



UNIVERZITET U BEOGRADU
GRAĐEVINSKI FAKULTET
ODSEK ZA HIDROTEHNIKU I VODNO-EKOLOŠKO INŽENJERSTVO

DOKTORSKE STUDIJE
MEHANIKA FULUIDA – NAPREDNI KURS

MODELIRANJE TURBULENCIJE U PRIZMATIČNOM KANALU PRIMENOM SOFTVERA iRIC 3.0

Profesor:
Prof. dr Dušan Prodanović

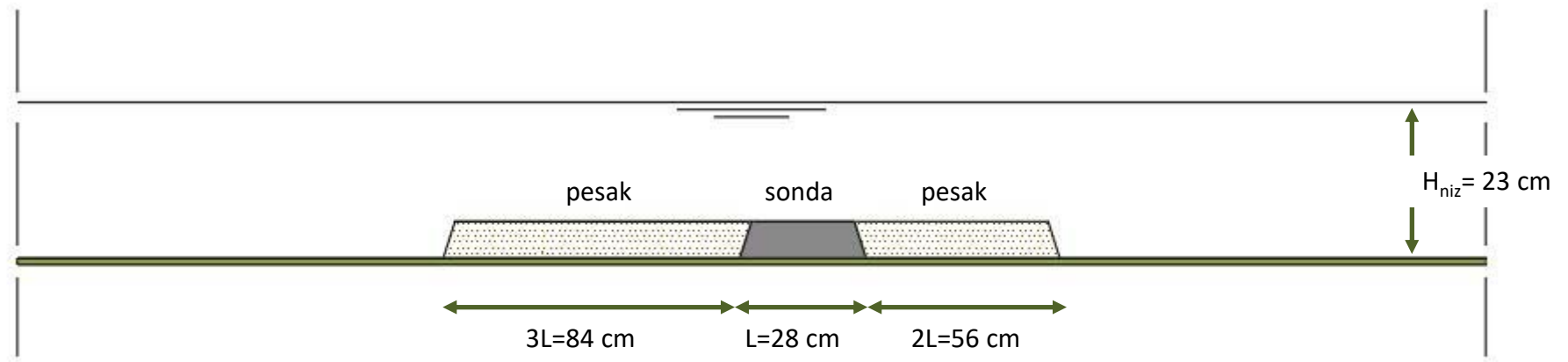
Student:
Ognjen Govedarica

Beograd, 2018

Sadržaj

- Opis i cilj zadatka
- iRIC - NaysCUBE
- Kreiranje mreže
- Zadavanje parametara
- Zadavanje prepreke
- Zadavanje promenjive hrapavosti u kanalu
- Rezultati – varijanta 1
- Rezultati – varijanta 2
- Zaključak

OPIS I CILJ ZADATKA



POZNATO

geometrija kanala:

- prizmatični kanal
- dužina $L=4\text{ m}$
- širina $B=24\text{ cm}$

dimenzije sonde:

- dužina $L=28\text{ cm}$
- širina $B=16\text{ cm}$
- visina: $h=2,3\text{ cm}$

uslovi tečenja:

- nizvodna dubina $H_{\text{niz}}=23\text{ cm}$
- protok $Q=11\text{ L/s}$

TRAŽI SE

UPOREDITI RASPORED BRZINA:

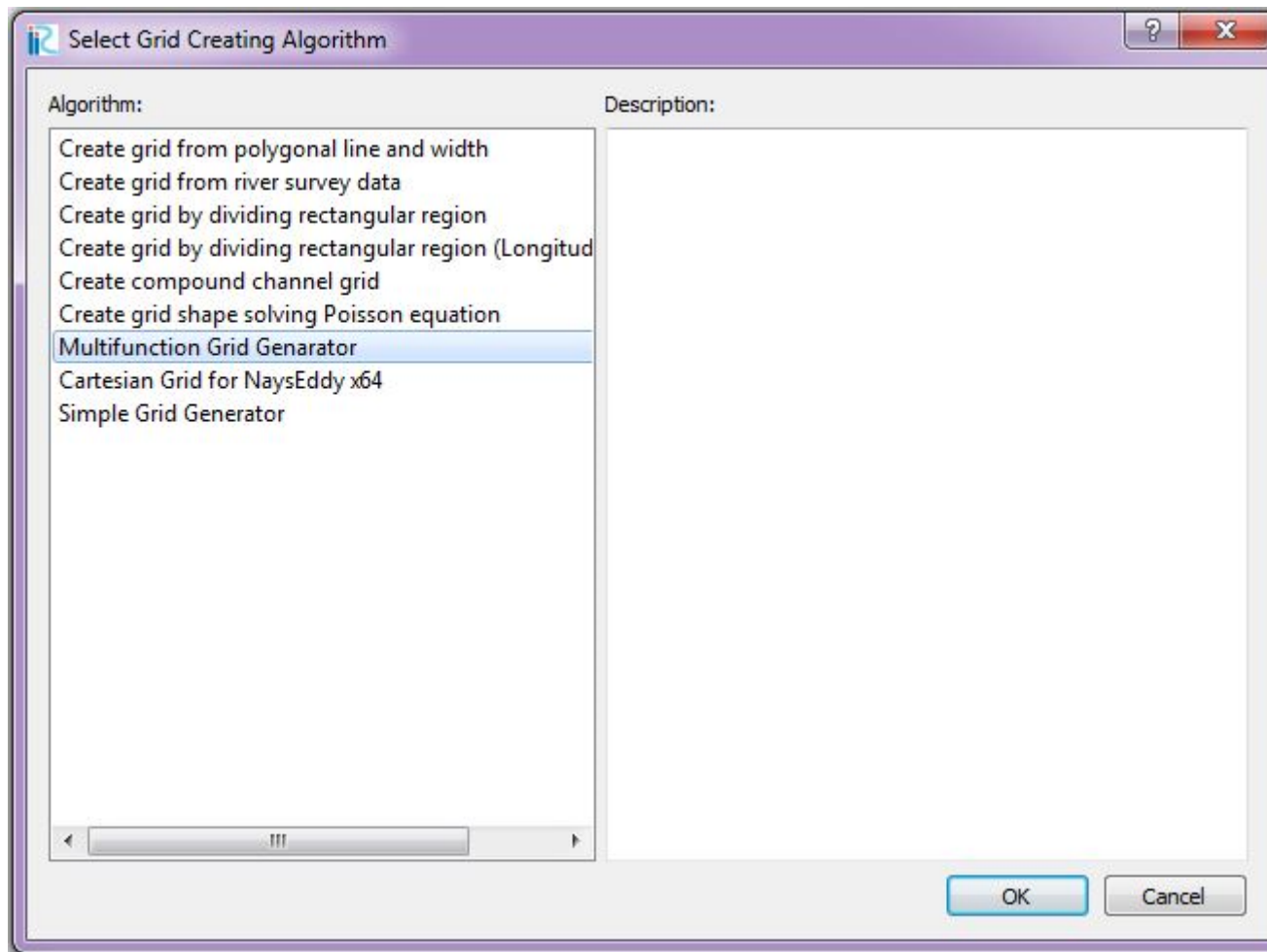
- po širini
- po dužini

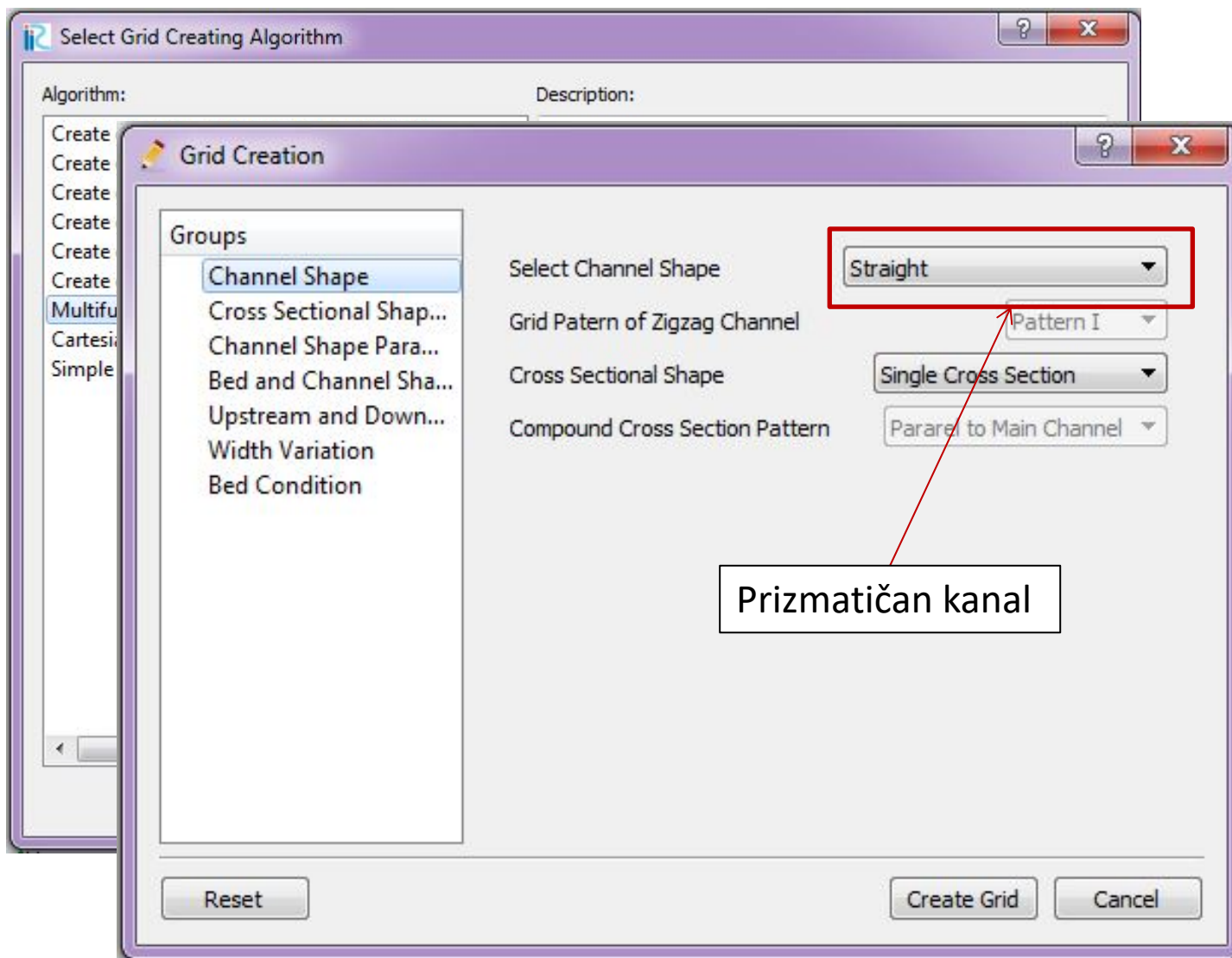
iRIC - NaysCUBE

iRIC - NaysCUBE

- Softver za proračun trodimenzionalnog tečenja u otvorenim tokovima i za proračune defromacije rečnog korita
- Može da simulira sekundarna strujanja, opstrujavanje oko objekata u tokovima, tečenje u tokovima sa ili bez prepreka
- Pogodan je za simuliranje ograničenog dela reke
- Nije pogodan za simuliranje celog širokog područja reke

KREIRANJE MREŽE





Grid Creation

Groups

- Channel Shape
- Cross Sectional Shap...
- Channel Shape Para...
- Bed and Channel Sha...
- Upstream and Down...
- Width Variation
- Bed Condition

Single Cross Section

Width(m)	0.24
Number of Grid in Lateral Direction	12

Compound Channel

Numbers of Grids

Left Floodplain

Low Water Channel

Right Floodplain

Low Water Channel Depth(m)

Bank Slope Ratio of Low Water Channel

Numbers of Grids in Low Water Channel Bank

Simple Compound Channel

Channel Width

Left Flood Channel Width(m)	0.3
Low Water Channel Width(m)	0.3
Right Flood Channel Width(m)	0.3

With Straight or Meandering Levees

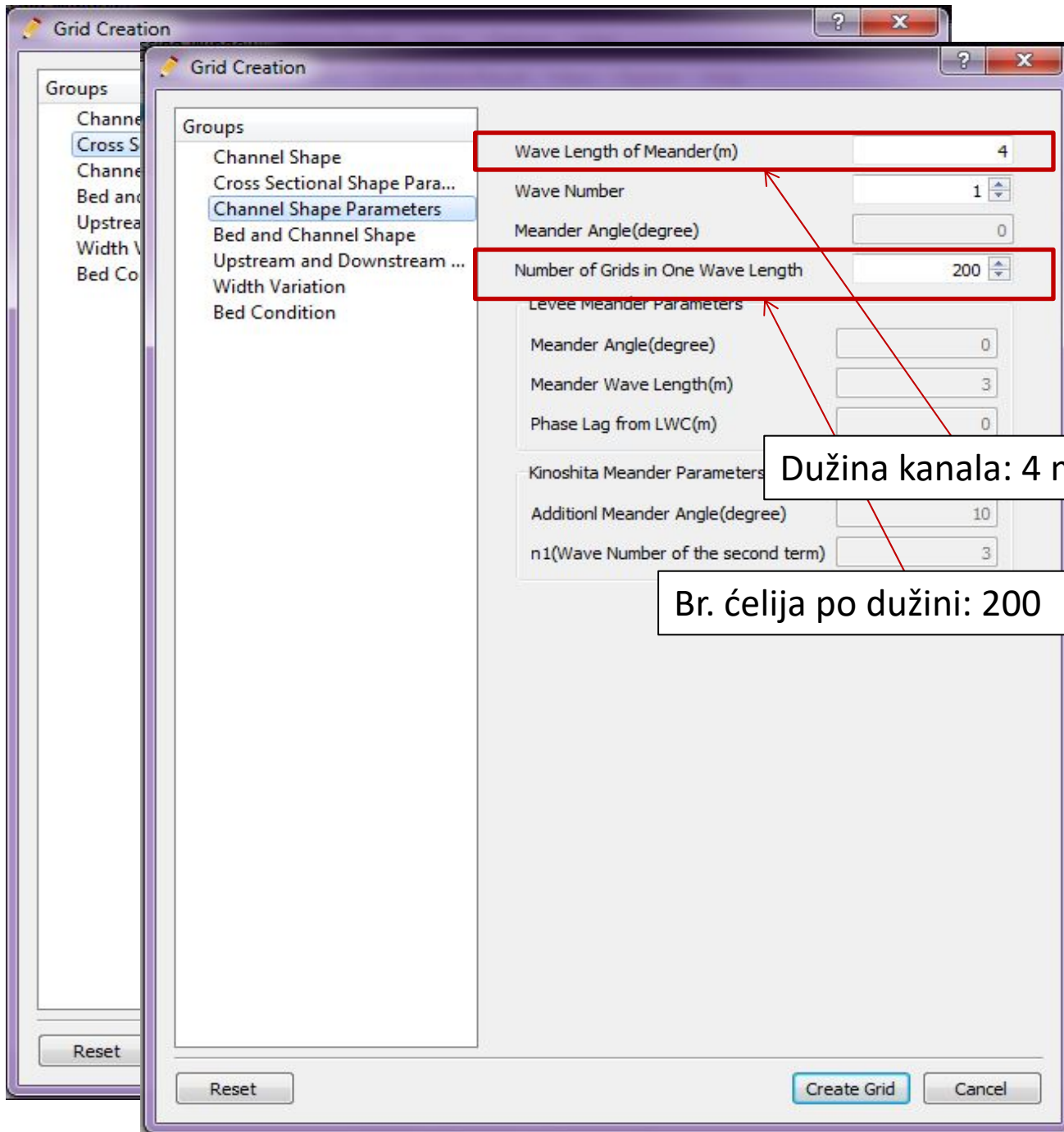
Total Width(m)	2
Low Water Channel Width(m)	0.3
Left Levee Distance from Channel Center(m)	2
Right Levee Distance from Channel Center(m)	2

