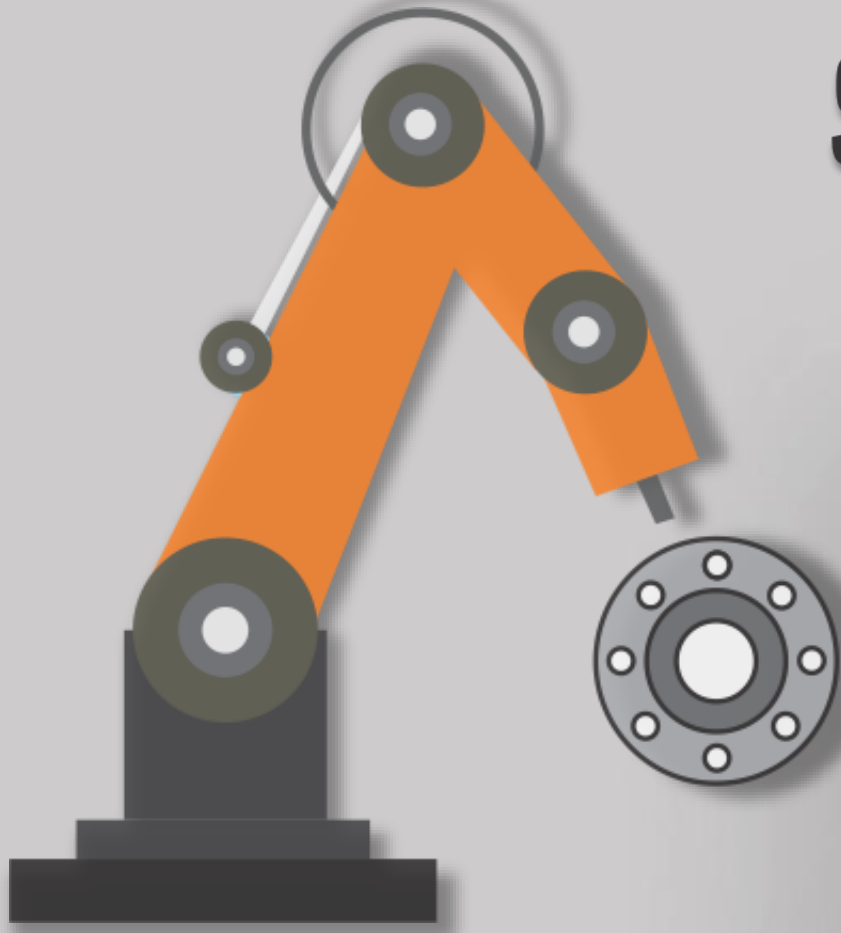


# AUTO SOLDAS



EM PARCERIA COM:





# OBJETIVOS



AUTO  
SOLDAS

- Desenvolver um **Braço Mecanizado** para Soldagem Circunferencial de Tubulações
- **Flexibilizar a produção** de Spools sem aumento de custos significativos
- Apresentar melhorias nas **condições de trabalho** do soldador/operador



fábrica de  
**Spool's**



Fonte: Novarc Technologies.



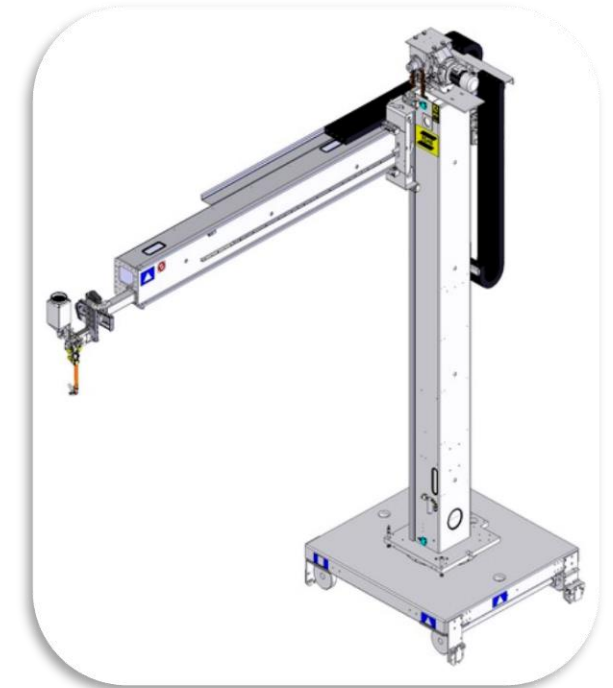


# MATRIZ DE DECISÃO



AUTO  
SOLDAS

MATRIZ DE DECISÃO FINAL	NOVARC	ESAB COLUNAS
BAIXO CUSTO	0,008	0,025
COMPACTO	0,008	0,002
PRODUTIVIDADE	0,035	0,012
FLEXIBILIDADE	0,214	0,118
INTEGRAÇÃO COM O PROCESSO ATUAL	0,038	0,064
CONFIABILIDADE	0,007	0,068
<b>NOTA FINAL</b>	<b>31,46%</b>	<b>33,12%</b>



Fonte: ESAB



Fonte: Novarc Technologies

## NOVARC

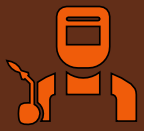
- Flexibilidade
- Produtividade
- Automação
- Dimensões

## ESAB

## COLUNAS

- Robustez
- Confiabilidade
- Simplicidade

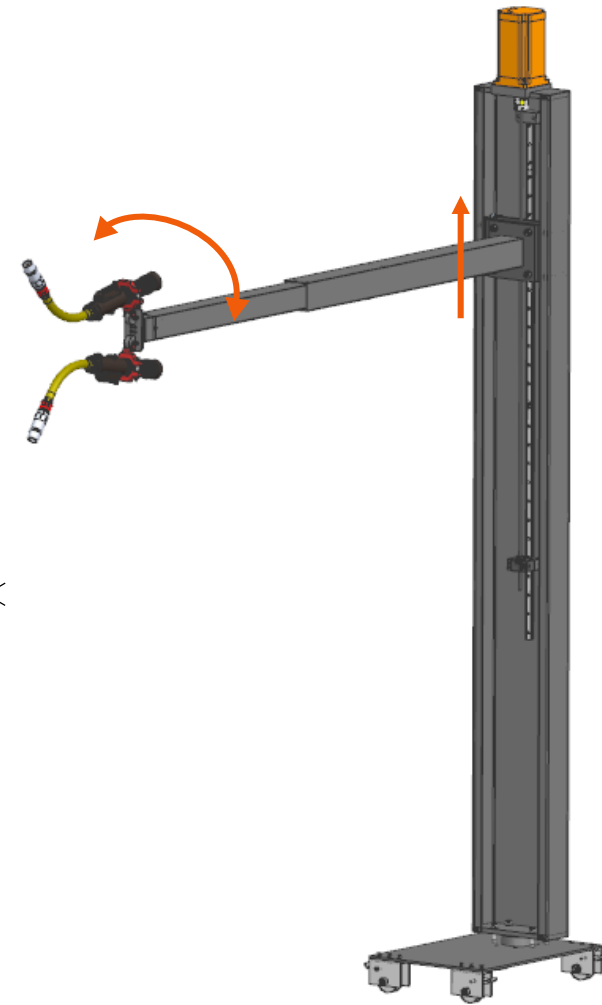
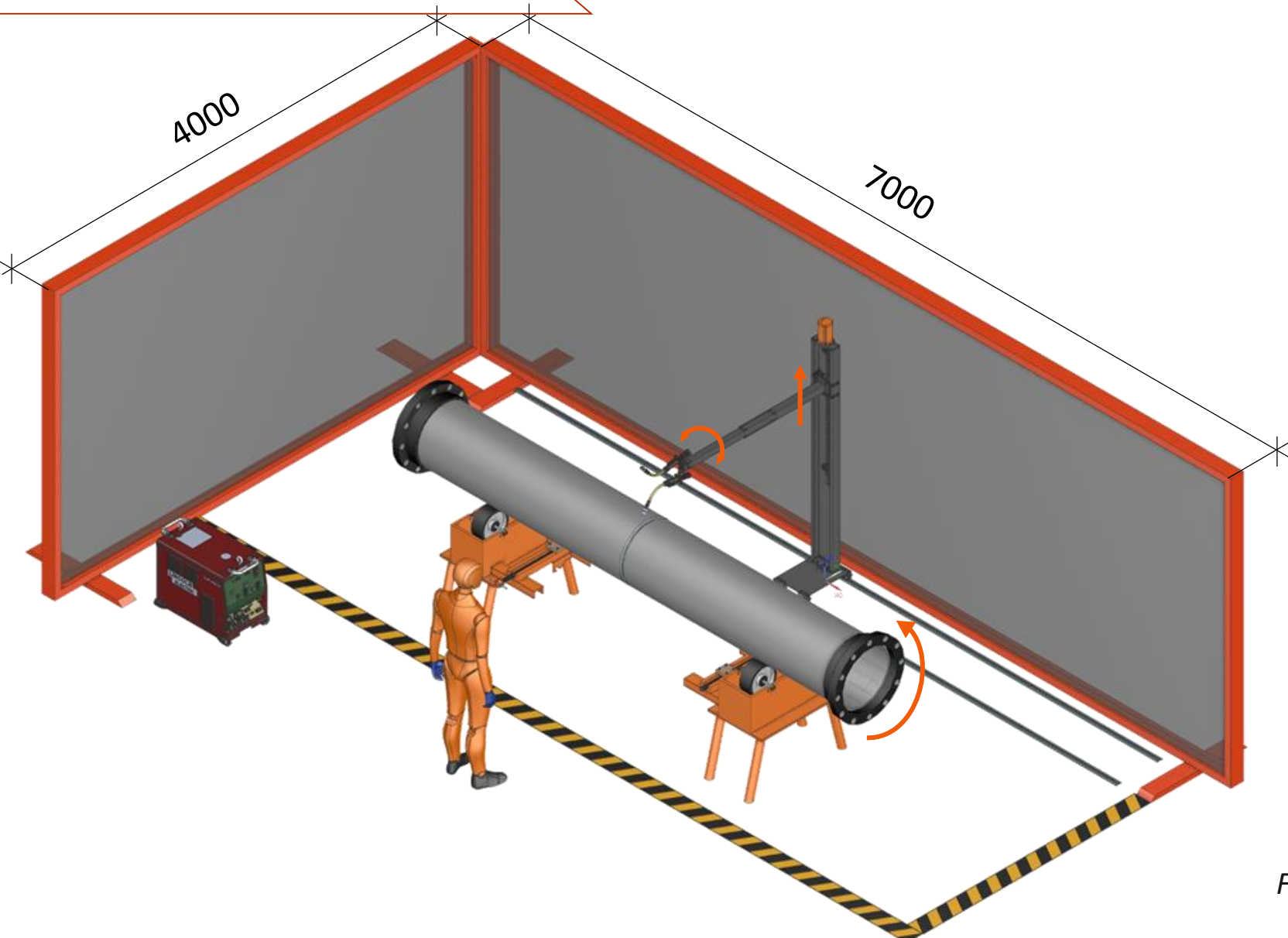




# LAY-OUT BÁSICO

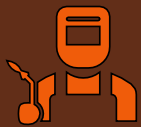


AUTO  
SOLDAS



Fonte: Autores.

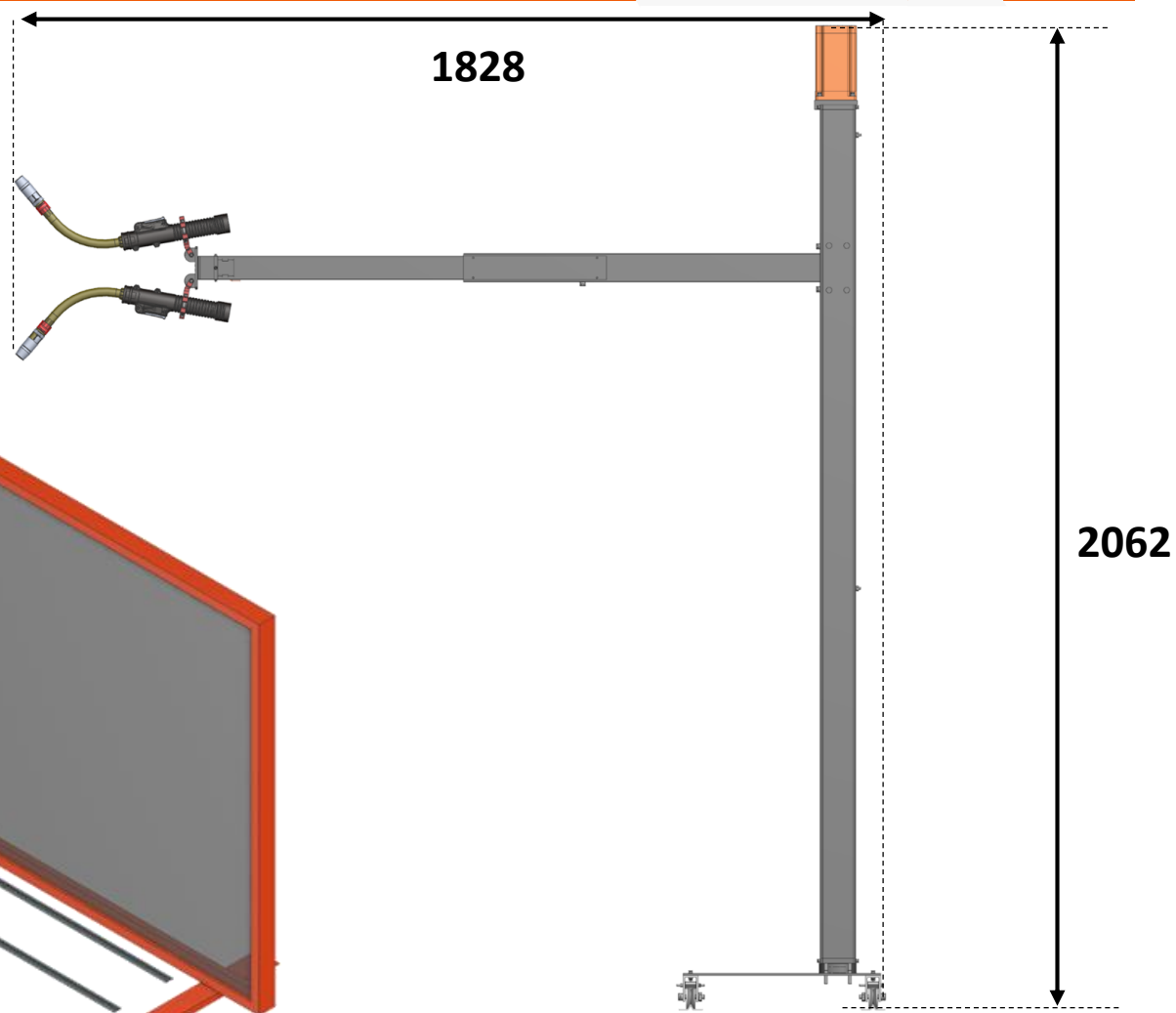
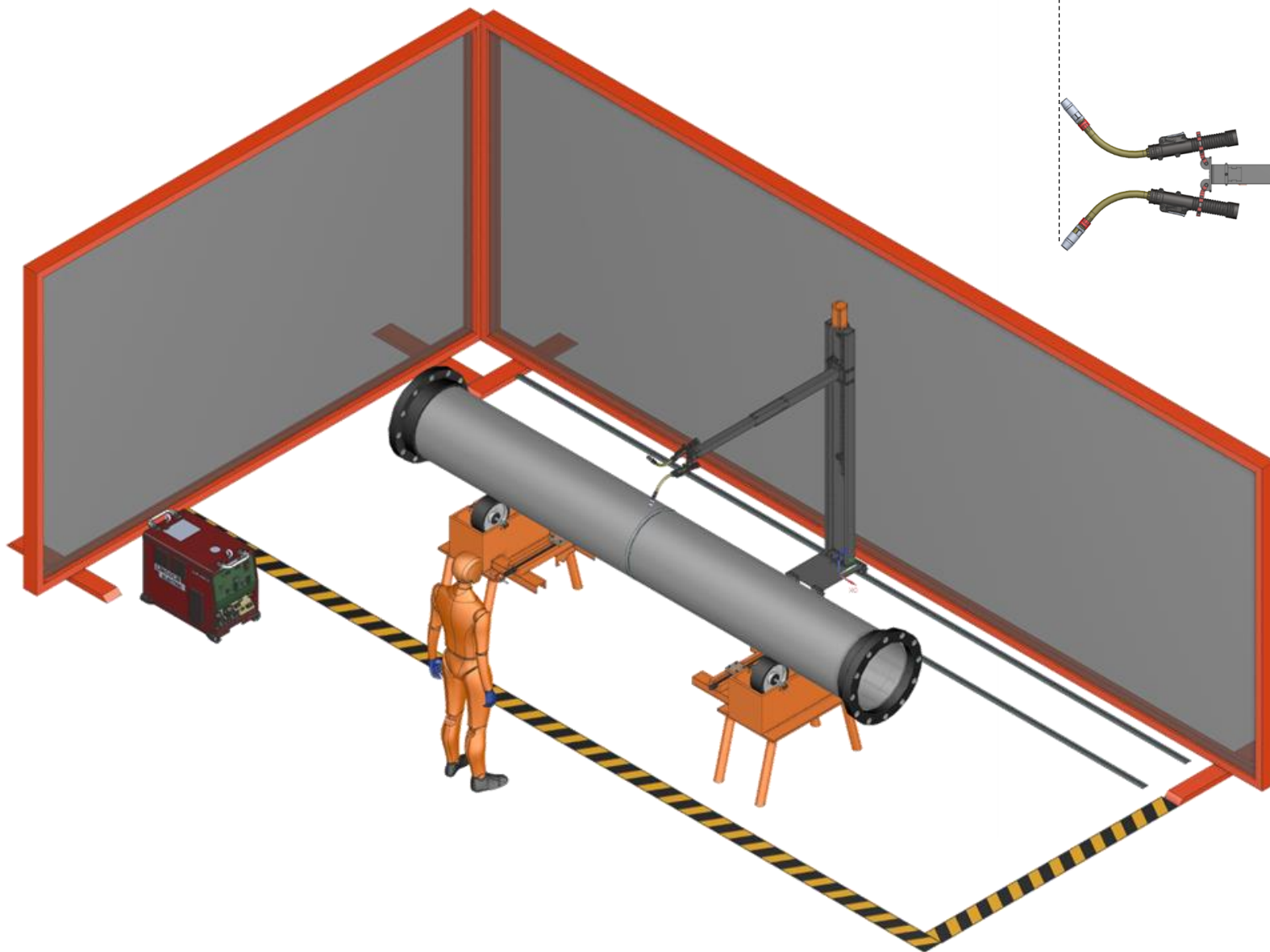




# LAY-OUT BÁSICO



AUTO  
SOLDAS



Fonte: Autores.





