



# MODELIRANJE TURBULENCIJE U PRIZMATIČNOM KANALU PRIMENOM SOFTVERA IRIC 2.3

MEHANIKA FLUIDA – NAPREDNI KURS

DOKTORSKE STUDIJE 2015/2016

MILOŠ MILAŠINOVIĆ 907/15

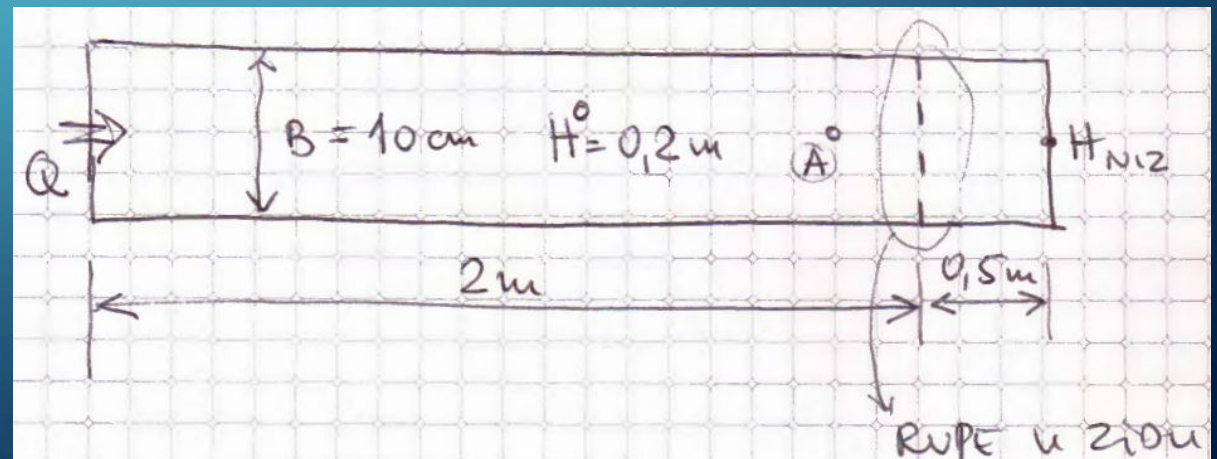
BEOGRAD 2016.

# SADRŽAJ

- Opis i cilj zadatka
- Metodologija
  - Kreiranje mreže
  - Postavljanje prepreka u tok
  - Zadavanje ulaznih podataka i turbulencije kao uzvodnog graničnog uslova
- Rezultati
- Zaključak

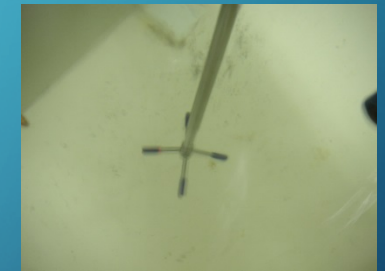
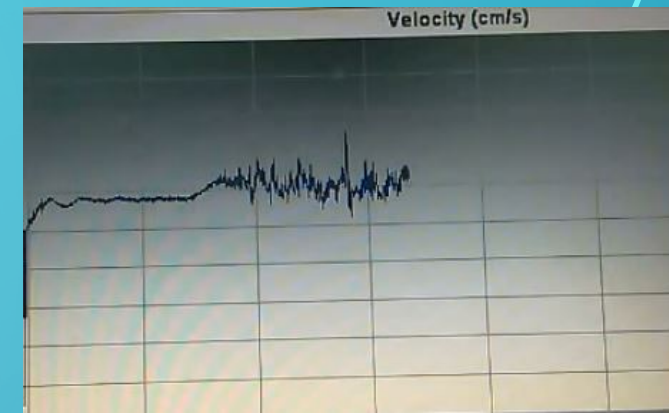
# OPIS ZADATKA

- Prizmatičan kanal, dužina 2,5 m, širina 0,1 m
- Na početku se sa nizvodne strane crpi 4 l/s, a upumpava sa uzvodne strane
- Na 2 m nalazi se prepreka u vidu zida sa rupama
- Podesiti otvore na zidu tako da se dobija stabilno ustaljeno tečenje
- Posmatraju se brzine u tački A



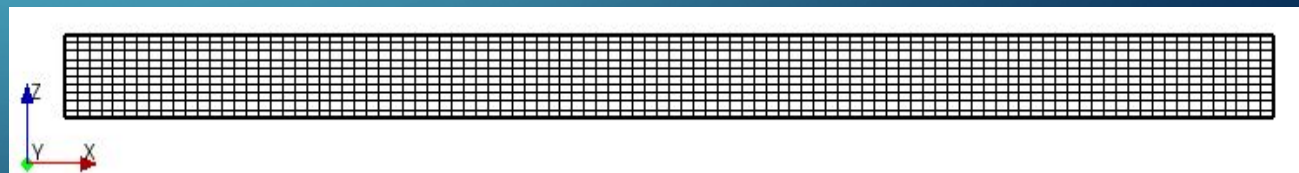
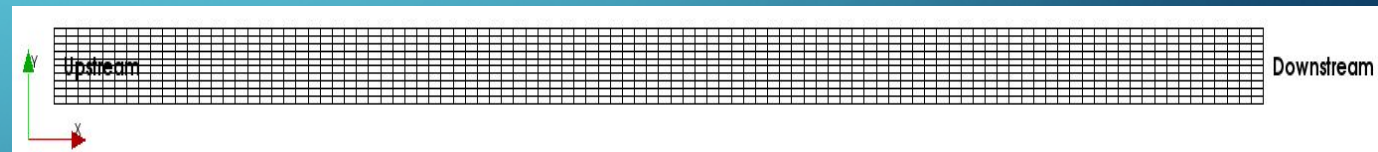
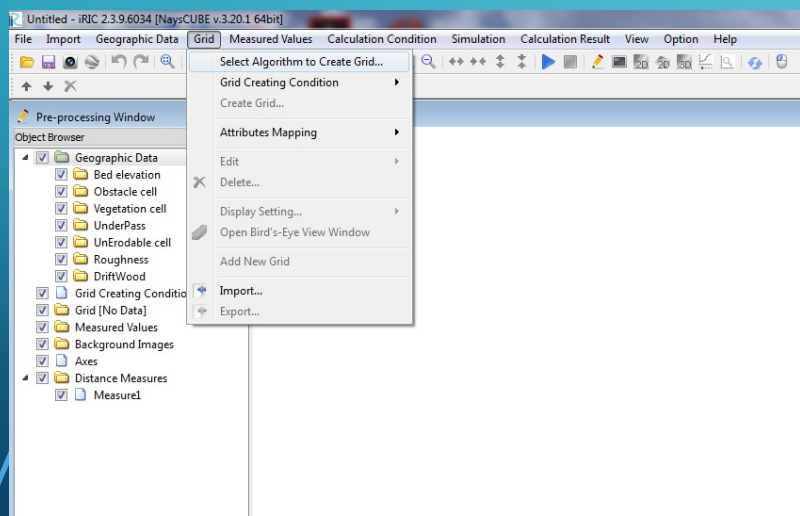
# CILJ ZADATKA