Reset Create Grid Cancel

Širina kanala: 24 cm

Br. ćelija po širini: 12

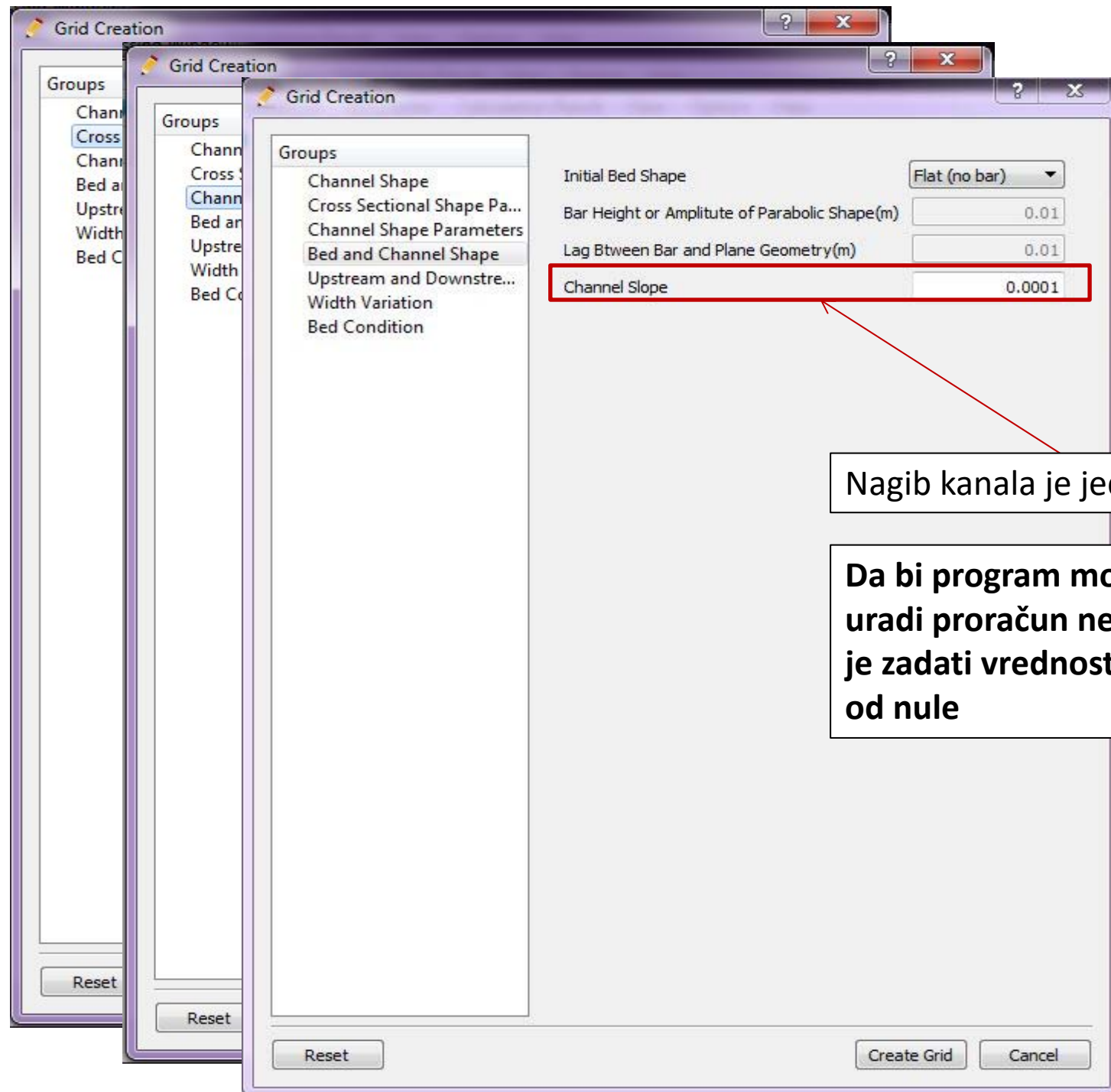
Veličina ćelije:
 $\Delta y = 0,02$ m



Dužina kanala: 4 m

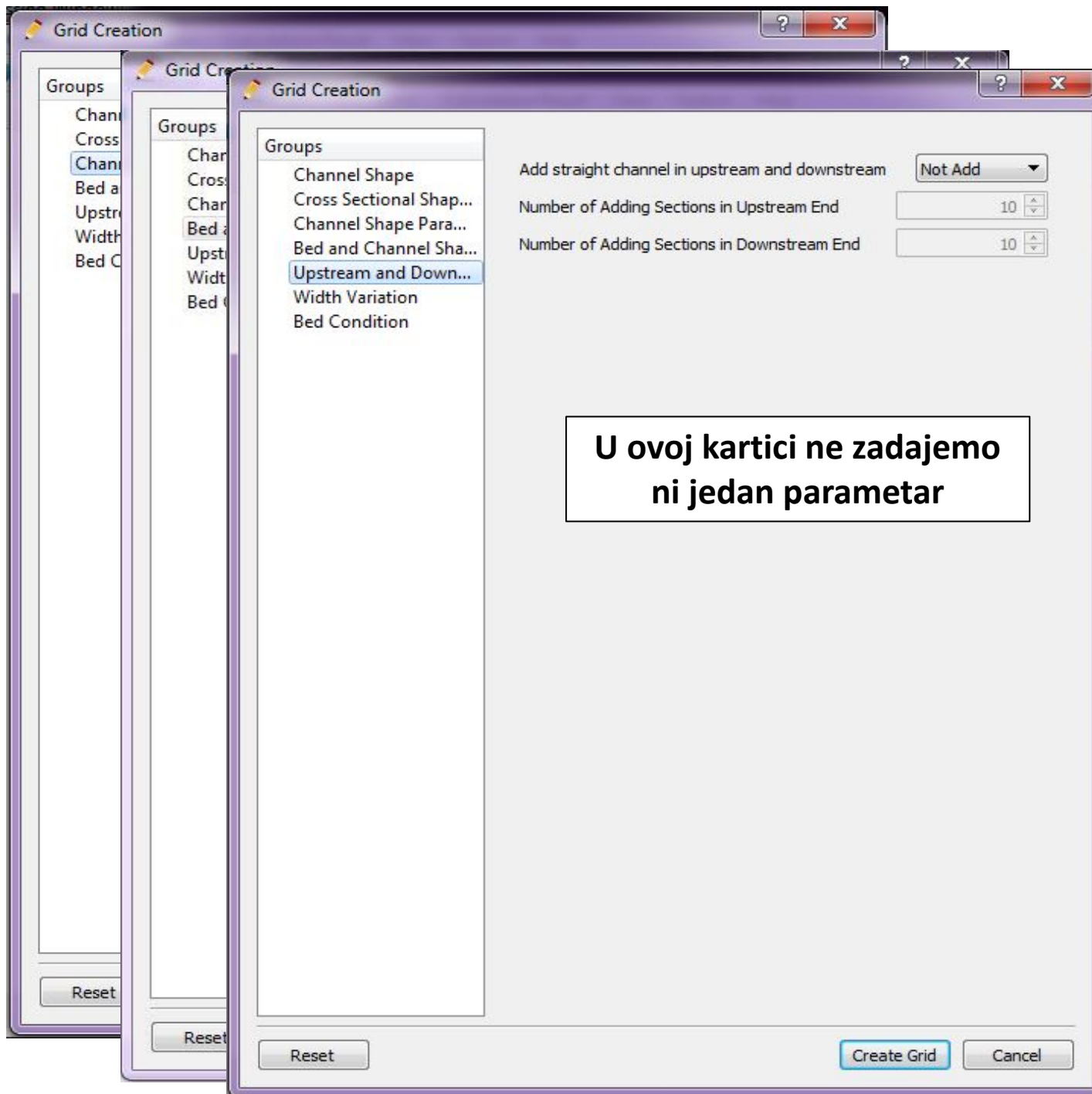
Br. ćelija po dužini: 200

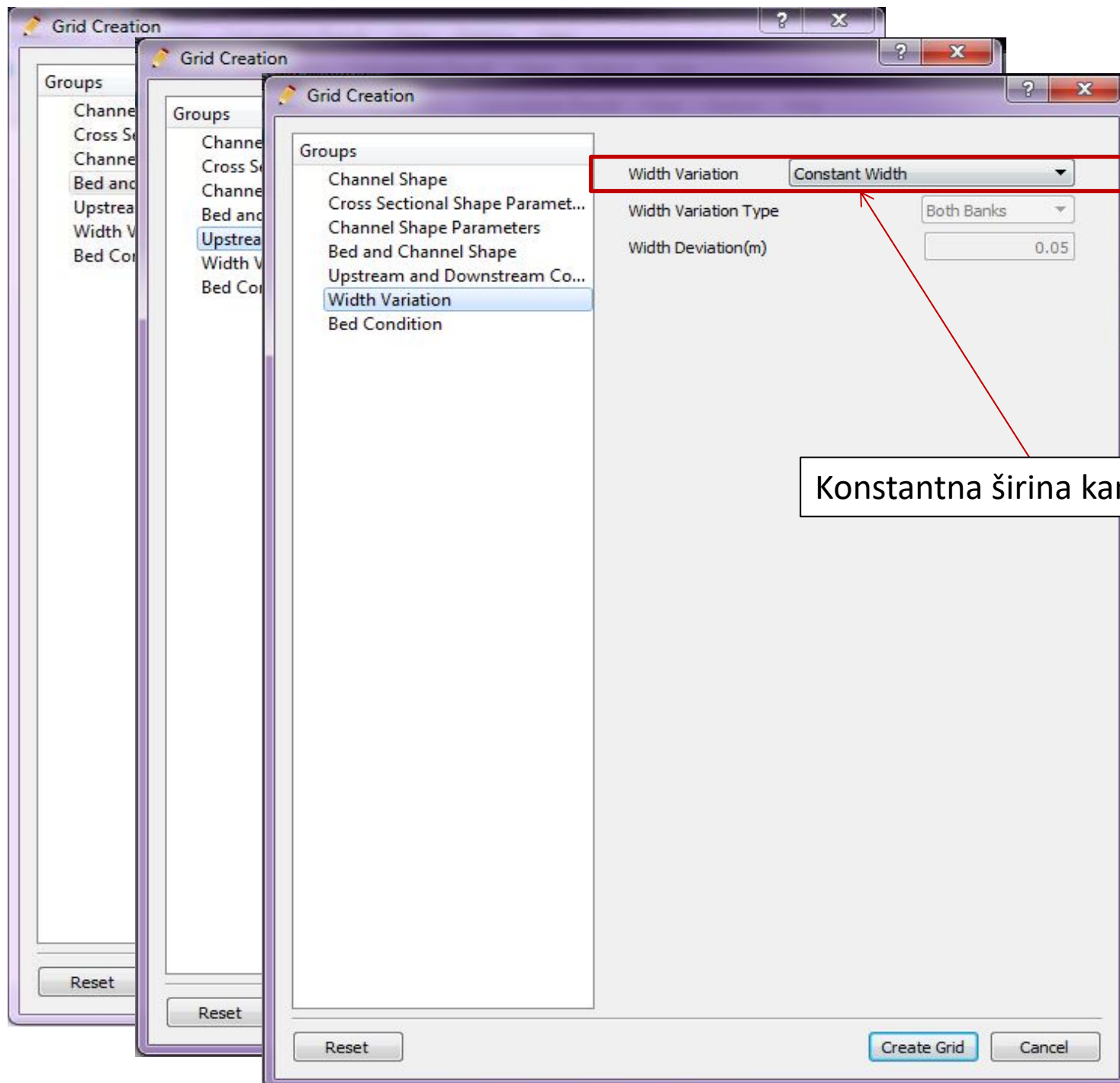
Veličina ćelije:
 $\Delta x = 0,02$ m



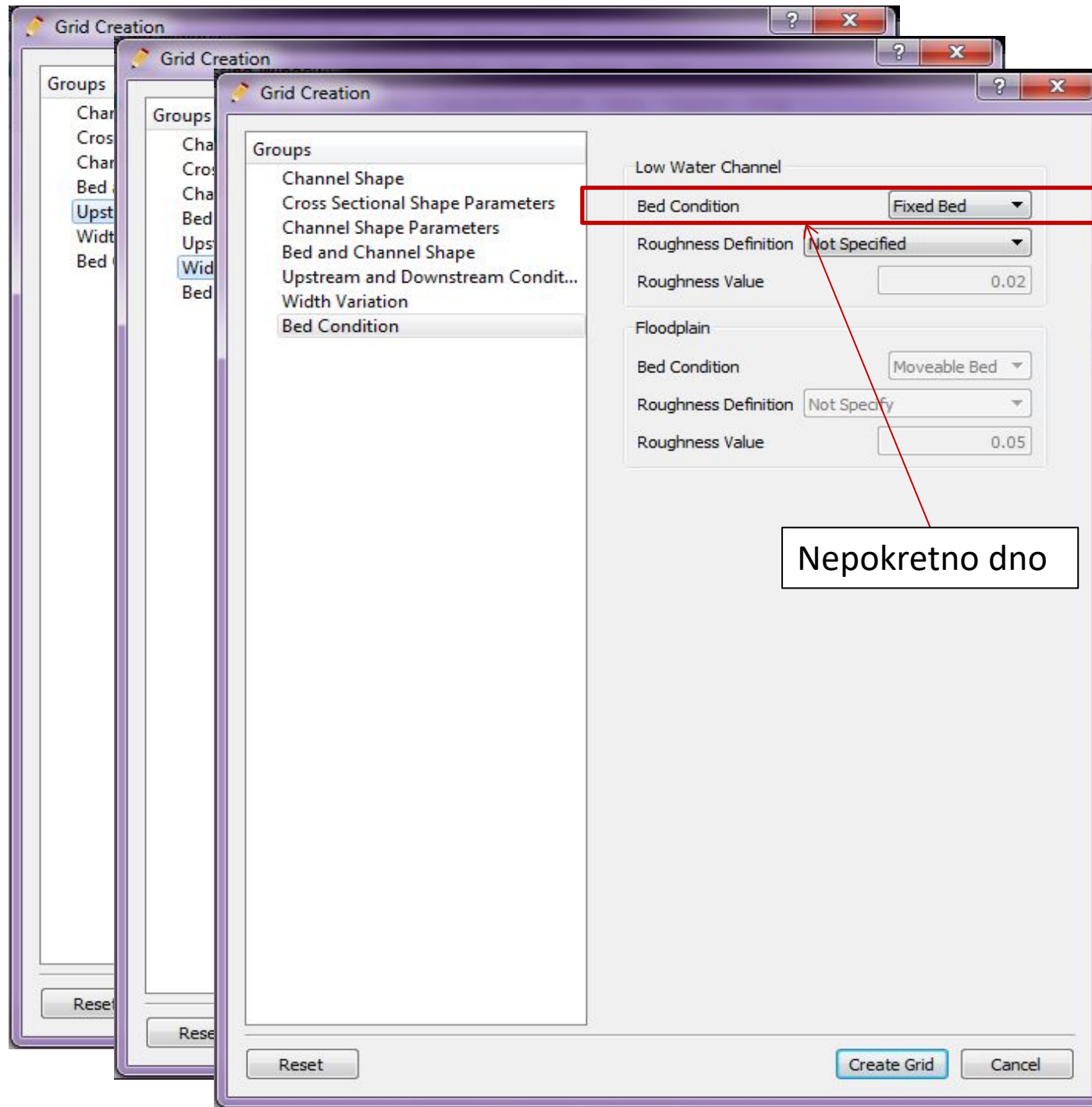
Nagib kanala je jednak 0

Da bi program mogao da uradi proračun neophodno je zadati vrednost različitu od nule

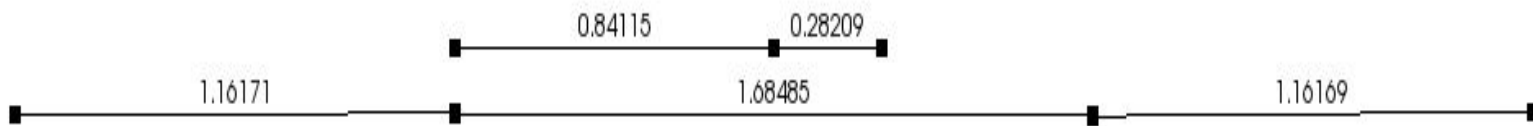
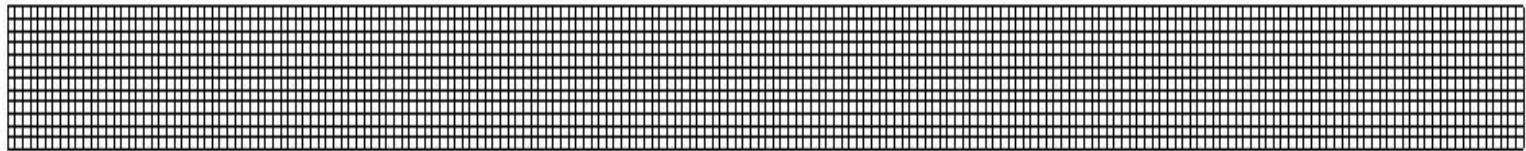




