

# Robot Structural Analysis API Add-Ins as Benefits for Structural Design Modeling

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# Robot Structural Analysis API

Custom-tailored software has never been easier to achieve in Robot Structural Analysis software.

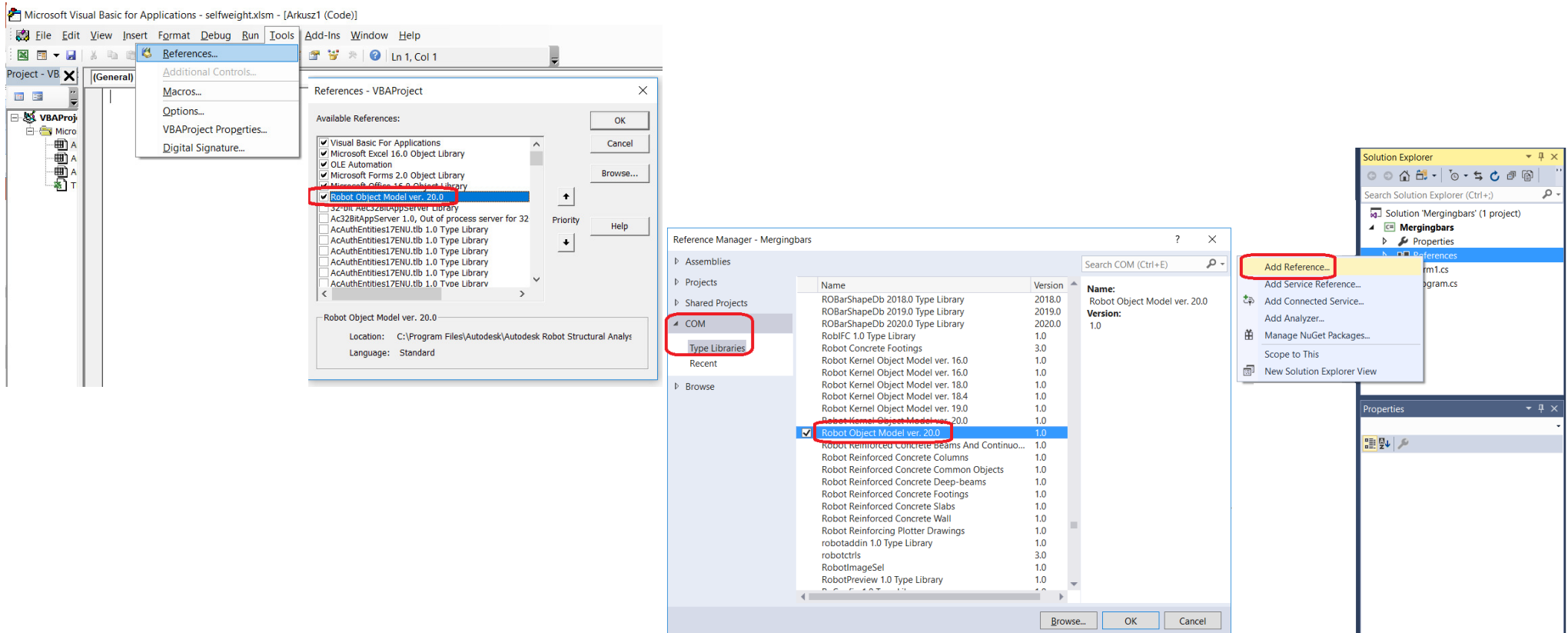
If you're writing, or willing to write, add-ins for Robot Structural Analysis to expand its capabilities, this is the perfect place to get to know the subject.

# API References

## Before starting

To get connected to Robot Structural Analysis API, reference to **Robot Object Modeler** must be set in programming environment.

# API References



# Macro in Excel

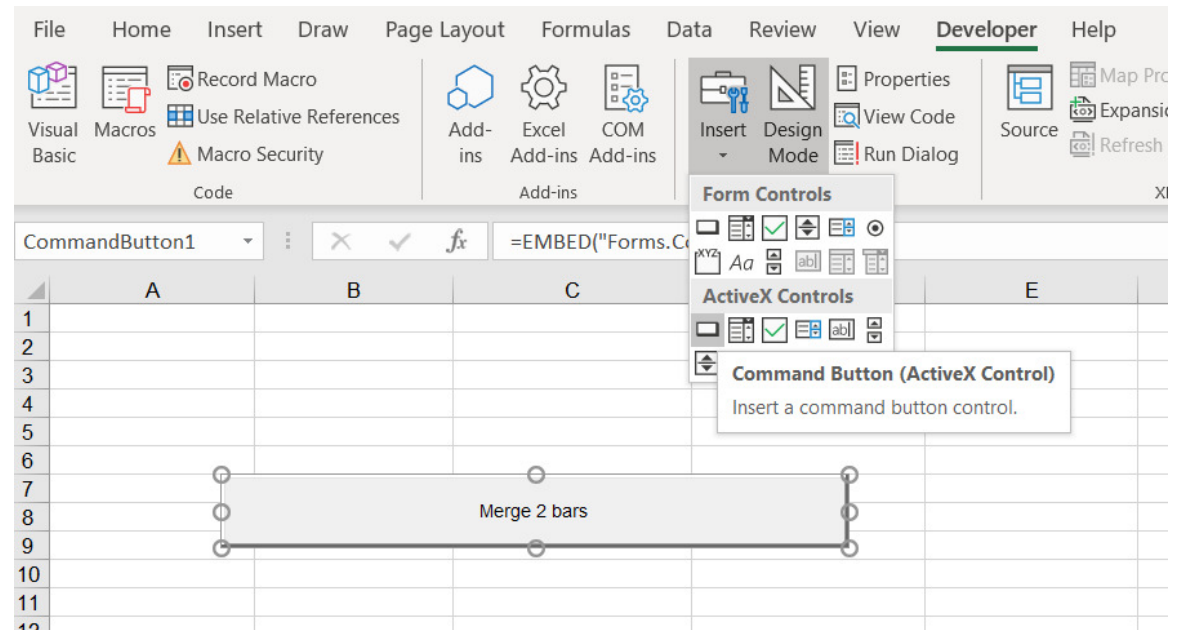


# Macro in Excel – Merging 2 Bars

## Add button to Sheet

On Developer tab

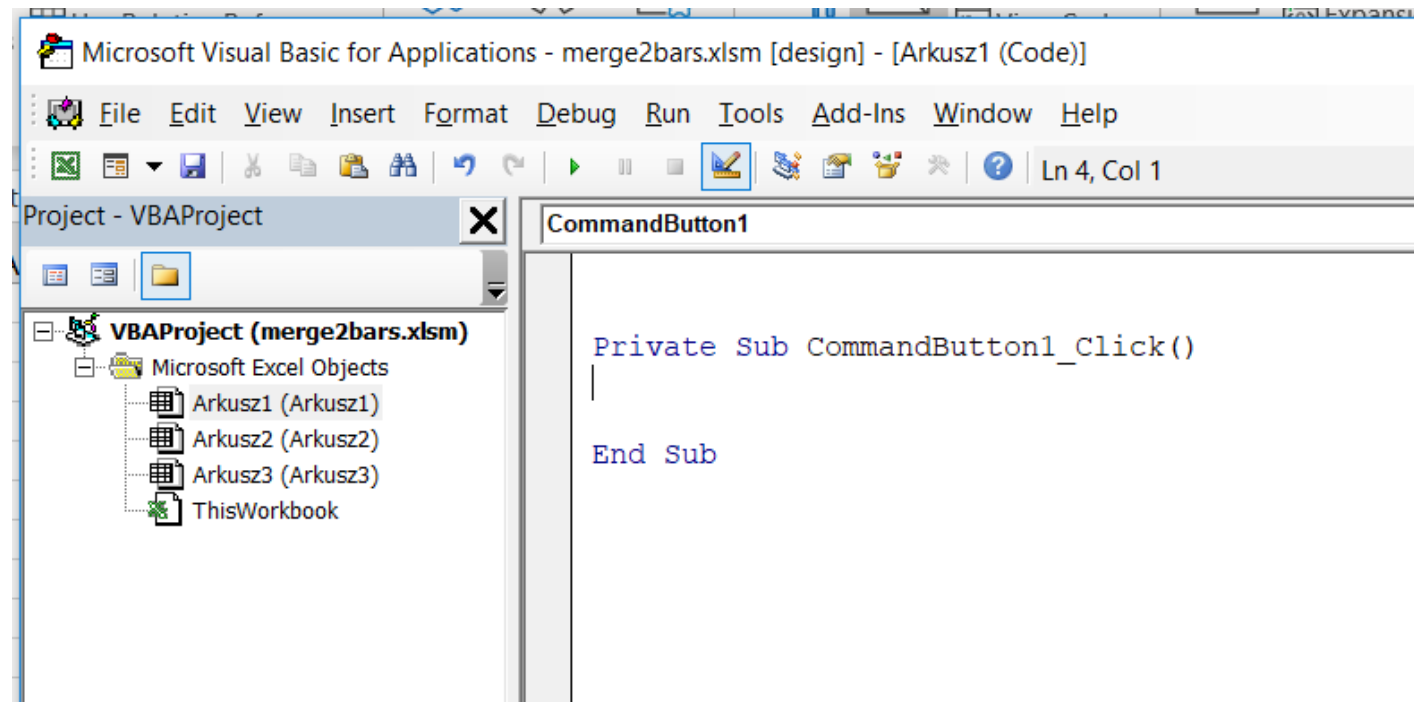
- Activate Design Mode
- Use Insert menu to add Command Button



