Univerzitet u Beogradu
Građevinski fakultet
Odsek za hidrotehniku i vodno-ekološko inženjerstvo

Doktorske studije
Mehanika fluida - napredni kurs

MODELIRANJE TEČENJA U KANALU SA SUŽENJEM PRIMENOM SOFTVERA TELEMAC-MASCARET

Mentori:

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Beograd, 2022.

Sadržaj

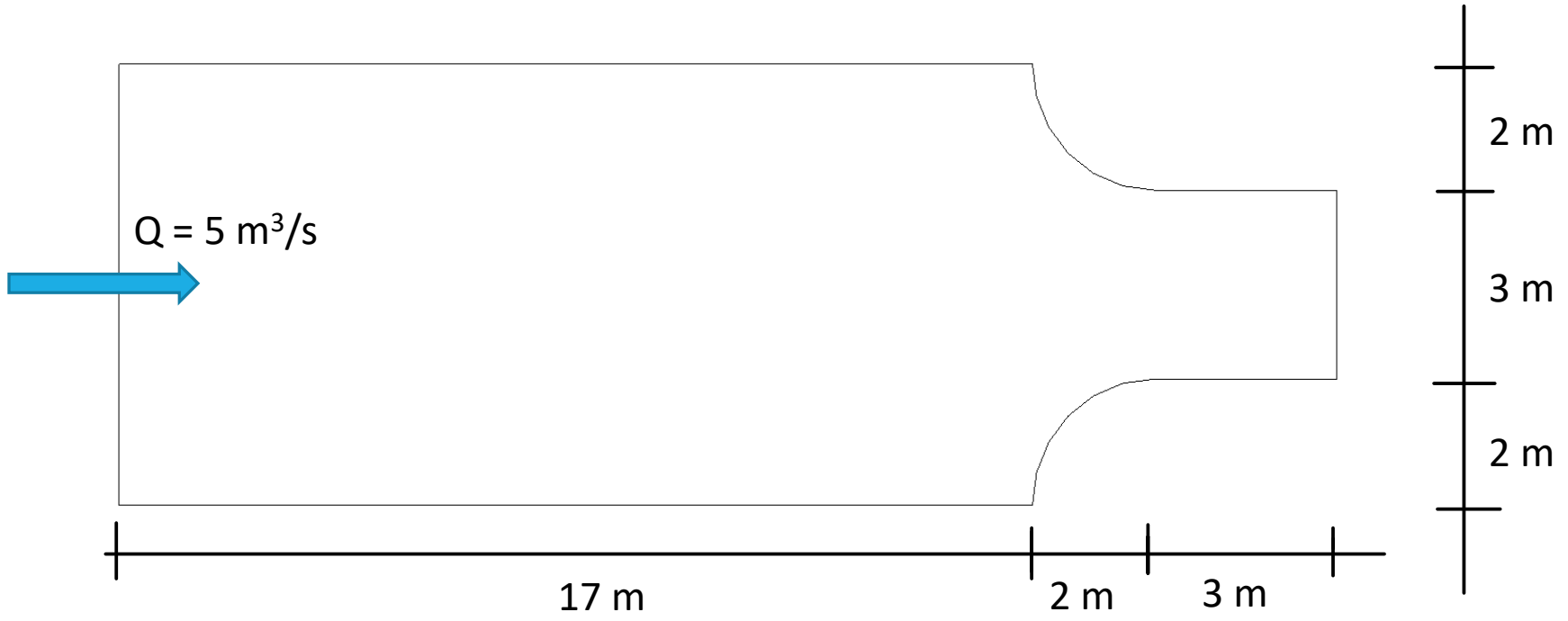
- Opis zadatka
- TELEMAC-MASCARET
- Kreiranje mreže - BlueKenue
- Zadavanje graničnih uslova - BlueKenue
- Podešavanje *case* fajla
- Rezultati – varijanta 1
- Rezultati – varijanta 2
- Zaključak i predlozi za dalja istraživanja

Opis zadatka

- Analiza uticaja suženja na tečenje u kanalu
- Pravougaoni kanal – 2 varijante:
  - Varijanta 1

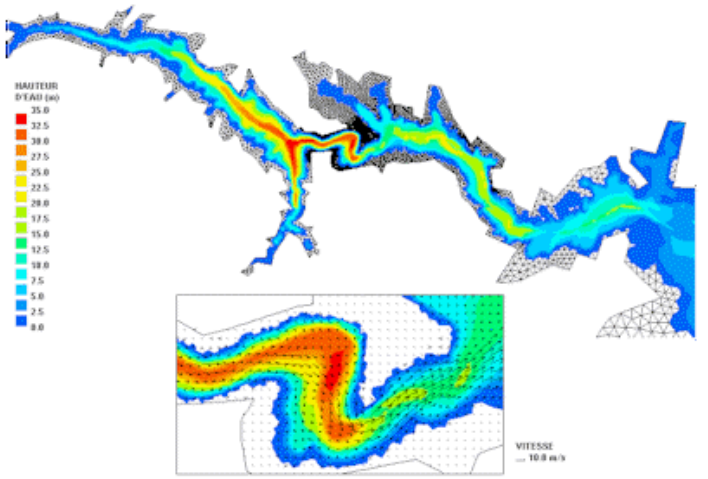
Opis zadatka

- Varijanta 2



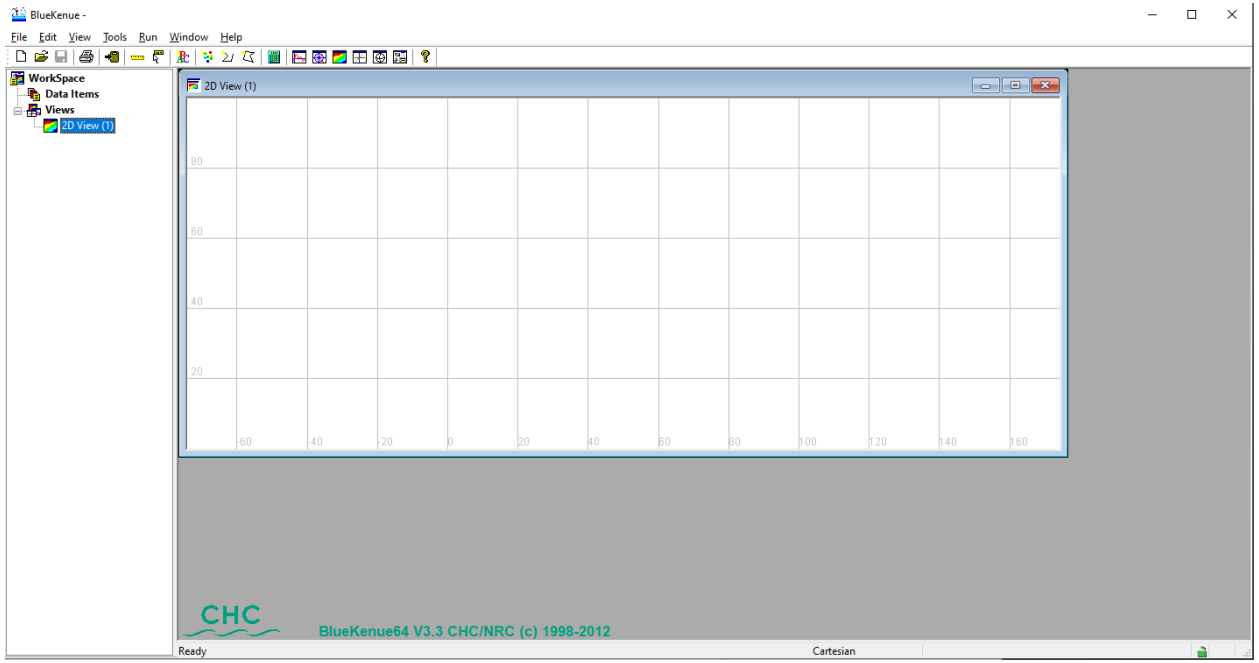
TELEMAC-MASCARET

- Integrisani alat za modeliranje u oblasti tečenja u otvorenim tokovima
- Moduli za simulaciju koriste algoritme zasnovane na metodi konačnih elemenata
- Prostor je diskretizovan u obliku mreže nepravilnih trouglova
- Priprema modela i vizuelizacija rezultata odrađeni u softveru BlueKenue