- Predstaciti tečenje u laboratorijskom bazenu preko CFD modela
- Posmatrane brzine u tački A, ono što bi pokazivala sonda u kanalu
- U kanalu „generator“ tečenja je motor od čamca, tj. elisa
- Značajna turbulencija na uzvodnom delu kanala
- Zadati poremećaj na uzvodnom delu u CFD modelu
  - Zadavanjem turbulencije kao graničnog uslova
  - Postavljanjem prepreka na uzvodnom kraju



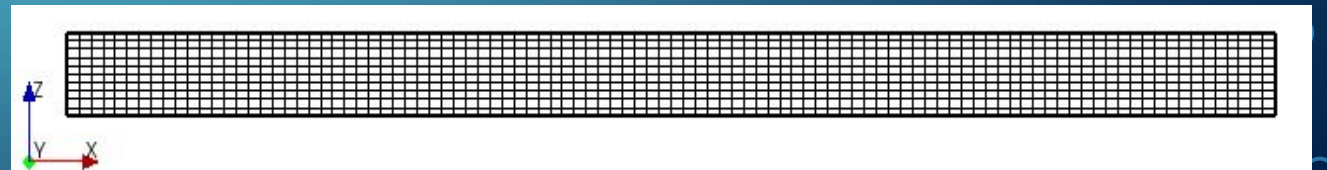
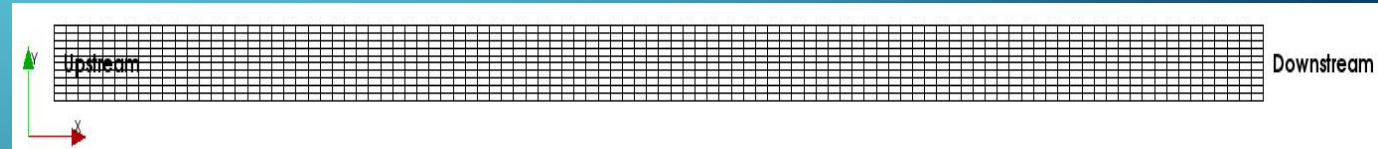
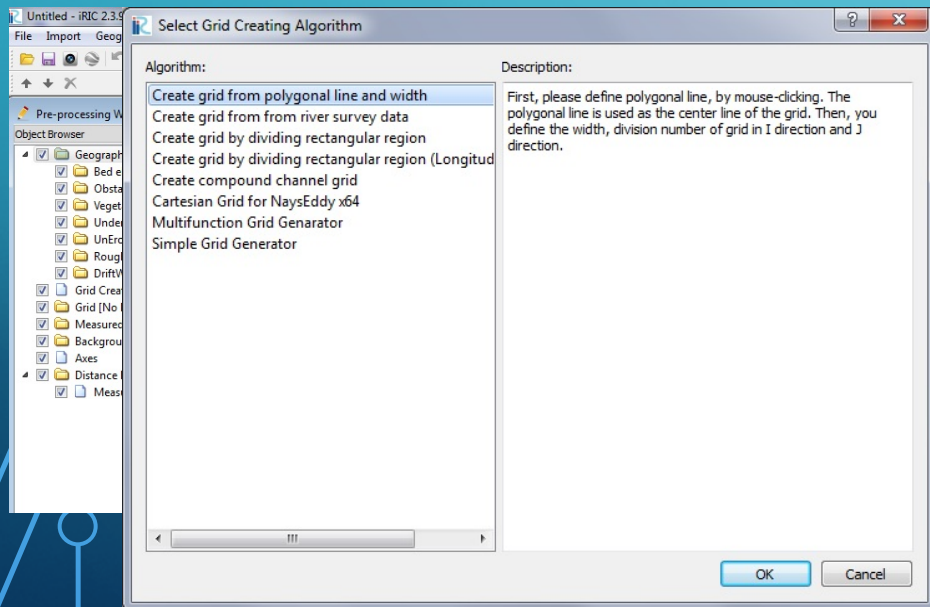
# METODOLOGIJA – KREIRANJE MREŽE

- Kanal 2,5x0,1 m, sa 10 slojeva po visini
- Mreža 100x10x10 ćelija:  $\Delta x = 2,5$  cm,  $\Delta y = 1$  cm



