

Obliczenia inżynierskie w chmurze

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Final report

FEA analysis of Beam structure using AZURE CLOUD COMPUTING and PYTHON

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1. Introduction

The purpose of this project is to carry out FEA analysis using AZURE cloud computing. The second objective is to familiarize with the procedure of setting up the virtual machine and using it to perform calculations that a given person needs.

Nowadays during the design process of many machines and devices engineers will be performing a variety of different simulations. Sometimes the available machines in the company are not able to complete calculations in reasonable time, so then a cloud computing becomes an option. It gives an opportunity for the engineers to move calculations to the big machines which services can be "rented". This can greatly reduce the time needed for big analysis thus speeding the entire design process

2. Virtual Machine set-up

Machine was set up according to provided instruction. Following picture summarizes the machine parameters.

The screenshot displays the RysioWM virtual machine management interface. The left sidebar contains navigation options: Przegląd, Dziennik aktywności, Kontrola dostępu (IAM), Tagi, Diagnostowanie i rozwiązywanie problemów, Ustawienia, Sieć, Połącz, Dyski, Rozmiar, Microsoft Defender for Cloud, Rekomendacje usługi Advisor, Rozszerzenia i aplikacje, Ciągłe dostarczanie, Dostępność i skalowanie, Konfiguracja, Tożsamość, Właściwości, Blokady, Operacje, Bastion, Automatyczne zamykanie, and Kopia zapasowa. The main content area shows the configuration for a virtual machine named 'RysioWM'. The 'Podstawowe elementy' section lists the resource group, status, location, subscription, and tags. The 'Właściwości' section provides detailed specifications for the virtual machine, including its name, status, operating system, publisher, offer, plan, generation, architecture, agent status, version, host group, host, placement group, and co-scheduling status. The 'Sieć' section shows the public and private IP addresses, and the 'Rozmiar' section shows the size, vCPU count, and RAM. The 'Dysk' section shows the operating system disk and the boot disk.

Podstawowe elementy	
Grupa zasobów (przenieś)	zasob_rysio
Stan	Uruchomione
Lokalizacja	West Europe
Subskrypcja (przenieś)	Azure for Students
Identyfikator subskrypcji	09b6c7ed-b04b-449c-96bd-82d2e359e47f
Tagi (edytuj)	Kliknij tutaj aby dodać tagi

Właściwości	
Nazwa komputera	RysioWM
Stan kondycji	-
System operacyjny	Linux (ubuntu 20.04)
Wydawca	canonical
Oferta	0001-com-ubuntu-server-focal
Plan	20_04-its-gen2
Generacja maszyny wirtualnej	V2
Architektura maszyny wirtualnej	x64
Stan agenta	Ready
Wersja agenta	2.8.0.11
Grupa hostów	Brak
Host	-
Grupa umieszczania w pobliżu	-
Stan współwystępowania	Nie dotyczy

Sieć	
Publiczny adres IP	13.73.177.211
Publiczny adres IP (IPv6)	-
Prywatny adres IP	10.0.0.5
Prywatny adres IP (IPv6)	-
Sieć/podsieć wirtualna	zasob_rysio-vnet/default
Nazwa DNS	Konfiguruj

Rozmiar	
Rozmiar	Standard B2s
Procesory wirtualne vCPU	2
Pamięć RAM	4 GiB

Dysk	
Dysk systemu operacyjnego	RysioWM_disk1_2761b209678549d2918bd049988e9be2
Szyfrowanie na hoście	Wyłączone

Figure 2-1 - Virtual Machine set-up

Ubuntu 20.04 was chosen for this machine. The access will be done by port 22 with the use of SSH key and such connection was established. Putty interface was used for establishing the connection and executing the commands on the virtual machine.

3. Analysed model

To perform the calculation using cloud computing a python code was prepared. It used solidspy library. It contains necessary commands for the 2D FEA analysis. The following picture shows the meshed model that was analysed. The mesh was done by the additional software called GMSH.