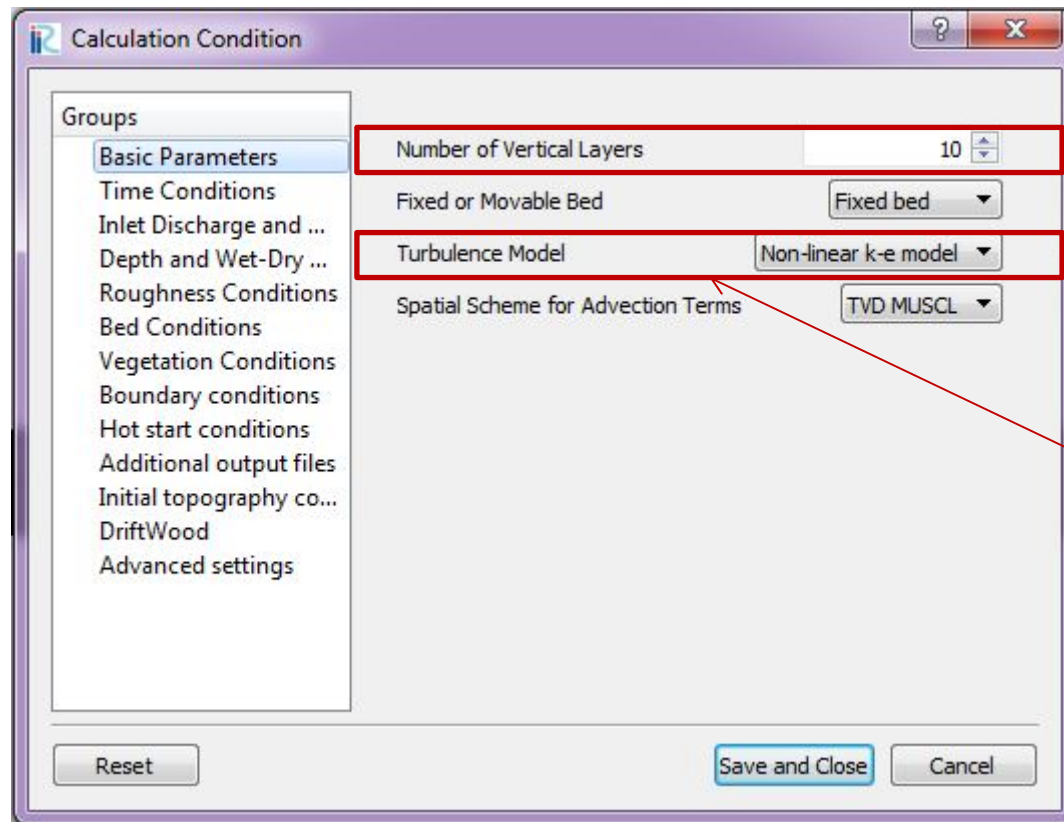
Konstantna širina kanala



Dobijena mreža

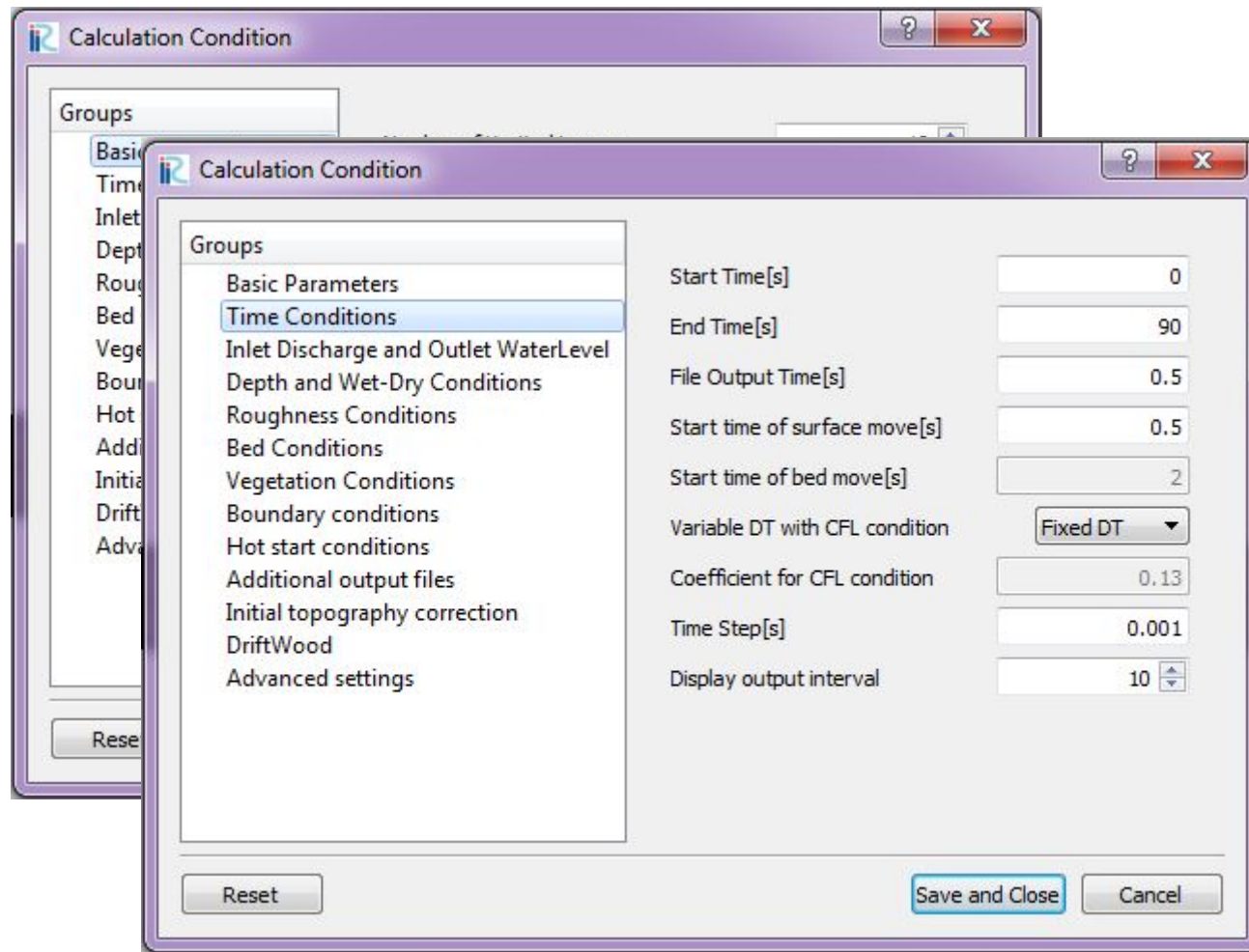


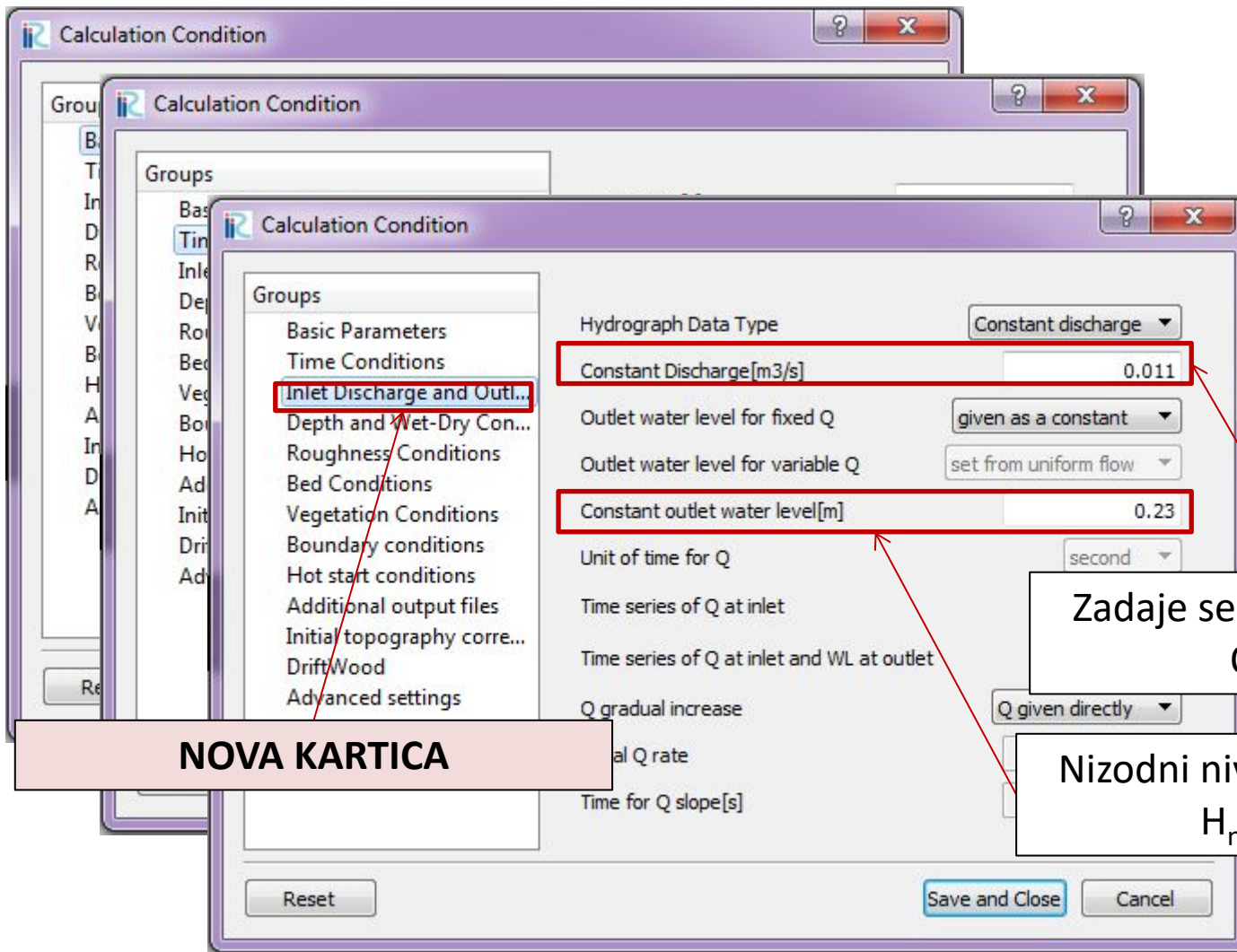
ZADAVANJE PARAMETARA



Broj ćelija po vertikali: 10

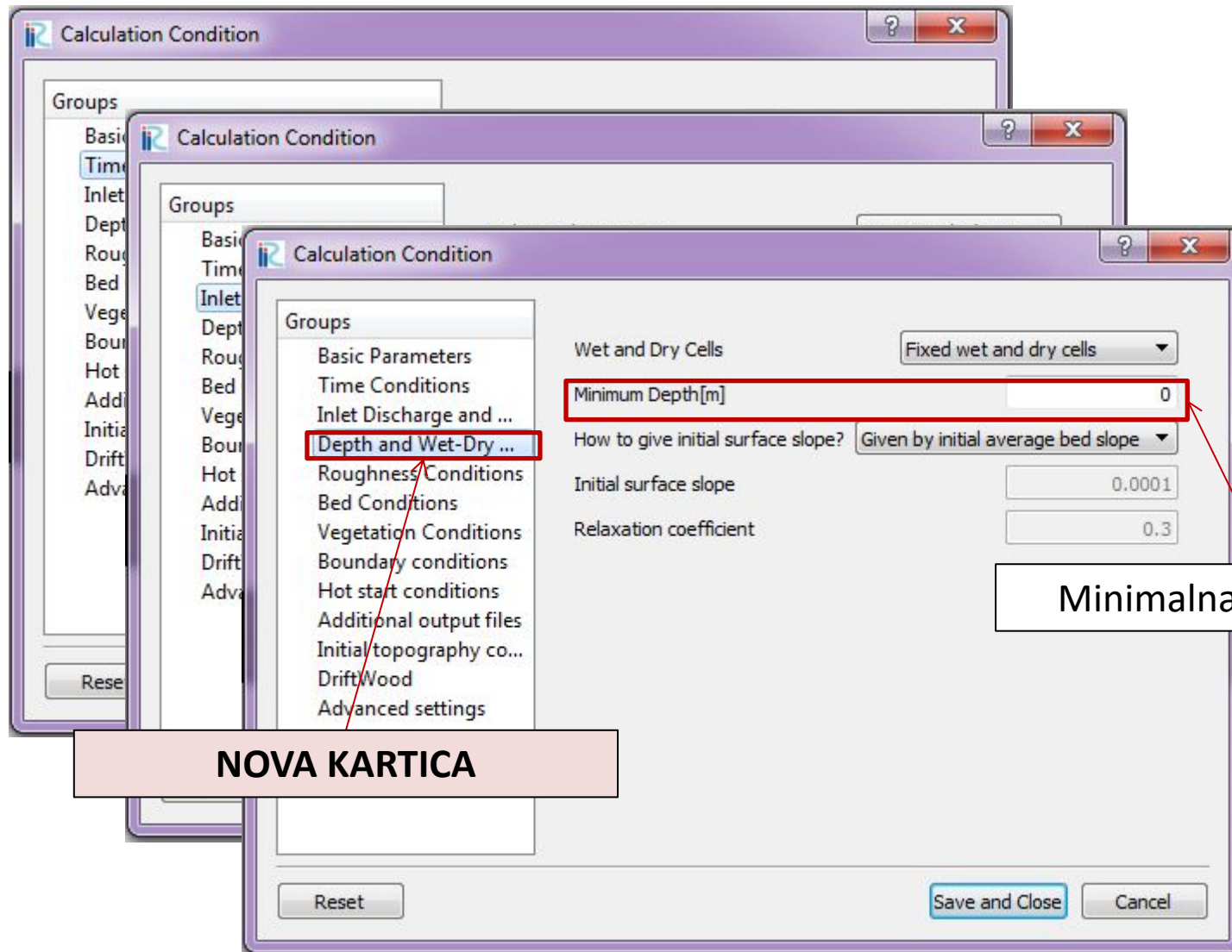
Nelinearan model





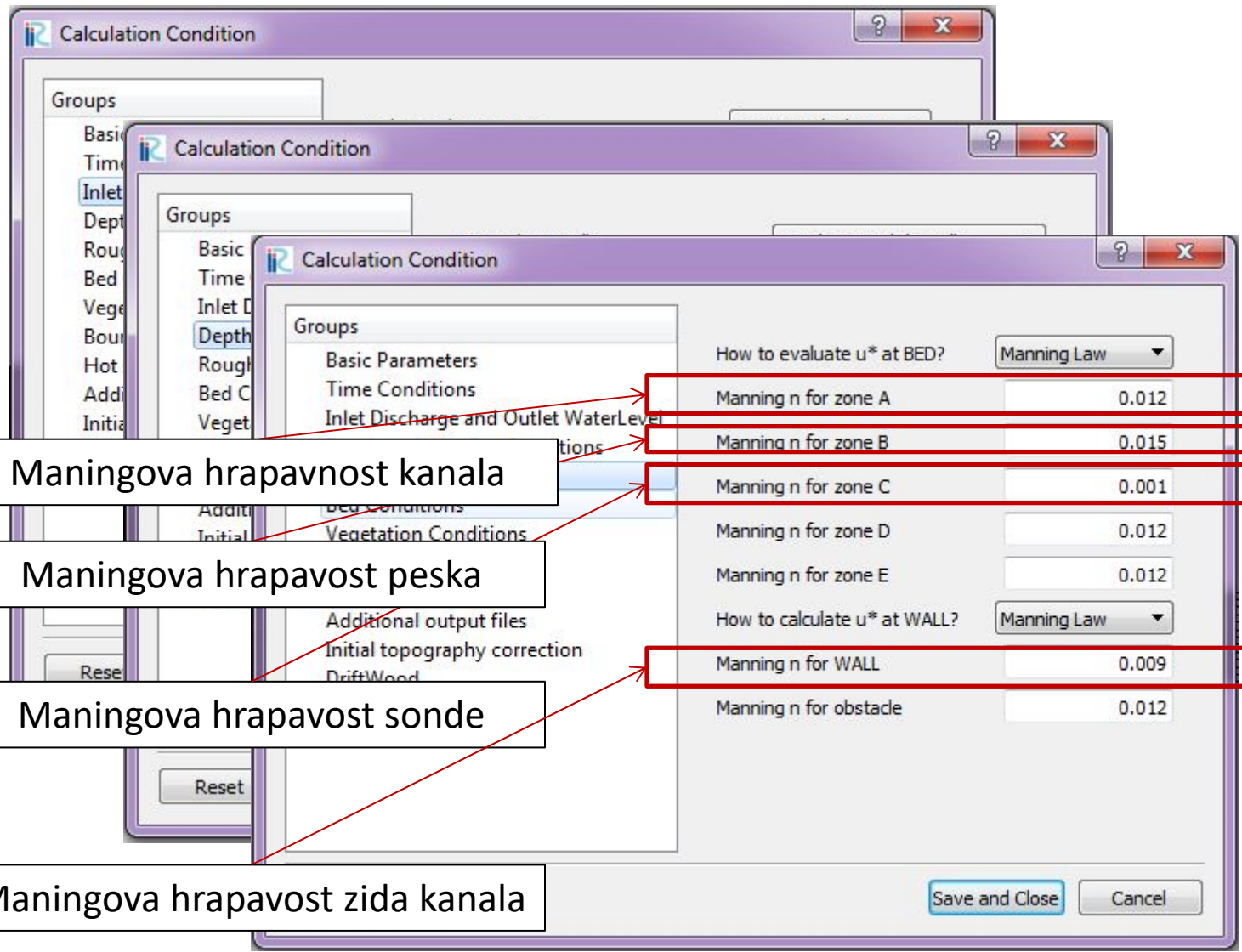
Zadaje se konsantan protok
 $Q = 11 \text{ L/s}$

Nizodni nivo vode u kanalu:
 $H_{\text{niz}} = 23 \text{ cm}$



NOVA KARTICA

Minimalna dubina je 0 m



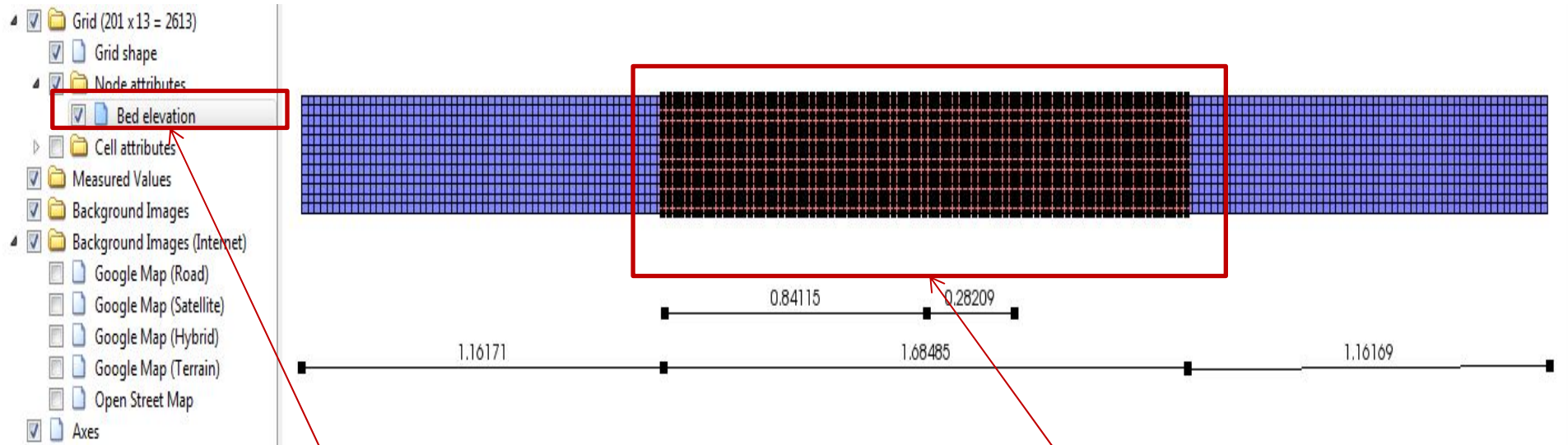
Maningova hrapavnost kanala