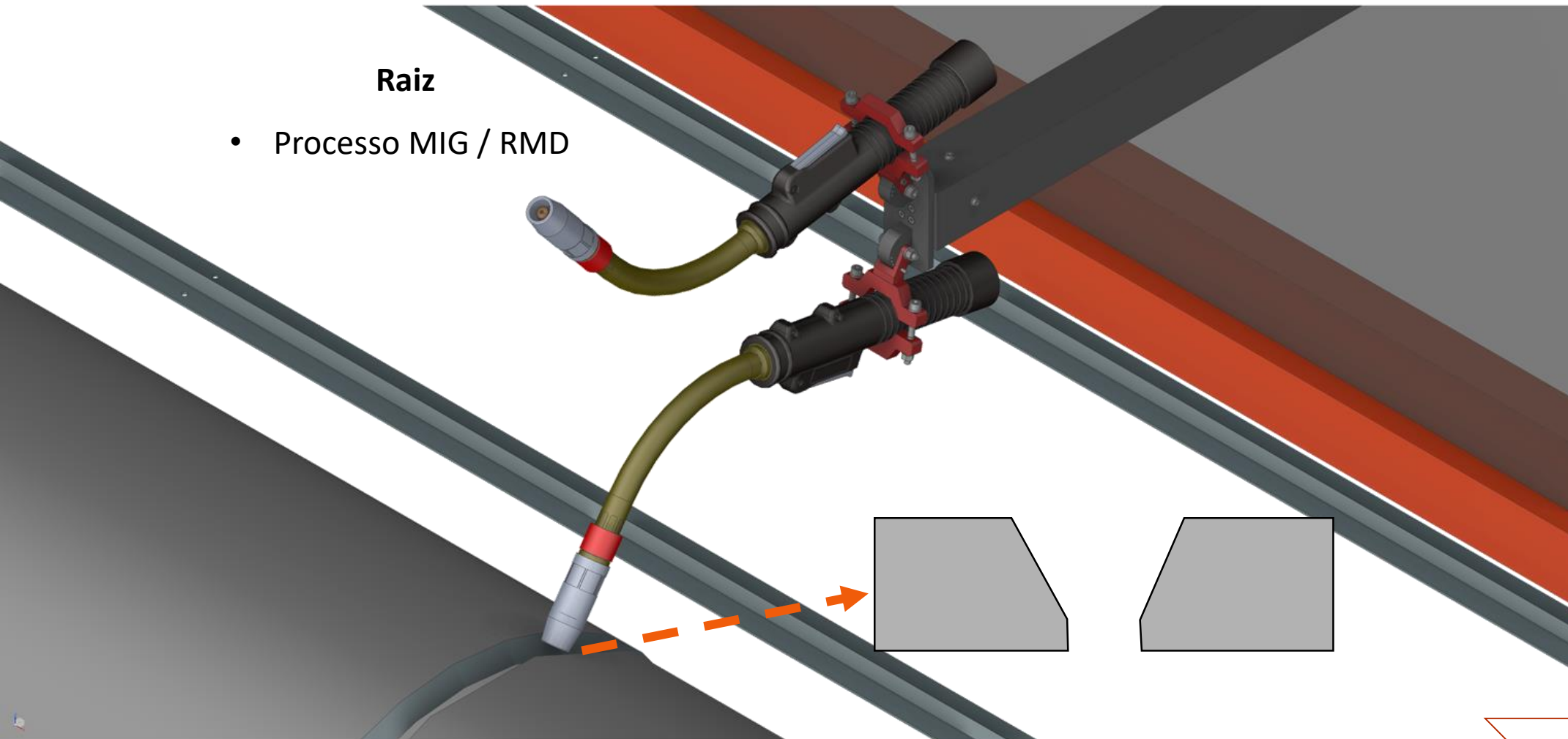
# MOVIMENTO ELEVATÓRIO



AUTO  
SOLDAS

## Raiz

- Processo MIG / RMD



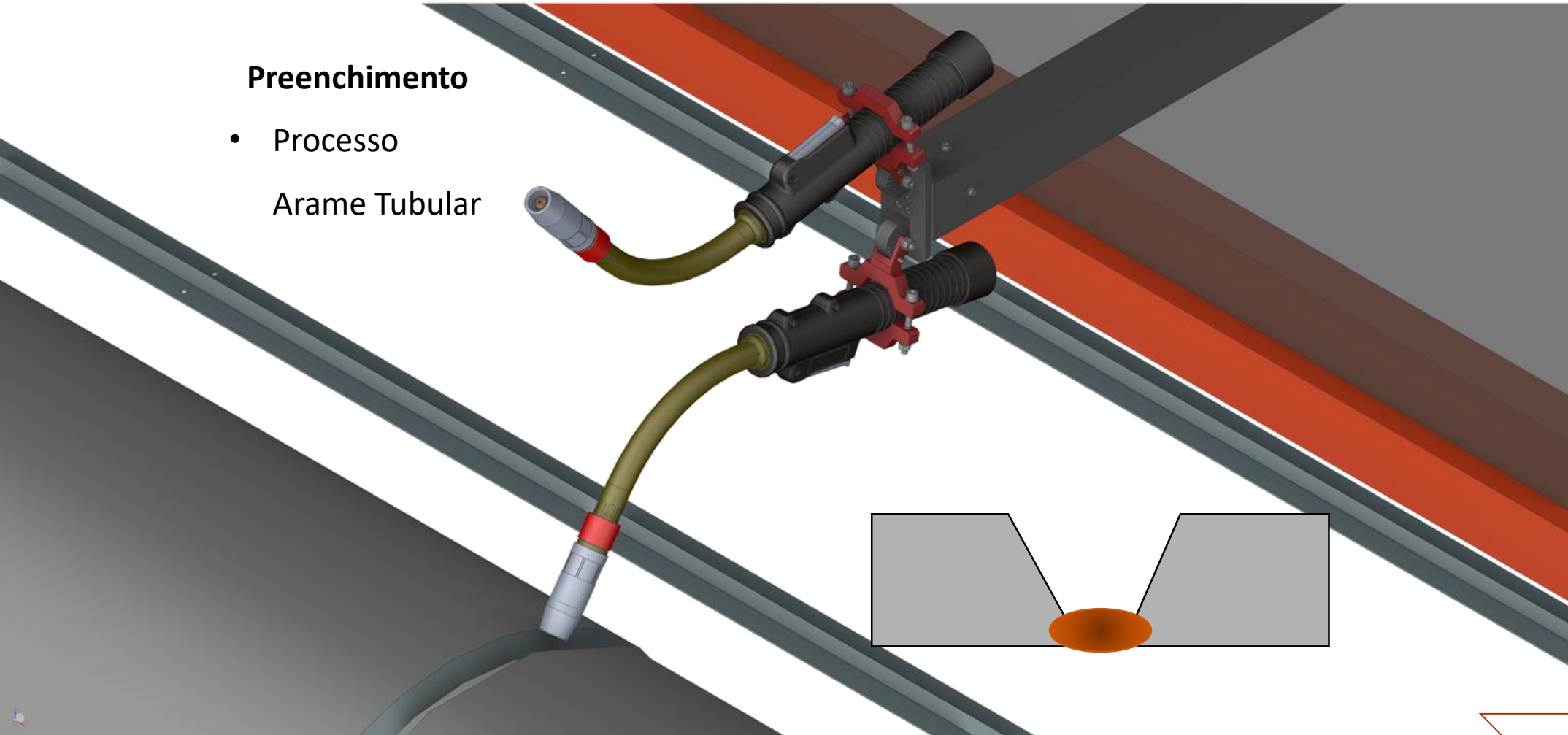
Fonte: Autores.

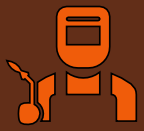




## Preenchimento

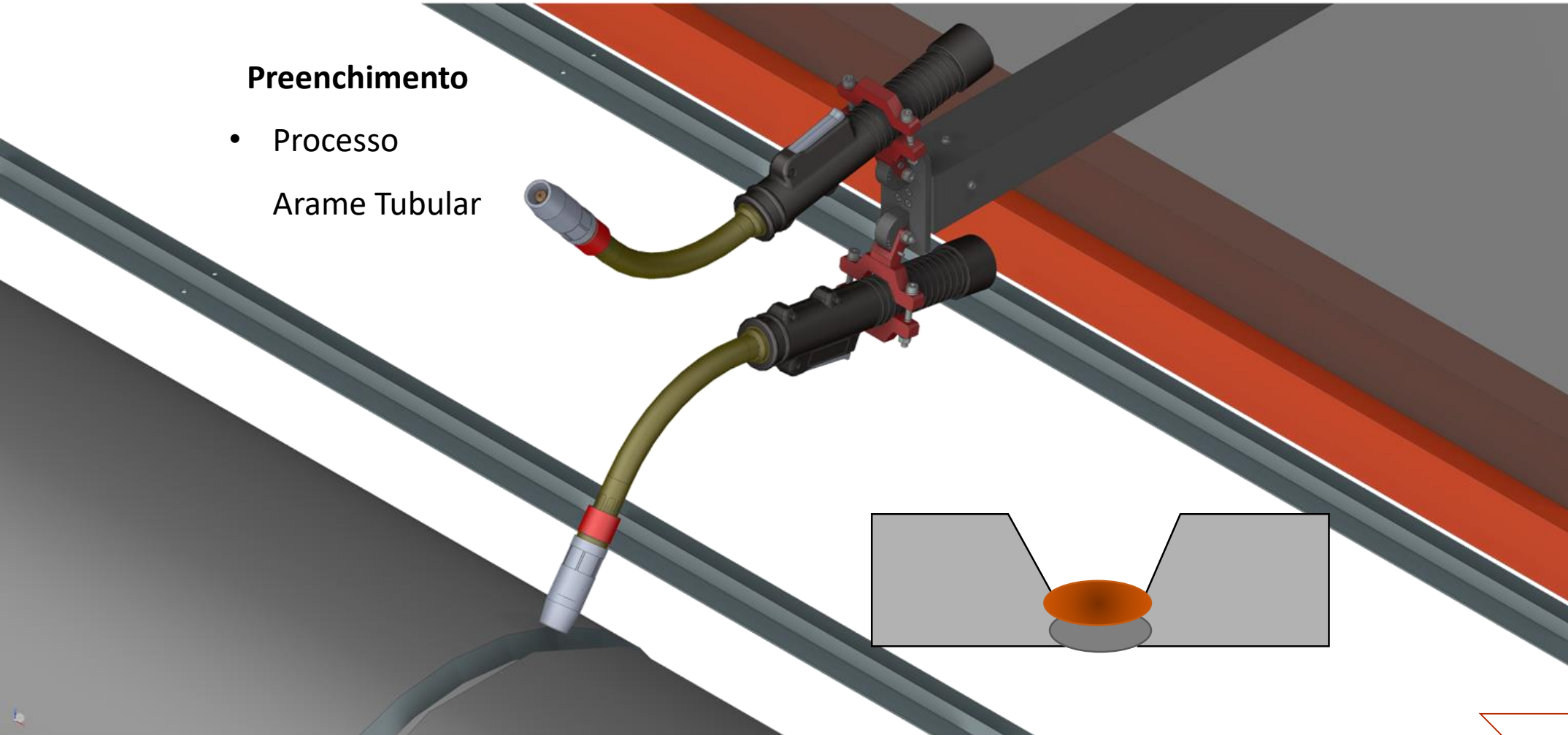
- Processo  
Arame Tubular





## Preenchimento

- Processo  
Arame Tubular

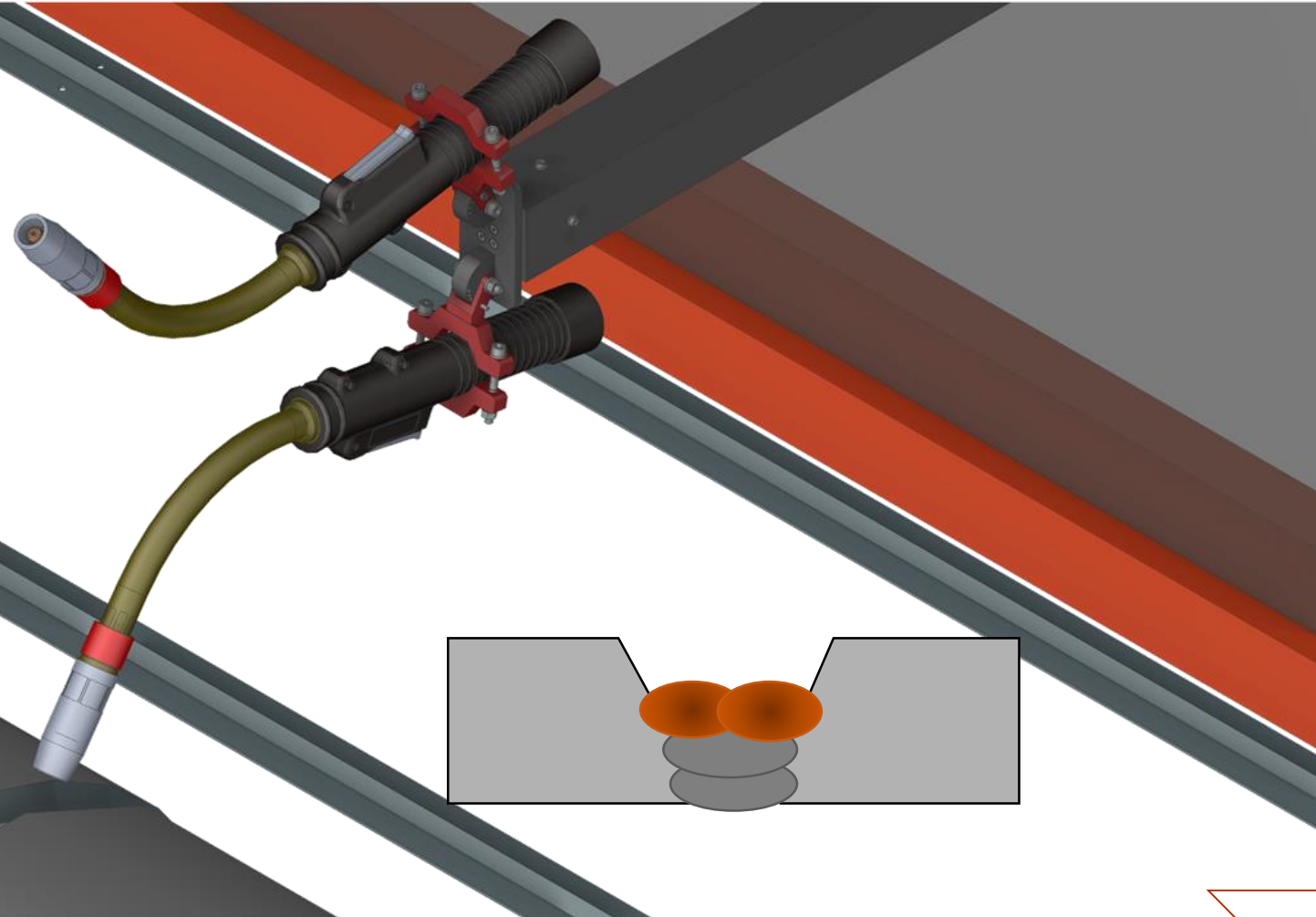


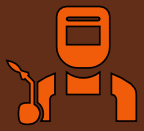




## Preenchimento

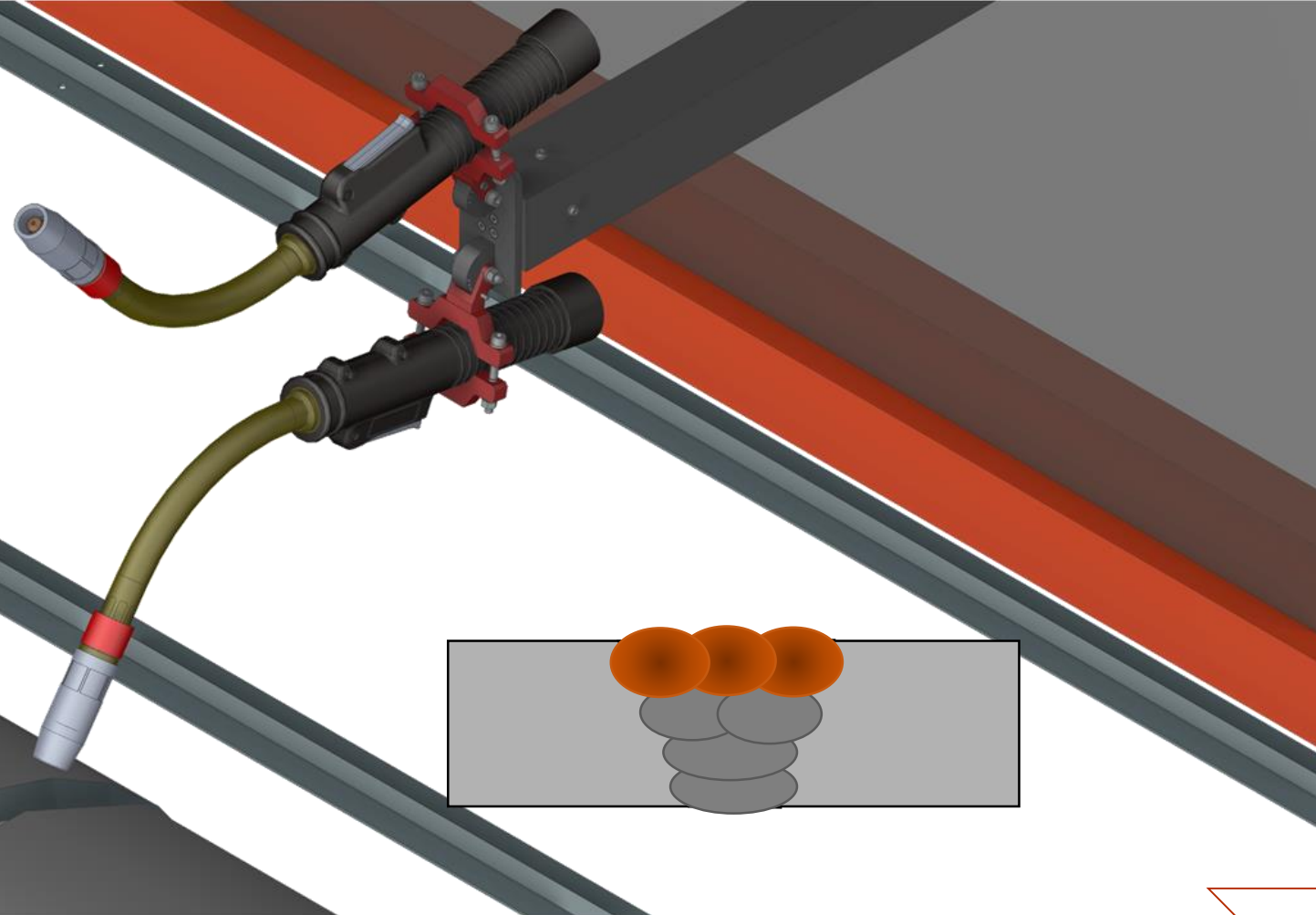
- Processo  
Arame Tubular

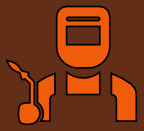




## Preenchimento

- Processo  
Arame Tubular

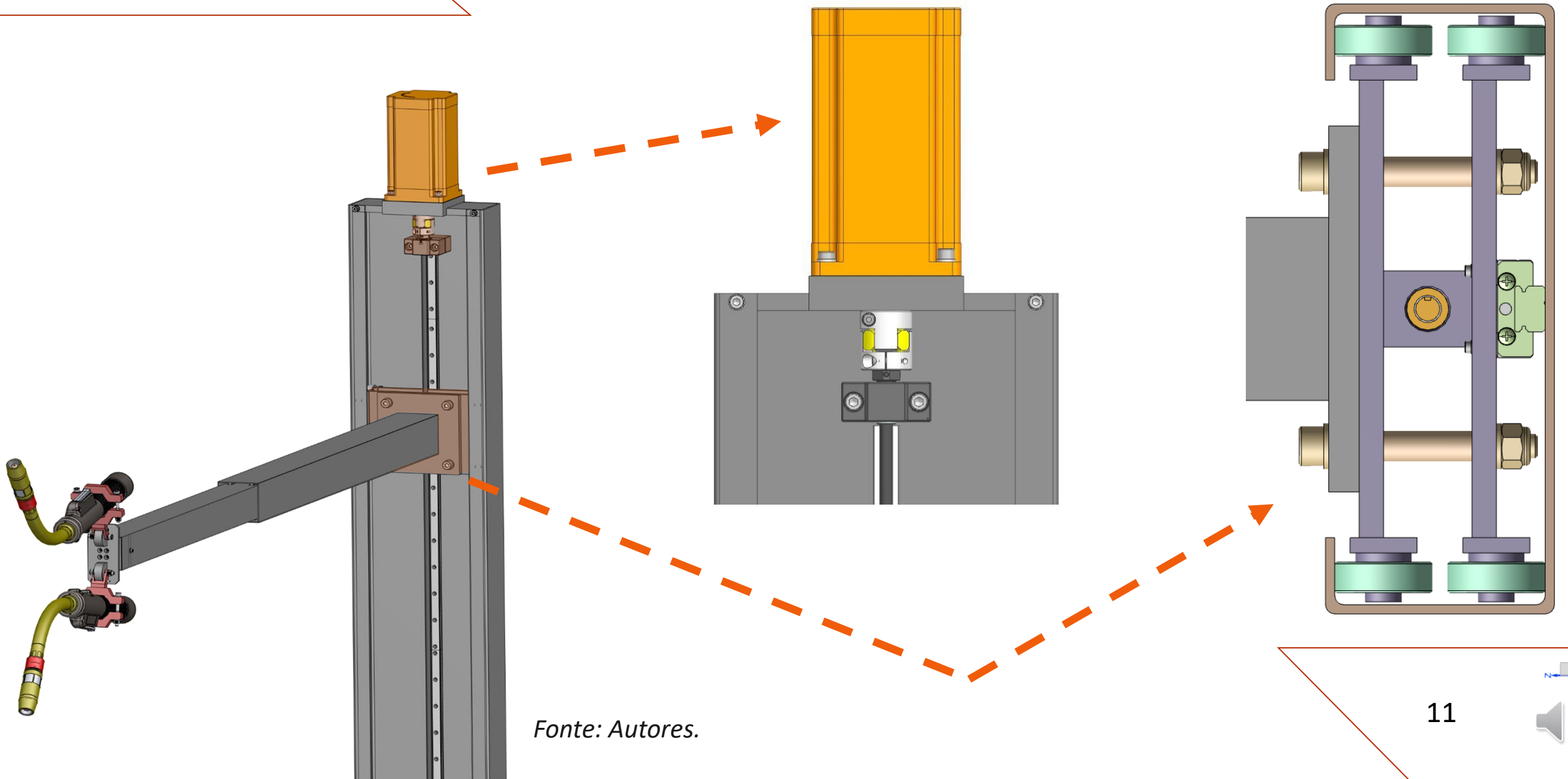




# CONJUNTO ELEVATÓRIO



AUTO  
SOLDAS



Fonte: Autores.





