC-9.
               05 FILLER             PIC X(130) VALUE
            '| No. de       |        S          Vu     ||       S         Vu
       -    ' ||         S          Vu     ||        S          Vu     ||        S
       -    '         Vu     |'.
            03 ENC-10.
               05 FILLER             PIC X(130) VALUE
            '| Designacion |    [ cm ]     [ Ton ] ||     [ cm ]    [ Ton ]
       -    ' ||      [ cm ]  [ Ton ] ||      [ cm ]  [ Ton ] ||    [ cm ]
       -    '     [ Ton ] |'.
      *
        01  VECTOR-1.
            03 RENGLON-1 OCCURS 5 TIMES.
               05 DET-NUMERO-DESIGNACION-1   PIC 9(05)V99.
               05 VALORES-S-VU OCCURS 5 TIMES.
                  07 V-SEPARACION-1             PIC 9(09)V99.
                  07 V-VU-1                     PIC 9(09)V99.
      *
        01  VECTOR-2.
            03 RENGLON-2 OCCURS 5 TIMES.
               05 DET-NUMERO-DESIGNACION-2   PIC 9(05)V99.
               05 VALORES-S-VU OCCURS 5 TIMES.
                  07 V-SEPARACION-2             PIC 9(09)V99.
                  07 V-VU-2                     PIC 9(09)V99.
      *
        01  VECTOR-3.
            03 RENGLON-3 OCCURS 10 TIMES.
               05 SEPARACION-MAXIMA             PIC 9(09)V99.
      *
        01  DETALLE-RESTRICCIONES.
            03 FILLER                           PIC X(10) VALUE
            '|         '.
            03 DET-R-NUMERO-DESIGNACION-1       PIC ZZ.Z.
            03 FILLER                           PIC X(10) VALUE
            '         |'.
            03 FILLER                           PIC X(08) VALUE SPACES.
            03 DET-SEPARACION-MAXIMA            PIC ZZ9.99.
            03 FILLER                           PIC X(09) VALUE
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172             '      |'.
173           03 DET-2AS-RESTRICCIONES.
174              05 FILLER                        PIC X(04) VALUE SPACES.
175              05 FORMULA-RESTRICCION-1          PIC X(37) VALUE SPACES.
176              05 DET-VU                        PIC ZZ9.99.
177              05 TONELADAS                     PIC X(04) VALUE
178           ' Ton'.
179              05 FILLER                        PIC X(04) VALUE SPACES.
180              05 FORMULA-RESTRICCION-2          PIC X(14) VALUE SPACES.
181              05 DET-SEPARACION-LIMITE         PIC ZZ9.99.
182              05 CENTIMETROS                   PIC X(03) VALUE
183           ' cm'.
184           03 FILLER                          PIC X(04) VALUE
185           '   |'.
186       *
187        01  DETALLE-1.
188           03 FILLER                          PIC X(05) VALUE '|    '.
189           03 DET-1-NUMERO-DESIGNACION-1      PIC ZZ.Z.
190           03 FILLER                          PIC X(06) VALUE '     |'.
191           03 FILLER                          PIC X(03) VALUE SPACES.
192           03 DET-1-SEPARACION-1-1            PIC ZZ9.99.
193           03 FILLER                          PIC X(03) VALUE SPACES.
194           03 DET-1-VU-1-1                    PIC ZZ9.99.
195           03 FILLER                          PIC X(06) VALUE '   || '.
196           03 DET-1-SEPARACION-1-2            PIC ZZ9.99.
197           03 FILLER                          PIC X(05) VALUE SPACES.
198           03 DET-1-VU-1-2                    PIC ZZ9.99.
199           03 FILLER                          PIC X(06) VALUE '   || '.
200           03 DET-1-SEPARACION-1-3            PIC ZZ9.99.
201           03 FILLER                          PIC X(05) VALUE SPACES.
202           03 DET-1-VU-1-3                    PIC ZZ9.99.
203           03 FILLER                          PIC X(06) VALUE '   || '.
204           03 DET-1-SEPARACION-1-4            PIC ZZ9.99.
205           03 FILLER                          PIC X(05) VALUE SPACES.
206           03 DET-1-VU-1-4                    PIC ZZ9.99.
207           03 FILLER                          PIC X(06) VALUE '   || '.
208           03 DET-1-SEPARACION-1-5            PIC ZZ9.99.
209           03 FILLER                          PIC X(05) VALUE SPACES.
210           03 DET-1-VU-1-5                    PIC ZZ9.99.
211           03 FILLER                          PIC X(06) VALUE '   | '.
212       *
213        01  DETALLE-2.
214           03 FILLER                          PIC X(05) VALUE '|    '.
215           03 DET-2-NUMERO-DESIGNACION-2      PIC ZZ.Z.
216           03 FILLER                          PIC X(06) VALUE '     |'.
217           03 FILLER                          PIC X(03) VALUE SPACES.
218           03 DET-2-SEPARACION-2-1            PIC ZZ9.99.
219           03 FILLER                          PIC X(03) VALUE SPACES.
220           03 DET-2-VU-2-1                    PIC ZZ9.99.
221           03 FILLER                          PIC X(06) VALUE '   || '.
222           03 DET-2-SEPARACION-2-2            PIC ZZ9.99.
223           03 FILLER                          PIC X(05) VALUE SPACES.
224           03 DET-2-VU-2-2                    PIC ZZ9.99.
225           03 FILLER                          PIC X(06) VALUE '   || '.
226           03 DET-2-SEPARACION-2-3            PIC ZZ9.99.
227           03 FILLER                          PIC X(05) VALUE SPACES.
228           03 DET-2-VU-2-3                    PIC ZZ9.99.
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229             03 FILLER                              PIC X(06) VALUE '   || '.
230             03 DET-2-SEPARACION-2-4                 PIC ZZ9.99.
231             03 FILLER                              PIC X(05) VALUE SPACES.
232             03 DET-2-VU-2-4                        PIC ZZ9.99.
233             03 FILLER                              PIC X(06) VALUE '   || '.
234             03 DET-2-SEPARACION-2-5                 PIC ZZ9.99 VALUE ZEROES.
235             03 FILLER                              PIC X(05) VALUE SPACES.
236             03 DET-2-VU-2-5                        PIC ZZ9.99 VALUE ZEROES.
237             03 FILLER                              PIC X(06) VALUE '   | '.
238         *
239          01  TABLA-A-V.
240             05 FILLER      PIC X(05) VALUE '00320'.
241             05 FILLER      PIC X(05) VALUE '00490'.
242             05 FILLER      PIC X(05) VALUE '00710'.
243             05 FILLER      PIC X(05) VALUE '01270'.
244             05 FILLER      PIC X(05) VALUE '02850'.
245         *
246          01  TABLA-A-V-R REDEFINES TABLA-A-V.
247             05 VALORES-A-V OCCURS 5 TIMES.
248                07 A-V      PIC 9(02)V9(03).
249         *
250          PROCEDURE DIVISION.
251         *
252          RUTINA-CONTROL.
253              OPEN OUTPUT REPORTE
254              PERFORM GENERA-TABLA UNTIL RESPUESTA EQUAL 'N'
255              CLOSE REPORTE
256              STOP RUN.
257         *
258         *
259         *
260          GENERA-TABLA.
261              PERFORM PREGUNTA
262              PERFORM INICIALIZA VARYING L FROM 1 BY 1
263                      UNTIL L > 5
264              MOVE ZEROES TO I J K L
265              PERFORM CALCULA VARYING L FROM 1 BY 1
266                      UNTIL L > 5
267              MOVE 99 TO CONTADOR-LINEAS
268              PERFORM IMPRIME-DETALLE-1 VARYING J FROM 1 BY 1 UNTIL J > 5
269              WRITE LINEA FROM GUIONES AFTER 1
270              WRITE LINEA FROM GUIONES AFTER 3
271              WRITE LINEA FROM ENC-8 AFTER 1
272              WRITE LINEA FROM ENC-9 AFTER 1
273              WRITE LINEA FROM ENC-10 AFTER 1
274              WRITE LINEA FROM GUIONES AFTER 1
275              PERFORM IMPRIME-DETALLE-2 VARYING J FROM 1 BY 1 UNTIL J > 5
276              WRITE LINEA FROM GUIONES AFTER 1
277              DISPLAY '********** TABLA 3 ***************'
278              DISPLAY 'QUIERES QUE GENERE OTRA TABLA S/N '
279                      WITH NO ADVANCING
280              ACCEPT RESPUESTA.
281         *
282          PREGUNTA.
283              DISPLAY 'DAME F PRIMA c ' WITH NO ADVANCING
284              ACCEPT F-PRIMA-C
285              DISPLAY 'DAME b          ' WITH NO ADVANCING
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286             ACCEPT B
287             DISPLAY 'DAME h              ' WITH NO ADVANCING
288             ACCEPT H
289             MOVE F-PRIMA-C TO ENC-F-PRIMA-C
290             MOVE B         TO ENC-B
291             MOVE H         TO ENC-H.
292          *
293           CALCULA.
294               IF L EQUAL 1
295                  MOVE 2 TO DET-NUMERO-DESIGNACION-1 ( L )
296                            DET-NUMERO-DESIGNACION-2 ( L )
297               ELSE
298                  IF L EQUAL 2
299                     MOVE 2.5 TO DET-NUMERO-DESIGNACION-1 ( L )
300                                 DET-NUMERO-DESIGNACION-2 ( L )
301                  ELSE
302                     IF L EQUAL 3
303                        MOVE 3 TO DET-NUMERO-DESIGNACION-1 ( L )
304                                  DET-NUMERO-DESIGNACION-2 ( L )
305                     ELSE
306                        IF L EQUAL 4
307                           MOVE 4 TO DET-NUMERO-DESIGNACION-1 ( L )
308                                     DET-NUMERO-DESIGNACION-2 ( L )
309                        ELSE
310                           IF L EQUAL 5
311                              MOVE 6 TO DET-NUMERO-DESIGNACION-1 ( L )
312                                        DET-NUMERO-DESIGNACION-2 ( L ).
313               IF DET-NUMERO-DESIGNACION-1 ( L ) = 2
314                  MOVE 2530 TO F-Y
315               ELSE
316                  MOVE 4200 TO F-Y.
317               COMPUTE D ROUNDED = H - R
318               COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
319               COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
320               COMPUTE VU-LIMITE-1 = 1.5 * F-R * B * D * RAIZ-F-ASTERISCO /
321                       1000
322               COMPUTE VU-LIMITE-2 = 2.0 * F-R * B * D * RAIZ-F-ASTERISCO /
323                       1000
324               COMPUTE SEPARACION-LIMITE-1 = D / 2
325               COMPUTE SEPARACION-LIMITE-2 = D / 4
326               COMPUTE SEPARACION-MAXIMA ( L ) = ( F-R * A-V ( L ) * F-Y ) /
327                                                 ( 3.5 * B )
328               MOVE ZEROES TO K
329               PERFORM PROCESO-CALCULO VARYING I FROM 1 BY 1 UNTIL I > 9.
330          *
331           PROCESO-CALCULO.
332               COMPUTE SEPARACION = I * 5
333               COMPUTE D ROUNDED = H - R
334               COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
335               COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
336               COMPUTE V-C-R = 0.5 * F-R * B * D * RAIZ-F-ASTERISCO
337               IF H NOT LESS 70
338                  COMPUTE V-C-R = 0.7 * V-C-R.
339               MOVE V-C-R TO VU-MIN
340               COMPUTE VU-MAX = 2.0 * F-R * B * D * RAIZ-F-ASTERISCO
341               COMPUTE VU = ( ( 2 * F-R * A-V ( L ) * F-Y * D ) /
342                              SEPARACION ) + VU-MIN
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343             IF I NOT GREATER 5
344                MOVE SEPARACION TO V-SEPARACION-1 ( L , I )
345                COMPUTE VU = VU / 1000
346                MOVE VU TO V-VU-1 ( L , I )
347             ELSE
348                ADD 1 TO K
349                MOVE SEPARACION TO V-SEPARACION-2 ( L , K )
350                COMPUTE VU = VU / 1000
351                MOVE VU TO V-VU-2 ( L , K ).
352          *
353           IMPRIME-DETALLE-RESTRICCIONES.
354               IF I = 2
355                  MOVE 'Vu <= 1.5 * FR * b * d * raiz f'c = ' TO
356                       FORMULA-RESTRICCION-1
357                  MOVE ' S = d / 2 = ' TO FORMULA-RESTRICCION-2
358                  MOVE VU-LIMITE-1 TO DET-VU
359                  MOVE SEPARACION-LIMITE-1 TO DET-SEPARACION-LIMITE
360                  MOVE ' Ton' TO TONELADAS
361                  MOVE ' cm' TO CENTIMETROS
362               ELSE
363                  IF I = 4
364                     MOVE 'Vu <= 2.0 * FR * b * d * raiz f'c = ' TO
365                          FORMULA-RESTRICCION-1
366                     MOVE ' S = d / 4 = ' TO FORMULA-RESTRICCION-2
367                     MOVE VU-LIMITE-2 TO DET-VU
368                     MOVE SEPARACION-LIMITE-2 TO DET-SEPARACION-LIMITE
369                     MOVE ' Ton' TO TONELADAS
370                     MOVE ' cm' TO CENTIMETROS
371               ELSE
372                  MOVE SPACES TO DET-2AS-RESTRICCIONES.
373               MOVE DET-NUMERO-DESIGNACION-1 ( I ) TO
374                    DET-R-NUMERO-DESIGNACION-1
375               MOVE SEPARACION-MAXIMA ( I ) TO DET-SEPARACION-MAXIMA
376               MOVE DETALLE-RESTRICCIONES TO LINEA
377               WRITE LINEA AFTER 1.
378          *
379           IMPRIME-DETALLE-1.
380               MOVE DET-NUMERO-DESIGNACION-1 ( J ) TO
381                    DET-1-NUMERO-DESIGNACION-1
382               PERFORM MUEVE-VECTOR-1-A-DETALLE
383               MOVE DETALLE-1 TO LINEA
384               PERFORM ESCRIBE.
385          *
386           MUEVE-VECTOR-1-A-DETALLE.
387               MOVE V-SEPARACION-1 ( J , 1 ) TO DET-1-SEPARACION-1-1
388               MOVE V-VU-1 ( J , 1 )         TO DET-1-VU-1-1
389               MOVE V-SEPARACION-1 ( J , 2 ) TO DET-1-SEPARACION-1-2
390               MOVE V-VU-1 ( J , 2 )         TO DET-1-VU-1-2
391               MOVE V-SEPARACION-1 ( J , 3 ) TO DET-1-SEPARACION-1-3
392               MOVE V-VU-1 ( J , 3 )         TO DET-1-VU-1-3
393               MOVE V-SEPARACION-1 ( J , 4 ) TO DET-1-SEPARACION-1-4
394               MOVE V-VU-1 ( J , 4 )         TO DET-1-VU-1-4
395               MOVE V-SEPARACION-1 ( J , 5 ) TO DET-1-SEPARACION-1-5
396               MOVE V-VU-1 ( J , 5 )         TO DET-1-VU-1-5.
397          *
398           IMPRIME-DETALLE-2.
399               MOVE DET-NUMERO-DESIGNACION-2 ( J ) TO
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400                 DET-2-NUMERO-DESIGNACION-2
401             PERFORM MUEVE-VECTOR-2-A-DETALLE
402             MOVE DETALLE-2 TO LINEA
403             PERFORM ESCRIBE.
404         *
405          MUEVE-VECTOR-2-A-DETALLE.
406             MOVE V-SEPARACION-2 ( J , 1 ) TO DET-2-SEPARACION-2-1
407             MOVE V-VU-2 ( J, 1 )          TO DET-2-VU-2-1
408             MOVE V-SEPARACION-2 ( J , 2 ) TO DET-2-SEPARACION-2-2
409             MOVE V-VU-2 ( J , 2 )         TO DET-2-VU-2-2
410             MOVE V-SEPARACION-2 ( J , 3 ) TO DET-2-SEPARACION-2-3
411             MOVE V-VU-2 ( J , 3 )         TO DET-2-VU-2-3
412             MOVE V-SEPARACION-2 ( J , 4 ) TO DET-2-SEPARACION-2-4
413             MOVE V-VU-2 ( J , 4 )         TO DET-2-VU-2-4
414             MOVE V-SEPARACION-2 ( J , 5 ) TO DET-2-SEPARACION-2-5
415             MOVE V-VU-2 ( J , 5 )         TO DET-2-VU-2-5.
416         *
417          INICIALIZA.
418             ADD 1 TO I
419             MOVE ZEROES TO DET-NUMERO-DESIGNACION-1 ( L )
420             MOVE ZEROES TO DET-NUMERO-DESIGNACION-2 ( L )
421             PERFORM VARIA VARYING I FROM 1 BY 1 UNTIL I > 5.
422         *
423          VARIA.
424             MOVE ZEROES TO V-SEPARACION-1 ( L , I )
425                            V-VU-1         ( L , I )
426                            V-SEPARACION-2 ( L , I )
427                            V-VU-2         ( L , I ).
428         *
429          ESCRIBE.
430             ADD 1 TO CONTADOR-LINEAS
431             IF CONTADOR-LINEAS > 56
432                MOVE ZEROES                 TO CONTADOR-LINEAS
433                ADD 1 TO CONTADOR-PAGINAS
434                MOVE LINEA TO LINEA-TEMPORAL
435                WRITE LINEA FROM ENC-1 AFTER PAGE
436                WRITE LINEA FROM ENC-2 AFTER 3
437                WRITE LINEA FROM ENC-3 AFTER 3
438                WRITE LINEA FROM ENC-4 AFTER 3
439                WRITE LINEA FROM ENC-6 AFTER 3
440                WRITE LINEA FROM GUIONES AFTER 1
441                WRITE LINEA FROM ENC-RESTRICCIONES
442                WRITE LINEA FROM ENC-RESTRICCION-1 AFTER 1
443                WRITE LINEA FROM ENC-RESTRICCION-2 AFTER 1
444                WRITE LINEA FROM ENC-RESTRICCION-3 AFTER 1
445                WRITE LINEA FROM GUIONES AFTER 1
446                PERFORM IMPRIME-DETALLE-RESTRICCIONES VARYING I
447                        FROM 1 BY 1 UNTIL I > 5
448                WRITE LINEA FROM GUIONES AFTER 1
449                WRITE LINEA FROM GUIONES AFTER 3
450                WRITE LINEA FROM ENC-8 AFTER 1
451                WRITE LINEA FROM ENC-9 AFTER 1
452                WRITE LINEA FROM ENC-10 AFTER 1
453                WRITE LINEA FROM GUIONES AFTER 1
454                MOVE LINEA-TEMPORAL TO LINEA.
455             WRITE LINEA AFTER 1
456             MOVE SPACES TO LINEA
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                                LINEA-TEMPORAL.
*
*****************************************************************
* FIN DEL PROGRAMA QUE EMITE LA TABLA 3                         *
*****************************************************************
*
*
*
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TABLA_3.A                                                25-Jul-1988 18:24:5
Compilation Summary                                      25-Jul-1988 10:57:3

PROGRAM SECTIONS

    Name                              Bytes   Attributes

  0 $CODE                              6244     PIC   CON   REL   LCL    SHR    EXE
  1 $LOCAL                             4548     PIC   CON   REL   LCL NOSHR NOEXE
  2 $PDATA                             1299     PIC   CON   REL   LCL    SHR NOEXE
  3 COB$NAMES_____2                      24     PIC   CON   REL   LCL    SHR NOEXE
  4 COB$NAMES_____4                      20     PIC   CON   REL   LCL    SHR NOEXE


DIAGNOSTICS

    Informational:       120 (suppressed by command qualifier)


COMMAND QUALIFIERS

    COBOL  TABLA_3A.COB/ANSI/CROSS/COPY/LIST=TABLA_3A.LIS

    /COPY_LIST  /NOMACHINE_CODE  /CROSS_REFERENCE=ALPHABETICAL
    /ANSI_FORMAT  /NOSEQUENCE_CHECK  /NOMAP
    /NOTRUNCATE  /NOAUDIT  /NOCONDITIONALS
    /CHECK=(NOPERFORM,NOBOUNDS)  /DEBUG=(NOSYMBOLS,TRACEBACK)
    /WARNINGS=(NOSTANDARD,OTHER,NOINFORMATION)
    /STANDARD=(NOSYNTAX,NOFDP11)  /NOFIPS


