TRACK FRAME EXCAVATOR DESIGN

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ABSTRACT

Excavators (excavators) are one of the heavy equipment most often used because of their very high flexibility and make them the right tools to do work such as digging, dredging, opening land, and others. bearing in mind that with so many work applications the most load stressed and withstand loads is the Track Frame (chassis). Here we can describe the Track Frame excavator by using the 2014 solidworks application. And we know that this Track Frame is very important to meet and support the forward or reverse wheels of the excavator, and we can find out and analyze the forces acting on the Track Frame when exposed to load , So the author tries to design the Track Frame on the excavator. Based on the results of the description of the author of the issue that occurs in the Track Frame when exposed to load on the axis 1 or center, when the load is at the center then burdened is the middle axis (1) and the left axis (2), right (3). We can conclude axis 1 with A, B, axis 2 C, D. and axis 3 E, F. The analysis to look for on this axis is the horizontal force is to prove $\Sigma fy = 0$, analysis of normal or N fields, analysis of fields or latitude and analysis of the M plane or moment. horizontal axis 1 analysis results 0.0116 + 0.0116-0.0232 = 0, axis 2 0.0058 + 0.0058-0.0116 = 0, axis 3 0.0058 + 0.0058-0.0116 = 0. Analysis of the normal field or N axis 1 value N = 0 value F or N = F, then N = 232 kg, axis 2 value N = 0 value F or N = F, then N = 116 kg, axis 3 value N = 0 value F or N = F, then N = 116 kg. Field analysis or latitude on axis 1 a = 231.7 kg, b = 231.7 kg. axis 2 c = 115.65 kg, d = 115.65 kg. axis 3 e = 115.65 kg, f = 115.65 kg. Analysis of midwife M or moment on axis 1 Ma = 69.6 kg, Mb = 69.6 kg. axis 2 Mc = 40.6 kg, Md = 40.6 kg. axis 3 Me = 40.6 kg, Mf = 40.6 kg.

Keywords: Track Frame excavator horizontal force analysis, normal plane, plane or latitude, Analyze moment plane.

I. Background

Today's technological advances are making modern industries strive to improve the quality, quantity, and effectiveness of the products they produce. Therefore, these modern industries require continuous automation and systems that are widely used today [1]. In the automation required careful design so that mistakes do not occur.

Design is the first step in realizing a product that is needed to facilitate work or human activities. Initially to master the way to design is done by the apprenticeship process by studying, observing, and following the steps carried out by a designer who already has a lot of experience in the process of designing a product. At present, various design methods can be used to design an machine. The French, Pahl and Beitz, Ullman, VDI (Verein Deutscher Ingenieure) methods, and the Ibrahim Zeid Method [2].

Excavators are heavy equipment units that function in the physical development sector such as excavation in mining areas, pioneering or expanding roads, excavating drainage channels or water pipelines, making canals, expanding agricultural land as well as physical development [3]. Heavy equipment in a building project has a very important role in terms of project sustainability [4]. In general, this Excavator construction consists of two parts, namely Attachment (attachment) and Base Machine (machine base) which means Attachment is: Boom, Arm, Bucket. And Base Machines are Base Frame such as Cabin, Machine, Counter Weight, and other components above, Track Frame, Track Shoe.

One of the parts that are very important to meet and support the forward or backward movement of the wheel on the excavator, one of them is the Track Frame, where the Track Frame serves to be the operational support or backbone of the undercarriage on the excavator.

The undercarriage or also called the bottom frame is part of a Crawler tractor that is used to support and forward the unit load to the ground together with the steering and braking system directing the Excavator to move forward, backward, right and left as an operator and supporter of the excavator . Undercarriage components such as Front idlers, Carriers rollers, Track rollers, Track chain assembly, and sprocket These Undercarriage components must be repaired or replaced periodically if not done will result in decreased performance on the tool.

And in this Track frame is a combination of iron that is shaped like a box (Box) which is arranged crossing each other and assembled with a welded plate, Track frame is specifically designed to be able to resist shock loads so that failure does not occur. Shock loads can be in light or heavy working conditions, which is meant by light working conditions when the Excavator is in a Bucket condition with no load and in heavy working conditions is when the Excavator is in the process of working, with the Bucket in a loaded or ground loaded condition. Failure is a phenomenon caused by contractions due to loading which cannot be resisted by metal material (properties). If the failure is left then it has the potential to cause interference with the performance of the engine unit [5].

