JKAU: Eng. Sci., **Vol. 34 No. 2**, pp: 39–51 (2024A.D.)
DOI:10.4197/Eng.34-2.3

Method to Replace Section with other sections with capacity Equal Tolerance in the case of plastic and flexible

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Abstract: Construction Engineers face difficulties during the execution of metallic construction works that compose standard Profiles or designer in other countries where the designer prescribes profiles which are not common in local area. This will cause sustention of construction works and consequently material and lasses. Those engineers may need a method for replacing these profiles with others. In this research, Author describes a novel method that enables designers to replace supposed metallic profiles Sections (e.g. solid Rectangular, ring section) with new Sections (Box, [, and I sections) provided that the moment of Inertia of the new section equals the moment assuming that the elastic theory is used. In Case the Plastic theory is used, the condition will be the static moment of the new section is equal to static moment of original section. The author evaluated the research results.

Keywords. Profiles replacement, Standard sections, elastic theory

1. The goal of the search

The research aims to introduce a new innovative manual method in which designer-imposed Profiles are replaced by other available or manufacturing able sections These new sections are equivalent to the old sections in the case of plasticity or flexibility [1]. Taking into account, the engineering rules and conditions so that the new sections make a equal for the old in terms of endurance and economic.

2. Reasons for moving between sections

In some cases, engineers encounter many difficulties in securing the materials they need for their work which depend on ready-made sections that are not present in the local market. On the other hand, taught in other countries where the studying engineer relies on unfamiliar passages in the construction or implementation area, which stops the work. Consequently, there are

material and moral losses [MH5], and some of these colleagues may need a way to replace the sections [MH6] imposed by the designer with other sections.
There are also problems to meet the architect's desire to change some sections with other for aesthetic reason. Additionally, issues arise when section need to be replaced to accommodate pipes or cables, or when mechanical or electrical engineers require specific section not available in the local market. Replacement may be used in scientific research to modify some sections and derive the necessary equations [2].

3. The foundations of the transition between sections

Replacing imposed sections with new sections is a reward for the replacement with engineering rules and conditions. So that the new sections make a reward [MH7] for the old in terms of stamina and economic mention of these features :

- The area of the new section is close or equal to the original section
- The inertia torque of the new section is equal to the inertia torque of the original section If the study is based on the status of the flexible (column section cases).
- The new section's resistant (static torque) is equal to the resistance to the original section. If the study is based on spandex (cases of prize clips and amounts).
- That the walls of the new sections must be of appropriate thickness to prevent them from being exposed to local curvature. Therefore, a large ratio between the length and thickness of the plate is adopted and hold not be exceeded, through which the thickness of the plate is sufficient to prevent curvature.

4. The proposed method of replacing one section with another.

Initially, we have a known section with specific dimensions and endurance, which allows us to calculate the equivalent dimensions for a new section. The researcher proposed a straightforward relationship to adjust the dimensions of the imposed section by incorporating a K factor to determine the new dimensions [3].
Example: Rectangle dimensions (b,h) the dimensions of the new rectangle become the following shape

$$b_1 = b + K.b \qquad h_1 = h + K.h$$

$$b_1 = b.(1 + K) \qquad h_1 = h.(1 + k)$$

The new dimensions will meet the conditions adopted for change. The reverse conversion can also be done in the same way in some cases. It is the conclusion of the value of the dimensions of a solid rectangular section of the dimensions of a rectangular vicious section similar to that of the determination to inertia in the next relationship:

$$b = \frac{b_1}{(1 + K)} \qquad h = \frac{h_1}{(1 + k)}$$

5. Replacements between sections.

cases discussed by the researcher This way the following:

- Replace a rectangular section full of deaf with a vicious section in flexible state. When the two spaces are not equal and in the non-economic situation when the two spaces are equal in shape Figure (1)
- Replace a rectangular solid section with a hollow section in the case of spandex in the event of inequality of the two spaces and in the non-economic situation when the two spaces are equal.