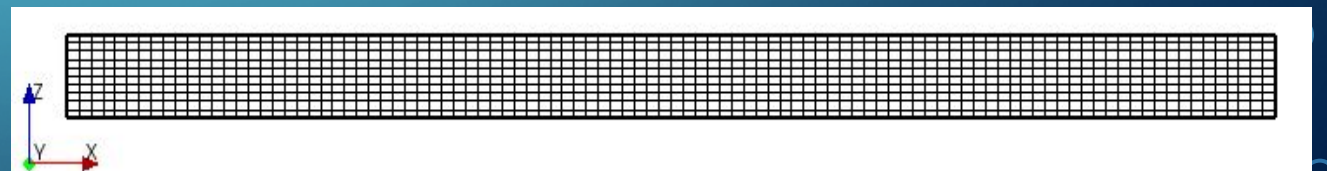
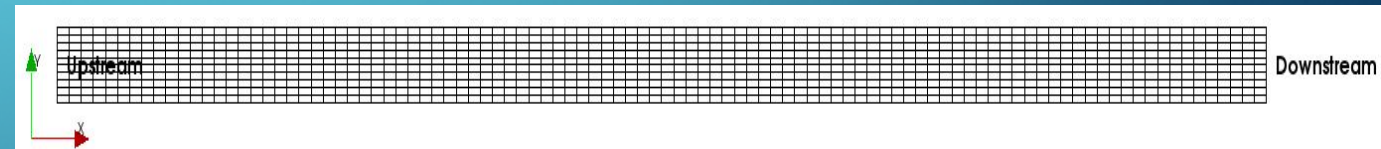
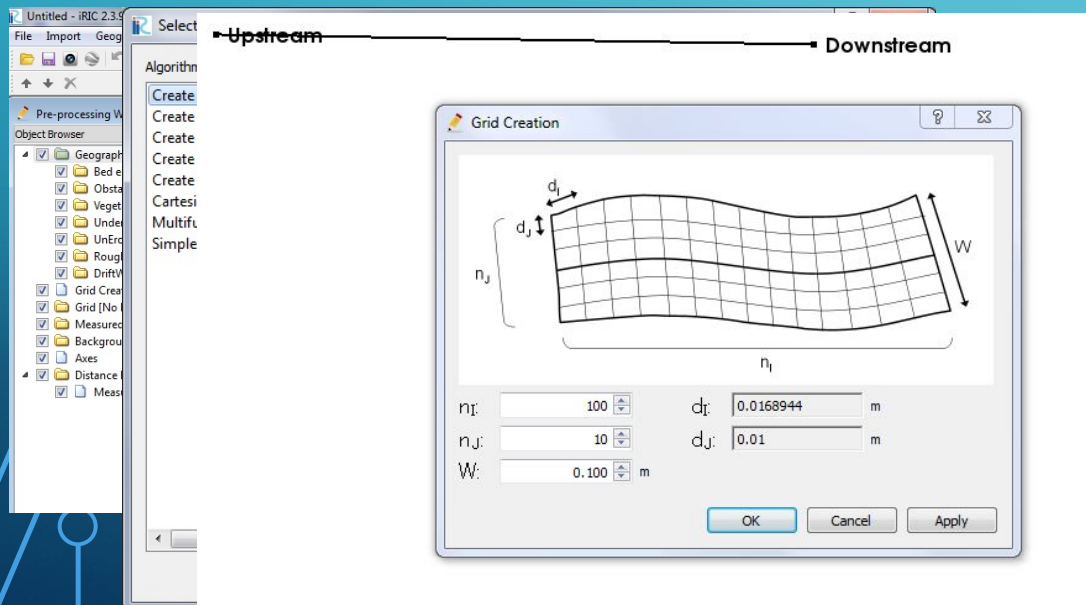
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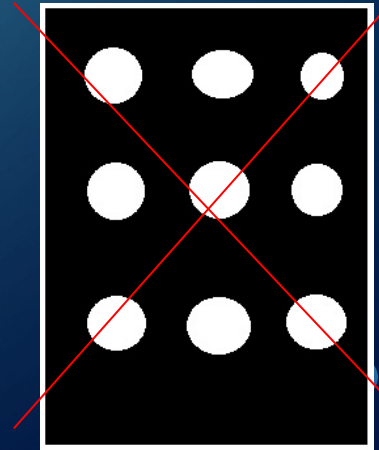
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# METODOLOGIJA – POSTAVLJANJE PREPREKA

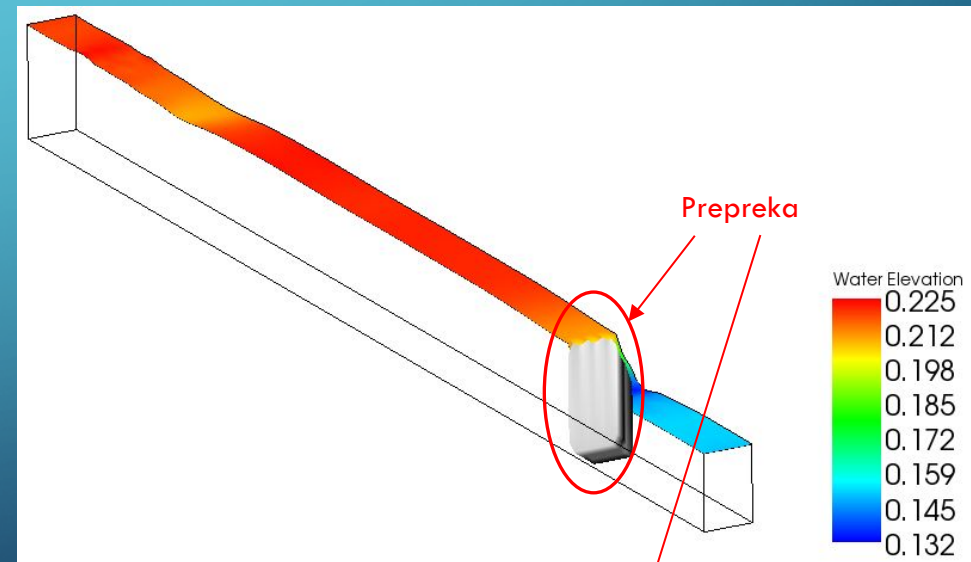
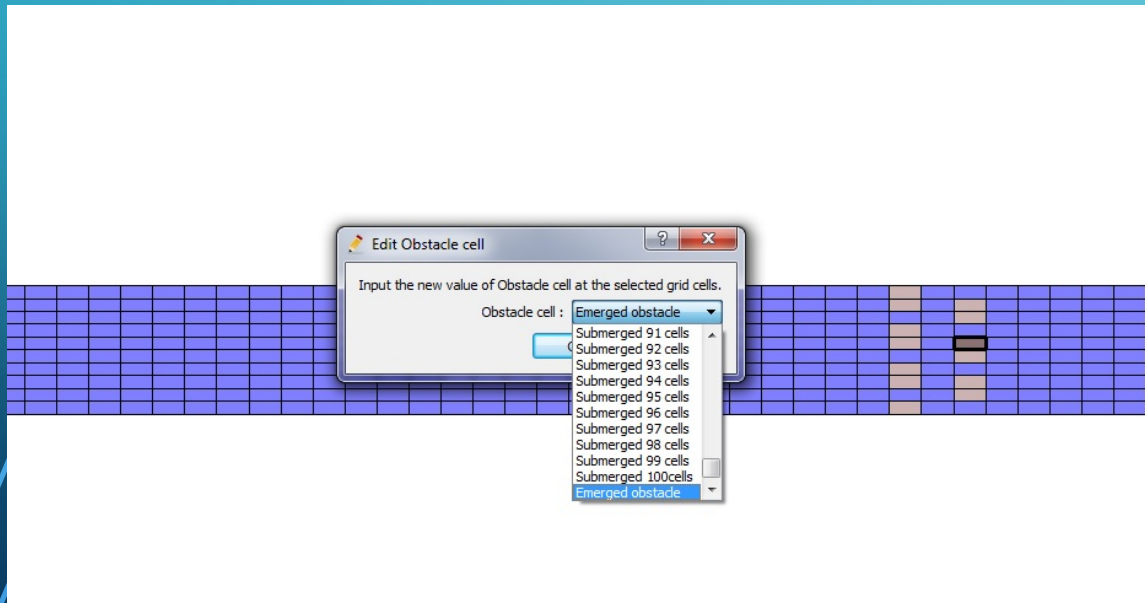
- Potrebno je postaviti zid sa rupama u YZ ravni kao prepreku na kojoj se ostvaruje lokalni gubitak (obstacle)
- Problem: iRIC ne pruža mogućnost postavljanja otvora u zidu na nekoj visini, već svi otvori moraju ići od dna
- Promena prepreke: postavljaju se stubići kao prepreka na kojoj se ostvaruje lokalni gubitak