Maningova hrapavnost peska

Maningova hrapavnost sonde

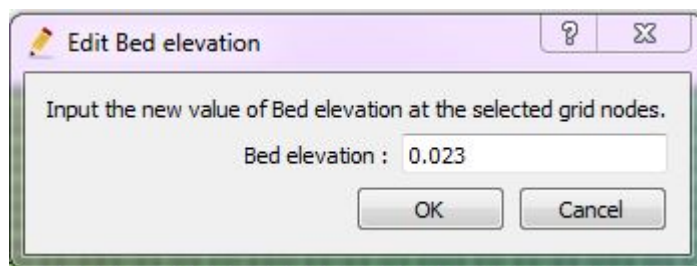
Maningova hrapavnost zida kanala

ZADAVANJE PREPREKE



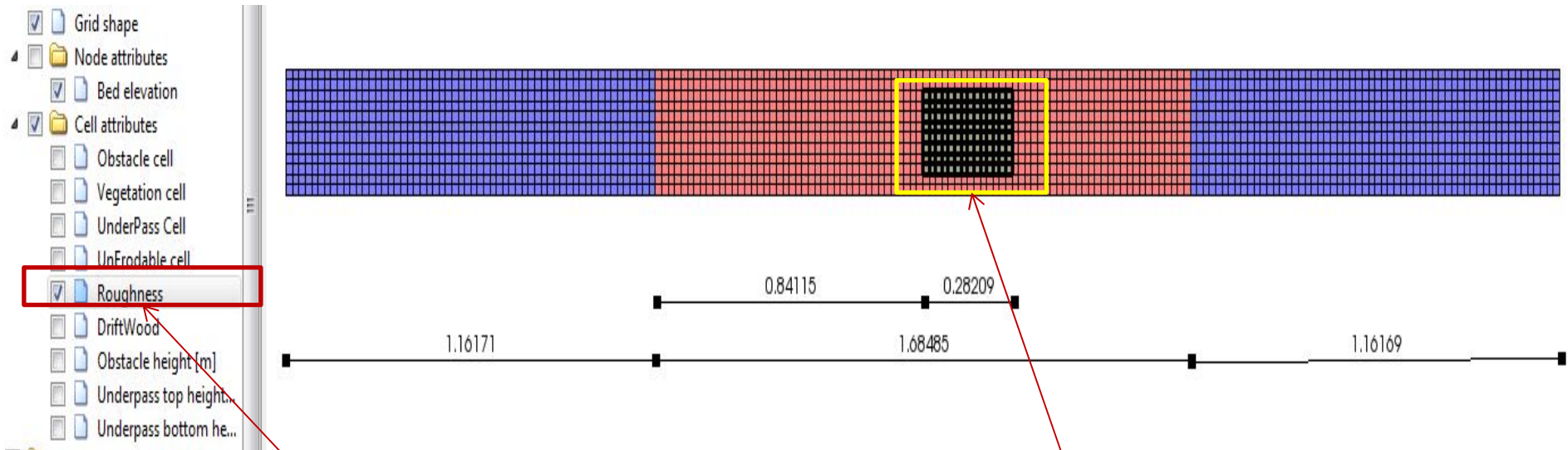
U meniju sa leve strane izabere se kartica *Bed elevation*

Označi se željeni deo mreže i pritiskom na desnik klik miša bira se *Edit value* iz padajućeg menija



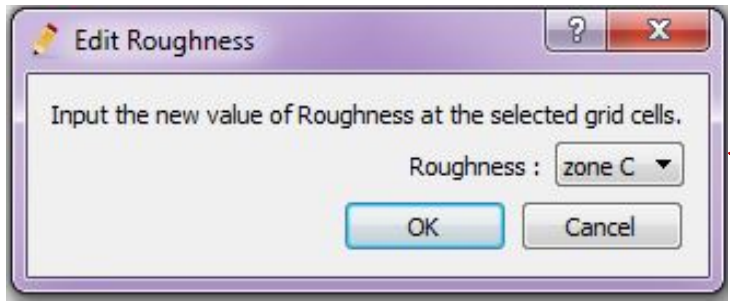
Na kraju se zadaje željena vrednost

ZADAVANJE PROMENJIVE HRAPAVOSI U KANALU



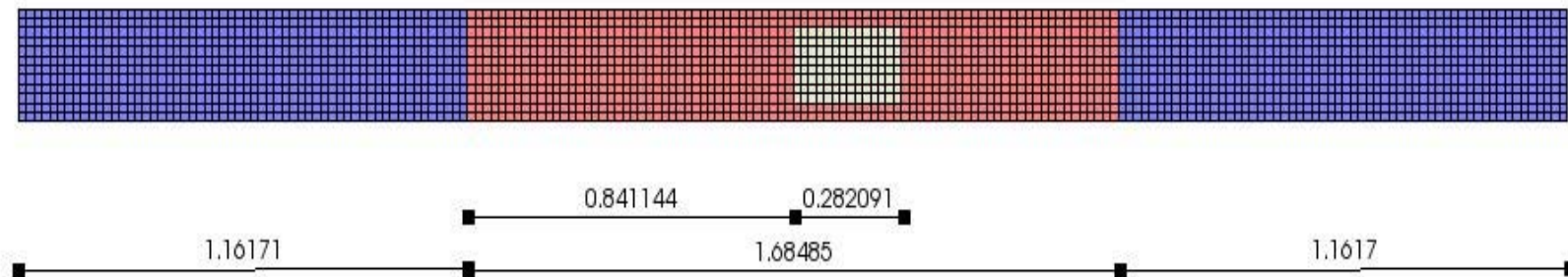
U meniju sa leve strane izabere se kartica *Roughness*