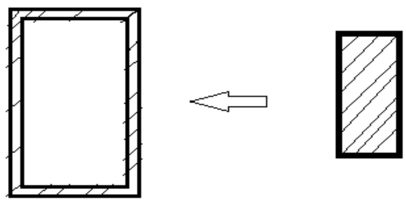


Figure (1) Replace a deaf rectangular section with a box section

- Replacement of a loop section (hollow circle) with section I in flexible and spandex (2)

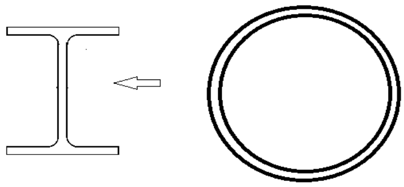


Figure (2) Replace a loop with I

- Replacement of a loop section with section [replaced by a section] in flexible Figure (3).

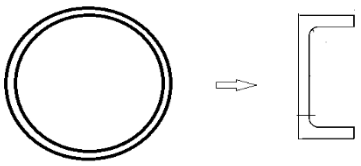


Figure (3) Replacing a loop with a section]

- Replace a loop with a box section (4) in flexible and spandex cases Figure (4).

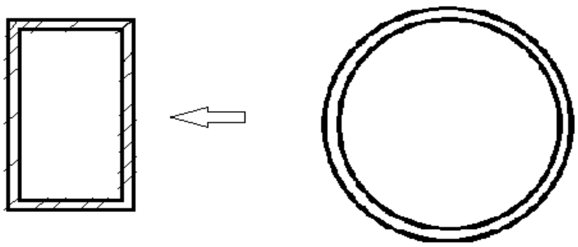


Figure (4) Replacement of a loop with a box section

6. Turn the rectangular section to empty.

The inertia torque of the solid rectangular section around Axis Y is calculated by the famous relationship

$$I_Y = \frac{b.h^3}{12}$$

The area is calcula $A = b.h$

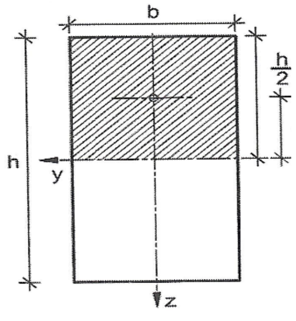


Figure (5) Dimensions of the basic rectangular section (b, h)

As for the empty box section, its new dimensions (b_1, h_1, t) It must be determined and met by the conditions form Figure (5). The value of the inertia resolve of the vicious clip is calculated as follows [4]:

$$I_{Y1} = \frac{b_1.h_1^{\ 3}}{12} - \frac{(b_1 - 2 * t_w).(h_1 - t_f)^3}{12}$$

$$I_{Z1} = \frac{h_1.b_1^{\ 3}}{12} - \frac{(h_1 - 2 * t_f).(b_1 - t_w)^3}{12}$$

:

$$A1 = b1.h1 - (b1 - 2.t_w) * (h1 - 2.t_f)$$

The dimensions of the new vacuum rectangle are determined as follows:

$b_1 = b + K.b$ $h_1 = h + K.h$

The dimensions of the new hollow rectangle are determined as follows: (b_1,h_1) t thickness of the plates formed for the box section is determined (b_1/t) (h_1/t) Some references offer a great percentage of plates To prevent curvature according to the design method adopted (flexibility-flexibility) h_1/t= (37.8), b_1/t=37.8

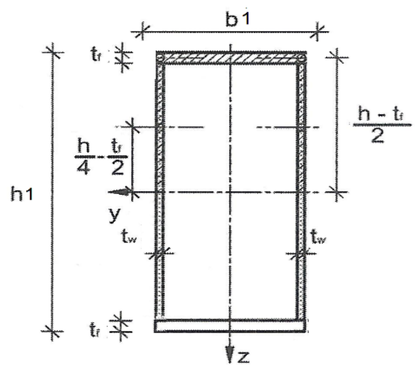


Figure (6) Dimensions of the new square rectangular section (b1,h1,t)

‣ In a flexible case with equal I_y inertia allowance for both sections is equal

)) The thick, expensive rectangle (I1y= Iy

) Box-empty rectangle((

The dimensions of the new vacuum rectangle are determined as follows:

$b_1 = b + K.b$ $h_1 = h + K.h$

K Determining the values of the worker by ratio (b_1/t) (h_1/t) Depending on the proportion of the dimensions of the rectangle (h/b):

And for the percentage (b1 /t = 37.8) or (h_1 /t = 37.8) As follows the table (1). For the rest of the ratios, I calculated the other K factor values. (b_1/t)or (h_1/t) In case of flexibility in the following table (2).