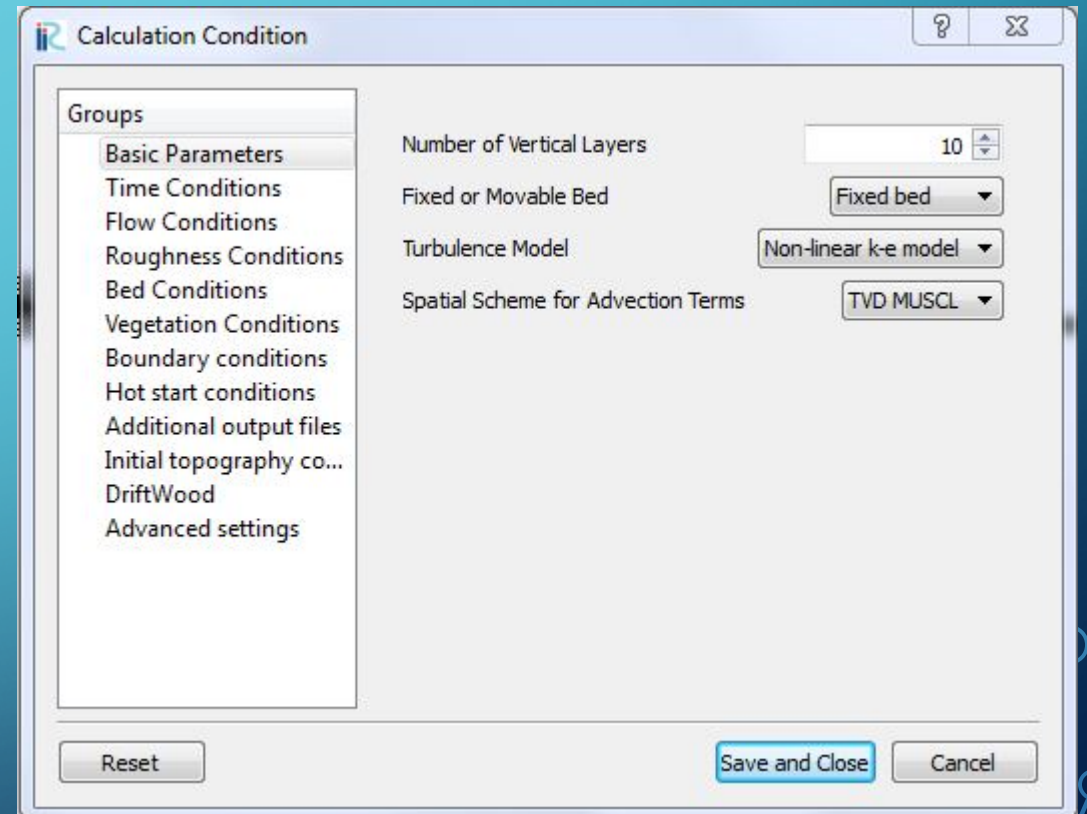
# METODOLOGIJA – REALIZOVANA PREPREKA

- Postavljanje prepreka vrši se preko opcije Obstacle cell
- Bira se ćelija u XY ravni i visina prepreke u Z pravcu