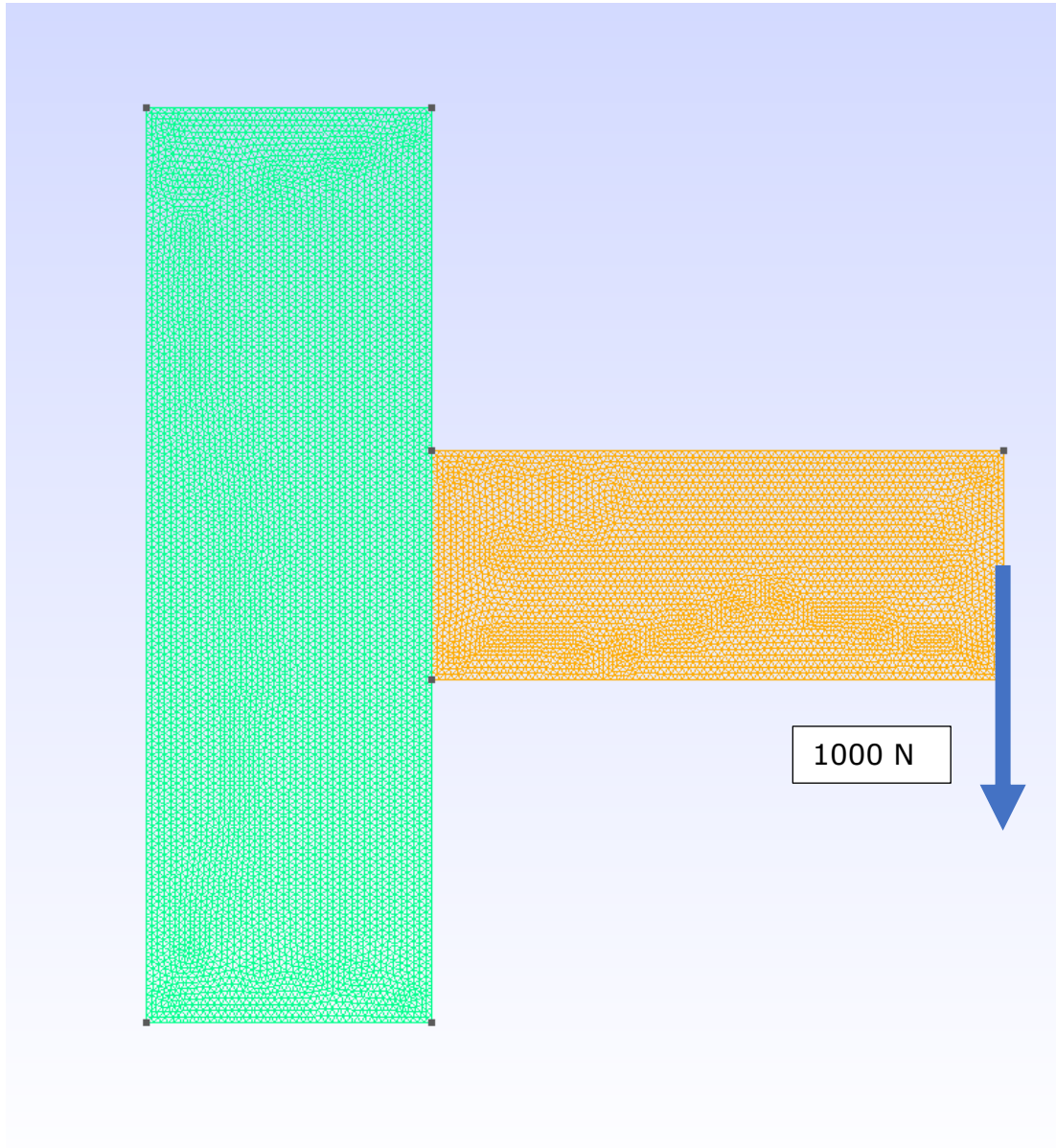


Figure 3-1 - Analysed model

It contains 18848 3-node elements that are triangles. It is loaded with 1kN of force at the end. This is a simple system of cantilever beam, but it is large enough that performing the calculations by hand is not feasible, thus it can be solved with the help of computer calculations .

The python code gets all the geometrical and material data for the analysis and constructs large stiffness matrix [K]. For this system it will be

19088x19088 matrix. This equation system was solved with the numpy module.

Then the prepared code is transferred to the virtual machine from the personal computer via SSH protocol and executed on the Virtual machine.

4. Results

The result of the analysis is a vector of the values of displacements for each of the nodes. They can be then used to obtain the deformed shape of the system and element stresses. Following pictures show the results.