Table (1) K values replace a rectangle with a box in case of flexibility

A1/A	K (b_1/t=37.8)	h/b
0.233	0.50402	1
0.246	0.54627	2
0.229	0.49078	3
0.209	0.42501	4
0.192	0.36547	5

Table (2) K values replace a rectangle with a box by ratios h/bو (b1/t)(h1/t)

K						
or(h1/t=80) (b1/t=80)	or(h1/t=70) (b1/t=70)	or(h1/t=60) (b1/t=60)	or(h1/t=50) (b1/t=50)	or(h1/t=40) (b1/t=40)	or(h1/t=30) (b1/t=30)	h/b
0.795063	0.738464	0.675747	0.605112	0.523763898	0.426991	1
0.851031	0.791980	0.72645	0.652495	0.567063068	0.520761	2
0.78759	0.730194	0.666448	0.594426	0.511090026	0.520761	3
0.710675	0.65550	0.594202	0.524885	0.44458955	0.520761	4
0.640527	0.58745	0.528464	0.461725	0.38435591	0.520761	5

Values can be found for other proportions on demand from (b/t)

❖ in a flexible case with equal Iz inertia allowance for both sections is equal

$$b = \frac{b_1}{(1+K)} \qquad h = \frac{h_1}{(1+k)}$$

In the flexible case, the worker's value was calculated to be the Iz inertia torque for both sections equal and the ratio (b1 /t = 37.8)or (h_1 /t = 37.8)

The thick, expensive rectangle (I1y =I y)

Box-empty rectangle.

A1/A	K (b_1/t=37.8)	h/b
0.187	0.346771	2
0.160	0.245835	3
0.143	0.17959	4
0.132	0.133203	5

Example 1 :We have a deaf rectangular section in dimensions 400X200 mm b/ t =2. It is to be replaced by a rectangular vacuum clip and the dimensions of this vacuum rectangle are required to be calculated in a flexible- flexible manner. For the ratio (h_1/t_f=37.8) و (b_1/tw=37.8)

Twice according to the proposed method :

➢ The first to be equal inertia torques around the axis K=0.546574 (Y) :

$$b_1 = 200 + 0.546274 * 200 = 309.25mm$$

$$h_1 = 400 + 0.546274 * 400 = 618.51mm$$

$$t_w = \frac{618.51}{37.8} = 16.36mm$$

$$t_w = 309.25/37.8 = 8.18mm$$

Therefore, the determination to inertia for the two parts

$$I = 400^3 * \frac{200}{12} = 1066666667 = 1.067.10^9 \text{mm}^4$$

$$I = I_1 = 6097820259 - 5031153593 = 1.067.10^9 \text{mm}^4$$

- The second two inertia torques are equal around the Z axis calculating dimensions About Axis Z Inertia

:

$$I = 200^3 * 400/12 = 2.6667.10^8 \text{mm}^4$$

factor K=0.346771

$$b_1 = 200 + 0.346771 * 200 = 269.3mm;$$

$$h_1 = 400 + 0.346771 * 400 = 538.7mm$$

$$t_w = \frac{269.3}{37.8} = 7.13mm$$

$$t_s = \frac{538.7}{37.8} = 14.25mmI$$

$$= I_1 = 877292328.8 - 610625662.1 = 266666666.7 = 2.66610^8 \text{mm}^4$$

Example 2: We have the vicious rectangular section. (333.33X1000) b/ t =3, Where the plate is thick. (t=16.66) h_1/t_f=60 To be compensated with a solid section in flexible condition and calculate the value of the new dimensions of the silent section .We apply the following relationship in case of flexibility and deduce the value of K=0.666448:

$$b = \frac{b_1}{(1+K)} \qquad h = \frac{h_1}{(1+K)}$$

$$b = \frac{333.33}{(1+0.666448)} = 200.0mm$$

$$h = \frac{1000}{(1+0.666448)} = 600$$

And the determination to disrupt the two parts Iy= 3600000000

In a situation where it is valuable (h/b) between two values in the table, the value of the worker K Takes the computational mediation between the two adjacent specified values such as the value of h/b=3.6 Value is taken between the two values 4 and 3

- In the case of plasticity, the value of the resistance torque depends on the value of the rectangular section and calculates its value for the rectangular section.

$$W_{pl,Y} = 2.S_y = 2.b.\frac{h}{2}.\frac{h}{4} = \frac{b.h^2}{4}$$

Stresses are achieved in award sections and cameras by being the value of the external torque applied smaller than the value of the allowable torque, which is the torque that the section bears in the case of plasticity $M_{pl,Y}$, [5]

$$M_{pl,Y} = W_{pl,Y}.f_{y,K} \geq M$$

$$M_{pl,Y,k} = \frac{b.t^2}{4}.f_{y,K}$$

In the same way we increase the dimensions of the silent rectangle by applying the relationship until it becomes dimensions The new vacuum rectangle section is enough to equal the values of the low-end resistance torque of the rectangles.