Kreiranje mreže - BlueKenue

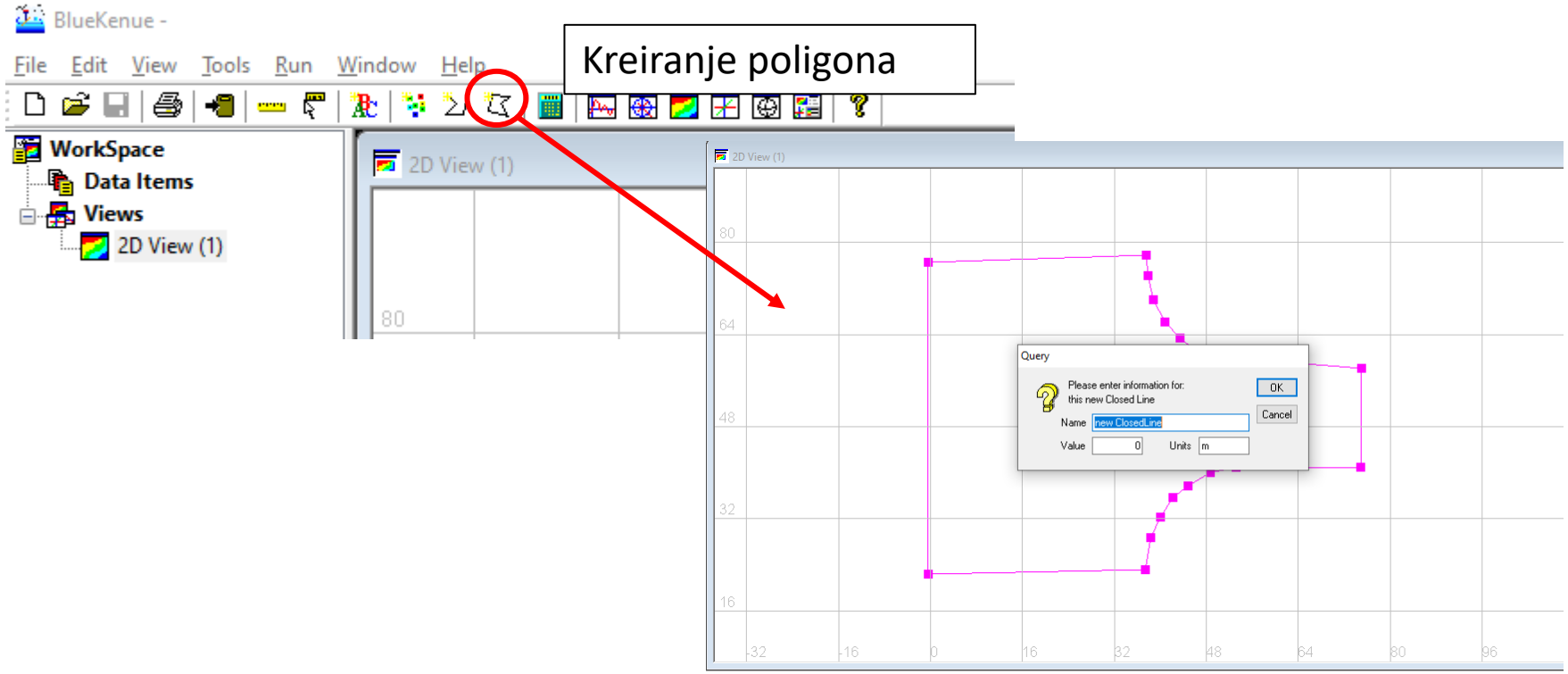
- Kreiranje mreže urađeno je u softveru **BlueKenue**



Korisnički interfejs

Kreiranje mreže - BlueKenue

- Zadavanje granica



Kreiranje mreže - BlueKenue

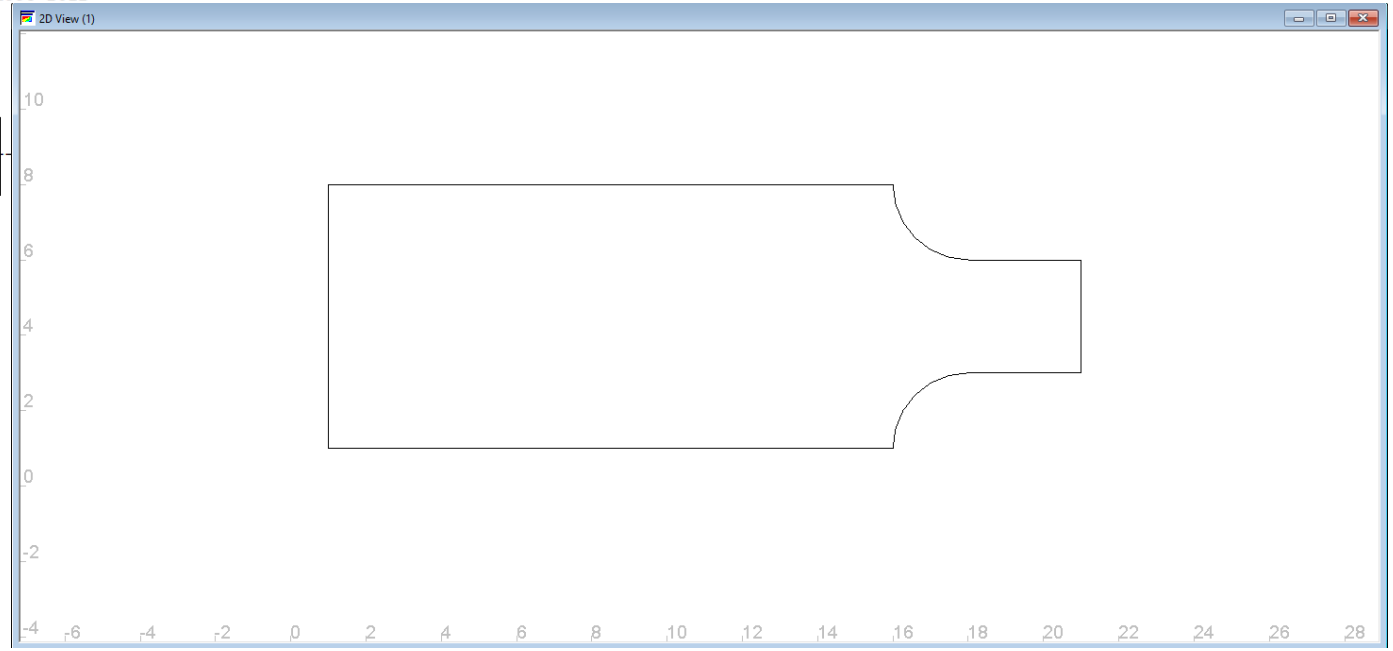
C:\opentelemac-mascaret\v8p0r0\examples\telemac3d\turb v2\MesherV2.i2s - Notepad++

File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?

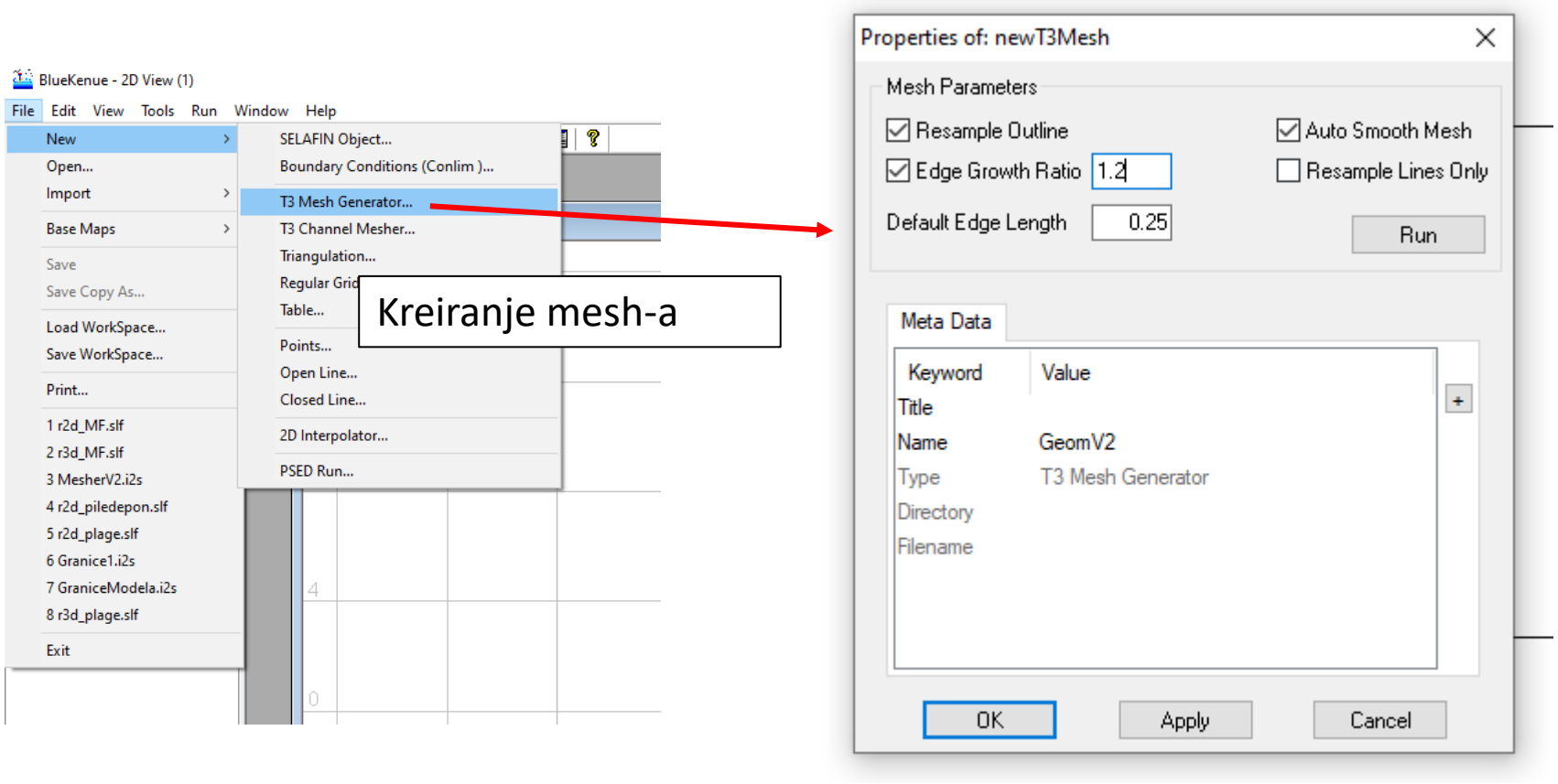
t3d_MF.cas | MesherV2.i2s

```
1  ################################################################################
2  :FileType i2s  ASCII  EnSim 1.0
3  # Canadian Hydraulics Centre/National Research Council (c) 1998-2012
4  # DataType                 2D Line Set
5  #
6  :Application             BlueKenue
7  :Version                 3.3.4
8  :WrittenBy               Marija
9  :CreationDate            Thu, Feb 24, 2022 06:35 PM
14 :AttributeUnits 1 m
15 :EndHeader
16 19 0
17 1 1
18 16  1
19 16.06814835 1.51763809
20 16.26794919 2
21 16.58578644 2.414213562
22 17  2.732050808
23 17.48236191 2.931851653
24 18  3
25 21 3
26 21 6
27 18  6
28 17.48236191 6.068148347
29 17  6.267949192
30 16.58578644 6.585786438
31 16.26794919 7
32 16.06814835 7.48236191
33 16  8
34 1 8
35 1 1
36
```