# COLUNA



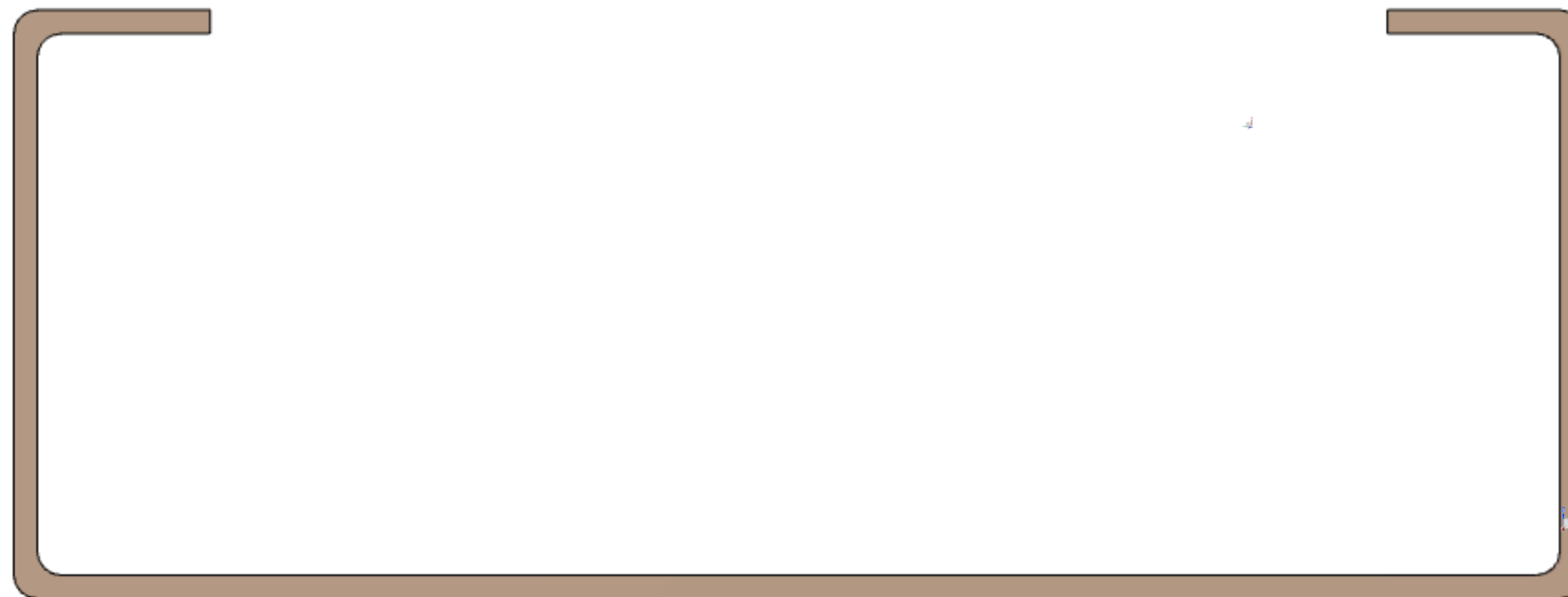
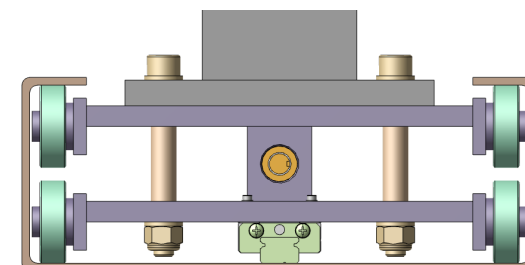
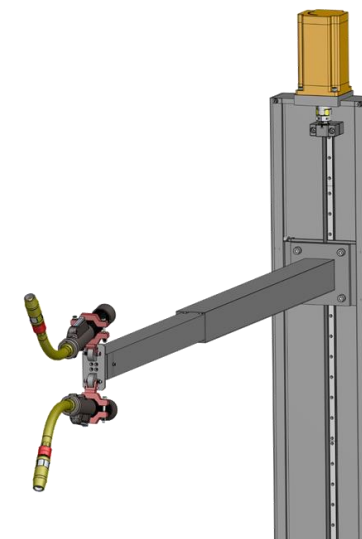
AUTO  
SOLDAS

## Principais Características:

- Perfil comercial
- Perfil U enrijecido
- 200x75x3 mm
- Aço carbono laminado a frio

Soluções  
**USIMINAS** 

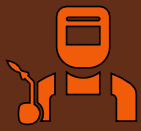
DESDE 1972  
**Braganfer**  
O Shopping Center do Aço



**Vista de Planta**

Fonte: Autores.





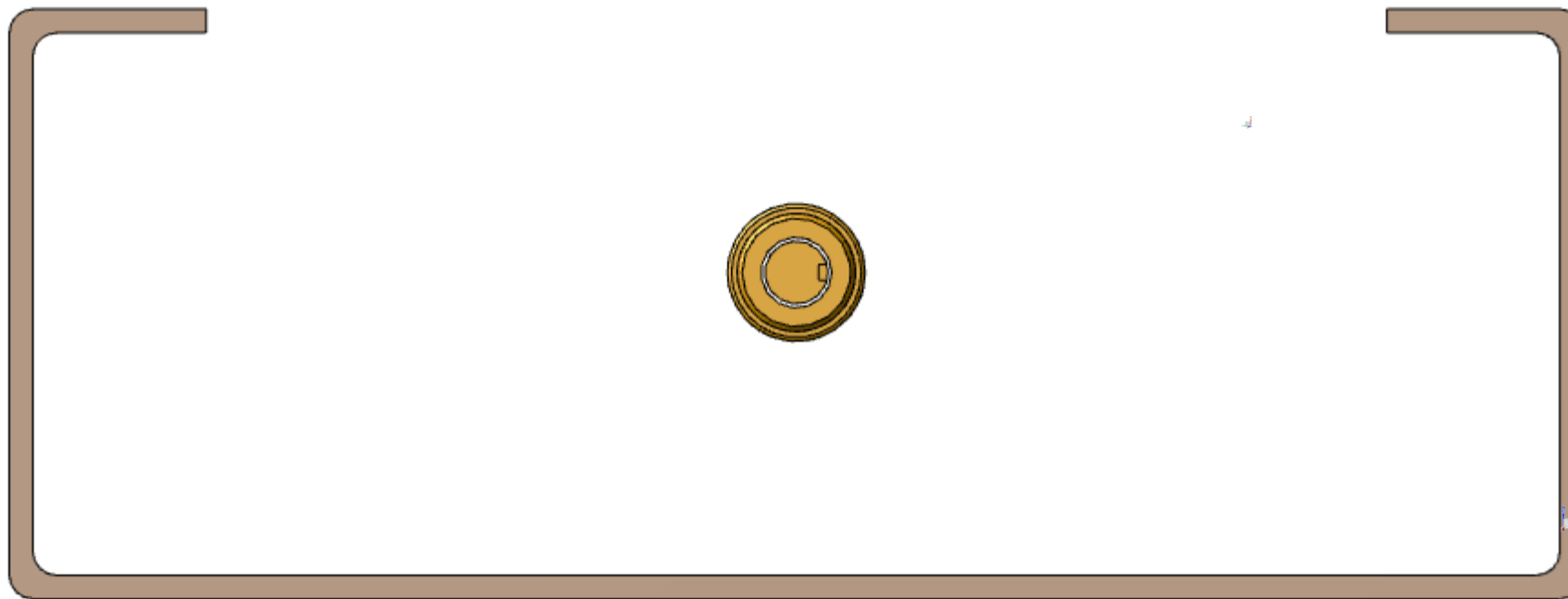
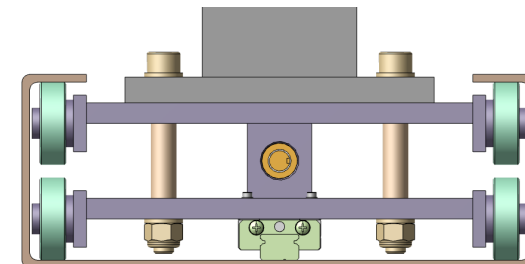
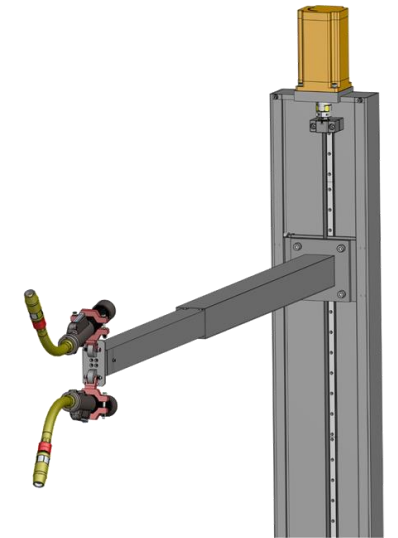
# FUSO DE ESFERAS



AUTO  
SOLDAS

## Principais Características:

- Diâmetro Nominal: 8 mm
- Passo: 2,5 mm
- CA (carga dinâmica) = 189 kgf
- $C_0A$  (carga estática) = 381 kgf



Vista de Planta

Fonte: Autores.





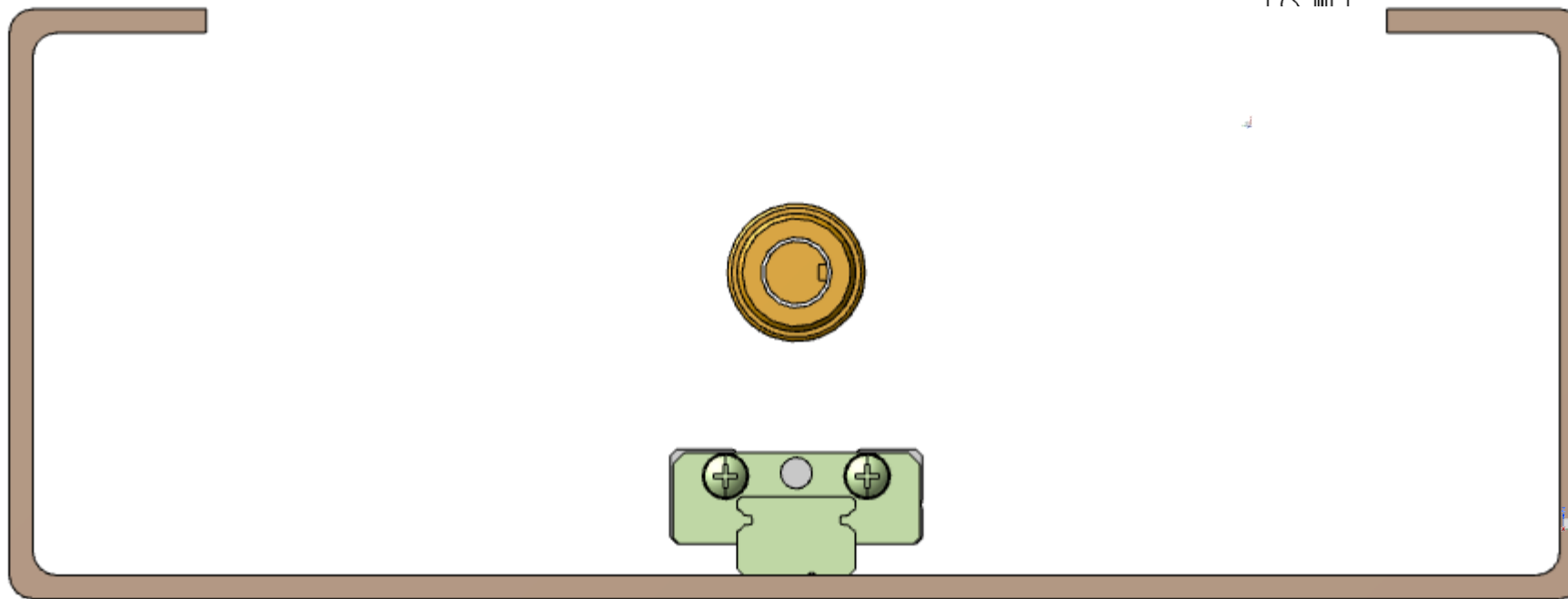
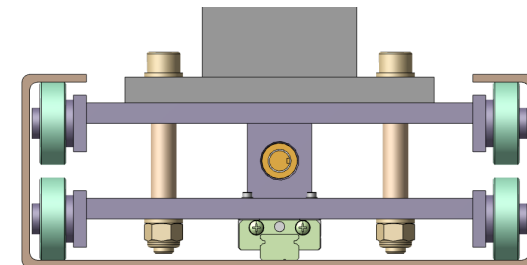
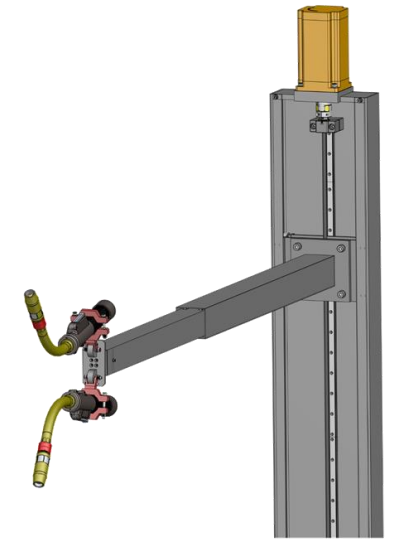
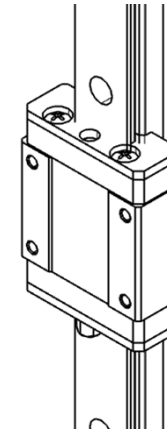
# GUIA LINEAR



AUTO  
SOLDAS

## Principais Características:

- $C_{100B}$  (carga dinâmica) = 3810 N
- $C_0$  (carga estática) = 5590 N



Vista de Planta

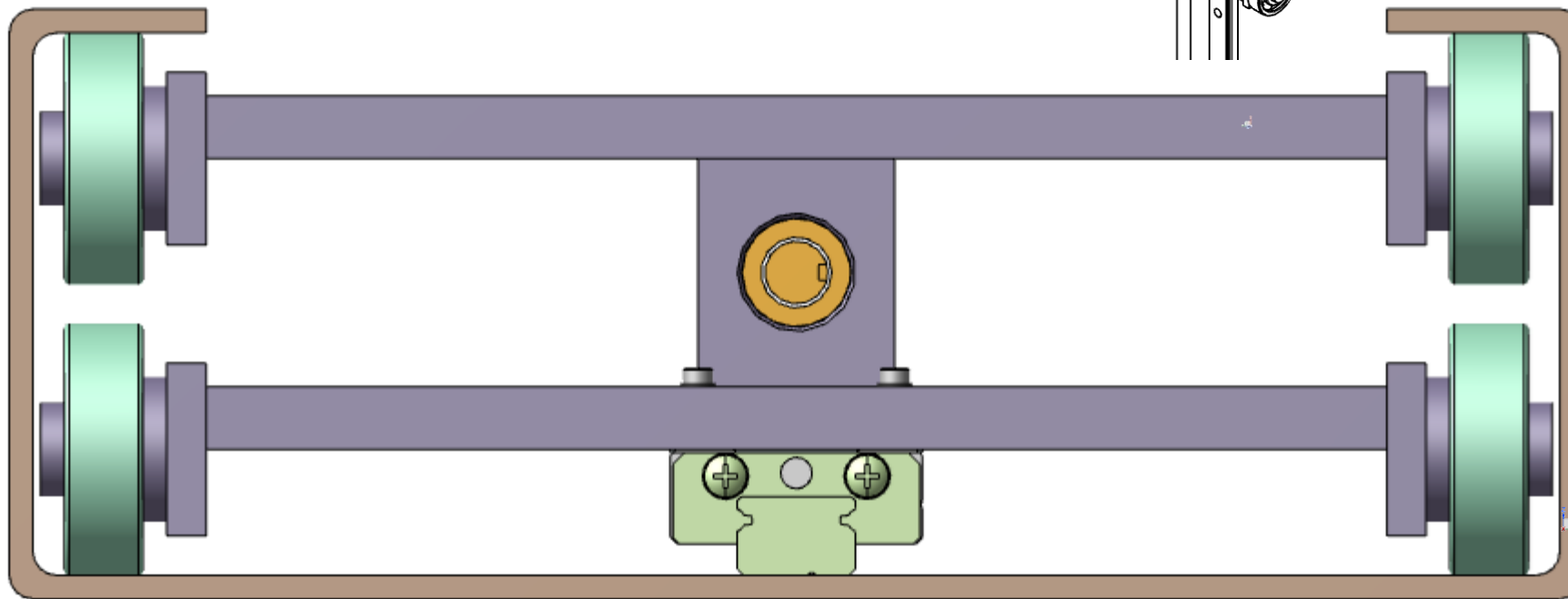
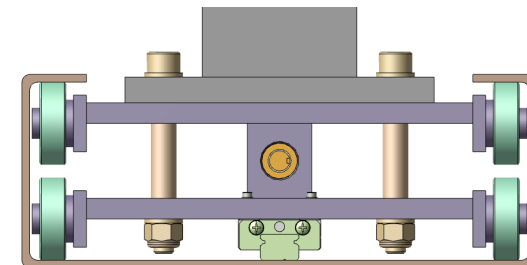
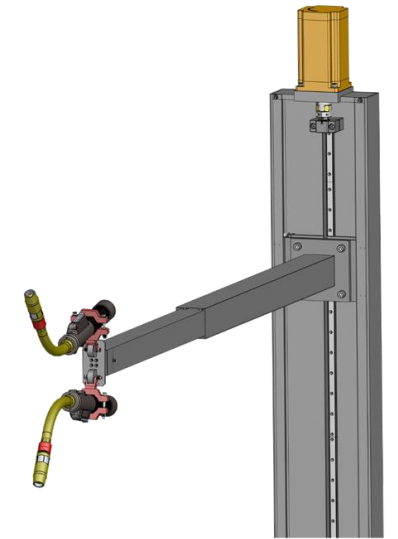
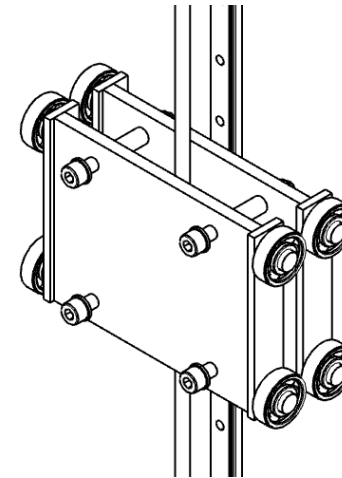
Fonte: Autores.





## Principais Características:

- Sistema hiperestático
- Rolamento SKF 6201

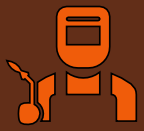


Vista de Planta



Fonte: Autores.

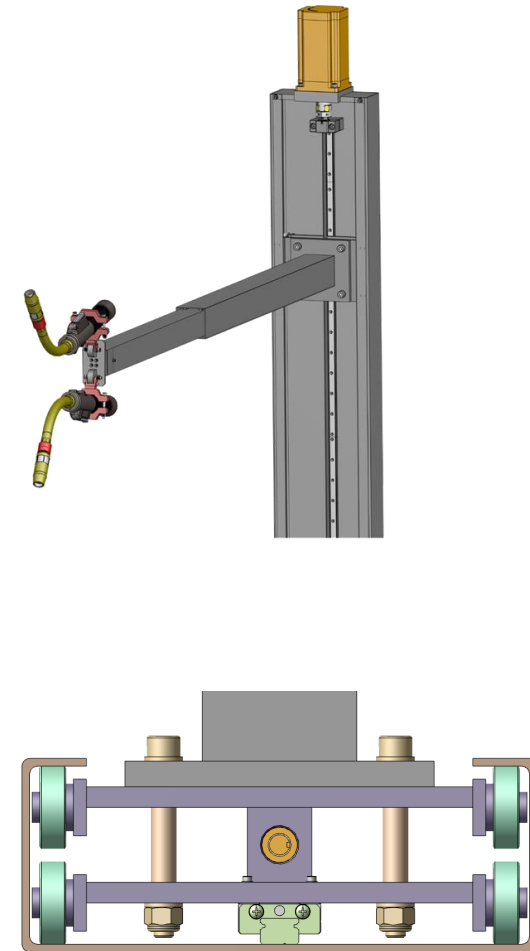
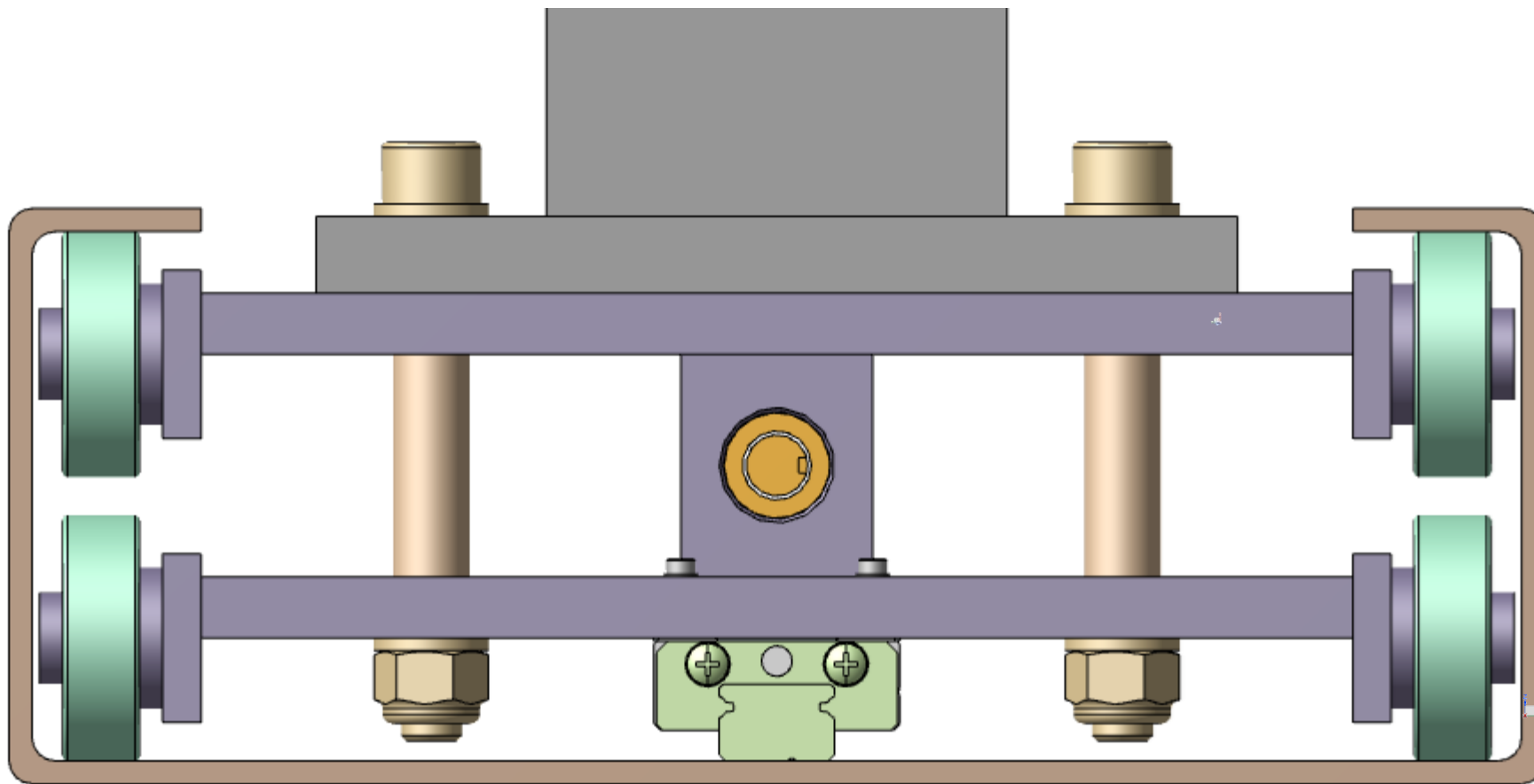




# BRAÇO



AUTO  
SOLDAS



Vista de Planta

Fonte: Autores.