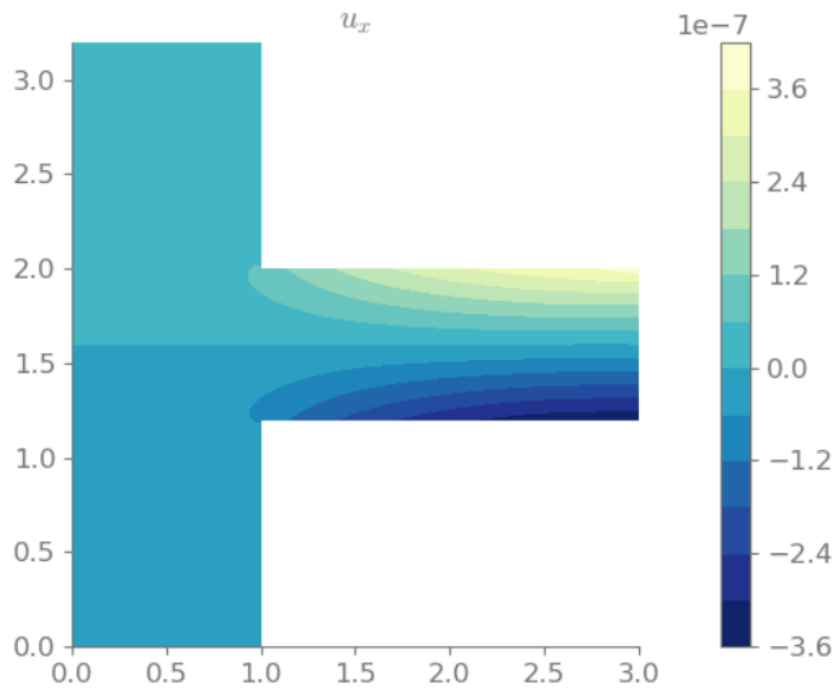


Figure 4-2 Displacement X- direction

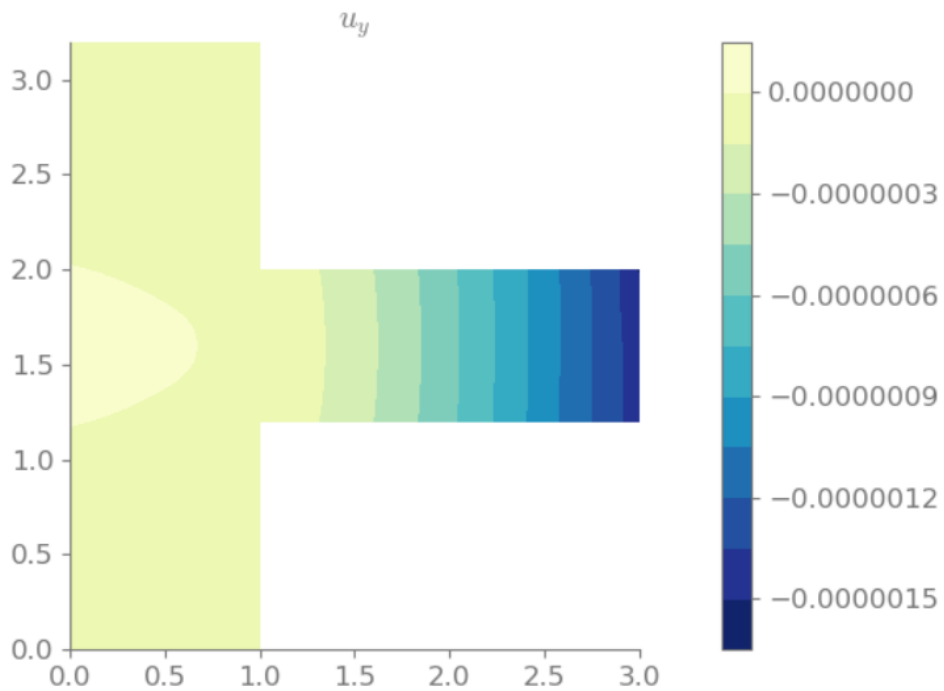


Figure 4-1 Displacement Y direction

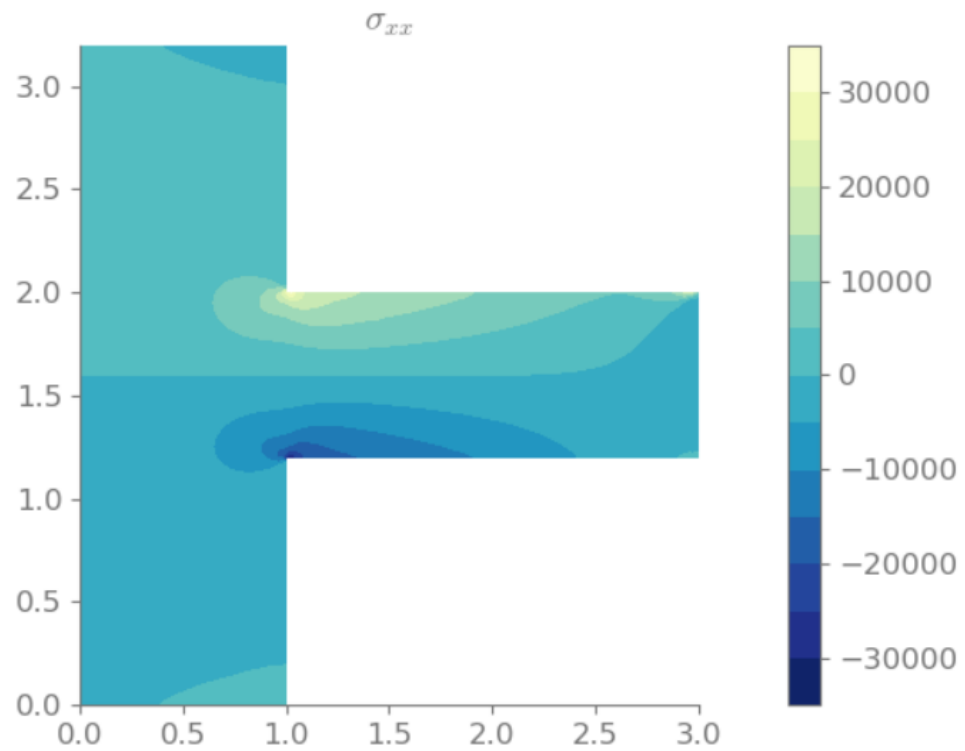


Figure 4-3 Stresses X direction

σ_{xx} stresses show that the beam is bended in the correct direction, so thus it is concluded that the simulation was set up correctly.