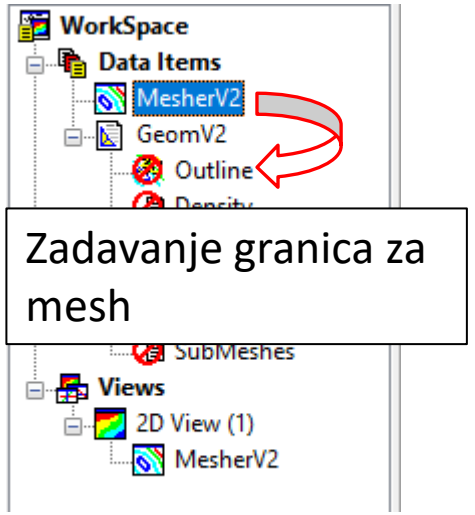
Podešavanje koordinata tačaka



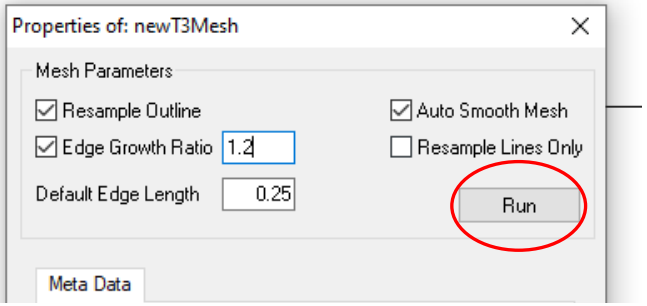
Kreiranje mreže - BlueKenue

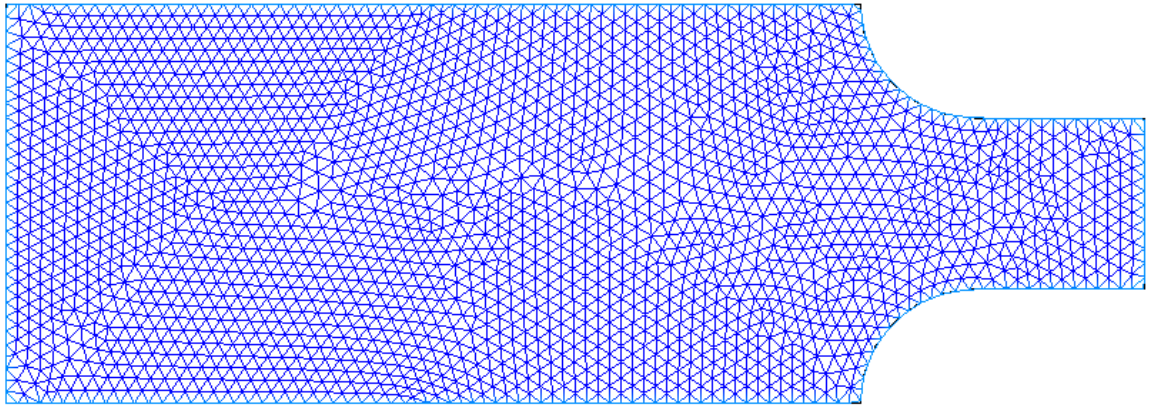


Kreiranje mreže - BlueKenue



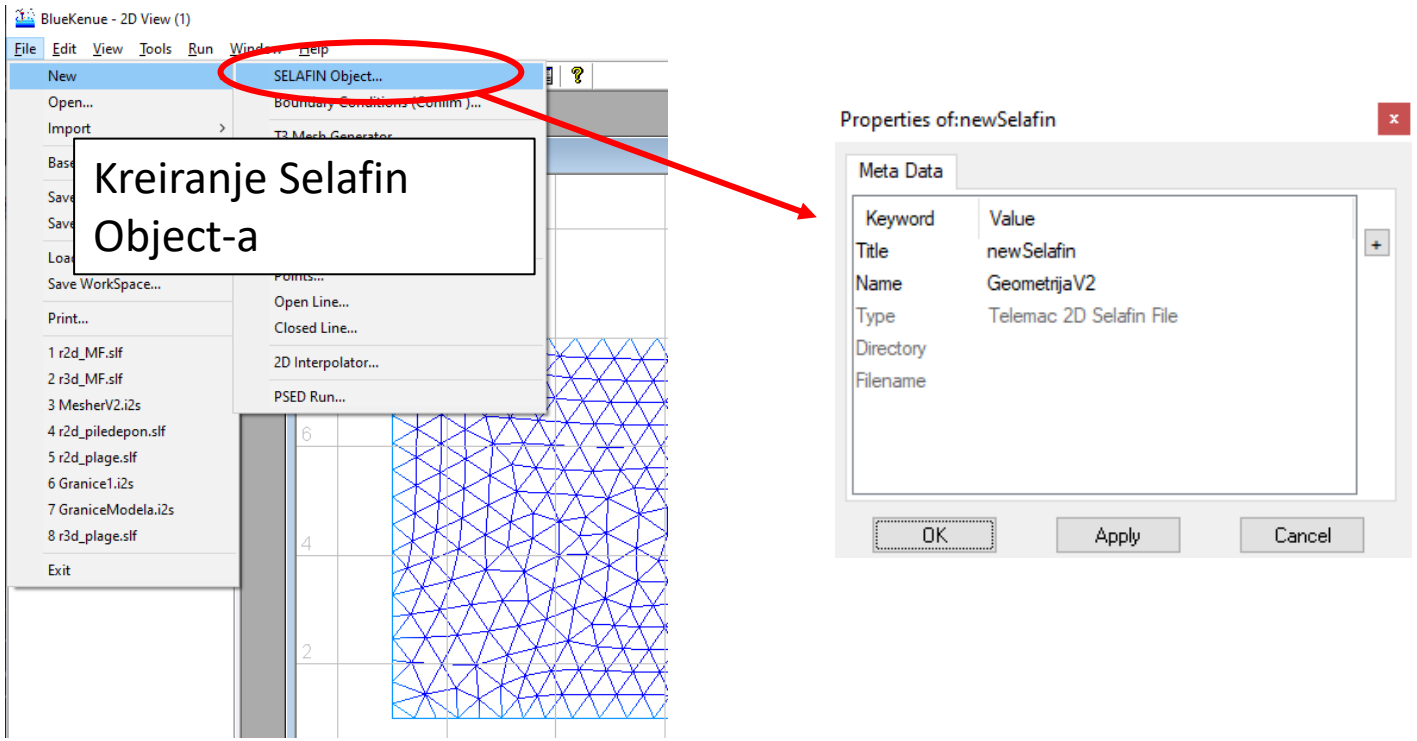
Zadavanje granica za mesh



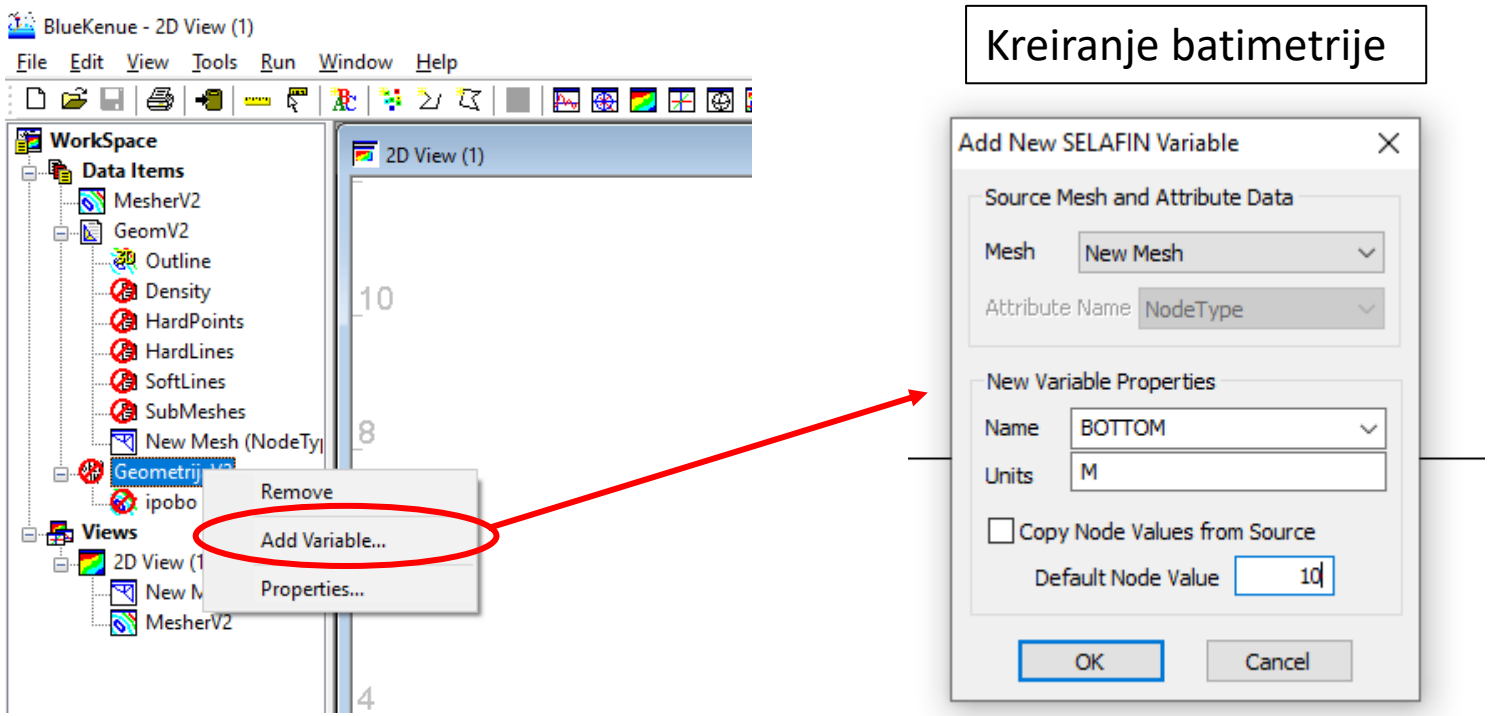


Rezultujuća mreža

Kreiranje mreže - BlueKenue

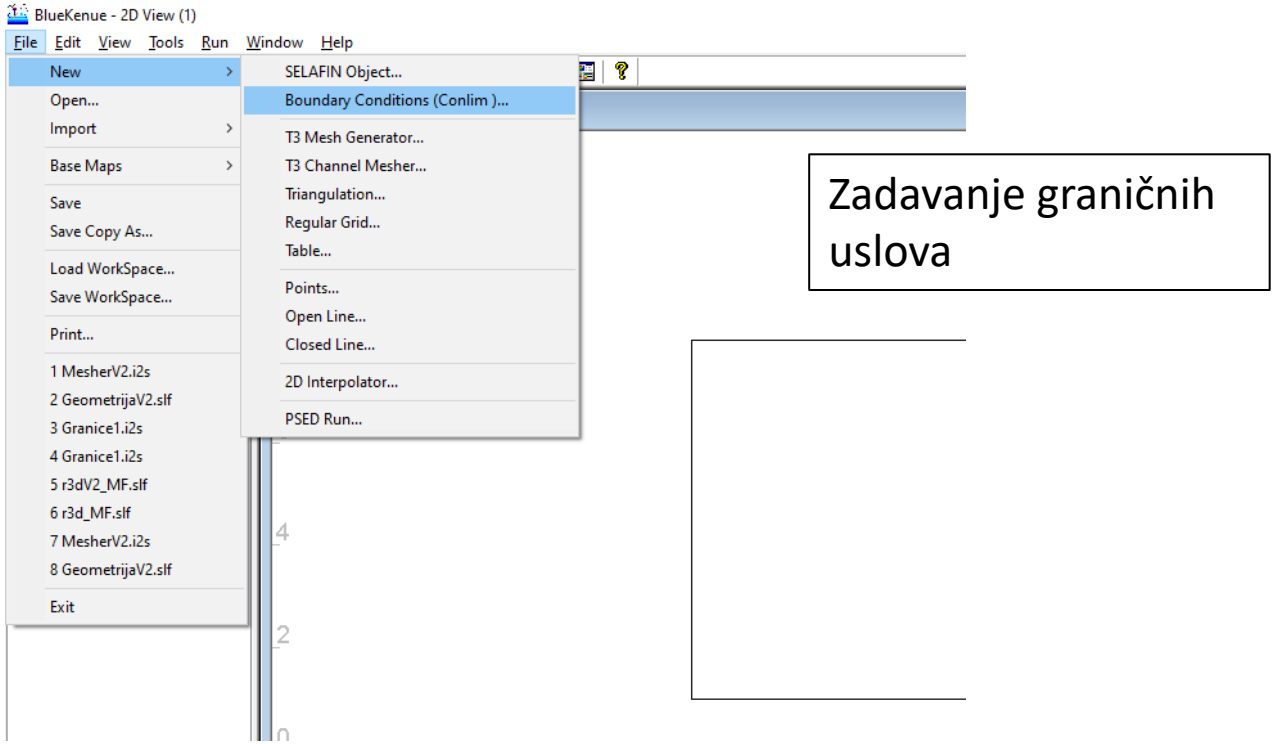


Kreiranje mreže - BlueKenue



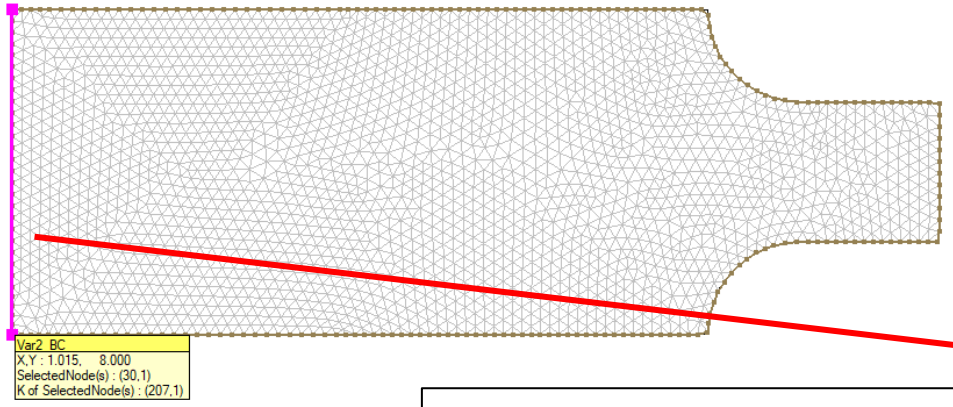
Kreiranje batimetrije

Zadavanje graničnih uslova - BlueKenue

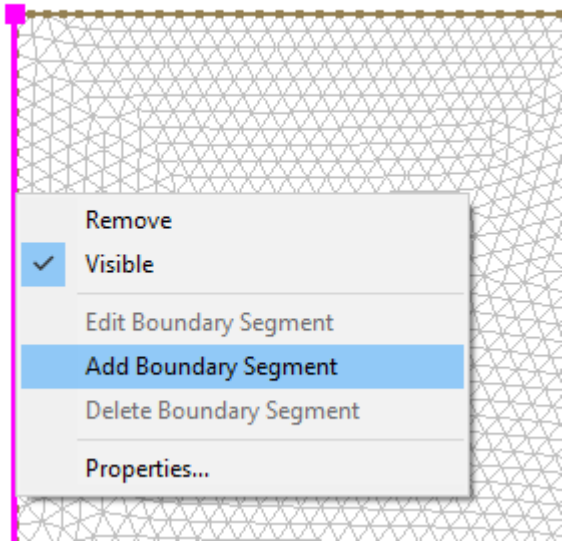


Zadavanje graničnih uslova

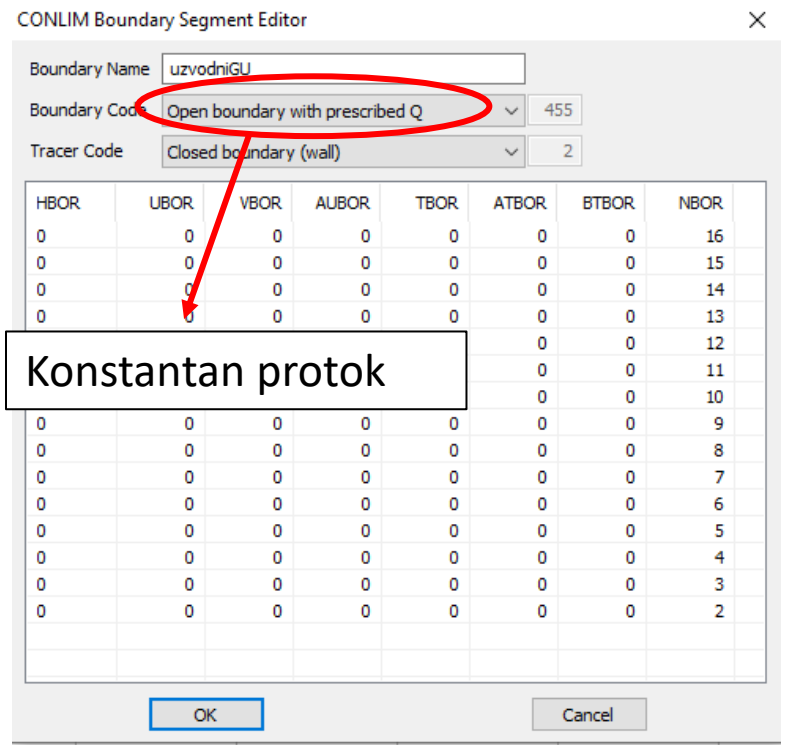
Zadavanje graničnih uslova - BlueKenue

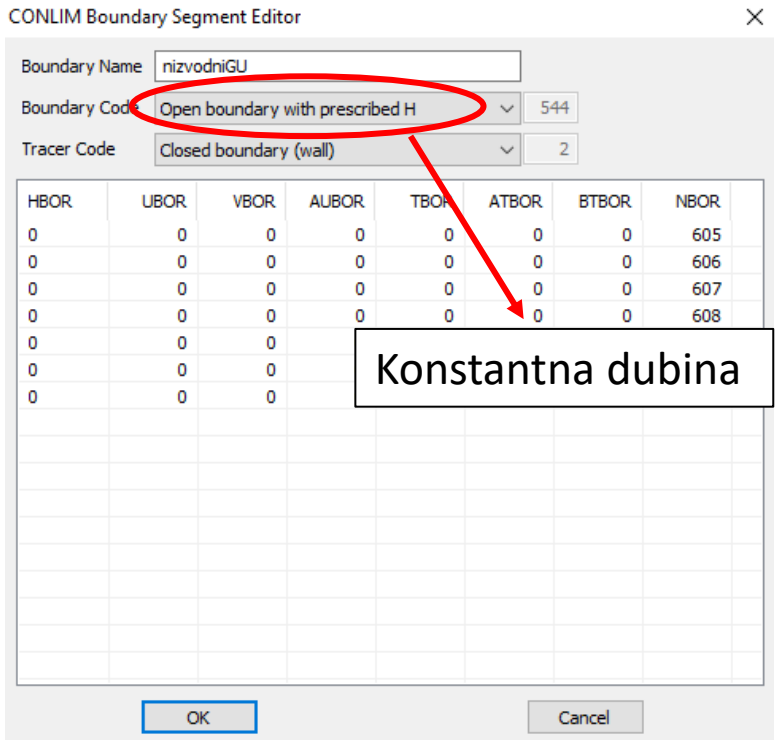


Zadavanje uzvodnog i nizvodnog graničnog uslova

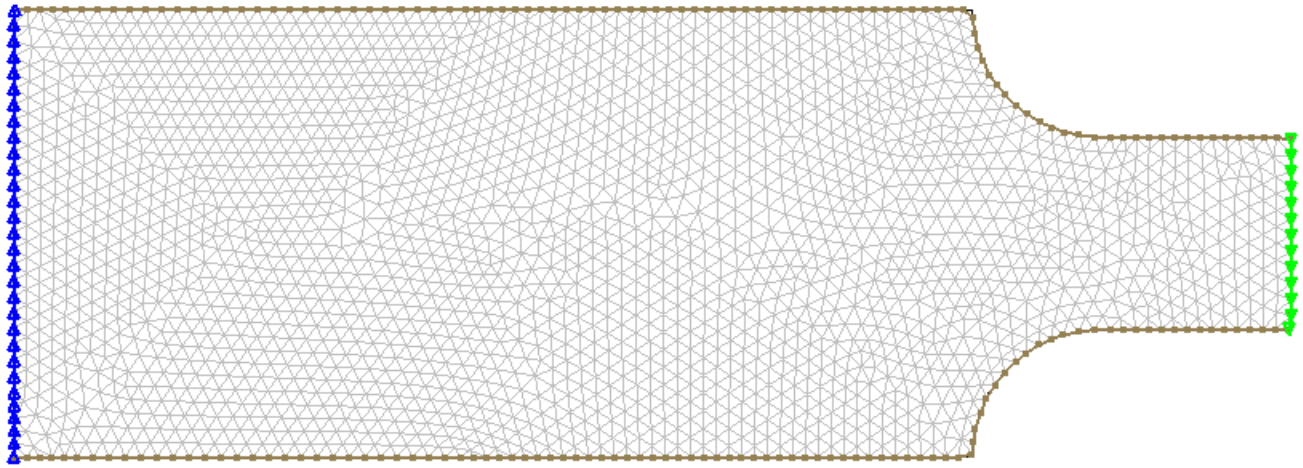


Zadavanje graničnih uslova - BlueKenue





Zadavanje graničnih uslova - BlueKenue



Mesh sa prikazanim lokacijama graničnih uslova

Podešavanje *case* fajla

```
BOUNDARY CONDITIONS FILE : Var2_BC.cli
GEOMETRY FILE            : GeometrijaV2.slf