(The thick, expensive rectangle (WPL1 =WPL) Box-empty rectangle)

The dimensions of the new vacuum rectangle are determined in the same way as:

$$b_1 = b + K.b \qquad h_1 = h + K.h$$

The value of the plastic resistant torque of the rectangular section is calculated as follows:

$$W_{pl,Y1} = [b.t_f.(h - t_f) + \frac{t_w.(h - 2.t_f)^2}{2}]$$

In the calculations of the plastic state we find that with the adoption of the same ratio between the width and thickness of the plates formed for the clip vicious because plasticity is considered topical: $b/_t \leq 37.8$ The researcher identified K values for the transformation between the two rectangles, which are silent in size. A ،W_{PL} A1, The researcher identified K values for the transformation between the two rectangles, which are silent in size.WPL1 For several cases of ratios between width and height h/b Table (3).

Table (3) K values for replacing a rectangle with a box in the case of plasticity

A1/A	**K** (h1/t=37.8) (b1/t=37.8)	h/b
0.364	0.88007	1
0.447	1.08205	2
0.473	1.14319	3
0.489	1.17884	4
0.502	1.20744	5

For the rest of the ratios, I calculated the other K factor values. (b_1/t)) h_1/t In case of flexibility in the following table (4).

Table (4) K values replace a rectangle with a box by ratios h/b , (b_1/t) or (h_1/t)

K						
(h1/t=80) (b1/t=80)	or(h1/t=70) (b1/t=70)	or(h1/t=60) (b1/t=60)	or(h1/t=50) (b1/t=50)	or(h1/t=40) (b1/t=40)	or(h1/t=30) (b1/t=30)	h/b
1.39119	1.28984	1.17864	1.05480	0.91397	0.74883	1
1.63932	1.52850	1.40706	1.27202	1.11884	0.93999	2
1.70540	1.59315	1.47034	1.33408	1.18007	1.00138	3
1.73713	1.62511	1.50278	1.36744	1.21515	1.03997	4
1.75851	1.64729	1.52609	1.39246	1.24292	1.07640	5

Example 3: We have the deaf rectangular section in dimensions. 600×200 mm; t =3 It is to be replaced by a rectangular vicious section and the desired to calculate the dimensions of a hollow rectangle according to the stage of plasticity with the equal value of the resistance torque where the ratio b_1/t_f=37.8, (h_1/t_w=37.8).

Dimensions are calculated according to the proposed method after we deduce the value of the worker K=1.14319 Then you calculate the new dimensions in the next relationship.

$$b_1 = 200 + 1.14319 \times 200 = 428.6mm$$

$$h_1 = 600 + 1.14319 \times 600 = 1285.92mm$$

$$t_w = \frac{428.6}{37.8} = 11.34mm$$

$$t_w = 1285.92/37.8 = 34.02mm$$

So the value of the resistance resolves of the two pieces :

$$Wpl = 600^2 * 200/4 = 18000000 = 1.8.10^7\text{mm}^4$$

$$W = W_1 = 17262740 + 737259.67 = 18000000 = 1.8.10^7\text{mm}^4$$

Example 4.1: We have the deaf rectangular section in dimensions. (600X200) mm;b/ t =3 It's to be replaced.