Therefore the Track Frame is designed as much as possible based on the binding (Mounting) to the mainframe, the track frame is classified into several types, namely Rigid Mounting Type and Pivot Mounting type.

II. Research methodology

The methodology used in this study can be seen in Figure 2.1 below.

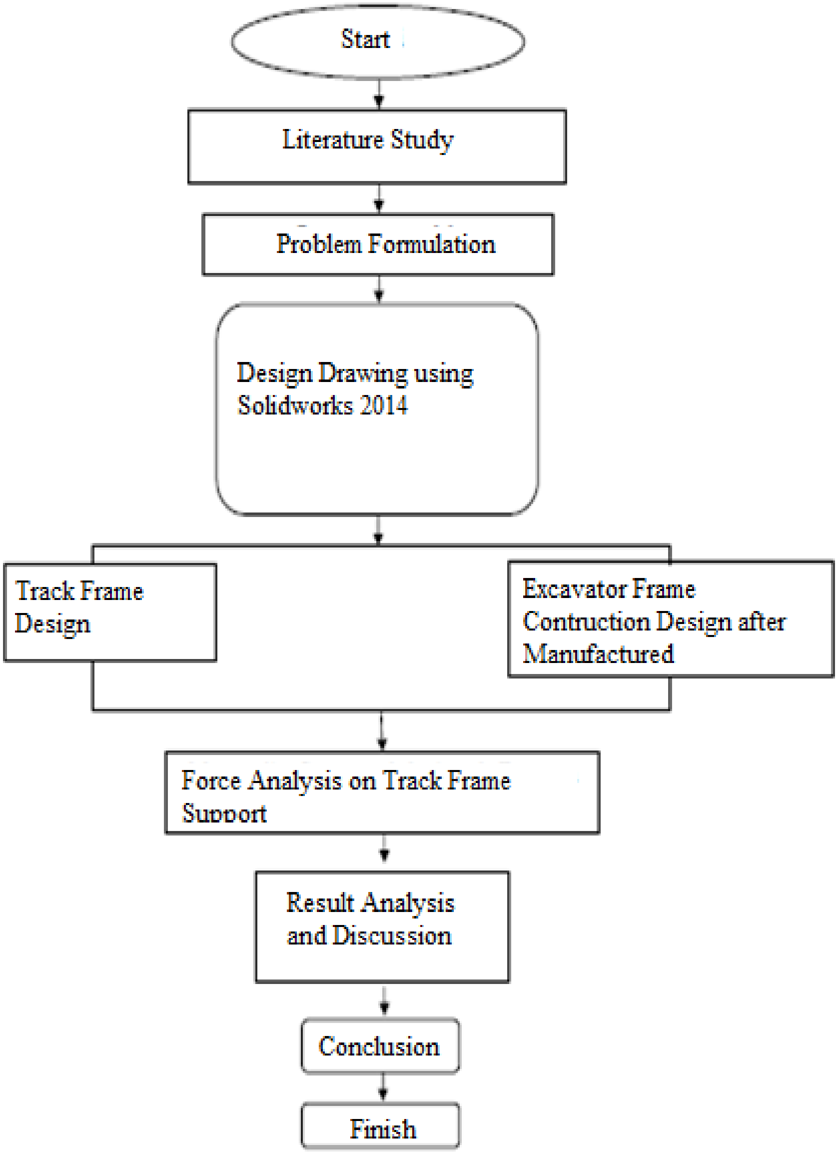

Figure 2.1 Flow Chart

The study began by drawing a design model using the 2014 SolidWorks software, then drawing the process scheme and the excavator frame construction design which was then made according to the manufacturing process. The following is the specification of the excavator framework design manufacturing in this research