STATISTICS

    Run Time:            14.80 seconds
    Elapsed Time:        124.01 seconds
    Page Faults:         685
    Dynamic Memory:      524 pages
```

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       IDENTIFICATION DIVISION.
       PROGRAM-ID.    TABLA_3B.
       AUTHOR.        PABLO ROMO MICHAUD.
       INSTALLATION.  UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO.
       DATE-WRITTEN.  29/OCT/87.
       DATE-COMPILED. 29/OCT/87.
      *REMARKS.
      *         ******************************************************
      *         * REPORTE DE TABLA 3.B                                *
      *         ******************************************************
       SECURITY. ESTE PROGRAMA ES PROPIEDAD DE LA UNAM.
       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.
       SOURCE-COMPUTER.  MICRO-VAX.
       OBJECT-COMPUTER.  MICRO-VAX.
       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
           SELECT REPORTE ASSIGN TO TABLA_3B.
      *
       DATA DIVISION.
      *
       FILE SECTION.
       FD  REPORTE
           LABEL RECORD IS STANDARD
           RECORD CONTAINS 132 CHARACTERS
           DATA RECORD IS LINEA.
       01  LINEA              PIC X(132).
      *
       WORKING-STORAGE SECTION.
      *
       01  VARIABLES.
           03 NUMEROS.
              05 CONTADOR-LINEAS   PIC 9(03) VALUE ZEROES.
              05 CONTADOR-PAGINAS  PIC 9(03) VALUE ZEROES.
              05 RESPUESTA         PIC X(01) VALUE SPACES.
              05 P-MINIMA          PIC S9(10)V9(08) VALUE ZEROES.
              05 P-MINIMA-PIS      PIC S9(10)V9(08) VALUE ZEROES.
              05 RAIZ-F-PRIMA-C    PIC S9(10)V9(08) VALUE ZEROES.
              05 F-PRIMA-C         PIC 9(03) VALUE ZEROES.
              05 RAIZ-F-ASTERISCO  PIC S9(10)V9(08) VALUE ZEROES.
              05 V-C-R             PIC S9(10)V9(08) VALUE ZEROES.
              05 VU-MAX            PIC S9(10)V9(08) VALUE ZEROES.
              05 VU-MIN            PIC S9(10)V9(08) VALUE ZEROES.
              05 VU                PIC S9(10)V9(08) VALUE ZEROES.
              05 SEPARACION-LIMITE-1 PIC S9(10)V9(08) VALUE ZEROES.
              05 SEPARACION-LIMITE-2 PIC S9(10)V9(08) VALUE ZEROES.
              05 VU-LIMITE-1       PIC S9(10)V9(08) VALUE ZEROES.
              05 VU-LIMITE-2       PIC S9(10)V9(08) VALUE ZEROES.
              05 F-Y               PIC S9(10)V9(08) VALUE ZEROES.
              05 P                 PIC 9(03)V9999 VALUE ZEROES.
              05 P-SALIDA          PIC 9(03)V9999 VALUE ZEROES.
              05 B                 PIC 9(03) VALUE ZEROES.
              05 H                 PIC 9(03) VALUE ZEROES.
              05 F-ASTERISCO       PIC S9(10)V9(08) VALUE ZEROES.
              05 R                 PIC S9(10)V9(08) VALUE 5.
              05 D                 PIC S9(10)V9(08) VALUE ZEROES.
              05 F-R               PIC S9(10)V9(08) VALUE .8.
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                  05 SEPARACION        PIC S9(10)V9(08) VALUE ZEROES.
                  05 I                 PIC 9(05) VALUE ZEROES.
                  05 J                 PIC 9(05) VALUE 1.
                  05 K                 PIC 9(05) VALUE ZEROES.
                  05 L                 PIC 9(05) VALUE ZEROES.
               03 ALFANUMERICOS.
                  05 LINEA-TEMPORAL    PIC X(132) VALUE SPACES.
      *
       01  FORMATO.
           03 ENC-1.
              05 FILLER                PIC X(61) VALUE SPACES.
              05 FILLER                PIC X(10) VALUE
           'TABLA #3.8'.
              05 FILLER                PIC X(25) VALUE SPACES.
              05 FILLER                PIC X(35) VALUE SPACES.
           03 ENC-2.
              05 FILLER                PIC X(36) VALUE SPACES.
              05 FILLER                PIC X(61) VALUE
           'S (Separacion de Estribos) vs VR (Cortante resistente total
      -    ')'.
           03 ENC-RESTRICCIONES.
              05 FILLER                PIC X(01) VALUE
              '|'.
              05 FILLER                PIC X(54) VALUE SPACES.
              05 FILLER                PIC X(13) VALUE
           'RESTRICCIONES'.
              05 FILLER                PIC X(60) VALUE SPACES.
              05 FILLER                PIC X(01) VALUE
              '|'.
           03 ENC-RESTRICCION-1.
              05 FILLER                PIC X(48) VALUE
           '|        Estribos        |        Separacion        |'.
              05 FILLER                PIC X(80) VALUE SPACES.
              05 FILLER                PIC X(01) VALUE '|'.
           03 ENC-RESTRICCION-2.
              05 FILLER                PIC X(130) VALUE
           '|       No. de           |          Maxima          |
      -    'Valores de          Vu ( Limite max )             S ( Maxima
      -    ')          |'.
           03 ENC-RESTRICCION-3.
              05 FILLER                PIC X(48) VALUE
           '|      Designacion       |          [ cm ]          |'.
              05 FILLER                PIC X(80) VALUE SPACES.
              05 FILLER                PIC X(01) VALUE '|'.
      *
           03 ENC-3.
              05 FILLER                PIC X(47) VALUE SPACES.
              05 FILLER                PIC X(39) VALUE
           'Vigas Rectangulares Simplemente Armadas'.
           03 ENC-4.
              05 FILLER                PIC X(15) VALUE SPACES.
              05 FILLER                PIC X(06) VALUE 'DATOS:'.
              05 FILLER                PIC X(15) VALUE SPACES.
              05 FILLER                PIC X(06) VALUE
           'f'c = '.
              05 ENC-F-PRIMA-C         PIC ZZ9 VALUE ZEROES.
              05 FILLER                PIC X(07) VALUE
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                 'Kg/cm2'.
                    05 FILLER            PIC X(18) VALUE SPACES.
                    05 FILLER            PIC X(09) VALUE
                 'Seccion: '.
                    05 FILLER            PIC X(04) VALUE
                 'b = '.
                    05 ENC-B             PIC ZZ9.
                    05 FILLER            PIC X(06) VALUE
                 ' cm x '.
                    05 FILLER            PIC X(04) VALUE
                 'h = '.
                    05 ENC-H             PIC ZZ9.
                    05 FILLER            PIC X(03) VALUE
                 ' cm'.
                 03 ENC-5.
                    05 FILLER               PIC X(63) VALUE SPACES.
                    05 FILLER               PIC X(02) VALUE '( '.
                    05 F-SALIDA-ENCABEZADO PIC 9.99999.
                    05 FILLER               PIC X(02) VALUE ' )'.
                 03 ENC-6.
                    05 FILLER               PIC X(50) VALUE SPACES.
                    05 FILLER               PIC X(31) VALUE
                 '*** Para Pmin <  P  < 0.01 ***'.
                 03 BLANCOS            PIC X(132) VALUE ALL ' '.
                 03 GUIONES            PIC X(129) VALUE ALL '-'.
                 03 ENC-8.
                    05 FILLER            PIC X(130) VALUE
                 '|  Estribos    |                    ||
          -      '||                    ||                    ||
          -      '                |'.
                 03 ENC-9.
                    05 FILLER            PIC X(130) VALUE
                 '| No. de       |     S          Vu     ||       S        Vu
          -      '||       S        Vu     ||       S        Vu     ||       S
          -      '        Vu     |'.
                 03 ENC-10.
                    05 FILLER            PIC X(130) VALUE
                 '| Designacion |   [ cm ]    [ Ton ] ||   [ cm ]   [ Ton ]
          -      '||   [ cm ]  [ Ton ] ||   [ cm ]  [ Ton ] ||   [ cm ]
          -      '    [ Ton ] |'.
             *
              01  VECTOR-1.
                 03 RENGLON-1 OCCURS 5 TIMES.
                    05 DET-NUMERO-DESIGNACION-1   PIC 9(05)V99.
                    05 VALORES-S-VU OCCURS 5 TIMES.
                       07 V-SEPARACION-1           PIC 9(09)V99.
                       07 V-VU-1                   PIC 9(09)V99.
             *
              01  VECTOR-2.
                 03 RENGLON-2 OCCURS 5 TIMES.
                    05 DET-NUMERO-DESIGNACION-2   PIC 9(05)V99.
                    05 VALORES-S-VU OCCURS 5 TIMES.
                       07 V-SEPARACION-2           PIC 9(09)V99.
                       07 V-VU-2                   PIC 9(09)V99.
             *
              01  VECTOR-3.
                 03 RENGLON-3 OCCURS 10 TIMES.
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           05 SEPARACION-MAXIMA              PIC 9(09)V99.
      *
       01  DETALLE-RESTRICCIONES.
           03 FILLER                         PIC X(10) VALUE
                     '.
           03 DET-R-NUMERO-DESIGNACION-1     PIC ZZ.Z.
           03 FILLER                         PIC X(10) VALUE
                     |'.
           03 FILLER                         PIC X(08) VALUE SPACES.
           03 DET-SEPARACION-MAXIMA          PIC ZZ9.99.
           03 FILLER                         PIC X(09) VALUE
           '         |'.
           03 DET-LAS-RESTRICCIONES.
              05 FILLER                      PIC X(04) VALUE SPACES.
              05 FORMULA-RESTRICCION-1       PIC X(37) VALUE SPACES.
              05 DET-VU                      PIC ZZ9.99.
              05 TONELADAS                   PIC X(04) VALUE
           ' Ton'.
              05 FILLER                      PIC X(04) VALUE SPACES.
              05 FORMULA-RESTRICCION-2       PIC X(14) VALUE SPACES.
              05 DET-SEPARACION-LIMITE       PIC ZZ9.99.
              05 CENTIMETROS                 PIC X(03) VALUE
           ' cm'.
           03 FILLER                     PIC X(04) VALUE
           '   |'.
      *
       01  DETALLE-1.
           03 FILLER                         PIC X(05) VALUE '|    '.
           03 DET-1-NUMERO-DESIGNACION-1     PIC ZZ.Z.
           03 FILLER                         PIC X(06) VALUE '     |'.
           03 FILLER                         PIC X(03) VALUE SPACES.
           03 DET-1-SEPARACION-1-1           PIC ZZ9.99.
           03 FILLER                         PIC X(03) VALUE SPACES.
           03 DET-1-VU-1-1                   PIC ZZ9.99.
           03 FILLER                         PIC X(06) VALUE '   || '.
           03 DET-1-SEPARACION-1-2           PIC ZZ9.99.
           03 FILLER                         PIC X(05) VALUE SPACES.
           03 DET-1-VU-1-2                   PIC ZZ9.99.
           03 FILLER                         PIC X(06) VALUE '   || '.
           03 DET-1-SEPARACION-1-3           PIC ZZ9.99.
           03 FILLER                         PIC X(05) VALUE SPACES.
           03 DET-1-VU-1-3                   PIC ZZ9.99.
           03 FILLER                         PIC X(06) VALUE '   || '.
           03 DET-1-SEPARACION-1-4           PIC ZZ9.99.
           03 FILLER                         PIC X(05) VALUE SPACES.
           03 DET-1-VU-1-4                   PIC ZZ9.99.
           03 FILLER                         PIC X(06) VALUE '   || '.
           03 DET-1-SEPARACION-1-5           PIC ZZ9.99.
           03 FILLER                         PIC X(05) VALUE SPACES.
           03 DET-1-VU-1-5                   PIC ZZ9.99.
           03 FILLER                         PIC X(06) VALUE '   |  '.
      *
       01  DETALLE-2.
           03 FILLER                         PIC X(05) VALUE '|    '.
           03 DET-2-NUMERO-DESIGNACION-2     PIC ZZ.Z.
           03 FILLER                         PIC X(06) VALUE '     |'.
           03 FILLER                         PIC X(03) VALUE SPACES.
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229             03 DET-2-SEPARACION-2-1          PIC ZZ9.99.
230             03 FILLER                         PIC X(03) VALUE SPACES.
231             03 DET-2-VU-2-1                   PIC ZZ9.99.
232             03 FILLER                         PIC X(06) VALUE '   || '.
233             03 DET-2-SEPARACION-2-2           PIC ZZ9.99.
234             03 FILLER                         PIC X(05) VALUE SPACES.
235             03 DET-2-VU-2-2                   PIC ZZ9.99.
236             03 FILLER                         PIC X(06) VALUE '   || '.
237             03 DET-2-SEPARACION-2-3           PIC ZZ9.99.
238             03 FILLER                         PIC X(05) VALUE SPACES.
239             03 DET-2-VU-2-3                   PIC ZZ9.99.
240             03 FILLER                         PIC X(06) VALUE '   || '.
241             03 DET-2-SEPARACION-2-4           PIC ZZ9.99.
242             03 FILLER                         PIC X(05) VALUE SPACES.
243             03 DET-2-VU-2-4                   PIC ZZ9.99.
244             03 FILLER                         PIC X(06) VALUE '   || '.
245             03 DET-2-SEPARACION-2-5           PIC ZZ9.99 VALUE ZEROES.
246             03 FILLER                         PIC X(05) VALUE SPACES.
247             03 DET-2-VU-2-5                   PIC ZZ9.99 VALUE ZEROES.
248             03 FILLER                         PIC X(06) VALUE '   | '.
249         *
250          01  TABLA-A-V.
251              05 FILLER      PIC X(05) VALUE '00320'.
252              05 FILLER      PIC X(05) VALUE '00490'.
253              05 FILLER      PIC X(05) VALUE '00710'.
254              05 FILLER      PIC X(05) VALUE '01270'.
255              05 FILLER      PIC X(05) VALUE '02850'.
256         *
257          01  TABLA-A-V-R REDEFINES TABLA-A-V.
258              05 VALORES-A-V OCCURS 5 TIMES.
259                 07 A-V      PIC 9(02)V9(03).
260         *
261          PROCEDURE DIVISION.
262         *
263          RUTINA-CONTROL.
264              OPEN OUTPUT REPORTE
265              PERFORM GENERA-TABLA UNTIL RESPUESTA EQUAL 'N'
266              CLOSE REPORTE
267              STOP RUN.
268         *
269         *
270         *
271          GENERA-TABLA.
272              PERFORM PREGUNTA
273              PERFORM INICIALIZA VARYING L FROM 1 BY 1
274                      UNTIL L > 5
275              MOVE ZEROES TO I J K L
276              PERFORM CALCULA VARYING L FROM 1 BY 1
277                      UNTIL L > 5
278              MOVE 99 TO CONTADOR-LINEAS
279              PERFORM IMPRIME-DETALLE-1 VARYING J FROM 1 BY 1 UNTIL J > 5
280              WRITE LINEA FROM GUIONES AFTER 1
281              WRITE LINEA FROM GUIONES AFTER 3
282              WRITE LINEA FROM ENC-8 AFTER 1
283              WRITE LINEA FROM ENC-9 AFTER 1
284              WRITE LINEA FROM ENC-10 AFTER 1
285              WRITE LINEA FROM GUIONES AFTER 1
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286             PERFORM IMPRIME-DETALLE-2 VARYING J FROM 1 BY 1 UNTIL J > 5
287             WRITE LINEA FROM GUIONES AFTER 1
288             DISPLAY '********** TABLA 3 ***************'
289             DISPLAY 'QUIERES QUE GENERE OTRA TABLA S/N '
290                     WITH NO ADVANCING
291             ACCEPT RESPUESTA.
292         *
293          PREGUNTA.
294             DISPLAY 'DAME F PRIMA c ' WITH NO ADVANCING
295             ACCEPT F-PRIMA-C
296             DISPLAY 'DAME b          ' WITH NO ADVANCING
297             ACCEPT B
298             DISPLAY 'DAME h          ' WITH NO ADVANCING
299             ACCEPT H
300             MOVE F-PRIMA-C TO ENC-F-PRIMA-C
301             MOVE B         TO ENC-B
302             MOVE H         TO ENC-H.
303         *
304          CALCULA.
305             IF L EQUAL 1
306                MOVE 2 TO DET-NUMERO-DESIGNACION-1 ( L )
307                          DET-NUMERO-DESIGNACION-2 ( L )
308             ELSE
309                IF L EQUAL 2
310                   MOVE 2.5 TO DET-NUMERO-DESIGNACION-1 ( L )
311                               DET-NUMERO-DESIGNACION-2 ( L )
312                ELSE
313                   IF L EQUAL 3
314                      MOVE 3 TO DET-NUMERO-DESIGNACION-1 ( L )
315                                DET-NUMERO-DESIGNACION-2 ( L )
316                   ELSE
317                      IF L EQUAL 4
318                         MOVE 4 TO DET-NUMERO-DESIGNACION-1 ( L )
319                                   DET-NUMERO-DESIGNACION-2 ( L )
320                      ELSE
321                         IF L EQUAL 5
322                            MOVE 6 TO DET-NUMERO-DESIGNACION-1 ( L )
323                                      DET-NUMERO-DESIGNACION-2 ( L ).
324             IF DET-NUMERO-DESIGNACION-1 ( L ) = 2
325                MOVE 2530 TO F-Y
326             ELSE
327                MOVE 4200 TO F-Y.
328             COMPUTE D ROUNDED = H - R
329             COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
330             COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
331             COMPUTE VU-LIMITE-1 = 1.5 * F-R * B * D * RAIZ-F-ASTERISCO /
332                     1000
333             COMPUTE VU-LIMITE-2 = 2.0 * F-R * B * D * RAIZ-F-ASTERISCO /
334                     1000
335             COMPUTE SEPARACION-LIMITE-1 = D / 2
336             COMPUTE SEPARACION-LIMITE-2 = D / 4
337             COMPUTE SEPARACION-MAXIMA ( L ) = ( F-R * A-V ( L ) * F-Y ) /
338                                               ( 3.5 * B )
339             MOVE ZEROES TO K
340             PERFORM PROCESO-CALCULO VARYING I FROM 1 BY 1 UNTIL I > 9.
341         *
342          PROCESO-CALCULO.
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343             COMPUTE RAIZ-F-PRIMA-C = F-PRIMA-C ** 0.5
344             COMPUTE P-MINIMA = ( 0.7 * RAIZ-F-PRIMA-C ) / F-Y
345             COMPUTE F-MINIMA-BIS = ( 0.7 * RAIZ-F-PRIMA-C ) / 4200
346             COMPUTE SEPARACION = I * 5
347             COMPUTE D ROUNDED = H - R
348             COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
349             COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
350             COMPUTE P = (( 0.01 - P-MINIMA ) / 2 ) + P-MINIMA
351             COMPUTE P-SALIDA =
352               (( 0.01 - P-MINIMA-BIS ) / 2 ) + P-MINIMA-BIS
353             MOVE P-SALIDA TO P-SALIDA-ENCABEZADO
354             COMPUTE V-C-R = F-R * B * D * RAIZ-F-ASTERISCO *
355                             ( 0.2 + 30 * P )
356             IF V-C-R NOT LESS 70
357                COMPUTE V-C-R = 0.7 * V-C-R.
358             MOVE V-C-R TO VU-MIN
359             COMPUTE VU-MAX = 2.0 * F-R * B * D * RAIZ-F-ASTERISCO
360             COMPUTE VU = ( ( 2 * F-R * A-V ( L ) * F-Y * D ) /
361                            SEPARACION ) + VU-MIN
362             IF I NOT GREATER 5
363                MOVE SEPARACION TO V-SEPARACION-1 ( L , I )
364                COMPUTE VU = VU / 1000
365                MOVE VU TO V-VU-1 ( L , I )
366             ELSE
367                ADD 1 TO K
368                MOVE SEPARACION TO V-SEPARACION-2 ( L , K )
369                COMPUTE VU = VU / 1000
370                MOVE VU TO V-VU-2 ( L , K ).
371         *
372          IMPRIME-DETALLE-RESTRICCIONES.
373             IF I = 2
374                MOVE 'Vu <= 1.5 * FR * b * d * raiz f'c = ' TO
375                     FORMULA-RESTRICCION-1
376                MOVE ' S = d / 2 = ' TO FORMULA-RESTRICCION-2
377                MOVE VU-LIMITE-1 TO DET-VU
378                MOVE SEPARACION-LIMITE-1 TO DET-SEPARACION-LIMITE
379                MOVE ' Ton' TO TONELADAS
380                MOVE ' cm' TO CENTIMETROS
381             ELSE
382                IF I = 4
383                   MOVE 'Vu <= 2.0 * FR * b * d * raiz f'c = ' TO
384                        FORMULA-RESTRICCION-1
385                   MOVE ' S = d / 4 = ' TO FORMULA-RESTRICCION-2
386                   MOVE VU-LIMITE-2 TO DET-VU
387                   MOVE SEPARACION-LIMITE-2 TO DET-SEPARACION-LIMITE
388                   MOVE ' Ton' TO TONELADAS
389                   MOVE ' cm' TO CENTIMETROS
390             ELSE
391                MOVE SPACES TO DET-2AS-RESTRICCIONES.
392             MOVE DET-NUMERO-DESIGNACION-1 ( I ) TO
393                  DET-R-NUMERO-DESIGNACION-1
394             MOVE SEPARACION-MAXIMA ( I ) TO DET-SEPARACION-MAXIMA
395             MOVE DETALLE-RESTRICCIONES TO LINEA
396             WRITE LINEA AFTER 1.
397         *
398          IMPRIME-DETALLE-1.
399             MOVE DET-NUMERO-DESIGNACION-1 ( J ) TO
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400                 DET-1-NUMERO-DESIGNACION-1
401             PERFORM MUEVE-VECTOR-1-A-DETALLE
402             MOVE DETALLE-1 TO LINEA
403             PERFORM ESCRIBE.
404         *
405          MUEVE-VECTOR-1-A-DETALLE.
406             MOVE V-SEPARACION-1 ( J , 1 ) TO DET-1-SEPARACION-1-1
407             MOVE V-VU-1 ( J , 1 )         TO DET-1-VU-1-1
408             MOVE V-SEPARACION-1 ( J , 2 ) TO DET-1-SEPARACION-1-2
409             MOVE V-VU-1 ( J , 2 )         TO DET-1-VU-1-2
410             MOVE V-SEPARACION-1 ( J , 3 ) TO DET-1-SEPARACION-1-3
411             MOVE V-VU-1 ( J , 3 )         TO DET-1-VU-1-3
412             MOVE V-SEPARACION-1 ( J , 4 ) TO DET-1-SEPARACION-1-4
413             MOVE V-VU-1 ( J , 4 )         TO DET-1-VU-1-4
414             MOVE V-SEPARACION-1 ( J , 5 ) TO DET-1-SEPARACION-1-5
415             MOVE V-VU-1 ( J , 5 )         TO DET-1-VU-1-5.
416         *
417          IMPRIME-DETALLE-2.
418             MOVE DET-NUMERO-DESIGNACION-2 ( J ) TO
419                  DET-2-NUMERO-DESIGNACION-2
420             PERFORM MUEVE-VECTOR-2-A-DETALLE
421             MOVE DETALLE-2 TO LINEA
422             PERFORM ESCRIBE.
423         *
424          MUEVE-VECTOR-2-A-DETALLE.
425             MOVE V-SEPARACION-2 ( J , 1 ) TO DET-2-SEPARACION-2-1
426             MOVE V-VU-2 ( J, 1 )          TO DET-2-VU-2-1
427             MOVE V-SEPARACION-2 ( J , 2 ) TO DET-2-SEPARACION-2-2
428             MOVE V-VU-2 ( J , 2 )         TO DET-2-VU-2-2
429             MOVE V-SEPARACION-2 ( J , 3 ) TO DET-2-SEPARACION-2-3
430             MOVE V-VU-2 ( J , 3 )         TO DET-2-VU-2-3
431             MOVE V-SEPARACION-2 ( J , 4 ) TO DET-2-SEPARACION-2-4
432             MOVE V-VU-2 ( J , 4 )         TO DET-2-VU-2-4
433             MOVE V-SEPARACION-2 ( J , 5 ) TO DET-2-SEPARACION-2-5
434             MOVE V-VU-2 ( J , 5 )         TO DET-2-VU-2-5.
435         *
436          INICIALIZA.
437             ADD 1 TO I
438             MOVE ZEROES TO DET-NUMERO-DESIGNACION-1 ( L )
439             MOVE ZEROES TO DET-NUMERO-DESIGNACION-2 ( L )
440             PERFORM VARIA VARYING I FROM 1 BY 1 UNTIL I > 5.
441         *
442          VARIA.
443             MOVE ZEROES TO V-SEPARACION-1 ( L , I )
444                            V-VU-1         ( L , I )
445                            V-SEPARACION-2 ( L , I )
446                            V-VU-2         ( L , I ).
447         *
448          ESCRIBE.
449             ADD 1 TO CONTADOR-LINEAS
450             IF CONTADOR-LINEAS > 56
451                MOVE ZEROES              TO CONTADOR-LINEAS
452                ADD 1 TO CONTADOR-PAGINAS
453                MOVE LINEA TO LINEA-TEMPORAL
454                WRITE LINEA FROM ENC-1 AFTER PAGE
455                WRITE LINEA FROM ENC-2 AFTER 3
456                WRITE LINEA FROM ENC-3 AFTER 3
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457             WRITE LINEA FROM ENC-4 AFTER 3
458             WRITE LINEA FROM ENC-5 AFTER 3
459             WRITE LINEA FROM ENC-6 AFTER 3
460             WRITE LINEA FROM GUIONES AFTER 1
461             WRITE LINEA FROM ENC-RESTRICCIONES
462             WRITE LINEA FROM ENC-RESTRICCION-1 AFTER 1
463             WRITE LINEA FROM ENC-RESTRICCION-2 AFTER 1
464             WRITE LINEA FROM ENC-RESTRICCION-3 AFTER 1
465             WRITE LINEA FROM GUIONES AFTER 1
466             PERFORM IMPRIME-DETALLE-RESTRICCIONES VARYING I
467                     FROM 1 BY 1 UNTIL I > 5
468             WRITE LINEA FROM GUIONES AFTER 1
469             WRITE LINEA FROM GUIONES AFTER 3
470             WRITE LINEA FROM ENC-8 AFTER 1
471             WRITE LINEA FROM ENC-9 AFTER 1
472             WRITE LINEA FROM ENC-10 AFTER 1
473             WRITE LINEA FROM GUIONES AFTER 1
474             MOVE LINEA-TEMPORAL TO LINEA.
475         WRITE LINEA AFTER 1
476         MOVE SPACES TO LINEA
477                        LINEA-TEMPORAL.
478     *
479     ****************************************************************
480     * FIN DEL PROGRAMA QUE EMITE LA TABLA 3                        *
481     ****************************************************************
482     *
483     *
484     *
```

```
TABLA_3B                                                25-Jul-1988 18:27:3.
Compilation Summary                                     25-Jul-1988 10:52:2

PROGRAM SECTIONS

    Name                              Bytes   Attributes

  0 $CODE                              6770     PIC   CON   REL   LCL   SHR   EXE
  1 $LOCAL                             4748     PIC   CON   REL   LCL NOSHR NOEXE
  2 $PDATA                             1495     PIC   CON   REL   LCL   SHR NOEXE
  3 COB$NAMES_____2                      24     PIC   CON   REL   LCL   SHR NOEXE
  4 COB$NAMES_____4                      20     PIC   CON   REL   LCL   SHR NOEXE

DIAGNOSTICS

    Informational:      126 (suppressed by command qualifier)

COMMAND QUALIFIERS

    COBOL  TABLA_3B.COB/ANSI/CROSS/COPY/LIST=TABLA_3B.LIS

    /COPY_LIST  /NOMACHINE_CODE  /CROSS_REFERENCE=ALPHABETICAL
    /ANSI_FORMAT  /NOSEQUENCE_CHECK  /NOMAP
    /NOTRUNCATE  /NOAUDIT  /NOCONDITIONALS
    /CHECK=(NOPERFORM,NOBOUNDS)  /DEBUG=(NOSYMBOLS,TRACEBACK)
    /WARNINGS=(NOSTANDARD,OTHER,NOINFORMATION)
    /STANDARD=(NOSYNTAX,NOPDP11)  /NOFIPS

STATISTICS

    Run Time:           15.40 seconds
    Elapsed Time:       141.06 seconds
    Page Faults:        710
    Dynamic memory:     531 pages
```

```
1         IDENTIFICATION DIVISION.
2         PROGRAM-ID.     TABLA_3C.
3         AUTHOR.         PABLO ROHO MICHAUD.
4         INSTALLATION.   UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO.
5         DATE-WRITTEN.   29/OCT/87.
6         DATE-COMPILED.  29/OCT/87.
7        *REMARKS.
8        *          ************************************************************
9        *          * REPORTE DE TABLA 3.C                                     *
10       *          ************************************************************
11        SECURITY. ESTE PROGRAMA ES PROPIEDAD DE LA UNAM.
12        ENVIRONMENT DIVISION.
13        CONFIGURATION SECTION.
14        SOURCE-COMPUTER.  MICRO-VAX.
15        OBJECT-COMPUTER.  MICRO-VAX.
16        INPUT-OUTPUT SECTION.
17        FILE-CONTROL.
18            SELECT REPORTE ASSIGN TO TABLA_3C.
19       *
20        DATA DIVISION.
21       *
22        FILE SECTION.
23        FD  REPORTE
24            LABEL RECORD IS STANDARD
25            RECORD CONTAINS 132 CHARACTERS
26            DATA RECORD IS LINEA.
27        01  LINEA              PIC X(132).
28       *
29        WORKING-STORAGE SECTION.
30       *
31        01  VARIABLES.
32            03 NUMEROS.
33               05 CONTADOR-LINEAS  PIC 9(03) VALUE ZEROES.
34               05 CONTADOR-PAGINAS PIC 9(03) VALUE ZEROES.
35               05 RESPUESTA        PIC X(01) VALUE SPACES.
36               05 P-MINIMA         PIC S9(10)V9(08) VALUE ZEROES.
37               05 P-MINIMA-BIS     PIC S9(10)V9(08) VALUE ZEROES.
38               05 RAIZ-F-PRIMA-C   PIC S9(10)V9(08) VALUE ZEROES.
39               05 F-PRIMA-C        PIC 9(03) VALUE ZEROES.
40               05 RAIZ-F-ASTERISCO PIC S9(10)V9(08) VALUE ZEROES.
41               05 V-C-R            PIC S9(10)V9(08) VALUE ZEROES.
42               05 VU-MAX           PIC S9(10)V9(08) VALUE ZEROES.
43               05 VU-MIN           PIC S9(10)V9(08) VALUE ZEROES.
44               05 VU               PIC S9(10)V9(08) VALUE ZEROES.
45               05 SEPARACION-LIMITE-1 PIC S9(10)V9(08) VALUE ZEROES.
46               05 SEPARACION-LIMITE-2 PIC S9(10)V9(08) VALUE ZEROES.
47               05 VU-LIMITE-1      PIC S9(10)V9(08) VALUE ZEROES.
48               05 VU-LIMITE-2      PIC S9(10)V9(08) VALUE ZEROES.
49               05 F-Y              PIC S9(10)V9(08) VALUE ZEROES.
50               05 P                PIC 9(03)V9999 VALUE ZEROES.
51               05 B                PIC 9(03) VALUE ZEROES.
52               05 H                PIC 9(03) VALUE ZEROES.
53               05 F-ASTERISCO      PIC S9(10)V9(08) VALUE ZEROES.
54               05 R                PIC S9(10)V9(08) VALUE 5.
55               05 D                PIC S9(10)V9(08) VALUE ZEROES.
56               05 F-R              PIC S9(10)V9(08) VALUE .8.
57               05 SEPARACION       PIC S9(10)V9(08) VALUE ZEROES.
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                05 I                    PIC 9(05) VALUE ZEROES.
                05 J                    PIC 9(05) VALUE 1.
                05 K                    PIC 9(05) VALUE ZEROES.
                05 L                    PIC 9(05) VALUE ZEROES.
             03 ALFANUMERICOS.
                05 LINEA-TEMPORAL       PIC X(132) VALUE SPACES.
      *
          01 FORMATO.
             03 ENC-1.
                05 FILLER               PIC X(61) VALUE SPACES.
                05 FILLER               PIC X(10) VALUE
             'TABLA #3.C'.
                05 FILLER               PIC X(25) VALUE SPACES.
             03 ENC-2.
                05 FILLER               PIC X(36) VALUE SPACES.
                05 FILLER               PIC X(61) VALUE
             'S (Separacion de Estribos) vs VR (Cortante resistente total
      -      ')'.
             03 ENC-RESTRICCIONES.
                05 FILLER               PIC X(01) VALUE
                '|'.
                05 FILLER               PIC X(54) VALUE SPACES.
                05 FILLER               PIC X(13) VALUE
             'RESTRICCIONES'.
                05 FILLER               PIC X(60) VALUE SPACES.
                05 FILLER               PIC X(01) VALUE
                '|'.
             03 ENC-RESTRICCION-1.
                05 FILLER               PIC X(48) VALUE
             '|       Estribos        |      Separacion       |'.
                05 FILLER               PIC X(80) VALUE SPACES.
                05 FILLER               PIC X(01) VALUE '|'.
             03 ENC-RESTRICCION-2.
                05 FILLER               PIC X(130) VALUE
             '|        No. de         |        Maxima         |
      -      'Valores de          Vu ( Limite max )            S ( Maxima
      -      ')    |'.
             03 ENC-RESTRICCION-3.
                05 FILLER               PIC X(48) VALUE
             '|     Designacion        |        [ cm ]         |'.
                05 FILLER               PIC X(80) VALUE SPACES.
                05 FILLER               PIC X(01) VALUE '|'.
      *
             03 ENC-3.
                05 FILLER               PIC X(47) VALUE SPACES.
                05 FILLER               PIC X(39) VALUE
             'Visas Rectangulares Simplemente Armadas'.
             03 ENC-4.
                05 FILLER               PIC X(15) VALUE SPACES.
                05 FILLER               PIC X(06) VALUE 'DATOS:'.
                05 FILLER               PIC X(15) VALUE SPACES.
                05 FILLER               PIC X(06) VALUE
             'f'c = '.
                05 ENC-F-PRIMA-C        PIC ZZ9 VALUE ZEROES.
                05 FILLER               PIC X(07) VALUE
             ' Kg/cm2'.
                05 FILLER               PIC X(18) VALUE SPACES.
```

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                05 FILLER           PIC X(09) VALUE
            'Seccion: '.
                05 FILLER           PIC X(04) VALUE
            'b = '.
                05 ENC-B            PIC ZZ9.
                05 FILLER           PIC X(08) VALUE
            ' cm  x  '.
                05 FILLER           PIC X(04) VALUE
            'h = '.
                05 ENC-H            PIC ZZ9.
                05 FILLER           PIC X(03) VALUE
            ' cm'.
            03 ENC-5.
                05 FILLER           PIC X(60) VALUE SPACES.
                05 FILLER           PIC X(02) VALUE '( '.
                05 P-MINIMA-BIS-ENC PIC 9.99999.
                05 FILLER           PIC X(02) VALUE ' )'.
            03 ENC-6.
                05 FILLER           PIC X(55) VALUE SPACES.
                05 FILLER           PIC X(22) VALUE
            '*** Para  P = Pmin ***'.
            03 BLANCOS          PIC X(132) VALUE ALL ' '.
            03 GUIONES          PIC X(129) VALUE ALL '-'.
            03 ENC-8.
                05 FILLER           PIC X(130) VALUE
            '|  Estribos   |                        ||
       -    ' ||                   ||                        ||
       -    '         |'.
            03 ENC-9.
                05 FILLER           PIC X(130) VALUE
            '| No. de      |      S          Vu     ||        S          Vu
       -    ' ||       S         Vu     ||        S         Vu     ||       S
       -    '      Vu     |'.
            03 ENC-10.
                05 FILLER           PIC X(130) VALUE
            '| Desisnacion |    [ cm ]     [ Ton ] ||     [ cm ]    [ Ton ]
       -    ' ||     [ cm ]  [ Ton ] ||     [ cm ]  [ Ton ] ||    [ cm ]
       -    '    [ Ton ] |'.
       *
        01  VECTOR-1.
            03 RENGLON-1 OCCURS 5 TIMES.
                05 DET-NUMERO-DESIGNACION-1   PIC 9(05)V99.
                05 VALORES-S-VU OCCURS 5 TIMES.
                    07 V-SEPARACION-1             PIC 9(09)V99.
                    07 V-VU-1                     PIC 9(09)V99.
       *
        01  VECTOR-2.
            03 RENGLON-2 OCCURS 5 TIMES.
                05 DET-NUMERO-DESIGNACION-2   PIC 9(05)V99.
                05 VALORES-S-VU OCCURS 5 TIMES.
                    07 V-SEPARACION-2             PIC 9(09)V99.
                    07 V-VU-2                     PIC 9(09)V99.
       *
        01  VECTOR-3.
            03 RENGLON-3 OCCURS 10 TIMES.
                05 SEPARACION-MAXIMA              PIC 9(09)V99.
       *
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  172          01  DETALLE-RESTRICCIONES.
  173              03 FILLER                          PIC X(10) VALUE
  174              '|        ',
  175              03 DET-R-NUMERO-DESIGNACION-1      PIC ZZ.Z.
  176              03 FILLER                          PIC X(10) VALUE
  177              '        |',
  178              03 FILLER                          PIC X(08) VALUE SPACES.
  179              03 DET-SEPARACION-MAXIMA           PIC ZZ9.99.
  180              03 FILLER                          PIC X(09) VALUE
  181              '        |',
  182              03 DET-2AS-RESTRICCIONES.
  183                 05 FILLER                       PIC X(04) VALUE SPACES.
  184                 05 FORMULA-RESTRICCION-1        PIC X(37) VALUE SPACES.
  185                 05 DET-VU                       PIC ZZ9.99.
  186                 05 TONELADAS                    PIC X(04) VALUE
  187              ' Ton',
  188                 05 FILLER                       PIC X(04) VALUE SPACES.
  189                 05 FORMULA-RESTRICCION-2        PIC X(14) VALUE SPACES.
  190                 05 DET-SEPARACION-LIMITE        PIC ZZ9.99.
  191                 05 CENTIMETROS                  PIC X(03) VALUE
  192              ' cm',
  193              03 FILLER                       PIC X(04) VALUE
  194              '   |'.
  195          *
  196           01  DETALLE-1.
  197              03 FILLER                          PIC X(05) VALUE '|    ',
  198              03 DET-1-NUMERO-DESIGNACION-1      PIC ZZ.Z.
  199              03 FILLER                          PIC X(06) VALUE '     |',
  200              03 FILLER                          PIC X(03) VALUE SPACES.
  201              03 DET-1-SEPARACION-1-1            PIC ZZ9.99.
  202              03 FILLER                          PIC X(03) VALUE SPACES.
  203              03 DET-1-VU-1-1                    PIC ZZ9.99.
  204              03 FILLER                          PIC X(06) VALUE '   || '.
  205              03 DET-1-SEPARACION-1-2            PIC ZZ9.99.
  206              03 FILLER                          PIC X(05) VALUE SPACES.
  207              03 DET-1-VU-1-2                    PIC ZZ9.99.
  208              03 FILLER                          PIC X(06) VALUE '   || '.
  209              03 DET-1-SEPARACION-1-3            PIC ZZ9.99.
  210              03 FILLER                          PIC X(05) VALUE SPACES.
  211              03 DET-1-VU-1-3                    PIC ZZ9.99.
  212              03 FILLER                          PIC X(06) VALUE '   || '.
  213              03 DET-1-SEPARACION-1-4            PIC ZZ9.99.
  214              03 FILLER                          PIC X(05) VALUE SPACES.
  215              03 DET-1-VU-1-4                    PIC ZZ9.99.
  216              03 FILLER                          PIC X(06) VALUE '   || '.
  217              03 DET-1-SEPARACION-1-5            PIC ZZ9.99.
  218              03 FILLER                          PIC X(05) VALUE SPACES.
  219              03 DET-1-VU-1-5                    PIC ZZ9.99.
  220              03 FILLER                          PIC X(06) VALUE '   | '.
  221          *
  222           01  DETALLE-2.
  223              03 FILLER                          PIC X(05) VALUE '|    '.
  224              03 DET-2-NUMERO-DESIGNACION-2      PIC ZZ.Z.
  225              03 FILLER                          PIC X(06) VALUE '     |'.
  226              03 FILLER                          PIC X(03) VALUE SPACES.
  227              03 DET-2-SEPARACION-2-1            PIC ZZ9.99.
  228              03 FILLER                          PIC X(03) VALUE SPACES.
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229             03 DET-2-VU-2-1                 PIC ZZ9.99.
230             03 FILLER                        PIC X(06) VALUE '   || '.
231             03 DET-2-SEPARACION-2-2          PIC ZZ9.99.
232             03 FILLER                        PIC X(05) VALUE SPACES.
233             03 DET-2-VU-2-2                  PIC ZZ9.99.
234             03 FILLER                        PIC X(06) VALUE '   || '.
235             03 DET-2-SEPARACION-2-3          PIC ZZ9.99.
236             03 FILLER                        PIC X(05) VALUE SPACES.
237             03 DET-2-VU-2-3                  PIC ZZ9.99.
238             03 FILLER                        PIC X(06) VALUE '   || '.
239             03 DET-2-SEPARACION-2-4          PIC ZZ9.99.
240             03 FILLER                        PIC X(05) VALUE SPACES.
241             03 DET-2-VU-2-4                  PIC ZZ9.99.
242             03 FILLER                        PIC X(06) VALUE '   || '.
243             03 DET-2-SEPARACION-2-5          PIC ZZ9.99 VALUE ZEROES.
244             03 FILLER                        PIC X(05) VALUE SPACES.
245             03 DET-2-VU-2-5                  PIC ZZ9.99 VALUE ZEROES.
246             03 FILLER                        PIC X(06) VALUE '   |  '.
247         *
248          01   TABLA-A-V.
249               05 FILLER      PIC X(05) VALUE '00320'.
250               05 FILLER      PIC X(05) VALUE '00490'.
251               05 FILLER      PIC X(05) VALUE '00710'.
252               05 FILLER      PIC X(05) VALUE '01270'.
253               05 FILLER      PIC X(05) VALUE '02850'.
254         *
255          01   TABLA-A-V-R REDEFINES TABLA-A-V.
256               05 VALORES-A-V OCCURS 5 TIMES.
257                  07 A-V      PIC 9(02)V9(03).
258         *
259          PROCEDURE DIVISION.
260         *
261          RUTINA-CONTROL.
262               OPEN OUTPUT REPORTE
263               PERFORM GENERA-TABLA UNTIL RESPUESTA EQUAL 'N'
264               CLOSE REPORTE
265               STOP RUN.
266         *
267         *
268         *
269          GENERA-TABLA.
270               PERFORM PREGUNTA
271               PERFORM INICIALIZA VARYING L FROM 1 BY 1
272                       UNTIL L > 5
273               MOVE ZEROES TO I J K L
274               PERFORM CALCULA VARYING L FROM 1 BY 1
275                       UNTIL L > 5
276               MOVE 99 TO CONTADOR-LINEAS
277               PERFORM IMPRIME-DETALLE-1 VARYING J FROM 1 BY 1 UNTIL J > 5
278               WRITE LINEA FROM GUIONES AFTER 1
279               WRITE LINEA FROM GUIONES AFTER 3
280               WRITE LINEA FROM ENC-8 AFTER 1
281               WRITE LINEA FROM ENC-9 AFTER 1
282               WRITE LINEA FROM ENC-10 AFTER 1
283               WRITE LINEA FROM GUIONES AFTER 1
284               PERFORM IMPRIME-DETALLE-2 VARYING J FROM 1 BY 1 UNTIL J > 5
285               WRITE LINEA FROM GUIONES AFTER 1
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286             DISPLAY '********** TABLA 3 ***************'
287             DISPLAY 'QUIERES QUE GENERE OTRA TABLA S/N '
288                     WITH NO ADVANCING
289             ACCEPT RESPUESTA.
290         *
291          PREGUNTA.
292             DISPLAY 'DAME F PRIMA c ' WITH NO ADVANCING
293             ACCEPT F-PRIMA-C
294             DISPLAY 'DAME b          ' WITH NO ADVANCING
295             ACCEPT B
296             DISPLAY 'DAME h          ' WITH NO ADVANCING
297             ACCEPT H
298             MOVE F-PRIMA-C TO ENC-F-PRIMA-C
299             MOVE B         TO ENC-B
300             MOVE H         TO ENC-H.
301         *
302          CALCULA.
303             IF L EQUAL 1
304                MOVE 2 TO DET-NUMERO-DESIGNACION-1 ( L )
305                          DET-NUMERO-DESIGNACION-2 ( L )
306             ELSE
307                IF L EQUAL 2
308                   MOVE 2.5 TO DET-NUMERO-DESIGNACION-1 ( L )
309                               DET-NUMERO-DESIGNACION-2 ( L )
310                ELSE
311                   IF L EQUAL 3
312                      MOVE 3 TO DET-NUMERO-DESIGNACION-1 ( L )
313                                DET-NUMERO-DESIGNACION-2 ( L )
314                   ELSE
315                      IF L EQUAL 4
316                         MOVE 4 TO DET-NUMERO-DESIGNACION-1 ( L )
317                                   DET-NUMERO-DESIGNACION-2 ( L )
318                      ELSE
319                         IF L EQUAL 5
320                            MOVE 6 TO DET-NUMERO-DESIGNACION-1 ( L )
321                                      DET-NUMERO-DESIGNACION-2 ( L ).
322             IF DET-NUMERO-DESIGNACION-1 ( L ) = 2
323                MOVE 2530 TO F-Y
324             ELSE
325                MOVE 4200 TO F-Y.
326             COMPUTE D ROUNDED = H - R
327             COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
328             COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
329             COMPUTE VU-LIMITE-1 = 1.5 * F-R * B * D * RAIZ-F-ASTERISCO /
330                     1000
331             COMPUTE VU-LIMITE-2 = 2.0 * F-R * B * D * RAIZ-F-ASTERISCO /
332                     1000
333             COMPUTE SEPARACION-LIMITE-1 = D / 2
334             COMPUTE SEPARACION-LIMITE-2 = D / 4
335             COMPUTE SEPARACION-MAXIMA ( L ) = ( F-R * A-V ( L ) * F-Y ) /
336                                               ( 3.5 * B )
337             MOVE ZEROES TO K
338             PERFORM PROCESO-CALCULO VARYING I FROM 1 BY 1 UNTIL I > 9.
339         *
340          PROCESO-CALCULO.
341             COMPUTE RAIZ-F-PRIMA-C = F-PRIMA-C ** 0.5
342             COMPUTE P-MINIMA = ( 0.7 * RAIZ-F-PRIMA-C ) / F-Y
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           COMPUTE P-MINIMA-BIS = ( 0.7 * RAIZ-F-PRIMA-C ) / 4200
           MOVE P-MINIMA-BIS TO P-MINIMA-BIS-ENC
           COMPUTE SEPARACION = I * 5
           COMPUTE D ROUNDED = H - R
           COMPUTE F-ASTERISCO ROUNDED = ( F-PRIMA-C * 0.8 ).
           COMPUTE RAIZ-F-ASTERISCO ROUNDED = F-ASTERISCO  ** 0.5
           COMPUTE P = F-MINIMA
           COMPUTE V-C-R = F-R * B * D * RAIZ-F-ASTERISCO *
                           ( 0.2 + 30 * P )
           IF V-C-R NOT LESS 70
              COMPUTE V-C-R = 0.7 * V-C-R.
           MOVE V-C-R TO VU-MIN
           COMPUTE VU = ( ( 2 * F-R * A-V ( L ) * F-Y * D ) /
                           SEPARACION ) + VU-MIN
           IF I NOT GREATER 5
              MOVE SEPARACION TO V-SEPARACION-1 ( L , I )
              COMPUTE VU = VU / 1000
              MOVE VU TO V-VU-1 ( L , I )
           ELSE
              ADD 1 TO K
              MOVE SEPARACION TO V-SEPARACION-2 ( L , K )
              COMPUTE VU = VU / 1000
              MOVE VU TO V-VU-2 ( L , K ).
       *
        IMPRIME-DETALLE-RESTRICCIONES.
           IF I = 2
              MOVE 'Vu <= 1.5 * FR * b * d * raiz f'c = ' TO
                   FORMULA-RESTRICCION-1
              MOVE ' S = d / 2 = ' TO FORMULA-RESTRICCION-2
              MOVE VU-LIMITE-1 TO DET-VU
              MOVE SEPARACION-LIMITE-1 TO DET-SEPARACION-LIMITE
              MOVE ' Ton' TO TONELADAS
              MOVE ' cm' TO CENTIMETROS
           ELSE
              IF I = 4
                 MOVE 'Vu <= 2.0 * FR * b * d * raiz f'c = ' TO
                      FORMULA-RESTRICCION-1
                 MOVE ' S = d / 4 = ' TO FORMULA-RESTRICCION-2
                 MOVE VU-LIMITE-2 TO DET-VU
                 MOVE SEPARACION-LIMITE-2 TO DET-SEPARACION-LIMITE
                 MOVE ' Ton' TO TONELADAS
                 MOVE ' cm' TO CENTIMETROS
           ELSE
              MOVE SPACES TO DET-2AS-RESTRICCIONES.
           MOVE DET-NUMERO-DESIGNACION-1 ( I ) TO
                DET-R-NUMERO-DESIGNACION-1
           MOVE SEPARACION-MAXIMA ( I ) TO DET-SEPARACION-MAXIMA
           MOVE DETALLE-RESTRICCIONES TO LINEA
           WRITE LINEA AFTER 1.
       *
        IMPRIME-DETALLE-1.
           MOVE DET-NUMERO-DESIGNACION-1 ( J ) TO
                DET-1-NUMERO-DESIGNACION-1
           PERFORM MUEVE-VECTOR-1 A DETALLE
           MOVE DETALLE-1 TO LINEA
           PERFORM ESCRIBE.
       *
```