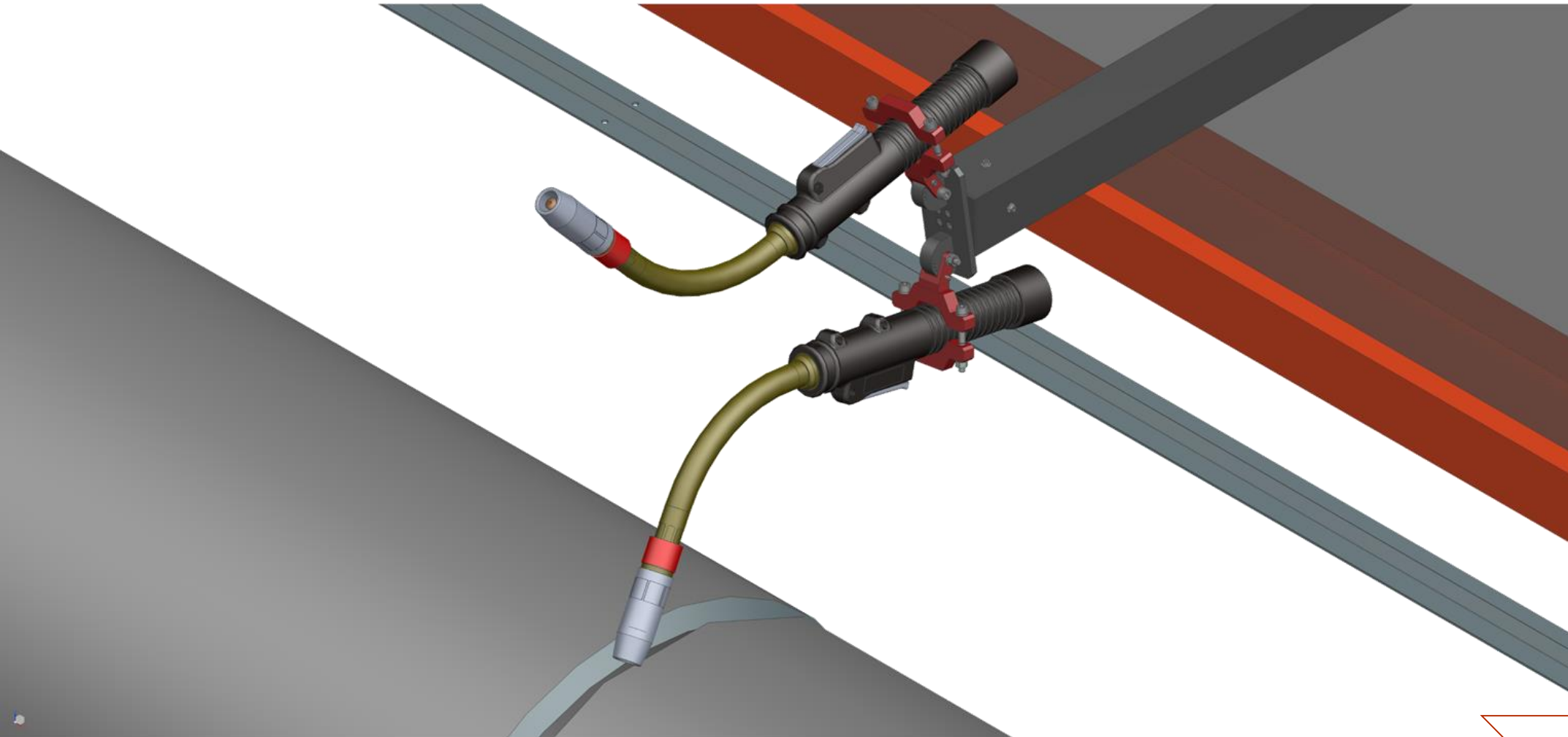




# MOVIMENTO OSCILATÓRIO

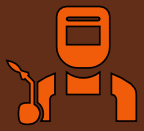


AUTO  
SOLDAS



Fonte: Autores.

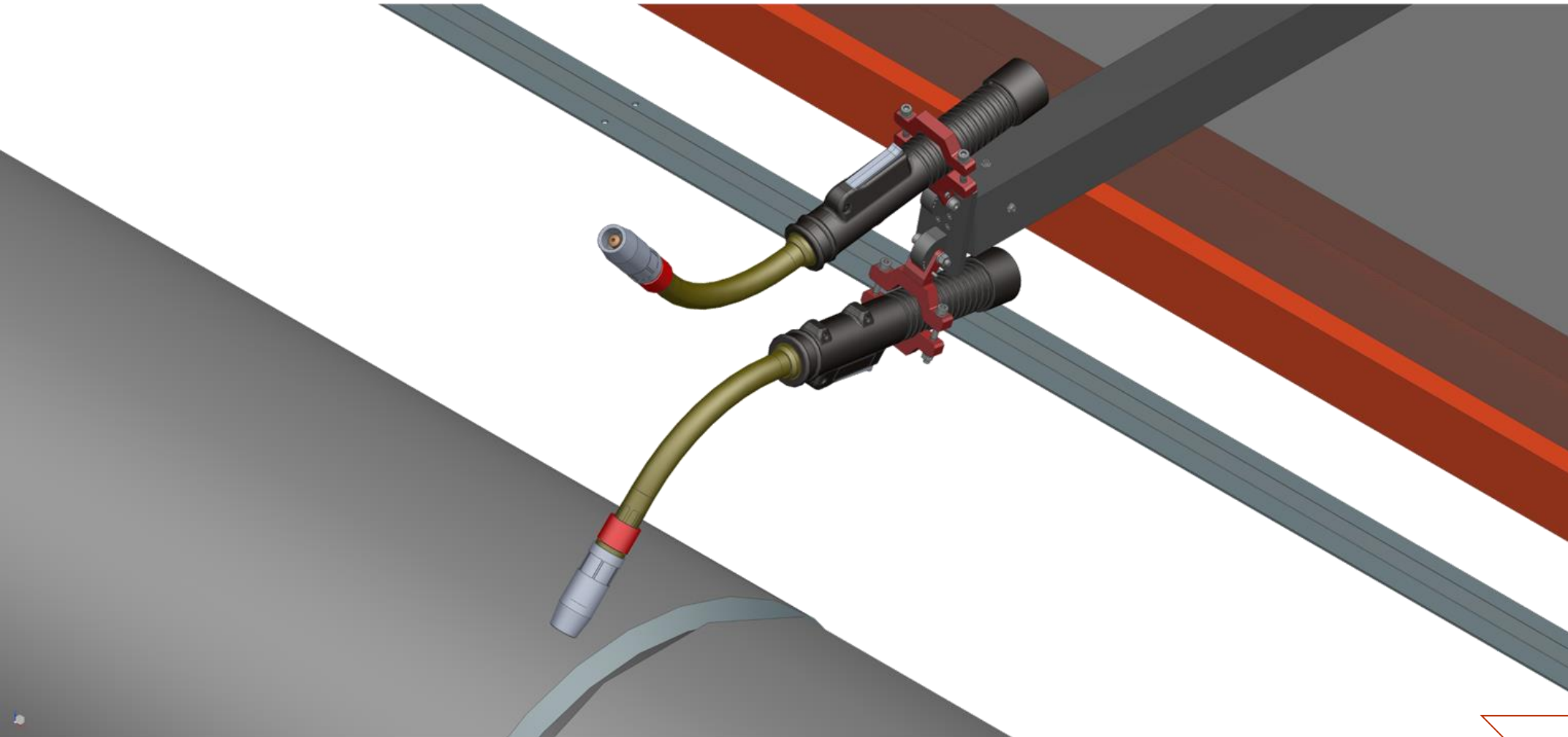




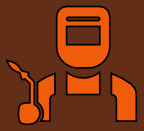
# MOVIMENTO OSCILATÓRIO



AUTO  
SOLDAS



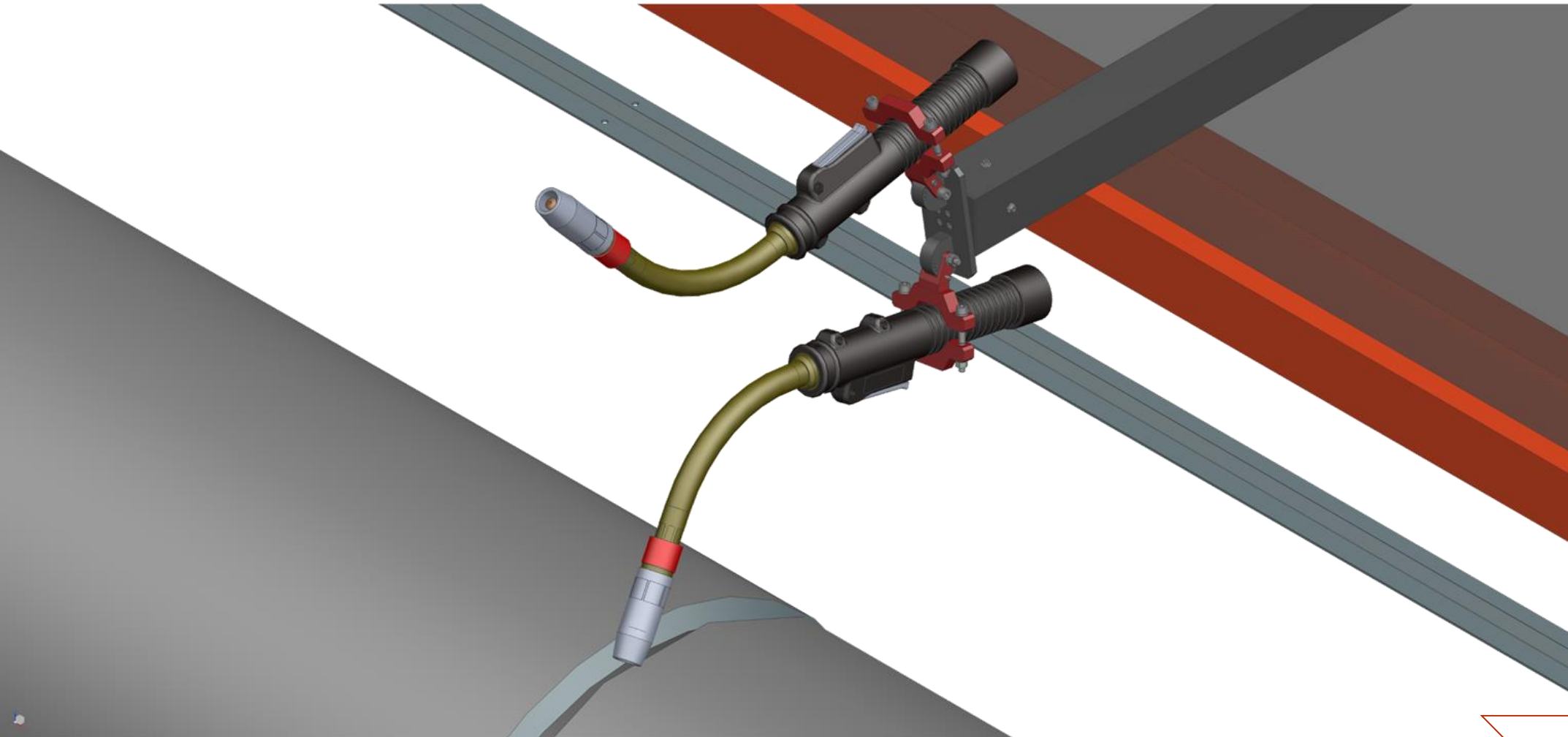
Fonte: Autores.



# MOVIMENTO OSCILATÓRIO



AUTO  
SOLDAS



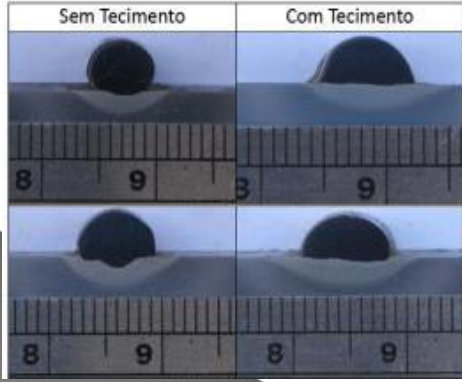
Fonte: Autores.



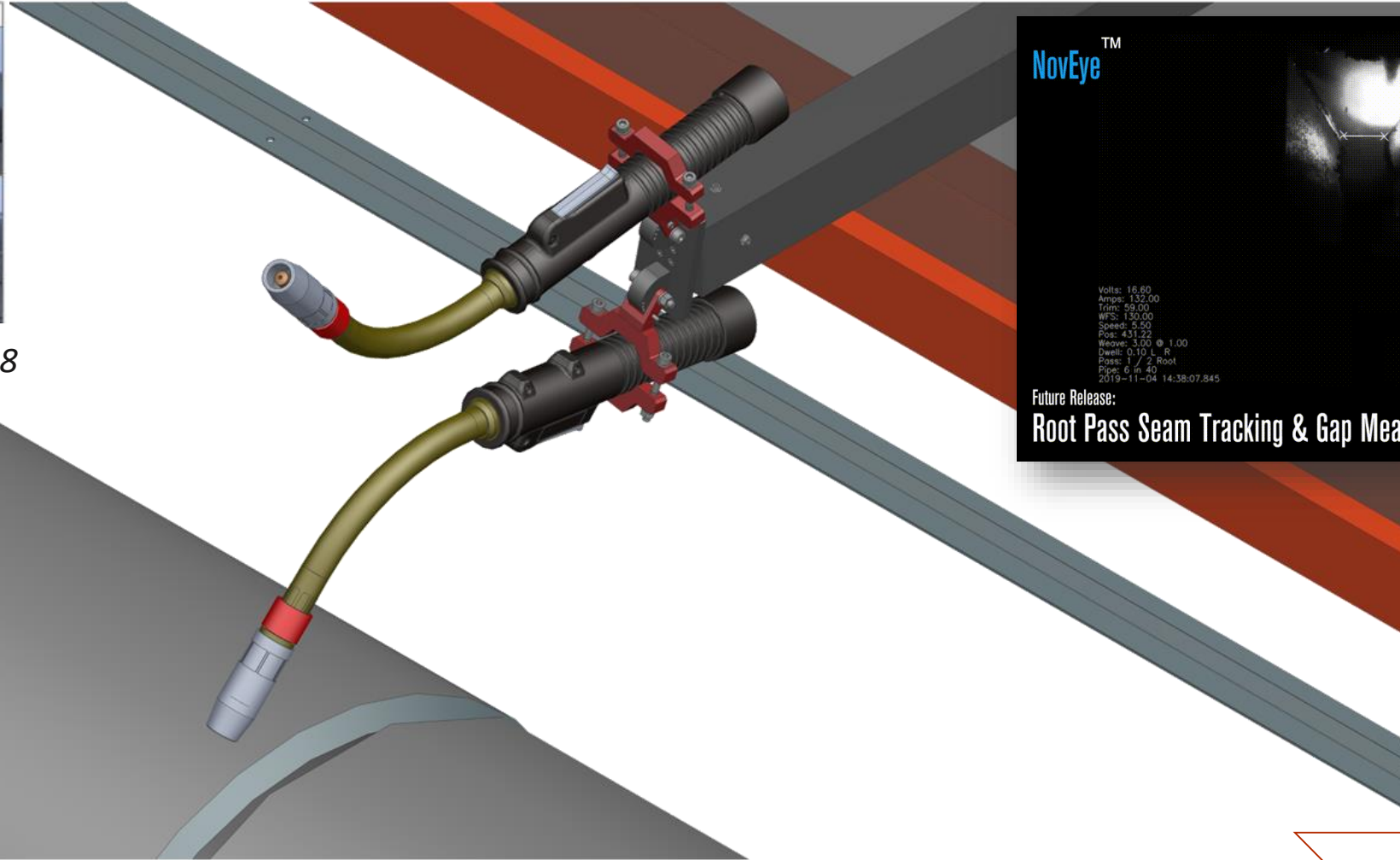
# MOVIMENTO OSCILATÓRIO



AUTO  
SOLDAS



Fonte: Cunha, Ribeiro, 2018



NovEye™

Volts: 18.60  
Amps: 132.00  
Trim: 59.00  
WFS: 130.00  
Speed: 5.50  
Pos: 431.22  
Weave: 3.00 @ 1.00  
Depth: 0.10 L-R  
Pass: 1 / 2 Root  
Pipe: 6 in 40  
2019-11-04 14:38:07.845

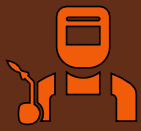
2.6mm GAP  
9 ROOT SAVE  
1.000 ROOT GAP  
0.000

Future Release:  
**Root Pass Seam Tracking & Gap Measurement**

NOVARC  
TECHNOLOGIES

Fonte: Autores.

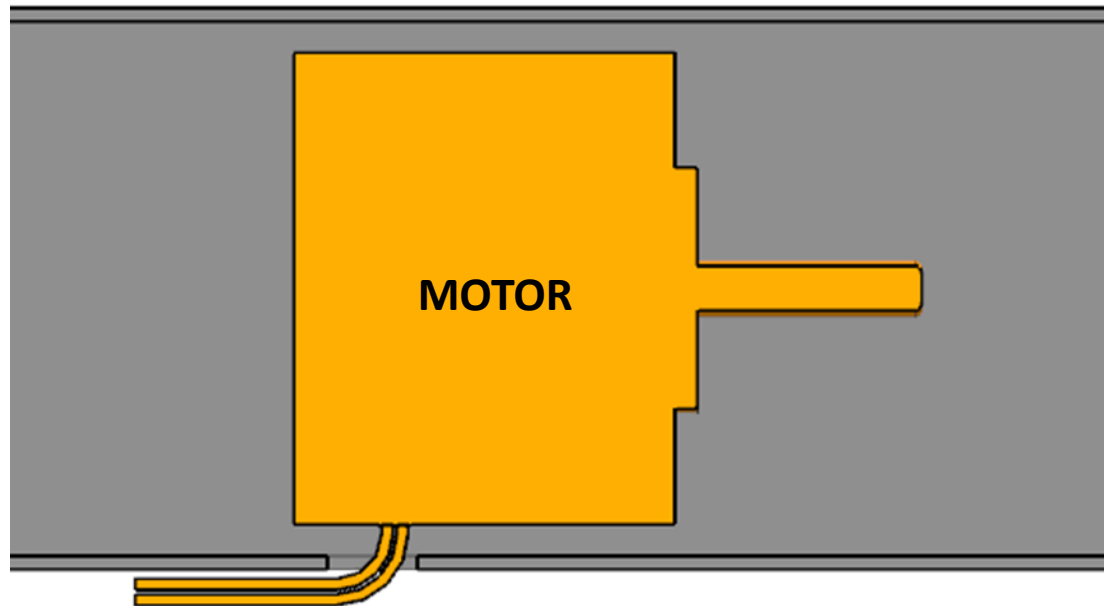




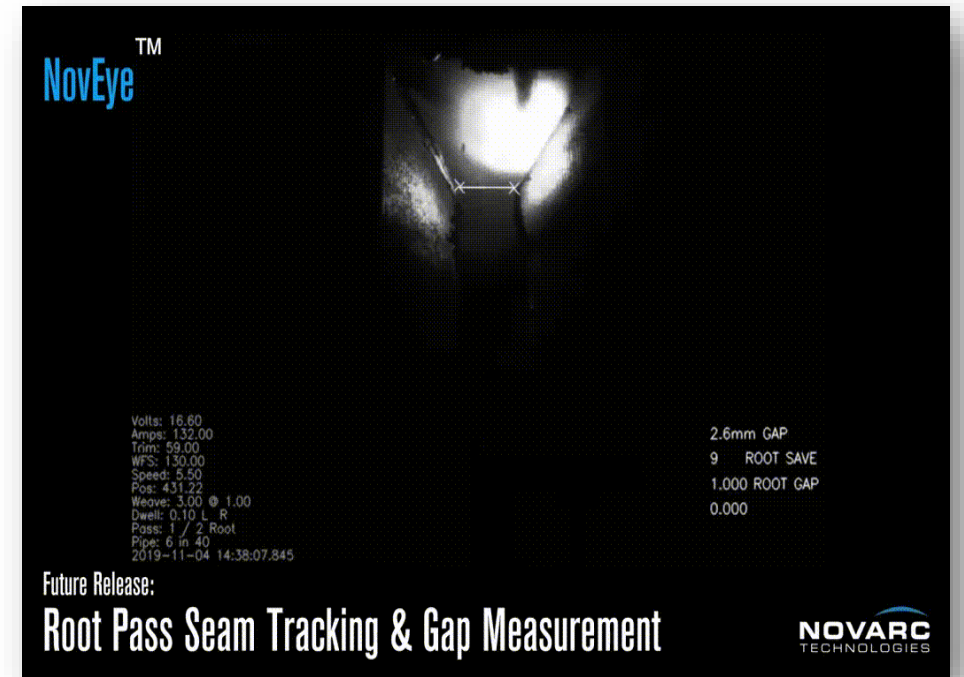
# NECESSIDADE DE MOTOR

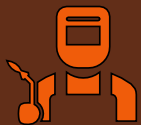


AUTO  
SOLDAS



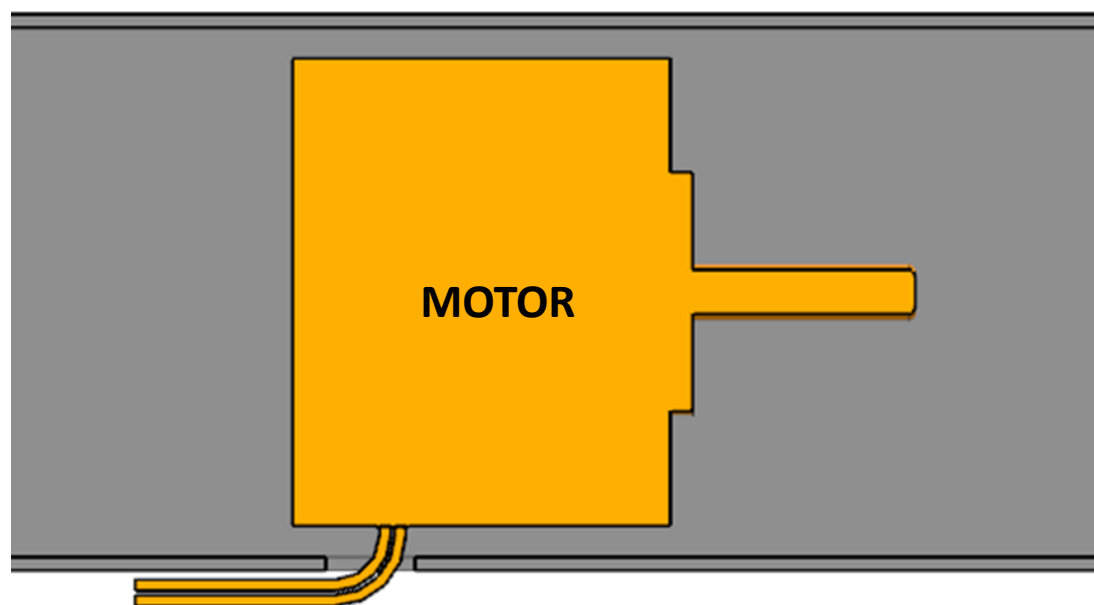
Fonte: Autores.