Drawing iron size and description

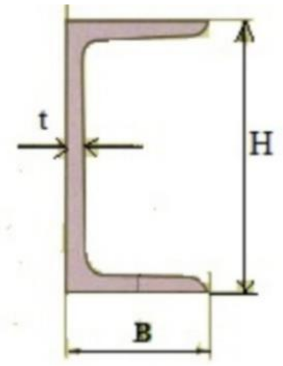

Figure 2.2 Size of iron Unp

Note: 5: Iron type
-12 M: iron length
t: 9.5 mm
H: 240 mm
B: 85 mm

Image Track frame that is ready to be designed

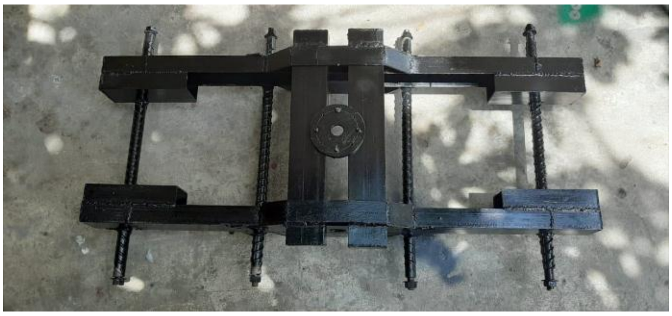

Figure 2.3 Tack frame

Model or type of track frame used is type H, where the size of the track frame is:
Length: 1.1 M (110 cm)
Width: 0.30 M (30 cm)

Figure 2.4 additional iron sizes

And where is the length of the additional iron: 0.20 M (20 cm) and width: 0.005 M (0.5 cm)

Figure 2.5 iron retaining center flashlight

Iron center flashlight
Length: 0.5 M (50 cm)

Figure 2.6 size of the iron holding flashlight center

Iron widths 1 and 2: 0.08 M (8 cm)

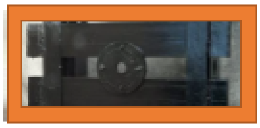

Figure 2.7 overall size of the center flashlight iron

Overall width of iron 1 and 2: 0.2 M (20 cm)

III. Results and Discussion

3.1 Figure of the whole Excavator model

Figure 3.1 Excavator model

3.2 Design results of Track Frame excavators

The results of the design of Track Frame Design using solidworks. The planning parameter is the Foot Reaction that occurs in the Track Frame.

1. Track Frame Design

Track Frame is part of the Excavator that serves as a place for Piles of Loads such as cabin, center, engine, arm, bucket, boom, counterweight and others.

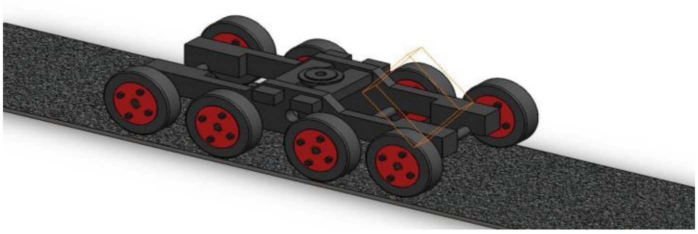

Figure 3.2 Track Frame

3.3 Tracke frame excavator scheme results

3.3.1 Schematic stripe schematic to be analyzed on the excavator track frame

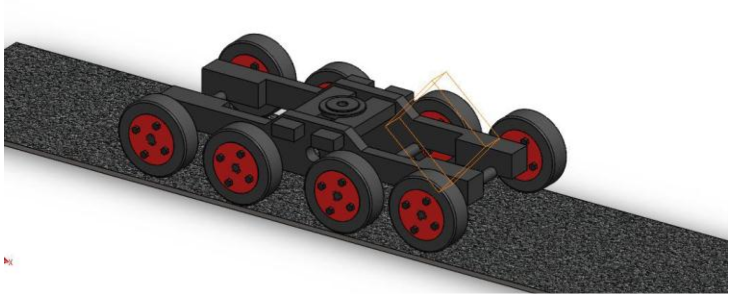

Figure 3.3 Track Frame and stem axis lines analyzed

3.3.2 Schematic axis of the tracke frame excavator, as in Figure 3.4 below.

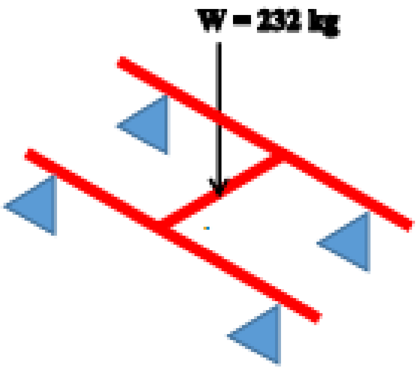

Figure 3.4 Track Frame Axes with loading

Ket:

1: Center rod axis on the excavator track frame

2: Left hand side rod axis on the excavator track frame

3: Right hand side axle on excavator track frame

W: the weight of the load received by the tracke frame excavator

3.4 Force analysis on each bar on the excavator track frame

Analysis of the forces acting on the track frame excavator is divided into three, namely on the middle rod (1), left (2) and right (3) chassis.