```
400         MUEVE-VECTOR-1-A-DETALLE.
401             MOVE V-SEPARACION-1 ( J , 1 ) TO DET-1-SEPARACION-1-1
402             MOVE V-VU-1 ( J , 1 )         TO DET-1-VU-1-1
403             MOVE V-SEPARACION-1 ( J , 2 ) TO DET-1-SEPARACION-1-2
404             MOVE V-VU-1 ( J , 2 )         TO DET-1-VU-1-2
405             MOVE V-SEPARACION-1 ( J , 3 ) TO DET-1-SEPARACION-1-3
406             MOVE V-VU-1 ( J , 3 )         TO DET-1-VU-1-3
407             MOVE V-SEPARACION-1 ( J , 4 ) TO DET-1-SEPARACION-1-4
408             MOVE V-VU-1 ( J , 4 )         TO DET-1-VU-1-4
409             MOVE V-SEPARACION-1 ( J , 5 ) TO DET-1-SEPARACION-1-5
410             MOVE V-VU-1 ( J , 5 )         TO DET-1-VU-1-5.
411         *
412         IMPRIME-DETALLE-2.
413             MOVE DET-NUMERO-DESIGNACION-2 ( J ) TO
414                  DET-2-NUMERO-DESIGNACION-2
415             PERFORM MUEVE-VECTOR-2-A-DETALLE
416             MOVE DETALLE-2 TO LINEA
417             PERFORM ESCRIBE.
418         *
419         MUEVE-VECTOR-2-A-DETALLE.
420             MOVE V-SEPARACION-2 ( J , 1 ) TO DET-2-SEPARACION-2-1
421             MOVE V-VU-2 ( J, 1 )          TO DET-2-VU-2-1
422             MOVE V-SEPARACION-2 ( J , 2 ) TO DET-2-SEPARACION-2-2
423             MOVE V-VU-2 ( J , 2 )         TO DET-2-VU-2-2
424             MOVE V-SEPARACION-2 ( J , 3 ) TO DET-2-SEPARACION-2-3
425             MOVE V-VU-2 ( J , 3 )         TO DET-2-VU-2-3
426             MOVE V-SEPARACION-2 ( J , 4 ) TO DET-2-SEPARACION-2-4
427             MOVE V-VU-2 ( J , 4 )         TO DET-2-VU-2-4
428             MOVE V-SEPARACION-2 ( J , 5 ) TO DET-2-SEPARACION-2-5
429             MOVE V-VU-2 ( J , 5 )         TO DET-2-VU-2-5.
430         *
431         INICIALIZA.
432             ADD 1 TO I
433             MOVE ZEROES TO DET-NUMERO-DESIGNACION-1 ( L )
434             MOVE ZEROES TO DET-NUMERO-DESIGNACION-2 ( L )
435             PERFORM VARIA VARYING I FROM 1 BY 1 UNTIL I > 5.
436         *
437         VARIA.
438             MOVE ZEROES TO V-SEPARACION-1 ( L , I )
439                            V-VU-1         ( L , I )
440                            V-SEPARACION-2 ( L , I )
441                            V-VU-2         ( L , I ).
442         *
443         ESCRIBE.
444             ADD 1 TO CONTADOR-LINEAS
445             IF CONTADOR-LINEAS > 56
446                MOVE ZEROES                 TO CONTADOR-LINEAS
447                ADD 1 TO CONTADOR-PAGINAS
448                MOVE LINEA TO LINEA-TEMPORAL
449                WRITE LINEA FROM ENC-1 AFTER PAGE
450                WRITE LINEA FROM ENC-2 AFTER 3
451                WRITE LINEA FROM ENC-3 AFTER 3
452                WRITE LINEA FROM ENC-4 AFTER 3
453                WRITE LINEA FROM ENC-5 AFTER 3
454                WRITE LINEA FROM ENC-6 AFTER 3
455                WRITE LINEA FROM GUIONES AFTER 1
456                WRITE LINEA FROM ENC-RESTRICCIONES
```

```
457             WRITE LINEA FROM ENC-RESTRICCION-1 AFTER 1
458             WRITE LINEA FROM ENC-RESTRICCION-2 AFTER 1
459             WRITE LINEA FROM ENC-RESTRICCION-3 AFTER 1
460             WRITE LINEA FROM GUIONES AFTER 1
461             PERFORM IMPRIME-DETALLE-RESTRICCIONES VARYING I
462                     FROM 1 BY 1 UNTIL I > 5
463             WRITE LINEA FROM GUIONES AFTER 1
464             WRITE LINEA FROM GUIONES AFTER 1
465             WRITE LINEA FROM ENC-8 AFTER 1
466             WRITE LINEA FROM ENC-9 AFTER 1
467             WRITE LINEA FROM ENC-10 AFTER 1
468             WRITE LINEA FROM GUIONES AFTER 1
469             MOVE LINEA-TEMPORAL TO LINEA.
470           WRITE LINEA AFTER 1
471           MOVE SPACES TO LINEA
472                          LINEA-TEMPORAL.
473       *
474       ******************************************************************
475       * FIN DEL PROGRAMA QUE EMITE LA TABLA 3                          *
476       ******************************************************************
477       *
478       *
479       *
```

```
TABLA_3C                                                    25-Jul-1988 18:30:3
Compilation Summary                                         23-Jul-1988 13:55:2

PROGRAM SECTIONS

    Name                                Bytes   Attributes

  0 $CODE                               6423      PIC   CON   REL   LCL    SHR    EXE
  1 $LOCAL                              4696      PIC   CON   REL   LCL  NOSHR  NOEXE
  2 $PDATA                              1427      PIC   CON   REL   LCL    SHR  NOEXE
  3 COB$NAMES_____2                       24      PIC   CON   REL   LCL    SHR  NOEXE
  4 COB$NAMES_____4                       20      PIC   CON   REL   LCL    SHR  NOEXE


DIAGNOSTICS

    Informational:      126 (suppressed by command qualifier)


COMMAND QUALIFIERS

    COBOL  TABLA_3C.COB/ANSI/CROSS/COPY/LIST=TABLA_3C.LIS

    /COPY_LIST  /NOMACHINE_CODE  /CROSS_REFERENCE=ALPHABETICAL
    /ANSI_FORMAT  /NOSEQUENCE_CHECK  /NOMAP
    /NOTRUNCATE  /NOAUDIT  /NOCONDITIONALS
    /CHECK=(NOPERFORM,NOBOUNDS)  /DEBUG=(NOSYMBOLS,TRACEBACK)
    /WARNINGS=(NOSTANDARD,OTHER,NOINFORMATION)
    /STANDARD=(NOSYNTAX,NOPDP11)  /NOFIPS