2D RESULT FILE           : r2d_MF2.slf
3D RESULT FILE           : r3d_MF2.slf
/
INITIAL CONDITIONS : 'CONSTANT ELEVATION'
INITIAL ELEVATION  : 11.2
PRESCRIBED ELEVATIONS : 10.6565 ; 0.0
PRESCRIBED FLOWRATES  : 0.  ; 5.0
/
LAW OF BOTTOM FRICTION : 3
FRICTION COEFFICIENT FOR THE BOTTOM : 60.
/
```

Zadavanje fajla sa graničnim uslovima

Zadavanje fajla sa geometrijom

2D rezultati

3D rezultati

Podešavanje *case* fajla

```
1  BOUNDARY CONDITIONS FILE : Var2_BC.cli
2  GEOMETRY FILE            : GeometrijaV2.slf
3  2D RESULT FILE           : r2d_MF2.slf
4  3D RESULT FILE           : r3d_MF2.slf
5  /
6  INITIAL CONDITIONS : 'CONSTANT ELEVATION'
7  INITIAL ELEVATION  : 11.2
8  PRESCRIBED ELEVATIONS : 10.6565 ; 0.0
9  PRESCRIBED FLOWRATES  : 0.  ; 5.0
10 /
11 LAW OF BOTTOM FRICTION : 3
12 FRICTION COEFFICIENT FOR THE BOTTOM : 60.
```

Tip početnog uslova

Početni uslov

Nizvodni i uzvodni zadati nivoi

Nizvodni i uzvodni zadati protoci

Zakon po kom se računaju gubici – Štriklerova formula

Podešavanje *case* fajla

Generalna podešavanja

```
TITLE : 'TEST canal MF'
VARIABLES FOR 2D GRAPHIC PRINTOUTS : 'U,V,H,S,B'