Rectangular vicious section and the dimensions of this rectangle are required to be calculated according to the stage of flexibility and ratio b_1/t_f=30 (h_1/t_w=30) Dimensions are calculated according to the proposed method:

Deduce the value of the worker K=0.52076148 Then you calculate the new dimensions in the next relationship: $b_1 = 200 + 0.52076148 * 200$

$$h_1 = 600 + 0.52076148 * 600$$

$$b_1 = 304.15mm \qquad h_1 = 912.45mm$$

$$t_w = \frac{304.15}{30} = 10.13mm$$

$$t_w = 912.45/30 = 30.41mm$$

So the determination to disrupt the two pieces

$$I = 600^3 * 200/4 = 36000000 = 3.6.10^9\text{mm}^4$$

$$I = I_1 = 19255150555 + 15655150555 = 18000000 = 1.8.10^7 \text{mm}^4$$

❖ This method is also used when replacing a vicious section with another treadmill to change the thickness of the plates between the two sections (h1/t)،(b1/t) . With equal resolve to inertia (flexible state) by converting the first vicious section imposed to (h2) silent section calculating the dimensions of the silencer according to the ratio h/b On the basis of equal value of the resolve of inertia to the two silent and empty and then turn it into a new vicious section for the plates (h1/t1)، (b1/t1) .Figure (6) .

We use the first conversion to calculate the following relationship to calculate the height after determining the ratio h/b :

$$h = \sqrt[4]{12 * (h2/b2) * I_y}$$

After calculating h, the b value is calculated and we follow the way shown above. ...

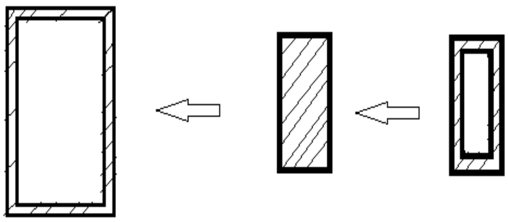


Figure (6) Dimensions of the new box rectangle section (b_1,h_1,t)

❖ When replacing a vicious section with another vicious section in the case of spandex where the resistance torque is calculated after the dimensions of the intermediate silent section of the resistance resolve are calculated:

$$h = \sqrt[3]{4 * (\text{h2/b2}) * \text{W}_{\text{pl,y}}}$$

Example4.2: We have the box section its dimensions (413.8×1655.5); h/b=4; And the thickness of the plates to their height(23.6 and 5.91) (h1/t)،(b1/t= 70) the determination of the unemployed Iy=20833333333. The section is to be converted into a vicious section, the ratio of plates to their height h2/t=37.5 ; (b1/t)=37.5 ,

At first we turn the section into a solid section and calculate the value of the height in the relationship:

$$h = \sqrt[4]{12 * \left(\frac{h2}{b2}\right) * I} = \sqrt[4]{12 * 4 * 2083333333} = 1000mm$$

And the show. b=1000/4=250;
Iy=20833333333 mm^3

And the determination of his work by applying the new method above, the dimensions values of the new section are calculated
(h1/t) =37.5 ،(b1/t)
By applying the new method above, the dimensions values of the new section are calculated where
K= 0.425, h=1425 mm , b= 356.25 , t_w=37.7mm ,t_f =9.42 mm
(Iy=20833333333)

7. Replace a loop with an I-shaped section using plate thickness

The geometric values of the ring section (inertia torque and space) are calculated as follows: t Where t thickness of the plate problem f +or the throat section d_a The outer diameter of the ring section.

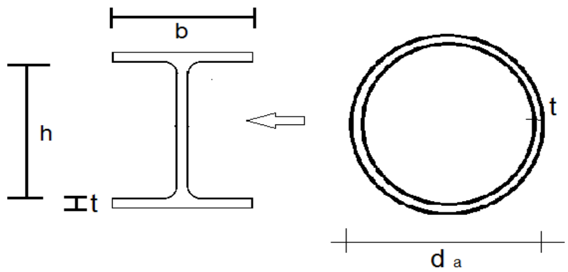


Figure (6) Dimensions of the throat section

$I = \pi . r_m^3 . t, \quad A = 2r_m . \pi . t$
$r_m = (d_a - t)/2$
Moreover, calculates the ocean.
$R = 2r_m . \pi$ And the resistance resolve

$$W_{pl} = \frac{4}{3}(\frac{d_a}{2})^3[1-(1-\frac{2t}{d_a})^3]$$

❖ Using the method in flexible state will switch between the loop and the section I b h Symmetrical for b-wing length h economically elevated body and the dimensions of the new section will be calculated so that:

❖ ((New I section) Iy = I y (vicious loop).)

In order for the new section I to be economically close to the old section, we have to use the same thickness as the t ring section in the composition of the section parts. The total lengths of the new section should be as close as possible to the length of the circumference of the loop section.