STATISTICS

    Run Time:           15.17 seconds
    Elapsed Time:       98.84 seconds
    Page Faults:        561
    Dynamic Memory:     527 pages
```

IV. CATALOGO DE TABLAS.

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	166.31	0.00424	329.29	0.00644	475.31
0.00211	172.01	0.00431	334.43	0.00651	479.89
0.00218	177.70	0.00438	339.55	0.00659	484.44
0.00226	183.37	0.00446	344.66	0.00666	488.98
0.00233	189.02	0.00453	349.74	0.00673	493.50
0.00240	194.65	0.00460	354.81	0.00681	498.00
0.00248	200.26	0.00468	359.85	0.00688	502.48
0.00255	205.85	0.00475	364.88	0.00695	506.94
0.00262	211.43	0.00482	369.89	0.00703	511.38
0.00270	216.98	0.00490	374.88	0.00710	515.81
0.00277	222.52	0.00497	379.85	0.00717	520.21
0.00284	228.04	0.00504	384.80	0.00725	524.60
0.00292	233.54	0.00512	389.74	0.00732	528.97
0.00299	239.02	0.00519	394.65	0.00739	533.32
0.00306	244.48	0.00526	399.55	0.00747	537.65
0.00314	249.92	0.00534	404.42	0.00754	541.96
0.00321	255.34	0.00541	409.28	0.00761	546.25
0.00328	260.75	0.00548	414.12	0.00769	550.52
0.00336	266.13	0.00556	418.94	0.00776	554.78
0.00343	271.50	0.00563	423.74	0.00783	559.01
0.00350	276.85	0.00570	428.52	0.00791	563.23
0.00358	282.18	0.00578	433.29	0.00798	567.43
0.00365	287.49	0.00585	438.03	0.00805	571.61
0.00372	292.78	0.00592	442.76	0.00813	575.77
0.00380	298.05	0.00600	447.46	0.00820	579.91
0.00387	303.31	0.00607	452.15	0.00827	584.03
0.00394	308.54	0.00614	456.82	0.00835	588.14
0.00402	313.76	0.00622	461.47	0.00842	592.22
0.00409	318.95	0.00629	466.10	0.00849	596.29
0.00416	324.13	0.00637	470.72	0.00857	600.33

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.26	0.98	0.48	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.36	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.59	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	0.00	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 1.97 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 2.62 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.54	10.00	2.60	15.00	1.95	20.00	1.62	25.00	1.43
2.5	5.00	10.53	10.00	5.59	15.00	3.95	20.00	3.12	25.00	2.63
3.0	5.00	14.97	10.00	7.81	15.00	5.42	20.00	4.23	25.00	3.51
4.0	5.00	26.26	10.00	13.45	15.00	9.19	20.00	7.05	25.00	5.77
6.0	5.00	58.11	10.00	29.38	15.00	19.80	20.00	15.02	25.00	12.14

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.30	35.00	1.21	40.00	1.14	45.00	1.08	0.00	0.00
2.5	30.00	2.30	35.00	2.06	40.00	1.89	45.00	1.75	0.00	0.00
3.0	30.00	3.04	35.00	2.70	40.00	2.44	45.00	2.24	0.00	0.00
4.0	30.00	4.92	35.00	4.31	40.00	3.85	45.00	3.50	0.00	0.00
6.0	30.00	10.23	35.00	8.86	40.00	7.83	45.00	7.04	0.00	0.00

TABLA #3.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)		S (Maxima)	
2.0	18.50				
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f'c =	1.97 Ton	S = d / 2 =	7.50 cm
3.0	68.16				
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f'c =	2.62 Ton	S = d / 4 =	3.75 cm
6.0	273.60				

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.25	10.00	2.30	15.00	1.66	20.00	1.33	25.00	1.14
2.5	5.00	10.22	10.00	5.28	15.00	3.64	20.00	2.81	25.00	2.32
3.0	5.00	14.66	10.00	7.50	15.00	5.12	20.00	3.92	25.00	3.21
4.0	5.00	25.95	10.00	13.15	15.00	8.88	20.00	6.75	25.00	5.47
6.0	5.00	57.80	10.00	29.07	15.00	19.50	20.00	14.71	25.00	11.84

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.01	35.00	0.92	40.00	0.85	45.00	0.79	0.00	0.00
2.5	30.00	1.99	35.00	1.76	40.00	1.58	45.00	1.44	0.00	0.00
3.0	30.00	2.73	35.00	2.39	40.00	2.13	45.00	1.94	0.00	0.00
4.0	30.00	4.61	35.00	4.00	40.00	3.55	45.00	3.19	0.00	0.00
6.0	30.00	9.92	35.00	8.55	40.00	7.53	45.00	6.73	0.00	0.00

TABLA 83.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS! **f'c = 150 Kg/cm2** **Seccion! b = 10 cm x h = 20 cm**

(0.00204)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 1.97 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 2.62 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.16	10.00	2.21	15.00	1.57	20.00	1.24	25.00	1.05
2.5	5.00	10.11	10.00	5.17	15.00	3.53	20.00	2.70	25.00	2.21
3.0	5.00	14.55	10.00	7.39	15.00	5.01	20.00	3.81	25.00	3.10
4.0	5.00	25.84	10.00	13.04	15.00	8.77	20.00	6.64	25.00	5.35
6.0	5.00	57.69	10.00	28.96	15.00	19.39	20.00	14.60	25.00	11.73

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	0.92	35.00	0.83	40.00	0.76	45.00	0.70	0.00	0.00
2.5	30.00	1.88	35.00	1.65	40.00	1.47	45.00	1.33	0.00	0.00
3.0	30.00	2.62	35.00	2.28	40.00	2.02	45.00	1.82	0.00	0.00
4.0	30.00	4.50	35.00	3.89	40.00	3.43	45.00	3.08	0.00	0.00
6.0	30.00	9.81	35.00	8.44	40.00	7.42	45.00	6.62	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	193.16	0.00541	422.03	0.00847	626.33
0.00245	201.19	0.00551	429.23	0.00857	632.72
0.00256	209.19	0.00561	436.41	0.00867	639.08
0.00266	217.16	0.00572	443.56	0.00877	645.41
0.00276	225.10	0.00582	450.69	0.00888	651.72
0.00286	233.01	0.00592	457.78	0.00898	657.99
0.00296	240.90	0.00602	464.85	0.00908	664.24
0.00307	248.76	0.00612	471.89	0.00918	670.47
0.00317	256.60	0.00623	478.91	0.00928	676.66
0.00327	264.40	0.00633	485.90	0.00939	682.83
0.00337	272.18	0.00643	492.86	0.00949	688.97
0.00347	279.93	0.00653	499.79	0.00959	695.09
0.00358	287.66	0.00663	506.70	0.00969	701.17
0.00368	295.35	0.00674	513.57	0.00979	707.23
0.00378	303.02	0.00684	520.42	0.00989	713.27
0.00388	310.67	0.00694	527.25	0.01000	719.27
0.00398	318.28	0.00704	534.05	0.01010	725.25
0.00408	325.87	0.00714	540.81	0.01020	731.20
0.00419	333.43	0.00724	547.56	0.01030	737.12
0.00429	340.96	0.00735	554.27	0.01040	743.02
0.00439	348.47	0.00745	560.96	0.01051	748.89
0.00449	355.95	0.00755	567.62	0.01061	754.73
0.00459	363.40	0.00765	574.25	0.01071	760.54
0.00470	370.82	0.00775	580.84	0.01081	766.33
0.00480	378.22	0.00786	587.43	0.01091	772.09
0.00490	385.59	0.00796	593.99	0.01102	777.82
0.00500	392.93	0.00806	600.51	0.01112	783.53
0.00510	400.25	0.00816	607.01	0.01122	789.20
0.00521	407.53	0.00826	613.47	0.01132	794.85
0.00531	414.79	0.00837	619.92	0.01142	800.48

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

# Barras =>	1		2		3		4		5	
No. de Desiinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.26	0.98	0.50	1.47	0.71	1.96	0.00	2.45	0.00
3.0	0.71	0.37	1.42	0.69	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.63	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	0.00	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desiinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Ks/cm2 **Seccion:** b = 10 cm x h = 20 cm

***** Para P >= 0.01 *****

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.27 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.03 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.64	10.00	2.70	15.00	2.05	20.00	1.73	25.00	1.53
2.5	5.00	10.63	10.00	5.69	15.00	4.05	20.00	3.22	25.00	2.73
3.0	5.00	15.07	10.00	7.91	15.00	5.53	20.00	4.33	25.00	3.62
4.0	5.00	26.36	10.00	13.56	15.00	9.29	20.00	7.15	25.00	5.87
6.0	5.00	58.21	10.00	29.48	15.00	19.91	20.00	15.12	25.00	12.25

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.40	35.00	1.31	40.00	1.24	45.00	1.19	0.00	0.00
2.5	30.00	2.40	35.00	2.17	40.00	1.99	45.00	1.85	0.00	0.00
3.0	30.00	3.14	35.00	2.80	40.00	2.54	45.00	2.34	0.00	0.00
4.0	30.00	5.02	35.00	4.41	40.00	3.95	45.00	3.60	0.00	0.00
6.0	30.00	10.33	35.00	8.96	40.00	7.94	45.00	7.14	0.00	0.00

TABLA #3.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00610)

Para Pmin < P < 0.01

RESTRICCIONES			
Estribos No. de Designacion	Separacion Maxima [cm]	Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.27 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.03 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.31	10.00	2.37	15.00	1.72	20.00	1.40	25.00	1.20		
2.5	5.00	10.28	10.00	5.34	15.00	3.69	20.00	2.87	25.00	2.38		
3.0	5.00	14.72	10.00	7.56	15.00	5.17	20.00	3.98	25.00	3.26		
4.0	5.00	26.01	10.00	13.20	15.00	8.94	20.00	6.80	25.00	5.52		
6.0	5.00	57.86	10.00	29.13	15.00	19.55	20.00	14.77	25.00	11.89		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.08	35.00	0.98	40.00	0.91	45.00	0.86	0.00	0.00		
2.5	30.00	2.05	35.00	1.81	40.00	1.64	45.00	1.50	0.00	0.00		
3.0	30.00	2.79	35.00	2.45	40.00	2.19	45.00	1.99	0.00	0.00		
4.0	30.00	4.67	35.00	4.06	40.00	3.60	45.00	3.25	0.00	0.00		
6.0	30.00	9.98	35.00	8.61	40.00	7.58	45.00	6.79	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.27 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.03 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.22	10.00	2.27	15.00	1.63	20.00	1.30	25.00	1.11
2.5	5.00	10.16	10.00	5.22	15.00	3.57	20.00	2.75	25.00	2.26
3.0	5.00	14.59	10.00	7.44	15.00	5.05	20.00	3.86	25.00	3.14
4.0	5.00	25.88	10.00	13.08	15.00	8.82	20.00	6.68	25.00	5.40
6.0	5.00	57.74	10.00	29.01	15.00	19.43	20.00	14.64	25.00	11.77

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	0.76	35.00	0.69	40.00	0.62	45.00	0.76	0.00	0.00
2.5	30.00	1.93	35.00	1.69	40.00	1.52	45.00	1.38	0.00	0.00
3.0	30.00	2.67	35.00	2.33	40.00	2.07	45.00	1.87	0.00	0.00
4.0	30.00	4.55	35.00	3.94	40.00	3.48	45.00	3.13	0.00	0.00
6.0	30.00	9.86	35.00	8.49	40.00	7.46	45.00	6.66	0.00	0.00

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f`c = 250 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	216.83	0.00656	512.87	0.0104B	776.51
0.00276	227.22	0.00669	522.18	0.01062	784.74
0.00289	237.57	0.00682	531.45	0.01075	792.93
0.00302	247.89	0.00695	540.69	0.01088	801.09
0.00315	258.17	0.00708	549.89	0.01101	809.21
0.00328	268.42	0.00721	559.06	0.01114	817.30
0.00342	278.63	0.00734	568.19	0.01127	825.35
0.00355	288.80	0.00747	577.28	0.01140	833.36
0.00368	298.94	0.00760	586.34	0.01153	841.34
0.00381	309.04	0.00774	595.36	0.01166	849.28
0.00394	319.11	0.00787	604.35	0.01179	857.19
0.00407	329.14	0.00800	613.30	0.01192	865.06
0.00420	339.13	0.00813	622.21	0.01206	872.89
0.00433	349.09	0.00826	631.09	0.01219	880.69
0.00446	359.01	0.00839	639.93	0.01232	888.45
0.00459	368.90	0.00852	648.74	0.01245	896.18
0.00472	378.75	0.00865	657.51	0.01258	903.87
0.00486	388.56	0.00878	666.25	0.01271	911.52
0.00499	398.34	0.00891	674.94	0.01284	919.14
0.00512	408.08	0.00904	683.61	0.01297	926.72
0.00525	417.79	0.00918	692.23	0.01310	934.27
0.00538	427.46	0.00931	700.82	0.01323	941.78
0.00551	437.09	0.00944	709.38	0.01336	949.25
0.00564	446.69	0.00957	717.89	0.01349	956.69
0.00577	456.25	0.00970	726.38	0.01363	964.09
0.00590	465.78	0.00983	734.82	0.01376	971.46
0.00603	475.27	0.00996	743.23	0.01389	978.79
0.00616	484.72	0.01009	751.60	0.01402	986.08
0.00630	494.14	0.01022	759.94	0.01415	993.34
0.00643	503.52	0.01035	768.24	0.01428	1,000.56

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.27	0.98	0.51	1.47	0.73	1.96	0.93	2.45	0.00
3.0	0.71	0.38	1.42	0.71	2.13	1.00	2.84	0.00	3.55	0.00
4.0	1.27	0.64	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.94	3.96	0.00	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	0.00	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.54 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.39 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.73	10.00	2.79	15.00	2.14	20.00	1.82	25.00	1.62
2.5	5.00	10.72	10.00	5.78	15.00	4.14	20.00	3.31	25.00	2.82
3.0	5.00	15.16	10.00	8.00	15.00	5.61	20.00	4.42	25.00	3.71
4.0	5.00	26.45	10.00	13.65	15.00	9.38	20.00	7.24	25.00	5.96
6.0	5.00	58.30	10.00	29.57	15.00	20.00	20.00	15.21	25.00	12.33

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.49	35.00	1.40	40.00	1.33	45.00	1.28	0.00	0.00
2.5	30.00	2.49	35.00	2.25	40.00	2.08	45.00	1.94	0.00	0.00
3.0	30.00	3.23	35.00	2.89	40.00	2.63	45.00	2.43	0.00	0.00
4.0	30.00	5.11	35.00	4.50	40.00	4.04	45.00	3.69	0.00	0.00
6.0	30.00	10.42	35.00	9.05	40.00	8.03	45.00	7.23	0.00	0.00

TABLA 83.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Desinacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)		S (Maxima)	
2.0	18.50				
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c =	2.54 Ton	S = d / 2 =	7.50 cm
3.0	68.16				
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c =	3.39 Ton	S = d / 4 =	3.75 cm
6.0	273.60				

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.37	10.00	2.43	15.00	1.78	20.00	1.46	25.00	1.26
2.5	5.00	10.34	10.00	5.40	15.00	3.75	20.00	2.93	25.00	2.43
3.0	5.00	14.77	10.00	7.61	15.00	5.23	20.00	4.04	25.00	3.32
4.0	5.00	26.06	10.00	13.26	15.00	8.99	20.00	6.86	25.00	5.58
6.0	5.00	57.91	10.00	29.19	15.00	19.61	20.00	14.82	25.00	11.75

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.13	35.00	1.04	40.00	0.97	45.00	0.92	0.00	0.00
2.5	30.00	2.10	35.00	1.87	40.00	1.69	45.00	1.55	0.00	0.00
3.0	30.00	2.84	35.00	2.50	40.00	2.25	45.00	2.05	0.00	0.00
4.0	30.00	4.72	35.00	4.11	40.00	3.66	45.00	3.36	0.00	0.00
6.0	30.00	10.03	35.00	8.67	40.00	7.64	45.00	6.84	0.00	0.00

TABLA #3.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00263)

Para P = Pmin

RESTRICCIONES			
Estribos No. de Designacion	Separacion Maxima [cm]	Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.54 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.39 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.27	10.00	2.33	15.00	1.68	20.00	1.36	25.00	1.16		
2.5	5.00	10.20	10.00	5.26	15.00	3.62	20.00	2.79	25.00	2.30		
3.0	5.00	14.64	10.00	7.48	15.00	5.10	20.00	3.90	25.00	3.19		
4.0	5.00	25.93	10.00	13.13	15.00	8.86	20.00	6.73	25.00	5.45		
6.0	5.00	57.78	10.00	29.05	15.00	19.48	20.00	14.69	25.00	11.82		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.03	35.00	0.94	40.00	0.87	45.00	0.82	0.00	0.00		
2.5	30.00	1.97	35.00	1.74	40.00	1.56	45.00	1.42	0.00	0.00		
3.0	30.00	2.71	35.00	2.37	40.00	2.11	45.00	1.92	0.00	0.00		
4.0	30.00	4.59	35.00	3.98	40.00	3.53	45.00	3.17	0.00	0.00		
6.0	30.00	9.90	35.00	8.53	40.00	7.51	45.00	6.71	0.00	0.00		

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 300 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 10 cm
h = 20 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	238.22	0.00769	602.41	0.01249	926.17
0.00304	251.01	0.00785	613.85	0.01265	936.26
0.00320	263.75	0.00801	625.25	0.01281	946.31
0.00336	276.46	0.00817	636.60	0.01297	956.32
0.00352	289.11	0.00833	647.91	0.01313	966.28
0.00368	301.72	0.00849	659.18	0.01329	976.19
0.00384	314.29	0.00865	670.40	0.01345	986.07
0.00400	326.81	0.00881	681.57	0.01361	995.89
0.00416	339.29	0.00897	692.70	0.01377	1,005.67
0.00432	351.72	0.00913	703.78	0.01393	1,015.41
0.00448	364.11	0.00929	714.82	0.01409	1,025.10
0.00464	376.45	0.00945	725.81	0.01425	1,034.75
0.00480	388.75	0.00961	736.76	0.01441	1,044.35
0.00496	401.00	0.00977	747.67	0.01457	1,053.90
0.00512	413.21	0.00993	758.53	0.01474	1,063.42
0.00528	425.37	0.01009	769.34	0.01490	1,072.88
0.00544	437.48	0.01025	780.11	0.01506	1,082.30
0.00560	449.56	0.01041	790.84	0.01522	1,091.68
0.00576	461.58	0.01057	801.52	0.01538	1,101.01
0.00593	473.57	0.01073	812.15	0.01554	1,110.30
0.00609	485.50	0.01089	822.74	0.01570	1,119.54
0.00625	497.40	0.01105	833.28	0.01586	1,128.74
0.00641	509.24	0.01121	843.78	0.01602	1,137.89
0.00657	521.05	0.01137	854.24	0.01618	1,147.00
0.00673	532.81	0.01153	864.65	0.01634	1,156.06
0.00689	544.52	0.01169	875.01	0.01650	1,165.08
0.00705	556.19	0.01185	885.33	0.01666	1,174.05
0.00721	567.81	0.01201	895.61	0.01682	1,182.98
0.00737	579.39	0.01217	905.84	0.01698	1,191.86
0.00753	590.92	0.01233	916.03	0.01714	1,200.70

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 10 cm
fy = 4200 Kg/cm2	h = 20 cm

# Barras =>	1		2		3		4		5	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.27	0.98	0.52	1.47	0.75	1.96	0.96	2.45	1.16
3.0	0.71	0.38	1.42	0.73	2.13	1.03	2.84	0.00	3.55	0.00
4.0	1.27	0.66	2.54	1.19	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.97	3.96	0.00	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	0.00	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

*** Para P >= 0.01 ***

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.78 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.71 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.81	10.00	2.87	15.00	2.22	20.00	1.90	25.00	1.70		
2.5	5.00	10.80	10.00	5.86	15.00	4.22	20.00	3.39	25.00	2.90		
3.0	5.00	15.24	10.00	8.08	15.00	5.70	20.00	4.50	25.00	3.79		
4.0	5.00	26.53	10.00	13.73	15.00	9.46	20.00	7.33	25.00	6.05		
6.0	5.00	58.38	10.00	29.65	15.00	20.08	20.00	15.29	25.00	12.42		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.57	35.00	1.48	40.00	1.41	45.00	1.36	0.00	0.00		
2.5	30.00	2.57	35.00	2.34	40.00	2.16	45.00	2.02	0.00	0.00		
3.0	30.00	3.31	35.00	2.97	40.00	2.71	45.00	2.51	0.00	0.00		
4.0	30.00	5.19	35.00	4.58	40.00	4.12	45.00	3.77	0.00	0.00		
6.0	30.00	10.50	35.00	9.13	40.00	8.11	45.00	7.31	0.00	0.00		

TABLA #3.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	18.50		
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c = 2.78 Ton	S = d / 2 = 7.50 cm
3.0	68.16		
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c = 3.71 Ton	S = d / 4 = 3.75 cm
6.0	273.60		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.43	10.00	2.48	15.00	1.84	20.00	1.51	25.00	1.32		
2.5	5.00	10.38	10.00	5.44	15.00	3.80	20.00	2.97	25.00	2.48		
3.0	5.00	14.82	10.00	7.66	15.00	5.28	20.00	4.08	25.00	3.37		
4.0	5.00	26.11	10.00	13.31	15.00	9.04	20.00	6.91	25.00	5.63		
6.0	5.00	57.96	10.00	29.23	15.00	19.66	20.00	14.87	25.00	12.00		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.19	35.00	1.10	40.00	1.03	45.00	0.97	0.00	0.00		
2.5	30.00	2.15	35.00	1.92	40.00	1.74	45.00	1.60	0.00	0.00		
3.0	30.00	2.89	35.00	2.55	40.00	2.29	45.00	2.10	0.00	0.00		
4.0	30.00	4.77	35.00	4.16	40.00	3.71	45.00	3.35	0.00	0.00		
6.0	30.00	10.08	35.00	8.71	40.00	7.69	45.00	6.89	0.00	0.00		

TABLA #3.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 10 cm x h = 20 cm

(0.00288)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	18.50			
2.5	47.04	Vu <= 1.5 * FR * b * d * raiz f* c =	2.78 Ton	S = d / 2 = 7.50 cm
3.0	68.16			
4.0	121.92	Vu <= 2.0 * FR * b * d * raiz f* c =	3.71 Ton	S = d / 4 = 3.75 cm
6.0	273.60			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	4.32	10.00	2.38	15.00	1.73	20.00	1.41	25.00	1.22
2.5	5.00	10.24	10.00	5.30	15.00	3.66	20.00	2.83	25.00	2.34
3.0	5.00	14.68	10.00	7.52	15.00	5.14	20.00	3.94	25.00	3.23
4.0	5.00	25.97	10.00	13.17	15.00	8.90	20.00	6.77	25.00	5.49
6.0	5.00	57.82	10.00	29.09	15.00	19.52	20.00	14.73	25.00	11.86

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.09	35.00	0.99	40.00	0.92	45.00	0.87	0.00	0.00
2.5	30.00	2.01	35.00	1.78	40.00	1.60	45.00	1.46	0.00	0.00
3.0	30.00	2.75	35.00	2.41	40.00	2.15	45.00	1.95	0.00	0.00
4.0	30.00	4.63	35.00	4.02	40.00	3.56	45.00	3.21	0.00	0.00
6.0	30.00	9.94	35.00	8.57	40.00	7.55	45.00	6.75	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	692.96	0.00424	1,372.07	0.00644	1,980.48
0.00211	716.74	0.00431	1,393.48	0.00651	1,999.54
0.00218	740.43	0.00438	1,414.83	0.00659	2,018.52
0.00226	764.05	0.00446	1,436.09	0.00666	2,037.43
0.00233	787.59	0.00453	1,457.27	0.00673	2,056.26
0.00240	811.05	0.00460	1,478.38	0.00681	2,075.00
0.00248	834.44	0.00468	1,499.40	0.00688	2,093.67
0.00255	857.74	0.00475	1,520.35	0.00695	2,112.27
0.00262	880.97	0.00482	1,541.22	0.00703	2,130.78
0.00270	904.11	0.00490	1,562.01	0.00710	2,149.21
0.00277	927.18	0.00497	1,582.72	0.00717	2,167.57
0.00284	950.17	0.00504	1,603.36	0.00725	2,185.85
0.00292	973.09	0.00512	1,623.91	0.00732	2,204.05
0.00299	995.92	0.00519	1,644.39	0.00739	2,222.17
0.00306	1,018.67	0.00526	1,664.79	0.00747	2,240.21
0.00314	1,041.35	0.00534	1,685.11	0.00754	2,258.17
0.00321	1,063.95	0.00541	1,705.35	0.00761	2,276.06
0.00328	1,086.47	0.00548	1,725.51	0.00769	2,293.86
0.00336	1,108.91	0.00556	1,745.60	0.00776	2,311.59
0.00343	1,131.27	0.00563	1,765.60	0.00783	2,329.24
0.00350	1,153.55	0.00570	1,785.53	0.00791	2,346.81
0.00358	1,175.76	0.00578	1,805.38	0.00798	2,364.30
0.00365	1,197.88	0.00585	1,825.15	0.00805	2,381.71
0.00372	1,219.93	0.00592	1,844.84	0.00813	2,399.05
0.00380	1,241.90	0.00600	1,864.45	0.00820	2,416.30
0.00387	1,263.79	0.00607	1,883.98	0.00827	2,433.48
0.00394	1,285.60	0.00614	1,903.44	0.00835	2,450.58
0.00402	1,307.34	0.00622	1,922.82	0.00842	2,467.60
0.00409	1,328.99	0.00629	1,942.11	0.00849	2,484.54
0.00416	1,350.57	0.00637	1,961.33	0.00857	2,501.41

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.88	1.47	1.28	1.96	1.65	2.45	2.00
3.0	0.71	0.00	1.42	1.24	2.13	1.78	2.84	2.27	3.55	0.00
4.0	1.27	1.12	2.54	2.07	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	1.67	3.96	0.00	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	2.27	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	2.33	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 **Seccion:** b = 15 cm x h = 30 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 4.92 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 6.57 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	8.11	10.00	4.88	15.00	3.80	20.00	3.26	25.00	2.93		
2.5	5.00	18.10	10.00	9.87	15.00	7.13	20.00	5.75	25.00	4.93		
3.0	5.00	25.49	10.00	13.57	15.00	9.59	20.00	7.60	25.00	6.41		
4.0	5.00	44.31	10.00	22.97	15.00	15.86	20.00	12.31	25.00	10.17		
6.0	5.00	97.40	10.00	49.52	15.00	33.56	20.00	25.58	25.00	20.79		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.72	35.00	2.56	40.00	2.45	45.00	2.36	0.00	0.00		
2.5	30.00	4.38	35.00	3.99	40.00	3.70	45.00	3.47	0.00	0.00		
3.0	30.00	5.61	35.00	5.05	40.00	4.62	45.00	4.29	0.00	0.00		
4.0	30.00	8.75	35.00	7.73	40.00	6.97	45.00	6.38	0.00	0.00		
6.0	30.00	17.60	35.00	15.32	40.00	13.61	45.00	12.28	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 4.92 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 6.57 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.39	10.00	4.15	15.00	3.07	20.00	2.53	25.00	2.21		
2.5	5.00	17.33	10.00	9.10	15.00	6.36	20.00	4.99	25.00	4.16		
3.0	5.00	24.73	10.00	12.80	15.00	8.82	20.00	6.83	25.00	5.64		
4.0	5.00	43.54	10.00	22.21	15.00	15.09	20.00	11.54	25.00	9.40		
6.0	5.00	96.63	10.00	48.75	15.00	32.79	20.00	24.81	25.00	20.02		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.99	35.00	1.84	40.00	1.72	45.00	1.63	0.00	0.00		
2.5	30.00	3.61	35.00	3.22	40.00	2.93	45.00	2.70	0.00	0.00		
3.0	30.00	4.85	35.00	4.28	40.00	3.85	45.00	3.52	0.00	0.00		
4.0	30.00	7.98	35.00	6.97	40.00	6.20	45.00	5.61	0.00	0.00		
6.0	30.00	16.83	35.00	14.55	40.00	12.84	45.00	11.51	0.00	0.00		

TABLA #3.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00204)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	12.33			
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c =	4.92 Ton	S = d / 2 = 12.50 cm
3.0	45.44			
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c =	6.57 Ton	S = d / 4 = 6.25 cm
6.0	182.40			

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.16	10.00	3.92	15.00	2.84	20.00	2.30	25.00	1.98		
2.5	5.00	17.06	10.00	8.83	15.00	6.08	20.00	4.71	25.00	3.89		
3.0	5.00	24.45	10.00	12.52	15.00	8.55	20.00	6.56	25.00	5.36		
4.0	5.00	43.27	10.00	21.93	15.00	14.82	20.00	11.26	25.00	9.13		
6.0	5.00	96.35	10.00	48.47	15.00	32.51	20.00	24.53	25.00	19.75		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.76	35.00	1.61	40.00	1.49	45.00	1.40	0.00	0.00		
2.5	30.00	3.34	35.00	2.95	40.00	2.65	45.00	2.42	0.00	0.00		
3.0	30.00	4.57	35.00	4.00	40.00	3.58	45.00	3.24	0.00	0.00		
4.0	30.00	7.71	35.00	6.69	40.00	5.93	45.00	5.33	0.00	0.00		
6.0	30.00	16.55	35.00	14.27	40.00	12.56	45.00	11.23	0.00	0.00		

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	804.06	0.00541	1,758.46	0.00847	2,609.73
0.00245	838.30	0.00551	1,788.49	0.00857	2,636.34
0.00256	871.62	0.00561	1,818.40	0.00867	2,662.84
0.00266	904.83	0.00572	1,848.19	0.00877	2,689.22
0.00276	937.92	0.00582	1,877.88	0.00888	2,715.50
0.00286	970.90	0.00592	1,907.45	0.00898	2,741.65
0.00296	1,003.77	0.00602	1,936.90	0.00908	2,767.70
0.00307	1,036.52	0.00612	1,966.24	0.00918	2,793.63
0.00317	1,069.16	0.00623	1,995.47	0.00928	2,819.45
0.00327	1,101.69	0.00633	2,024.59	0.00939	2,845.15
0.00337	1,134.10	0.00643	2,053.59	0.00949	2,870.74
0.00347	1,166.40	0.00653	2,082.47	0.00959	2,896.21
0.00358	1,198.58	0.00663	2,111.25	0.00969	2,921.58
0.00368	1,230.65	0.00674	2,139.91	0.00979	2,946.83
0.00378	1,262.61	0.00684	2,168.45	0.00989	2,971.96
0.00388	1,294.45	0.00694	2,196.89	0.01000	2,996.98
0.00398	1,326.18	0.00704	2,225.20	0.01010	3,021.89
0.00408	1,357.80	0.00714	2,253.41	0.01020	3,046.68
0.00419	1,389.30	0.00724	2,281.50	0.01030	3,071.36
0.00429	1,420.69	0.00735	2,309.48	0.01040	3,095.93
0.00439	1,451.97	0.00745	2,337.34	0.01051	3,120.38
0.00449	1,483.13	0.00755	2,365.09	0.01061	3,144.72
0.00459	1,514.18	0.00765	2,392.73	0.01071	3,168.95
0.00470	1,545.11	0.00775	2,420.25	0.01081	3,193.06
0.00480	1,575.93	0.00786	2,447.66	0.01091	3,217.06
0.00490	1,606.64	0.00796	2,474.95	0.01102	3,240.94
0.00500	1,637.23	0.00806	2,502.14	0.01112	3,264.71
0.00510	1,667.71	0.00816	2,529.20	0.01122	3,288.37
0.00521	1,698.07	0.00826	2,556.16	0.01132	3,311.91
0.00531	1,728.32	0.00837	2,583.00	0.01142	3,335.34

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 200 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 15 cm
h = 30 cm

# Barras =>	1		2		3		4		5	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.89	1.47	1.31	1.96	1.70	2.45	2.08
3.0	0.71	0.00	1.42	1.26	2.13	1.84	2.84	2.37	3.55	2.86
4.0	1.27	1.14	2.54	2.15	3.81	3.04	5.08	0.00	6.35	0.00
5.0	1.98	1.72	3.96	3.13	5.94	4.00	7.92	0.00	9.90	0.00
6.0	2.85	2.38	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	0.00	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	2.44	3.43	2.78	3.92	3.11	4.41	0.00	4.90	0.00
3.0	4.26	3.32	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.92	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	12.33			
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c =	5.69 Ton	S = d / 2 = 12.50 cm
3.0	45.44			
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c =	7.58 Ton	S = d / 4 = 6.25 cm
6.0	182.40			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	8.37	10.00	5.13	15.00	4.05	20.00	3.51	25.00	3.19		
2.5	5.00	18.36	10.00	10.12	15.00	7.38	20.00	6.01	25.00	5.19		
3.0	5.00	25.75	10.00	13.82	15.00	9.84	20.00	7.86	25.00	6.66		
4.0	5.00	44.56	10.00	23.23	15.00	16.12	20.00	12.56	25.00	10.43		
6.0	5.00	97.65	10.00	49.77	15.00	33.81	20.00	25.83	25.00	21.04		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.97	35.00	2.82	40.00	2.70	45.00	2.61	0.00	0.00		
2.5	30.00	4.64	35.00	4.24	40.00	3.95	45.00	3.72	0.00	0.00		
3.0	30.00	5.87	35.00	5.30	40.00	4.87	45.00	4.54	0.00	0.00		
4.0	30.00	9.00	35.00	7.99	40.00	7.23	45.00	6.63	0.00	0.00		
6.0	30.00	17.85	35.00	15.57	40.00	13.86	45.00	12.53	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00610)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 5.69 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 7.58 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.55	10.00	4.31	15.00	3.24	20.00	2.70	25.00	2.37		
2.5	5.00	17.48	10.00	9.24	15.00	6.50	20.00	5.13	25.00	4.31		
3.0	5.00	24.87	10.00	12.94	15.00	8.96	20.00	6.98	25.00	5.78		
4.0	5.00	43.68	10.00	22.35	15.00	15.24	20.00	11.68	25.00	9.55		
6.0	5.00	96.77	10.00	48.89	15.00	32.93	20.00	24.95	25.00	20.16		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.16	35.00	2.00	40.00	1.89	45.00	1.80	0.00	0.00		
2.5	30.00	3.76	35.00	3.36	40.00	3.07	45.00	2.84	0.00	0.00		
3.0	30.00	4.99	35.00	4.42	40.00	3.99	45.00	3.66	0.00	0.00		
4.0	30.00	8.12	35.00	7.11	40.00	6.35	45.00	5.75	0.00	0.00		
6.0	30.00	16.97	35.00	14.69	40.00	12.98	45.00	11.65	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 5.69 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 7.58 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.31	10.00	4.08	15.00	3.00	20.00	2.46	25.00	2.13		
2.5	5.00	17.17	10.00	8.94	15.00	6.20	20.00	4.83	25.00	4.00		
3.0	5.00	24.57	10.00	12.64	15.00	8.66	20.00	6.67	25.00	5.48		
4.0	5.00	43.38	10.00	22.05	15.00	14.93	20.00	11.38	25.00	9.24		
6.0	5.00	96.47	10.00	48.59	15.00	32.63	20.00	24.65	25.00	19.86		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	1.92	35.00	1.76	40.00	1.65	45.00	1.56	0.00	0.00		
2.5	30.00	3.45	35.00	3.06	40.00	2.77	45.00	2.54	0.00	0.00		
3.0	30.00	4.69	35.00	4.12	40.00	3.69	45.00	3.36	0.00	0.00		
4.0	30.00	7.82	35.00	6.81	40.00	6.04	45.00	5.45	0.00	0.00		
6.0	30.00	16.67	35.00	14.39	40.00	12.68	45.00	11.35	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	903.45	0.00656	2,136.97	0.01048	3,235.48
0.00276	946.75	0.00669	2,175.77	0.01062	3,269.77
0.00289	989.89	0.00682	2,214.41	0.01075	3,303.91
0.00302	1,032.88	0.00695	2,252.90	0.01088	3,337.90
0.00315	1,075.73	0.00708	2,291.24	0.01101	3,371.74
0.00328	1,118.42	0.00721	2,329.43	0.01114	3,405.44
0.00342	1,160.96	0.00734	2,367.48	0.01127	3,438.98
0.00355	1,203.35	0.00747	2,405.37	0.01140	3,472.37
0.00368	1,245.59	0.00760	2,443.11	0.01153	3,505.61
0.00381	1,287.69	0.00774	2,480.70	0.01166	3,538.70
0.00394	1,329.63	0.00787	2,518.14	0.01179	3,571.64
0.00407	1,371.42	0.00800	2,555.44	0.01192	3,604.43
0.00420	1,413.06	0.00813	2,592.58	0.01206	3,637.07
0.00433	1,454.56	0.00826	2,629.57	0.01219	3,669.57
0.00446	1,495.90	0.00839	2,666.41	0.01232	3,701.91
0.00459	1,537.09	0.00852	2,703.10	0.01245	3,734.10
0.00472	1,578.13	0.00865	2,739.64	0.01258	3,766.14
0.00486	1,619.03	0.00878	2,776.04	0.01271	3,798.03
0.00499	1,659.77	0.00891	2,812.28	0.01284	3,829.77
0.00512	1,700.36	0.00904	2,848.37	0.01297	3,861.36
0.00525	1,740.80	0.00918	2,884.31	0.01310	3,892.80
0.00538	1,781.10	0.00931	2,920.10	0.01323	3,924.10
0.00551	1,821.24	0.00944	2,955.75	0.01336	3,955.24
0.00564	1,861.23	0.00957	2,991.24	0.01349	3,986.23
0.00577	1,901.07	0.00970	3,026.58	0.01363	4,017.07
0.00590	1,940.76	0.00983	3,061.77	0.01376	4,047.76
0.00603	1,980.31	0.00996	3,096.81	0.01389	4,078.30
0.00616	2,019.70	0.01009	3,131.70	0.01402	4,108.69
0.00630	2,058.94	0.01022	3,166.44	0.01415	4,138.93
0.00643	2,098.03	0.01035	3,201.04	0.01428	4,169.02

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	1.32	1.96	1.73	2.45	2.13
3.0	0.71	0.00	1.42	1.28	2.13	1.87	2.84	2.43	3.55	2.96
4.0	1.27	1.15	2.54	2.20	3.81	3.15	5.08	4.00	6.35	0.00
5.0	1.98	1.75	3.96	3.25	5.94	0.00	7.92	0.00	9.90	0.00
6.0	2.85	2.44	5.70	0.00	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	3.99	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	2.51	3.43	2.88	3.92	3.23	4.41	3.56	4.90	3.88
3.0	4.26	3.46	4.97	3.93	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 6.36 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 8.48 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	8.59	10.00	5.35	15.00	4.28	20.00	3.74	25.00	3.41
2.5	5.00	18.58	10.00	10.35	15.00	7.60	20.00	6.23	25.00	5.41
3.0	5.00	25.97	10.00	14.04	15.00	10.07	20.00	8.08	25.00	6.89
4.0	5.00	44.79	10.00	23.45	15.00	16.34	20.00	12.78	25.00	10.65
6.0	5.00	97.88	10.00	50.00	15.00	34.04	20.00	26.06	25.00	21.27

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.20	35.00	3.04	40.00	2.93	45.00	2.84	0.00	0.00
2.5	30.00	4.86	35.00	4.47	40.00	4.17	45.00	3.95	0.00	0.00
3.0	30.00	6.09	35.00	5.52	40.00	5.10	45.00	4.77	0.00	0.00
4.0	30.00	9.23	35.00	8.21	40.00	7.45	45.00	6.86	0.00	0.00
6.0	30.00	18.08	35.00	15.80	40.00	14.09	45.00	12.76	0.00	0.00

TABLA 03.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 6.36 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 8.48 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.70	10.00	4.46	15.00	3.38	20.00	2.84	25.00	2.52		
2.5	5.00	17.61	10.00	9.38	15.00	6.64	20.00	5.27	25.00	4.44		
3.0	5.00	25.01	10.00	13.08	15.00	9.10	20.00	7.11	25.00	5.92		
4.0	5.00	43.82	10.00	22.49	15.00	15.37	20.00	11.82	25.00	9.68		
6.0	5.00	96.91	10.00	49.03	15.00	33.07	20.00	25.09	25.00	20.30		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.30	35.00	2.15	40.00	2.03	45.00	1.94	0.00	0.00		
2.5	30.00	3.89	35.00	3.50	40.00	3.21	45.00	2.98	0.00	0.00		
3.0	30.00	5.13	35.00	4.56	40.00	4.13	45.00	3.80	0.00	0.00		
4.0	30.00	8.26	35.00	7.25	40.00	6.48	45.00	5.89	0.00	0.00		