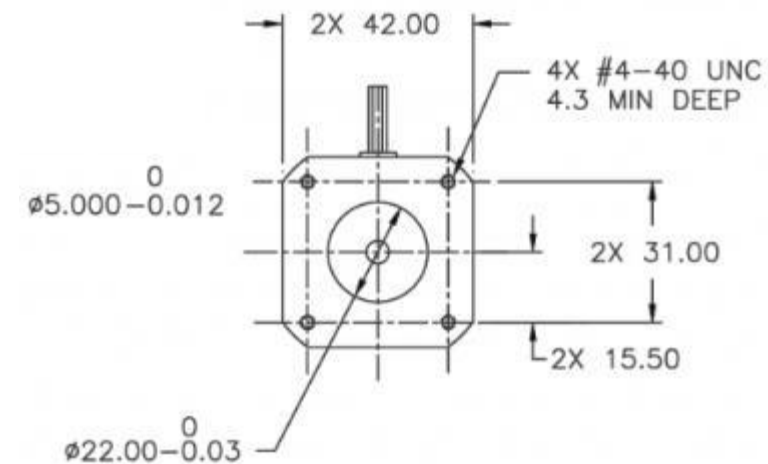
## Principais Características:

- KTC-5017-008 NEMA 17



### Vista de Elevação

Fonte: Autores.

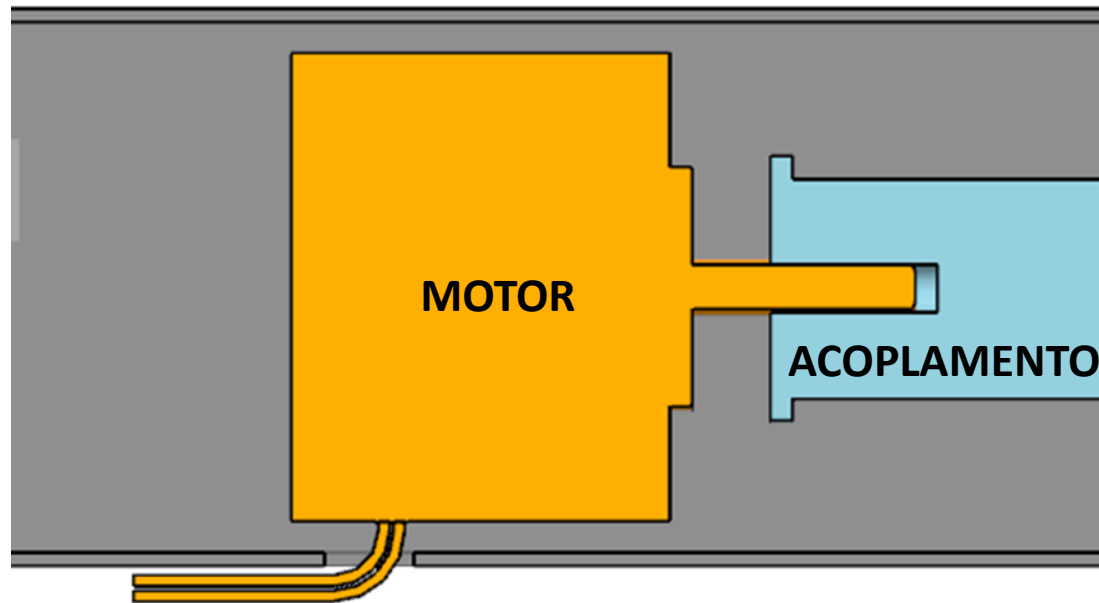




# ACOPLAMENTO



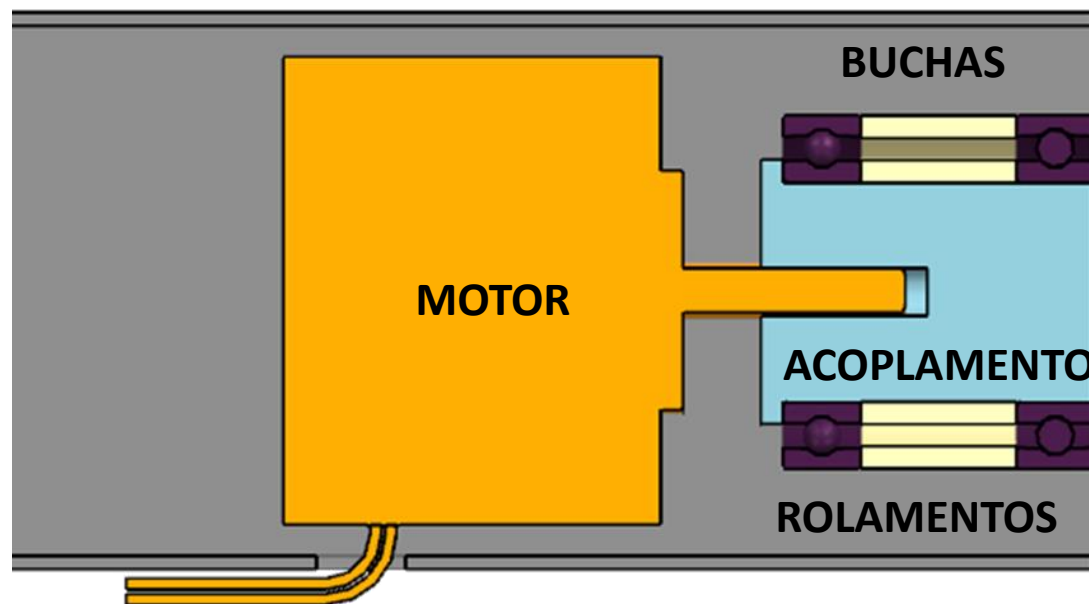
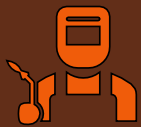
AUTO  
SOLDAS



## Vista de Elevação

*Fonte: Autores.*



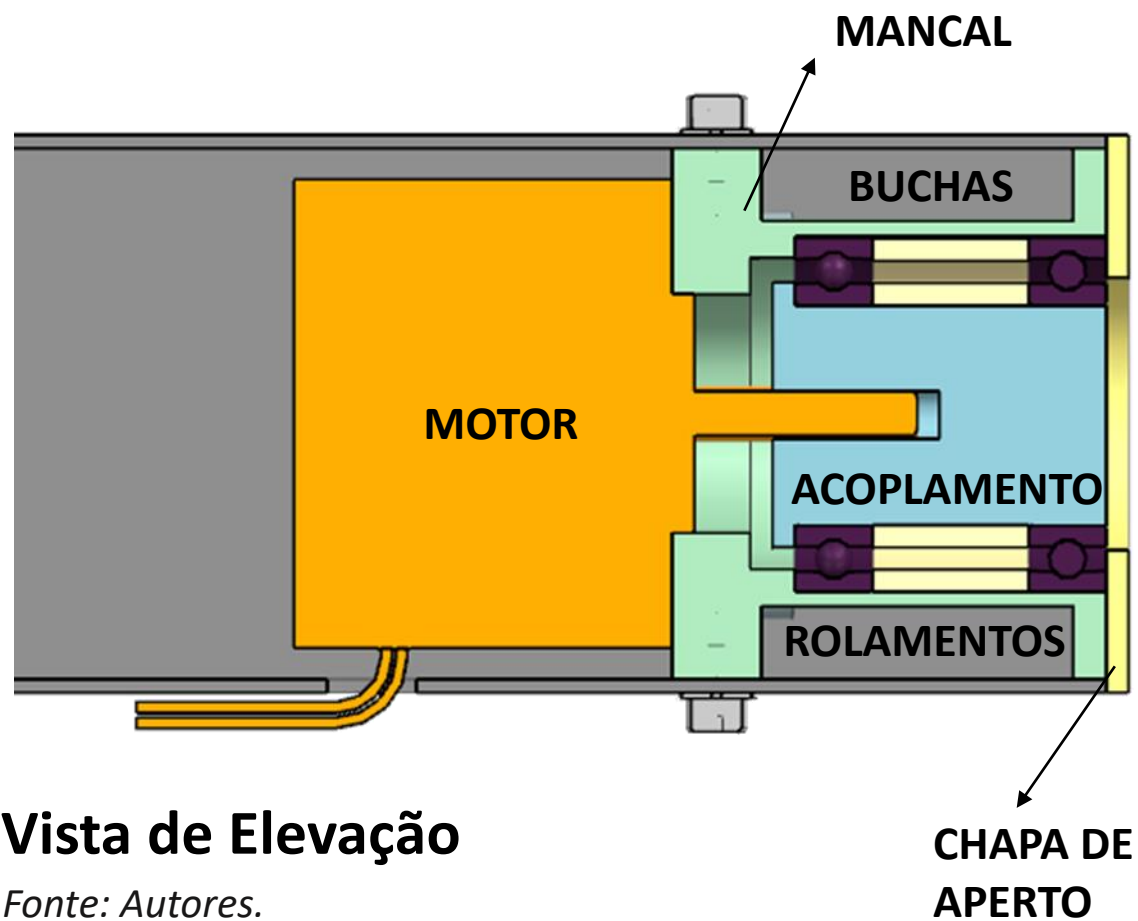


## Vista de Elevação

Fonte: Autores.







## Vista de Elevação

Fonte: Autores.

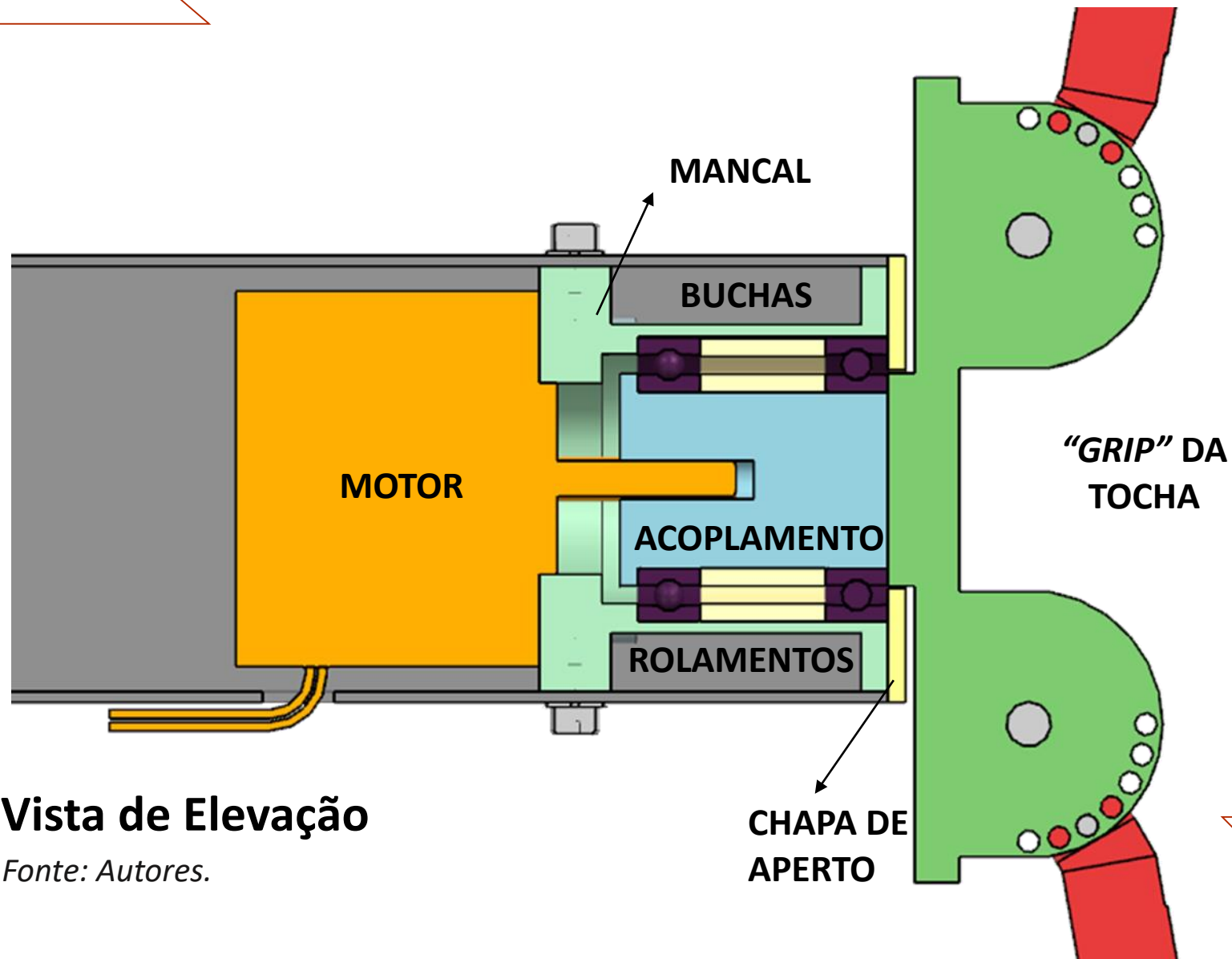




# CONJUNTO OSCILATÓRIO



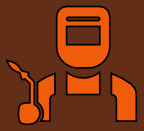
AUTO  
SOLDAS



**Vista de Elevação**

*Fonte: Autores.*

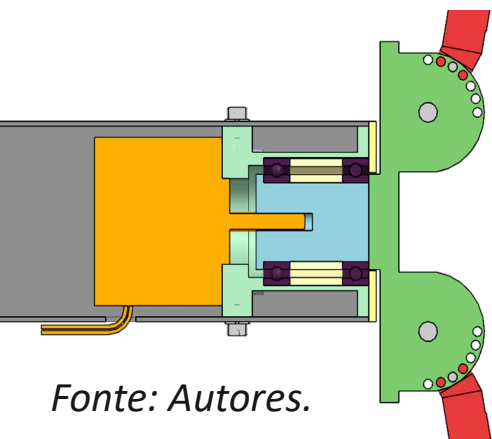
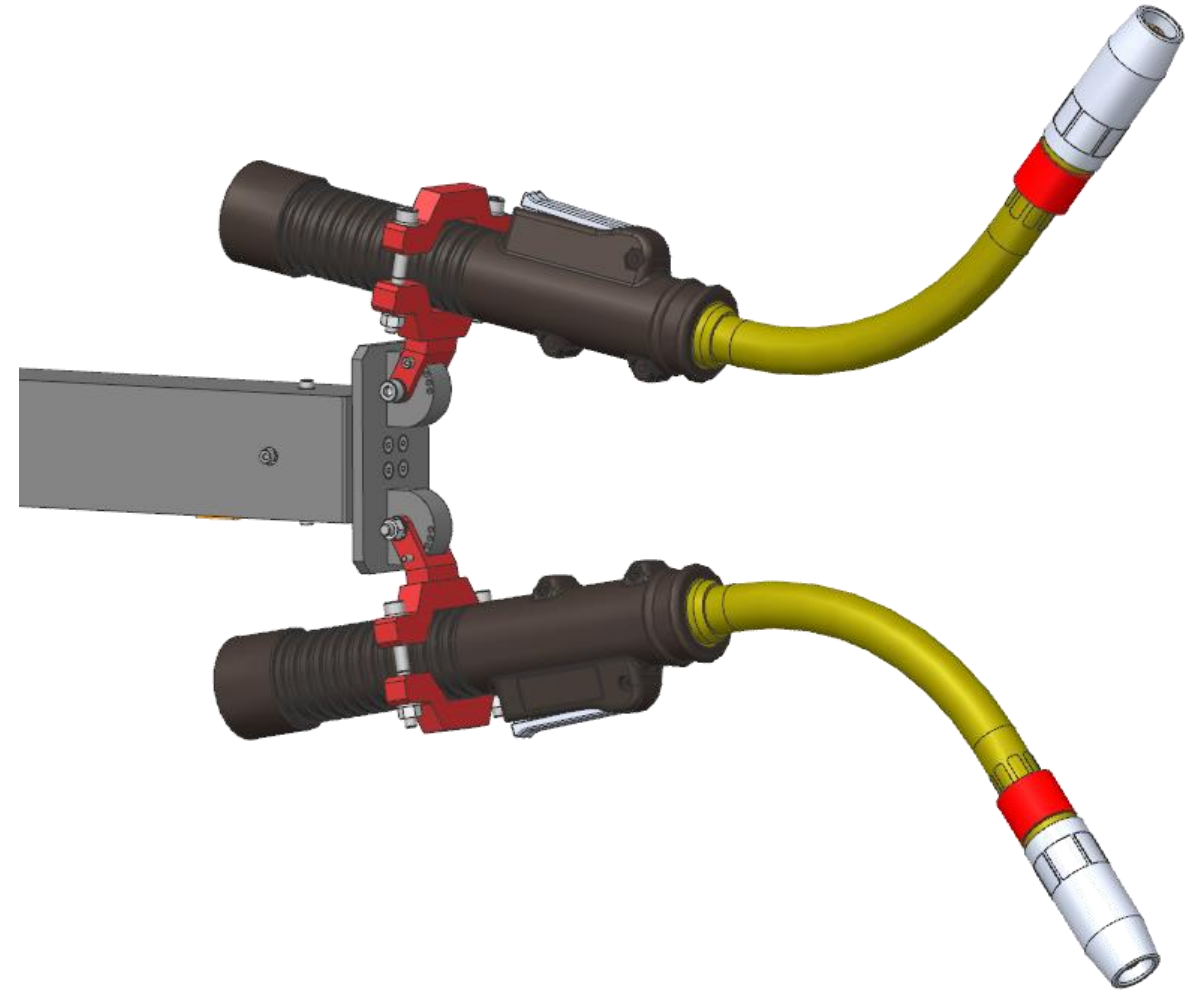
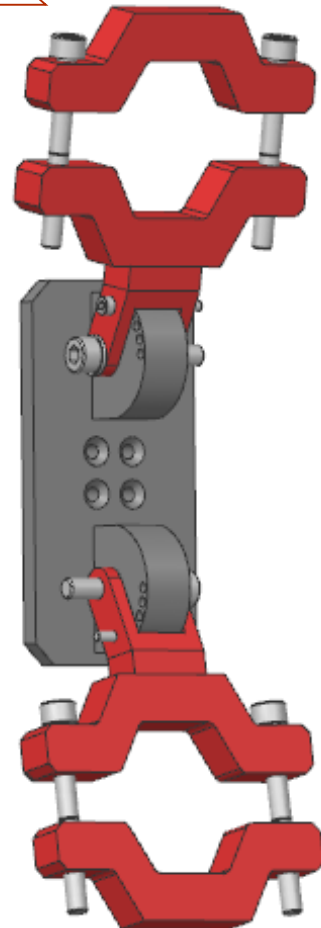
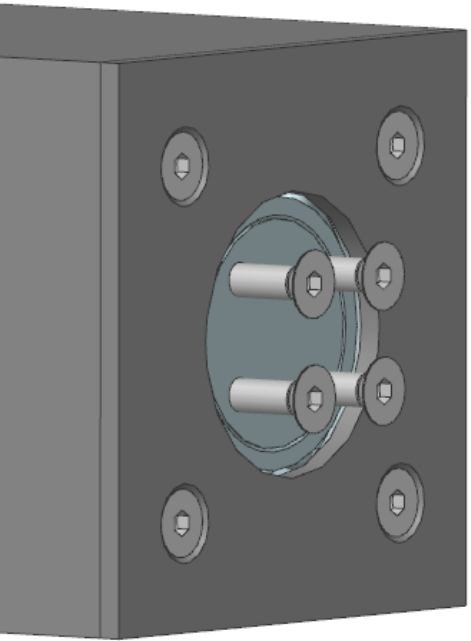




# GRIP DA TOCHA



AUTO  
SOLDAS



Fonte: Autores.