Označi se željeni deo mreže i pritiskom na desnik klik miša bira se *Edit value* iz padajućeg menija



Na kraju se zadaje željena vrednost

Prikaz mreže sa različitim vrednostima Manningovog koeficijenta hrapavosti



Razmatrane varijante

Varijanta 1

$$n=0,015 \text{ m}^{-1/3}\text{s}$$

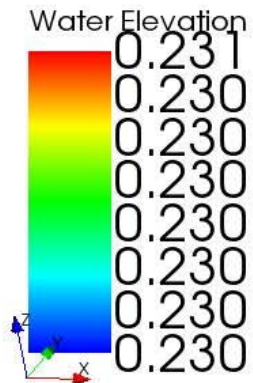
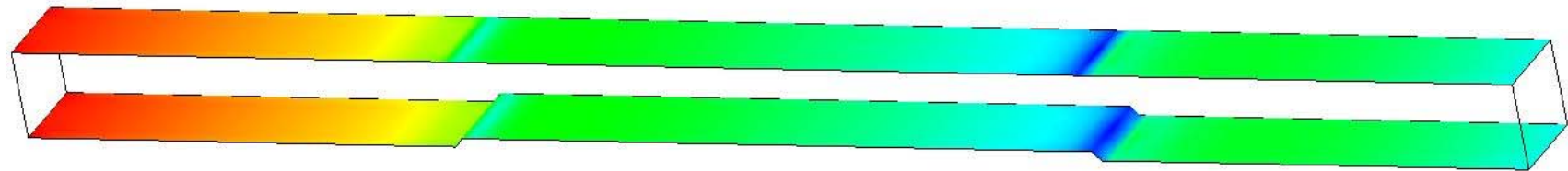
Varijanta 2

$$n=0,030 \text{ m}^{-1/3}\text{s}$$

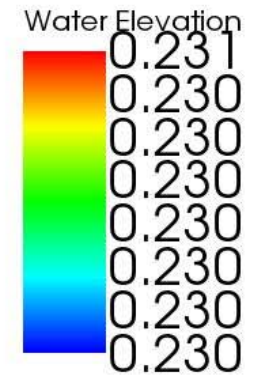
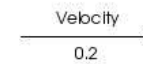


Rezultati varijanta 1

Nivoi vode u kanalu na sredini simulacije

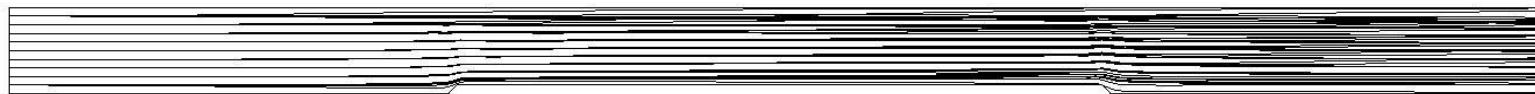


Time: 45 sec

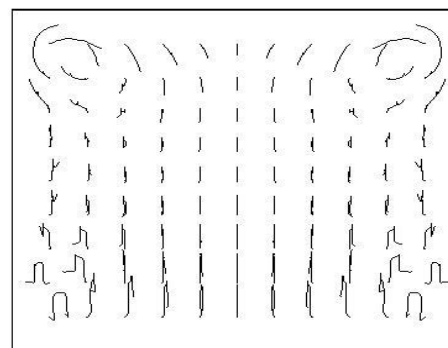


STRUJNICE

PODUŽNI PRESEK

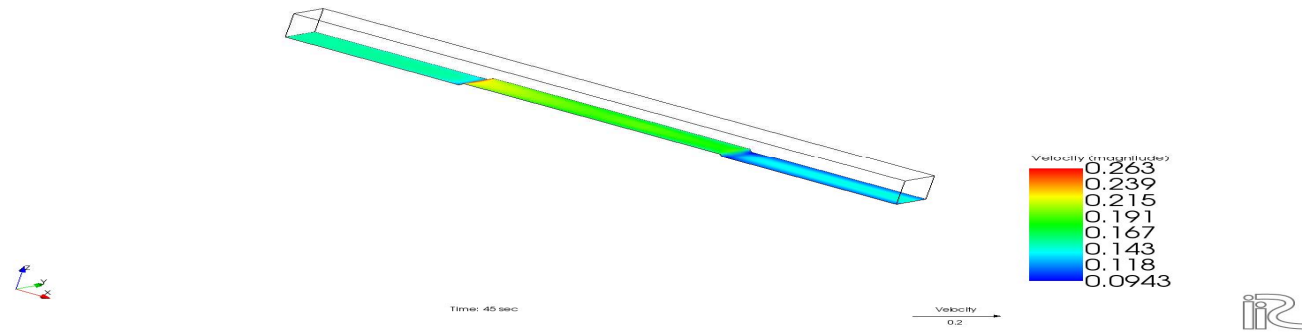


POPREČNI PRESEK

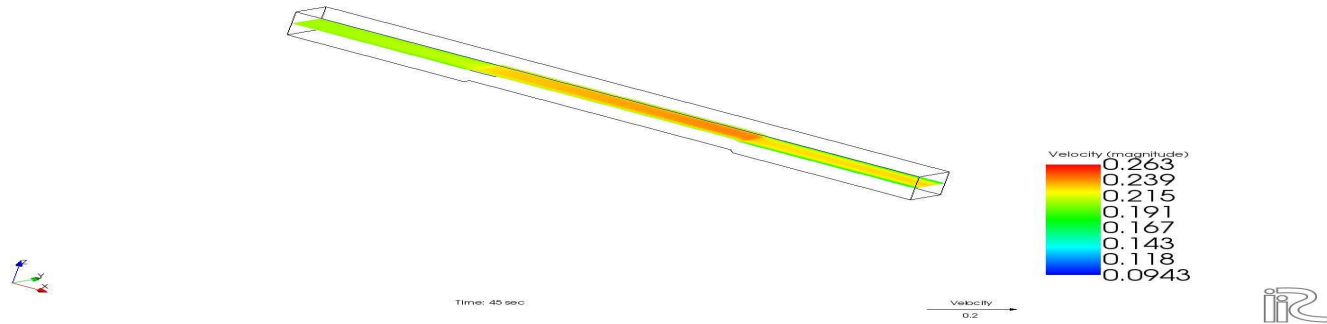


Brzine vode (za konstantno z)

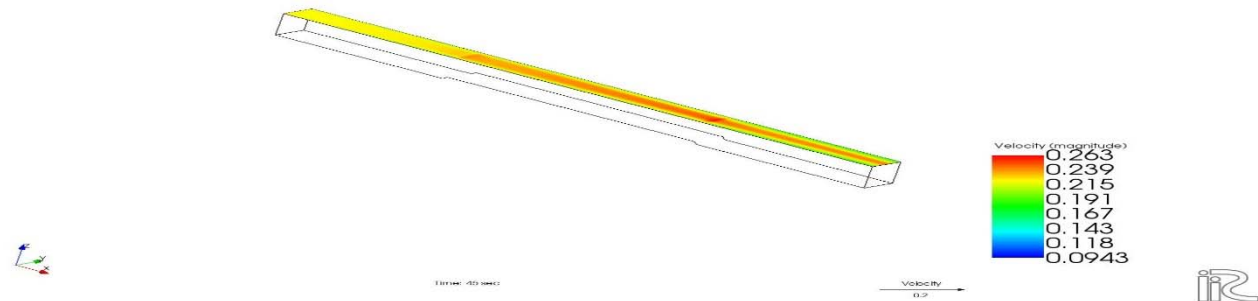
K=1



K=6

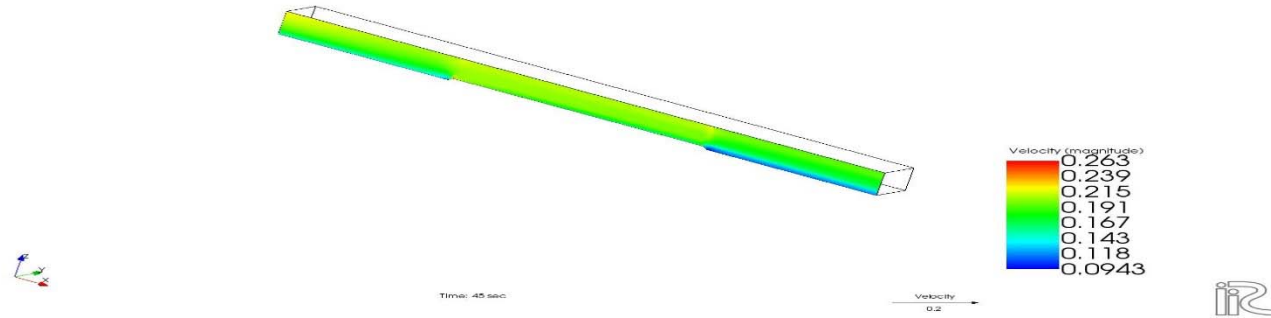


K=11

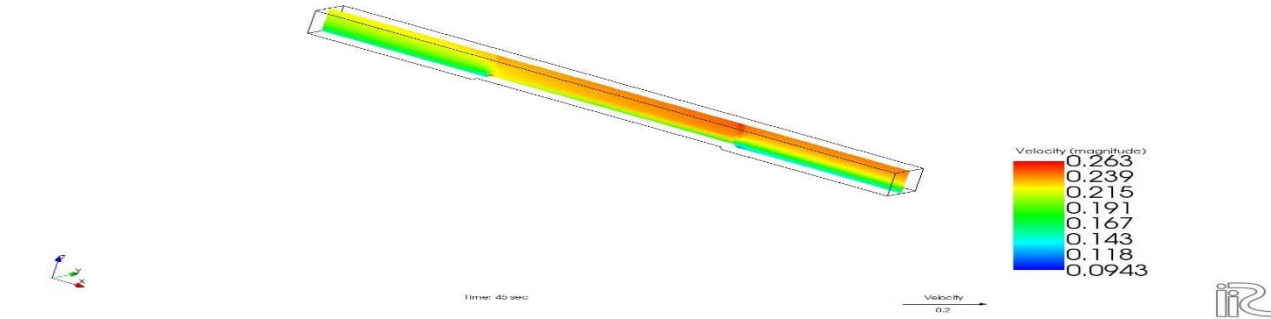


Brzine vode (za konstantno y)

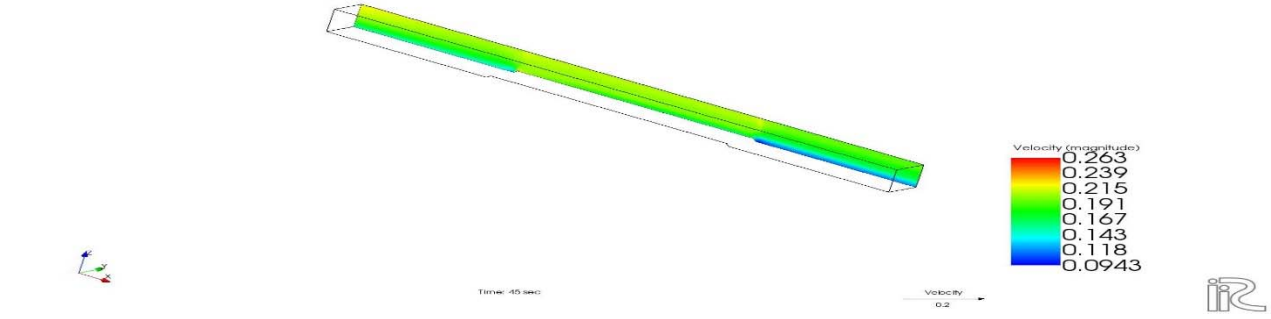
J=1



J=7

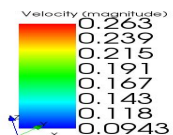
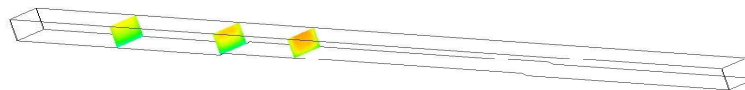
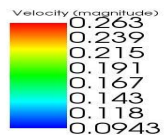


J=13

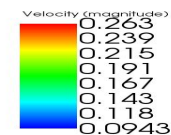


Brzine vode (za konstantno x)

$I=(29,58,79)$



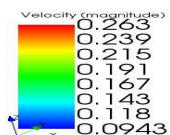
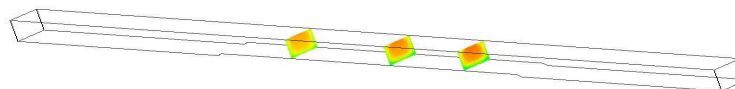
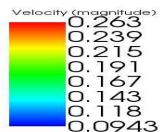
Time: 45 sec



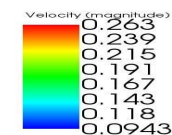
Velocity
0.2



$I=(79,107,128)$



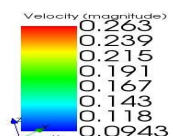
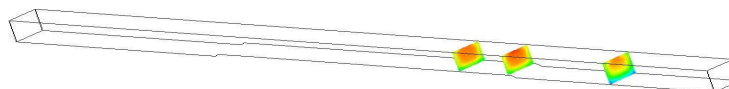
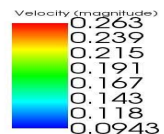
Time: 45 sec