VARIABLES FOR 3D GRAPHIC PRINTOUTS : 'Z,U,V,W'
TIME STEP : 0.5
NUMBER OF TIME STEPS : 12000
GRAPHIC PRINTOUT PERIOD : 100
LISTING PRINTOUT PERIOD : 200
NUMBER OF HORIZONTAL LEVELS : 10
/
```

Naziv proračuna

Izlazne veličine (2D)

Izlazne veličine (3D)

Vremenski korak

Broj vremenskih koraka

Broj horizontalnih preseka

Podešavanje *case* fajla

Numerička podešavanja

```
/---------------------------------------------------------------------
TIDAL FLATS : NO
/
MASS-BALANCE                                  : YES
VERTICAL TURBULENCE MODEL                   : 7
ACCURACY FOR DIFFUSION OF K-EPSILON         : 1.E-8
HORIZONTAL TURBULENCE MODEL                 : 7
/
SCHEME FOR ADVECTION OF VELOCITIES          : 1
/
ACCURACY FOR DIFFUSION OF VELOCITIES        : 1.E-7
SOLVER FOR PROPAGATION                      : 2
IMPLICITATION FOR DEPTH                     : 0.6
IMPLICITATION FOR VELOCITIES                : 0.6
/
```

Zadavanje modela turbulencije (k-ω)

Zadavanje šeme za advekciju brzina (preuzeto iz uglednog primera)

Tip solvera za propagaciju (preuzeto iz uglednog primera)