If we initially assume that the circumference of the R ring section and with the selection of a specific ratio (h/b) we find that the length of the wing and body is initially as follows:

$$b = \frac{R}{(2+2\frac{h}{b})} \qquad h = b*(\frac{h}{b})$$

Then we use the same relationship to calculate the new dimensions of the new clip:

$$b_1 = b.(1+K) \qquad h_1 = h.(1+K)$$

Factor K values are determined by h/b ratio in table flexible state; Table (5):

Table (5) K values for replacing a loop section with a single I-torque section are equal

A1/A	K	h/b
0.668	0.667509	2
0.609	0.609107	3
0.587	0.586887	4
0.572	0.571972	5

Noting that there is a slight difference between my inertia torque values may in some cases be only 5% and the more regular the dimensions of the loop section, the lower the error.

Example 5: An outer diameter loop (600 mm) and 10 mm plate thickness are to be replaced by a section h/b=3 By choosing a ratio of 3=h/b. Values are calculated for the loop :

$I = 806521447 mm^4$;
$A = 18535.4 mm^2$;
$r_m = 292.5 mm$;
$R = 1825.5 mm$

The initial values of the section are calculated I:

b =370.7 mm; h = 1112.1mm

From the table(5) . h/b = 3 ; K= 0.6091

The final values of Section I are calculated:
t=10 ;b1=225.8 mm ; h1= 677.4mm

And the determination to unemployment for the new section I :

$$Iy = 792552719.8\ mm^4$$

❖ Switch between the loop and section I in the case of spandex by first searching for the axis that halves the section into two equal parts and then combines the static torque around this axis to the upper and lower sections of the section. The area of each part multiplied by its distance from the equitable axis of the area .Factor K values were calculated according to the h/b dimensions ratio in the case of table 6 spandex:

$$W_{pl,y} = 2*S_{x,y}$$
$$W_{pl,y} = 2*(b*t*(h/2-t/2)+t*h*(h/2))$$

Table (6) K values for replacing a loop section with a section I is equally resistant

A/A1	K	h/b
1.478191	1.478191	2
1.397503	1.397503	3
1.358954	1.358954	4
1.337245	1.337245	5

With these values, the error rate is smaller 3%

Example 6: Dimensions of the previous example: We calculate W_{pl} = 14161333 mm^3 for the rest of the ratios, I calculated the other K factor values. For the throat clip.

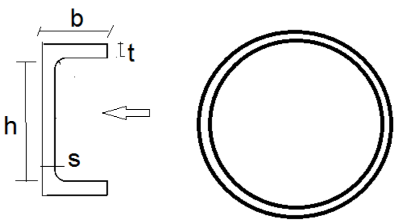
Final values of the dimensions of the new section K= 1.39753

t = 10 ; b_l=518.1 mm ; h_l = 1554 mm
The value of the new section-resistant torque :The value of the new section-resistant torque $W_{pl,y}$ = 1414237 mm^3 .
And the error rate. 0.01%

8. Replace a loop with a shape section [using plate thickness (flexible state)

A loop can be replaced by a section] and this section that resembles an I section in flexible state. Where the inertia torque value of the clip is calculated [around the symmetry axis Y and the dimensions of one wing ... (b, t) h ,s(Dimensions in the next relationship:

$$Iy = 2(\frac{b.t^3}{12}) + \frac{s.h^3}{12} + 2(b.t.(h/2 + t/2)^2)$$



In the same way, initial values are calculated from the circumference of the loop. R Considering that the ratio h/b Specific to the length of the wing and body as follows:

$$b = \frac{R}{(2 + \frac{h}{b})} \qquad h = b * (\frac{h}{b})$$

Then we use the same relationship to calculate the new dimensions of the new clip.:

$$b_1 = b.(1 + K) \qquad h_1 = h.(1 + K)$$

Factor K values are determined by dimensions' ratio h/b (5) In the flexible case table:

Table (5) K values for replacing a loop section with a single I-torque section are equal

A1/A	K	h/b
0.61	0.6149	3
0.59	0.5883	4
0.57	0.5735	5
0.56	0.5619	6

It should be noted that there is a small percentage of uncertainty up to %4 between the values of inertia torque calculated for the two parts in this case.
Example 7: An outer diameter loop is to be replaced 500 mm And the thickness of the plate is 15 mm by section by choosing a ratio h/b=3 Values are calculated for the loop:

$I = 672010967 mm^4$;
$A = 22855 mm^2$;
$r_m = 242.5 mm$;
$R = 1523.67 mm$

[The initial values of the section are calculated:
b =R/(2+ h/b)= 304.7 mm; h = 914.2 mm
h/b = 3; K= 0.6091
From table (5)
[The final values of the section are calculated:
t =15 mm; b1=187.4 mm; h1 = 562.16 mm
I And the determination to unemployment for the new section:
Error=1 %
$Iy = 690317814.9 \ mm^4$

9. Replace a loop with a box section.

The same way we switch the loop. (d_a , t)With a new box section.(b1,h1); And the plate is as thick as the ring.