Then make double click on it

# Macro in Excel – Merging 2 Bars

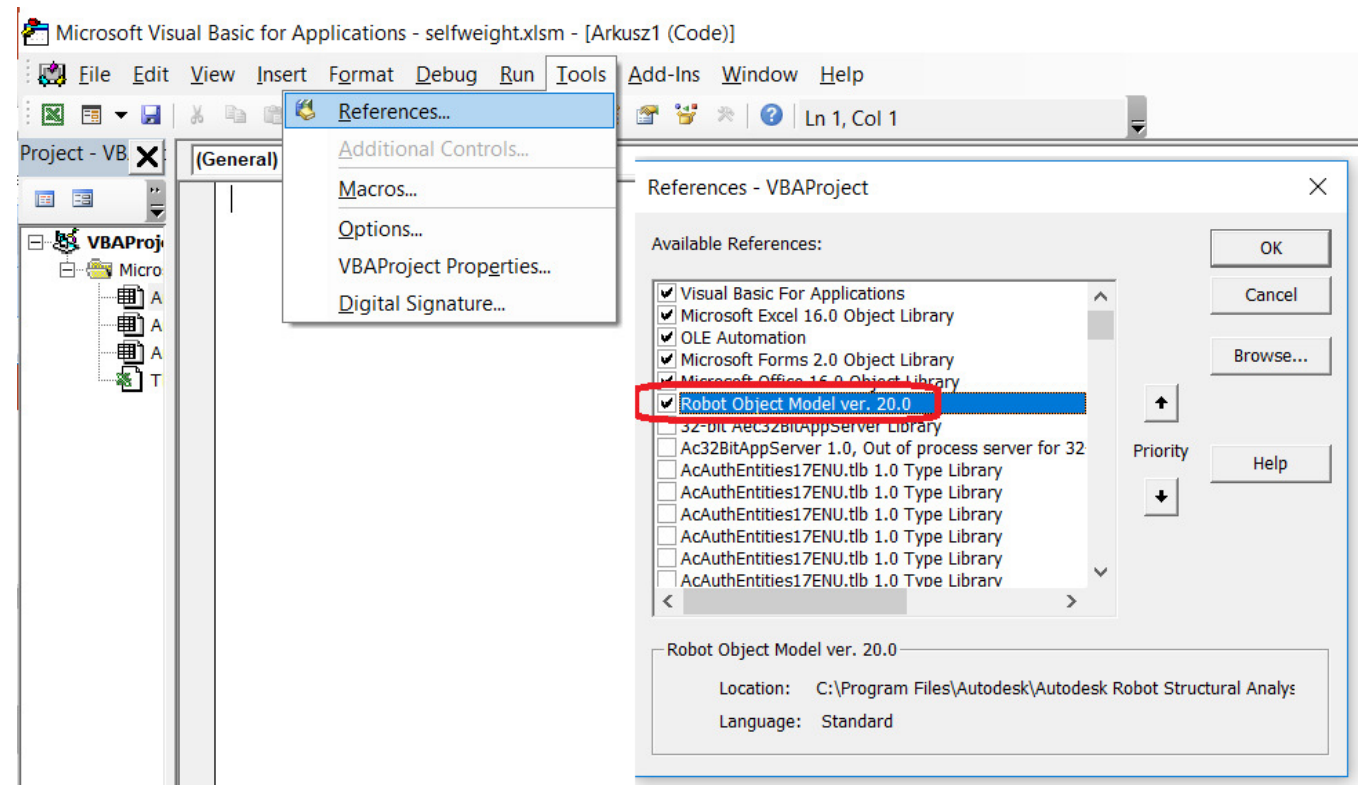
## VBA Editor



Note: VBA Editor can be accessed also by pressing ALT+F11

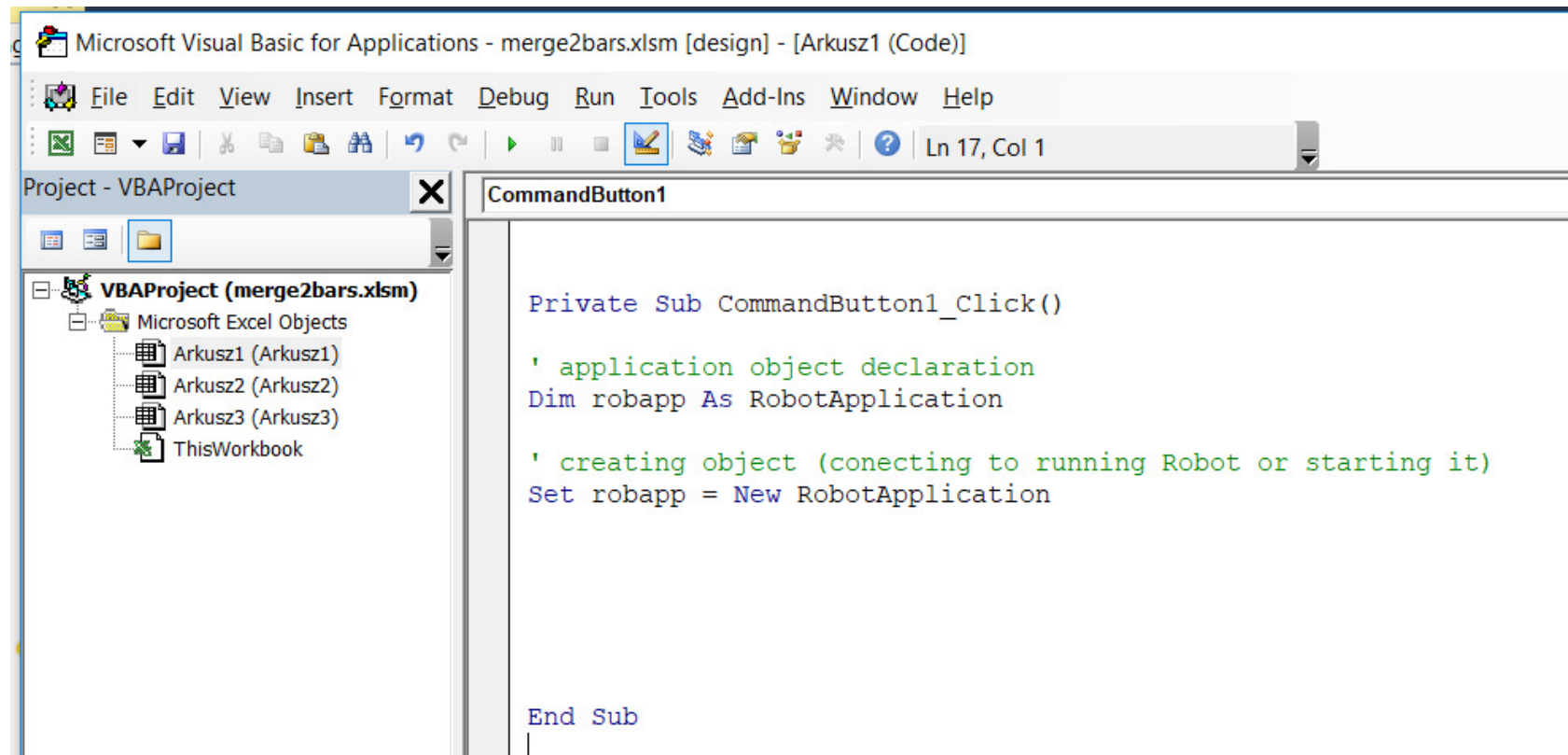
# Macro in Excel – Merging 2 Bars

## Setting up Reference

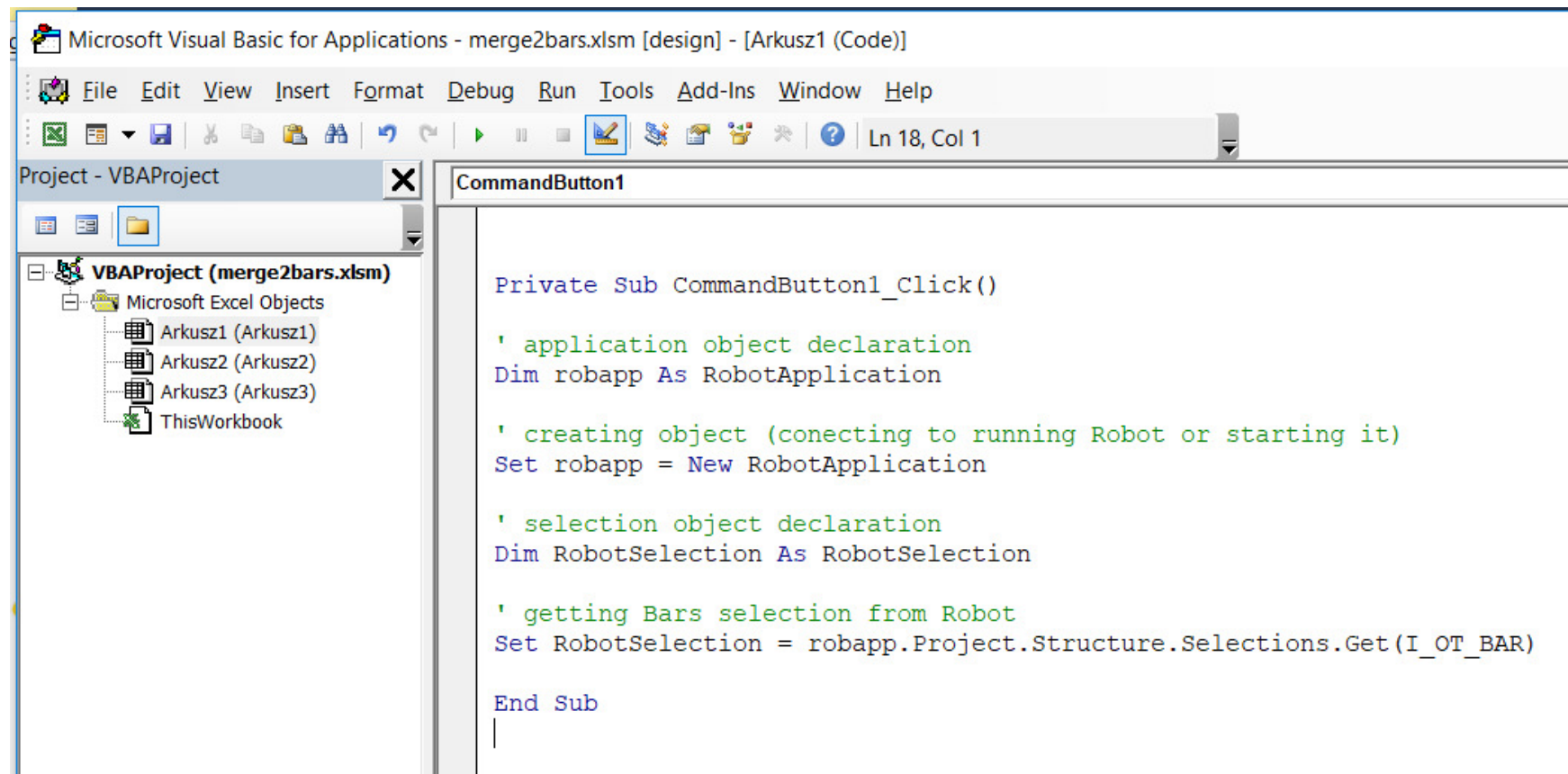




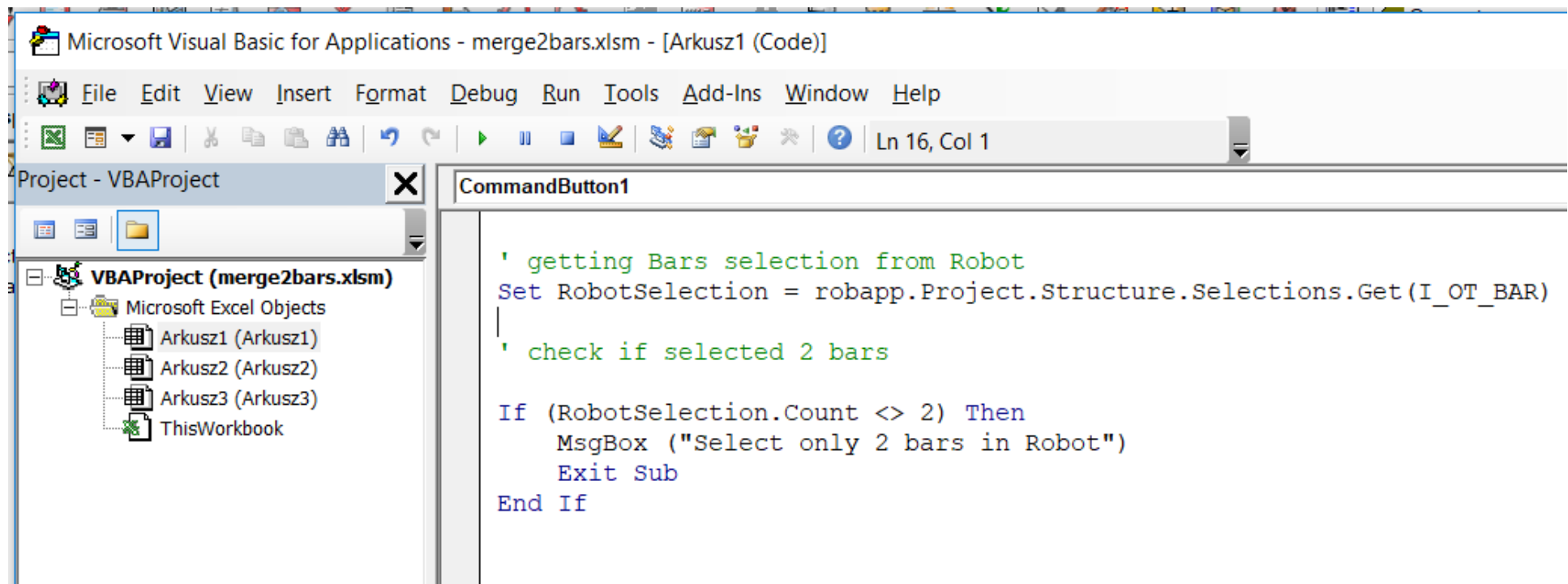
# Macro in Excel – Merging 2 Bars



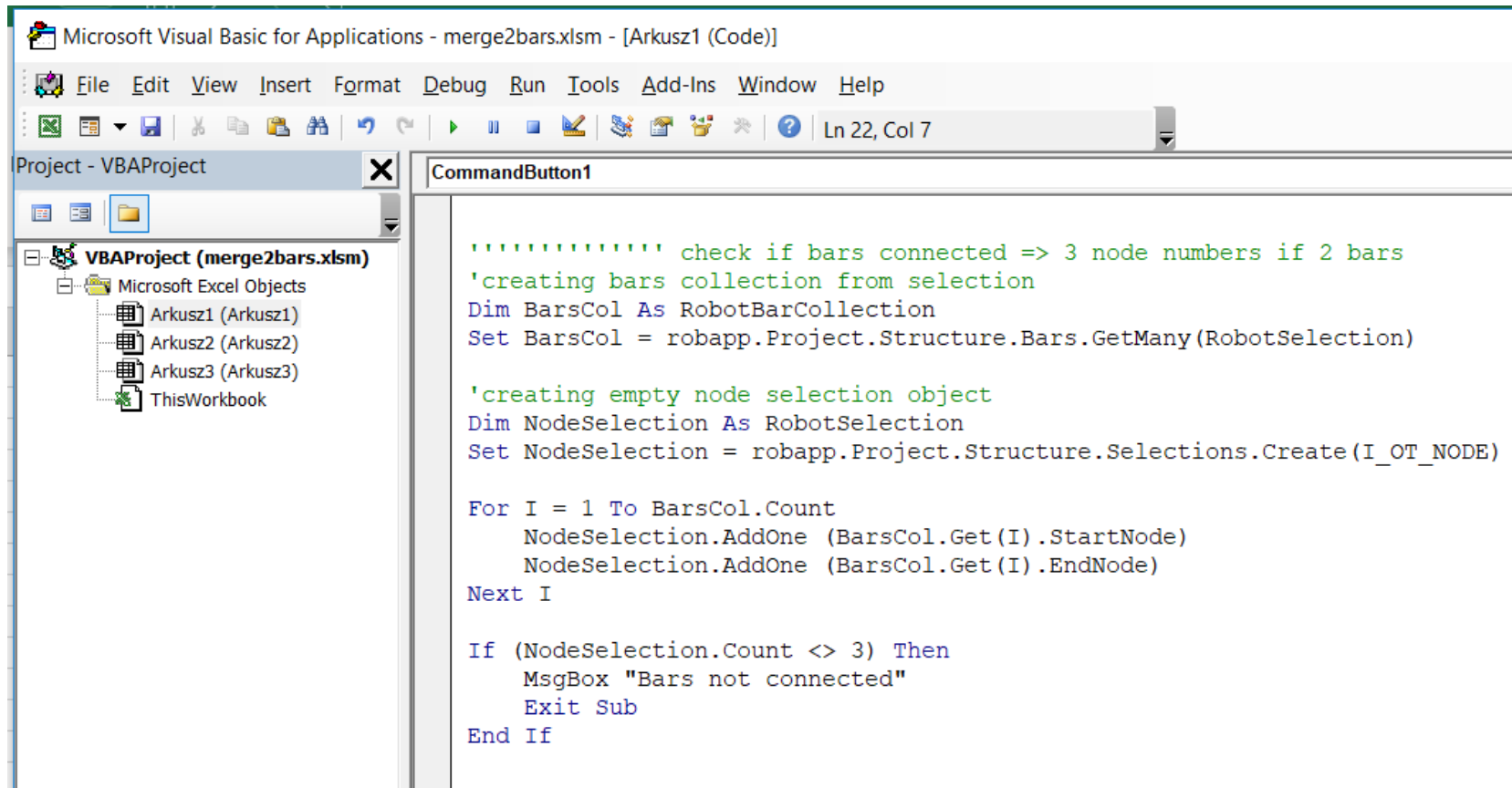
# Macro in Excel – Merging 2 Bars



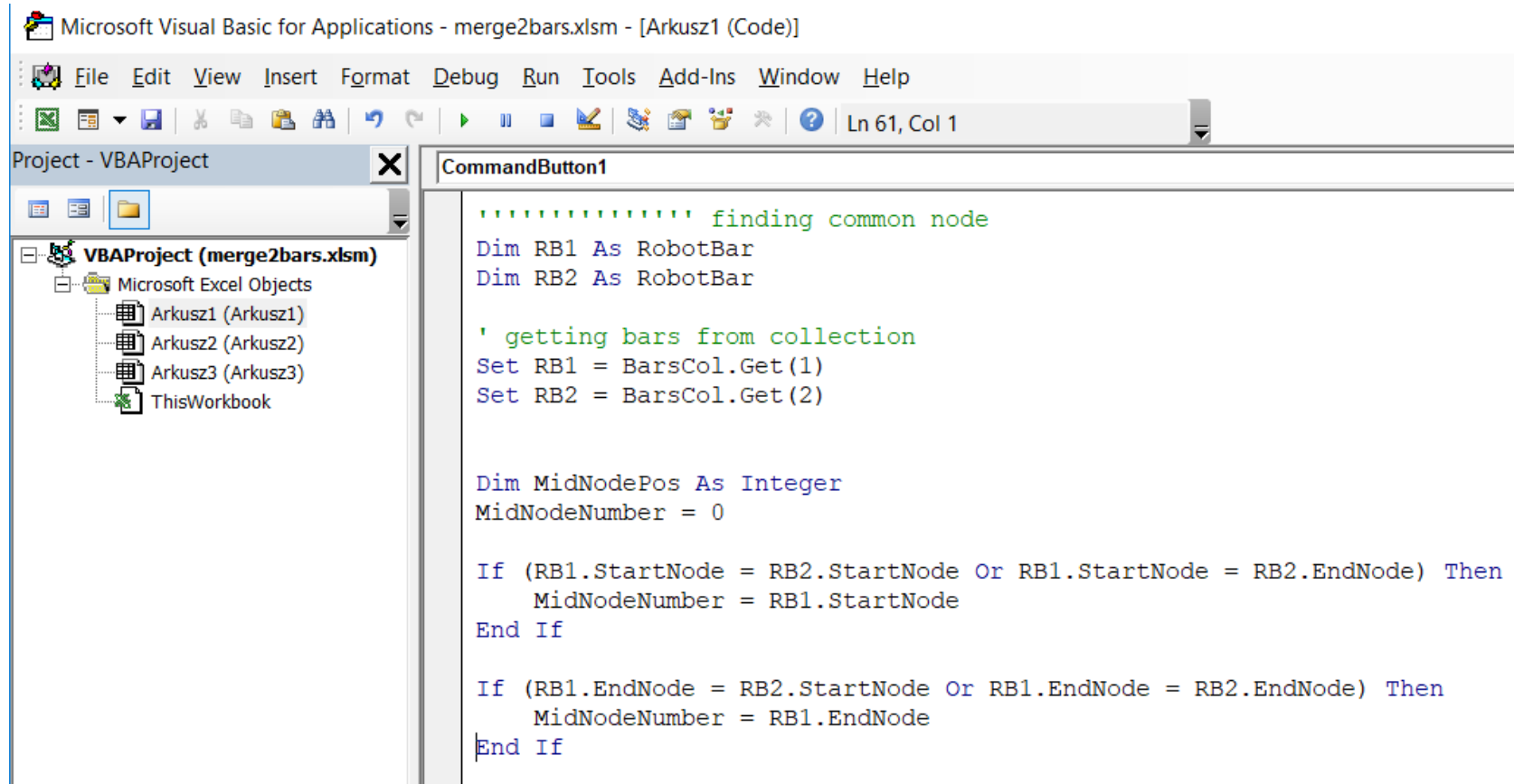