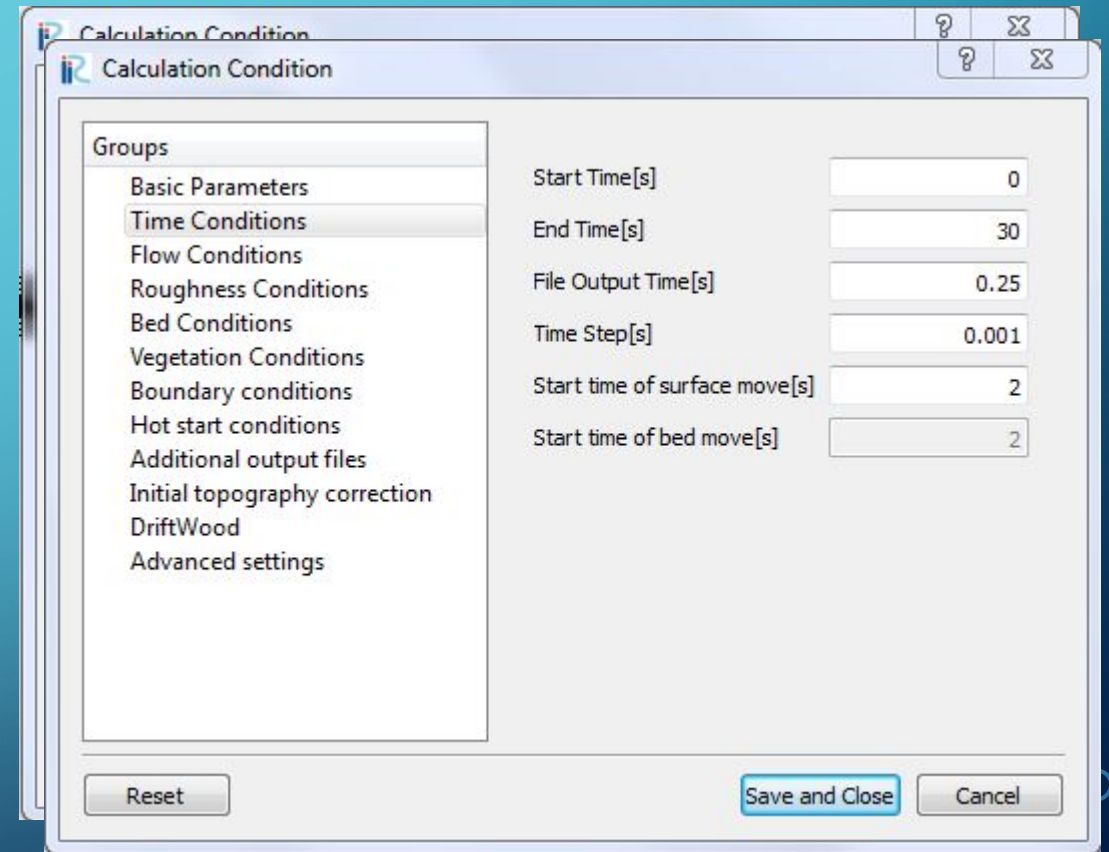
# METODOLOGIJA – UNOŠENJE PODATAKA

- Podaci koje je potrebno uneti:
  - Broj slojeva = 10
  - $Q = 4 \text{ l/s}$
  - $n = 0,012 \text{ m}^{-1/3}\text{s}$
  - $\Delta t = 0,001 \text{ s}$
  - $H_{\text{niz}} = 0,15 \text{ m}$
  - Stepen turbulencije na ulazu (inlet disturbance)