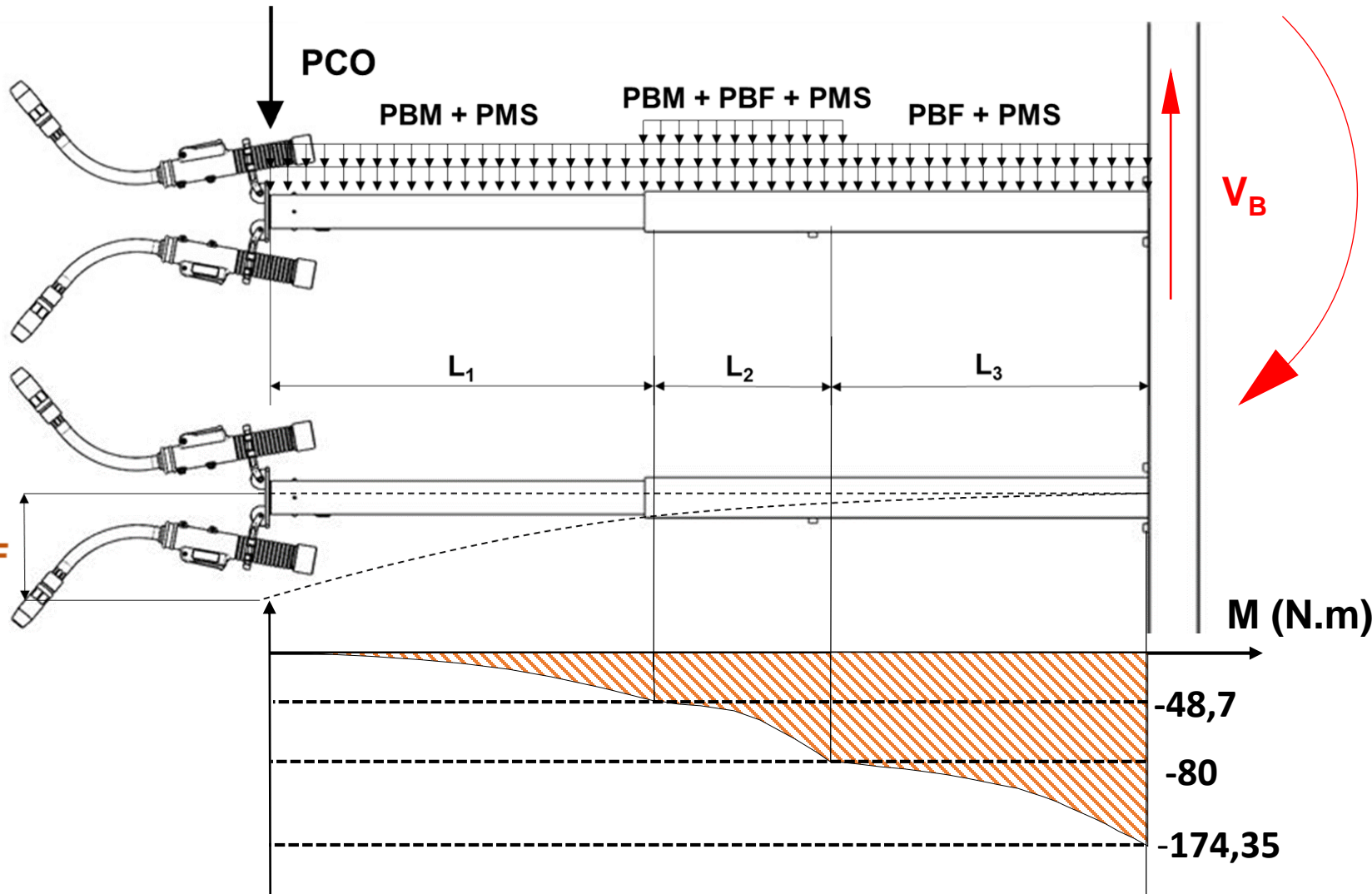




# CÁLCULOS - BRAÇO



AUTO  
SOLDAS



$$\left. \begin{aligned} \frac{dy}{dx} &= \theta(x) \\ \frac{d\theta}{dx} &= M(x) \\ \therefore \\ \frac{d^2y}{dx^2} &= M(x) \end{aligned} \right\} \text{Para cada trecho}$$

Com:

$PCO=78,48$  N;

$PBM=18,64$  N/m;

$PBF=19,32$  N/m;

$PMS=14,71$  N/m;

$L_1=0,555$ m;  $L_2=0,3$ m e  $L_3=0,75$ m:

$y_F = 4 \times 10^{-6}$  m

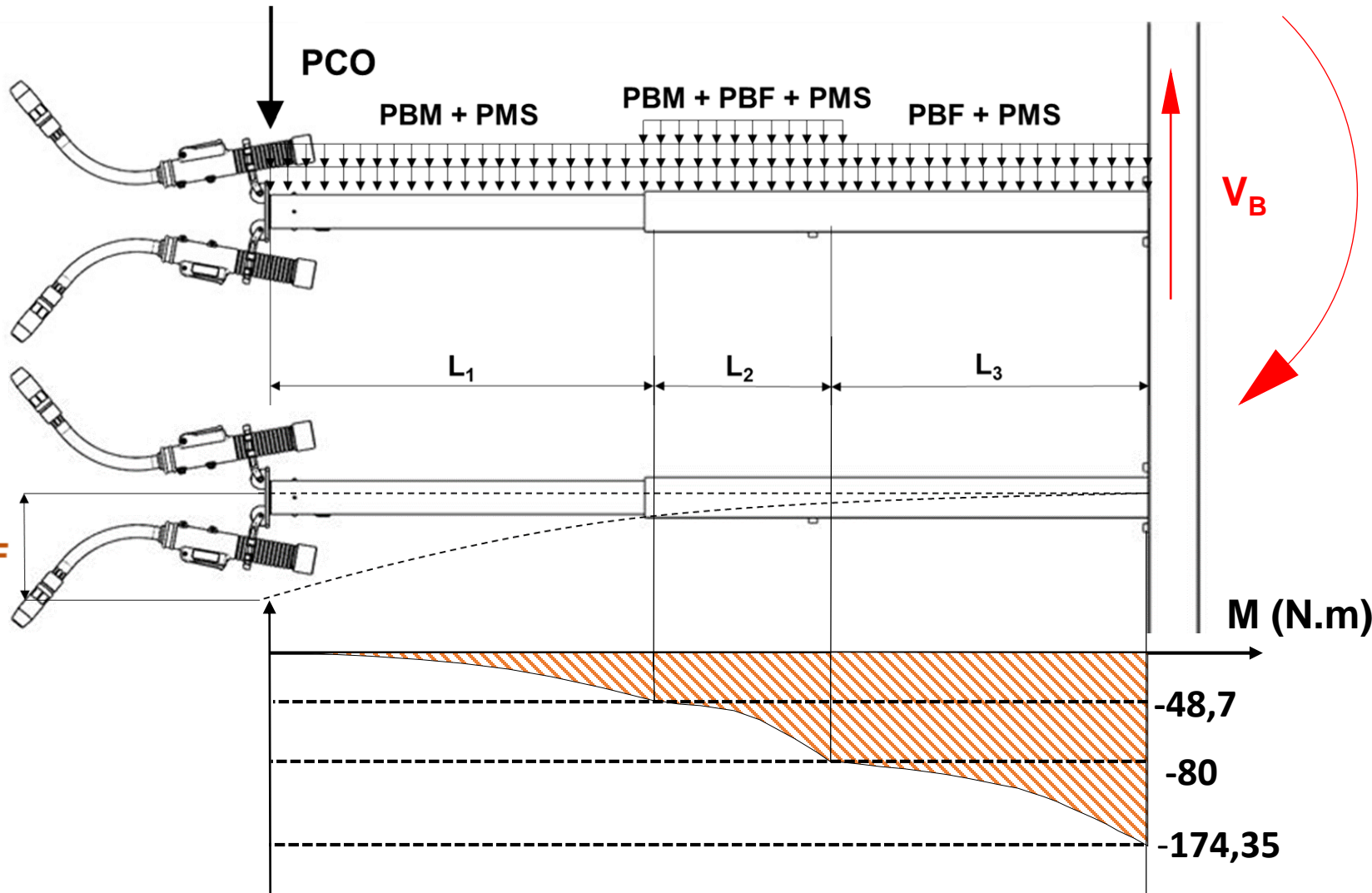




# CÁLCULOS - BRAÇO



AUTO  
SOLDAS



$$\frac{dy}{dx} = \theta(x)$$

$$\frac{d\theta}{dx} = M(x)$$

$$\therefore \frac{d^2y}{dx^2} = M(x)$$

Para cada trecho

Com:

$PCO=78,48$  N;

$PBM=18,64$  N/m;

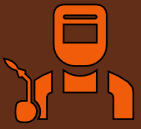
$PBF=19,32$  N/m;

$PMS=14,71$  N/m;

$L_1=0,555$ m;  $L_2=0,3$ m e  $L_3=0,75$ m:

$y_F = 4 \times 10^{-6}$  m

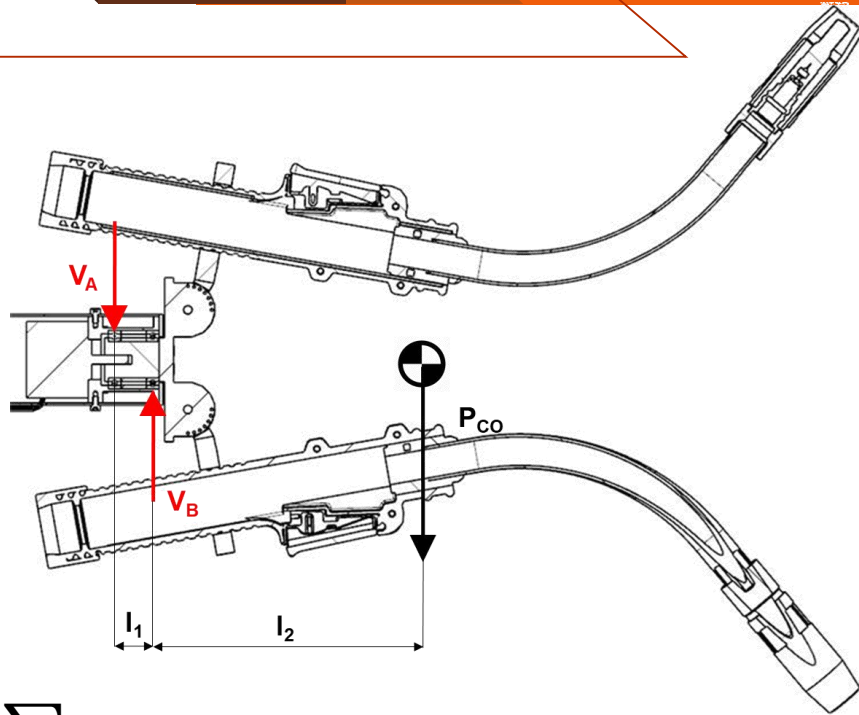




# CÁLCULOS – CONJ. OSCILATÓRIO



AUTO  
SOLDAS

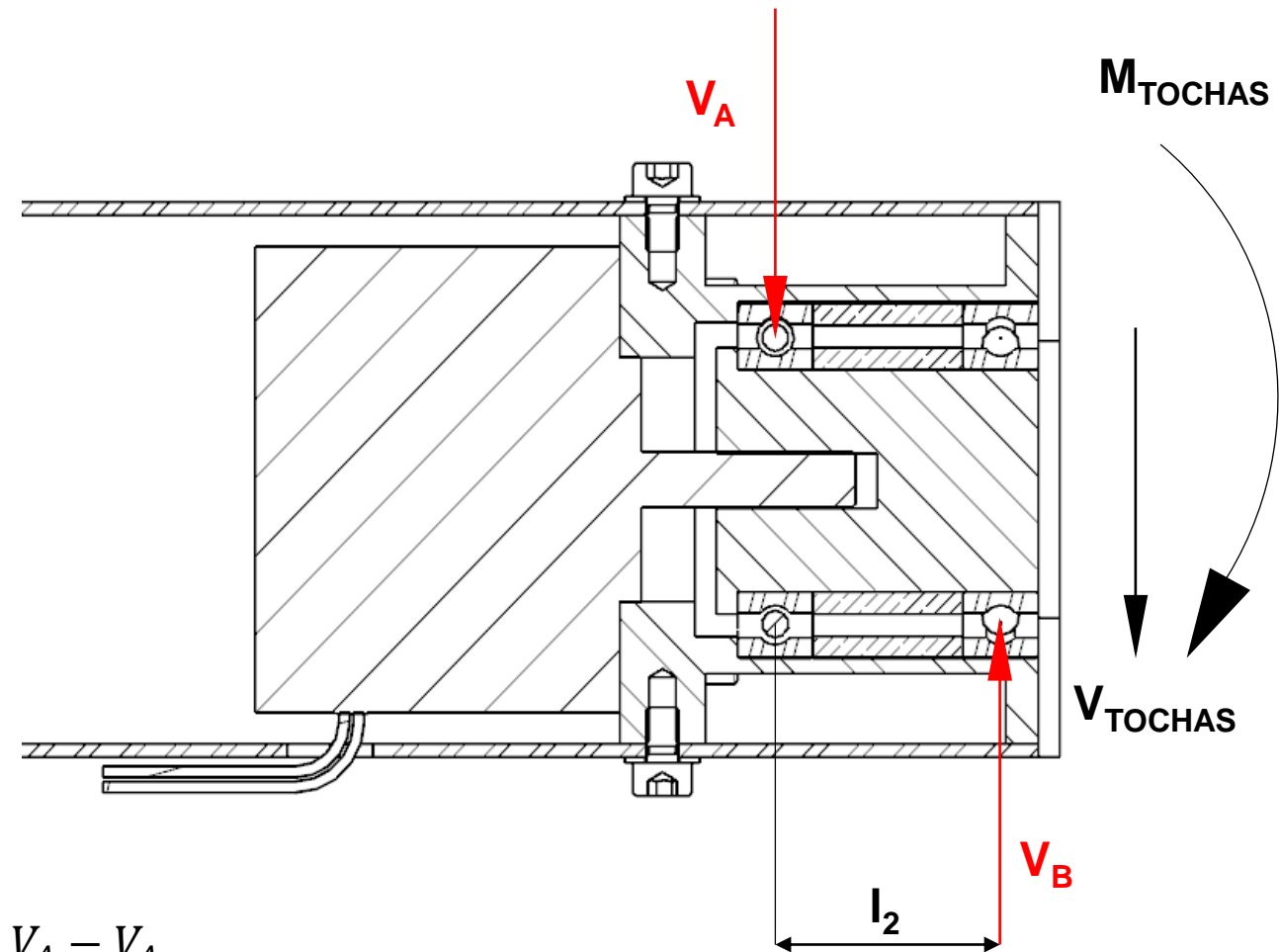


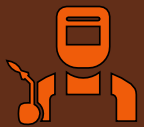
$$\sum V = 0; P_{CO} + V_A - V_B = 0$$

$$\sum M_A = 0; P_{CO}(L_1 + L_2) - V_B L_1 = 0$$

$$V_B L_2 = V_A (L_1 + L_2)$$

$$P_{CO} = \left(1 + \frac{L_1}{L_2}\right) V_A - V_A$$

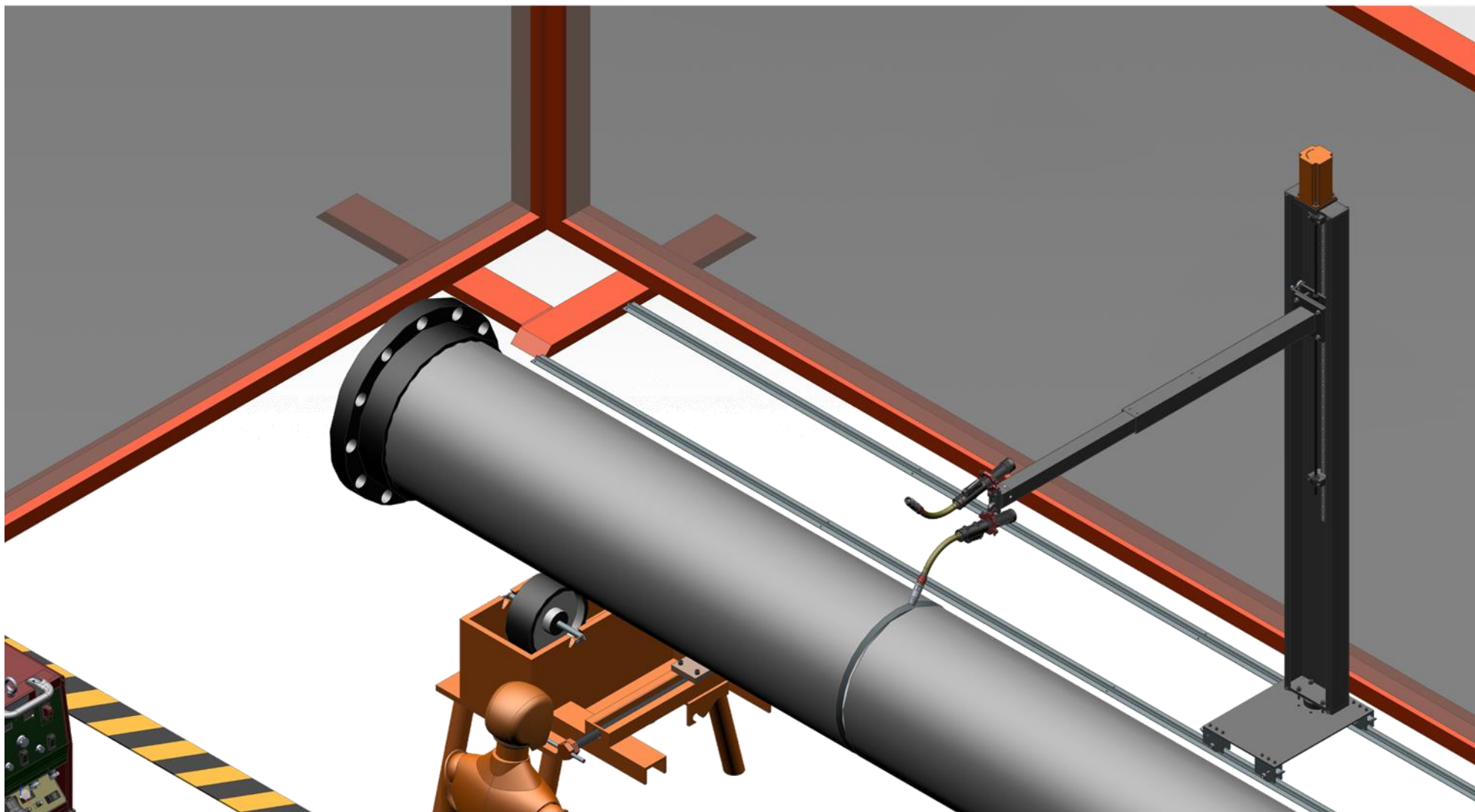




# RETRAÇÃO DO BRAÇO

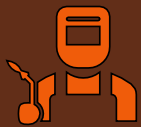


AUTO  
SOLDAS



Fonte: Autores.