# Macro in Excel – Merging 2 Bars



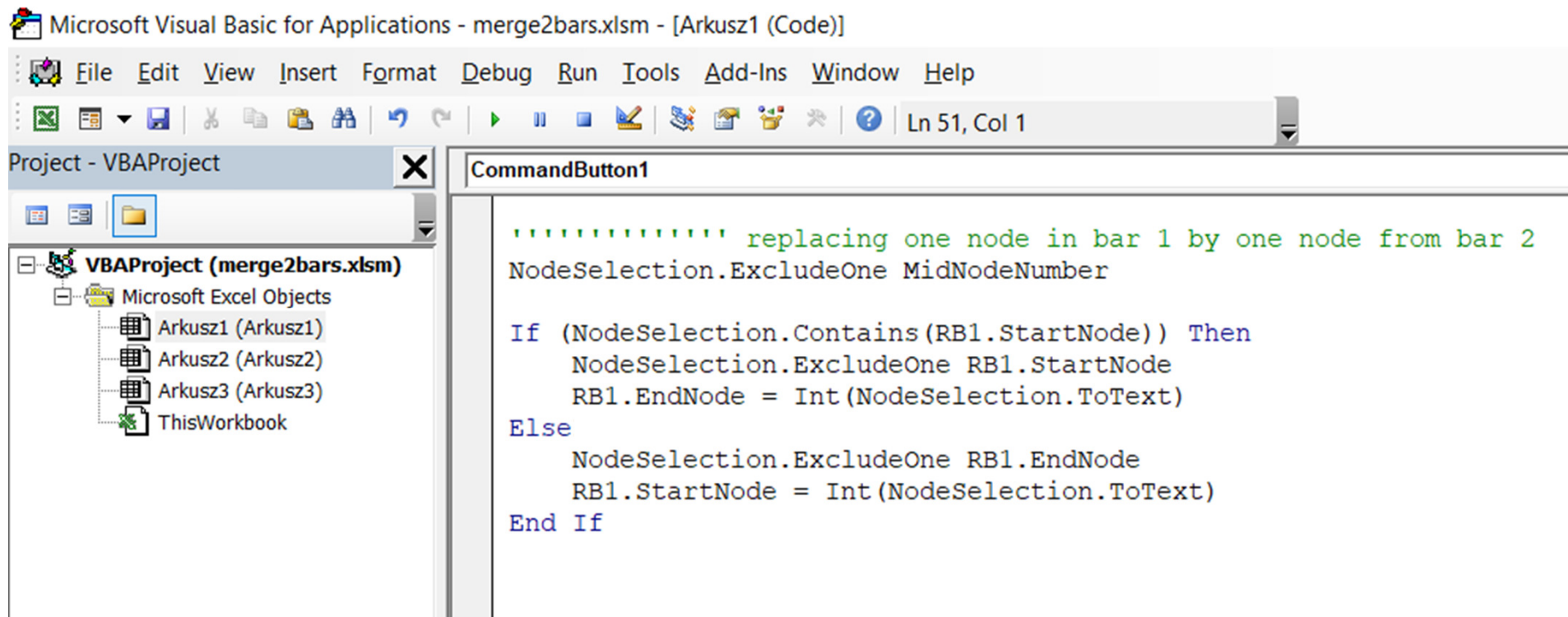
# Macro in Excel – Merging 2 Bars



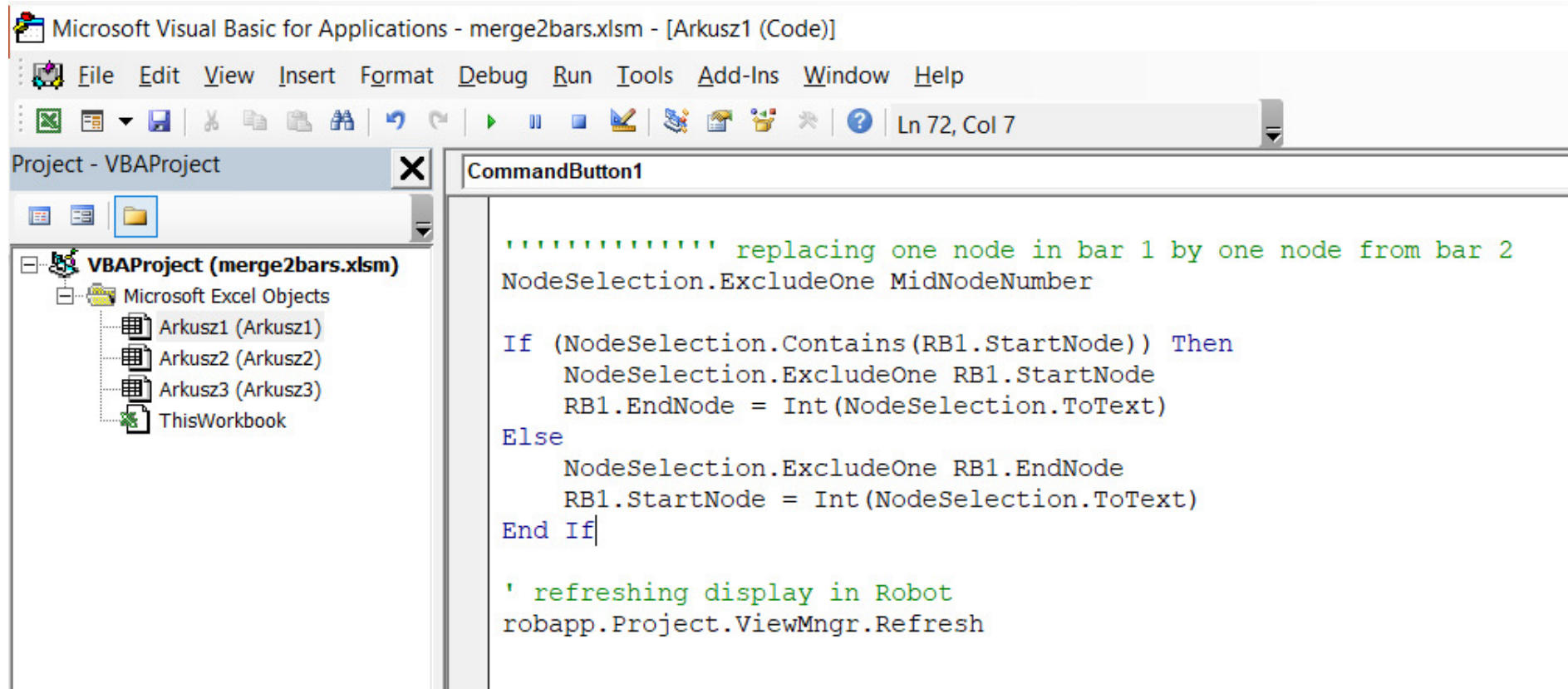
# Macro in Excel – Merging 2 Bars



# Macro in Excel – Merging 2 Bars



# Macro in Excel – Merging 2 Bars



# Macro in Excel – Merging 2 Bars

Microsoft Visual Basic for Applications - merge2bars.xlsm - [Arkusz1 (Code)]

File Edit View Insert Format Debug Run Tools Add-Ins Window Help

Ln 77, Col 1

Project - VBAProject

VBAProject (merge2bars.xlsm)