6.0	30.00	17.11	35.00	14.83	40.00	13.12	45.00	11.79	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00263)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f'c = 6.36 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f'c = 8.48 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.45	10.00	4.21	15.00	3.13	20.00	2.59	25.00	2.27
2.5	5.00	17.28	10.00	9.05	15.00	6.31	20.00	4.94	25.00	4.11
3.0	5.00	24.68	10.00	12.75	15.00	8.77	20.00	6.78	25.00	5.59
4.0	5.00	43.49	10.00	22.16	15.00	15.04	20.00	11.49	25.00	9.36
6.0	5.00	96.58	10.00	48.70	15.00	32.74	20.00	24.76	25.00	19.97

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.05	35.00	1.90	40.00	1.78	45.00	1.69	0.00	0.00
2.5	30.00	3.56	35.00	3.17	40.00	2.88	45.00	2.65	0.00	0.00
3.0	30.00	4.80	35.00	4.23	40.00	3.80	45.00	3.47	0.00	0.00
4.0	30.00	7.93	35.00	6.92	40.00	6.15	45.00	5.56	0.00	0.00
6.0	30.00	16.78	35.00	14.50	40.00	12.79	45.00	11.46	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 15 cm
fy = 4200 Kg/cm2	h = 30 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	992.59	0.00769	2,510.05	0.01249	3,859.04
0.00304	1,045.88	0.00785	2,557.73	0.01265	3,901.11
0.00320	1,098.99	0.00801	2,605.23	0.01281	3,942.98
0.00336	1,151.92	0.00817	2,652.53	0.01297	3,984.67
0.00352	1,204.65	0.00833	2,699.65	0.01313	4,026.18
0.00368	1,257.20	0.00849	2,746.58	0.01329	4,067.49
0.00384	1,309.56	0.00865	2,793.33	0.01345	4,108.62
0.00400	1,361.73	0.00881	2,839.89	0.01361	4,149.56
0.00416	1,413.72	0.00897	2,886.26	0.01377	4,190.32
0.00432	1,465.52	0.00913	2,932.44	0.01393	4,230.88
0.00448	1,517.13	0.00929	2,978.44	0.01409	4,271.26
0.00464	1,568.55	0.00945	3,024.24	0.01425	4,311.46
0.00480	1,619.79	0.00961	3,069.87	0.01441	4,351.46
0.00496	1,670.84	0.00977	3,115.30	0.01457	4,391.28
0.00512	1,721.70	0.00993	3,160.55	0.01474	4,430.91
0.00528	1,772.38	0.01009	3,205.61	0.01490	4,470.36
0.00544	1,822.87	0.01025	3,250.48	0.01506	4,509.61
0.00560	1,873.17	0.01041	3,295.16	0.01522	4,548.68
0.00576	1,923.28	0.01057	3,339.66	0.01538	4,587.57
0.00593	1,973.21	0.01073	3,383.97	0.01554	4,626.26
0.00609	2,022.95	0.01089	3,428.10	0.01570	4,664.77
0.00625	2,072.50	0.01105	3,472.03	0.01586	4,703.09
0.00641	2,121.87	0.01121	3,515.78	0.01602	4,741.22
0.00657	2,171.05	0.01137	3,559.35	0.01618	4,779.17
0.00673	2,220.04	0.01153	3,602.72	0.01634	4,816.93
0.00689	2,268.84	0.01169	3,645.91	0.01650	4,854.50
0.00705	2,317.46	0.01185	3,688.91	0.01666	4,891.88
0.00721	2,365.89	0.01201	3,731.72	0.01682	4,929.08
0.00737	2,414.13	0.01217	3,774.35	0.01698	4,966.09
0.00753	2,462.18	0.01233	3,816.79	0.01714	5,002.92

TABLA 82

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Ks/cm2	b = 15 cm
fy = 4200 Ks/cm2	h = 30 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	1.33	1.96	1.75	2.45	2.16
3.0	0.71	0.00	1.42	1.29	2.13	1.90	2.84	2.47	3.55	3.03
4.0	1.27	1.16	2.54	2.22	3.81	3.22	5.08	4.13	6.35	4.95
5.0	1.98	1.77	3.96	3.34	5.94	4.70	7.92	0.00	9.90	0.00
6.0	2.85	2.48	5.70	4.54	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	4.12	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	2.59	3.43	2.94	3.92	3.31	4.41	3.66	4.90	4.01
3.0	4.26	3.55	4.97	4.06	5.68	4.53	6.39	4.98	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Ks/cm2 Seccion: b = 15 cm x h = 30 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)		S (Maxima)	
2.0	12.33				
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c =	6.97 Ton	S = d / 2 =	12.50 cm
3.0	45.44				
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c =	9.29 Ton	S = d / 4 =	6.25 cm
6.0	182.40				

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	8.80	10.00	5.56	15.00	4.48	20.00	3.94	25.00	3.61		
2.5	5.00	18.78	10.00	10.55	15.00	7.81	20.00	6.43	25.00	5.61		
3.0	5.00	26.17	10.00	14.25	15.00	10.27	20.00	8.28	25.00	7.09		
4.0	5.00	44.99	10.00	23.65	15.00	16.54	20.00	12.99	25.00	10.85		
6.0	5.00	98.08	10.00	50.20	15.00	34.24	20.00	26.26	25.00	21.47		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.40	35.00	3.24	40.00	3.13	45.00	3.04	0.00	0.00		
2.5	30.00	5.06	35.00	4.67	40.00	4.38	45.00	4.15	0.00	0.00		
3.0	30.00	6.29	35.00	5.73	40.00	5.30	45.00	4.97	0.00	0.00		
4.0	30.00	9.43	35.00	8.41	40.00	7.65	45.00	7.06	0.00	0.00		
6.0	30.00	18.28	35.00	16.00	40.00	14.29	45.00	12.96	0.00	0.00		

TABLA 63.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 **Seccion:** b = 15 cm x h = 30 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 6.97 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 9.29 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.83	10.00	4.60	15.00	3.52	20.00	2.98	25.00	2.65		
2.5	5.00	17.73	10.00	9.50	15.00	6.76	20.00	5.39	25.00	4.56		
3.0	5.00	25.13	10.00	13.20	15.00	9.22	20.00	7.23	25.00	6.04		
4.0	5.00	43.94	10.00	22.61	15.00	15.49	20.00	11.94	25.00	9.80		
6.0	5.00	97.03	10.00	49.15	15.00	33.19	20.00	25.21	25.00	20.42		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.44	35.00	2.28	40.00	2.17	45.00	2.08	0.00	0.00		
2.5	30.00	4.01	35.00	3.62	40.00	3.33	45.00	3.10	0.00	0.00		
3.0	30.00	5.25	35.00	4.68	40.00	4.25	45.00	3.92	0.00	0.00		
4.0	30.00	8.38	35.00	7.37	40.00	6.60	45.00	6.01	0.00	0.00		
6.0	30.00	17.23	35.00	14.95	40.00	13.24	45.00	11.91	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 15 cm x h = 30 cm

(0.00288)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	12.33		
2.5	31.36	Vu <= 1.5 * FR * b * d * raiz f* c = 6.97 Ton	S = d / 2 = 12.50 cm
3.0	45.44		
4.0	81.28	Vu <= 2.0 * FR * b * d * raiz f* c = 9.29 Ton	S = d / 4 = 6.25 cm
6.0	182.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	7.58	10.00	4.34	15.00	3.26	20.00	2.72	25.00	2.40		
2.5	5.00	17.38	10.00	9.15	15.00	6.41	20.00	5.03	25.00	4.21		
3.0	5.00	24.77	10.00	12.85	15.00	8.87	20.00	6.88	25.00	5.69		
4.0	5.00	43.59	10.00	22.25	15.00	15.14	20.00	11.59	25.00	9.45		
6.0	5.00	96.68	10.00	48.80	15.00	32.84	20.00	24.86	25.00	20.07		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.18	35.00	2.03	40.00	1.91	45.00	1.82	0.00	0.00		
2.5	30.00	3.66	35.00	3.27	40.00	2.98	45.00	2.75	0.00	0.00		
3.0	30.00	4.89	35.00	4.33	40.00	3.90	45.00	3.57	0.00	0.00		
4.0	30.00	8.03	35.00	7.01	40.00	6.25	45.00	5.66	0.00	0.00		
6.0	30.00	16.88	35.00	14.60	40.00	12.89	45.00	11.56	0.00	0.00		

TABLA 61

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 150 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 20 cm
h = 40 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	1,810.94	0.00424	3,585.67	0.00644	5,175.65
0.00211	1,873.08	0.00431	3,641.65	0.00651	5,225.47
0.00218	1,935.01	0.00438	3,697.42	0.00659	5,275.08
0.00226	1,996.73	0.00446	3,752.98	0.00666	5,324.49
0.00233	2,058.25	0.00453	3,808.34	0.00673	5,373.69
0.00240	2,119.56	0.00460	3,863.50	0.00681	5,422.69
0.00248	2,180.67	0.00468	3,918.45	0.00688	5,471.48
0.00255	2,241.57	0.00475	3,973.19	0.00695	5,520.06
0.00262	2,302.27	0.00482	4,027.73	0.00703	5,568.44
0.00270	2,362.76	0.00490	4,082.07	0.00710	5,616.62
0.00277	2,423.05	0.00497	4,136.19	0.00717	5,664.59
0.00284	2,483.13	0.00504	4,190.12	0.00725	5,712.35
0.00292	2,543.00	0.00512	4,243.83	0.00732	5,759.91
0.00299	2,602.68	0.00519	4,297.35	0.00739	5,807.27
0.00306	2,662.14	0.00526	4,350.65	0.00747	5,854.42
0.00314	2,721.40	0.00534	4,403.76	0.00754	5,901.36
0.00321	2,780.46	0.00541	4,456.65	0.00761	5,948.10
0.00328	2,839.31	0.00548	4,509.34	0.00769	5,994.63
0.00336	2,897.95	0.00556	4,561.83	0.00776	6,040.96
0.00343	2,956.39	0.00563	4,614.11	0.00783	6,087.08
0.00350	3,014.62	0.00570	4,666.19	0.00791	6,133.00
0.00358	3,072.65	0.00578	4,718.06	0.00798	6,178.71
0.00365	3,130.48	0.00585	4,769.72	0.00805	6,224.22
0.00372	3,188.09	0.00592	4,821.18	0.00813	6,269.52
0.00380	3,245.51	0.00600	4,872.44	0.00820	6,314.62
0.00387	3,302.71	0.00607	4,923.49	0.00827	6,359.51
0.00394	3,359.72	0.00614	4,974.33	0.00835	6,404.19
0.00402	3,416.51	0.00622	5,024.97	0.00842	6,448.67
0.00409	3,473.11	0.00629	5,075.40	0.00849	6,492.95
0.00416	3,529.49	0.00637	5,125.63	0.00857	6,537.02

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	1.86	1.96	2.44	2.45	3.01
3.0	0.71	0.00	1.42	0.00	2.13	2.64	2.84	3.44	3.55	4.21
4.0	1.27	0.00	2.54	3.11	3.81	4.48	5.08	5.72	6.35	0.00
5.0	1.98	2.47	3.96	4.63	5.94	6.49	7.92	0.00	9.90	0.00
6.0	2.85	3.45	5.70	6.28	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	5.71	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	0.00	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	3.55	3.43	4.08	3.92	4.59	4.41	5.08	4.90	5.55
3.0	4.26	4.93	4.97	5.61	5.68	6.26	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 9.20 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 12.26 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	12.13	10.00	7.60	15.00	6.08	20.00	5.30	25.00	4.88		
2.5	5.00	26.11	10.00	14.59	15.00	10.75	20.00	8.82	25.00	7.67		
3.0	5.00	36.46	10.00	19.76	15.00	14.20	20.00	11.41	25.00	9.74		
4.0	5.00	62.80	10.00	32.93	15.00	22.98	20.00	18.00	25.00	15.01		
6.0	5.00	137.13	10.00	70.09	15.00	47.75	20.00	36.58	25.00	29.88		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.57	35.00	4.36	40.00	4.20	45.00	4.07	0.00	0.00		
2.5	30.00	6.90	35.00	6.36	40.00	5.94	45.00	5.62	0.00	0.00		
3.0	30.00	8.63	35.00	7.83	40.00	7.24	45.00	6.77	0.00	0.00		
4.0	30.00	13.02	35.00	11.60	40.00	10.53	45.00	9.70	0.00	0.00		
6.0	30.00	25.41	35.00	22.21	40.00	19.82	45.00	17.96	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 9.20 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 12.26 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	10.77	10.00	6.24	15.00	4.73	20.00	3.97	25.00	3.52		
2.5	5.00	24.48	10.00	13.15	15.00	9.31	20.00	7.39	25.00	6.24		
3.0	5.00	35.03	10.00	18.33	15.00	12.76	20.00	9.98	25.00	8.31		
4.0	5.00	61.37	10.00	31.50	15.00	21.54	20.00	16.56	25.00	13.57		
6.0	5.00	135.69	10.00	68.66	15.00	46.31	20.00	35.14	25.00	28.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.22	35.00	3.00	40.00	2.84	45.00	2.71	0.00	0.00		
2.5	30.00	5.47	35.00	4.92	40.00	4.51	45.00	4.19	0.00	0.00		
3.0	30.00	7.19	35.00	6.40	40.00	5.80	45.00	5.34	0.00	0.00		
4.0	30.00	11.58	35.00	10.16	40.00	9.09	45.00	8.26	0.00	0.00		
6.0	30.00	23.97	35.00	20.78	40.00	18.38	45.00	16.52	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00204)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maximo)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f'c = 9.20 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f'c = 12.26 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	10.35	10.00	5.81	15.00	4.30	20.00	3.55	25.00	3.09		
2.5	5.00	24.16	10.00	12.64	15.00	8.79	20.00	6.87	25.00	5.72		
3.0	5.00	34.51	10.00	17.81	15.00	12.24	20.00	9.46	25.00	7.79		
4.0	5.00	60.85	10.00	30.98	15.00	21.03	20.00	16.05	25.00	13.06		
6.0	5.00	135.18	10.00	68.14	15.00	45.80	20.00	34.63	25.00	27.92		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	2.79	35.00	2.57	40.00	2.41	45.00	2.29	0.00	0.00		
2.5	30.00	4.95	35.00	4.48	40.00	3.99	45.00	3.67	0.00	0.00		
3.0	30.00	6.68	35.00	5.88	40.00	5.29	45.00	4.82	0.00	0.00		
4.0	30.00	11.07	35.00	9.65	40.00	8.58	45.00	7.75	0.00	0.00		
6.0	30.00	23.46	35.00	20.26	40.00	17.87	45.00	16.01	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	2,103.39	0.00541	4,595.45	0.00847	6,820.09
0.00245	2,190.76	0.00551	4,673.92	0.00857	6,889.64
0.00256	2,277.84	0.00561	4,752.08	0.00867	6,958.89
0.00266	2,364.63	0.00572	4,829.95	0.00877	7,027.84
0.00276	2,451.11	0.00582	4,907.52	0.00888	7,096.50
0.00286	2,537.30	0.00592	4,984.80	0.00898	7,164.86
0.00296	2,623.19	0.00602	5,061.78	0.00908	7,232.93
0.00307	2,708.79	0.00612	5,138.46	0.00918	7,300.69
0.00317	2,794.09	0.00623	5,214.84	0.00928	7,368.16
0.00327	2,879.09	0.00633	5,290.93	0.00939	7,435.33
0.00337	2,963.79	0.00643	5,366.71	0.00949	7,502.21
0.00347	3,048.20	0.00653	5,442.21	0.00959	7,568.78
0.00358	3,132.31	0.00663	5,517.40	0.00969	7,635.06
0.00368	3,216.12	0.00674	5,592.30	0.00979	7,701.05
0.00378	3,299.63	0.00684	5,666.90	0.00989	7,766.73
0.00388	3,382.85	0.00694	5,741.20	0.01000	7,832.12
0.00398	3,465.77	0.00704	5,815.21	0.01010	7,897.21
0.00408	3,548.39	0.00714	5,888.92	0.01020	7,962.01
0.00419	3,630.72	0.00724	5,962.33	0.01030	8,026.50
0.00429	3,712.75	0.00735	6,035.44	0.01040	8,090.70
0.00439	3,794.48	0.00745	6,108.26	0.01051	8,154.61
0.00449	3,875.91	0.00755	6,180.78	0.01061	8,218.21
0.00459	3,957.05	0.00765	6,253.00	0.01071	8,281.52
0.00470	4,037.89	0.00775	6,324.93	0.01081	8,344.53
0.00480	4,118.44	0.00786	6,396.56	0.01091	8,407.25
0.00490	4,198.68	0.00796	6,467.89	0.01102	8,469.66
0.00500	4,278.63	0.00806	6,538.92	0.01112	8,531.78
0.00510	4,358.28	0.00816	6,609.66	0.01122	8,593.61
0.00521	4,437.64	0.00826	6,680.10	0.01132	8,655.13
0.00531	4,516.69	0.00837	6,750.24	0.01142	8,716.36

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

# Barras =>	1		2		3		4		5	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	2.48	2.45	3.07
3.0	0.71	0.00	1.42	0.00	2.13	2.69	2.84	3.52	3.55	4.33
4.0	1.27	0.00	2.54	3.17	3.81	4.62	5.08	5.97	6.35	7.22
5.0	1.98	2.51	3.96	4.78	5.94	6.83	7.92	8.65	9.90	0.00
6.0	2.85	3.53	5.70	6.59	8.55	0.00	11.40	0.00	14.25	0.00
8.0	5.07	5.96	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	8.65	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	3.64	3.43	4.19	3.92	4.74	4.41	5.27	4.90	5.78
3.0	4.26	5.11	4.97	5.85	5.68	6.57	6.39	7.26	7.10	7.92
4.0	7.62	8.39	8.89	0.00	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f'c = 10.62 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f'c = 14.16 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	12.60	10.00	8.07	15.00	6.56	20.00	5.80	25.00	5.35		
2.5	5.00	26.59	10.00	15.06	15.00	11.22	20.00	9.30	25.00	8.15		
3.0	5.00	36.94	10.00	20.24	15.00	14.67	20.00	11.89	25.00	10.22		
4.0	5.00	63.28	10.00	33.41	15.00	23.45	20.00	18.47	25.00	15.48		
6.0	5.00	137.60	10.00	70.57	15.00	48.22	20.00	37.05	25.00	30.35		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.05	35.00	4.83	40.00	4.67	45.00	4.54	0.00	0.00		
2.5	30.00	7.38	35.00	6.83	40.00	6.42	45.00	6.10	0.00	0.00		
3.0	30.00	9.10	35.00	8.31	40.00	7.71	45.00	7.25	0.00	0.00		
4.0	30.00	13.49	35.00	12.07	40.00	11.00	45.00	10.17	0.00	0.00		
6.0	30.00	25.88	35.00	22.69	40.00	20.29	45.00	18.43	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00610)

*** Para Pmin < P < 0.01 ***

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 10.62 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 14.16 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	11.08	10.00	6.55	15.00	5.04	20.00	4.28	25.00	3.83		
2.5	5.00	24.94	10.00	13.42	15.00	9.58	20.00	7.66	25.00	6.50		
3.0	5.00	35.29	10.00	18.59	15.00	13.03	20.00	10.24	25.00	8.57		
4.0	5.00	61.63	10.00	31.76	15.00	21.81	20.00	16.83	25.00	13.84		
6.0	5.00	135.96	10.00	68.93	15.00	46.58	20.00	35.41	25.00	28.71		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.52	35.00	3.31	40.00	3.15	45.00	3.02	0.00	0.00		
2.5	30.00	5.74	35.00	5.19	40.00	4.78	45.00	4.46	0.00	0.00		
3.0	30.00	7.46	35.00	6.67	40.00	6.07	45.00	5.61	0.00	0.00		
4.0	30.00	11.85	35.00	10.43	40.00	9.36	45.00	8.53	0.00	0.00		
6.0	30.00	24.24	35.00	21.05	40.00	18.65	45.00	16.79	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 10.62 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 14.16 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	10.63	10.00	6.10	15.00	4.59	20.00	3.83	25.00	3.38		
2.5	5.00	24.38	10.00	12.85	15.00	9.01	20.00	7.09	25.00	5.94		
3.0	5.00	34.73	10.00	18.03	15.00	12.46	20.00	9.68	25.00	8.01		
4.0	5.00	61.07	10.00	31.20	15.00	21.24	20.00	16.26	25.00	13.28		
6.0	5.00	135.39	10.00	68.36	15.00	46.02	20.00	34.84	25.00	28.14		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.08	35.00	2.86	40.00	2.70	45.00	2.57	0.00	0.00		
2.5	30.00	5.17	35.00	4.62	40.00	4.21	45.00	3.89	0.00	0.00		
3.0	30.00	6.90	35.00	6.10	40.00	5.50	45.00	5.04	0.00	0.00		
4.0	30.00	11.29	35.00	9.86	40.00	8.80	45.00	7.97	0.00	0.00		
6.0	30.00	23.47	35.00	20.48	40.00	18.09	45.00	16.22	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 250 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 20 cm
h = 40 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	2,361.04	0.00656	5,584.63	0.01048	8,455.39
0.00276	2,474.17	0.00669	5,686.01	0.01062	8,545.01
0.00289	2,586.92	0.00682	5,787.00	0.01075	8,634.23
0.00302	2,699.27	0.00695	5,887.59	0.01088	8,723.06
0.00315	2,811.24	0.00708	5,987.79	0.01101	8,811.50
0.00328	2,922.81	0.00721	6,087.60	0.01114	8,899.55
0.00342	3,033.98	0.00734	6,187.01	0.01127	8,987.20
0.00355	3,144.77	0.00747	6,286.04	0.01140	9,074.46
0.00368	3,255.16	0.00760	6,384.67	0.01153	9,161.33
0.00381	3,365.16	0.00774	6,482.91	0.01166	9,247.81
0.00394	3,474.77	0.00787	6,580.76	0.01179	9,333.90
0.00407	3,583.99	0.00800	6,678.21	0.01192	9,419.59
0.00420	3,692.82	0.00813	6,775.28	0.01206	9,504.90
0.00433	3,801.25	0.00826	6,871.95	0.01219	9,589.81
0.00446	3,909.29	0.00839	6,968.23	0.01232	9,674.33
0.00459	4,016.94	0.00852	7,064.12	0.01245	9,758.45
0.00472	4,124.20	0.00865	7,159.61	0.01258	9,842.19
0.00486	4,231.06	0.00878	7,254.72	0.01271	9,925.53
0.00499	4,337.54	0.00891	7,349.43	0.01284	10,008.48
0.00512	4,443.62	0.00904	7,443.75	0.01297	10,091.04
0.00525	4,549.31	0.00918	7,537.68	0.01310	10,173.20
0.00538	4,654.60	0.00931	7,631.21	0.01323	10,254.98
0.00551	4,759.51	0.00944	7,724.36	0.01336	10,336.36
0.00564	4,864.02	0.00957	7,817.11	0.01349	10,417.35
0.00577	4,968.14	0.00970	7,909.47	0.01363	10,497.95
0.00590	5,071.87	0.00983	8,001.43	0.01376	10,578.16
0.00603	5,175.21	0.00996	8,093.01	0.01389	10,657.97
0.00616	5,278.15	0.01009	8,184.19	0.01402	10,737.39
0.00630	5,380.71	0.01022	8,274.98	0.01415	10,816.42
0.00643	5,482.87	0.01035	8,365.38	0.01428	10,895.06

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplesente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	2.50	2.45	3.10
3.0	0.71	0.00	1.42	0.00	2.13	2.71	2.84	3.57	3.55	4.40
4.0	1.27	0.00	2.54	3.21	3.81	4.70	5.08	6.12	6.35	7.46
5.0	1.98	2.53	3.96	4.87	5.94	7.03	7.92	9.31	9.90	10.81
6.0	2.85	3.58	5.70	6.78	8.55	9.60	11.40	0.00	14.25	0.00
8.0	5.07	6.11	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	9.01	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	3.69	3.43	4.26	3.92	4.83	4.41	5.38	4.90	5.92
3.0	4.26	5.21	4.97	6.00	5.68	6.76	6.39	7.55	7.10	8.22
4.0	7.62	8.73	8.89	9.92	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 11.87 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 15.83 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	13.02	10.00	8.49	15.00	6.98	20.00	6.22	25.00	5.77		
2.5	5.00	27.00	10.00	15.48	15.00	11.64	20.00	9.72	25.00	8.56		
3.0	5.00	37.35	10.00	20.65	15.00	15.09	20.00	12.30	25.00	10.63		
4.0	5.00	63.70	10.00	33.83	15.00	23.87	20.00	18.89	25.00	15.90		
6.0	5.00	138.02	10.00	70.99	15.00	48.64	20.00	37.47	25.00	30.77		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.47	35.00	5.25	40.00	5.09	45.00	4.96	0.00	0.00		
2.5	30.00	7.80	35.00	7.25	40.00	6.84	45.00	6.52	0.00	0.00		
3.0	30.00	9.52	35.00	8.73	40.00	8.13	45.00	7.67	0.00	0.00		
4.0	30.00	13.91	35.00	12.49	40.00	11.42	45.00	10.59	0.00	0.00		
6.0	30.00	26.30	35.00	23.11	40.00	20.71	45.00	18.85	0.00	0.00		

TABLA 03.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00630)

*** Para Pmin < P < 0.01 ***

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 11.87 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 15.83 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	11.35	10.00	6.82	15.00	5.31	20.00	4.55	25.00	4.10		
2.5	5.00	25.20	10.00	13.68	15.00	9.83	20.00	7.91	25.00	6.76		
3.0	5.00	35.55	10.00	18.85	15.00	13.28	20.00	10.50	25.00	8.83		
4.0	5.00	61.89	10.00	32.02	15.00	22.07	20.00	17.09	25.00	14.10		
6.0	5.00	136.22	10.00	69.18	15.00	46.84	20.00	35.67	25.00	28.96		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.80	35.00	3.58	40.00	3.42	45.00	3.29	0.00	0.00		
2.5	30.00	5.99	35.00	5.44	40.00	5.03	45.00	4.71	0.00	0.00		
3.0	30.00	7.72	35.00	6.92	40.00	6.33	45.00	5.86	0.00	0.00		
4.0	30.00	12.11	35.00	10.69	40.00	9.62	45.00	8.79	0.00	0.00		
6.0	30.00	24.50	35.00	21.30	40.00	18.91	45.00	17.05	0.00	0.00		

TABLA 63.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00263)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 11.87 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 15.83 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	10.89	10.00	6.35	15.00	4.84	20.00	4.09	25.00	3.63
2.5	5.00	24.59	10.00	13.06	15.00	9.22	20.00	7.30	25.00	6.15
3.0	5.00	34.93	10.00	18.24	15.00	12.67	20.00	9.89	25.00	8.22
4.0	5.00	61.28	10.00	31.41	15.00	21.45	20.00	16.47	25.00	13.48
6.0	5.00	135.60	10.00	68.57	15.00	46.22	20.00	35.05	25.00	28.35

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.33	35.00	3.11	40.00	2.95	45.00	2.83	0.00	0.00
2.5	30.00	5.38	35.00	4.83	40.00	4.42	45.00	4.10	0.00	0.00
3.0	30.00	7.10	35.00	6.31	40.00	5.71	45.00	5.25	0.00	0.00
4.0	30.00	11.49	35.00	10.07	40.00	9.00	45.00	8.17	0.00	0.00
6.0	30.00	23.88	35.00	20.69	40.00	18.29	45.00	16.43	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	2,593.97	0.00769	6,559.61	0.01249	10,084.97
0.00304	2,733.25	0.00785	6,684.22	0.01265	10,194.90
0.00320	2,872.04	0.00801	6,808.33	0.01281	10,304.34
0.00336	3,010.35	0.00817	6,931.96	0.01297	10,413.29
0.00352	3,148.16	0.00833	7,055.10	0.01313	10,521.75
0.00368	3,285.49	0.00849	7,177.75	0.01329	10,629.72
0.00384	3,422.32	0.00865	7,299.91	0.01345	10,737.21
0.00400	3,558.67	0.00881	7,421.58	0.01361	10,844.20
0.00416	3,694.52	0.00897	7,542.76	0.01377	10,950.70
0.00432	3,829.89	0.00913	7,663.45	0.01393	11,056.72
0.00448	3,964.77	0.00929	7,783.65	0.01409	11,162.25
0.00464	4,099.16	0.00945	7,903.37	0.01425	11,267.28
0.00480	4,233.06	0.00961	8,022.59	0.01441	11,371.83
0.00496	4,366.47	0.00977	8,141.32	0.01457	11,475.89
0.00512	4,499.39	0.00993	8,259.57	0.01474	11,579.46
0.00528	4,631.83	0.01009	8,377.33	0.01490	11,682.54
0.00544	4,763.77	0.01025	8,494.59	0.01506	11,785.13
0.00560	4,895.22	0.01041	8,611.37	0.01522	11,887.23
0.00576	5,026.19	0.01057	8,727.66	0.01538	11,988.84
0.00593	5,156.67	0.01073	8,843.46	0.01554	12,089.97
0.00609	5,286.65	0.01089	8,958.77	0.01570	12,190.60
0.00625	5,416.15	0.01105	9,073.59	0.01586	12,290.75
0.00641	5,545.16	0.01121	9,187.92	0.01602	12,390.40
0.00657	5,673.68	0.01137	9,301.77	0.01618	12,489.57
0.00673	5,801.71	0.01153	9,415.12	0.01634	12,588.25
0.00689	5,929.25	0.01169	9,527.99	0.01650	12,686.44
0.00705	6,056.30	0.01185	9,640.36	0.01666	12,784.13
0.00721	6,182.86	0.01201	9,752.25	0.01682	12,881.34
0.00737	6,308.93	0.01217	9,863.64	0.01698	12,978.06
0.00753	6,434.52	0.01233	9,974.55	0.01714	13,074.30

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 20 cm
fy = 4200 Kg/cm2	h = 40 cm

# Barras =>	1		2		3		4		5	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	3.12
3.0	0.71	0.00	1.42	0.00	2.13	2.73	2.84	3.60	3.55	4.45
4.0	1.27	0.00	2.54	3.23	3.81	4.76	5.08	6.22	6.35	7.62
5.0	1.98	0.00	3.96	4.93	5.94	7.17	7.92	9.26	9.90	11.19
6.0	2.85	3.61	5.70	6.91	8.55	9.89	11.40	12.55	14.25	0.00
8.0	5.07	6.21	10.14	11.41	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	9.26	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	12.55	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desimacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	3.72	3.43	4.31	3.92	4.89	4.41	5.46	4.90	6.02
3.0	4.26	5.28	4.97	6.09	5.68	6.89	6.39	7.65	7.10	8.41
4.0	7.62	8.95	8.89	10.22	10.16	11.43	11.43	12.58	12.70	0.00
5.0	11.88	12.97	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c = 13.01 Ton	S = d / 2 = 17.50 cm
3.0	34.08		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c = 17.35 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	13.40	10.00	8.87	15.00	7.36	20.00	6.66	25.00	6.15		
2.5	5.00	27.38	10.00	15.86	15.00	12.02	20.00	10.19	25.00	8.94		
3.0	5.00	37.73	10.00	21.03	15.00	15.47	20.00	12.68	25.00	11.01		
4.0	5.00	64.07	10.00	34.20	15.00	24.25	20.00	19.27	25.00	16.28		
6.0	5.00	138.40	10.00	71.36	15.00	49.02	20.00	37.85	25.00	31.15		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.84	35.00	5.63	40.00	5.47	45.00	5.34	0.00	0.00		
2.5	30.00	8.17	35.00	7.63	40.00	7.21	45.00	6.89	0.00	0.00		
3.0	30.00	9.90	35.00	9.10	40.00	8.51	45.00	8.04	0.00	0.00		
4.0	30.00	14.29	35.00	12.87	40.00	11.80	45.00	10.97	0.00	0.00		
6.0	30.00	26.68	35.00	23.48	40.00	21.09	45.00	19.23	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	9.25		
2.5	23.12	Vu <= 1.5 * FR * b * d * raiz ft c = 13.01 Ton	S = d / 2 = 17.50 cm
3.0	34.68		
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz ft c = 17.35 Ton	S = d / 4 = 8.75 cm
6.0	136.80		

No. de Estribos	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	11.61	10.00	7.07	15.00	5.56	20.00	4.81	25.00	4.35		
2.5	5.00	25.43	10.00	13.90	15.00	10.06	20.00	8.14	25.00	6.99		
3.0	5.00	35.77	10.00	19.07	15.00	13.51	20.00	10.73	25.00	9.06		
4.0	5.00	62.12	10.00	32.25	15.00	22.29	20.00	17.31	25.00	14.32		
6.0	5.00	136.44	10.00	69.41	15.00	47.06	20.00	35.89	25.00	29.19		

No. de Estribos	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.05	35.00	3.83	40.00	3.67	45.00	3.55	0.00	0.00		
2.5	30.00	6.22	35.00	5.67	40.00	5.26	45.00	4.94	0.00	0.00		
3.0	30.00	7.94	35.00	7.15	40.00	6.55	45.00	6.09	0.00	0.00		
4.0	30.00	12.33	35.00	10.91	40.00	9.84	45.00	9.01	0.00	0.00		
6.0	30.00	24.72	35.00	21.53	40.00	19.13	45.00	17.27	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 20 cm x h = 40 cm

(0.00288)

Para P = Pmin

Estribos No. de Desinacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	9.25			
2.5	23.52	Vu <= 1.5 * FR * b * d * raiz f* c =	13.01 Ton	S = d / 2 = 17.50 cm
3.0	34.08			
4.0	60.96	Vu <= 2.0 * FR * b * d * raiz f* c =	17.35 Ton	S = d / 4 = 8.75 cm
6.0	136.80			

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	11.13	10.00	6.60	15.00	5.09	20.00	4.33	25.00	3.88
2.5	5.00	24.77	10.00	13.24	15.00	9.40	20.00	7.48	25.00	6.33
3.0	5.00	35.12	10.00	18.42	15.00	12.85	20.00	10.07	25.00	8.40
4.0	5.00	61.46	10.00	31.59	15.00	21.63	20.00	16.65	25.00	13.67
6.0	5.00	135.78	10.00	68.75	15.00	46.41	20.00	35.24	25.00	28.53

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	3.58	35.00	3.36	40.00	3.20	45.00	3.07	0.00	0.00
2.5	30.00	5.56	35.00	5.01	40.00	4.60	45.00	4.28	0.00	0.00
3.0	30.00	7.29	35.00	6.49	40.00	5.89	45.00	5.43	0.00	0.00
4.0	30.00	11.68	35.00	10.25	40.00	9.19	45.00	8.36	0.00	0.00
6.0	30.00	24.06	35.00	20.87	40.00	18.48	45.00	16.62	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 150 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 25 cm
h = 50 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	3,742.00	0.00424	7,409.18	0.00644	10,694.59
0.00211	3,870.39	0.00431	7,524.84	0.00651	10,797.53
0.00218	3,998.36	0.00438	7,640.08	0.00659	10,900.05
0.00226	4,125.90	0.00446	7,754.90	0.00666	11,002.14
0.00233	4,253.02	0.00453	7,869.29	0.00673	11,103.80
0.00240	4,379.71	0.00460	7,983.26	0.00681	11,205.05
0.00248	4,505.98	0.00468	8,096.80	0.00688	11,305.87
0.00255	4,631.82	0.00475	8,209.92	0.00695	11,406.26
0.00262	4,757.24	0.00482	8,322.61	0.00703	11,506.23
0.00270	4,882.24	0.00490	8,434.89	0.00710	11,605.78
0.00277	5,006.81	0.00497	8,546.73	0.00717	11,704.90
0.00284	5,130.96	0.00504	8,658.16	0.00725	11,803.59
0.00292	5,254.68	0.00512	8,769.15	0.00732	11,901.87
0.00299	5,377.98	0.00519	8,879.73	0.00739	11,999.72
0.00306	5,500.86	0.00526	8,989.88	0.00747	12,097.14
0.00314	5,623.31	0.00534	9,099.60	0.00754	12,194.14
0.00321	5,745.34	0.00541	9,208.91	0.00761	12,290.72
0.00328	5,866.94	0.00548	9,317.78	0.00769	12,386.87
0.00336	5,988.12	0.00556	9,426.24	0.00776	12,482.60
0.00343	6,108.87	0.00563	9,534.27	0.00783	12,577.90
0.00350	6,229.20	0.00570	9,641.87	0.00791	12,672.78
0.00358	6,349.11	0.00578	9,749.05	0.00798	12,767.24
0.00365	6,468.59	0.00585	9,855.81	0.00805	12,861.27
0.00372	6,587.65	0.00592	9,962.14	0.00813	12,954.88
0.00380	6,706.28	0.00600	10,068.05	0.00820	13,048.06
0.00387	6,824.49	0.00607	10,173.53	0.00827	13,140.82
0.00394	6,942.28	0.00614	10,278.59	0.00835	13,233.16
0.00402	7,059.64	0.00622	10,383.23	0.00842	13,325.07
0.00409	7,176.58	0.00629	10,487.44	0.00849	13,416.55
0.00416	7,293.09	0.00637	10,591.23	0.00857	13,507.62

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

# Barras =>	1		2		3		4		5	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	3.98
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	4.58	3.55	5.65
4.0	1.27	0.00	2.54	4.12	3.81	5.03	5.08	7.84	6.35	9.55
5.0	1.98	0.00	3.96	6.25	5.94	9.01	7.92	11.52	9.90	0.00
6.0	2.85	4.59	5.70	8.68	8.55	12.27	11.40	0.00	14.25	0.00
8.0	5.07	7.82	10.14	0.00	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	11.52	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	0.00	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	4.73	3.43	5.47	3.92	6.19	4.41	6.90	4.90	7.59
3.0	4.26	6.83	4.97	7.69	5.68	8.66	6.39	9.60	7.10	10.51
4.0	7.62	11.15	8.89	12.66	10.16	0.00	11.43	0.00	12.70	0.00
5.0	11.88	0.00	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 14.78 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 19.71 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	16.58	10.00	10.75	15.00	8.81	20.00	7.84	25.00	7.26		
2.5	5.00	34.56	10.00	19.74	15.00	14.80	20.00	12.33	25.00	10.85		
3.0	5.00	47.87	10.00	26.39	15.00	19.24	20.00	15.66	25.00	13.51		
4.0	5.00	81.73	10.00	43.33	15.00	30.53	20.00	24.13	25.00	20.29		
6.0	5.00	177.29	10.00	91.11	15.00	62.38	20.00	48.02	25.00	39.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.87	35.00	6.59	40.00	6.38	45.00	6.22	0.00	0.00		
2.5	30.00	9.86	35.00	9.16	40.00	8.63	45.00	8.22	0.00	0.00		
3.0	30.00	12.08	35.00	11.06	40.00	10.29	45.00	9.70	0.00	0.00		
4.0	30.00	17.73	35.00	15.90	40.00	14.53	45.00	13.46	0.00	0.00		
6.0	30.00	33.65	35.00	29.55	40.00	26.47	45.00	24.08	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Desinacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 14.78 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 19.71 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	14.40	10.00	8.57	15.00	6.63	20.00	5.66	25.00	5.07		
2.5	5.00	32.25	10.00	17.44	15.00	12.50	20.00	10.03	25.00	8.54		
3.0	5.00	45.56	10.00	24.09	15.00	16.93	20.00	13.35	25.00	11.21		
4.0	5.00	79.43	10.00	41.02	15.00	28.22	20.00	21.82	25.00	17.98		
6.0	5.00	174.99	10.00	88.80	15.00	60.07	20.00	45.71	25.00	37.09		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.68	35.00	4.41	40.00	4.20	45.00	4.04	0.00	0.00		
2.5	30.00	7.56	35.00	6.85	40.00	6.32	45.00	5.91	0.00	0.00		
3.0	30.00	9.77	35.00	8.75	40.00	7.99	45.00	7.39	0.00	0.00		
4.0	30.00	15.42	35.00	13.59	40.00	12.22	45.00	11.15	0.00	0.00		
6.0	30.00	31.35	35.00	27.24	40.00	24.16	45.00	21.77	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Ks/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00204)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 14.78 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 19.71 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	13.72	10.00	7.89	15.00	5.94	20.00	4.97	25.00	4.39		
2.5	5.00	31.42	10.00	16.61	15.00	11.67	20.00	9.20	25.00	7.72		
3.0	5.00	44.73	10.00	23.26	15.00	16.10	20.00	12.52	25.00	10.38		
4.0	5.00	78.60	10.00	40.19	15.00	27.39	20.00	20.99	25.00	17.15		
6.0	5.00	174.16	10.00	87.97	15.00	59.25	20.00	44.88	25.00	36.26		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.00	35.00	3.72	40.00	3.52	45.00	3.35	0.00	0.00		
2.5	30.00	6.73	35.00	6.02	40.00	5.49	45.00	5.08	0.00	0.00		
3.0	30.00	8.95	35.00	7.92	40.00	7.16	45.00	6.56	0.00	0.00		
4.0	30.00	14.59	35.00	12.76	40.00	11.39	45.00	10.32	0.00	0.00		
6.0	30.00	30.52	35.00	26.41	40.00	23.34	45.00	20.94	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	4,346.29	0.00541	9,495.72	0.00847	14,092.54
0.00245	4,526.84	0.00551	9,657.85	0.00857	14,236.25
0.00256	4,706.78	0.00561	9,819.36	0.00867	14,379.35
0.00266	4,886.10	0.00572	9,980.27	0.00877	14,521.83
0.00276	5,064.81	0.00582	10,140.55	0.00888	14,663.70
0.00286	5,242.90	0.00592	10,300.23	0.00898	14,804.95