❖ For the flexible case, the dimensions of the new section are initially calculated economically so that the length of the ring plate is equal to the sum of the dimensions of the box section h،b. For the flexible case, the dimensions of the new section are initially calculated economically so that the length of the ring plate is equal to the sum of the dimensions of the box section.

$$b = \frac{R}{(2 + 2\frac{h}{b})} \qquad h = b * (\frac{h}{b})$$

It then adjusts the relationship:

$$b_1 = b.(1 + K), \qquad h_1 = h.(1 + K)$$

The worker's values have been calculated. K h/b)

Depending on the proportion of h/b rectangle dimensions in the flexible case table (7) to switch between the loop and the box:

Table (7) K values for replacing a loop section with a box section and equal inertia torque

K	h/b
0.953611	2
0.913643	3
0.895954	4
0.886529	5

❖ In the case of plasticity, the values of factor K depending on the proportion of h/b rectangle dimensions vary completely and calculated as follows in the table 8:

Table (8) K values for replacing a loop with an equal two-piece torque box section

K	h/b
1.942573	2
1.89194	3
1.869935	4
1.858364	5

Example 8: loop section 700 mm and plate thickness is 8 mm to be replaced. In flexible and spandex cases, the width-to-length ratio (5=h/b) is cut into two boxes.

Loop values:

A = 17391.9 mm^2 , I = 1041041772 mm^4;

r_m= 346mm

R =2173.98 mm

Initial dimensions of the box section (5=h/b) as a whole equal to the circumference of the ring:

b = 181.2; h = 905.8 mm; t = 8mm

For a flexible state equal K = 0.886529 to the inertia torque of Table 7 we find that

The final dimensions of the box section :

t = 10 ; b_1=160.6 mm ; h_1 = 803.4 mm

I = 1056116648 mm^4

For the plastic state and when the resistance is equal to the resistance, we find K =1.858364 The resistance to the throat clip : Wpl = 15501483 mm^3

The final dimensions of the box section :

t = 10 ; b_1=336.6 mm ; h_1 = 1683.3 mm

Wpl = 15632630 mm^3

And the uncertainty in both cases is less than 4%

10. Replace a solid rectangular section with a box section with two spaces equal.

In the non-economic case of replacing a silent rectangle with a vacuum rectangle, the space for both of them must be equal, in which case we distribute the entire space to the edges of the new vacuum rectangle and using the following modified relationship to calculate the new dimensions of the vicious section.:

$$b_1 = 2.5 * b + K * b \qquad h_1 = 2 * h + K * h$$

Where A=A1 calculates thickness in the following relationship that the researcher derived:

$$t = \frac{A}{(2.h1 + 2.b1 - (2.A/(h1 + b1 - 1.42857.A/(h1 + b1))))}$$

The value of factor K in a flexible state when the two fault torques of both rectangles are equal and the ratio after the body plate to thickness:

(b1/t=)	(h1/t=)	K	h/b
3.362	4.342	-1.08873	2
3.071	5.974	-1.07802	3
2.982	7.7626	-1.06877	4
2.950	9.626	-1.06113	5

It should be noted that the value of the inertia torque used in column investigations by calculating thinness needs factor K in previous values only, but in the case of prizes .

The value of the agent in the spandex state is equal to the plastic resistance torque of both rectangles when A=A1 we use the basic relationship to calculate the new dimensions of the new section:

$$b_1 = b.(1+K) \qquad h_1 = h.(1+K)$$

Thickness is calculated in the following relationship:

$$t = \frac{A}{(2.h1 + 2.b1 - (2.A/(h1 + b1 - 2.A/1.4/(h1 + b1))))}$$

K And the value of the worker K:

K	h/b
0.43346	2
0.90351	3
1.38202	4
1.86555	5
2.97930	6

Example 9: We have a 600-× 200 mm section to be replaced by a hollow rectangle. The value of the area of the rectangles should be equal and the determination to instant the two sections around Y is equal h/b=3.