- Microsoft Excel Objects
  - Arkusz1 (Arkusz1)
  - Arkusz2 (Arkusz2)
  - Arkusz3 (Arkusz3)
  - ThisWorkbook

CommandButton1 Click

```
Set RB1 = BarsCol.Get(1)
Set RB2 = BarsCol.Get(2)

'..... checking if aligned
Dim V1x, V1y, V1z, V2x, V2y, V2z As Double

Dim N1, N2 As RobotNode
Set N1 = robapp.Project.Structure.Nodes.Get(RB1.StartNode)
Set N2 = robapp.Project.Structure.Nodes.Get(RB1.EndNode)

' versor of bar 1 vector
V1x = (N2.X - N1.X) / RB1.Length
V1y = (N2.Y - N1.Y) / RB1.Length
V1z = (N2.Z - N1.Z) / RB1.Length

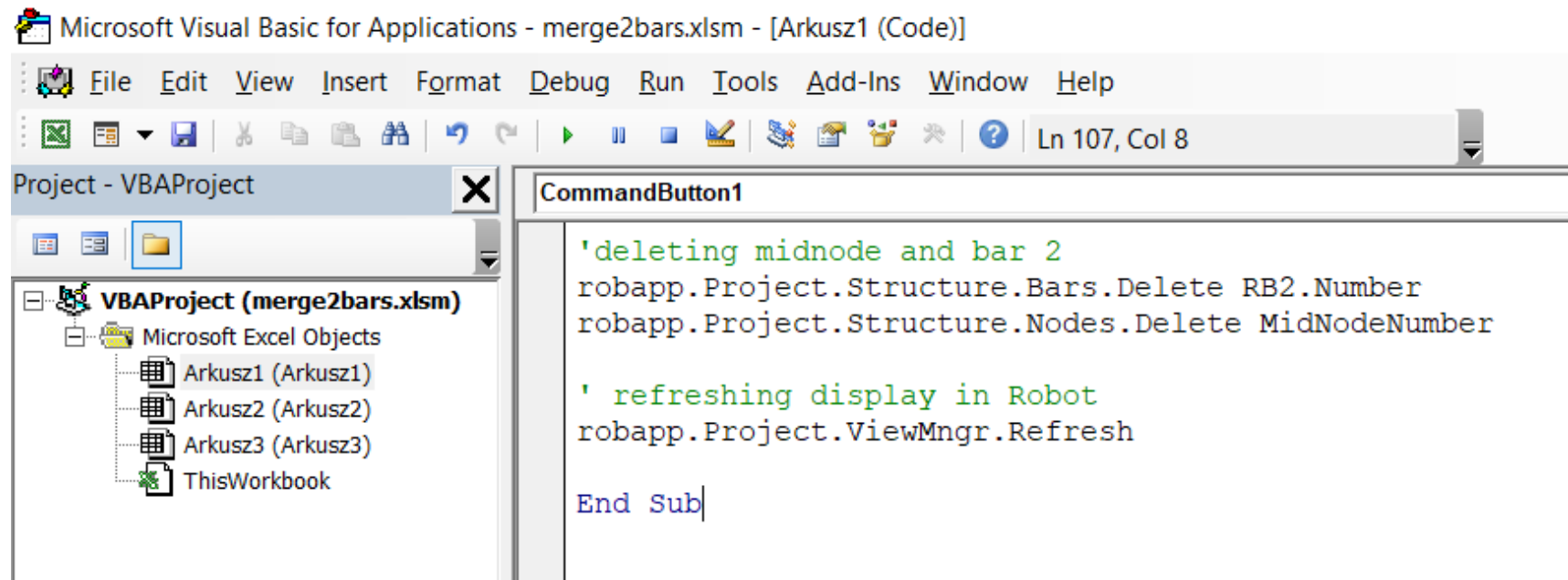
Set N1 = robapp.Project.Structure.Nodes.Get(RB2.StartNode)
Set N2 = robapp.Project.Structure.Nodes.Get(RB2.EndNode)

' versor of bar 2 vector
V2x = (N2.X - N1.X) / RB2.Length
V2y = (N2.Y - N1.Y) / RB2.Length
V2z = (N2.Z - N1.Z) / RB2.Length

If (Abs(V1x - V2x) <= 0.001 And Abs(V1y - V2y) <= 0.001 And Abs(V1z - V2z) <= 0.001) Then
ElseIf (Not (Abs(V1x + V2x) <= 0.001 And Abs(V1y + V2y) <= 0.001 And Abs(V1z + V2z) <= 0.001)) Then
    MsgBox "Bars not aligned"
    Exit Sub
End If
```