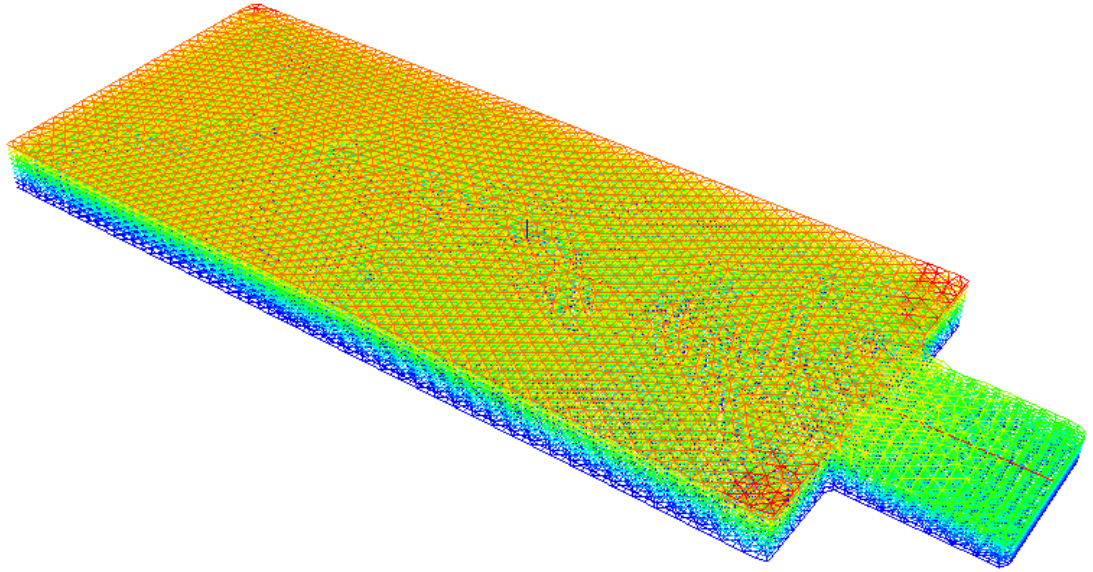
Podešavanje *case* fajla

- Proračun se pokreće kroz Python pokretanjem skripte za Telemac 3D i zadavanjem putanje ka *case* fajlu

```
C:\opentelemac-mascaret\v8p0r0\scripts\python27>python telemac3d.py ..\..\examples\telemac3d\trub_v1\t3dV1_MF.cas --ncsize=1

Loading Options and Configurations
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

... parsing configuration file: C:\opentelemac-mascaret\v8p0r0\configs\Win10gfortPLL.cfg

Running your CAS file for:
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

    +> configuration: wing64mpi
    +> root:          C:\opentelemac-mascaret\v8p0r0

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

Rezultati – varijanta 1

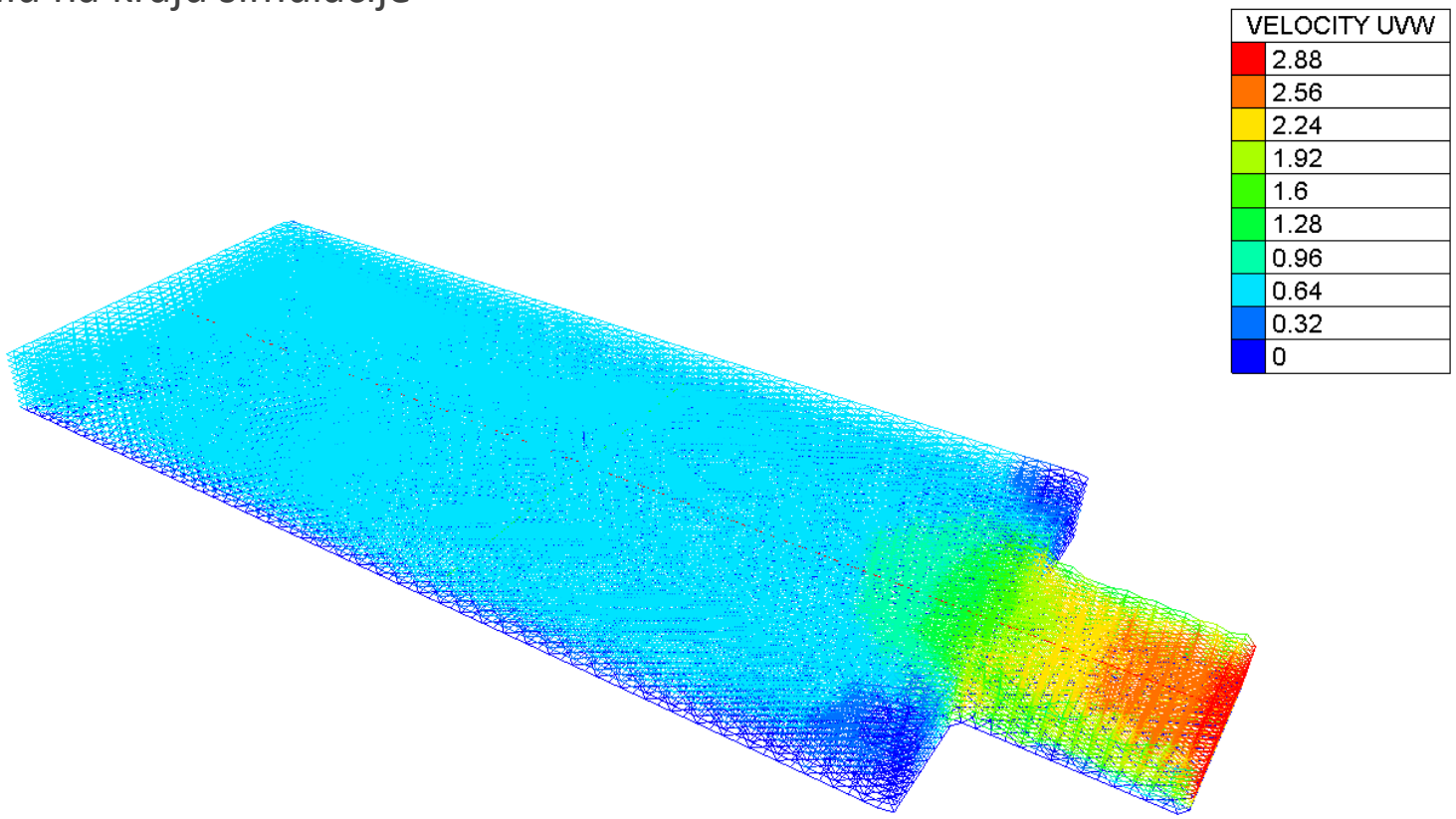