3.4.1 Analysis on rod 1

Rod analysis 1 is analysis on the center rod axis of the excavator.

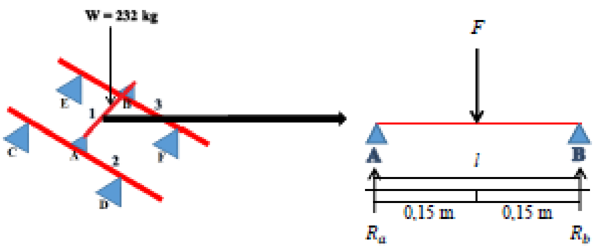

Figure 3.5 Bar analysis 1

3.4.2 Analysis on the rod 2
Rod analysis 2 is the analysis on the left axle track frame excavator shaft.

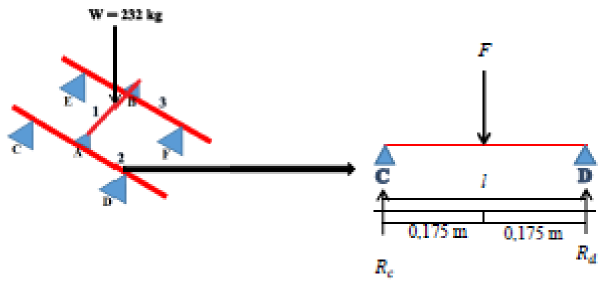

Figure 3.6 stem analysis 2

3.4.3 Analysis on the stem 3
Rod analysis 3 is the analysis on the right axis of the track frame of the excavator track.

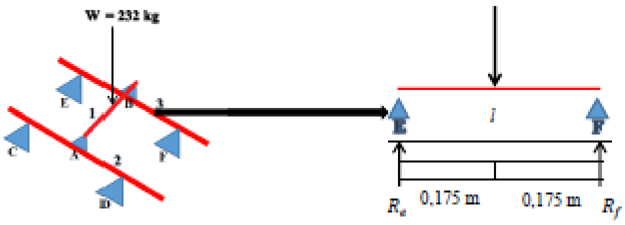

Figure 3.7 stem analysis 3

3.4.4 Figure bar Track Frame diagram I
Image of a Normal Field with a mass of 232 Kg

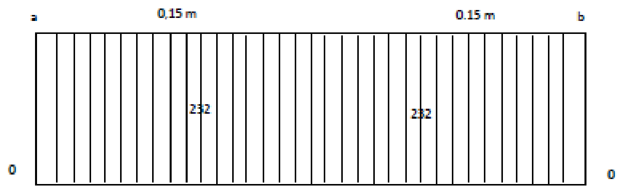

Figure 3.8 normal plane 1

From the calculation of the Norrmal Field that has been obtained on the track frame I have 232 kg
Image Analysis of Reaction Force results

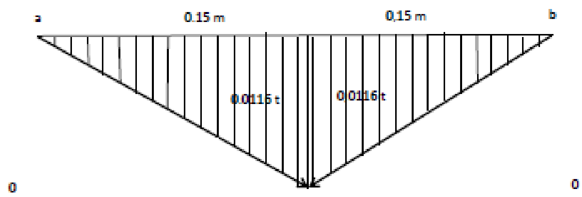

Figure 3.9 reaction force 1

From the calculation of the Norrmal Field that has been obtained on the track frame I have 232 kg
Figure Field of latitude with a mass of 232 kg

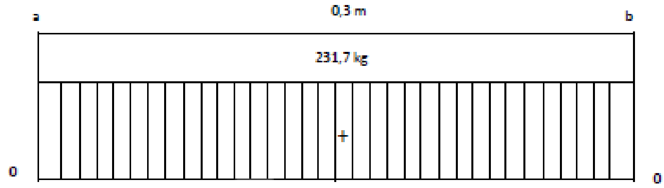

Figure 3.10 latitude 1

From the results of the calculation of the latitude field that has been obtained on the track frame I is 232 kg
Field Pictures Moment Field with mass 232 Kg