Solution: The area of the silencer (A=120000) mm2 and the determination of its

Iy= 3600000000 mm4

By applying the previous modified relationship, we find that the calculated dimensions of the vicious clip:

h/b =3 K=-1.07802

h1= 553.18mm b1= 284.39 mm

t= 92.59 mm

The value of the inertia torque of the dump was calculated as follows:

Iy= 3600000000 mm^4

A1= 120816 mm^2 ؛ The area is: A1 = 120816.6 mm2 and is only slightly different from the area That's A 1/A= 1.006. In the case of spandex, the silent section has:

A=120000, Wpl = 18000000mm^3

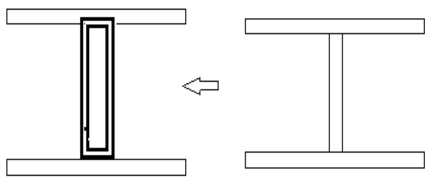
K= 0.903515, h1= 1142.11; b1 = 380.7 mm; t= 41.73 mm

A= 120359.1; Wpl = 18000000mm^3

We note that the area is different from the original scanner by A1/A=1.001

Example 10: We have the metal section I wings (10 x50) and the body (100x20) to replace the body with a box section equal to the determination of inertia to pass pipes and cables counting its dimensions.

For the inertia torque section Iy=4700000 calculated for the body (b/t =5) and inertia torque Iy=1666666.7 ;K=0.36547136.5 × 27.3The new body has a box section (136.5 × 27.3) the thickness of the 3.6 mm height plate and the upper and lower limbs are 0.72 mm.



11. Conclusion, observations and recommendations

It is noted from the above that the new method presented by the researcher is able to replace imposed sections with other sections and provides solutions for engineers working in the field of implementation for this purpose and we conclude from the above.

1.The proposed method of replacing the solid rectangular section with a hollow box section gave a good result in plasticity and elasticity modes and for almost all h/b cases and is recommended for use in metal structures.

2. We found that the new method is able to replace the section with the I section in the case of elasticity and plasticity and in the plasticity mode the loop section is preferred over the I section and the box hollow rectangular section.
3. The new proposed method has proven its worth and gave new or acceptable results in the cases covered and can be used to replace other sections or shapes.
4. It enables us to replace a loop section with a section] or section I with equal the inertia torque in the elastic state and the static moment in the elastic state.
5. In the non-economic case of replacing the rectangular section with a rectangular section where the area is equal with the equal the inertia torque, we find that the modified relationship gave negative values for the value K and this equation was used to make the new dimensions logical even though the value of the factor is negative.

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طريقة لاستبدال بعض المقاطع بمقاطع أخرى ذات قدرة تحمل متساوية في الحالة اللدنة والمرنة

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الملخص

يلاقي مهندسو التنفيذ صعوبات عديدة عند تأمين المواد التي يحتاجونها في العمل والتي تعتمد على مقاطع جاهزة غير موجودة بالسوق المحلية أو تصمم في بلدان أخرى يعتمد فيها المهندس الدارس على مقاطع غير مألوفة في منطقة الإنشاء أو التنفيذ مما توقف الأعمال وبالتالي إلى خسائر مادية ومعنوية وقد يحتاج بعض هؤلاء الزملاء إلى طريقة يتم فيها استبدال المقاطع مفروضة من قبل المصمم بمقاطع أخرى.

في هذا البحث قمنا بعرض طريقة جديدة تمكن من استبدال مقاطع مستعملة بالهندسة المدنية والكهربائية أو الميكانيكية مثل (مستطيل مصمت، مقطع حلقي) بمقاطع جديدة (مقطع صندوقي، مقطعI) على أن يكون عزم عطالة للمقطع الجديد يساوي عزم العطالة للمقطع الأصلي إذا كانت الدراسة على أساس الحالة المرنة، أو أن يكون العزم المقاوم اللدن (العزم الستاتيكي) للمقطع الجديد مساوياً للعزم المقاوم اللدن للمقطع الأصلي إذا كانت الدراسة على أساس الحالة اللدنة. وقد قمنا بتقييم النتائج.

كلمات مفتاحية. استبدال المقاطع، المقاطع القياسية، عزم عطالة