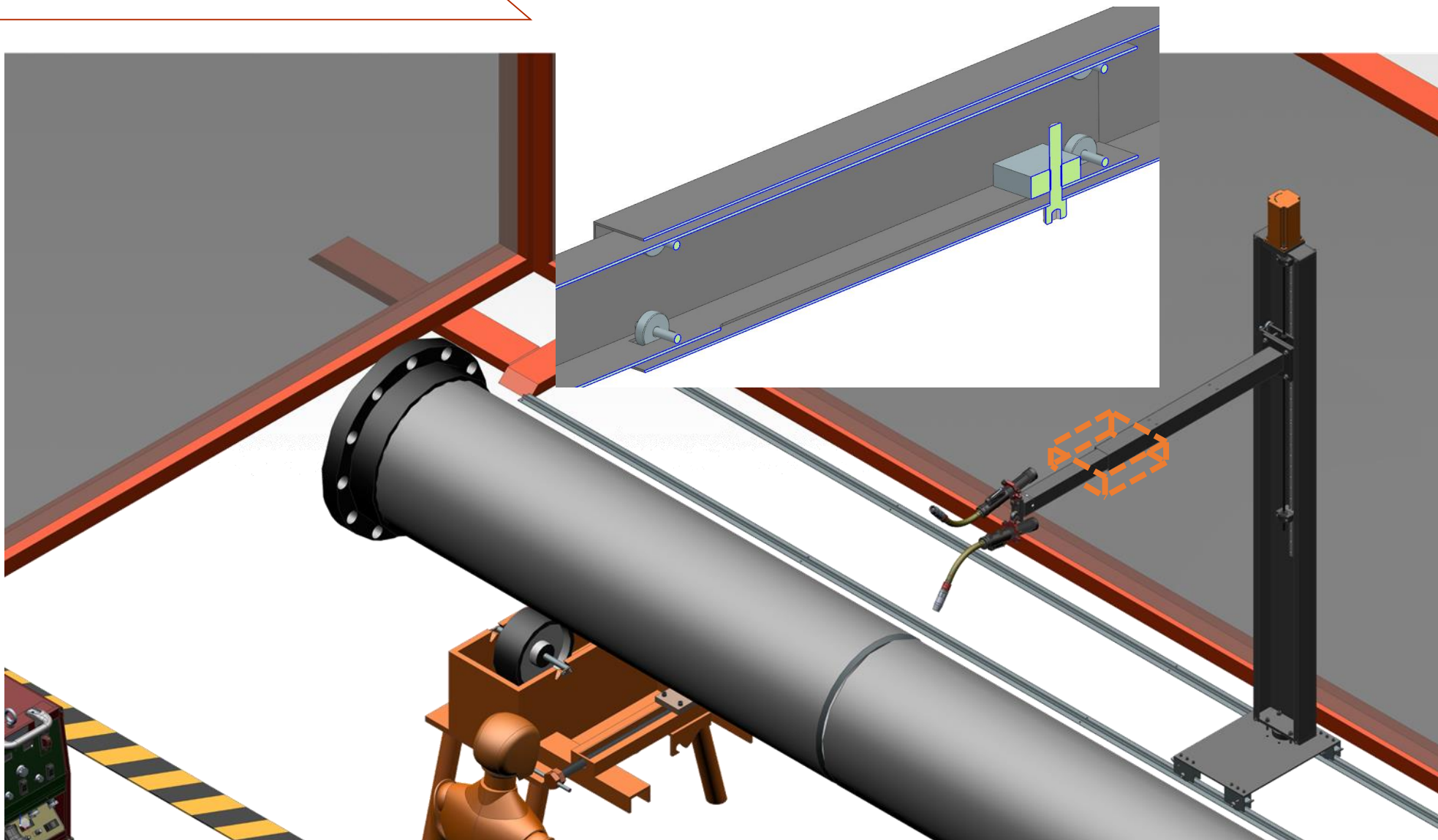




# RETRAÇÃO DO BRAÇO



AUTO  
SOLDAS

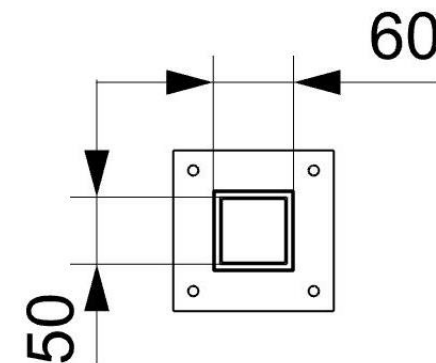


## Braço Móvel:

- Tubo quadrado 50 x 50 x 1,5 mm
- Aço ao Carbono

## Braço Fixo:

- Tubo quadrado 60 x 60 x 1,06 mm
- Aço ao Carbono



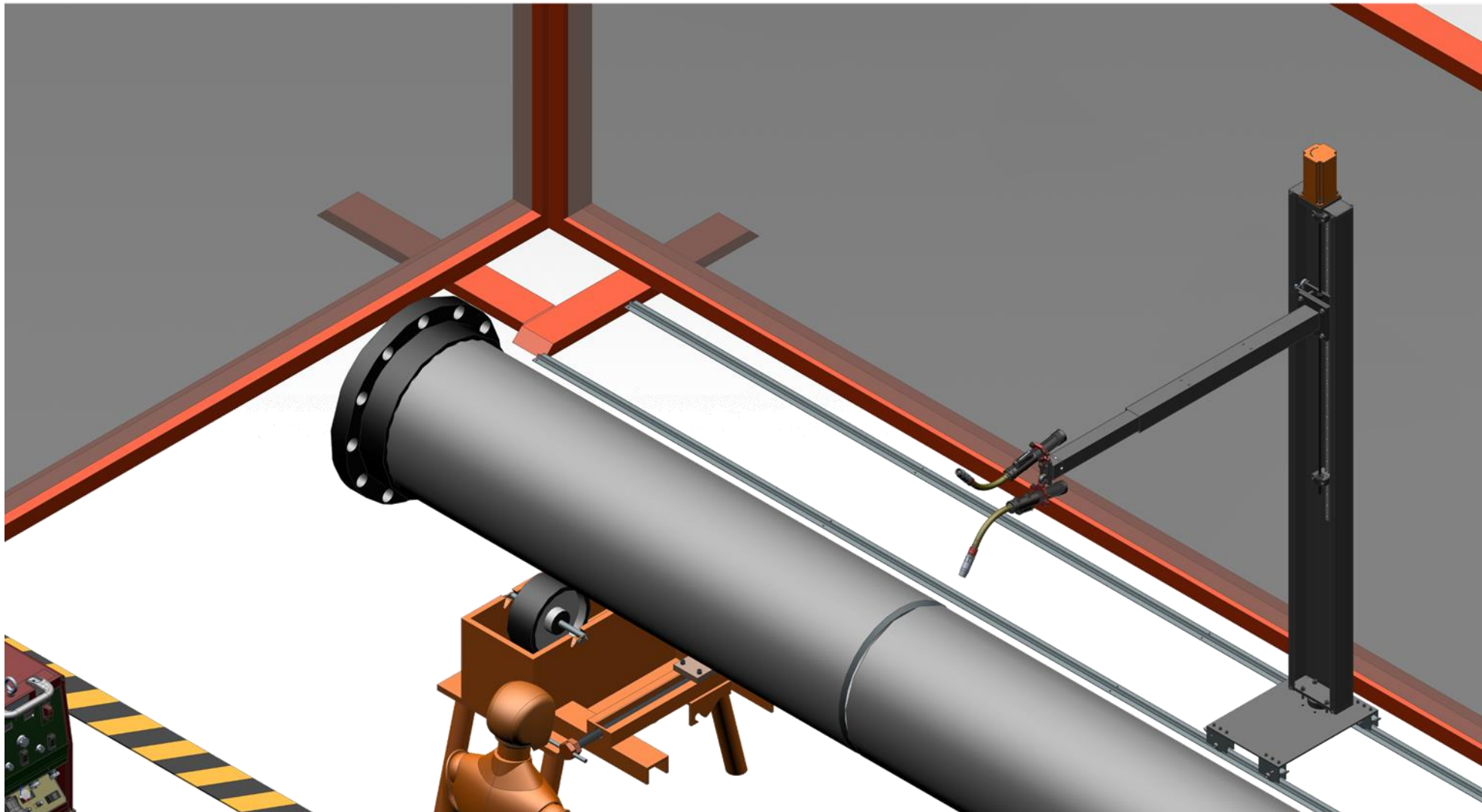




# TRANSLAÇÃO DA MÁQUINA

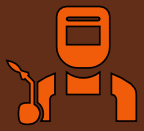


AUTO  
SOLDAS



Fonte: Autores.

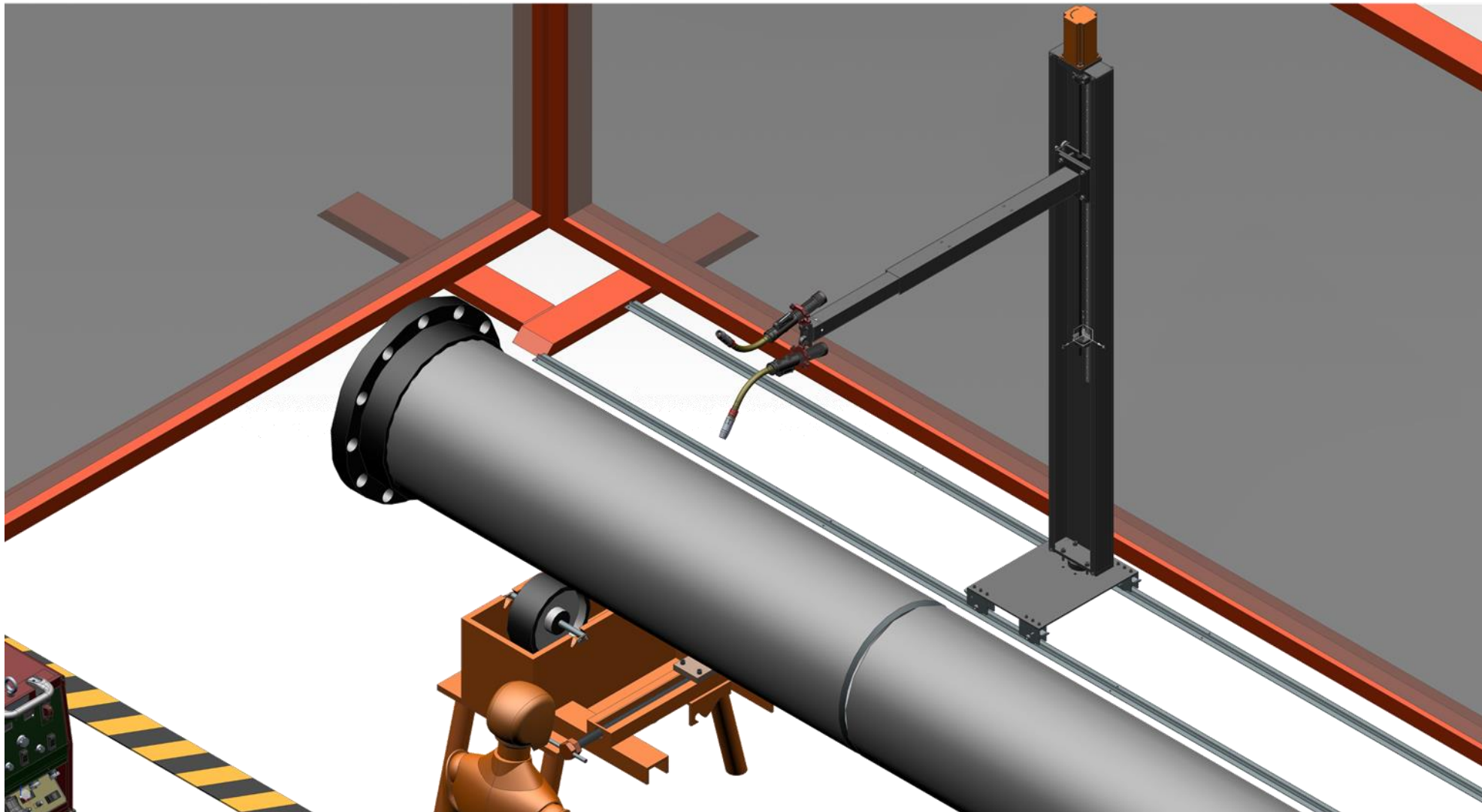




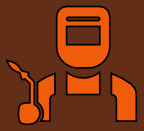
# TRANSLAÇÃO DA MÁQUINA



AUTO  
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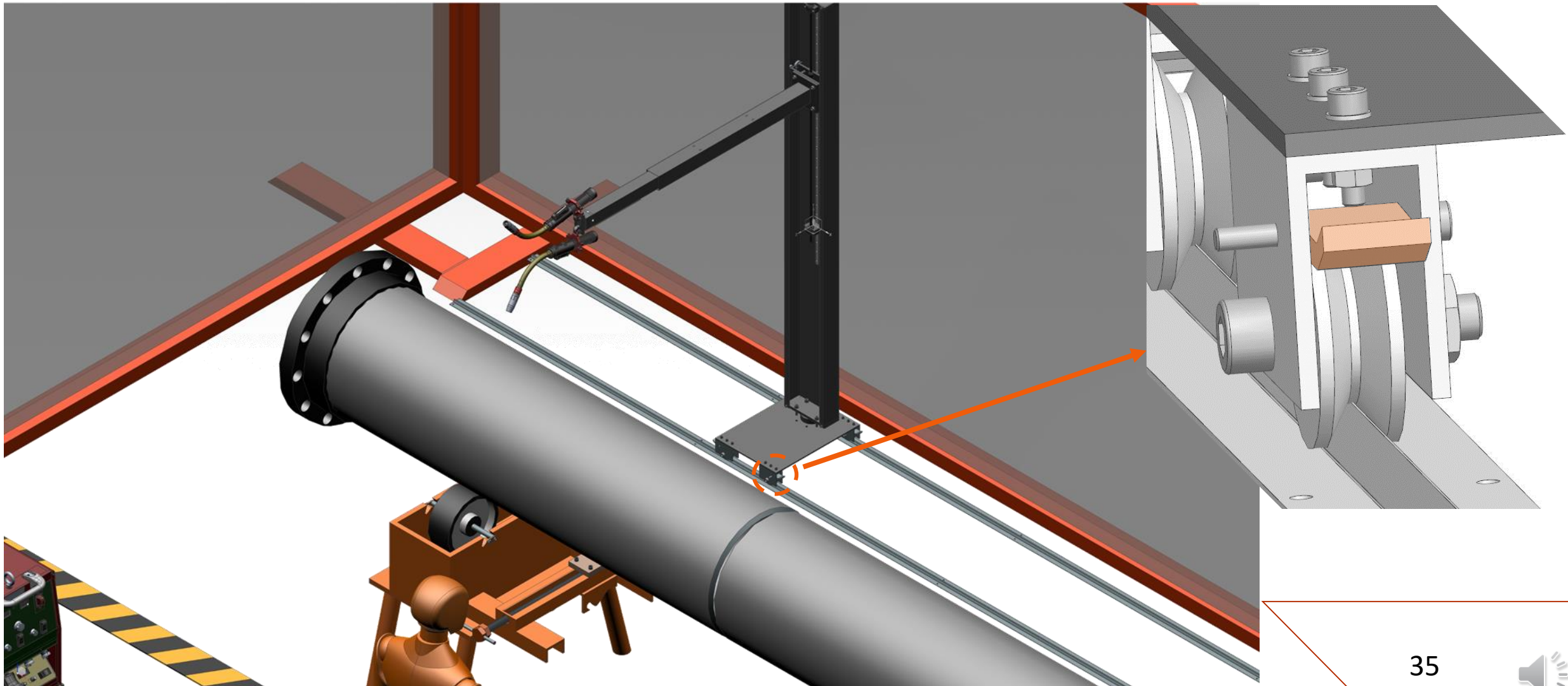
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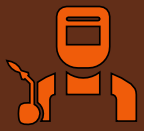


# TRANSLAÇÃO DA MÁQUINA



AUTO  
SOLDAS

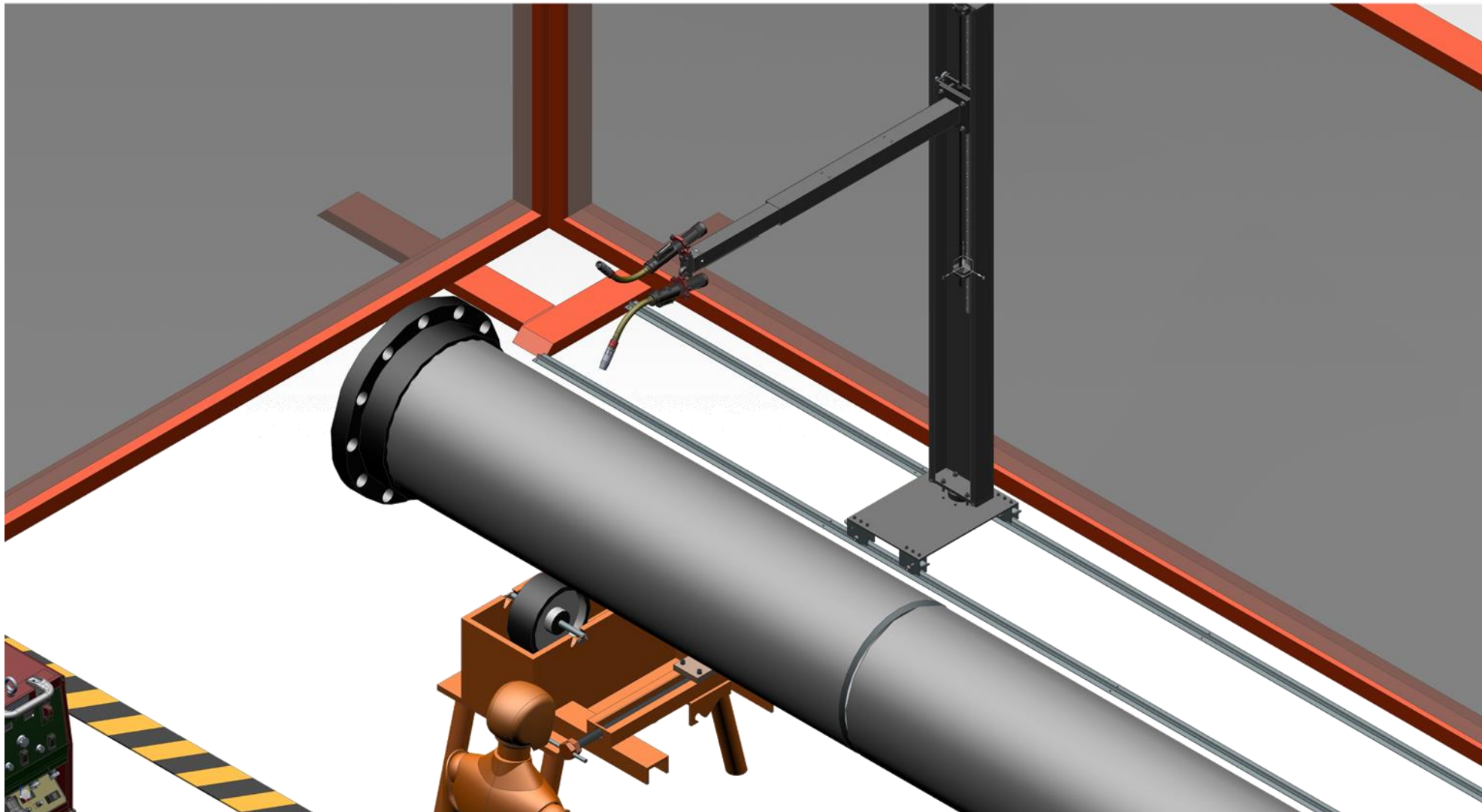




# TRANSLAÇÃO DA MÁQUINA



AUTO  
SOLDAS



Fonte: Autores.



# CÁLCULOS - TRILHO



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$$\sum M_A = 0; F_P L_A - R_B (L_A + L_B) = 0$$

$$\sum V = 0; R_A + R_B = F_P e$$

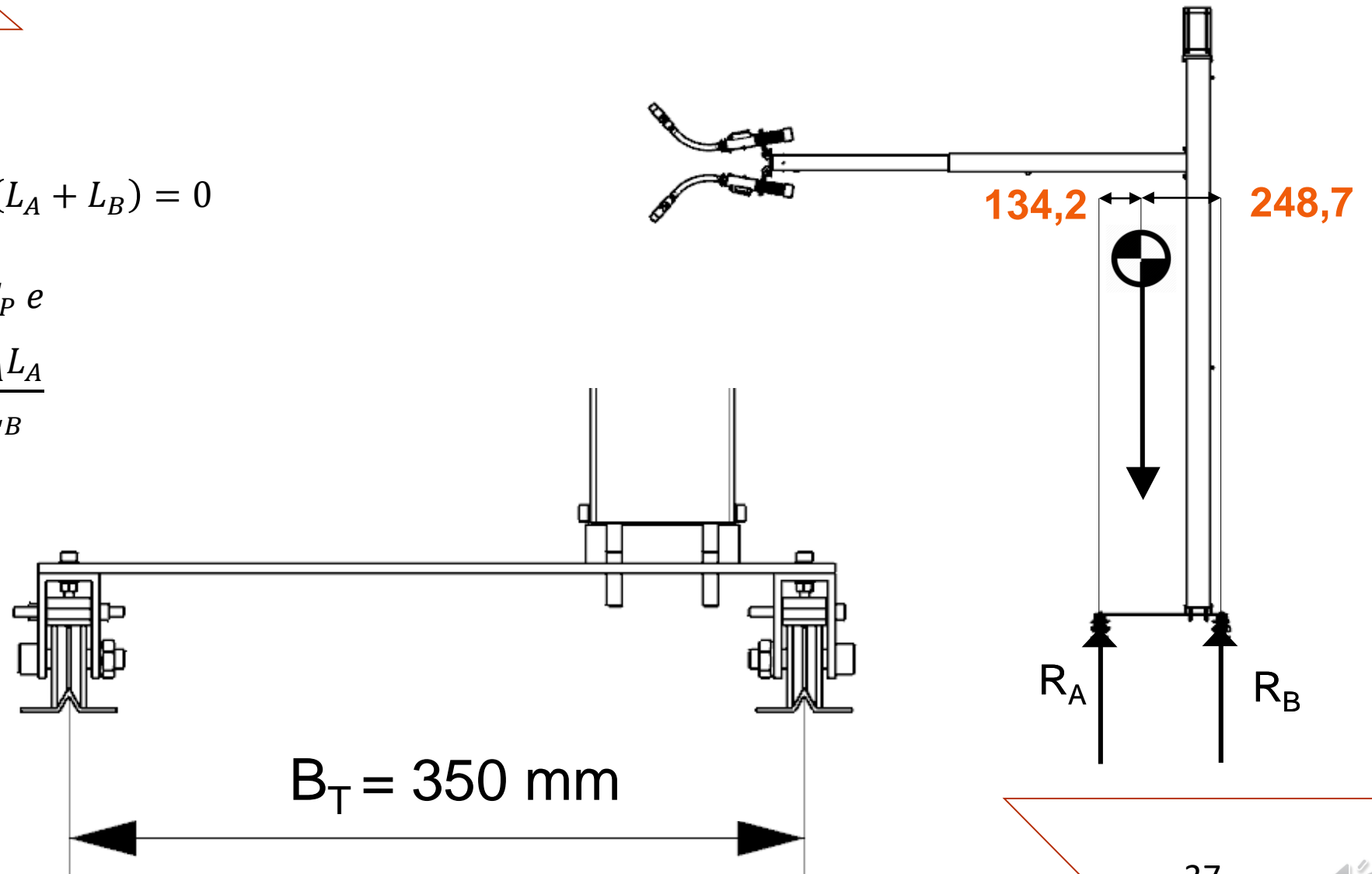
$$R_B L_B = R_A L_A; R_B = \frac{R_A L_A}{L_B}$$

$$R_A = F_P - \frac{R_A L_A}{L_B}$$

$$R_A = \frac{F_P}{1 + \frac{L_A}{L_B}}$$

$$B_T > 248,7 \text{ mm}$$

$$B_T = 350 \text{ mm}$$

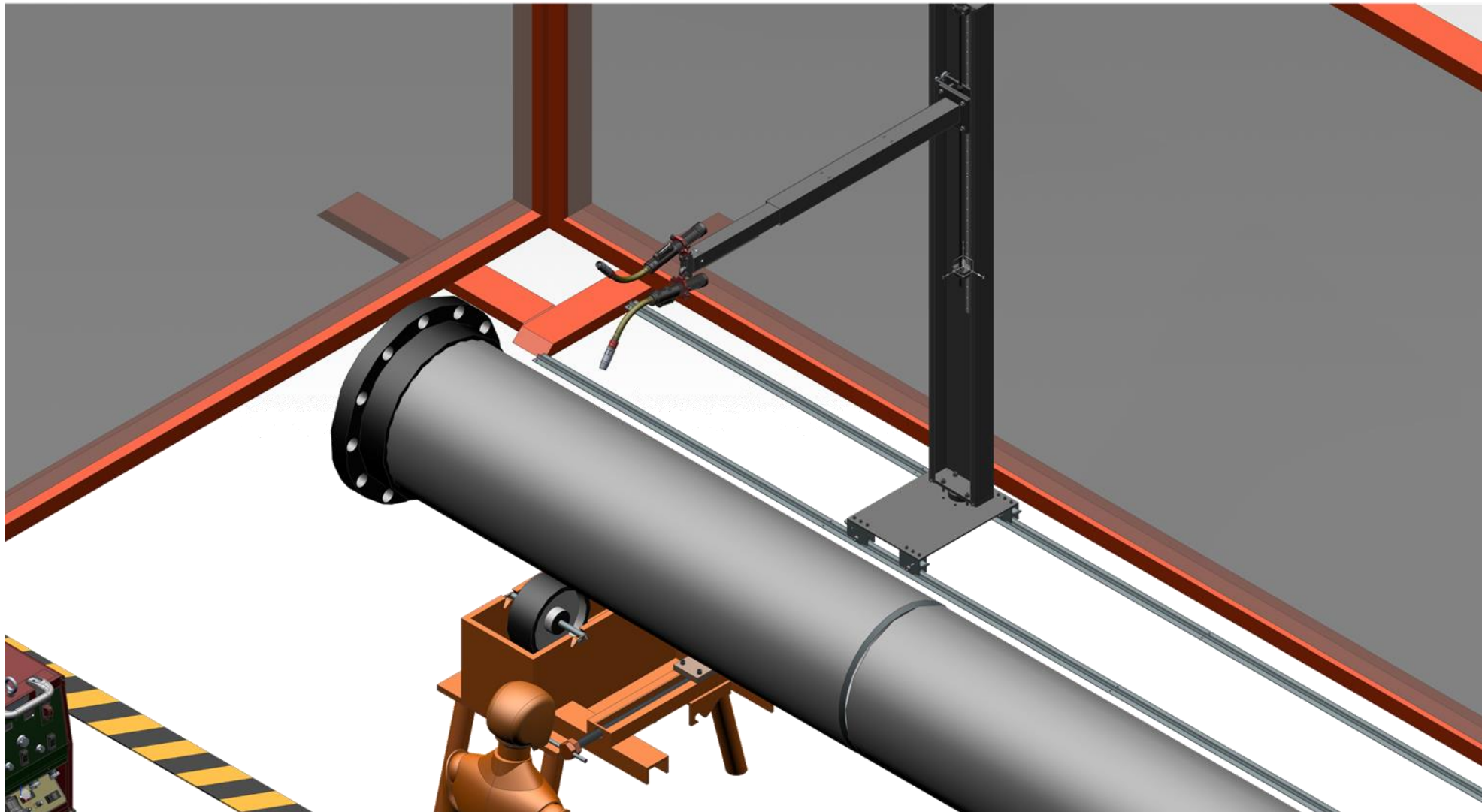




# ROTAÇÃO DA COLUNA



AUTO  
SOLDAS



Fonte: Autores.