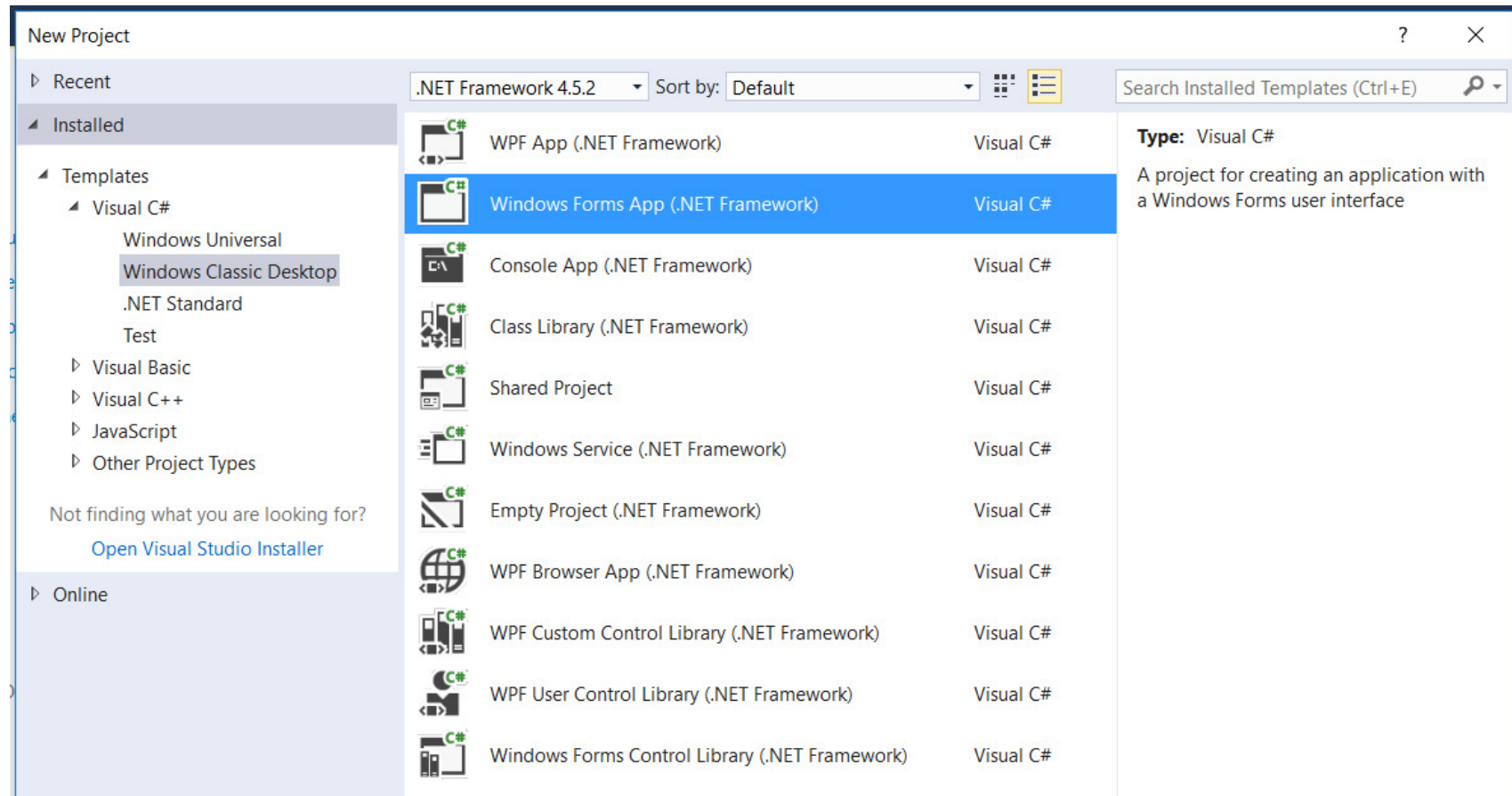
# Macro in Excel – Merging 2 Bars



C# addin

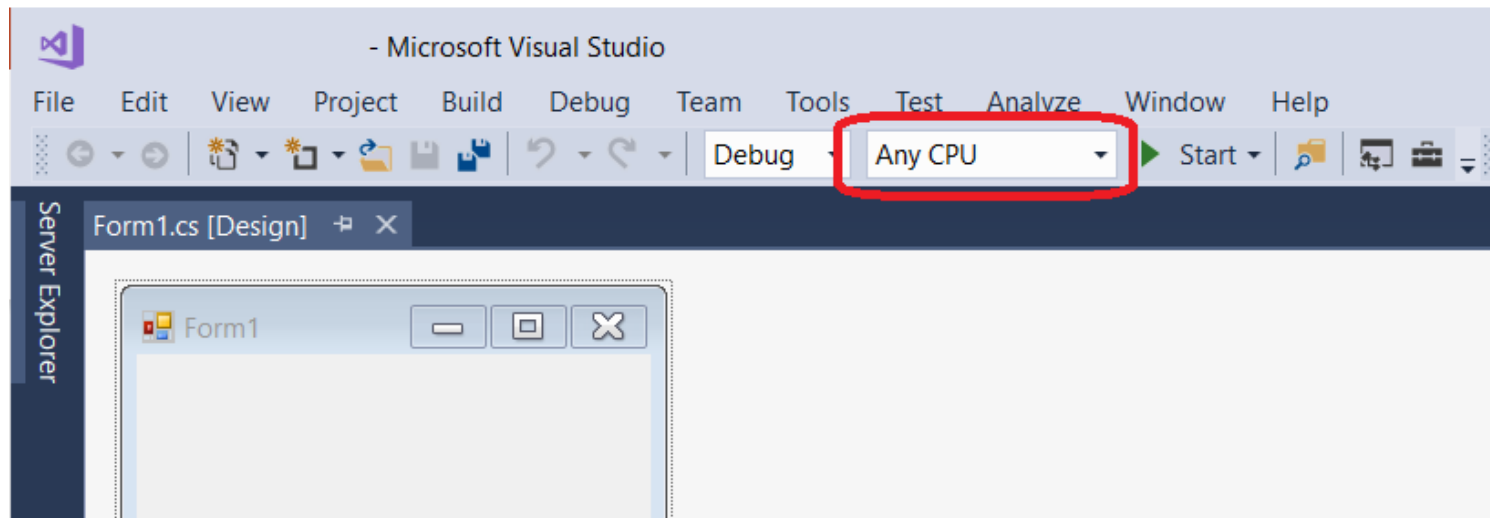


# C# addin



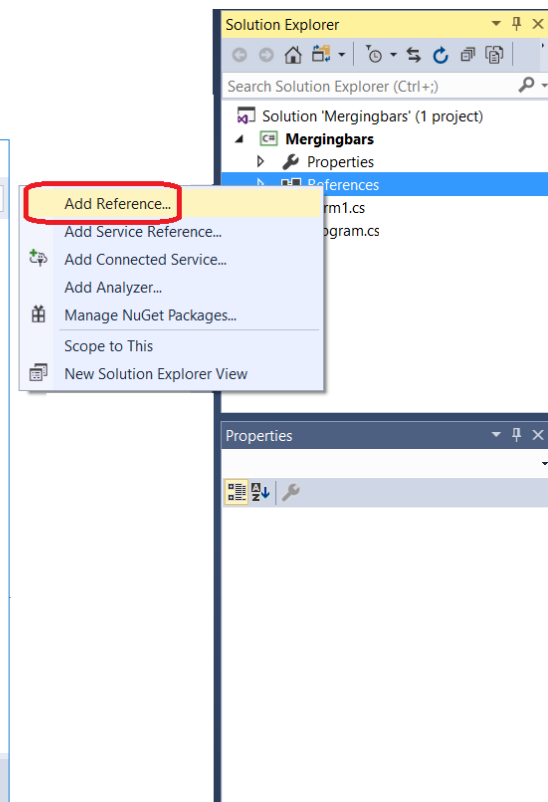
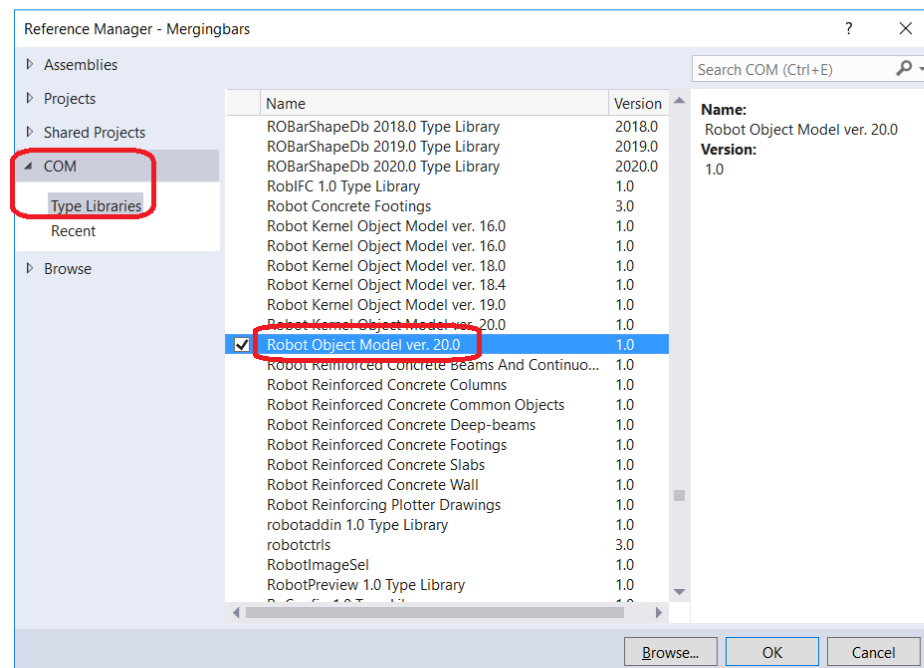
# C# addin

Build for Any CPU



# C# addin

## Add COM reference

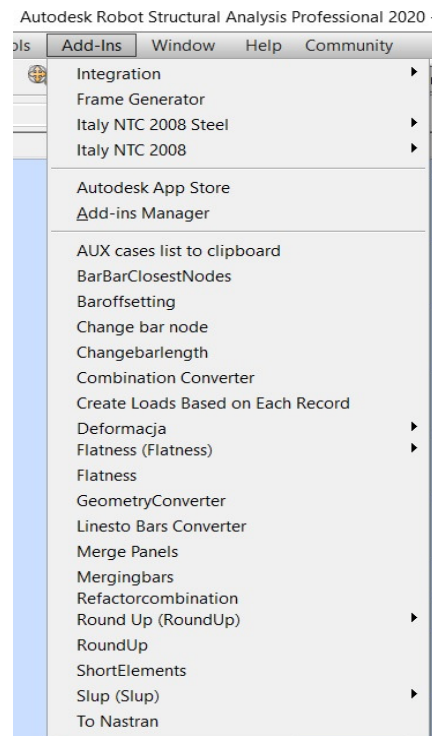


# C# addin - Merging 2 Bars

Complete C# project available in class materials

# Robot Add-Ins menu

Developed addins can be attached to Robot menu



# Example programs and addins





# Buro Happold

FE plate analysis of complex geometry steel connections

XRL megacolumn nodes

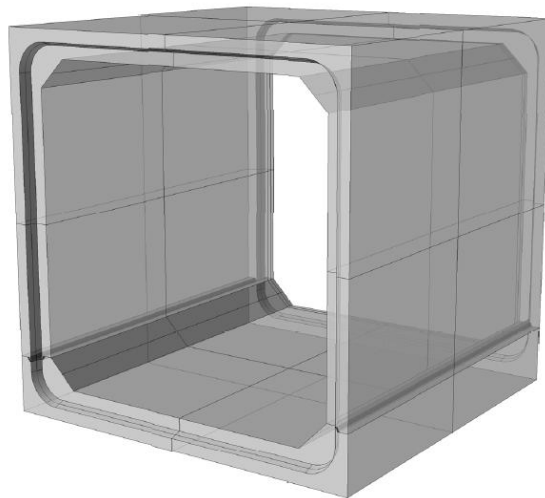
22nd July 2013

# Buro Happold

Sharjah Dome  
Parametric Geometry Definition  
& Link to Analysis

# Hector Bernardo

The parametric design has been implemented through an Excel sheet with VBA macros, handling ROBOT via API interface.



Tool for design of Concrete Culverts		Office:	Designer:
Version	5.9	Date:	29/11/2019
		Project:	
		Destinatory:	

Folddir: \_\_\_\_\_

### 1. Geometry and Materials

Type:	Biapoyado	Culvert Structural Type
Height:	2.00 [m]	Free inner height
Width:	3.00 [m]	Free inner width
Top thickness:	0.20 [m]	Top slab thickness
Bottom Thickness:	0.25 [m]	Bottom slab thickness
Wall thickness:	0.20 [m]	Wall thickness
Horizontal chamfer:	0.15 [m]	
Vertical Chamfer:	0.15 [m]	
Concrete:	HA-45	Concrete grade

### 2. Soil parameters

Groundwater presence:	SI	Is the Groundwater level in the walls?
Distance to GWL:	1.00 [m]	Height to the groundwater level measured from the bottom slab
Soil Specific Weight:	20.00 [kN/m³]	Soil specific weight (Dry)