0.00296	5,420.38	0.00602	10,459.29	0.00908	14,945.59
0.00307	5,597.25	0.00612	10,617.73	0.00918	15,085.62
0.00317	5,773.50	0.00623	10,775.57	0.00928	15,225.03
0.00327	5,949.14	0.00633	10,932.79	0.00939	15,363.83
0.00337	6,124.16	0.00643	11,089.39	0.00949	15,502.01
0.00347	6,298.58	0.00653	11,245.38	0.00959	15,639.58
0.00358	6,472.37	0.00663	11,400.76	0.00969	15,776.54
0.00368	6,645.55	0.00674	11,555.52	0.00979	15,912.88
0.00378	6,818.12	0.00684	11,709.67	0.00989	16,048.61
0.00388	6,990.08	0.00694	11,863.20	0.01000	16,183.72
0.00398	7,161.42	0.00704	12,016.12	0.01010	16,318.22
0.00408	7,332.14	0.00714	12,168.43	0.01020	16,452.11
0.00419	7,502.26	0.00724	12,320.12	0.01030	16,585.38
0.00429	7,671.76	0.00735	12,471.20	0.01040	16,718.04
0.00439	7,840.64	0.00745	12,621.66	0.01051	16,850.09
0.00449	8,008.91	0.00755	12,771.52	0.01061	16,981.52
0.00459	8,176.57	0.00765	12,920.75	0.01071	17,112.33
0.00470	8,343.61	0.00775	13,069.37	0.01081	17,242.53
0.00480	8,510.04	0.00786	13,217.38	0.01091	17,372.12
0.00490	8,675.85	0.00796	13,364.78	0.01102	17,501.10
0.00500	8,841.05	0.00806	13,511.56	0.01112	17,629.46
0.00510	9,005.64	0.00816	13,657.72	0.01122	17,757.20
0.00521	9,169.61	0.00826	13,803.28	0.01132	17,884.34
0.00531	9,332.97	0.00837	13,948.21	0.01142	18,010.85

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 200 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 25 cm
h = 50 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	4.64	3.55	5.74
4.0	1.27	0.00	2.54	0.00	3.81	6.14	5.08	8.11	6.35	9.86
5.0	1.98	0.00	3.96	6.37	5.94	9.28	7.92	12.01	9.90	14.55
6.0	2.85	4.66	5.70	8.94	8.55	12.84	11.40	16.36	14.25	0.00
8.0	5.07	8.02	10.14	14.85	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	12.01	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	16.36	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	4.80	3.43	5.56	3.92	6.31	4.41	7.05	4.90	7.77
3.0	4.26	6.82	4.97	7.88	5.68	8.91	6.39	9.92	7.10	10.90
4.0	7.62	11.61	8.89	13.28	10.16	14.87	11.43	16.39	12.70	17.84
5.0	11.88	16.91	13.86	0.00	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	7.40			
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c =	17.07 Ton	S = d / 2 = 22.50 cm
3.0	27.26			
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c =	22.76 Ton	S = d / 4 = 11.25 cm
6.0	109.44			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	17.35	10.00	11.52	15.00	9.57	20.00	8.60	25.00	8.02
2.5	5.00	35.32	10.00	20.50	15.00	15.57	20.00	13.10	25.00	11.61
3.0	5.00	48.63	10.00	27.16	15.00	20.00	20.00	16.42	25.00	14.28
4.0	5.00	82.50	10.00	44.09	15.00	31.29	20.00	24.89	25.00	21.05
6.0	5.00	178.06	10.00	91.87	15.00	63.14	20.00	48.78	25.00	40.16

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	7.63	35.00	7.35	40.00	7.14	45.00	6.98	0.00	0.00
2.5	30.00	10.63	35.00	9.92	40.00	9.39	45.00	8.98	0.00	0.00
3.0	30.00	12.84	35.00	11.82	40.00	11.05	45.00	10.46	0.00	0.00
4.0	30.00	18.49	35.00	16.66	40.00	15.29	45.00	14.22	0.00	0.00
6.0	30.00	34.42	35.00	30.31	40.00	27.23	45.00	24.84	0.00	0.00

TABLA 43.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Ks/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00610)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 17.07 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 22.76 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	14.90	10.00	9.07	15.00	7.12	20.00	6.15	25.00	5.57		
2.5	5.00	32.68	10.00	17.86	15.00	12.93	20.00	10.46	25.00	8.97		
3.0	5.00	45.99	10.00	24.52	15.00	17.36	20.00	13.78	25.00	11.64		
4.0	5.00	79.86	10.00	41.45	15.00	28.65	20.00	22.25	25.00	18.41		
6.0	5.00	175.42	10.00	89.23	15.00	60.50	20.00	46.14	25.00	37.52		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.18	35.00	4.90	40.00	4.70	45.00	4.53	0.00	0.00		
2.5	30.00	7.99	35.00	7.28	40.00	6.75	45.00	6.34	0.00	0.00		
3.0	30.00	10.20	35.00	9.18	40.00	8.41	45.00	7.82	0.00	0.00		
4.0	30.00	15.85	35.00	14.02	40.00	12.65	45.00	11.58	0.00	0.00		
6.0	30.00	31.78	35.00	27.67	40.00	24.59	45.00	22.20	0.00	0.00		

TABLA #3.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 17.07 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 22.76 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	14.18	10.00	8.35	15.00	6.41	20.00	5.44	25.00	4.85		
2.5	5.00	31.77	10.00	16.96	15.00	12.02	20.00	9.55	25.00	8.07		
3.0	5.00	45.08	10.00	23.61	15.00	16.45	20.00	12.87	25.00	10.73		
4.0	5.00	78.95	10.00	40.54	15.00	27.74	20.00	21.34	25.00	17.50		
6.0	5.00	174.51	10.00	88.32	15.00	59.59	20.00	45.23	25.00	36.61		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.46	35.00	4.19	40.00	3.98	45.00	3.82	0.00	0.00		
2.5	30.00	7.08	35.00	6.37	40.00	5.84	45.00	5.43	0.00	0.00		
3.0	30.00	9.30	35.00	8.27	40.00	7.51	45.00	6.91	0.00	0.00		
4.0	30.00	14.94	35.00	13.11	40.00	11.74	45.00	10.67	0.00	0.00		
6.0	30.00	30.87	35.00	26.76	40.00	23.68	45.00	21.29	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	4,878.68	0.00656	11,539.68	0.01048	17,471.60
0.00276	5,112.46	0.00669	11,749.16	0.01062	17,656.78
0.00289	5,345.43	0.00682	11,957.83	0.01075	17,841.14
0.00302	5,577.59	0.00695	12,165.68	0.01088	18,024.70
0.00315	5,808.94	0.00708	12,372.73	0.01101	18,207.44
0.00328	6,039.48	0.00721	12,578.97	0.01114	18,389.37
0.00342	6,269.21	0.00734	12,784.39	0.01127	18,570.50
0.00355	6,498.13	0.00747	12,989.01	0.01140	18,750.81
0.00368	6,726.23	0.00760	13,192.82	0.01153	18,930.31
0.00381	6,953.53	0.00774	13,395.81	0.01166	19,109.01
0.00394	7,180.02	0.00787	13,598.00	0.01179	19,286.89
0.00407	7,405.70	0.00800	13,799.38	0.01192	19,463.96
0.00420	7,630.57	0.00813	13,999.94	0.01206	19,640.23
0.00433	7,854.63	0.00826	14,199.70	0.01219	19,815.68
0.00446	8,077.88	0.00839	14,398.64	0.01232	19,990.32
0.00459	8,300.32	0.00852	14,596.78	0.01245	20,164.16
0.00472	8,521.95	0.00865	14,794.10	0.01258	20,337.18
0.00486	8,742.76	0.00878	14,990.62	0.01271	20,509.39
0.00499	8,962.77	0.00891	15,186.33	0.01284	20,680.79
0.00512	9,181.97	0.00904	15,381.22	0.01297	20,851.39
0.00525	9,400.36	0.00918	15,575.31	0.01310	21,021.17
0.00538	9,617.94	0.00931	15,768.58	0.01323	21,190.14
0.00551	9,834.70	0.00944	15,961.05	0.01336	21,358.30
0.00564	10,050.66	0.00957	16,152.70	0.01349	21,525.65
0.00577	10,265.81	0.00970	16,343.55	0.01363	21,692.20
0.00590	10,480.15	0.00983	16,533.59	0.01376	21,857.93
0.00603	10,693.67	0.00996	16,722.81	0.01389	22,022.85
0.00616	10,906.39	0.01009	16,911.22	0.01402	22,186.96
0.00630	11,118.30	0.01022	17,098.82	0.01415	22,350.26
0.00643	11,329.40	0.01035	17,285.62	0.01428	22,512.75

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	5.80
4.0	1.27	0.00	2.54	0.00	3.81	6.21	5.08	8.16	6.35	10.05
5.0	1.98	0.00	3.96	6.44	5.94	9.44	7.92	12.30	9.90	15.01
6.0	2.85	0.00	5.70	9.09	8.55	13.18	11.40	16.96	14.25	20.45
8.0	5.07	8.14	10.14	15.37	15.21	21.55	20.28	0.00	25.35	0.00
10.0	7.92	12.29	15.84	22.26	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	16.96	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =,	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	5.61	3.92	6.38	4.41	7.14	4.90	7.89
3.0	4.26	6.91	4.97	7.99	5.68	9.06	6.39	10.11	7.10	11.14
4.0	7.62	11.88	8.89	13.65	10.16	15.35	11.43	17.00	12.70	18.59
5.0	11.88	17.57	13.86	19.99	15.84	22.26	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.47	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 19.09 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 25.45 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	18.02	10.00	12.19	15.00	10.25	20.00	9.27	25.00	8.69
2.5	5.00	35.99	10.00	21.18	15.00	16.24	20.00	13.77	25.00	12.29
3.0	5.00	49.30	10.00	27.83	15.00	20.67	20.00	17.99	25.00	14.95
4.0	5.00	83.17	10.00	44.76	15.00	31.96	20.00	25.56	25.00	21.72
6.0	5.00	178.73	10.00	92.54	15.00	63.81	20.00	49.45	25.00	40.83

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.30	35.00	8.02	40.00	7.82	45.00	7.65	0.00	0.00
2.5	30.00	11.30	35.00	10.59	40.00	10.06	45.00	9.65	0.00	0.00
3.0	30.00	13.52	35.00	12.49	40.00	11.73	45.00	11.13	0.00	0.00
4.0	30.00	19.16	35.00	17.33	40.00	15.96	45.00	14.89	0.00	0.00
6.0	30.00	35.09	35.00	30.98	40.00	27.90	45.00	25.51	0.00	0.00

TABLA #3.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 19.09 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 25.45 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	15.33	10.00	9.50	15.00	7.56	20.00	6.59	25.00	6.01
2.5	5.00	33.10	10.00	18.28	15.00	13.34	20.00	10.87	25.00	9.39
3.0	5.00	46.40	10.00	24.93	15.00	17.77	20.00	14.20	25.00	12.05
4.0	5.00	80.27	10.00	41.87	15.00	29.06	20.00	22.66	25.00	18.82
6.0	5.00	175.83	10.00	89.64	15.00	60.92	20.00	46.55	25.00	37.93

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.62	35.00	5.34	40.00	5.13	45.00	4.97	0.00	0.00
2.5	30.00	8.40	35.00	7.69	40.00	7.17	45.00	6.75	0.00	0.00
3.0	30.00	10.62	35.00	9.60	40.00	8.83	45.00	8.23	0.00	0.00
4.0	30.00	16.26	35.00	14.43	40.00	13.06	45.00	12.00	0.00	0.00
6.0	30.00	32.19	35.00	28.08	40.00	25.01	45.00	22.61	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00263)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 19.09 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 25.45 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	14.58	10.00	8.76	15.00	6.81	20.00	5.84	25.00	5.26		
2.5	5.00	32.11	10.00	17.29	15.00	12.35	20.00	9.88	25.00	8.40		
3.0	5.00	45.41	10.00	23.94	15.00	16.79	20.00	13.21	25.00	11.06		
4.0	5.00	79.28	10.00	40.88	15.00	28.08	20.00	21.67	25.00	17.83		
6.0	5.00	174.84	10.00	88.66	15.00	59.93	20.00	45.56	25.00	36.95		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	4.87	35.00	4.59	40.00	4.38	45.00	4.22	0.00	0.00		
2.5	30.00	7.41	35.00	6.71	40.00	6.18	45.00	5.76	0.00	0.00		
3.0	30.00	9.63	35.00	8.61	40.00	7.84	45.00	7.24	0.00	0.00		
4.0	30.00	15.27	35.00	13.44	40.00	12.07	45.00	11.01	0.00	0.00		
6.0	30.00	31.20	35.00	27.10	40.00	24.02	45.00	21.62	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	5,359.99	0.00769	13,554.31	0.01249	20,838.84
0.00304	5,647.79	0.00785	13,811.78	0.01265	21,065.99
0.00320	5,934.58	0.00801	14,068.25	0.01281	21,292.13
0.00336	6,220.36	0.00817	14,323.70	0.01297	21,517.26
0.00352	6,505.13	0.00833	14,578.14	0.01313	21,741.38
0.00368	6,788.89	0.00849	14,831.58	0.01329	21,964.48
0.00384	7,071.64	0.00865	15,084.00	0.01345	22,186.58
0.00400	7,353.37	0.00881	15,335.41	0.01361	22,407.66
0.00416	7,634.10	0.00897	15,585.81	0.01377	22,627.74
0.00432	7,913.81	0.00913	15,835.19	0.01393	22,846.80
0.00448	8,192.52	0.00929	16,083.57	0.01409	23,064.85
0.00464	8,470.21	0.00945	16,330.94	0.01425	23,281.89
0.00480	8,746.89	0.00961	16,577.30	0.01441	23,497.92
0.00496	9,022.56	0.00977	16,822.64	0.01457	23,712.94
0.00512	9,297.22	0.00993	17,066.97	0.01474	23,926.95
0.00528	9,570.87	0.01009	17,310.30	0.01490	24,139.95
0.00544	9,843.51	0.01025	17,552.61	0.01506	24,351.93
0.00560	10,115.14	0.01041	17,793.91	0.01522	24,562.91
0.00576	10,385.75	0.01057	18,034.20	0.01538	24,772.87
0.00593	10,655.36	0.01073	18,273.48	0.01554	24,981.83
0.00609	10,923.96	0.01089	18,511.75	0.01570	25,189.77
0.00625	11,191.54	0.01105	18,749.01	0.01586	25,396.70
0.00641	11,458.11	0.01121	18,985.26	0.01602	25,602.62
0.00657	11,723.68	0.01137	19,220.49	0.01618	25,807.53
0.00673	11,988.23	0.01153	19,454.72	0.01634	26,011.43
0.00689	12,251.77	0.01169	19,687.93	0.01650	26,214.32
0.00705	12,514.30	0.01185	19,920.14	0.01666	26,416.20
0.00721	12,775.82	0.01201	20,151.33	0.01682	26,617.07
0.00737	13,036.32	0.01217	20,381.51	0.01698	26,816.92
0.00753	13,295.82	0.01233	20,610.68	0.01714	27,015.77

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 25 cm
fy = 4200 Kg/cm2	h = 50 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	5.84
4.0	1.27	0.00	2.54	0.00	3.81	6.25	5.08	8.24	6.35	10.17
5.0	1.98	0.00	3.96	6.49	5.94	9.55	7.92	12.50	9.90	15.31
6.0	2.85	0.00	5.70	9.19	8.55	13.41	11.40	17.37	14.25	21.08
8.0	5.07	8.22	10.14	15.65	15.21	22.27	20.28	0.00	25.35	0.00
10.0	7.92	12.50	15.84	23.04	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	17.37	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	5.65	3.92	6.43	4.41	7.20	4.90	7.96
3.0	4.26	6.96	4.97	8.07	5.68	9.16	6.39	10.23	7.10	11.29
4.0	7.62	12.06	8.89	13.89	10.16	15.68	11.43	17.41	12.70	19.09
5.0	11.88	18.01	13.86	20.59	15.84	23.04	17.82	25.37	19.80	0.00
6.0	17.10	24.54	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA #3.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f* c = 20.91 Ton	S = d / 2 = 22.50 cm
3.0	27.26		
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f* c = 27.88 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	18.62	10.00	12.80	15.00	10.85	20.00	9.88	25.00	9.30		
2.5	5.00	36.60	10.00	21.78	15.00	16.84	20.00	14.38	25.00	12.89		
3.0	5.00	49.91	10.00	28.44	15.00	21.28	20.00	17.70	25.00	15.55		
4.0	5.00	83.78	10.00	45.37	15.00	32.57	20.00	26.17	25.00	22.33		
6.0	5.00	179.33	10.00	93.15	15.00	64.42	20.00	50.96	25.00	41.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.91	35.00	8.63	40.00	8.42	45.00	8.26	0.00	0.00		
2.5	30.00	11.91	35.00	11.20	40.00	10.67	45.00	10.26	0.00	0.00		
3.0	30.00	14.12	35.00	13.10	40.00	12.33	45.00	11.74	0.00	0.00		
4.0	30.00	19.77	35.00	17.94	40.00	16.57	45.00	15.50	0.00	0.00		
6.0	30.00	35.69	35.00	31.59	40.00	28.51	45.00	26.12	0.00	0.00		

TABLA #3.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	7.40		
2.5	18.51	Vu <= 1.5 * FR * b * d * raiz f* c = 20.91 Ton	S = d / 2 = 22.50 cm
3.0	27.2[illegible]		
4.0	48.[illegible]	Vu <= 2.0 * FR * b * d * raiz f* c = 27.88 Ton	S = d / 4 = 11.25 cm
6.0	109.44		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	15.74	10.00	9.91	15.00	7.97	20.00	7.00	25.00	6.42
2.5	5.00	33.46	10.00	18.64	15.00	13.70	20.00	11.23	25.00	9.75
3.0	5.00	46.76	10.00	25.29	15.00	18.13	20.00	14.56	25.00	12.41
4.0	5.00	80.63	10.00	42.23	15.00	29.42	20.00	23.02	25.00	19.18
6.0	5.00	176.19	10.00	90.00	15.00	61.28	20.00	46.91	25.00	38.29

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.03	35.00	5.75	40.00	5.54	45.00	5.38	0.00	0.00
2.5	30.00	8.76	35.00	8.05	40.00	7.53	45.00	7.11	0.00	0.00
3.0	30.00	10.98	35.00	9.96	40.00	9.19	45.00	8.59	0.00	0.00
4.0	30.00	16.62	35.00	14.79	40.00	13.42	45.00	12.36	0.00	0.00
6.0	30.00	32.55	35.00	28.44	40.00	25.37	45.00	22.97	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 25 cm x h = 50 cm

. 0.00288)

Para P = Pmin

RESTRICCIONES				
Estribos No. de Desimacion	Separacion Maxima [cm]	Valores de Vu (Limite max)		S (Maxima)
2.0	7.40			
2.5	18.81	Vu <= 1.5 * FR * b * d * raiz f'c =	20.91 Ton	S = d / 2 = 22.50 cm
3.0	27.26			
4.0	48.76	Vu <= 2.0 * FR * b * d * raiz f'c =	27.88 Ton	S = d / 4 = 11.25 cm
6.0	109.44			

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	14.98	10.00	9.15	15.00	7.21	20.00	6.24	25.00	5.65
2.5	5.00	32.40	10.00	17.58	15.00	12.65	20.00	10.18	25.00	8.6[illegible]
3.0	5.00	45.71	10.00	24.24	15.00	17.08	20.00	13.50	25.00	11.35
4.0	5.00	79.58	10.00	41.17	15.00	28.37	20.00	21.97	25.00	18.13
6.0	5.00	175.13	10.00	88.95	15.00	60.22	20.00	45.86	25.00	37.24

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.27	35.00	4.99	40.00	4.78	45.00	4.62	0.00	0.00
2.5	30.00	7.71	35.00	7.00	40.00	6.47	45.00	6.06	0.00	0.00
3.0	30.00	9.92	35.00	8.90	40.00	8.13	45.00	7.54	0.00	0.00
4.0	30.00	15.57	35.00	13.74	40.00	12.37	45.00	11.30	0.00	0.00
6.0	30.00	31.49	35.00	27.39	40.00	24.31	45.00	21.92	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 30 cm
fy = 4200 Kg/cm2	h = 60 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	6,707.89	0.00424	13,281.64	0.00644	19,171.05
0.00211	6,938.04	0.00431	13,488.98	0.00651	19,355.58
0.00218	7,167.43	0.00438	13,695.56	0.00659	19,539.35
0.00226	7,396.06	0.00446	13,901.38	0.00666	19,722.36
0.00233	7,623.93	0.00453	14,106.43	0.00673	19,904.60
0.00240	7,851.04	0.00460	14,310.73	0.00681	20,086.09
0.00248	8,077.39	0.00468	14,514.27	0.00688	20,266.82
0.00255	8,302.98	0.00475	14,717.05	0.00695	20,446.78
0.00262	8,527.80	0.00482	14,919.06	0.00703	20,625.99
0.00270	8,751.87	0.00490	15,120.32	0.00710	20,804.43
0.00277	8,975.18	0.00497	15,320.81	0.00717	20,982.12
0.00284	9,197.72	0.00504	15,520.55	0.00725	21,159.04
0.00292	9,419.51	0.00512	15,719.52	0.00732	21,335.20
0.00299	9,640.54	0.00519	15,917.74	0.00739	21,510.61
0.00306	9,860.80	0.00526	16,115.19	0.00747	21,685.25
0.00314	10,080.31	0.00534	16,311.89	0.00754	21,859.13
0.00321	10,299.05	0.00541	16,507.82	0.00761	22,032.26
0.00328	10,517.04	0.00548	16,702.99	0.00769	22,204.62
0.00336	10,734.26	0.00556	16,897.41	0.00776	22,376.22
0.00343	10,950.72	0.00563	17,091.06	0.00783	22,547.06
0.00350	11,166.43	0.00570	17,283.95	0.00791	22,717.14
0.00358	11,381.37	0.00578	17,476.08	0.00798	22,886.46
0.00365	11,595.55	0.00585	17,667.45	0.00805	23,055.02
0.00372	11,808.97	0.00592	17,858.07	0.00813	23,222.82
0.00380	12,021.64	0.00600	18,047.92	0.00820	23,389.86
0.00387	12,233.54	0.00607	18,237.01	0.00827	23,556.14
0.00394	12,444.68	0.00614	18,425.34	0.00835	23,721.66
0.00402	12,655.06	0.00622	18,612.91	0.00842	23,886.42
0.00409	12,864.68	0.00629	18,799.72	0.00849	24,050.42
0.00416	13,073.54	0.00637	18,985.76	0.00857	24,213.66

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 30 cm
fy = 4200 kg/cm2	h = 60 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	7.05
4.0	1.27	0.00	2.54	0.00	3.81	7.54	5.08	9.89	6.35	12.16
5.0	1.98	0.00	3.96	7.83	5.94	11.43	7.92	14.84	9.90	18.04
6.0	2.85	0.00	5.70	11.01	8.55	15.88	11.40	20.33	14.25	0.00
8.0	5.07	9.87	10.14	18.41	15.21	0.00	20.28	0.00	25.35	0.00
10.0	7.92	14.84	15.84	0.00	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	20.33	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	6.83	3.92	7.75	4.41	8.66	4.90	9.56
3.0	4.26	8.39	4.97	9.69	5.68	10.97	6.39	12.23	7.10	13.45
4.0	7.62	14.34	8.89	16.43	10.16	18.44	11.43	20.37	12.70	22.22
5.0	11.88	21.04	13.86	23.83	15.84	0.00	17.82	0.00	19.80	0.00
6.0	17.10	0.00	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Ks/cm2 Seccion: b = 30 cm x h = 60 cm

Para P >= 0.01

Estribos No. de Desisnacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 21.68 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 28.91 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	21.47	10.00	14.35	15.00	11.97	20.00	10.79	25.00	10.07
2.5	5.00	43.45	10.00	25.34	15.00	19.30	20.00	16.28	25.00	14.47
3.0	5.00	59.71	10.00	33.47	15.00	24.72	20.00	20.35	25.00	17.72
4.0	5.00	101.10	10.00	54.16	15.00	38.52	20.00	30.69	25.00	26.00
6.0	5.00	217.90	10.00	112.56	15.00	77.45	20.00	59.89	25.00	49.36

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	9.60	35.00	9.26	40.00	9.01	45.00	8.81	0.00	0.00
2.5	30.00	13.26	35.00	12.40	40.00	11.75	45.00	11.25	0.00	0.00
3.0	30.00	15.97	35.00	14.72	40.00	13.79	45.00	13.06	0.00	0.00
4.0	30.00	22.87	35.00	20.64	40.00	18.96	45.00	17.66	0.00	0.00
6.0	30.00	42.34	35.00	37.32	40.00	33.56	45.00	30.63	0.00	0.00

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	6.16			
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c =	21.68 Ton	S = d / 2 = 27.50 cm
3.0	22.72			
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c =	28.91 Ton	S = d / 4 = 13.75 cm
6.0	91.20			

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	18.27	10.00	11.15	15.00	8.77	20.00	7.59	25.00	6.87		
2.5	5.00	40.06	10.00	21.95	15.00	15.91	20.00	12.90	25.00	11.09		
3.0	5.00	56.32	10.00	30.08	15.00	21.34	20.00	16.96	25.00	14.34		
4.0	5.00	97.72	10.00	50.78	15.00	35.13	20.00	27.31	25.00	22.62		
6.0	5.00	214.51	10.00	109.18	15.00	74.07	20.00	56.51	25.00	45.98		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.40	35.00	6.06	40.00	5.80	45.00	5.61	0.00	0.00		
2.5	30.00	9.88	35.00	9.02	40.00	8.37	45.00	7.87	0.00	0.00		
3.0	30.00	12.59	35.00	11.34	40.00	10.40	45.00	9.67	0.00	0.00		
4.0	30.00	19.49	35.00	17.25	40.00	15.58	45.00	14.27	0.00	0.00		
6.0	30.00	38.95	35.00	33.94	40.00	30.18	45.00	27.25	0.00	0.00		

TABLA #3.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Ks/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00204)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f'c = 21.68 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f'c = 28.91 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	17.27	10.00	10.15	15.00	7.77	20.00	6.58	25.00	5.87
2.5	5.00	38.85	10.00	20.74	15.00	14.70	20.00	11.68	25.00	9.87
3.0	5.00	55.11	10.00	28.87	15.00	20.12	20.00	15.75	25.00	13.12
4.0	5.00	96.51	10.00	49.57	15.00	33.92	20.00	26.10	25.00	21.40
6.0	5.00	213.30	10.00	107.96	15.00	72.85	20.00	55.29	25.00	44.76

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	5.40	35.00	5.06	40.00	4.80	45.00	4.60	0.00	0.00
2.5	30.00	8.66	35.00	7.80	40.00	7.15	45.00	6.65	0.00	0.00
3.0	30.00	11.37	35.00	10.12	40.00	9.19	45.00	8.46	0.00	0.00
4.0	30.00	18.27	35.00	16.04	40.00	14.36	45.00	13.06	0.00	0.00
6.0	30.00	37.74	35.00	32.72	40.00	28.96	45.00	26.03	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales		Seccion	
f'c =	200 Kg/cm2	b =	30 cm
fy =	4200 Kg/cm2	h =	60 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	7,791.13	0.00541	17,021.95	0.00847	25,262.18
0.00245	8,114.78	0.00551	17,312.59	0.00857	25,519.80
0.00256	8,437.34	0.00561	17,602.12	0.00867	25,776.31
0.00266	8,758.79	0.00572	17,890.55	0.00877	26,031.72
0.00276	9,079.14	0.00582	18,177.89	0.00888	26,286.04
0.00286	9,398.39	0.00592	18,464.12	0.00898	26,539.25
0.00296	9,716.54	0.00602	18,749.25	0.00908	26,791.36
0.00307	10,033.59	0.00612	19,033.28	0.00918	27,042.37
0.00317	10,349.54	0.00623	19,316.21	0.00928	27,292.28
0.00327	10,664.39	0.00633	19,598.03	0.00939	27,541.09
0.00337	10,978.14	0.00643	19,878.76	0.00949	27,788.80
0.00347	11,290.78	0.00653	20,158.39	0.00959	28,035.40
0.00358	11,602.33	0.00663	20,436.92	0.00969	28,280.91
0.00368	11,912.78	0.00674	20,714.34	0.00979	28,525.32
0.00378	12,222.12	0.00684	20,990.67	0.00989	28,768.62
0.00388	12,530.37	0.00694	21,265.89	0.01000	29,010.83
0.00398	12,837.51	0.00704	21,540.02	0.01010	29,251.93
0.00408	13,143.55	0.00714	21,813.04	0.01020	29,491.94
0.00419	13,448.49	0.00724	22,084.96	0.01030	29,730.84
0.00429	13,752.34	0.00735	22,355.79	0.01040	29,968.64
0.00439	14,055.08	0.00745	22,625.51	0.01051	30,205.34
0.00449	14,356.72	0.00755	22,894.13	0.01061	30,440.94
0.00459	14,657.26	0.00765	23,161.65	0.01071	30,675.44
0.00470	14,956.70	0.00775	23,428.07	0.01081	30,908.84
0.00480	15,255.04	0.00786	23,693.39	0.01091	31,141.14
0.00490	15,552.27	0.00796	23,957.60	0.01102	31,372.34
0.00500	15,848.41	0.00806	24,220.72	0.01112	31,602.44
0.00510	16,143.45	0.00816	24,482.74	0.01122	31,831.44
0.00521	16,437.38	0.00826	24,743.65	0.01132	32,059.32
0.00531	16,730.22	0.00837	25,003.47	0.01142	32,286.13

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 30 cm
fy = 4200 Kg/cm2	h = 60 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	10.06	6.35	12.42
5.0	1.98	0.00	3.96	7.93	5.94	11.66	7.92	15.25	9.90	18.68
6.0	2.85	0.00	5.70	11.22	8.55	16.35	11.40	21.17	14.25	25.67
8.0	5.07	10.04	10.14	19.08	15.21	27.12	20.28	0.00	25.35	0.00
10.0	7.92	15.25	15.84	28.05	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	21.17	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	7.85	4.41	8.75	4.90	9.72
3.0	4.26	8.50	4.97	9.85	5.68	11.18	6.39	12.49	7.10	13.78
4.0	7.62	14.71	8.85	16.94	10.16	19.11	11.43	21.22	12.70	23.27
5.0	11.88	21.95	13.86	25.08	15.84	28.05	17.82	30.87	19.80	0.00
6.0	17.10	29.86	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 **Seccion:** b = 30 cm x h = 60 cm

*** Para P >= 0.01 ***

Estribos No. de Desisnacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 25.04 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 33.39 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	22.59	10.00	15.47	15.00	13.09	20.00	11.91	25.00	11.19		
2.5	5.00	44.56	10.00	26.45	15.00	20.42	20.00	17.40	25.00	15.59		
3.0	5.00	60.83	10.00	34.59	15.00	25.84	20.00	21.46	25.00	18.84		
4.0	5.00	102.22	10.00	55.28	15.00	39.64	20.00	31.81	25.00	27.12		
6.0	5.00	219.02	10.00	113.68	15.00	78.57	20.00	61.01	25.00	50.48		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	10.72	35.00	10.38	40.00	10.12	45.00	9.93	0.00	0.00		
2.5	30.00	14.38	35.00	13.52	40.00	12.87	45.00	12.37	0.00	0.00		
3.0	30.00	17.09	35.00	15.84	40.00	14.90	45.00	14.17	0.00	0.00		
4.0	30.00	23.99	35.00	21.75	40.00	20.08	45.00	18.77	0.00	0.00		
6.0	30.00	43.46	35.00	38.44	40.00	34.68	45.00	31.75	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00610)

$$$ Para Pmin < P < 0.01 $$$

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 25.04 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 33.39 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	19.00	10.00	11.88	15.00	9.50	20.00	8.31	25.00	7.60		
2.5	5.00	40.69	10.00	22.58	15.00	16.55	20.00	13.53	25.00	11.72		
3.0	5.00	56.95	10.00	30.71	15.00	21.97	20.00	17.59	25.00	14.97		
4.0	5.00	98.35	10.00	51.41	15.00	35.76	20.00	27.94	25.00	23.25		
6.0	5.00	215.14	10.00	109.81	15.00	74.70	20.00	57.14	25.00	46.61		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	7.13	35.00	6.79	40.00	6.53	45.00	6.34	0.00	0.00		
2.5	30.00	10.51	35.00	9.65	40.00	9.00	45.00	8.50	0.00	0.00		
3.0	30.00	13.22	35.00	11.97	40.00	11.03	45.00	10.30	0.00	0.00		
4.0	30.00	20.12	35.00	17.88	40.00	16.21	45.00	14.90	0.00	0.00		
6.0	30.00	39.58	35.00	34.57	40.00	30.81	45.00	27.88	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	6.16			
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c =	25.04 Ton	S = d / 2 = 27.50 cm
3.0	22.72			
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c =	33.39 Ton	S = d / 4 = 13.75 cm
6.0	91.20			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	17.95	10.00	10.82	15.00	8.45	20.00	7.26	25.00	6.55
2.5	5.00	39.36	10.00	21.25	15.00	15.21	20.00	12.19	25.00	10.38
3.0	5.00	55.62	10.00	29.38	15.00	20.63	20.00	16.26	25.00	13.64
4.0	5.00	97.02	10.00	50.08	15.00	34.43	20.00	26.61	25.00	21.91
6.0	5.00	213.81	10.00	108.48	15.00	73.36	20.00	55.81	25.00	45.27

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.07	35.00	5.74	40.00	5.48	45.00	5.28	0.00	0.00
2.5	30.00	9.18	35.00	8.31	40.00	7.67	45.00	7.16	0.00	0.00
3.0	30.00	11.89	35.00	10.64	40.00	9.70	45.00	8.97	0.00	0.00
4.0	30.00	18.79	35.00	16.55	40.00	14.87	45.00	13.57	0.00	0.00
6.0	30.00	38.25	35.00	33.24	40.00	29.47	45.00	26.55	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 30 cm
fy = 4200 Kg/cm2	h = 60 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	8,745.49	0.00656	20,685.96	0.01048	31,319.47
0.00276	9,164.56	0.00669	21,061.46	0.01062	31,651.41
0.00289	9,582.10	0.00682	21,435.52	0.01075	31,981.90
0.00302	9,998.35	0.00695	21,808.12	0.01088	32,310.94
0.00315	10,413.06	0.00708	22,179.27	0.01101	32,638.52
0.00328	10,826.33	0.00721	22,548.97	0.01114	32,964.66
0.00342	11,238.14	0.00734	22,917.21	0.01127	33,289.34
0.00355	11,648.50	0.00747	23,284.01	0.01140	33,612.57
0.00368	12,057.40	0.00760	23,649.35	0.01153	33,934.34
0.00381	12,464.86	0.00774	24,013.24	0.01166	34,254.67
0.00394	12,870.86	0.00787	24,375.68	0.01179	34,573.54
0.00407	13,275.41	0.00800	24,736.66	0.01192	34,890.96
0.00420	13,678.51	0.00813	25,096.20	0.01206	35,206.93
0.00433	14,080.15	0.00826	25,454.28	0.01219	35,521.44
0.00446	14,480.35	0.00839	25,810.91	0.01232	35,834.51
0.00459	14,879.09	0.00852	26,166.08	0.01245	36,146.12
0.00472	15,276.38	0.00865	26,519.81	0.01258	36,456.28
0.00486	15,672.22	0.00878	26,872.08	0.01271	36,764.99
0.00499	16,066.60	0.00891	27,222.90	0.01284	37,072.24
0.00512	16,459.54	0.00904	27,572.27	0.01297	37,378.04
0.00525	16,851.02	0.00918	27,920.18	0.01310	37,682.39
0.00538	17,241.05	0.00931	28,266.65	0.01323	37,985.29
0.00551	17,629.62	0.00944	28,611.66	0.01336	38,286.74
0.00564	18,016.75	0.00957	28,955.22	0.01349	38,586.73
0.00577	18,402.42	0.00970	29,297.32	0.01363	38,885.27
0.00590	18,786.64	0.00983	29,637.98	0.01376	39,182.36
0.00603	19,169.41	0.00996	29,977.18	0.01389	39,478.00
0.00616	19,550.72	0.01009	30,314.93	0.01402	39,772.19
0.00630	19,930.59	0.01022	30,651.23	0.01415	40,064.92
0.00643	20,309.00	0.01035	30,986.08	0.01428	40,356.20

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 30 cm
fy = 4200 Kg/cm2	h = 60 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	10.16	6.35	12.57
5.0	1.98	0.00	3.96	0.00	5.94	11.80	7.92	15.49	9.90	19.06
6.0	2.85	0.00	5.70	11.34	8.55	16.64	11.40	21.68	14.25	26.47
8.0	5.07	10.14	10.14	19.48	15.21	28.02	20.28	35.76	25.35	0.00
10.0	7.92	15.49	15.84	29.03	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	21.68	22.80	39.31	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	8.87	4.90	9.81
3.0	4.26	0.00	4.97	9.95	5.68	11.31	6.39	12.65	7.10	13.99
4.0	7.62	14.94	8.89	17.25	10.16	19.52	11.43	21.73	12.70	23.89
5.0	11.88	22.50	13.86	25.92	15.84	29.03	17.82	32.11	19.80	35.06
6.0	17.10	31.00	19.95	35.28	22.80	39.31	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistante total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 **Seccion:** b = 30 cm x h = 60 cm

*** Para P >= 0.01 ***

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 28.00 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 37.33 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	23.58	10.00	16.45	15.00	14.08	20.00	12.89	25.00	12.18		
2.5	5.00	45.55	10.00	27.44	15.00	21.40	20.00	18.38	25.00	16.57		
3.0	5.00	61.81	10.00	35.57	15.00	26.82	20.00	22.45	25.00	19.83		
4.0	5.00	103.21	10.00	56.27	15.00	40.62	20.00	32.80	25.00	28.10		
6.0	5.00	220.00	10.00	114.66	15.00	79.55	20.00	62.00	25.00	51.46		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	11.70	35.00	11.36	40.00	11.11	45.00	10.91	0.00	0.00		
2.5	30.00	15.37	35.00	14.50	40.00	13.86	45.00	13.35	0.00	0.00		
3.0	30.00	18.08	35.00	16.83	40.00	15.89	45.00	15.16	0.00	0.00		
4.0	30.00	24.98	35.00	22.74	40.00	21.06	45.00	19.76	0.00	0.00		
6.0	30.00	44.44	35.00	39.42	40.00	35.66	45.00	32.74	0.00	0.00		

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Ks/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 28.00 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 37.33 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	19.64	10.00	12.52	15.00	10.14	20.00	8.95	25.00	8.24		
2.5	5.00	41.30	10.00	23.19	15.00	17.15	20.00	14.13	25.00	12.32		
3.0	5.00	57.56	10.00	31.32	15.00	22.57	20.00	18.20	25.00	15.57		
4.0	5.00	98.96	10.00	52.02	15.00	36.37	20.00	28.55	25.00	23.85		
6.0	5.00	215.75	10.00	110.41	15.00	75.30	20.00	57.75	25.00	47.21		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	7.77	35.00	7.43	40.00	7.17	45.00	6.98	0.00	0.00		
2.5	30.00	11.11	35.00	10.25	40.00	9.61	45.00	9.10	0.00	0.00		
3.0	30.00	13.83	35.00	12.58	40.00	11.64	45.00	10.91	0.00	0.00		
4.0	30.00	20.72	35.00	18.49	40.00	16.81	45.00	15.51	0.00	0.00		
6.0	30.00	40.19	35.00	35.17	40.00	31.41	45.00	28.49	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00263)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	6.16			
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c =	28.00 Ton	S = d / 2 = 27.50 cm
3.0	22.72			
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c =	37.33 Ton	S = d / 4 = 13.75 cm
6.0	91.20			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	18.54	10.00	11.42	15.00	9.04	20.00	7.86	25.00	7.14
2.5	5.00	39.85	10.00	21.74	15.00	15.70	20.00	12.68	25.00	10.87
3.0	5.00	56.11	10.00	29.87	15.00	21.12	20.00	16.75	25.00	14.12
4.0	5.00	97.51	10.00	50.57	15.00	34.92	20.00	27.10	25.00	22.40
6.0	5.00	214.30	10.00	108.96	15.00	73.85	20.00	56.30	25.00	45.76

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.67	35.00	6.33	40.00	6.08	45.00	5.88	0.00	0.00
2.5	30.00	9.66	35.00	8.80	40.00	8.16	45.00	7.65	0.00	0.00
3.0	30.00	12.37	35.00	11.13	40.00	10.19	45.00	9.46	0.00	0.00
4.0	30.00	19.27	35.00	17.04	40.00	15.36	45.00	14.06	0.00	0.00
6.0	30.00	38.74	35.00	33.72	40.00	29.96	45.00	27.04	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales		Seccion	
f'c =	300 Kg/cm2	b =	30 cm
fy =	4200 Kg/cm2	h =	60 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	9,608.29	0.00769	24,297.35	0.01249	37,355.56