- **Nivoi** vode u kanalu na kraju simulacije



ELEVATION Z
11.08
10.96
10.84
10.72
10.6
10.48
10.36
10.24
10.12
10

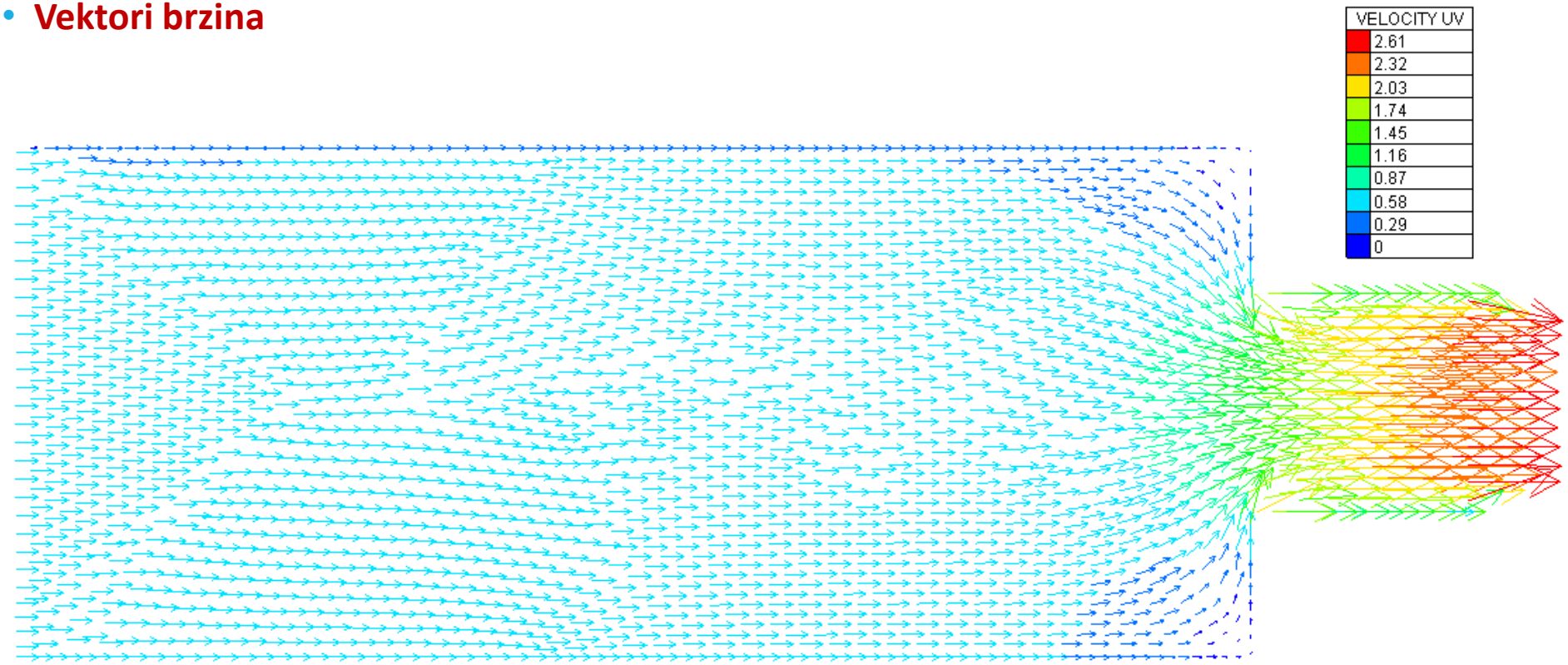
Rezultati – varijanta 1

- **Brzine** u kanalu na kraju simulacije



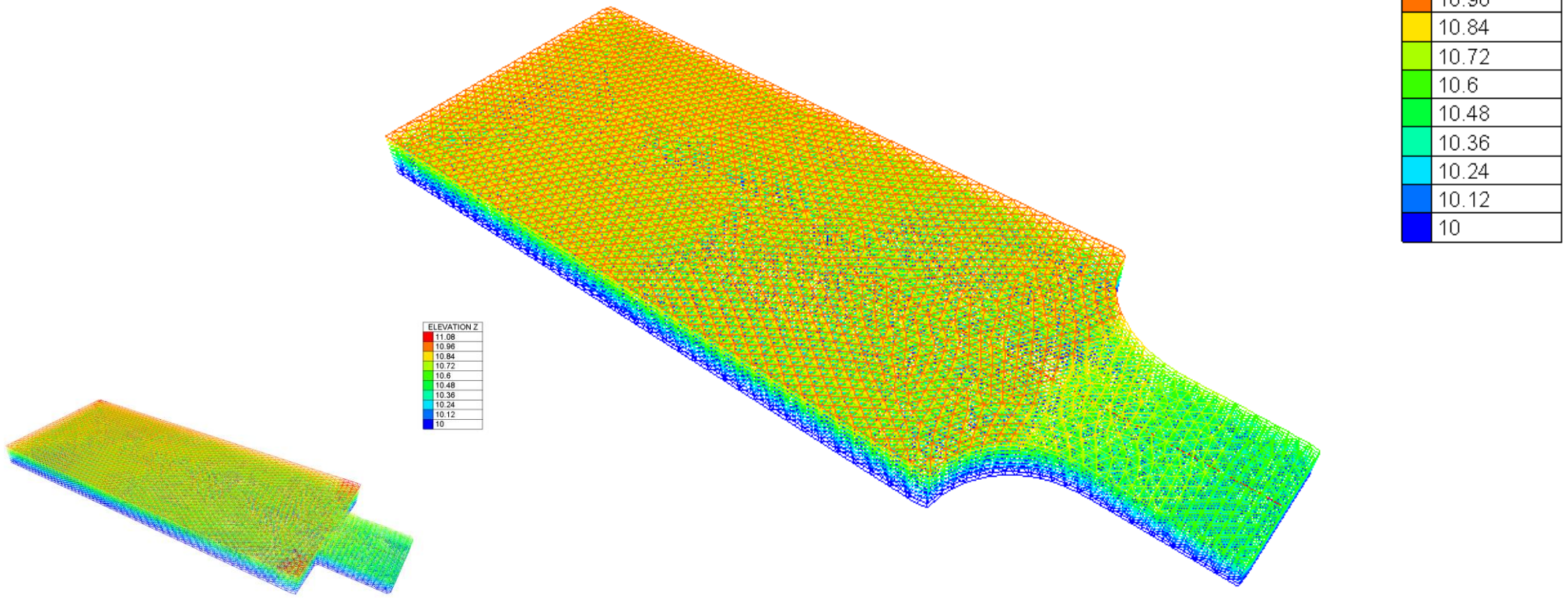
Rezultati – varijanta 1

- **Vektori brzina**



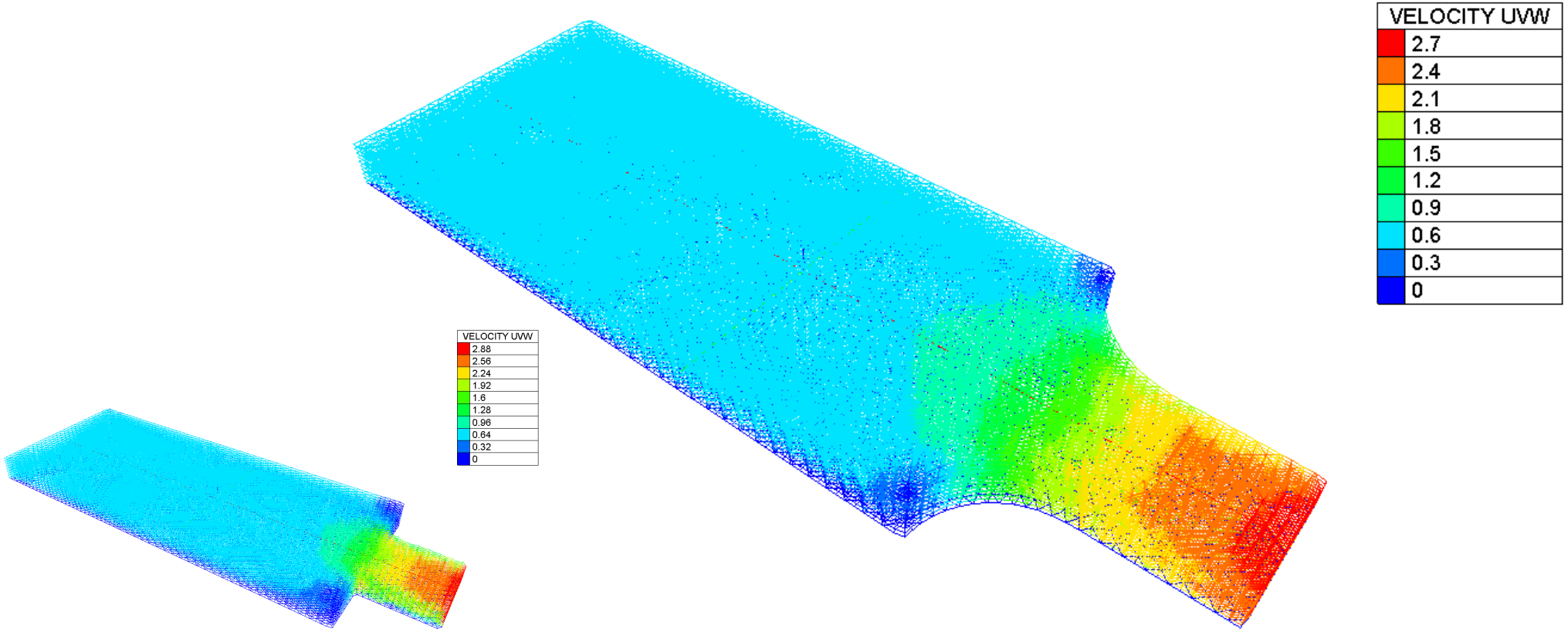
Rezultati – varijanta 2

- **Nivoi** vode u kanalu na kraju simulacije



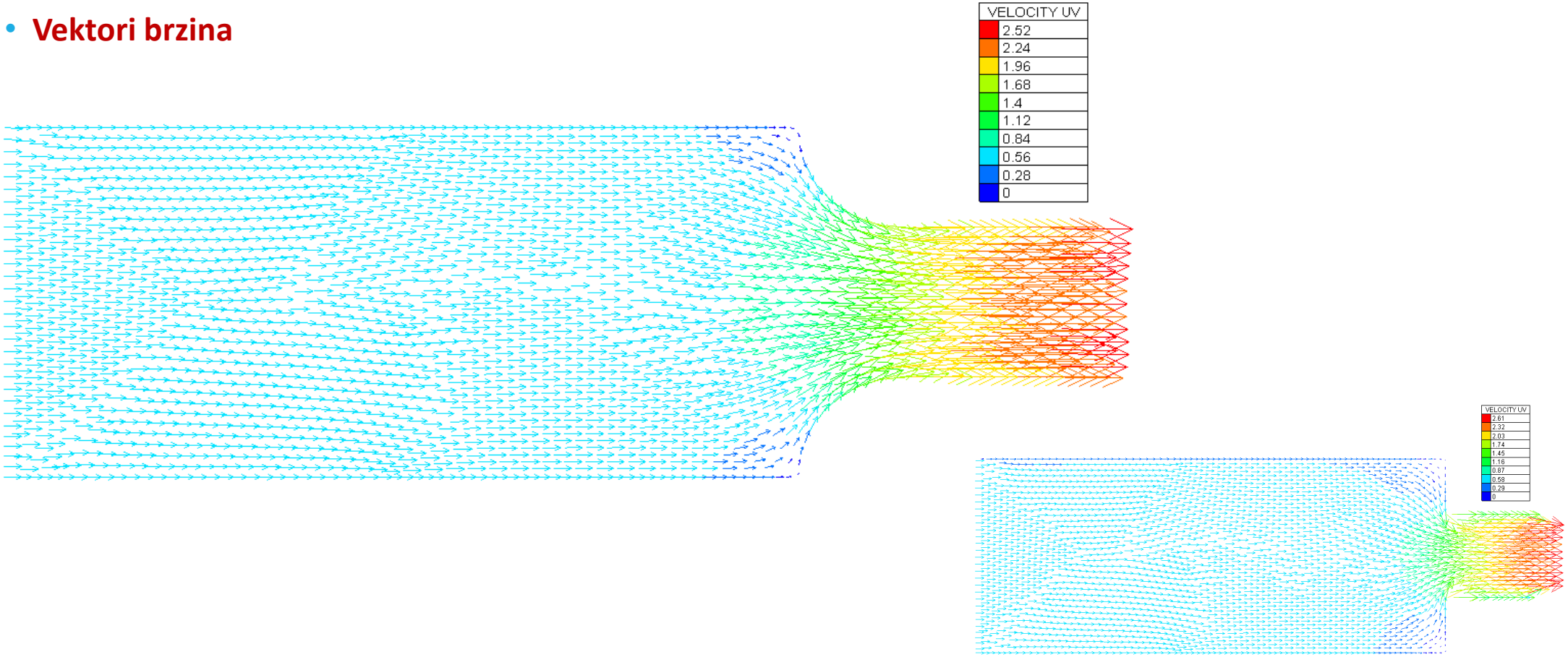
Rezultati – varijanta 2

- **Brzine** u kanalu na kraju simulacije



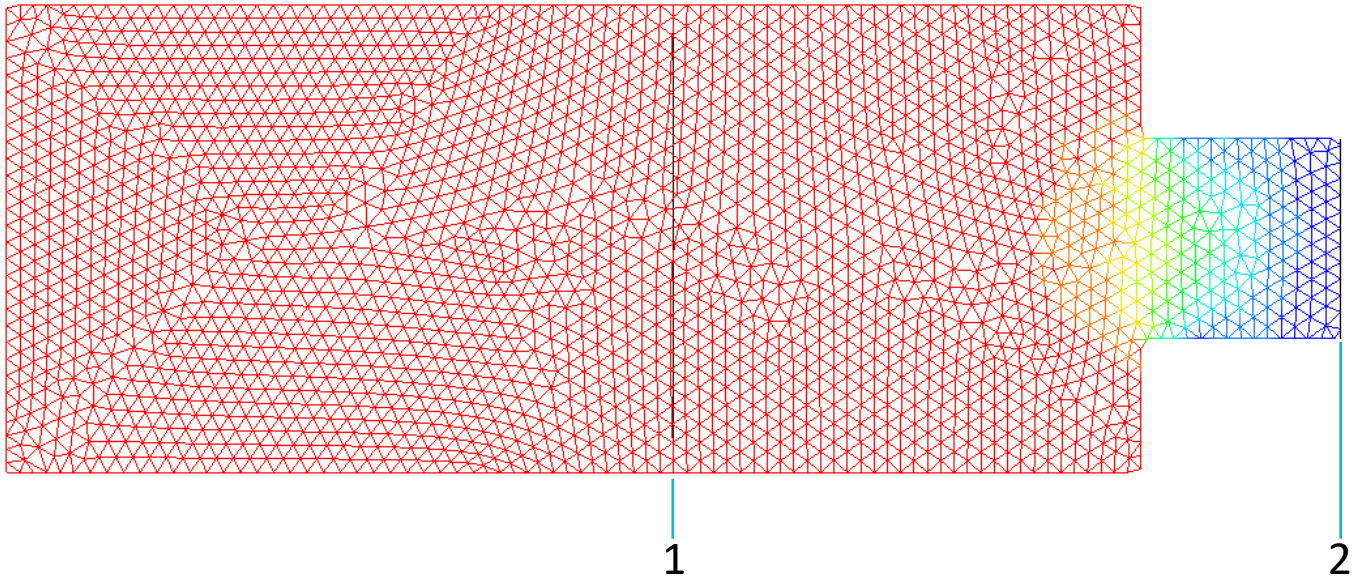
Rezultati – varijanta 2

- **Vektori brzina**



Zaključak i predlozi za dalja istraživanja

- Koeficijenti lokalnih gubitaka energije sračunati su za obe varijante proračuna
- $\xi_1 = 0{,}318$