Submerged Soil Spec. W:	40.00 [kN/m³]	Soil specific weight (Submerged)
Horizontal Earth Pres. Coef:	0.50	Horizontal Earth Pressure coefficient
Vertical K modulus:	50000 [kN/m²]	Vertical Subgrade Reaction Modulus for the foundation soil
E <sub>soil</sub> /E <sub>soil</sub> ratio:	1.00	Relation between Elasticity Modulus of soil over the top slab and walls

### 4. Loads

Permanent Load:	0.00 [kN/m²]	Permanent load over the embankment			
Separate V. and H. Loads:	SI	Create different Load Case for vertical and horizontal component of the load			
Asymmetric earth pressures:	10%	Asymmetry between soil pressure each side			
Marston Theory:	SI	Marston Theory			
Uniform Load:	9.00 [kN/m²]	Uniform Distributed Load			
Special Vehicle Standard:	AP2011	Loads Standard			
Type of equivalent Load:	Top42042	Type of equivalent distributed loads (EDL) for embankment <0.5m			
Max EDL Value:	11.90 [kN/m²]	Max distributed Load value due to special vehicle			
Distance to max load:	1.60 [m]	Distance from left wall to max distributed load			
Left EDL Value:	9.45 [kN/m²]	Value of equivalent distributed load over left wall			
Right EDL Value:	9.45 [kN/m²]	Value of equivalent distributed load over right wall			
Inner Distributed Load:	0.00 [kN/m²]	Uniform distributed load on the bottom slab			
Inner water level:	NO	Inner water level?			
Number of cases:	4	Number of embankment heights			
Case	h [m]	Type	Res. T. Loads	Dist. Res. T.C. Iz	Res. T.C. Der
1	1.00	Trapezoidal	37.75	1.60	13.29
2	2.00	Trapezoidal	23.00	1.60	16.69
3	3.00	Trapezoidal	16.70	1.60	12.91
4	4.00	Trapezoidal	11.90	1.60	9.45