0.00304	10,124.20	0.00785	24,758.90	0.01265	37,762.75
0.00320	10,638.30	0.00801	25,218.64	0.01281	38,168.12
0.00336	11,150.58	0.00817	25,676.56	0.01297	38,571.69
0.00352	11,661.06	0.00833	26,132.68	0.01313	38,973.44
0.00368	12,169.72	0.00849	26,586.98	0.01329	39,373.37
0.00384	12,676.57	0.00865	27,039.46	0.01345	39,771.50
0.00400	13,181.61	0.00881	27,490.14	0.01361	40,167.81
0.00416	13,684.83	0.00897	27,939.01	0.01377	40,562.32
0.00432	14,186.25	0.00913	28,386.06	0.01393	40,955.01
0.00448	14,685.85	0.00929	28,831.30	0.01409	41,345.88
0.00464	15,183.64	0.00945	29,274.72	0.01425	41,734.95
0.00480	15,679.62	0.00961	29,716.34	0.01441	42,122.20
0.00496	16,173.78	0.00977	30,156.14	0.01457	42,507.65
0.00512	16,666.14	0.00993	30,594.14	0.01474	42,891.28
0.00528	17,156.68	0.01009	31,030.32	0.01490	43,273.09
0.00544	17,645.41	0.01025	31,464.68	0.01506	43,653.10
0.00560	18,132.33	0.01041	31,897.24	0.01522	44,031.29
0.00576	18,617.43	0.01057	32,327.98	0.01538	44,407.67
0.00593	19,100.72	0.01073	32,756.91	0.01554	44,782.24
0.00609	19,582.21	0.01089	33,184.03	0.01570	45,155.00
0.00625	20,061.87	0.01105	33,609.34	0.01586	45,525.94
0.00641	20,539.73	0.01121	34,032.84	0.01602	45,895.08
0.00657	21,015.78	0.01137	34,454.52	0.01618	46,262.40
0.00673	21,490.01	0.01153	34,874.39	0.01634	46,627.91
0.00689	21,962.43	0.01169	35,292.45	0.01650	46,991.61
0.00705	22,433.04	0.01185	35,708.69	0.01666	47,353.49
0.00721	22,901.84	0.01201	36,123.13	0.01682	47,713.56
0.00737	23,368.82	0.01217	36,535.75	0.01698	48,071.82
0.00753	23,833.99	0.01233	36,946.56	0.01714	48,428.27

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 30 cm
fy = 4200 Kg/cm2	h = 60 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	10.23	6.35	12.68
5.0	1.98	0.00	3.96	0.00	5.94	11.89	7.92	15.65	9.90	19.31
6.0	2.85	0.00	5.70	11.43	8.55	16.83	11.40	22.01	14.25	26.99
8.0	5.07	10.21	10.14	19.75	15.21	28.62	20.28	36.83	25.35	44.37
10.0	7.92	15.65	15.84	29.68	23.76	42.07	31.68	0.00	39.60	0.00
12.0	11.40	22.01	22.80	40.66	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	9.88
3.0	4.26	0.00	4.97	10.01	5.68	11.39	6.39	12.76	7.10	14.11
4.0	7.62	15.09	8.89	17.46	10.16	19.78	11.43	22.07	12.70	24.31
5.0	11.88	22.87	13.86	26.32	15.84	29.68	17.82	32.93	19.80	36.08
6.0	17.10	31.76	19.95	36.31	22.80	40.66	25.65	44.79	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 83.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 30.67 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 40.89 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	24.47	10.00	17.34	15.00	14.97	20.00	13.78	25.00	13.07
2.5	5.00	46.44	10.00	28.33	15.00	22.29	20.00	19.27	25.00	17.46
3.0	5.00	62.70	10.00	36.46	15.00	27.71	20.00	23.34	25.00	20.72
4.0	5.00	104.10	10.00	57.16	15.00	41.51	20.00	33.69	25.00	29.00
6.0	5.00	220.89	10.00	115.56	15.00	80.44	20.00	62.89	25.00	52.35

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	12.59	35.00	12.26	40.00	12.00	45.00	11.80	0.00	0.00
2.5	30.00	16.26	35.00	15.39	40.00	14.75	45.00	14.24	0.00	0.00
3.0	30.00	18.97	35.00	17.72	40.00	16.78	45.00	16.05	0.00	0.00
4.0	30.00	25.87	35.00	23.63	40.00	21.95	45.00	20.65	0.00	0.00
6.0	30.00	45.33	35.00	40.32	40.00	36.55	45.00	33.63	0.00	0.00

TABLA 83.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Ks/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 30.67 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 40.89 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	20.24	10.00	13.12	15.00	10.74	20.00	9.56	25.00	8.84		
2.5	5.00	41.83	10.00	23.72	15.00	17.68	20.00	14.66	25.00	12.85		
3.0	5.00	58.09	10.00	31.85	15.00	23.10	20.00	18.73	25.00	16.10		
4.0	5.00	99.48	10.00	52.55	15.00	36.90	20.00	29.08	25.00	24.38		
6.0	5.00	216.28	10.00	110.94	15.00	75.83	20.00	58.27	25.00	47.74		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.37	35.00	8.03	40.00	7.77	45.00	7.58	0.00	0.00		
2.5	30.00	11.64	35.00	10.78	40.00	10.13	45.00	9.63	0.00	0.00		
3.0	30.00	14.35	35.00	13.10	40.00	12.17	45.00	11.44	0.00	0.00		
4.0	30.00	21.25	35.00	19.02	40.00	17.34	45.00	16.04	0.00	0.00		
6.0	30.00	40.72	35.00	35.70	40.00	31.94	45.00	29.01	0.00	0.00		

TABLA 43.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 30 cm x h = 60 cm

(0.00288)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	6.16		
2.5	15.68	Vu <= 1.5 * FR * b * d * raiz f* c = 30.67 Ton	S = d / 2 = 27.50 cm
3.0	22.72		
4.0	40.64	Vu <= 2.0 * FR * b * d * raiz f* c = 40.89 Ton	S = d / 4 = 13.75 cm
6.0	91.20		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	19.13	10.00	12.00	15.00	9.63	20.00	8.44	25.00	7.73
2.5	5.00	40.28	10.00	22.17	15.00	16.13	20.00	13.12	25.00	11.30
3.0	5.00	56.54	10.00	30.30	15.00	21.55	20.00	17.18	25.00	14.56
4.0	5.00	97.94	10.00	51.00	15.00	35.35	20.00	27.53	25.00	22.84
6.0	5.00	214.73	10.00	109.40	15.00	74.28	20.00	56.73	25.00	46.19

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	7.25	35.00	6.91	40.00	6.66	45.00	6.46	0.00	0.00
2.5	30.00	10.10	35.00	9.23	40.00	8.57	45.00	8.08	0.00	0.00
3.0	30.00	12.81	35.00	11.56	40.00	10.62	45.00	9.89	0.00	0.00
4.0	30.00	19.71	35.00	17.47	40.00	15.80	45.00	14.49	0.00	0.00
6.0	30.00	39.17	35.00	34.16	40.00	30.39	45.00	27.47	0.00	0.00

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	10,930.36	0.00424	21,642.12	0.00644	31,238.78
0.00211	11,305.38	0.00431	21,979.98	0.00651	31,539.47
0.00218	11,679.17	0.00438	22,316.59	0.00659	31,838.91
0.00226	12,051.71	0.00446	22,651.97	0.00666	32,137.12
0.00233	12,423.02	0.00453	22,986.11	0.00673	32,434.09
0.00240	12,793.09	0.00460	23,319.00	0.00681	32,729.81
0.00248	13,161.92	0.00468	23,650.66	0.00688	33,024.30
0.00255	13,529.51	0.00475	23,981.08	0.00695	33,317.55
0.00262	13,895.86	0.00482	24,310.26	0.00703	33,609.57
0.00270	14,260.97	0.00490	24,638.21	0.00710	33,900.34
0.00277	14,624.85	0.00497	24,964.91	0.00717	34,189.87
0.00284	14,987.48	0.00504	25,290.37	0.00725	34,478.16
0.00292	15,348.88	0.00512	25,614.60	0.00732	34,765.22
0.00299	15,709.03	0.00519	25,937.59	0.00739	35,051.04
0.00306	16,067.95	0.00526	26,259.33	0.00747	35,335.61
0.00314	16,425.63	0.00534	26,579.84	0.00754	35,618.95
0.00321	16,782.07	0.00541	26,899.11	0.00761	35,901.05
0.00328	17,137.27	0.00548	27,217.14	0.00769	36,181.91
0.00336	17,491.23	0.00556	27,533.93	0.00776	36,461.53
0.00343	17,843.95	0.00563	27,849.48	0.00783	36,739.91
0.00350	18,195.43	0.00570	28,163.80	0.00791	37,017.06
0.00358	18,545.68	0.00578	28,476.87	0.00798	37,292.96
0.00365	18,894.68	0.00585	28,788.71	0.00805	37,567.63
0.00372	19,242.45	0.00592	29,099.30	0.00813	37,841.05
0.00380	19,588.98	0.00600	29,408.66	0.00820	38,113.24
0.00387	19,934.27	0.00607	29,716.78	0.00827	38,384.19
0.00394	20,278.32	0.00614	30,023.66	0.00835	38,653.90
0.00402	20,621.13	0.00622	30,329.30	0.00842	38,922.37
0.00409	20,962.70	0.00629	30,633.70	0.00849	39,189.60
0.00416	21,303.03	0.00637	30,936.86	0.00857	39,455.59

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

# Barras =>	1		2		3		4		5	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	11.91	6.35	14.71
5.0	1.98	0.00	3.96	0.00	5.94	13.81	7.92	18.06	9.90	22.15
6.0	2.85	0.00	5.70	13.28	8.55	19.38	11.40	25.12	14.25	30.50
8.0	5.07	11.89	10.14	22.63	15.21	32.23	20.28	0.00	25.35	0.00
10.0	7.92	18.06	15.84	33.34	23.76	0.00	31.68	0.00	39.60	0.00
12.0	11.40	25.12	22.80	0.00	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	11.51
3.0	4.26	0.00	4.97	11.66	5.68	13.24	6.39	14.79	7.10	16.32
4.0	7.62	17.43	8.89	20.09	10.16	22.67	11.43	25.18	12.70	27.62
5.0	11.88	26.05	13.86	29.78	15.84	33.34	17.82	36.72	19.80	0.00
6.0	17.10	35.51	19.95	0.00	22.80	0.00	25.65	0.00	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Ks/cm2 Seccion: b = 35 cm x h = 70 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	5.28			
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c =	29.90 Ton	S = d / 2 = 32.50 cm
3.0	19.47			
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c =	39.87 Ton	S = d / 4 = 16.25 cm
6.0	78.17			

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	23.81	10.00	15.39	15.00	12.59	20.00	11.18	25.00	10.34
2.5	5.00	49.78	10.00	28.38	15.00	21.24	20.00	17.67	25.00	15.53
3.0	5.00	69.00	10.00	37.99	15.00	27.65	20.00	22.48	25.00	19.38
4.0	5.00	117.92	10.00	62.45	15.00	43.96	20.00	34.71	25.00	29.16
6.0	5.00	255.95	10.00	131.46	15.00	89.96	20.00	69.22	25.00	56.77

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	9.78	35.00	9.38	40.00	9.09	45.00	8.84	0.00	0.00
2.5	30.00	14.11	35.00	13.09	40.00	12.32	45.00	11.73	0.00	0.00
3.0	30.00	17.51	35.00	15.83	40.00	14.73	45.00	13.86	0.00	0.00
4.0	30.00	25.46	35.00	22.82	40.00	20.84	45.00	19.39	0.00	0.00
6.0	30.00	48.47	35.00	42.54	40.00	38.09	45.00	34.64	0.00	0.00

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 29.90 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 39.87 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	22.39	10.00	13.97	15.00	11.16	20.00	9.76	25.00	8.92
2.5	5.00	48.10	10.00	26.70	15.00	19.57	20.00	16.00	25.00	13.86
3.0	5.00	67.32	10.00	36.31	15.00	25.97	20.00	20.80	25.00	17.70
4.0	5.00	116.25	10.00	60.77	15.00	42.28	20.00	33.04	25.00	27.49
6.0	5.00	254.27	10.00	129.79	15.00	88.29	20.00	67.54	25.00	55.09

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.36	35.00	7.96	40.00	7.65	45.00	7.42	0.00	0.00
2.5	30.00	12.43	35.00	11.41	40.00	10.65	45.00	10.05	0.00	0.00
3.0	30.00	15.64	35.00	14.16	40.00	13.05	45.00	12.19	0.00	0.00
4.0	30.00	23.79	35.00	21.15	40.00	19.17	45.00	17.63	0.00	0.00
6.0	30.00	46.79	35.00	40.87	40.00	36.42	45.00	32.96	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00204)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 29.90 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 39.87 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	21.01	10.00	12.59	15.00	9.78	20.00	8.38	25.00	7.54		
2.5	5.00	46.43	10.00	25.03	15.00	17.89	20.00	14.33	25.00	12.18		
3.0	5.00	65.65	10.00	34.64	15.00	24.30	20.00	19.13	25.00	16.03		
4.0	5.00	114.57	10.00	59.10	15.00	40.61	20.00	31.36	25.00	25.81		
6.0	5.00	252.60	10.00	128.11	15.00	86.62	20.00	65.87	25.00	53.42		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	6.97	35.00	6.57	40.00	6.27	45.00	6.04	0.00	0.00		
2.5	30.00	10.76	35.00	9.74	40.00	8.97	45.00	8.38	0.00	0.00		
3.0	30.00	13.96	35.00	12.48	40.00	11.38	45.00	10.52	0.00	0.00		
4.0	30.00	22.11	35.00	19.47	40.00	17.49	45.00	15.95	0.00	0.00		
6.0	30.00	45.12	35.00	39.19	40.00	34.75	45.00	31.29	0.00	0.00		

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00235	12,695.47	0.00541	27,736.88	0.00847	41,164.14
0.00245	13,222.85	0.00551	28,210.46	0.00857	41,583.92
0.00256	13,748.44	0.00561	28,682.25	0.00867	42,001.90
0.00266	14,272.24	0.00572	29,152.24	0.00877	42,418.09
0.00276	14,794.25	0.00582	29,620.44	0.00888	42,832.49
0.00286	15,314.46	0.00592	30,086.85	0.00898	43,245.09
0.00296	15,832.88	0.00602	30,551.46	0.00908	43,655.90
0.00307	16,349.50	0.00612	31,014.28	0.00918	44,064.91
0.00317	16,864.34	0.00623	31,475.31	0.00928	44,472.13
0.00327	17,377.37	0.00633	31,934.54	0.00939	44,877.56
0.00337	17,888.62	0.00643	32,391.98	0.00949	45,281.20
0.00347	18,398.07	0.00653	32,847.63	0.00959	45,683.04
0.00358	18,905.73	0.00663	33,301.48	0.00969	46,083.08
0.00368	19,411.59	0.00674	33,753.54	0.00979	46,481.34
0.00378	19,915.66	0.00684	34,203.81	0.00989	46,877.80
0.00388	20,417.94	0.00694	34,652.28	0.01000	47,272.47
0.00398	20,918.42	0.00704	35,098.96	0.01010	47,665.34
0.00408	21,417.11	0.00714	35,543.84	0.01020	48,056.42
0.00419	21,914.01	0.00724	35,986.93	0.01030	48,445.71
0.00429	22,409.11	0.00735	36,428.23	0.01040	48,833.20
0.00439	22,902.42	0.00745	36,867.74	0.01051	49,218.90
0.00449	23,393.94	0.00755	37,305.45	0.01061	49,602.81
0.00459	23,883.66	0.00765	37,741.37	0.01071	49,984.92
0.00470	24,371.59	0.00775	38,175.49	0.01081	50,365.24
0.00480	24,857.73	0.00786	38,607.82	0.01091	50,743.77
0.00490	25,342.07	0.00796	39,038.36	0.01102	51,120.50
0.00500	25,824.62	0.00806	39,467.10	0.01112	51,495.44
0.00510	26,305.37	0.00816	39,894.05	0.01122	51,868.58
0.00521	26,784.33	0.00826	40,319.21	0.01132	52,239.93
0.00531	27,261.50	0.00837	40,742.57	0.01142	52,609.49

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 200 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 35 cm
h = 70 cm

# Barras =>	1		2		3		4		5	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	14.93
5.0	1.98	0.00	3.96	0.00	5.94	14.01	7.92	18.41	9.90	22.69
6.0	2.85	0.00	5.70	13.46	8.55	19.79	11.40	25.84	14.25	31.63
8.0	5.07	0.00	10.14	23.20	15.21	33.51	20.28	42.97	25.35	51.57
10.0	7.92	18.41	15.84	34.73	23.76	48.96	31.68	0.00	39.60	0.00
12.0	11.40	25.84	22.80	47.35	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	13.42	6.39	15.03	7.10	16.60
4.0	7.62	17.75	8.89	20.52	10.16	23.24	11.43	25.90	12.70	28.51
5.0	11.88	26.84	13.86	30.85	15.84	34.73	17.82	38.49	19.80	42.11
6.0	17.10	37.14	19.95	42.38	22.80	47.35	25.65	52.05	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 34.53 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 46.04 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	24.89	10.00	16.47	15.00	13.67	20.00	12.26	25.00	11.42
2.5	5.00	50.86	10.00	29.46	15.00	22.32	20.00	18.75	25.00	16.61
3.0	5.00	70.08	10.00	39.07	15.00	28.73	20.00	23.56	25.00	20.46
4.0	5.00	119.00	10.00	63.53	15.00	45.03	20.00	35.79	25.00	30.24
6.0	5.00	257.03	10.00	132.54	15.00	91.04	20.00	70.30	25.00	57.85

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	10.86	35.00	10.46	40.00	10.16	45.00	9.92	0.00	0.00
2.5	30.00	15.19	35.00	14.17	40.00	13.40	45.00	12.81	0.00	0.00
3.0	30.00	18.39	35.00	16.91	40.00	15.81	45.00	14.94	0.00	0.00
4.0	30.00	26.54	35.00	23.96	40.00	21.92	45.00	20.38	0.00	0.00
6.0	30.00	49.55	35.00	43.62	40.00	39.17	45.00	35.72	0.00	0.00

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00610)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 34.53 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 46.04 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	23.39	10.00	14.97	15.00	12.17	20.00	10.76	25.00	9.92
2.5	5.00	48.97	10.00	27.57	15.00	20.44	20.00	16.87	25.00	14.73
3.0	5.00	68.19	10.00	37.18	15.00	26.84	20.00	21.67	25.00	18.57
4.0	5.00	117.11	10.00	61.64	15.00	43.15	20.00	33.90	25.00	28.36
6.0	5.00	255.14	10.00	130.66	15.00	89.16	20.00	68.41	25.00	55.96

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	9.36	35.00	8.96	40.00	8.66	45.00	8.42	0.00	0.00
2.5	30.00	13.30	35.00	12.28	40.00	11.52	45.00	10.92	0.00	0.00
3.0	30.00	16.50	35.00	15.03	40.00	13.92	45.00	13.06	0.00	0.00
4.0	30.00	24.66	35.00	22.02	40.00	20.04	45.00	18.49	0.00	0.00
6.0	30.00	47.66	35.00	41.74	40.00	37.29	45.00	33.83	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00235)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 34.53 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 46.04 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	21.94	10.00	13.52	15.00	10.72	20.00	9.31	25.00	8.47		
2.5	5.00	47.14	10.00	25.73	15.00	18.60	20.00	15.03	25.00	12.89		
3.0	5.00	66.36	10.00	35.34	15.00	25.01	20.00	19.84	25.00	16.74		
4.0	5.00	115.28	10.00	59.80	15.00	41.31	20.00	32.07	25.00	26.52		
6.0	5.00	253.31	10.00	128.82	15.00	87.32	20.00	66.57	25.00	54.13		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	7.91	35.00	7.51	40.00	7.21	45.00	6.97	0.00	0.00		
2.5	30.00	11.46	35.00	10.45	40.00	9.68	45.00	9.09	0.00	0.00		
3.0	30.00	14.67	35.00	13.19	40.00	12.08	45.00	11.22	0.00	0.00		
4.0	30.00	22.82	35.00	20.18	40.00	18.20	45.00	16.66	0.00	0.00		
6.0	30.00	45.83	35.00	39.90	40.00	35.45	45.00	31.99	0.00	0.00		

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	14,250.57	0.00656	33,707.28	0.01048	51,034.35
0.00276	14,933.44	0.00669	34,319.16	0.01062	51,575.24
0.00289	15,613.94	0.00682	34,928.68	0.01075	52,113.76
0.00302	16,292.07	0.00695	35,535.82	0.01088	52,649.92
0.00315	16,967.84	0.00708	36,140.61	0.01101	53,183.71
0.00328	17,641.25	0.00721	36,743.02	0.01114	53,715.14
0.00342	18,312.28	0.00734	37,343.07	0.01127	54,244.20
0.00355	18,980.95	0.00747	37,940.75	0.01140	54,770.89
0.00368	19,647.26	0.00760	38,536.07	0.01153	55,295.22
0.00381	20,311.20	0.00774	39,129.02	0.01166	55,817.18
0.00394	20,972.77	0.00787	39,719.60	0.01179	56,336.78
0.00407	21,631.97	0.00800	40,307.82	0.01192	56,854.01
0.00420	22,288.81	0.00813	40,893.67	0.01206	57,368.87
0.00433	22,943.29	0.00826	41,477.15	0.01219	57,881.36
0.00446	23,595.39	0.00839	42,058.27	0.01232	58,391.49
0.00459	24,245.13	0.00852	42,637.02	0.01245	58,899.26
0.00472	24,892.51	0.00865	43,213.41	0.01258	59,404.66
0.00486	25,537.51	0.00878	43,787.43	0.01271	59,907.69
0.00499	26,180.15	0.00891	44,359.08	0.01284	60,408.35
0.00512	26,820.43	0.00904	44,928.37	0.01297	60,906.65
0.00525	27,458.34	0.00918	45,495.29	0.01310	61,402.58
0.00538	28,093.88	0.00931	46,059.84	0.01323	61,896.15
0.00551	28,727.06	0.00944	46,622.03	0.01336	62,387.35
0.00564	29,357.87	0.00957	47,181.85	0.01349	62,876.18
0.00577	29,986.31	0.00970	47,739.31	0.01363	63,362.65
0.00590	30,612.39	0.00983	48,294.40	0.01376	63,846.75
0.00603	31,236.10	0.00996	48,847.12	0.01389	64,328.48
0.00616	31,857.45	0.01009	49,397.47	0.01402	64,807.85
0.00630	32,476.43	0.01022	49,945.46	0.01415	65,284.85
0.00643	33,093.04	0.01035	50,491.09	0.01428	65,759.49

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	15.06
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	18.62	9.90	23.02
6.0	2.85	0.00	5.70	0.00	8.55	20.03	11.40	26.28	14.25	32.30
8.0	5.07	0.00	10.14	23.54	15.21	34.28	20.28	44.34	25.35	53.71
10.0	7.92	18.62	15.84	35.57	23.76	50.85	31.68	64.45	39.60	0.00
12.0	11.40	26.28	22.80	49.08	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	15.16	7.10	16.77
4.0	7.62	17.95	8.89	20.79	10.16	23.59	11.43	26.34	12.70	29.05
5.0	11.88	27.31	13.86	31.49	15.84	35.57	17.82	39.55	19.80	43.42
6.0	17.10	38.11	19.95	43.71	22.80	49.08	25.65	54.24	28.50	59.19
8.0	30.42	62.40	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

*** Para P >= 0.01 ***

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 38.60 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 51.47 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	25.84	10.00	17.42	15.00	14.62	20.00	13.21	25.00	12.37		
2.5	5.00	51.81	10.00	30.41	15.00	23.27	20.00	19.71	25.00	17.56		
3.0	5.00	71.83	10.00	40.02	15.00	29.68	20.00	24.51	25.00	21.41		
4.0	5.00	115.55	10.00	64.48	15.00	45.99	20.00	36.74	25.00	31.19		
6.0	5.00	257.98	10.00	133.49	15.00	92.00	20.00	71.25	25.00	58.80		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	11.81	35.00	11.41	40.00	11.11	45.00	10.87	0.00	0.00		
2.5	30.00	15.14	35.00	15.12	40.00	14.35	45.00	13.76	0.00	0.00		
3.0	30.00	19.34	35.00	17.86	40.00	16.76	45.00	15.90	0.00	0.00		
4.0	30.00	27.49	35.00	24.85	40.00	22.87	45.00	21.33	0.00	0.00		
6.0	30.00	50.50	35.00	44.57	40.00	40.13	45.00	36.67	0.00	0.00		

TABLA 6J.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 38.60 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 51.47 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	24.28	10.00	15.86	15.00	13.05	20.00	11.65	25.00	10.80		
2.5	5.00	49.81	10.00	28.41	15.00	21.27	20.00	17.71	25.00	15.56		
3.0	5.00	69.03	10.00	38.02	15.00	27.68	20.00	22.51	25.00	19.41		
4.0	5.00	117.95	10.00	62.48	15.00	43.99	20.00	34.74	25.00	29.19		
6.0	5.00	255.98	10.00	131.49	15.00	90.00	20.00	69.25	25.00	56.80		

Estribos No. de Desisnacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	10.24	35.00	9.84	40.00	9.54	45.00	9.31	0.00	0.00		
2.5	30.00	14.14	35.00	13.12	40.00	12.35	45.00	11.76	0.00	0.00		
3.0	30.00	17.34	35.00	15.86	40.00	14.76	45.00	13.90	0.00	0.00		
4.0	30.00	25.49	35.00	22.85	40.00	20.87	45.00	19.33	0.00	0.00		
6.0	30.00	48.50	35.00	42.57	40.00	38.13	45.00	34.67	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00263)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 38.60 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 51.47 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	22.76	10.00	14.34	15.00	11.54	20.00	10.13	25.00	9.29		
2.5	5.00	47.81	10.00	26.41	15.00	19.27	20.00	15.71	25.00	13.57		
3.0	5.00	67.03	10.00	36.02	15.00	25.68	20.00	20.51	25.00	17.41		
4.0	5.00	115.95	10.00	60.48	15.00	41.99	20.00	32.74	25.00	27.19		
6.0	5.00	253.98	10.00	129.49	15.00	88.00	20.00	67.25	25.00	54.80		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.73	35.00	8.33	40.00	8.03	45.00	7.79	0.00	0.00		
2.5	30.00	12.14	35.00	11.12	40.00	10.35	45.00	9.76	0.00	0.00		
3.0	30.00	15.34	35.00	13.86	40.00	12.76	45.00	11.90	0.00	0.00		
4.0	30.00	23.49	35.00	20.85	40.00	18.87	45.00	17.33	0.00	0.00		
6.0	30.00	46.50	35.00	40.57	40.00	36.13	45.00	32.67	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 35 cm
fy = 4200 Kg/cm2	h = 70 cm

Porcentaje De Acero	Momento Resistente (Kg x m)	Porcentaje De Acero	Momento Resistente (Kg x m)	Porcentaje De Acero	Momento Resistente (Kg x m)
0.00288	15,656.48	0.00769	39,591.97	0.01249	60,870.02
0.00304	16,497.15	0.00785	40,344.06	0.01265	61,533.52
0.00320	17,334.86	0.00801	41,093.19	0.01281	62,194.07
0.00336	18,169.62	0.00817	41,839.36	0.01297	62,851.66
0.00352	19,001.42	0.00833	42,582.59	0.01313	63,506.30
0.00368	19,830.28	0.00849	43,322.86	0.01329	64,157.99
0.00384	20,656.18	0.00865	44,060.18	0.01345	64,806.73
0.00400	21,479.13	0.00881	44,794.54	0.01361	65,452.52
0.00416	22,299.12	0.00897	45,525.96	0.01377	66,095.35
0.00432	23,116.16	0.00913	46,254.42	0.01393	66,735.23
0.00448	23,930.25	0.00929	46,979.93	0.01409	67,372.15
0.00464	24,741.39	0.00945	47,702.48	0.01425	68,006.13
0.00480	25,549.57	0.00761	48,422.08	0.01441	68,637.15
0.00496	26,354.80	0.00977	49,138.73	0.01457	69,265.22
0.00512	27,157.08	0.00993	49,852.43	0.01474	69,890.33
0.00528	27,956.41	0.01009	50,563.18	0.01490	70,512.49
0.00544	28,752.78	0.01025	51,270.97	0.01506	71,131.70
0.00560	29,546.20	0.01041	51,975.81	0.01522	71,747.96
0.00576	30,336.67	0.01057	52,677.69	0.01538	72,361.27
0.00593	31,124.19	0.01073	53,376.63	0.01554	72,971.62
0.00609	31,908.75	0.01089	54,072.61	0.01570	73,579.02
0.00625	32,690.36	0.01105	54,765.64	0.01586	74,183.46
0.00641	33,469.02	0.01121	55,455.71	0.01602	74,784.96
0.00657	34,244.72	0.01137	56,142.83	0.01618	75,383.50
0.00673	35,017.47	0.01153	56,827.00	0.01634	75,979.09
0.00689	35,787.27	0.01169	57,508.22	0.01650	76,571.72
0.00705	36,554.12	0.01185	58,186.49	0.01666	77,161.41
0.00721	37,318.01	0.01201	58,861.80	0.01682	77,748.14
0.00737	38,078.95	0.01217	59,534.16	0.01698	78,331.91
0.00753	38,836.94	0.01233	60,203.56	0.01714	78,912.74

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 300 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 35 cm
h = 70 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	18.76	9.90	23.23
6.0	2.85	0.00	5.70	0.00	8.55	20.19	11.40	26.56	14.25	32.75
8.0	5.07	0.00	10.14	23.77	15.21	34.80	20.28	45.26	25.35	55.14
10.0	7.92	18.76	15.84	36.13	23.76	52.10	31.68	66.68	39.60	0.00
12.0	11.40	26.56	22.80	50.24	34.20	71.03	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	16.88
4.0	7.62	18.08	8.89	20.96	10.16	23.82	11.43	26.63	12.70	29.41
5.0	11.88	27.62	13.86	31.92	15.84	36.13	17.82	40.25	19.80	44.29
6.0	17.10	38.76	19.95	44.59	22.80	50.24	25.65	55.71	28.50	60.99
8.0	30.42	64.45	35.49	73.20	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 42.29 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 56.39 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	26.70	10.00	18.28	15.00	15.48	20.00	14.07	25.00	13.23
2.5	5.00	52.67	10.00	31.27	15.00	24.13	20.00	20.56	25.00	18.42
3.0	5.00	71.89	10.00	40.88	15.00	30.54	20.00	25.37	25.00	22.27
4.0	5.00	120.81	10.00	65.34	15.00	46.85	20.00	37.60	25.00	32.05
6.0	5.00	258.84	10.00	134.35	15.00	92.86	20.00	72.11	25.00	59.66

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	12.67	35.00	12.27	40.00	11.97	45.00	11.73	0.00	0.00
2.5	30.00	17.00	35.00	15.98	40.00	15.21	45.00	14.62	0.00	0.00
3.0	30.00	20.20	35.00	18.72	40.00	17.62	45.00	16.76	0.00	0.00
4.0	30.00	28.35	35.00	25.71	40.00	23.73	45.00	22.19	0.00	0.00
6.0	30.00	51.36	35.00	45.43	40.00	40.99	45.00	37.53	0.00	0.00

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

f'c = 300 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 42.29 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 56.39 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	25.10	10.00	16.68	15.00	13.88	20.00	12.47	25.00	11.63
2.5	5.00	50.54	10.00	29.13	15.00	22.00	20.00	18.43	25.00	16.29
3.0	5.00	69.76	10.00	38.74	15.00	28.41	20.00	23.24	25.00	20.14
4.0	5.00	118.68	10.00	63.21	15.00	44.71	20.00	35.47	25.00	29.92
6.0	5.00	256.71	10.00	132.22	15.00	90.72	20.00	69.98	25.00	57.53

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	11.07	35.00	10.67	40.00	10.37	45.00	10.14	0.00	0.00
2.5	30.00	14.87	35.00	13.85	40.00	13.08	45.00	12.49	0.00	0.00
3.0	30.00	18.07	35.00	16.59	40.00	15.48	45.00	14.62	0.00	0.00
4.0	30.00	26.22	35.00	23.58	40.00	21.60	45.00	20.06	0.00	0.00
6.0	30.00	49.23	35.00	43.30	40.00	38.85	45.00	35.40	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 35 cm x h = 70 cm

(0.00288)

Para P = Pmin

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	5.28		
2.5	13.44	Vu <= 1.5 * FR * b * d * raiz f* c = 42.29 Ton	S = d / 2 = 32.50 cm
3.0	19.47		
4.0	34.83	Vu <= 2.0 * FR * b * d * raiz f* c = 56.39 Ton	S = d / 4 = 16.25 cm
6.0	78.17		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	23.56	10.00	15.15	15.00	12.34	20.00	10.94	25.00	10.09
2.5	5.00	48.41	10.00	27.00	15.00	19.87	20.00	16.30	25.00	14.16
3.0	5.00	67.63	10.00	36.61	15.00	26.28	20.00	21.11	25.00	18.01
4.0	5.00	116.55	10.00	61.07	15.00	42.58	20.00	33.34	25.00	27.79
6.0	5.00	254.58	10.00	130.09	15.00	88.59	20.00	67.84	25.00	55.40

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	9.53	35.00	9.13	40.00	8.83	45.00	8.60	0.00	0.00
2.5	30.00	12.73	35.00	11.72	40.00	10.95	45.00	10.36	0.00	0.00
3.0	30.00	15.94	35.00	14.46	40.00	13.35	45.00	12.49	0.00	0.00
4.0	30.00	24.09	35.00	21.45	40.00	19.47	45.00	17.93	0.00	0.00
6.0	30.00	47.10	35.00	41.17	40.00	36.72	45.00	33.26	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 150 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 40 cm
h = 80 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00204	16,631.15	0.00424	32,929.69	0.00644	47,531.54
0.00211	17,201.77	0.00431	33,443.75	0.00651	47,989.05
0.00218	17,770.50	0.00438	33,955.93	0.00659	48,444.67
0.00226	18,337.35	0.00446	34,466.23	0.00666	48,898.41
0.00233	18,902.32	0.00453	34,974.64	0.00673	49,350.26
0.00240	19,465.40	0.00460	35,481.16	0.00681	49,800.23
0.00248	20,026.59	0.00468	35,985.80	0.00688	50,248.31
0.00255	20,585.90	0.00475	36,488.55	0.00695	50,694.51
0.00262	21,143.32	0.00482	36,989.42	0.00703	51,138.82
0.00270	21,698.86	0.00490	37,488.40	0.00710	51,581.24
0.00277	22,252.52	0.00497	37,985.50	0.00717	52,021.78
0.00284	22,804.28	0.00504	38,480.71	0.00725	52,460.44
0.00292	23,354.17	0.00512	38,974.03	0.00732	52,897.21
0.00299	23,902.17	0.00519	39,465.48	0.00739	53,332.09
0.00306	24,448.28	0.00526	39,955.03	0.00747	53,765.09
0.00314	24,992.51	0.00534	40,442.70	0.00754	54,196.21
0.00321	25,534.85	0.00541	40,928.49	0.00761	54,625.44
0.00328	26,075.30	0.00548	41,412.39	0.00769	55,052.78
0.00336	26,613.88	0.00556	41,894.40	0.00776	55,478.24
0.00343	27,150.56	0.00563	42,374.53	0.00783	55,901.82
0.00350	27,685.36	0.00570	42,852.78	0.00791	56,323.50
0.00358	28,218.28	0.00578	43,329.14	0.00798	56,743.31
0.00365	28,749.31	0.00585	43,803.61	0.00805	57,161.23
0.00372	29,278.46	0.00592	44,276.20	0.00813	57,577.26
0.00380	29,805.72	0.00600	44,746.91	0.00820	57,991.41
0.00387	30,331.09	0.00607	45,215.73	0.00827	58,403.67
0.00394	30,854.58	0.00614	45,682.66	0.00835	58,814.05
0.00402	31,376.19	0.00622	46,147.71	0.00842	59,222.54
0.00409	31,895.91	0.00629	46,610.87	0.00849	59,629.14
0.00416	32,413.74	0.00637	47,072.15	0.00857	60,033.87

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 150 Kg/cm2	b = 40 cm
fy = 4200 Kg/cm2	h = 80 cm

# Barras =>	1		2		3		4		5	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	17.22
5.0	1.98	0.00	3.95	0.00	5.94	0.00	7.92	21.23	9.90	26.16
6.0	2.85	0.00	5.70	0.00	8.55	22.82	11.40	29.79	14.25	36.45
8.0	5.07	0.00	10.14	26.75	15.21	38.62	20.28	49.49	25.35	59.36
10.0	7.92	21.23	15.84	40.02	23.76	56.38	31.68	0.00	39.60	0.00
12.0	11.40	29.79	22.80	54.52	34.20	0.00	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Designacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	17.32	7.10	19.15
4.0	7.62	20.47	8.89	23.67	10.16	26.80	11.43	29.86	12.70	32.87
5.0	11.88	30.93	13.86	35.56	15.84	40.02	17.82	44.34	19.80	48.51
6.0	17.10	42.79	19.95	48.81	22.80	54.52	25.65	59.92	28.50	0.00
8.0	30.42	0.00	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA #3.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max.)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 39.43 Ton	S = d / 2 = 37.50 cm
3.0	17.64		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 52.58 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	28.63	10.00	18.91	15.00	15.67	20.00	14.05	25.00	13.08
2.5	5.00	58.59	10.00	33.89	15.00	25.66	20.00	21.54	25.00	19.08
3.0	5.00	80.76	10.00	44.98	15.00	33.05	20.00	27.09	25.00	23.51
4.0	5.00	137.21	10.00	73.20	15.00	51.87	20.00	41.20	25.00	34.80
6.0	5.00	296.48	10.00	152.84	15.00	104.96	20.00	81.62	25.00	66.65

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	12.44	35.00	11.97	40.00	11.63	45.00	11.36	0.00	0.00
2.5	30.00	17.43	35.00	16.25	40.00	15.37	45.00	14.68	0.00	0.00
3.0	30.00	21.12	35.00	19.42	40.00	18.14	45.00	17.15	0.00	0.00
4.0	30.00	30.53	35.00	27.48	40.00	25.20	45.00	23.42	0.00	0.00
6.0	30.00	57.08	35.00	50.24	40.00	45.11	45.00	41.12	0.00	0.00

TABLA #3.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00600)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	4.62			
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c =	39.43 Ton	S = d / 2 = 37.50 cm
3.0	17.04			
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c =	52.58 Ton	S = d / 4 = 18.75 cm
6.0	68.40			

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	26.75	10.00	17.03	15.00	13.80	20.00	12.18	25.00	11.21		
2.5	5.00	56.38	10.00	31.68	15.00	23.45	20.00	19.34	25.00	16.87		
3.0	5.00	78.56	10.00	42.77	15.00	30.84	20.00	24.88	25.00	21.30		
4.0	5.00	135.00	10.00	71.00	15.00	49.66	20.00	38.99	25.00	32.59		
6.0	5.00	294.27	10.00	150.63	15.00	102.75	20.00	78.81	25.00	64.44		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	10.56	35.00	10.10	40.00	9.75	45.00	9.48	0.00	0.00		
2.5	30.00	15.22	35.00	14.04	40.00	13.16	45.00	12.48	0.00	0.00		
3.0	30.00	18.92	35.00	17.21	40.00	15.93	45.00	14.94	0.00	0.00		
4.0	30.00	28.32	35.00	25.28	40.00	22.99	45.00	21.21	0.00	0.00		
6.0	30.00	54.87	35.00	48.03	40.00	42.90	45.00	38.91	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 150 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00204)

888 Para P = Pmin 888

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 39.43 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 52.58 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	24.93	10.00	15.21	15.00	11.97	20.00	10.36	25.00	9.38		
2.5	5.00	54.17	10.00	29.48	15.00	21.24	20.00	17.13	25.00	14.66		
3.0	5.00	76.35	10.00	40.56	15.00	28.64	20.00	22.67	25.00	19.09		
4.0	5.00	132.80	10.00	68.79	15.00	47.45	20.00	36.78	25.00	30.38		
6.0	5.00	292.66	10.00	148.42	15.00	100.54	20.00	76.60	25.00	62.24		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	8.74	35.00	8.27	40.00	7.93	45.00	7.66	0.00	0.00		
2.5	30.00	13.01	35.00	11.84	40.00	10.95	45.00	10.27	0.00	0.00		
3.0	30.00	16.71	35.00	15.00	40.00	13.73	45.00	12.73	0.00	0.00		
4.0	30.00	26.12	35.00	23.07	40.00	20.78	45.00	19.00	0.00	0.00		
6.0	30.00	52.66	35.00	45.82	40.00	40.69	45.00	36.70	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 200 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 40 cm