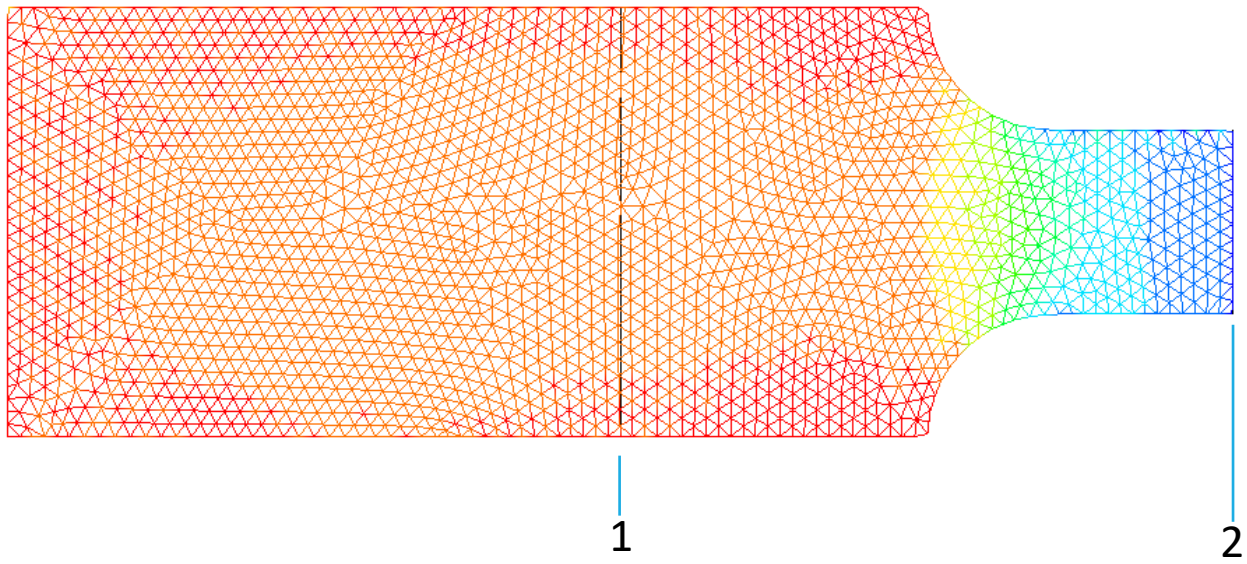


$V_1 = 1{,}56$
$h_1 = 1{,}0667$

$V_2 = 2{,}54$
$h_2 = 0{,}6565$

Zaključak i predlozi za dalja istraživanja

- $\xi_2 = 0{,}222$



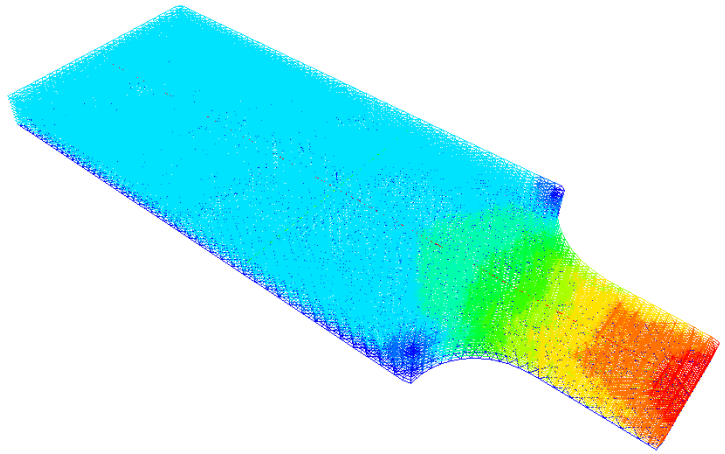
$V_1 = 1{,}61$
$h_1 = 1{,}0336$

$V_2 = 2{,}54$
$h_2 = 0{,}6565$

- Promena geometrije suženja uticala je na **smanjenje** koeficijenta lokalnog gubitka

Zaključak i predlozi za dalja istraživanja

- Ispitati blažu promenu geometrije suženja u odnosu na varijantu 2
- Sagledati rezultate pri promeni gustine mreže i veličine vremenskog koraka
- Radi bolje i lakše vizuelizacije, i izvlačenja rezultata isprobati primenu alata poput Paraview-a, PostTelemac-a (add-on za QGIS) ili Tecplot-a



Hvala na pažnji!

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