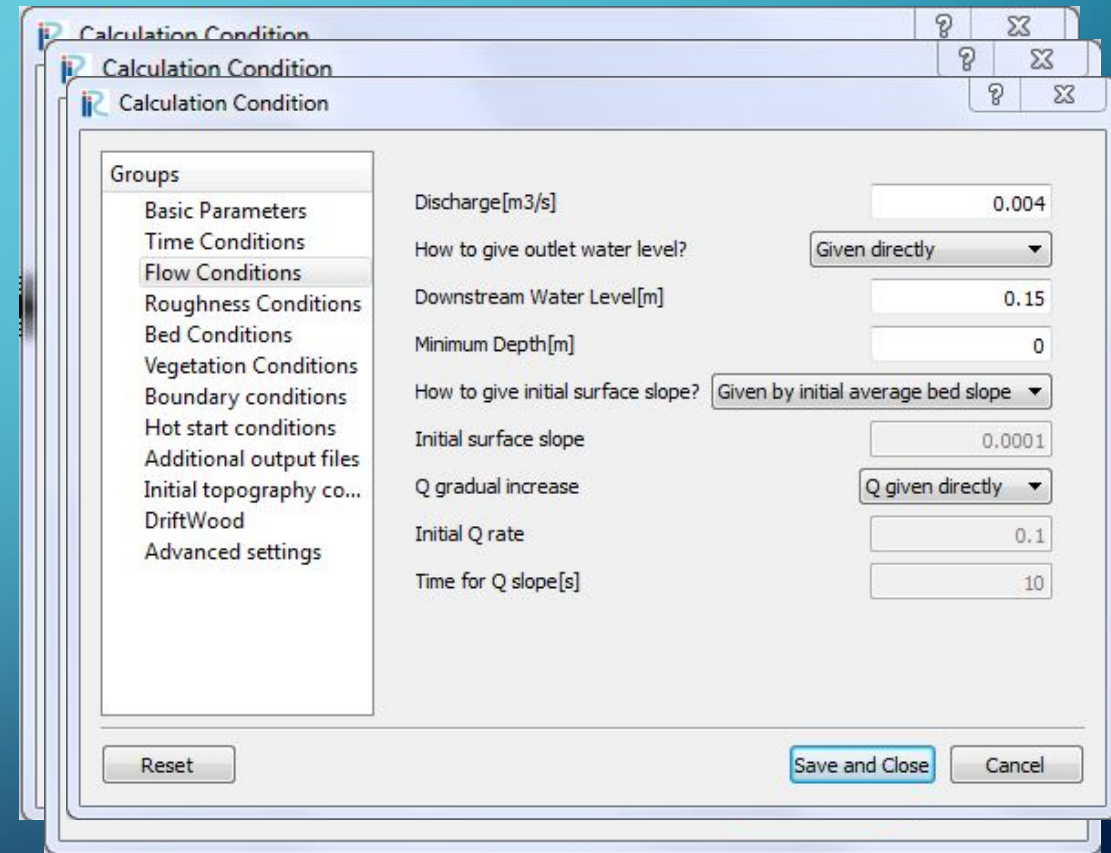
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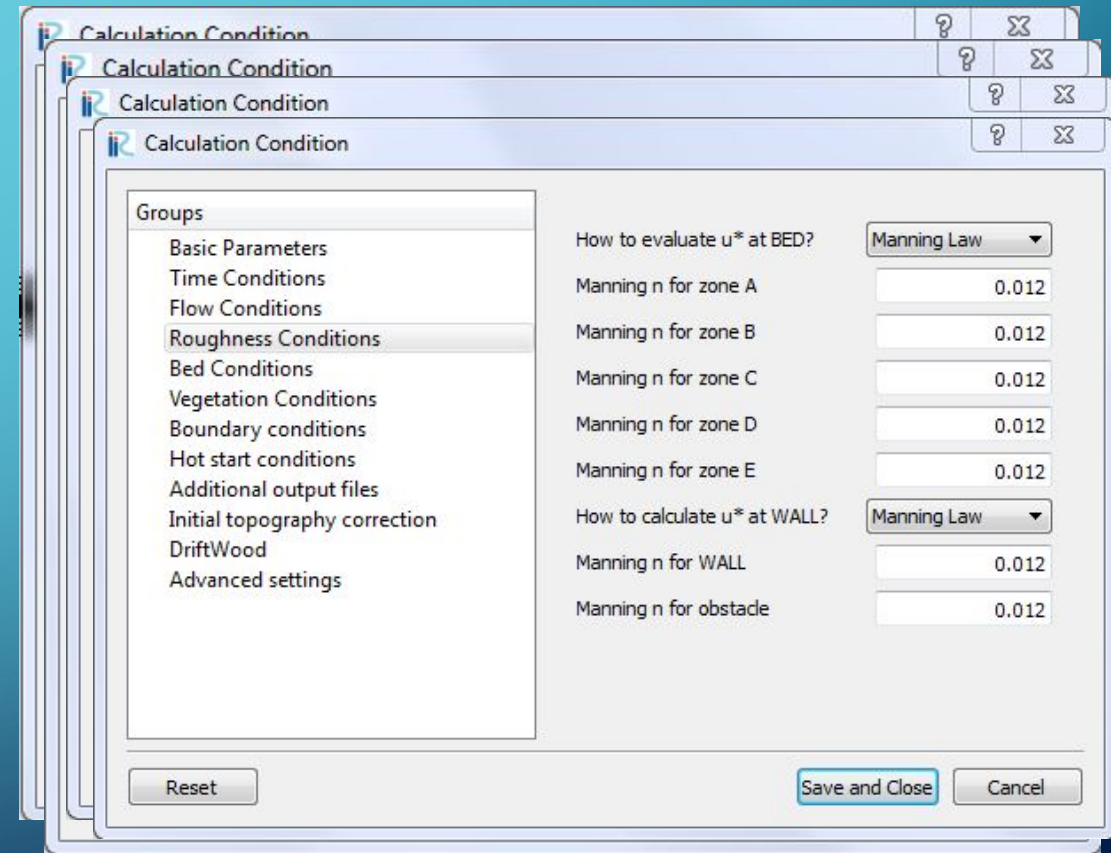
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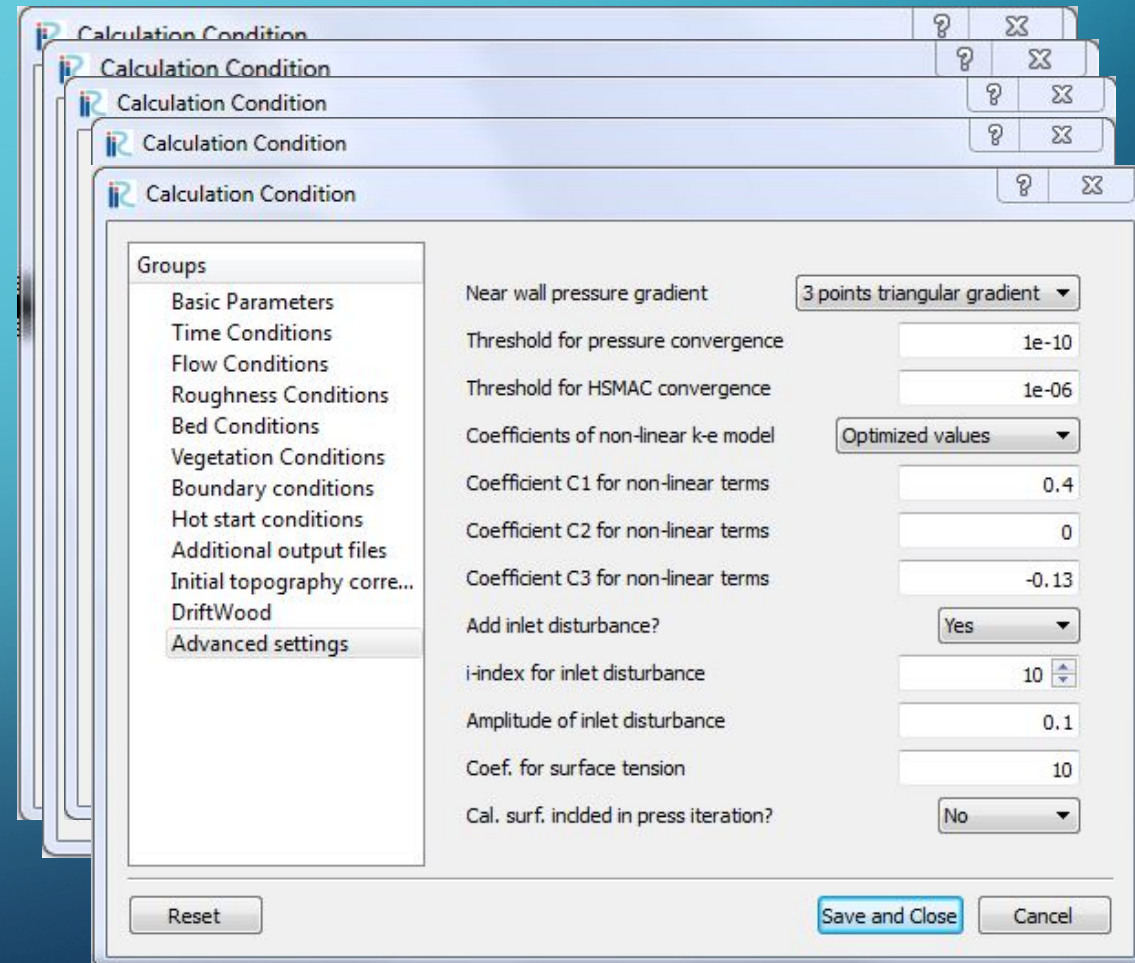
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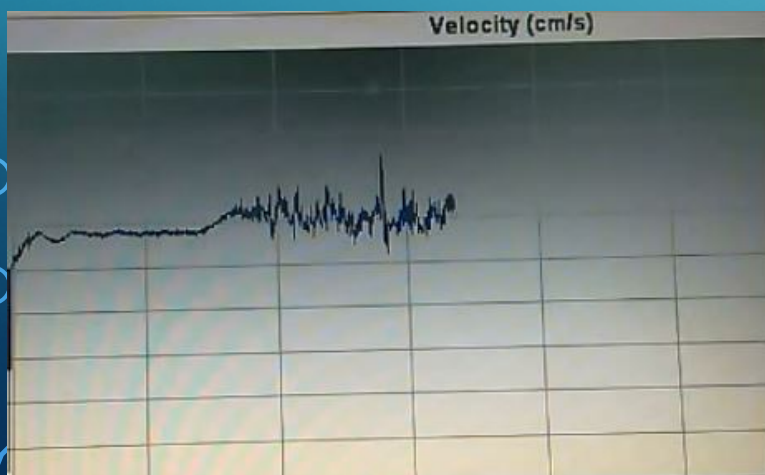
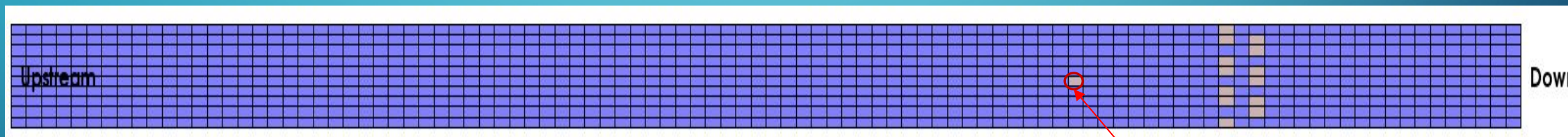
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# REZULTATI