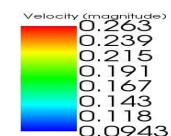
Velocity
0.2



$I=(128,142,171)$



Time: 45 sec

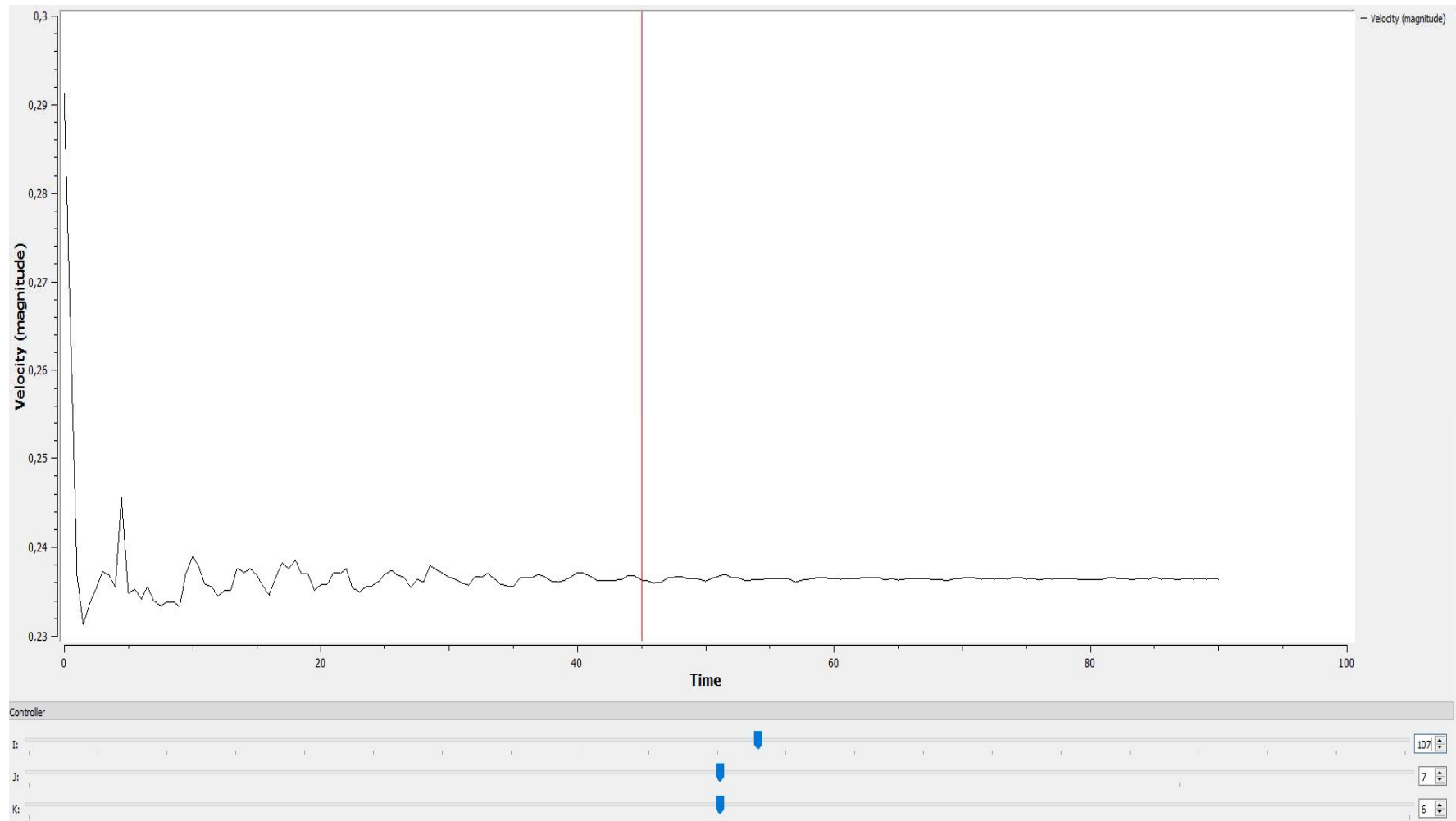


Velocity
0.2



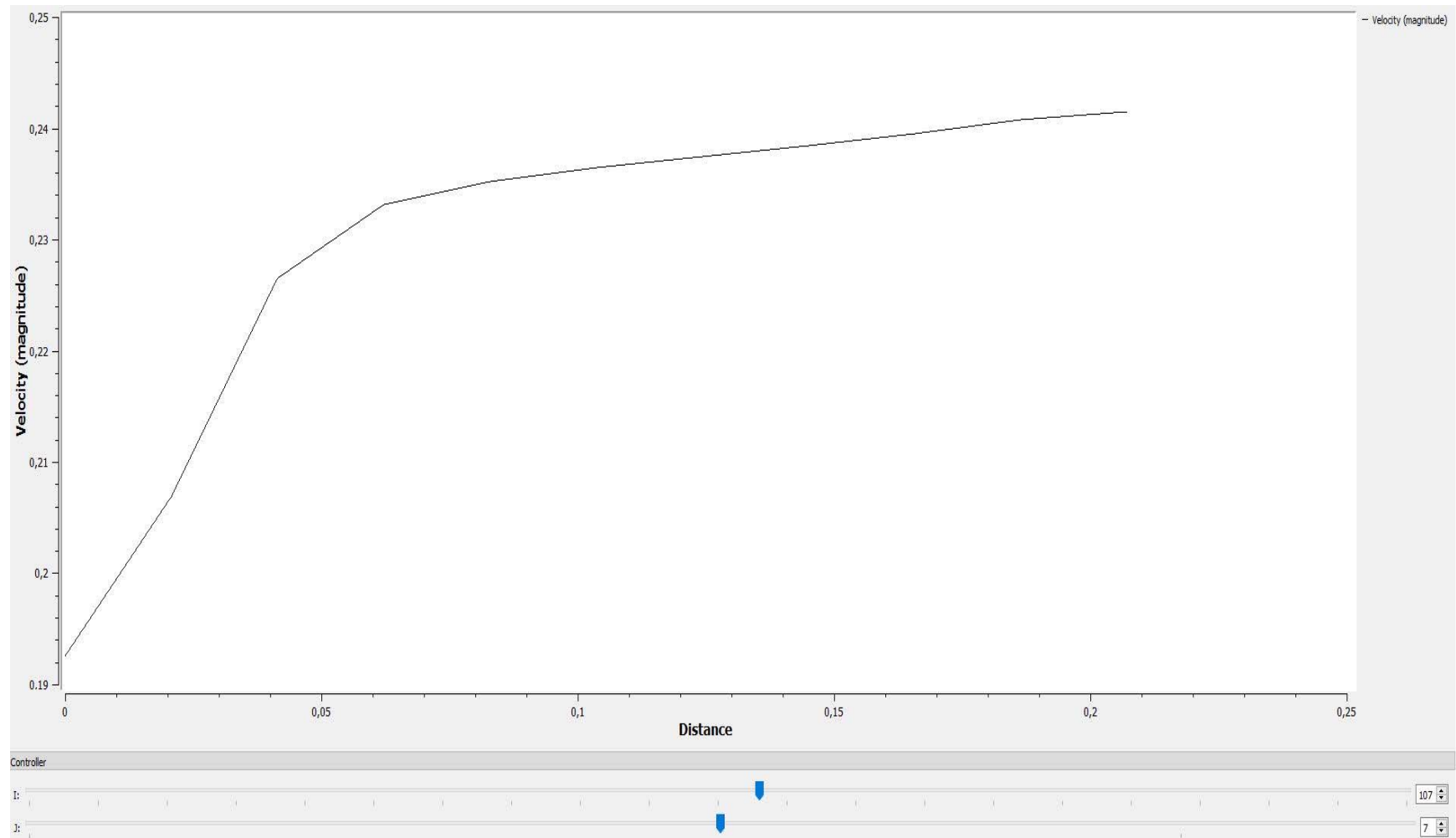
Promena brzine u vremenu

Posmatra se tačka na sredini kanala iznad sonde:



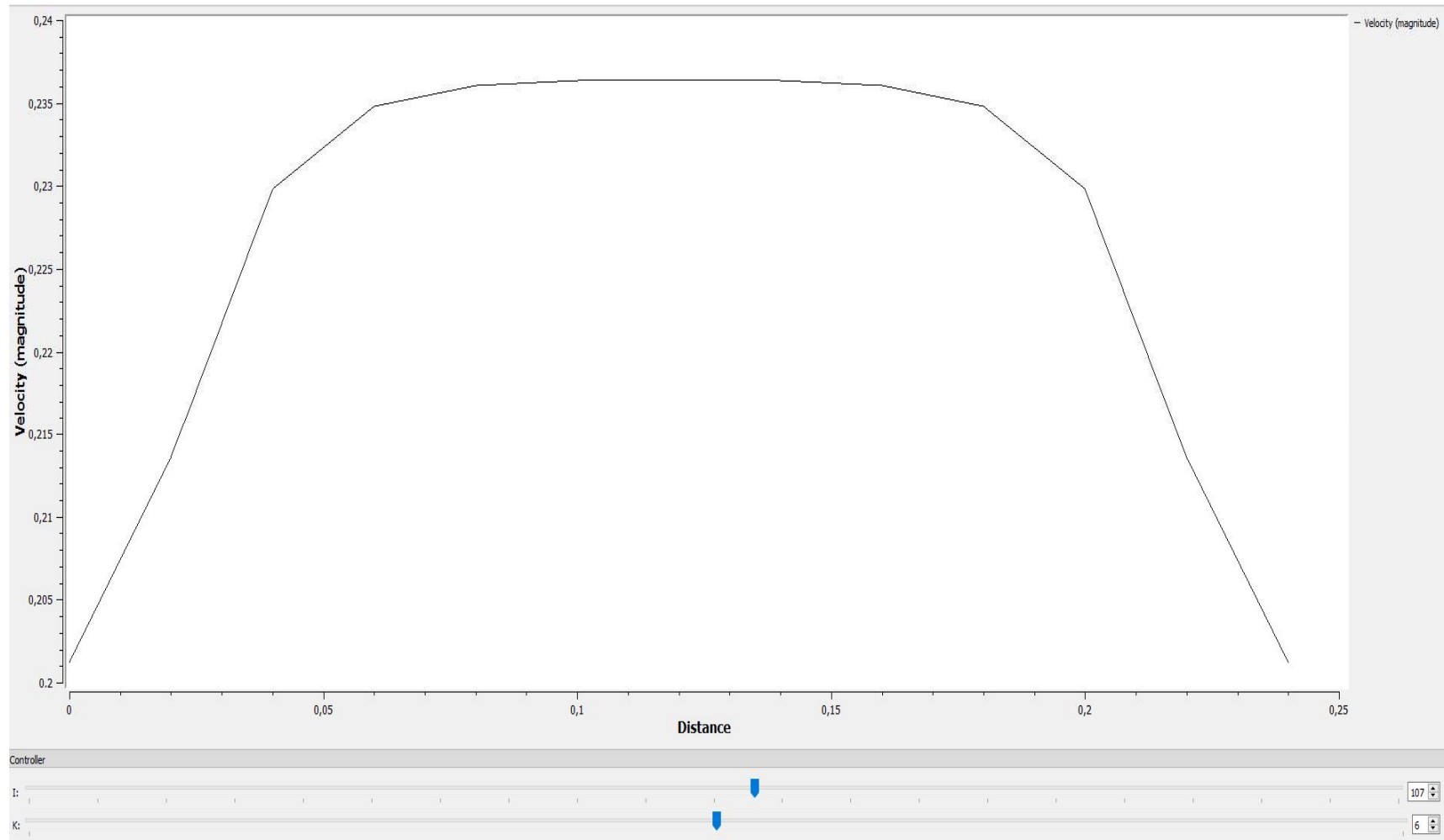
Promena brzine po z

Posmatra se tačka na sredini kanala iznad sonde:



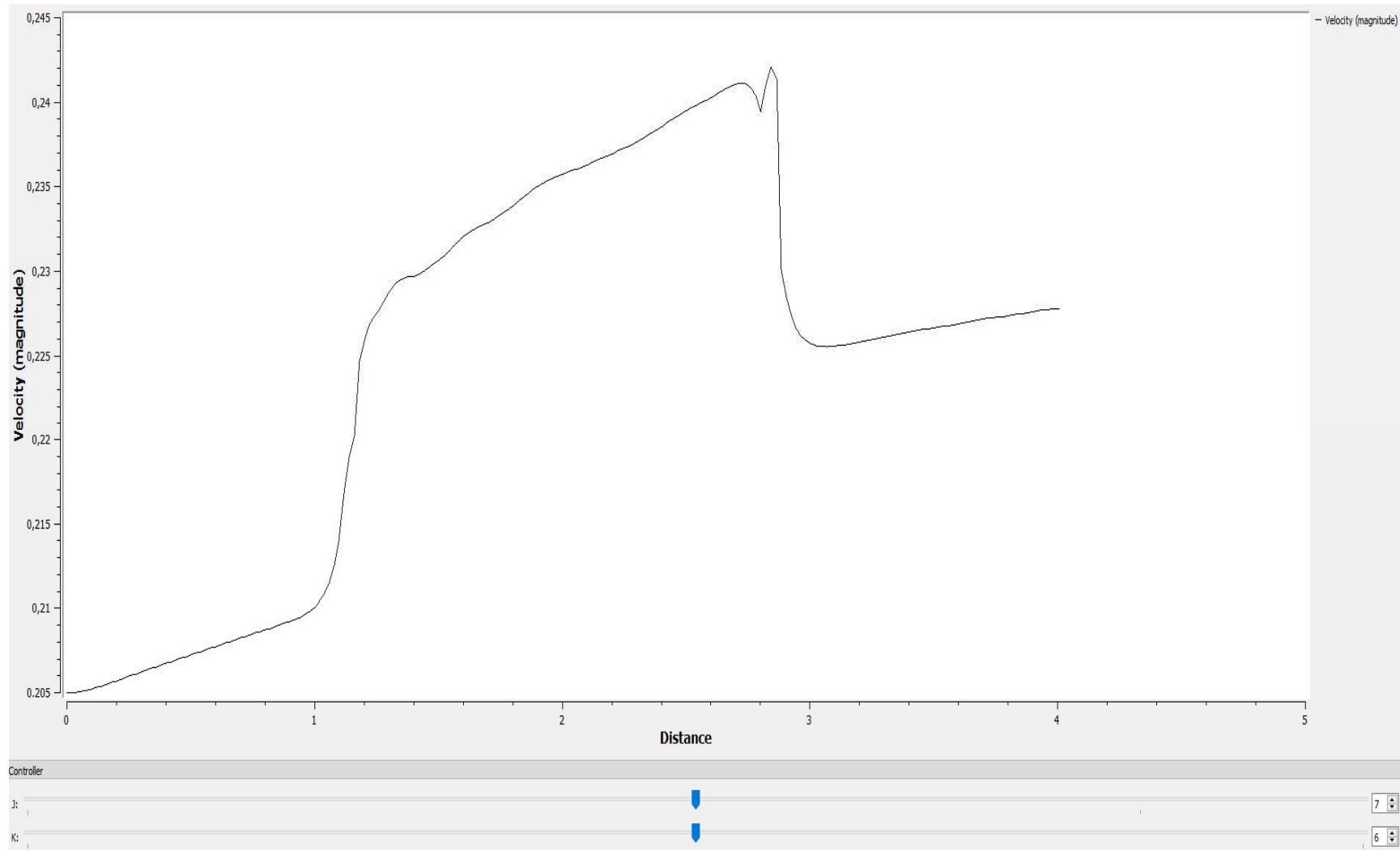
Promena brzine po y

Posmatra se tačka na sredini kanala iznad sonde:



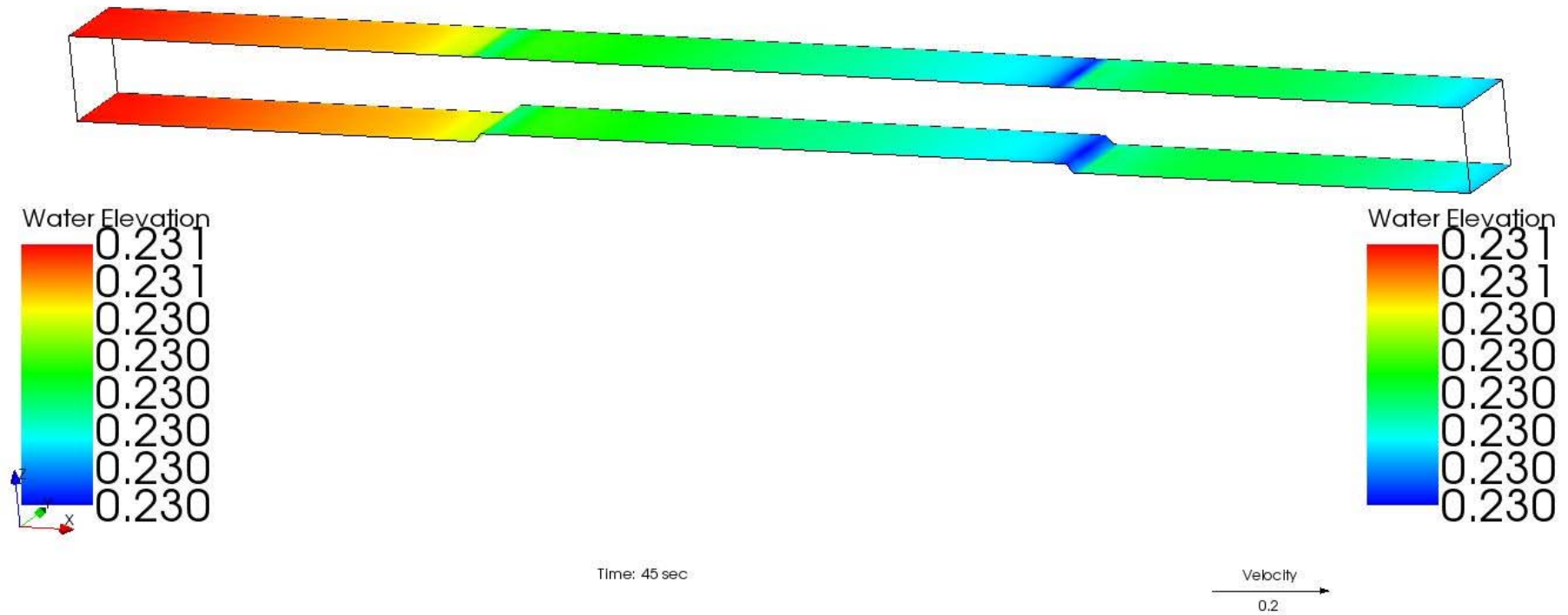
Promena brzine po x

Posmatra se tačka na sredini kanala iznad sonde:



Rezultati varijanta 2

Nivoi vode u kanalu na sredini simulacije

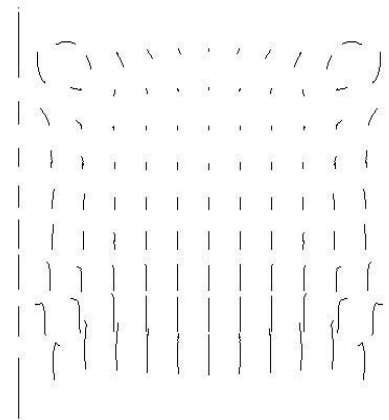


STRUJNICE

PODUŽNI PRESEK



POPŘEČNI PRESEK

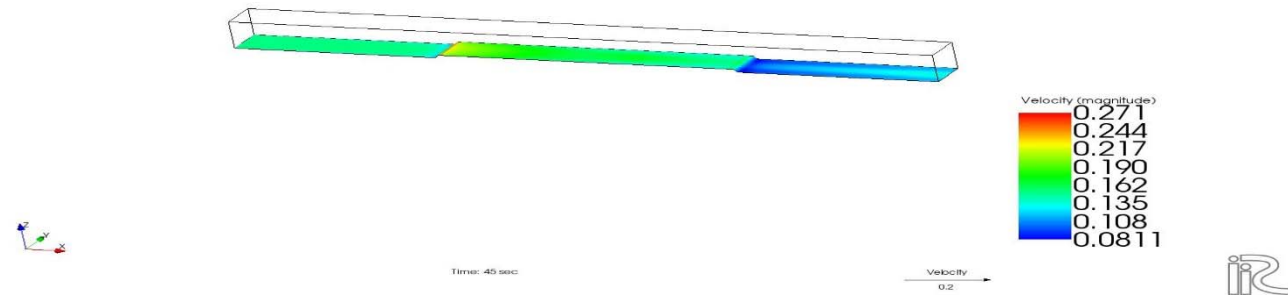


Time: 45 sec

Velocity
0.2

Brzine vode (za konstantno z)

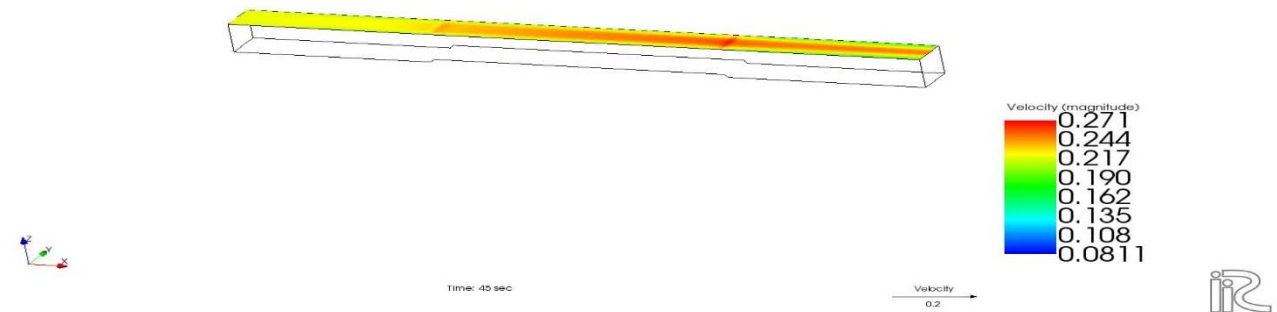
K=1



K=6

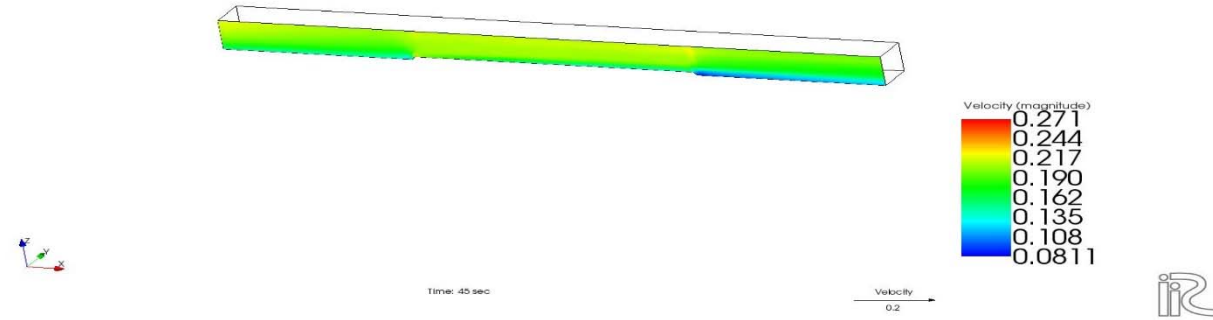


K=11

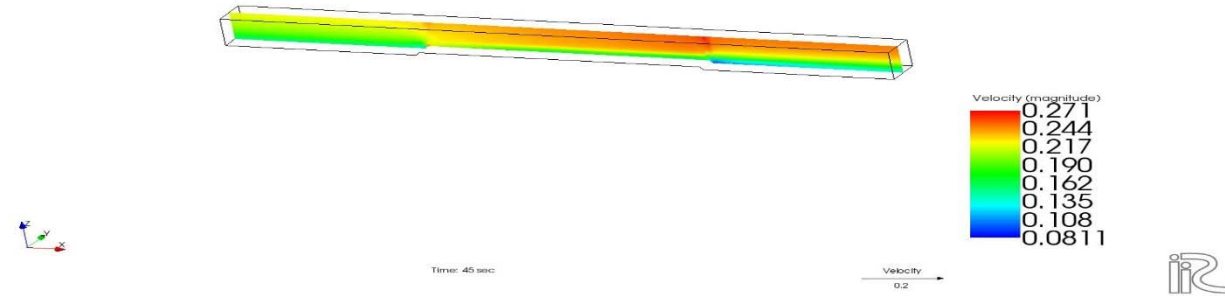


Brzine vode (za konstantno y)

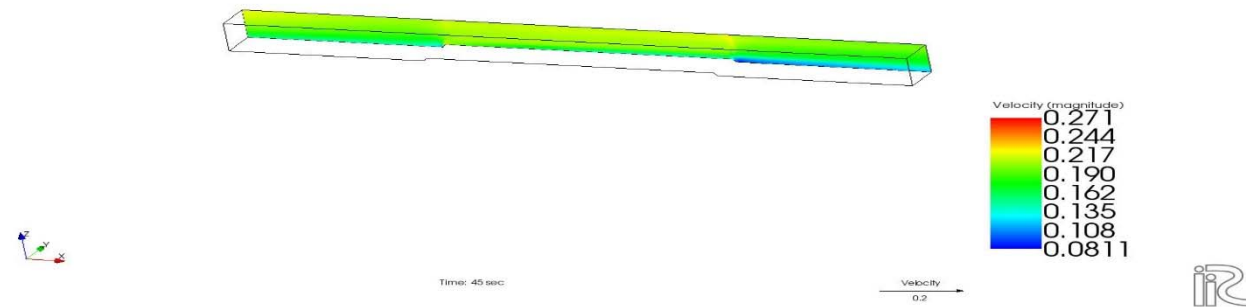
J=1



J=7

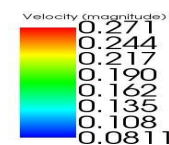
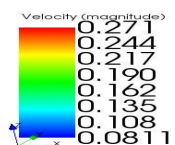
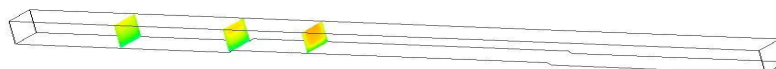
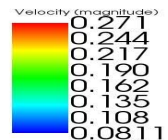


J=13

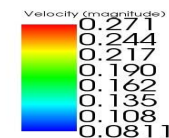
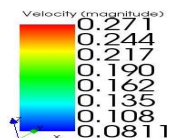
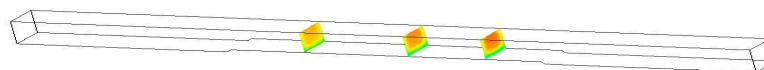
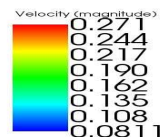


Brzine vode (za konstantno x)

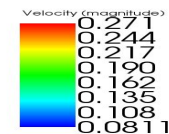
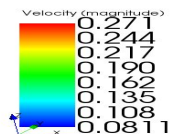
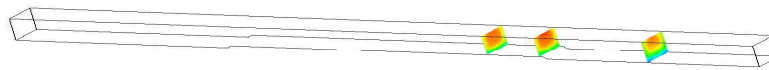
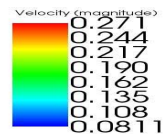
$I=(29,58,79)$