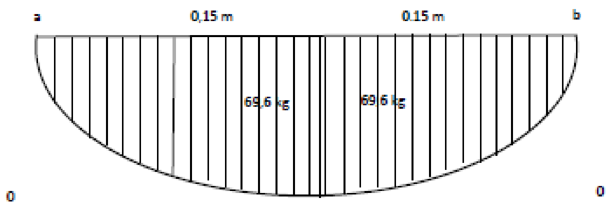

Figure 3.11 moment field 1

From the calculation of the Moment Field that has been obtained on the track frame I mass 232 kg

3.4.5 Figure Track Bar Frame diagram 2
Image of Normal Field with mass 116 Kg

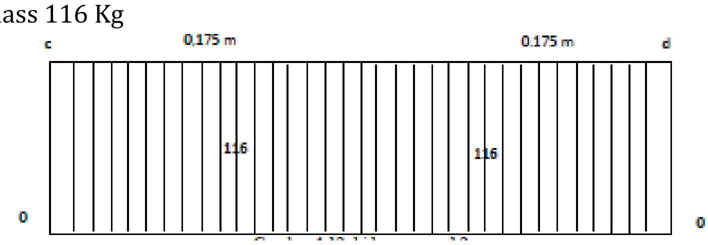

Figure 3.12 normal fields 2

From the calculation of the Norrmal Field that has been obtained on the track frame 2 116 kg masses
Image Analysis of Reaction Force results

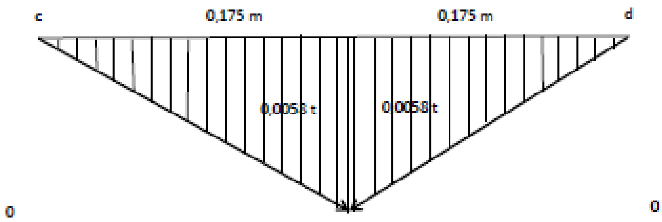

Figure 3.13 reaction plane 2

From the calculation of the Norrmal Field that has been obtained on the track frame 2 116 kg masses
Figure Field of latitude with a mass of 116 kg

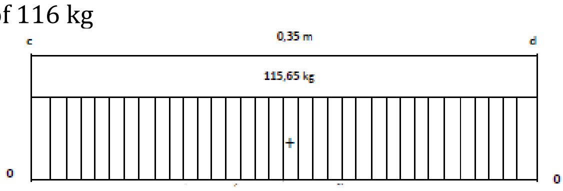

Figure 3.14 area of latitude 2

From the results of the calculation of the latitude field that has been obtained on the track frame 2 mass 116 kg

Image Fields Fields of Moments with a mass of 116 Kg

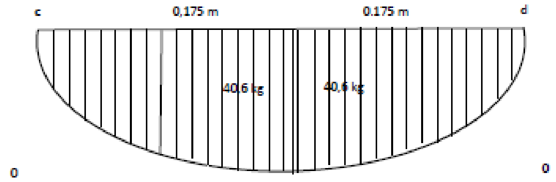

Figure 3.15 moment field 2

From the calculation of the Moment Field that has been obtained on the track frame 2 116 kg masses

3.4.6 Figure Track Bar Frame diagram 3
Image of Normal Field with mass 116 Kg

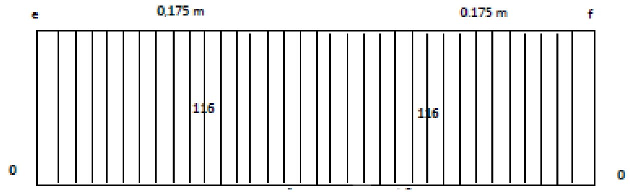

Figure 3.16 normal plane 3

From the calculation of the Norrmal Field that has been obtained on the track frame 3 116 kg masses

Image Analysis of Reaction Force results

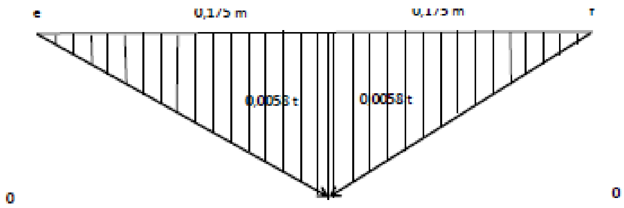

Figure 3.17 reaction force 3

From the calculation of the Norrmal Field that has been obtained on the track frame 3 116 kg masses