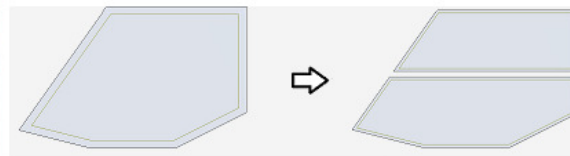
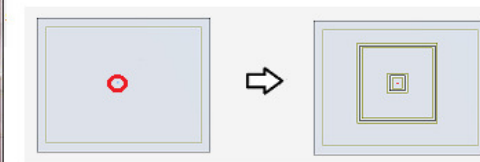
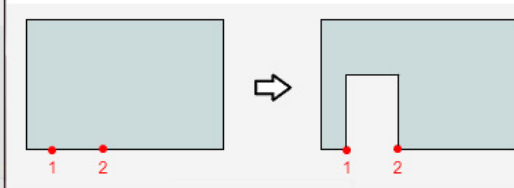
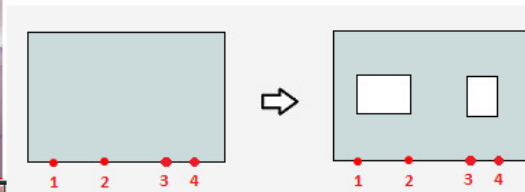
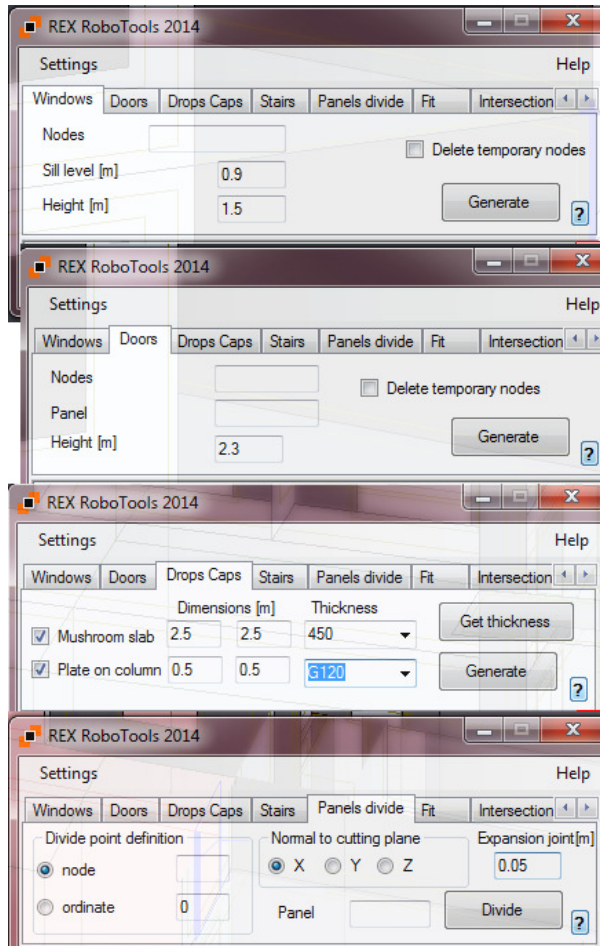
### 5. Calculation Model Parameters

Num. of elements top slab:	1	No. Of Elements to consider in the top slab
Num. of el. Bottom slab:	1	No. Of Elements to consider in the bottom slab
Num. of el. In walls:	2	No. Of Elements to consider in the walls
Node stiffness:	SI	Consider increased stiffness in the nodes
Rnodes/Rbars:	10000	Ratio between node and bars stiffness

### 5. Results

Point per bar:	11
Case:	ELU

# EJG Bulat



# PIM Projekt

## RC Column Design

Utwórz słup z selekcji 221019 s1.rtd

Wczytaj Oblicz 1

Przekrój S R40x60 Kombinacje QPR 8

Materiał C35/45  $\Phi(=t_0) = 1.86$   $\sigma_{qpr} = 82.26 \text{ MPa}$

☒ Pełzanie nieliniowe  $0.45 f_{ck} = 15.75 \text{ MPa} < \sigma_{qpr} \Rightarrow \Phi_{eff} = 1.19$

☒ Eck (zgodnie z tab 3.1 i rys 3.4)  $\pm 20.00 \text{ GPa}$   $E_{eff} = 7.60 \text{ GPa}$

☒  $E_c = E_{ck} / 1.2$

Otulina 3 [cm] Pret A-IIIN (B500SP).500 MF

Pręty narożne  $\emptyset 8$  ☐ Wiązka 2

Pręty wzdłuż h  $\emptyset 8$  ☐ Siatka Rozstaw = 10 [cm]

Pręty wzdłuż b  $\emptyset 8$   $\emptyset 8$

h1 = 10.6 cm

hśr = 10.6 cm

4

b = 40.0 cm

h = 60.0 cm

Pozycja sił 0 [x\L]

Przypadek 7

N = 567.873 kN

My = 513.639 kNm

Mz = 393.044 kNm

Pow zbrojenia 9.05 cm<sup>2</sup>

Procent zbrojenia 0.40 %

☐ Pokaz numery pretow

85.89 MPa

Rezultaty dla obwiedni

	Przypadek	Słup	Wartość	Wsp
Max napr w betonie	7	1	85.89 [MPa]	3.68
Max napr w stali	7	1	4115.50 [MPa]	9.47
Min sztywność Y	7	1	18.08 [MNm <sup>2</sup> ]	0.07
Min sztywność Z	7	1	8.09 [MNm <sup>2</sup> ]	0.07
Rysy	7	1	5.24 [mm]	

Rezultaty dla przypadku 7 Słup 1

Rezultat	Wartość	
Szt Betonu Y	244.80	Wsp szt Y
Eceff'lyspr	18.08	0.07 < 0.35
Szt Stali +3%Bet Y	10.30	0.04
Szt Betonu Z	108.80	Wsp szt Z
Eceff'lyspr	8.09	0.07 < 0.30
Szt Stali +3%Bet Z	4.51	0.04
Beton Max naprężenie [MPa]	85.89	
Stal Max naprężenie [MPa]	4115.50	
$\Phi_{eff}$	1.19	
Rysy	5.24	mm

## **Robot Forum**

<http://forums.autodesk.com/t5/Autodesk-Robot-Structural/bd-p/351>

## **API Examples on Forum**

<http://forums.autodesk.com/t5/Robot-Structural-Analysis/useful-addins-for-Robot-API/td-p/3899448>

## **SDK installation**

DVD\x86\Tools\RSASDK

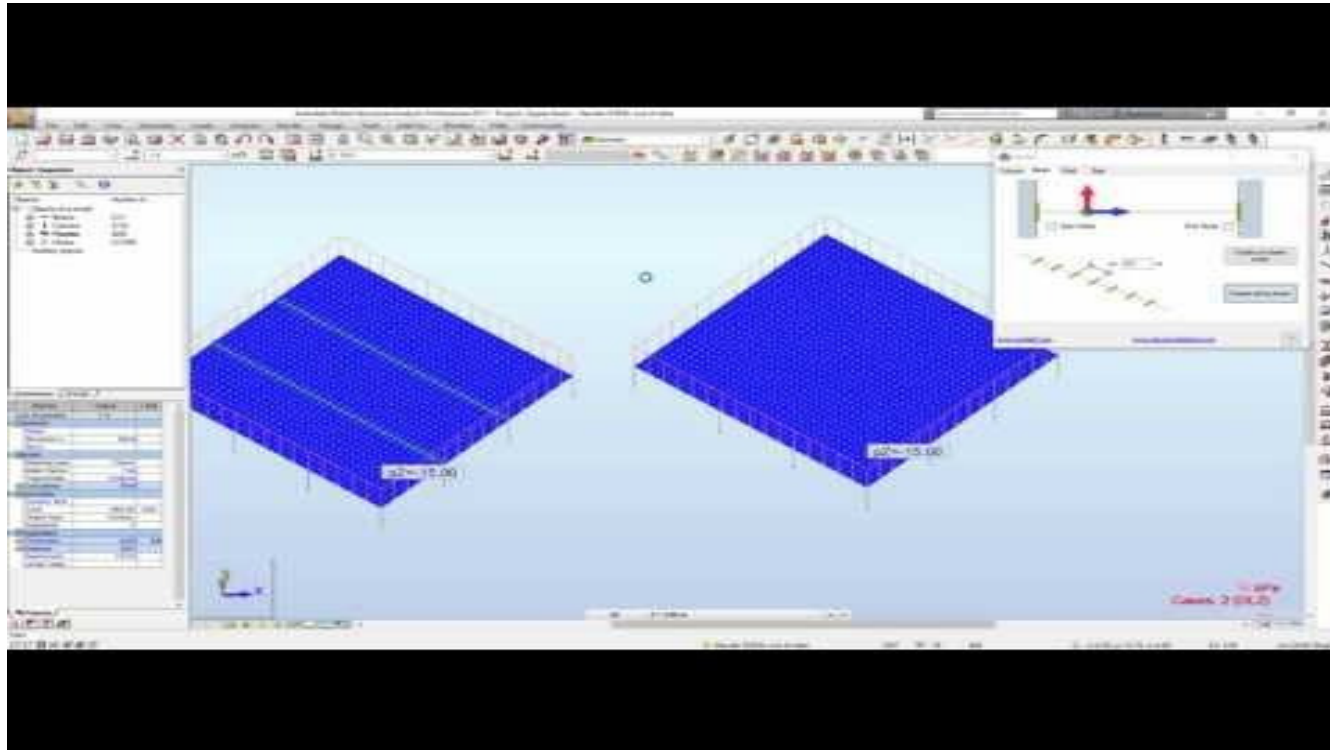
## **SDK and Examples on computer after installation**

C:\Program Files\Autodesk\Autodesk Robot Structural Analysis Professional  
2020\SDK\ROBOTSDK.html

# Autodesk APP Store

## Spider Pro

<https://apps.autodesk.com/RSA/Detail/Index?id=964813656627065816&appLang=en&os=Win64>





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