- Posmatra se promena srednje brzine po dubini na 175 cm od uzvodnog kraja na sredini kanala
- Raličiti granični uslovi u vidu turbulencije

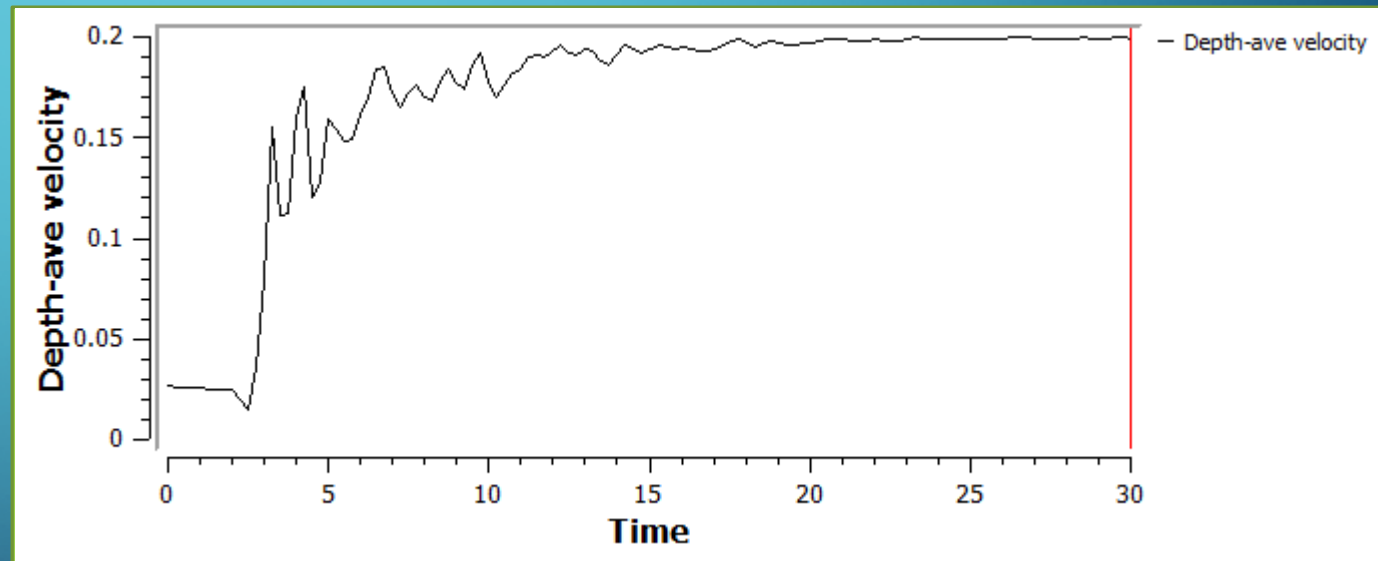
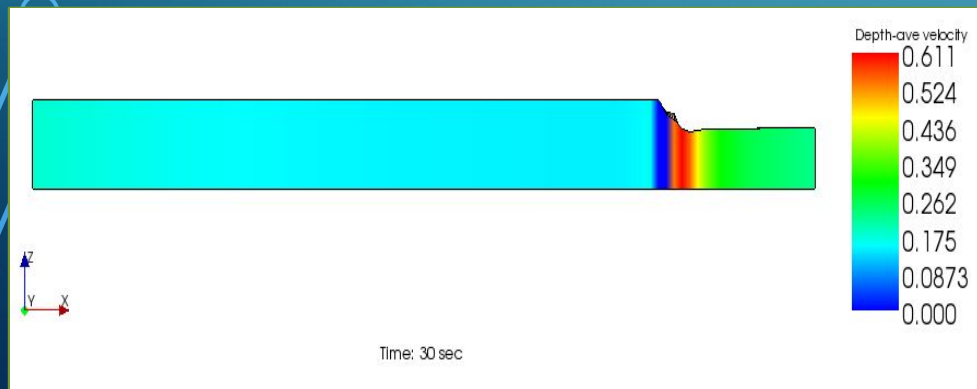
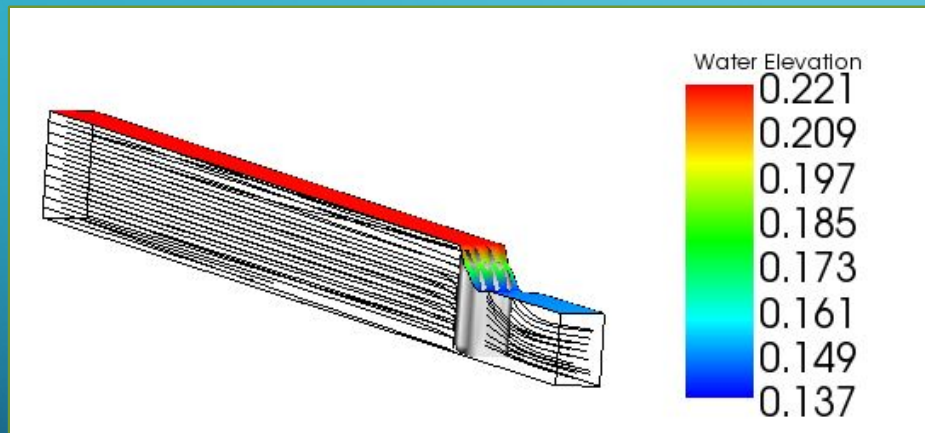
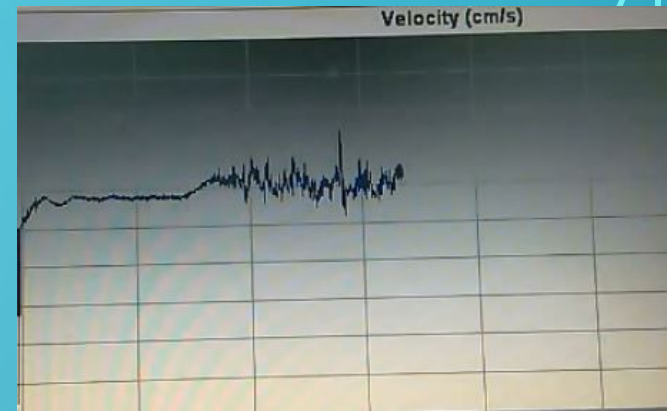