Figure Field of latitude with a mass of 116 kg

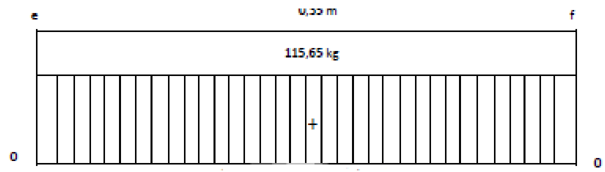

Figure 3.18 latitude 3

From the results of the calculation of the latitude field that has been obtained on the track frame 3 mass 116 kg

Image Fields Fields of Moments with a mass of 116 Kg

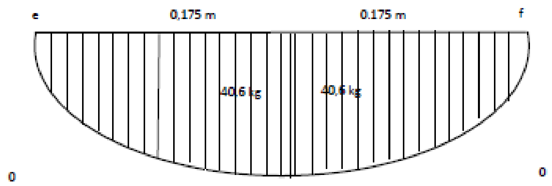

Figure 3.19 normal fields 3

From the calculation of the Moment Field that has been obtained on the track frame3 116 kg masses

IV. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

From the results of this calculation it can be concluded that the forces acting on the Track Frame by looking for the Reaction of the forces acting on the Track Frame, the Field or the Style of the Latitude and the Moment Field are obtained as follows:

A. Normal Field Analysis
N = F
a. Track frame bar 1
232 kg = 232 kg
b. Track frame rod 2
116 kg = 116 kg
c. Track frame 3
116 kg = 116 kg
B. Analysis of Force Reaction Results that Work on Track Frames
• Analysis on the Track frame frame 1
Axis Reaction: Ra = 0.0116 Ton
Rb = 0.0116 Ton
• Analysis on the Track frame frame 2
Axis Reaction: Rc = 0.0058 Ton
Rd = 0.0058 Tons
• Analysis on the Track frame frame 3
Axis Reaction: Re = 0.0058 Ton
Rf = 0.0058 Tons
C. Field Analysis or Latitude
a = 231.7 kg
b = 231.7 kg
c = 115.65 kg
d = 115.65 kg
e = 115.65 kg
f = 115.65 kg
D. Moment Field Analysis
• Moments in the Track frame 1 bar
Ma = 69.6 kg
Mb = 69.6 kg
• Moments in the Track frame 2 bar
Mc = 40.6 kg
Md = 40.6 kg
• Moments in the Track frame 3 bar
Me = 40.6 kg
Mf = 40.6 kg

V. SUGGESTION

Suggestions that can be used as improvements in the calculation of this track frame is:

1. Learn to Build Track Frames on Excavators.
2. Equip sufficient equipment to carry out the manufacturing process on Track Frame.
3. Thorough in calculating every process of making and Reaction of the Force work on any of these tools.
4. Carefully in calculating the plane of latitude and moment of the force acting on track frame.

BIBLIOGRAPHY

1. Nishane, Swapnil S. (2016). Modelling and Static Analysis of Backhoe Excavator Bucket. International Journal of Research in Advent Technology.
2. Reddy, B. Govinda. (2018). Structural Analysis of Excavator Bucket with Different Design Modification. International Journal & Magazine of Engineering, Technology, Management, and Research.

3. Khedkar, Y. (2017). Study of Force Acting on Excavator Bucket While Digging. Journal of Applied Mechanical Engineering.
4. Biradar, Sharanagouda A. (2018). Design, Analysis and Optimization of heavy duty Excavator bucket using Finite Element Analysis. International Journal of Scientific Development and Research.
5. Bilal, P. & Abid, M. "Analysis of Bucket Teeth of Backhoe Excavator Loader and its Weight Optimization." International Journal of Engineering Research & Technology (IJERT), Vol. 4 Issue 05, May-2015
6. SAE J1179: Hydraulic Excavator and Backhoe Digging Force. Warrendale: SAE International, 1990.
7. Oñate, E. "Structural Analysis with the Finite Element Method." Linear Statics Lecture Notes on Numerical Methods in Engineering and Sciences. Barcelona: Artes Gráficas Torres S.A., 2003.