h = 80 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0,00235	19,316.86	0,00541	42,203.20	0,00847	62,633.52
0,00245	20,119.30	0,00551	42,923.78	0,00857	63,272.24
0,00256	20,919.02	0,00561	43,641.63	0,00867	63,908.22
0,00266	21,716.01	0,00572	44,356.75	0,00877	64,541.47
0,00276	22,510.27	0,00582	45,069.14	0,00888	65,172.00
0,00286	23,301.80	0,00592	45,778.81	0,00898	65,799.80
0,00296	24,090.61	0,00602	46,485.74	0,00908	66,424.87
0,00307	24,876.68	0,00612	47,189.95	0,00918	67,047.20
0,00317	25,660.02	0,00623	47,891.43	0,00928	67,666.82
0,00327	26,440.64	0,00633	48,590.18	0,00939	68,283.70
0,00337	27,218.53	0,00643	49,286.20	0,00949	68,897.85
0,00347	27,993.69	0,00653	49,979.49	0,00959	69,509.27
0,00358	28,766.11	0,00663	50,670.05	0,00969	70,117.97
0,00368	29,535.81	0,00674	51,357.88	0,00979	70,723.93
0,00378	30,302.79	0,00684	52,042.99	0,00989	71,327.17
0,00388	31,067.03	0,00694	52,725.36	0,01000	71,927.68
0,00398	31,828.54	0,00704	53,405.01	0,01010	72,525.46
0,00408	32,587.33	0,00714	54,081.93	0,01020	73,120.51
0,00419	33,343.38	0,00724	54,756.11	0,01030	73,712.83
0,00429	34,096.71	0,00735	55,427.57	0,01040	74,302.42
0,00439	34,847.31	0,00745	56,096.30	0,01051	74,889.29
0,00449	35,595.18	0,00755	56,762.31	0,01061	75,473.42
0,00459	36,340.32	0,00765	57,425.58	0,01071	76,054.83
0,00470	37,082.73	0,00775	58,086.12	0,01081	76,633.50
0,00480	37,822.41	0,00786	58,743.94	0,01091	77,209.45
0,00490	38,559.36	0,00796	59,399.03	0,01102	77,782.67
0,00500	39,293.59	0,00806	60,051.38	0,01112	78,353.16
0,00510	40,025.08	0,00816	60,701.01	0,01122	78,920.92
0,00521	40,753.85	0,00826	61,347.91	0,01132	79,485.95
0,00531	41,479.89	0,00837	61,992.08	0,01142	80,048.26

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 200 Kg/cm2	b = 40 cm
fy = 4200 Kg/cm2	h = 80 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	21.54	9.90	26.64
6.0	2.85	0.00	5.70	0.00	8.55	23.17	11.40	30.42	14.25	37.44
8.0	5.07	0.00	10.14	27.25	15.21	39.74	20.28	51.49	25.35	62.49
10.0	7.92	21.54	15.84	41.25	23.76	59.12	31.68	75.17	39.60	0.00
12.0	11.40	30.42	22.80	57.05	34.20	79.89	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	19.39
4.0	7.62	20.76	8.89	24.05	10.16	27.30	11.43	30.50	12.70	33.65
5.0	11.88	31.62	13.86	36.49	15.84	41.25	17.82	45.89	19.80	50.41
6.0	17.10	44.21	19.95	50.75	22.80	57.05	25.65	63.12	28.50	68.95
8.0	30.42	72.74	35.49	0.00	40.56	0.00	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 03.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

Para P >= 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES: Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 45.53 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 60.71 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	30.05	10.00	20.34	15.00	17.10	20.00	15.48	25.00	14.51
2.5	5.00	60.01	10.00	35.32	15.00	27.08	20.00	22.97	25.00	20.50
3.0	5.00	82.19	10.00	46.40	15.00	34.48	20.00	28.51	25.00	24.93
4.0	5.00	133.64	10.00	74.63	15.00	53.29	20.00	42.62	25.00	36.22
6.0	5.00	297.30	10.00	154.26	15.00	106.38	20.00	82.44	25.00	68.08

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	13.86	35.00	13.40	40.00	13.05	45.00	12.78	0.00	0.00
2.5	30.00	18.85	35.00	17.68	40.00	16.79	45.00	16.11	0.00	0.00
3.0	30.00	22.55	35.00	20.84	40.00	19.57	45.00	18.57	0.00	0.00
4.0	30.00	31.96	35.00	28.91	40.00	26.62	45.00	24.84	0.00	0.00
6.0	30.00	58.50	35.00	51.66	40.00	46.53	45.00	42.54	0.00	0.00

TABLA 03.B

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00610)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f'c = 45.53 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f'c = 60.71 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	28.07	10.00	18.36	15.00	15.12	20.00	13.50	25.00	12.53		
2.5	5.00	57.53	10.00	32.83	15.00	24.60	20.00	20.48	25.00	18.01		
3.0	5.00	79.70	10.00	43.92	15.00	31.99	20.00	26.03	25.00	22.45		
4.0	5.00	136.15	10.00	72.14	15.00	50.81	20.00	40.14	25.00	33.74		
6.0	5.00	295.41	10.00	151.77	15.00	103.89	20.00	79.95	25.00	65.59		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	11.88	35.00	11.42	40.00	11.07	45.00	10.80	0.00	0.00		
2.5	30.00	16.37	35.00	15.19	40.00	14.31	45.00	13.62	0.00	0.00		
3.0	30.00	20.06	35.00	18.36	40.00	17.08	45.00	16.09	0.00	0.00		
4.0	30.00	29.47	35.00	26.42	40.00	24.14	45.00	22.36	0.00	0.00		
6.0	30.00	56.01	35.00	49.17	40.00	44.04	45.00	40.05	0.00	0.00		

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 200 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00235)

Para P = Pmin

Estribos No. de Desinacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 45.53 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 60.71 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	26.16	10.00	16.45	15.00	13.21	20.00	11.59	25.00	10.62
2.5	5.00	55.10	10.00	30.41	15.00	22.18	20.00	18.06	25.00	15.59
3.0	5.00	77.28	10.00	41.50	15.00	29.57	20.00	23.60	25.00	20.02
4.0	5.00	133.73	10.00	69.72	15.00	48.38	20.00	37.72	25.00	31.31
6.0	5.00	292.99	10.00	149.35	15.00	101.47	20.00	77.53	25.00	63.17

Estribos No. de Desinacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	9.97	35.00	9.51	40.00	9.16	45.00	8.89	0.00	0.00
2.5	30.00	13.94	35.00	12.77	40.00	11.89	45.00	11.20	0.00	0.00
3.0	30.00	17.64	35.00	15.94	40.00	14.66	45.00	13.66	0.00	0.00
4.0	30.00	27.05	35.00	24.00	40.00	21.71	45.00	19.94	0.00	0.00
6.0	30.00	53.59	35.00	46.75	40.00	41.62	45.00	37.63	0.00	0.00

TABLA 01

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales

f'c = 250 Kg/cm2
fy = 4200 Kg/cm2

Seccion

b = 40 cm
h = 80 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00263	21,683.03	0.00656	51,287.50	0.01048	77,651.59
0.00276	22,722.05	0.00669	52,218.51	0.01062	78,474.58
0.00289	23,757.47	0.00682	53,145.92	0.01075	79,293.98
0.00302	24,789.30	0.00695	54,069.73	0.01088	80,109.77
0.00315	25,817.52	0.00708	54,989.93	0.01101	80,921.97
0.00328	26,842.14	0.00721	55,906.54	0.01114	81,730.56
0.00342	27,863.16	0.00734	56,819.55	0.01127	82,535.56
0.00355	28,880.58	0.00747	57,728.96	0.01140	83,336.95
0.00368	29,894.39	0.00760	58,634.76	0.01153	84,134.74
0.00381	30,904.61	0.00774	59,536.97	0.01166	84,928.94
0.00394	31,911.23	0.00787	60,435.57	0.01179	85,719.53
0.00407	32,914.25	0.00800	61,330.58	0.01192	86,506.52
0.00420	33,913.67	0.00813	62,221.98	0.01206	87,289.91
0.00433	34,909.48	0.00826	63,109.78	0.01219	88,069.70
0.00446	35,901.70	0.00839	63,993.99	0.01232	88,845.89
0.00459	36,890.31	0.00852	64,874.59	0.01245	89,618.48
0.00472	37,875.33	0.00865	65,751.59	0.01258	90,387.47
0.00486	38,856.74	0.00878	66,625.00	0.01271	91,152.86
0.00499	39,834.56	0.00891	67,494.80	0.01284	91,914.65
0.00512	40,808.77	0.00904	68,361.00	0.01297	92,672.84
0.00525	41,779.39	0.00918	69,223.60	0.01310	93,427.43
0.00538	42,746.40	0.00931	70,082.60	0.01323	94,178.42
0.00551	43,709.81	0.00944	70,938.00	0.01336	94,925.80
0.00564	44,669.63	0.00957	71,789.80	0.01349	95,669.59
0.00577	45,625.84	0.00970	72,638.00	0.01363	96,409.78
0.00590	46,578.45	0.00983	73,482.60	0.01376	97,146.36
0.00603	47,527.46	0.00996	74,323.60	0.01389	97,879.35
0.00616	48,472.87	0.01009	75,160.99	0.01402	98,608.73
0.00630	49,414.68	0.01022	75,994.79	0.01415	99,334.52
0.00643	50,352.89	0.01035	76,824.99	0.01428	56.70

TABLA 02

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 250 Kg/cm2	b = 40 cm
fy = 4200 Kg/cm2	h = 80 cm

# Barras =>	1		2		3		4		5	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	21.72	9.90	26.92
6.0	2.85	0.00	5.70	0.00	8.55	23.39	11.40	30.80	14.25	38.03
8.0	5.07	0.00	10.14	27.55	15.21	40.42	20.28	52.69	25.35	64.37
10.0	7.92	21.72	15.84	41.58	23.76	60.77	31.68	78.10	39.60	93.96
12.0	11.40	30.80	22.80	58.57	34.20	83.30	45.60	0.00	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desisnacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	24.28	10.16	27.60	11.43	30.88	12.70	34.12
5.0	11.88	32.03	13.86	37.05	15.84	41.98	17.82	46.81	19.80	51.56
6.0	17.10	45.07	19.95	51.91	22.80	58.57	25.65	65.04	28.50	71.32
8.0	30.42	75.44	35.49	85.91	40.56	95.78	45.63	0.00	50.70	0.00
10.0	47.52	0.00	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA #3.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 50.91 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 67.88 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	31.30	10.00	21.59	15.00	18.35	20.00	16.73	25.00	15.76
2.5	5.00	61.27	10.00	36.57	15.00	28.34	20.00	24.22	25.00	21.75
3.0	5.00	83.44	10.00	47.66	15.00	35.73	20.00	29.77	25.00	26.19
4.0	5.00	139.89	10.00	75.88	15.00	54.55	20.00	43.88	25.00	37.48
6.0	5.00	299.15	10.00	155.51	15.00	107.63	20.00	83.69	25.00	69.33

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	15.11	35.00	14.65	40.00	14.30	45.00	14.03	0.00	0.00
2.5	30.00	20.11	35.00	18.93	40.00	18.05	45.00	17.36	0.00	0.00
3.0	30.00	23.80	35.00	22.10	40.00	20.82	45.00	19.83	0.00	0.00
4.0	30.00	33.21	35.00	30.15	40.00	27.88	45.00	26.10	0.00	0.00
6.0	30.00	59.75	35.00	52.91	40.00	47.78	45.00	43.79	0.00	0.00

TABLA 03.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 **Seccion:** b = 40 cm x h = 80 cm

(0.00630)

Para Pmin < P < 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de	Vu (Limite max)	S (Maxima)
2.0	4.62			
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c =	50.91 Ton	S = d / 2 = 37.50 cm
3.0	17.04			
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c =	67.88 Ton	S = d / 4 = 18.75 cm
6.0	68.40			

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	29.24	10.00	19.52	15.00	16.28	20.00	14.66	25.00	13.69
2.5	5.00	58.63	10.00	33.93	15.00	25.70	20.00	21.59	25.00	19.12
3.0	5.00	80.81	10.00	45.02	15.00	33.09	20.00	27.13	25.00	23.55
4.0	5.00	137.25	10.00	73.25	15.00	51.91	20.00	41.24	25.00	34.84
6.0	5.00	296.52	10.00	152.88	15.00	105.00	20.00	81.06	25.00	66.69

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	13.05	35.00	12.58	40.00	12.24	45.00	11.97	0.00	0.00
2.5	30.00	17.47	35.00	16.29	40.00	15.41	45.00	14.73	0.00	0.00
3.0	30.00	21.17	35.00	19.46	40.00	18.18	45.00	17.19	0.00	0.00
4.0	30.00	30.57	35.00	27.53	40.00	25.24	45.00	23.46	0.00	0.00
6.0	30.00	57.12	35.00	50.28	40.00	45.15	45.00	41.16	0.00	0.00

TABLA 03.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 250 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00263)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 50.91 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 67.88 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	27.24	10.00	17.53	15.00	14.29	20.00	12.67	25.00	11.70		
2.5	5.00	55.99	10.00	31.30	15.00	23.06	20.00	18.95	25.00	16.48		
3.0	5.00	78.17	10.00	42.38	15.00	30.46	20.00	24.49	25.00	20.91		
4.0	5.00	134.62	10.00	70.61	15.00	49.27	20.00	38.60	25.00	32.20		
6.0	5.00	293.88	10.00	150.24	15.00	102.36	20.00	78.42	25.00	64.06		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	11.05	35.00	10.59	40.00	10.24	45.00	9.97	0.00	0.00		
2.5	30.00	14.83	35.00	13.66	40.00	12.77	45.00	12.09	0.00	0.00		
3.0	30.00	18.53	35.00	16.82	40.00	15.55	45.00	14.55	0.00	0.00		
4.0	30.00	27.94	35.00	24.89	40.00	22.60	45.00	20.82	0.00	0.00		
6.0	30.00	54.48	35.00	47.64	40.00	42.51	45.00	38.52	0.00	0.00		

TABLA #1

P (Porcentaje de acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 40 cm
fy = 4200 Kg/cm2	h = 80 cm

Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]	Porcentaje De Acero	Momento Resistente [Kg x m]
0.00288	23,822.21	0.00769	60,241.38	0.01249	92,617.10
0.00304	25,101.33	0.00785	61,385.72	0.01265	93,626.66
0.00320	26,375.95	0.00801	62,525.56	0.01281	94,631.72
0.00336	27,646.08	0.00817	63,660.91	0.01297	95,632.28
0.00352	28,911.72	0.00833	64,791.77	0.01313	96,628.36
0.00368	30,172.87	0.00849	65,918.13	0.01329	97,619.94
0.00384	31,429.52	0.00865	67,040.00	0.01345	98,607.03
0.00400	32,681.68	0.00881	68,157.38	0.01361	99,589.63
0.00416	33,929.35	0.00897	69,270.27	0.01377	567.73
0.00432	35,172.52	0.00913	70,378.66	0.01393	1,541.34
0.00448	36,411.21	0.00929	71,482.56	0.01409	2,510.46
0.00464	37,645.40	0.00945	72,581.97	0.01425	3,475.09
0.00480	38,875.09	0.00961	73,676.89	0.01441	4,435.22
0.00496	40,100.30	0.00977	74,767.31	0.01457	5,390.86
0.00512	41,321.01	0.00993	75,853.24	0.01474	6,342.01
0.00528	42,537.23	0.01009	76,934.67	0.01490	7,288.67
0.00544	43,748.95	0.01025	78,011.62	0.01506	8,230.83
0.00560	44,956.19	0.01041	79,084.07	0.01522	9,168.50
0.00576	46,158.93	0.01057	80,152.03	0.01538	10,101.68
0.00593	47,357.18	0.01073	81,215.50	0.01554	11,030.36
0.00609	48,550.93	0.01089	82,274.47	0.01570	11,954.55
0.00625	49,740.19	0.01105	83,328.95	0.01586	12,874.25
0.00641	50,924.96	0.01121	84,378.94	0.01602	13,789.46
0.00657	52,105.24	0.01137	85,424.43	0.01618	14,700.17
0.00673	53,281.02	0.01153	86,465.43	0.01634	15,606.39
0.00689	54,452.32	0.01169	87,501.94	0.01650	16,508.12
0.00705	55,619.11	0.01185	88,533.96	0.01666	17,405.35
0.00721	56,781.42	0.01201	89,561.49	0.01682	18,298.10
0.00737	57,939.23	0.01217	90,584.52	0.01698	19,186.35
0.00753	59,092.55	0.01233	91,603.06	0.01714	20,070.10

TABLA #2

As (Area de Acero) vs MR (Momento Resistente)

Vigas Rectangulares Simplemente Armadas

DATOS:

Materiales	Seccion
f'c = 300 Kg/cm2	b = 40 cm
fy = 4200 Kg/cm2	h = 80 cm

# Barras =>	1		2		3		4		5	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	0.49	0.00	0.98	0.00	1.47	0.00	1.96	0.00	2.45	0.00
3.0	0.71	0.00	1.42	0.00	2.13	0.00	2.84	0.00	3.55	0.00
4.0	1.27	0.00	2.54	0.00	3.81	0.00	5.08	0.00	6.35	0.00
5.0	1.98	0.00	3.96	0.00	5.94	0.00	7.92	0.00	9.90	27.11
6.0	2.85	0.00	5.70	0.00	8.55	0.00	11.40	31.05	14.25	38.42
8.0	5.07	0.00	10.14	27.75	15.21	40.87	20.28	53.49	25.35	65.62
10.0	7.92	0.00	15.84	42.47	23.76	61.87	31.68	80.05	39.60	97.01
12.0	11.40	31.05	22.80	59.58	34.20	85.58	45.60	109.05	57.00	0.00

# Barras =>	6		7		8		9		10	
No. de Desinacion	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR	cm2 As	Ton.m MR
2.5	2.94	0.00	3.43	0.00	3.92	0.00	4.41	0.00	4.90	0.00
3.0	4.26	0.00	4.97	0.00	5.68	0.00	6.39	0.00	7.10	0.00
4.0	7.62	0.00	8.89	24.43	10.16	27.80	11.43	31.13	12.70	34.44
5.0	11.88	32.31	13.86	37.42	15.84	42.47	17.82	47.43	19.80	52.32
6.0	17.10	45.63	19.95	52.69	22.80	59.58	25.65	66.32	28.50	72.90
8.0	30.42	77.24	35.49	88.36	40.56	98.98	45.63	109.11	50.70	118.73
10.0	47.52	112.75	55.44	0.00	63.36	0.00	71.28	0.00	79.20	0.00
12.0	68.40	0.00	79.80	0.00	91.20	0.00	102.60	0.00	114.00	0.00

TABLA 63.A

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Ks/cm2 Seccion: b = 40 cm x h = 80 cm

Para P >= 0.01

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maximo)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 55.77 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 74.36 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	32.44	10.00	22.72	15.00	19.49	20.00	17.87	25.00	16.89
2.5	5.00	62.40	10.00	37.79	15.00	29.47	20.00	25.36	25.00	22.89
3.0	5.00	84.58	10.00	48.79	15.00	36.86	20.00	30.90	25.00	27.32
4.0	5.00	141.02	10.00	77.02	15.00	55.68	20.00	45.01	25.00	38.61
6.0	5.00	300.29	10.00	156.65	15.00	108.77	20.00	84.83	25.00	70.46

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	16.25	35.00	15.78	40.00	15.44	45.00	15.17	0.00	0.00
2.5	30.00	21.24	35.00	20.06	40.00	19.18	45.00	18.58	0.00	0.00
3.0	30.00	24.94	35.00	23.23	40.00	21.95	45.00	20.96	0.00	0.00
4.0	30.00	34.34	35.00	31.30	40.00	29.01	45.00	27.23	0.00	0.00
6.0	30.00	60.89	35.00	54.05	40.00	48.92	45.00	44.93	0.00	0.00

TABLA 83.8

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00640)

Para Pmin < P < 0.01

Estribos No. de Designacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)	S (Maxima)
2.0	4.62		
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c = 55.77 Ton	S = d / 2 = 37.50 cm
3.0	17.04		
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c = 74.36 Ton	S = d / 4 = 18.75 cm
6.0	68.40		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	30.33	10.00	20.62	15.00	17.38	20.00	15.76	25.00	14.79		
2.5	5.00	59.59	10.00	34.89	15.00	26.66	20.00	22.55	25.00	20.08		
3.0	5.00	81.77	10.00	45.98	15.00	34.05	20.00	28.09	25.00	24.51		
4.0	5.00	138.21	10.00	74.21	15.00	52.87	20.00	42.20	25.00	35.80		
6.0	5.00	297.48	10.00	153.84	15.00	105.96	20.00	82.02	25.00	67.65		

Estribos No. de Designacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	14.14	35.00	13.68	40.00	13.33	45.00	13.06	0.00	0.00		
2.5	30.00	18.43	35.00	17.25	40.00	16.37	45.00	15.69	0.00	0.00		
3.0	30.00	22.13	35.00	20.42	40.00	19.14	45.00	18.15	0.00	0.00		
4.0	30.00	31.53	35.00	28.49	40.00	26.20	45.00	24.42	0.00	0.00		
6.0	30.00	58.06	35.00	51.24	40.00	46.11	45.00	42.12	0.00	0.00		

TABLA 43.C

S (Separacion de Estribos) vs VR (Cortante resistente total)

Vigas Rectangulares Simplemente Armadas

DATOS: f'c = 300 Kg/cm2 Seccion: b = 40 cm x h = 80 cm

(0.00288)

Para P = Pmin

Estribos No. de Desimacion	Separacion Maxima [cm]	RESTRICCIONES Valores de Vu (Limite max)		S (Maxima)	
2.0	4.62				
2.5	11.76	Vu <= 1.5 * FR * b * d * raiz f* c =	55.77 Ton	S = d / 2 =	37.50 cm
3.0	17.04				
4.0	30.48	Vu <= 2.0 * FR * b * d * raiz f* c =	74.36 Ton	S = d / 4 =	18.75 cm
6.0	68.40				

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	5.00	28.30	10.00	18.59	15.00	15.35	20.00	13.73	25.00	12.76
2.5	5.00	56.78	10.00	32.08	15.00	23.85	20.00	19.73	25.00	17.26
3.0	5.00	78.95	10.00	43.17	15.00	31.24	20.00	25.28	25.00	21.70
4.0	5.00	135.40	10.00	71.39	15.00	50.06	20.00	39.39	25.00	32.99
6.0	5.00	294.67	10.00	151.03	15.00	103.15	20.00	79.21	25.00	64.84

Estribos No. de Desimacion	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]	S [cm]	Vu [Ton]
2.0	30.00	12.11	35.00	11.65	40.00	11.30	45.00	11.03	0.00	0.00
2.5	30.00	15.62	35.00	14.44	40.00	13.56	45.00	12.87	0.00	0.00
3.0	30.00	19.31	35.00	17.61	40.00	16.33	45.00	15.34	0.00	0.00
4.0	30.00	28.72	35.00	25.67	40.00	23.39	45.00	21.61	0.00	0.00
6.0	30.00	55.27	35.00	48.43	40.00	43.30	45.00	39.31	0.00	0.00

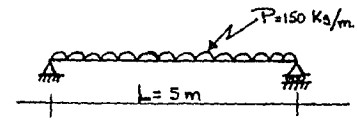
V. EJEMPLOS.

En este capítulo se tratará de mostrar la forma de utilizar las tablas proporcionadas en el catálogo -- presentado en este trabajo de tesis.

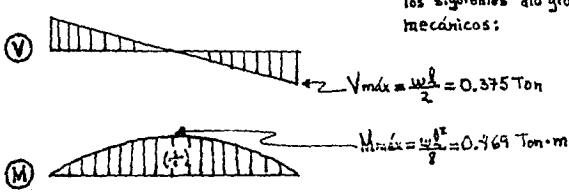
* EJEMPLO No. 1 *

Diseñar por flexión y cortante la siguiente viga isostática, proponiendo los armados correspondientes.

DATOS:	MATERIALES	SECCION
	$f'c = 150$ kg/cm^2	$b = 10$ cm
	$Fy = 4200$ kg/cm^2	$h = 20$ cm $\Rightarrow r = 5$ cm.



$\Rightarrow$ Resolviendo la viga se obtienen los siguientes diagramas de elementos mecánicos:



Diseño por Flexión: (Se usarán las tablas correspondientes a los Datos iniciales del ejemplo).

De la tabla 1 $\Rightarrow$ entrando con el valor del momento máximo se obtiene el valor del porcentaje de acero ($p = 0.00637$);

Una de las conclusiones con respecto a esta primer tabla es que sí se puede diseñar por flexión la viga propuesta con la sección dada y las características de sus materiales (principal atención a la resistencia del concreto).

De la tabla 2 ⇒ a esta tabla se entra también con el valor del momento máximo en la viga y se observa que con una combinación de dos barras (varillas) del número 2.5 (5/16") se cumple con el momento resistente pedido, y por lo tanto el armado por flexión será:

2 barras del #2.5 en el lecho bajo (por tratarse de M (+)) y
2 barras del #2.5 en el lecho alto (por cumplir con el acero mínimo y por construcción).

Diseño por Cortante:

Existen 3 opciones de consulta que son:

Tabla 3.A para $p \geq 0.01$

Tabla 3.B para $p_{mín} < p < 0.01$ (=0.00602).
↑ p medio interpolado entre p=0.01 y $p_{mín}$.

Tabla 3.C para $p_{mín} = 0.00204$

Ahora, comparando el valor de p obtenido de la tabla 1 con las tres opciones tenemos que el más cercano es el de la tabla 3.B para p_{medio} y que es el valor más "parecido":

P=0.00637 (de la tabla 1) ⇒ Tabla 3.A $p \leq 0.01$ (no corresponde)
Tabla 3.B p=0.00602 (Este es el más cercano). *
Tabla 3.C p=0.00204 (muy bajo)

* ∴ Se usará la tabla 3.B para el diseño por cortante.

De la tabla 3.B ⇒ buscamos el valor del cortante resistente más cercano al q' se obtuvo del diagrama de cortante $V_{máx} = 0.375$ Ton. y tenemos que una combinación de estribos del #2 a cada 45 cm dan el diseño, pero revisando las restricciones se tiene lo siguiente:

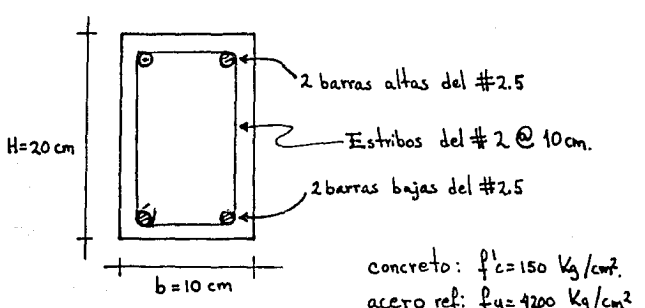
1º : para estribos del 2 ⇒ $s_{máx} = 18.50$ cm

2º : Como $V_u (0.375 \text{ ton}) \leq 1.97$ ton ⇒ $s = 7.50$ cm.

∴ se concluye que, se podrán usar estribos del #2 a cada 10 cm, ya que el cortante localizado en la tabla 3.B estaba "sobrado" con respecto al $V_{máx}$ q' se necesitará en la viga.

Resumen:

El diseño obtenido fue el siguiente:



La revisión por Deflexiones quedará como sigue:

flecha inmediata:

$$a_i = \frac{5wL^4}{384EI} = \frac{5(150)5^4}{384EI} = 5.3234 \times 10^{-6}\ cm (\doteq 0) \quad \text{donde} \quad E = 97,979.59\ Kg/cm^2,\ I = 2,340.3321\ cm^4$$

$$y\ a_d = a_i \frac{2}{1+50\rho'} = 5.3234 \times 10^{-6} \frac{2}{1+50(0.00151)} = 8.0322 \times 10^{-6}\ cm$$

y el valor que indica que la viga prácticamente no sufre ninguna flecha es:

$$a_T = a_i + a_d = 1.3355 \times 10^{-5}\ cm \doteq 0$$

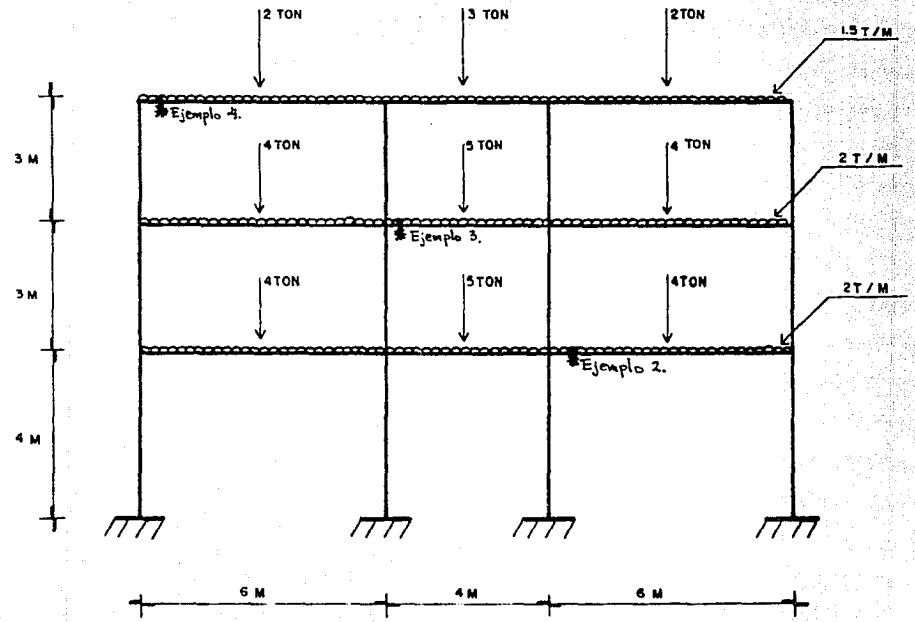
Por lo tanto la viga queda correctamente diseñada (por resistencia) y revisada (por deflexiones).

* EJEMPLOS No. 2, 3 y 4 *

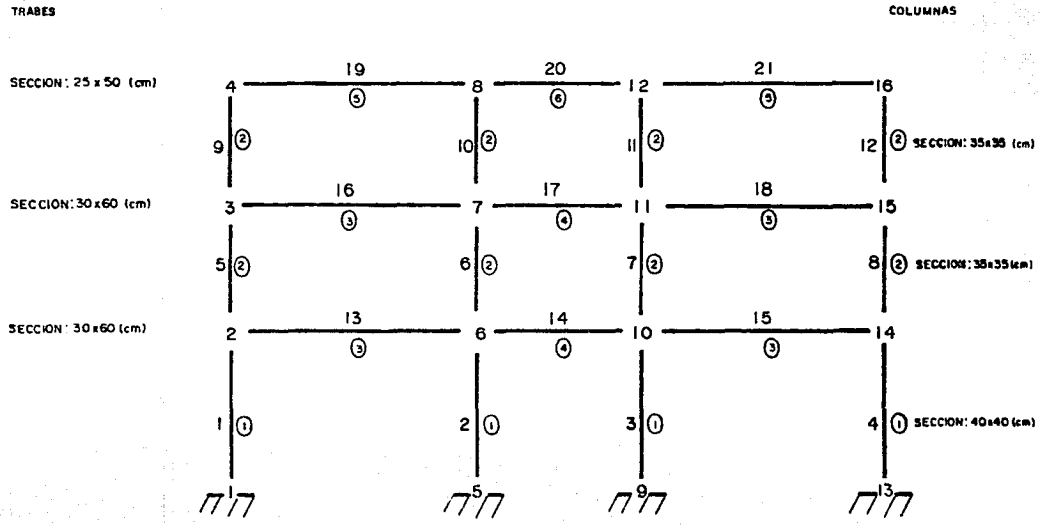
Los siguientes ejemplos se realizarán con datos reales de un marco estructural de un edificio de tres niveles en los cuales al igual que en el ejemplo anterior se darán como datos las características de los materiales, y que serán los mismos para todas las vigas del marco, con un Fy de 4200 kg/cm^2. y un F'c igual a 250 kg/cm^2. esto último, es porque se trata de una estructura que pertenece al grupo B1 de los clasificados por el Reglamento.

También se proponen como datos las secciones que deberán tener cada una de las vigas, las cuales podrán variar para cada caso.

Se muestra la obtención de los diagramas de los elementos mecánicos actuantes en cada viga a partir de la resolución del marco plano que las contiene y que, con la ayuda de un programa de computadora que proporciona los valores de los momentos y cortantes actuantes en los extremos de cada elemento; Por superposición se podrán trazar con facilidad los diagramas respectivos de momentos y cortantes en toda la longitud de cada viga que se va a diseñar.


2 TON
3 TON
2TON
1.5 T/M
Ejemplo 4.
4TON
5 TON
4 TON
2 T/M
Ejemplo 3.
4TON
5TON
4TON
2T/M
Ejemplo 2.
3 M
3 M
4 M
6 M
4 M
6 M

DESCRIPCION: No. NUDOS : 1,2,...,16
No. BARRAS: 1,2,...,21
TIPO BARRA: 1;2,...,6 (①)



DATOS DEL MARCO TESIS PABLO ROMO

ARCHIVO DE DATOS: B:PABLO

E= 1581140
G= 632455

BARRAS= 21 # NUDOS= 16 # BARRAS TIPICAS= 6

CONDICIONES DE CARGA= 1 # GDL= 36 ANCHO BANDA= 12

BARRAS TIPICAS

BARRA TIPO 1
LONGITUD 4
ANGULO 90
A. AXIAL .16
A. CORTE .1333
INERCIA .0021333

BARRA TIPO 2
LONGITUD 3
ANGULO 90
A. AXIAL .1225
A. CORTE .10208
INERCIA 1.25052E-03

BARRA TIPO 3
LONGITUD 6
ANGULO 0
A. AXIAL .18
A. CORTE .15
INERCIA .0054

BARRA TIPO 4
LONGITUD 4
ANGULO 0
A. AXIAL .18
A. CORTE .15
INERCIA .0054

BARRA TIPO 5
LONGITUD 6
ANGULO 0
A. AXIAL .125
A. CORTE .104166
INERCIA .002604

BARRA TIPO 6

DATOS DEL MARCO TESIS PABLO ROMO

LONGITUD 4
ANGULO 0
A. AXIAL .125
A. CORTE .104166
INERCIA .002604

APOYOS NUDO	RESTRICCION X Y Z
1	S S S
5	S S S
9	S S S
13	S S S

INCIDENCIA DE BARRAS

BARRA	TIPO	NUDOS
1	1	1 - 2
2	1	5 - 6
3	1	9 - 10
4	1	13 - 14
5	2	2 - 3
6	2	6 - 7
7	2	10 - 11
8	2	14 - 15
9	2	3 - 4
10	2	7 - 8
11	2	11 - 12
12	2	15 - 16
13	3	2 - 6
14	4	6 - 10
15	3	10 - 14
16	3	3 - 7
17	4	7 - 11
18	3	11 - 15
19	5	4 - 8
20	6	8 - 12
21	5	12 - 16

CONDICION DE CARGA # 1 ARCHIVO:B:PABLO.C1

CARGAS EN BARRAS

INCIDENCIA DE CARGAS TIPICAS

BARRA	CARGA TIPO
13	1
14	2
15	1

RESULTADOS DEL MARCO TESIS PABLO ROMO

DESPLAZAMIENTOS (X 1000) CONDICION 1

NUDO	DESPL.X	DESPL.Y	GIRO
1	0	0	0
2	-.025	-.32	-.823
3	-.01	-.517	-.762
4	.006	-.596	-1.174
5	0	0	0
6	-.005	-.638	.336
7	-.002	-1.029	.28
8	.014	-1.19	.449
9	0	0	0
10	.004	-.638	-.337
11	.001	-1.029	-.281
12	-.015	-1.19	-.45
13	0	0	0
14	.024	-.32	.822
15	.009	-.517	.761
16	-.007	-.596	1.173

ELEM. MECANICOS EN BARRAS CONDICION 1

#	AXIAL I	MI	MJ	VI	VJ
1	20.193	-1.358	-2.745	-1.026	1.025
2	40.386	.538	1.104	.411	-.412
3	40.386	-.539	-1.107	-.412	.411
4	20.193	1.357	2.744	1.025	-1.026
5	12.718	-3.031	-2.95	-1.994	1.993
6	25.281	1.213	1.139	.784	-.785
7	25.281	-1.214	-1.14	-.785	.784
8	12.718	3.03	2.949	1.993	-1.994
9	5.146	-3.283	-3.826	-2.37	2.369
10	10.353	1.294	1.519	.938	-.939
11	10.353	-1.297	-1.52	-.939	.938
12	5.146	3.282	3.825	2.369	-2.37
13	-.969	5.775	-8.925	7.475	8.524
14	-.595	6.664	-6.665	6.5	6.5
15	-.969	8.924	-5.774	8.524	7.475
16	-.374	6.232	-8.802	7.571	8.428001
17	-.222	6.365	-6.366	6.499	6.5
18	-.376	8.801	-6.233	8.428001	7.571
19	2.369	3.825	-5.947	5.146	5.853
20	1.43	4.426	-4.427	4.5	4.5
21	2.369	5.946	-3.826	5.853	5.146

Vigas 15, 17 y 19 que se diseñarán en los ejemplos, 2, 3 y 4 respectivamente.

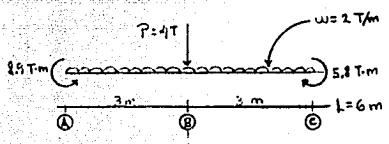
* Ejemplo No. 2 * Diseñar por Flexión y Cortante la Viga No 15 del Marco.

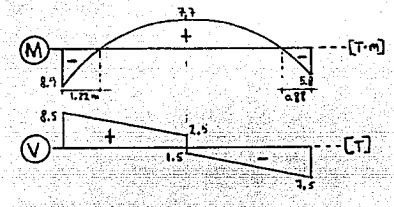
Datos:

$f'_c = 250\ Kg/cm^2$ $\quad b = 30\ cm$

$f_y = 4200\ Kg/cm^2$ $\quad h = 60\ cm$

$r = 5\ cm$





Diagramas de la Isostática corregidos con los momentos en los extremos.

Diseño por Flexión:

De la Tabla 1.

Sección (A) Para $M_R = 9.2\ T \Rightarrow p = 0.00276$ (Momento Negativo ⇒ acero arriba).

Sección (B) Para $M_R = 8.7\ T \Rightarrow p = 0.00263$ (Momento Positivo ⇒ acero abajo).

Sección (C) Para $M_R = 8.7\ T \Rightarrow p = 0.00263$ (Momento Negativo ⇒ acero arriba).

De la Tabla 2.

Sección (A) Para $M_R = 10.2\ (>9.2)\ T \Rightarrow$ 4 del #4 (altas hasta m + Ld)

Sección (B) Para $M_R = 10.2\ (>8.7)\ T \Rightarrow$ 4 del #4 (bajas corridas)

Sección (C) Para $M_R = 10.2\ (>8.7)\ T \Rightarrow$ 4 del #4 (altas hasta m + Ld)

Ld: longitud de desarrollo (anclaje).

Diseño por Cortante:

Sección Ⓐ-Ⓒ con $p = 0.00315$ (de la Tabla 1) $\geq p_{mín} = 0.00263 \Rightarrow$ Hay que Utilizar la tabla 3.C:

Para $V_u = 8.8\ T\ (> 8.5T) \Rightarrow$ Estribos del #2.5 @ 35 cm, Pero por las restricciones q' hay q' cumplir para S, así como por criterio de construcción se reducirá $S = 25$ cm. Así pues revisando la tabla 3.C se observa que el cortante último es mayor que el solicitado, esto es: E# 2.5 @ 25 $\Rightarrow V_u = 10.87$ Ton con lo cual concluimos que el diseño por resistencia es correcto. Pero para asegurar que el diseño esta completo se revisarán las deflexiones:

Utilizando el método de la sección transformada y agrietada y calculando la flecha inmediata con un método reconocido (doble integración, de área momento o viga conjugada) se tiene:

$a_i = 0.078$ cm

Y para calcular la flecha diferida se usa la expresión dada por el Reglamento: $a_d = a_i \frac{2}{1 + 50\rho'}$, se tiene $a_d = 0.135$ cm.

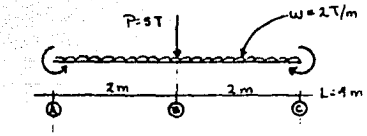
Por lo tanto la flecha total será:

$a_T = a_i + a_d = 0.213\ cm \leq \frac{l}{480} + 0.30\ cm = 1.55\ cm$ (Restricción del Reglamento Art. 184).

∴ La viga queda diseñada y Revisada por deflexiones.

Resumiendo, el diseño será el correcto si pasa por resistencia y también pasa para las condiciones de servicio.

* Ejemplo No 3 * Diseñar por Flexión y Cortante la Viga N-17 del Marco.

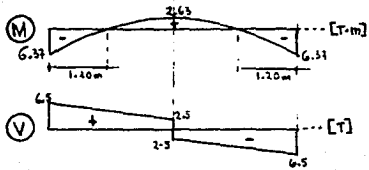


Datos

$f'_c = 250\ Kg/cm^2$ $b = 20\ cm$

$f_y = 4200\ Kg/cm^2$ $h = 40\ cm$

$r = 5\ cm$



Diagramas de Elementos Mecánicos

Diseño por Flexión.

De la Tabla 1.

Sección (A) Para $M_R = 6.9\ T \Rightarrow \rho = 0.00760$ (Momento Negativo ⇒ acero arriba).

Sección (B) Para $M_R = 2.6\ T \Rightarrow \rho = 0.00302$ (Momento Positivo ⇒ acero abajo).

Sección (C) (Es igual que para la sección (A))

De la Tabla 2.

Seccion (A) Para $M_R = 6.76\ (>6.4)\ T \Rightarrow$ 8 del #3 (altas hasta 1.20 m + Ld).

Sección (B) Para $M_R = 2.7\ (>2.6)\ T \Rightarrow$ 3 del #3 (bajas corridas).

Seccion (C) (Es igual que para la sección (A)).

Diseño por Cortante:

De la tabla 1 (pág 152) ⇒ con $p = 0.00760$ un M_R máximo en la viga ⇒ que p es $\doteq$ p medio (entre 0.01 y $p_{mín}$) ⇒ usar la tabla 3.B (pág 155) para $V_u = 6.33\,T$ ⇒ estribos del #3 @ 35 cm, pero por las restricciones de separación y construcción quedarán como sigue: E #3 @ 20 cm los cuales resistirán (consultando la misma tabla 3.B) de $V_u = 10.50\,T$.

Por lo anterior se concluye que el diseño está correcto por Resistencia. Ahora revisando la flecha se tiene:

$a_i = 0.448$ cm ; $a_d = 0.649$ cm ∴ $a_T = a_i + a_d = 1.097$ cm

que es menor que $\frac{400}{480} + 0.30$ cm $= 1.13$ cm ← Restricción del Reglamento (Art. 184).

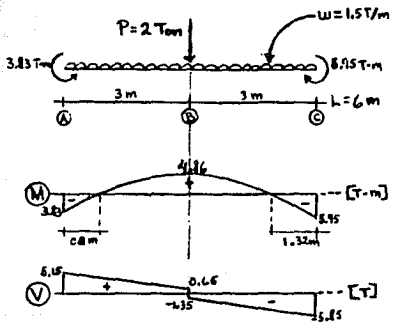
Ejemplo No 1 Diseñar por Flexión y Cortante la Viga No 19 del Marco

Datos:

$f'_c = 250\ Kg/cm^2$ $\quad b = 25\ cm$

$f_y = 4200\ Kg/cm^2$ $\quad h = 50\ cm$

$r = 5\ cm$



Diagramas de Elementos Mecánicos

Diseño por Flexión:

De la Tabla 1

Sección (A) Para $M_R = 4.88T \Rightarrow p = 0.00263$ (Momento Negativo → acero arriba)

Sección (B) Para $M_R = 4.88T \Rightarrow p = 0.00263$ (Momento Positivo → acero abajo).

Sección (C) Para $M_R = 6.04T \Rightarrow p = 0.00328$ (Momento Negativo → acero arriba).

De la Tabla 2

Sección (A) Para $M_R = 5.8\ (>4.88)T \Rightarrow$ 5 del # 3 (altas hasta 0.8m + Ld)

Sección (B) Para $M_R = 5.8\ (>4.88)T \Rightarrow$ 5 del # 3 (bajas corridas)

Sección (C) Para $M_R = 6.21\ (>6.04)T \Rightarrow$ 3 del # 4 (altas hasta 1.32 m + Ld)

Diseño por Cortante.

De la tabla 1 (pág 172) ⇒ con $\rho = 0.00342$ para $M_{máx}$ en la viga.

$\doteq$ p intermedio (entre 0.01 y $\rho_{mín}$) ⇒ usar la tabla 3.B (pág 175)

Para $V_u = 6.75\ T\ (>5.85)$ ⇒ Estribos #2.5 @ 18.81 cm para c/RAMA,

pero por restricciones de s y de construcción se tendrá:

los mismos estribos (#2.5) @ 22.5 cm ⇒ como distancia práctica = @ 25cm

y consultando q' cortante se resiste con esta última combinación (E #2.5

@ 25cm) tenemos $V_u = 9.39\ T\ (>6.75\ T)$.

Por lo anterior se concluye q' el diseño esta correcto por resistencia. Ahora revisando la flecha se tiene:

$a_i + a_d = 0.33\ cm$ que es menor que $\frac{600}{480} + 0.3\ cm = 1.55\ cm$

VI. CONCLUSIONES.

El presente trabajo pretende poder explicar - de una forma sencilla y clara un resumen de la teoría de las estructuras sometidas a esfuerzos (combinados) de -- flexión y cortante. Por otra parte las tablas elaboradas con los programas de computadora anexos permiten hacer - un diseño rápido y eficiente (desde los puntos de vista del diseño y su construcción) de vigas rectangulares simplemente armadas.

Cabe señalar que tomando en cuenta la gama de valores presentados en la primer tabla (p vs. MR), revisando visualmente de una manera rápida y sencilla, se -- puede dar cuenta el diseñador de la cantidad de acero -- que puede requerir un diseño determinado, esto es, que si uno observa que la cuantía de acero necesaria para resistir un momento en particular esta muy cerca del valor -- frontera superior (p máx), fácilmente se concluirá de -- que tal vez no es recomendable utilizar esa sección, sino otra mejor, ya que al necesitar una cantidad de acero

alta, el costo de nuestra viga podría incrementarse notablemente; considerando que la implicación económica de esta primer tabla (p vs. MP) es importante en los tiempos inflacionarios que vivimos.

Una ventaja adicional que pretende aportar este trabajo, es presentar los listados de los programas de computadora (fuentes) , ya que pueden tomarse como base para poder realizar aquellos diseños que no se encuentran comtemplados en el catálogo de tablas presentado, ya que éste contiene únicamente aquellos ejemplos que por experiencia se pueden considerar como más usuales.

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