$I=(79,107,128)$

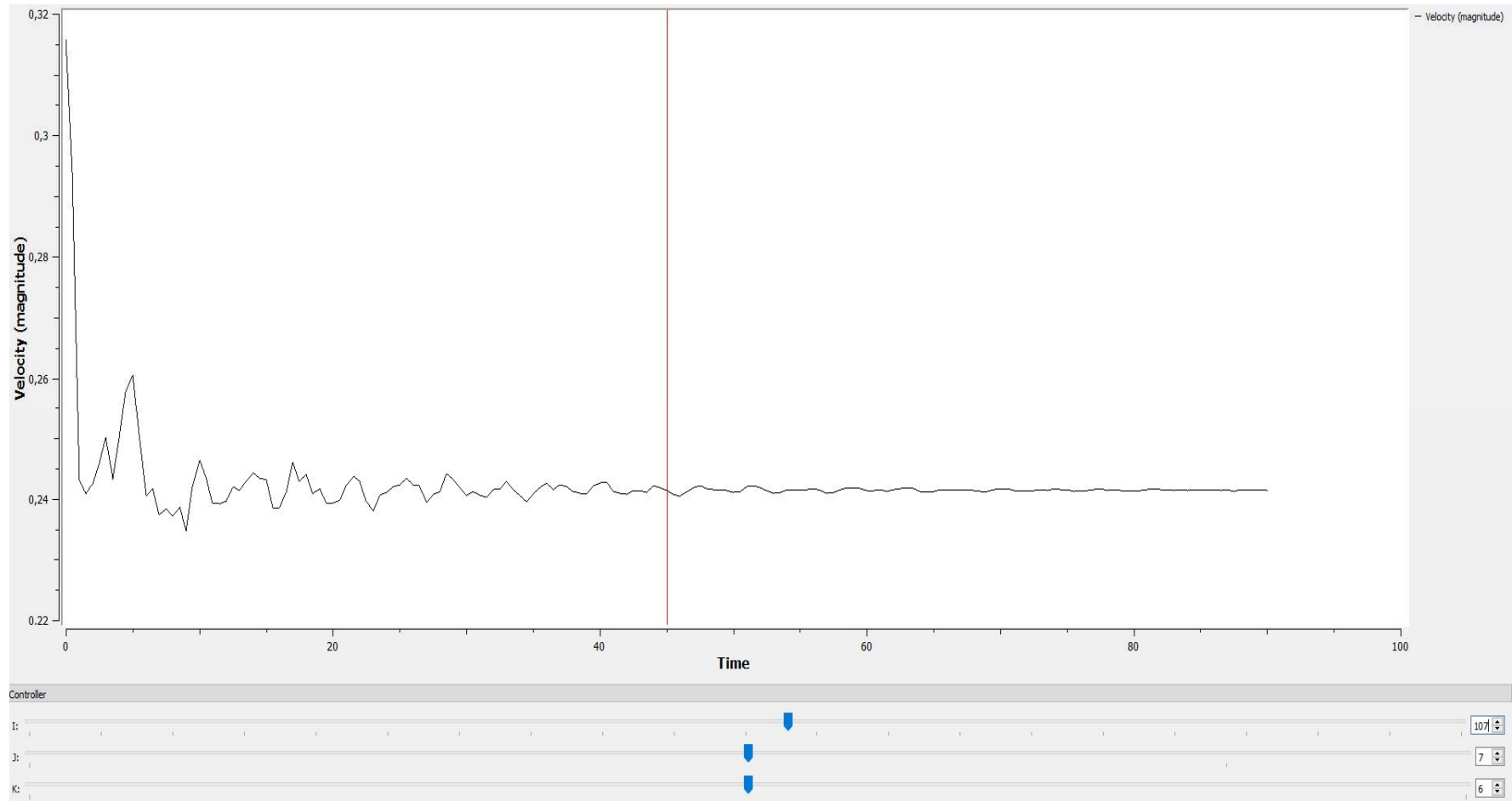


$I=(128,142,171)$



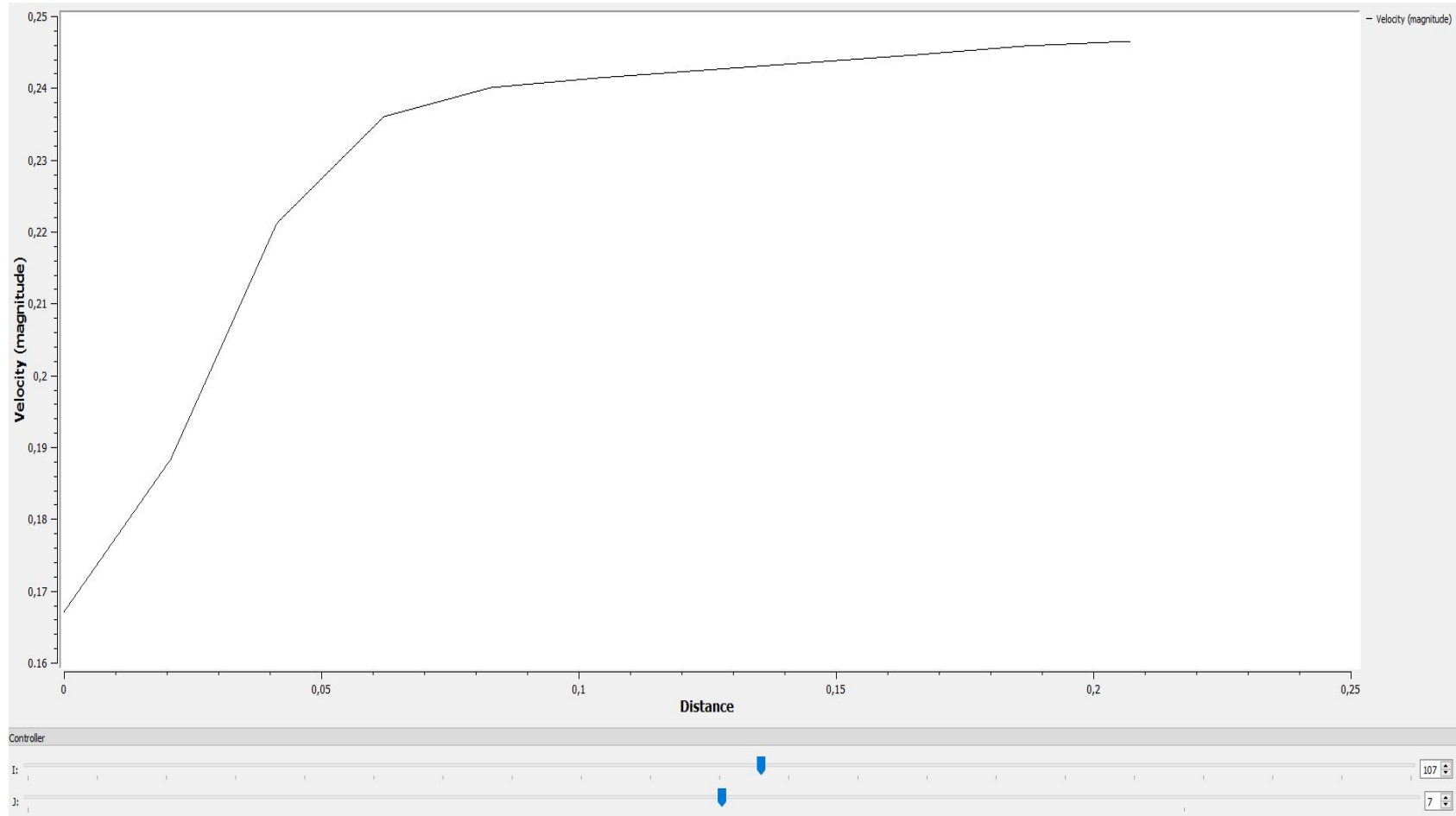
Promena brzine u vremenu

Posmatra se tačka na sredini kanala iznad sonde:



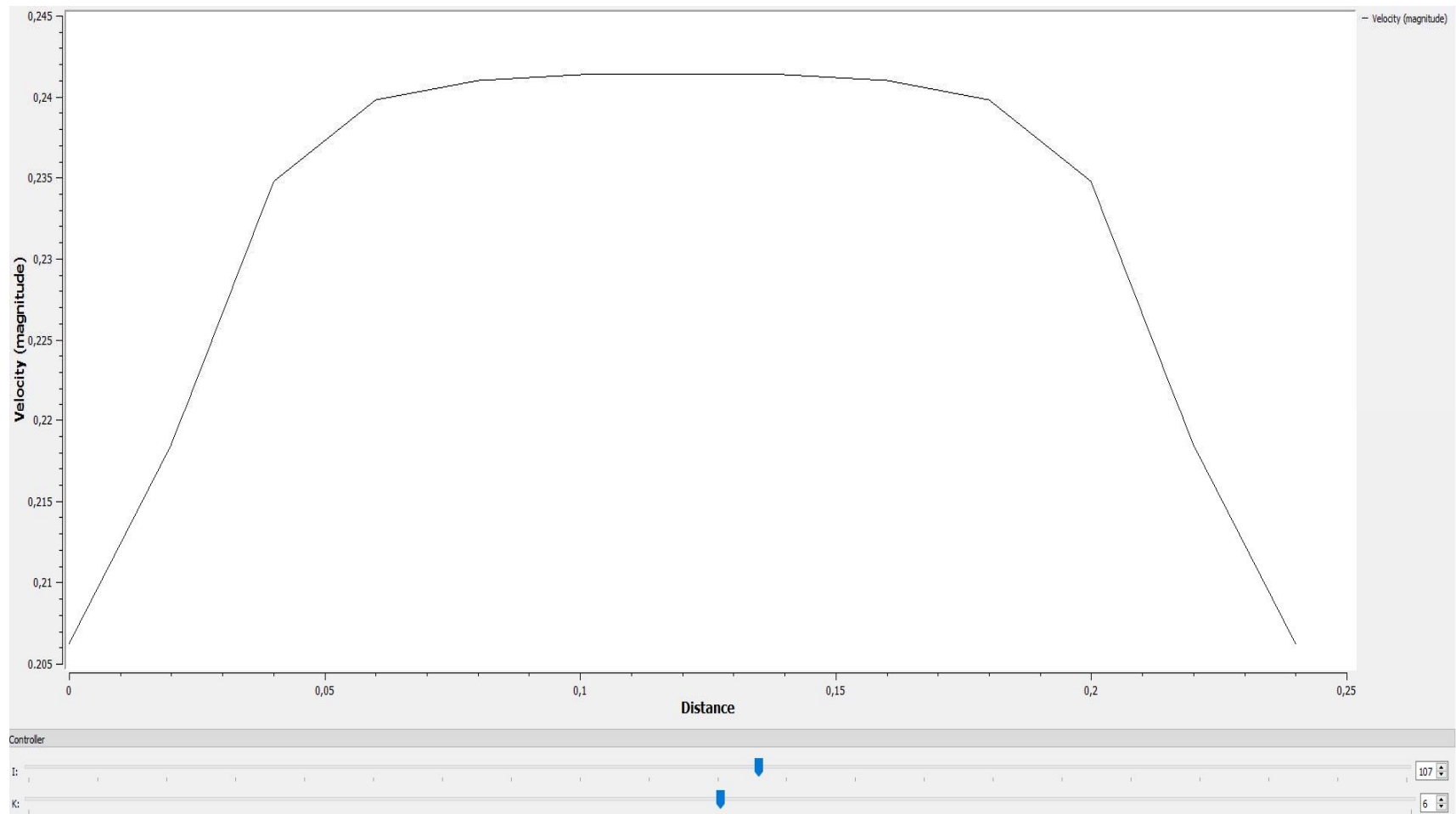
Promena brzine po z

Posmatra se tačka na sredini kanala iznad sonde:



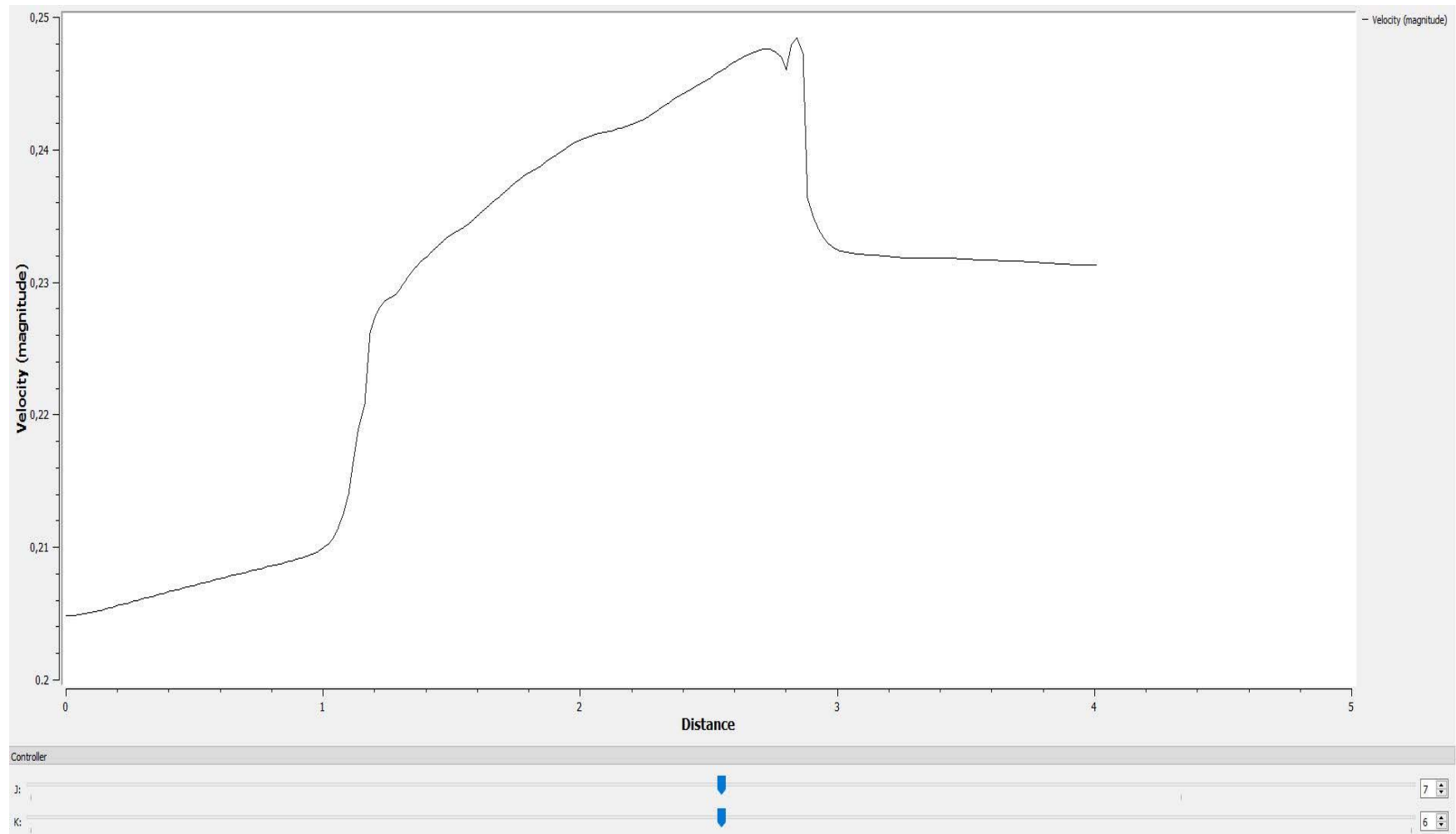
Promena brzine po y

Posmatra se tačka na sredini kanala iznad sonde:



Promena brzine po x

Posmatra se tačka na sredini kanala iznad sonde:



Zaključak

- Brzine se kreću u uskom opsegu od 0,2 m/s do 0,24 m/s
- Promena Manningovog koeficijenta hrapavosti nije značajno uticala na raspored brzina
- Prepreka (pesak + sonda) nema značajan uticaj na strujanje vode
- Raspored brzina po z-osi prati izmereni raspored brzina

HVALA NA PAŽNJI