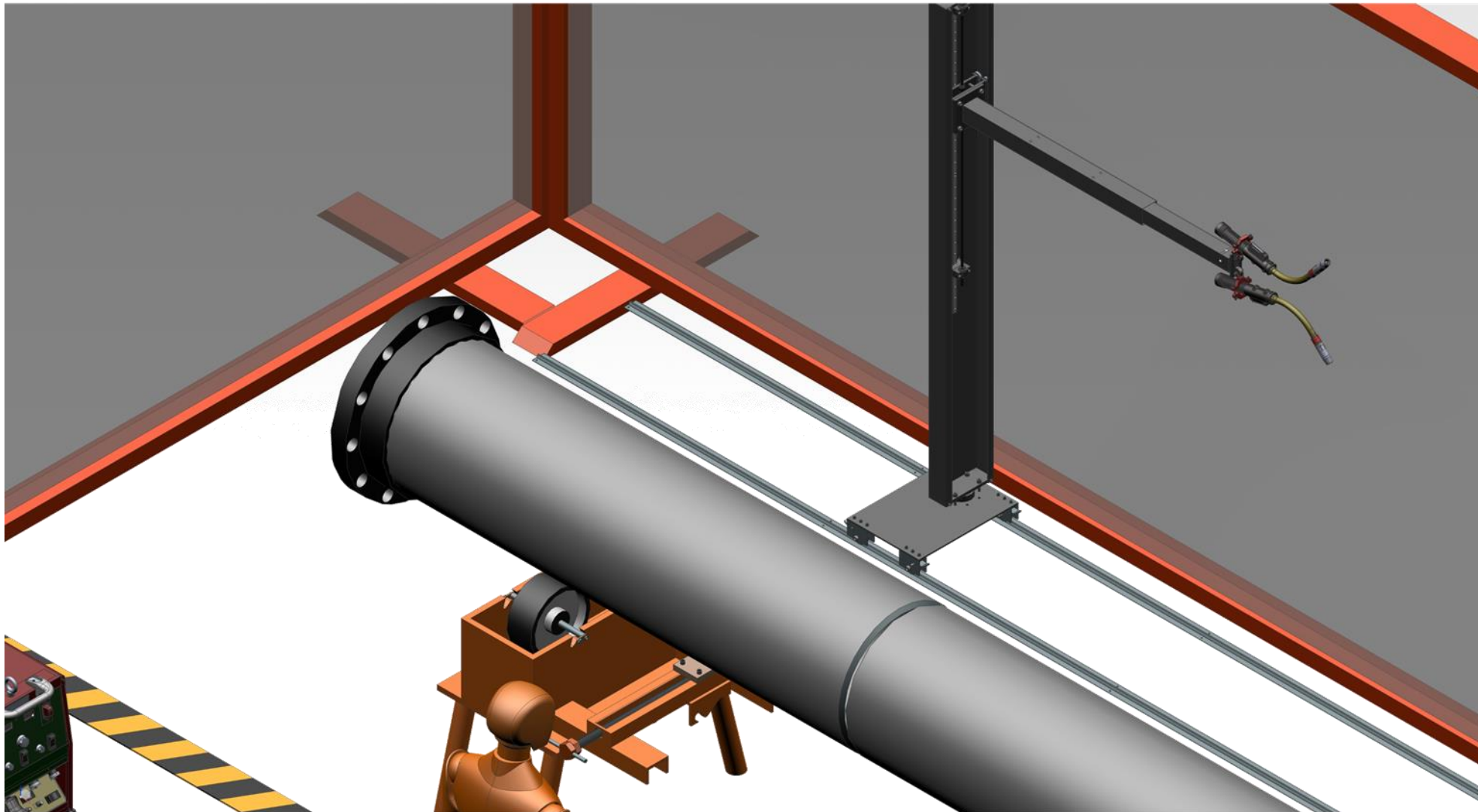




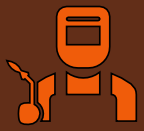
# ROTAÇÃO DA COLUNA



AUTO  
SOLDAS



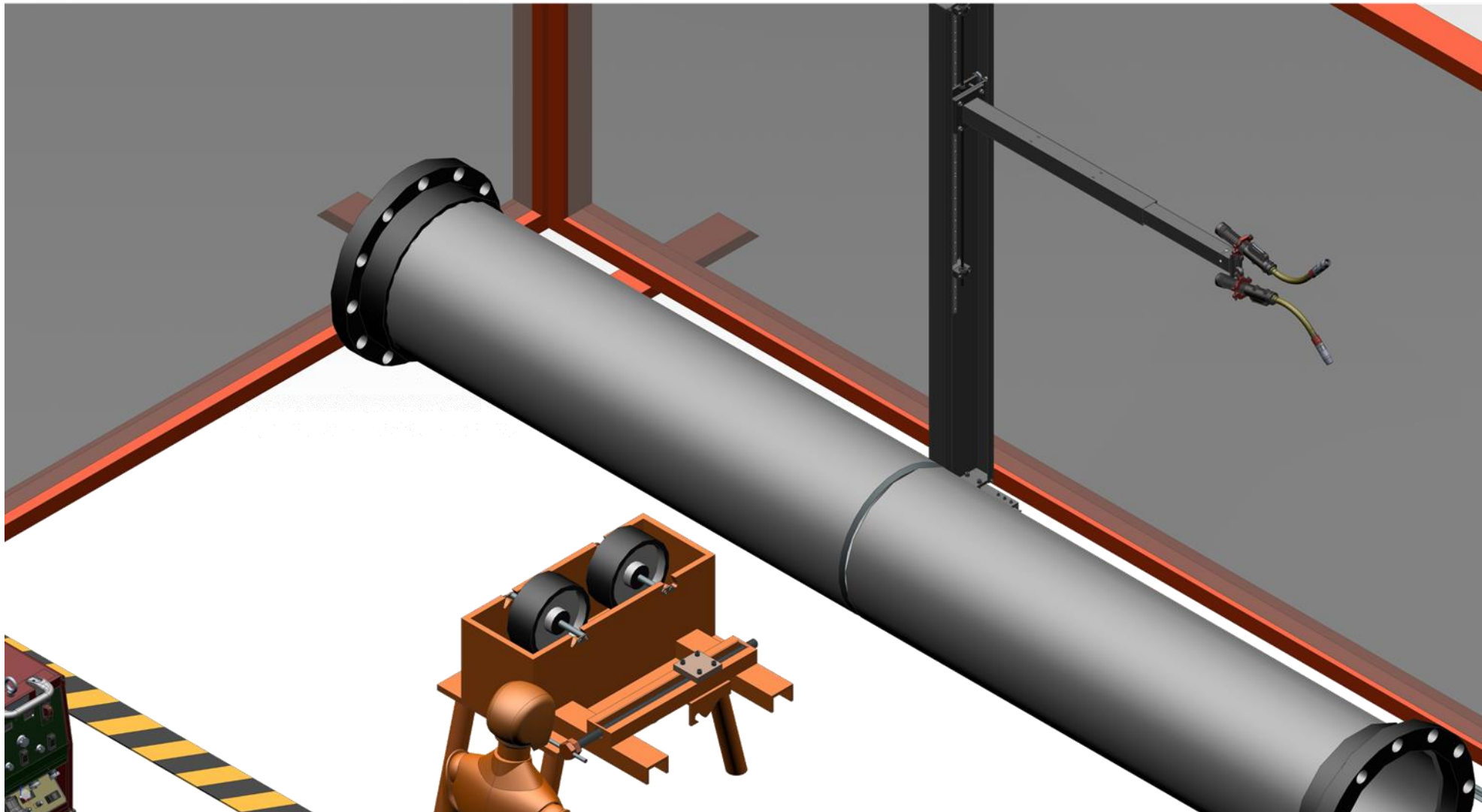
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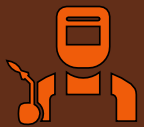
# ROTAÇÃO DA COLUNA



AUTO  
SOLDAS



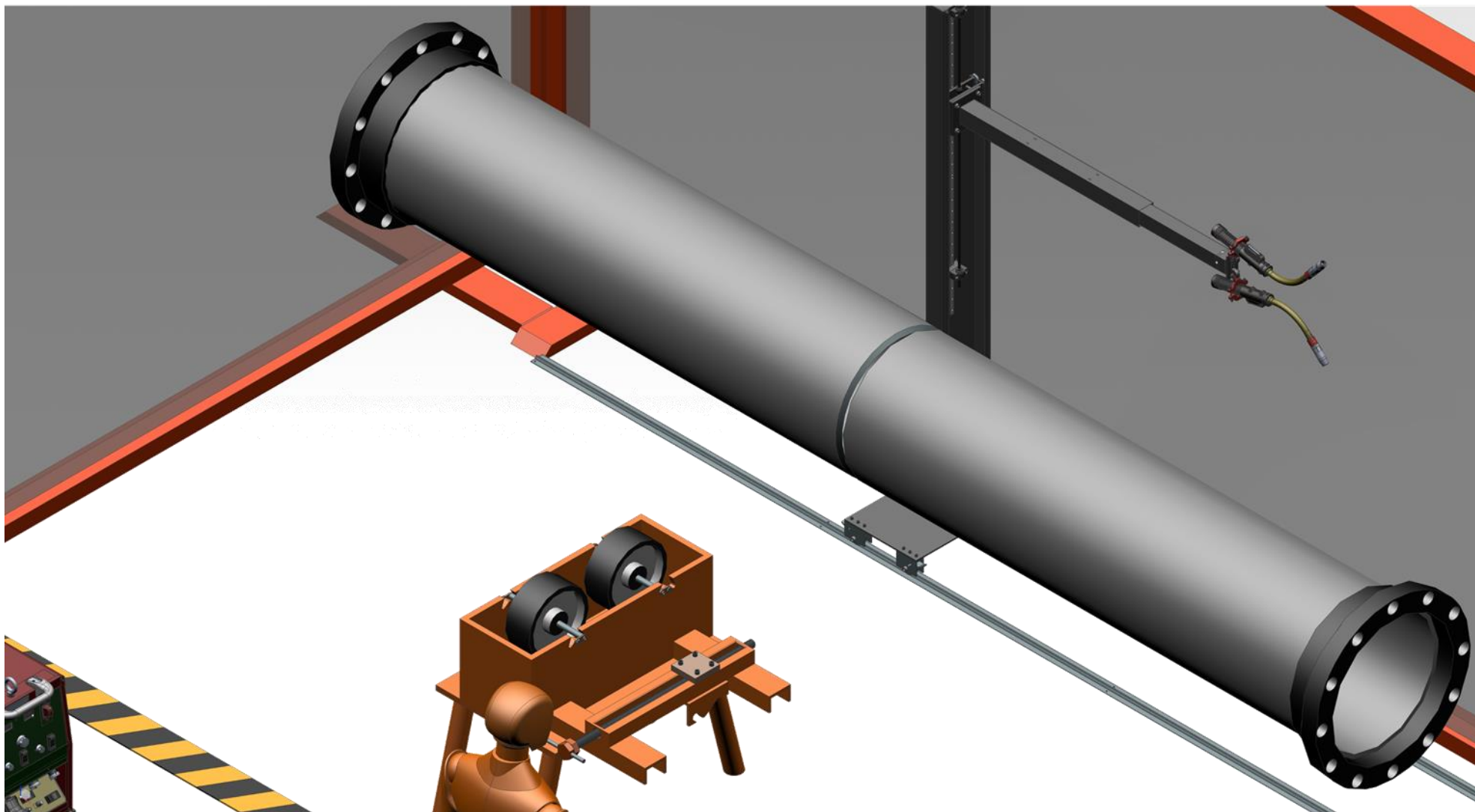




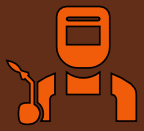
# ROTAÇÃO DA COLUNA



AUTO  
SOLDAS



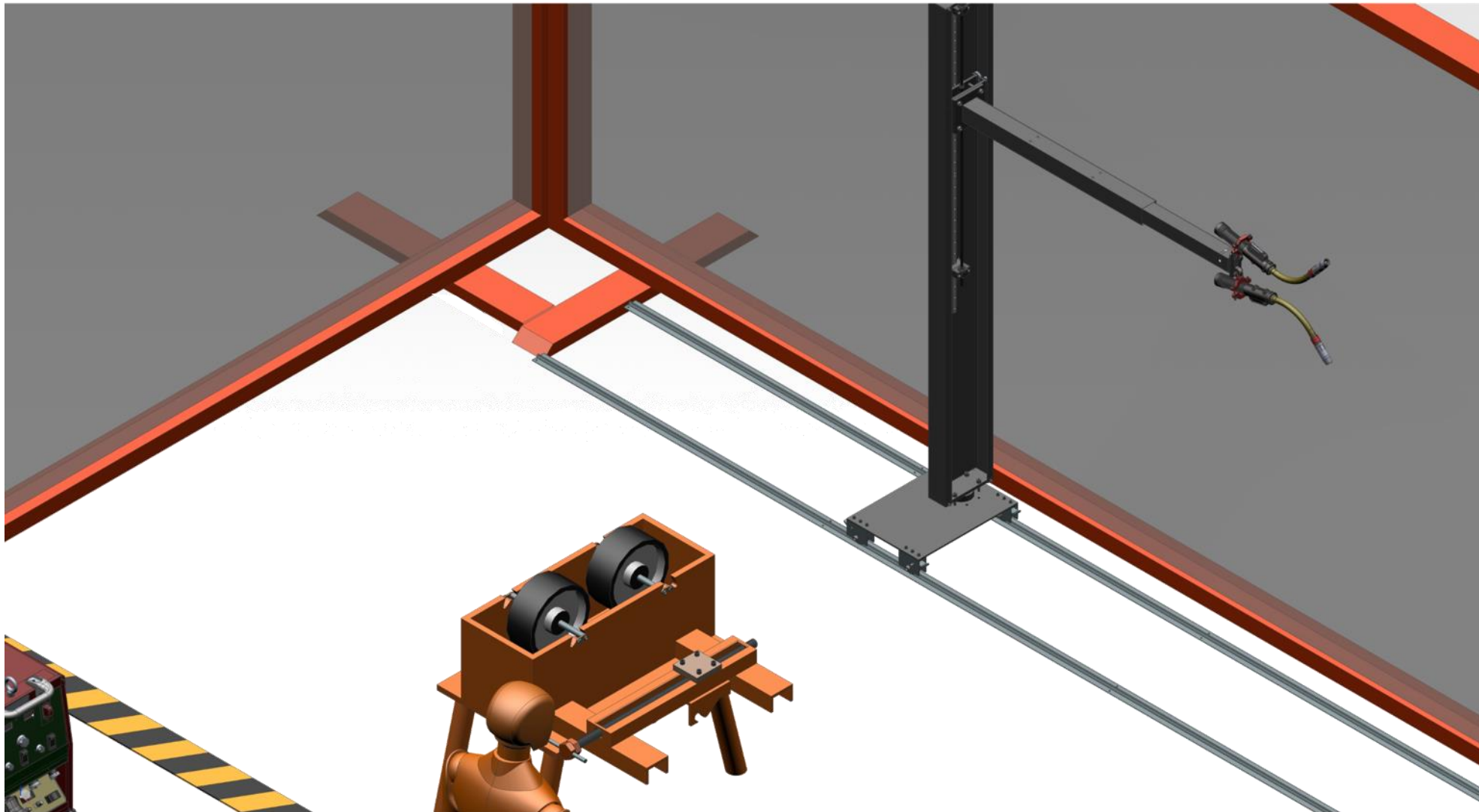
Fonte: Autores.



# ROTAÇÃO DA COLUNA

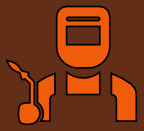


AUTO  
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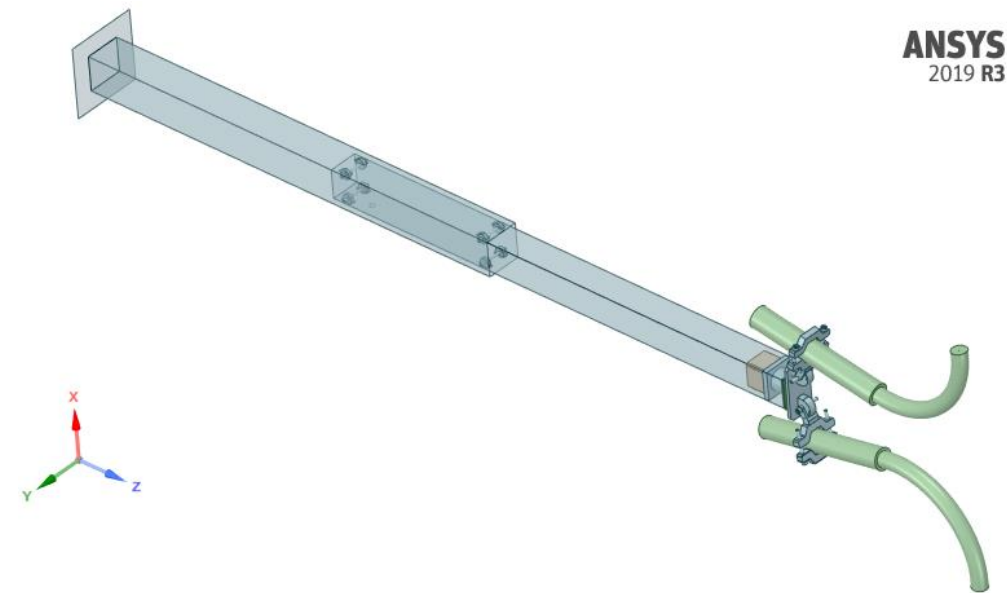


Fonte: Autores.





## Simplificação da Estrutura e Geração da Malha de Elementos Finitos





# PRÓXIMOS PASSOS



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- Aprofundamento das **simulações computacionais** estáticas, dinâmicas, modais e harmônicas
- Determinação da **alimentação e programação** dos motores de passo
- Estudos de viabilidade **econômica**

ANSYS<sup>®</sup>

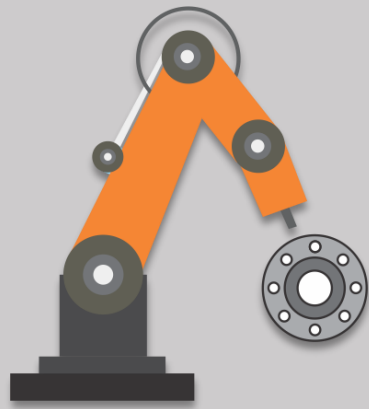
Altair Inspire<sup>™</sup>

A | Adams<sup>™</sup>



Bang good  
COM





# AUTO SOLDAS

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**Lucas de A. Gabriel**

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**Marcos D. Costa**

**Sthefany Leopoldo**

**Tiago de G. A. Cordeiro**

**Victor Sangaletti Roque**

**MSc. Taylor Mac Intyer Fonseca Jr.**

**Dr. Maurício de Carvalho Silva**