Vertikala u kojoj se posmatraju srednje brzine po dubini („Tačka“ A)

Snimljene brzine u laboratorijskom kanalu

# REZULTATI

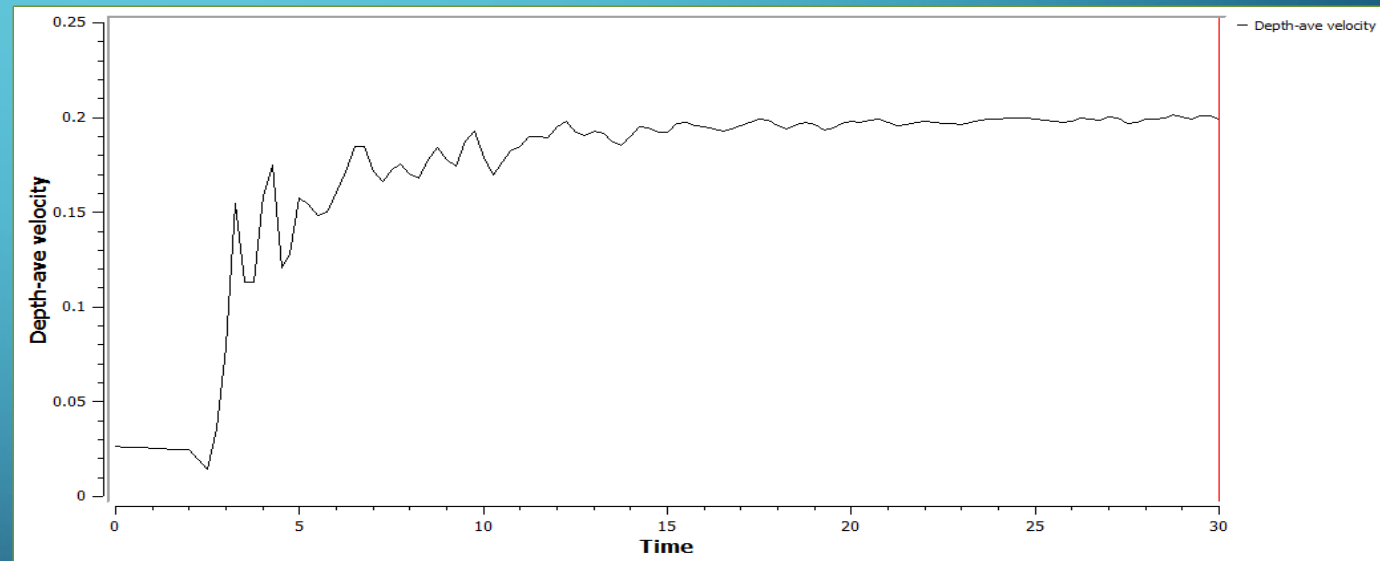
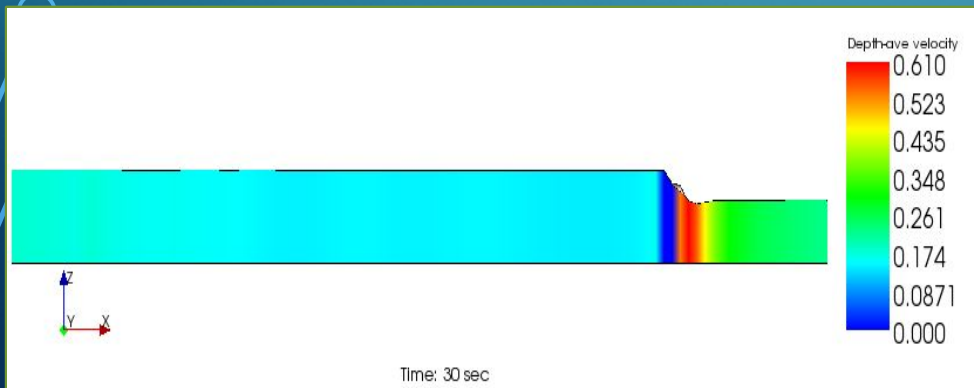
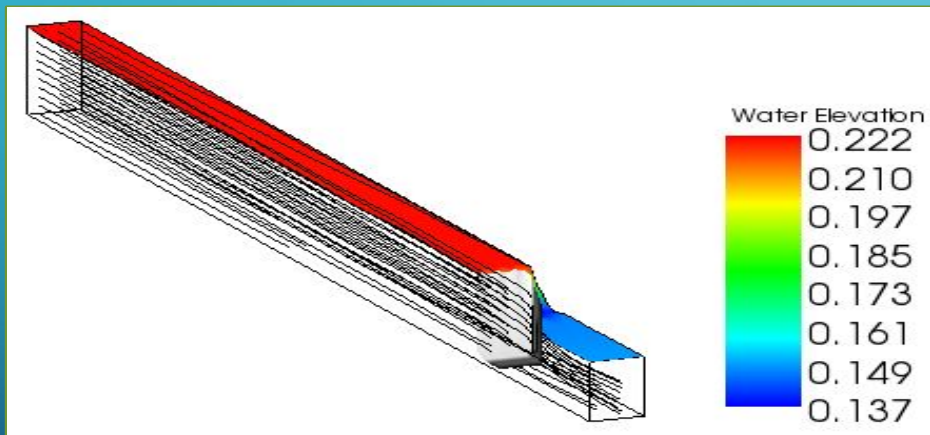
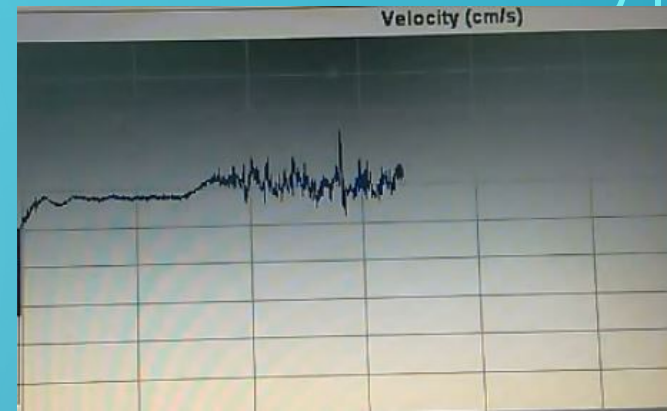
- Bez pojačane turbulencije





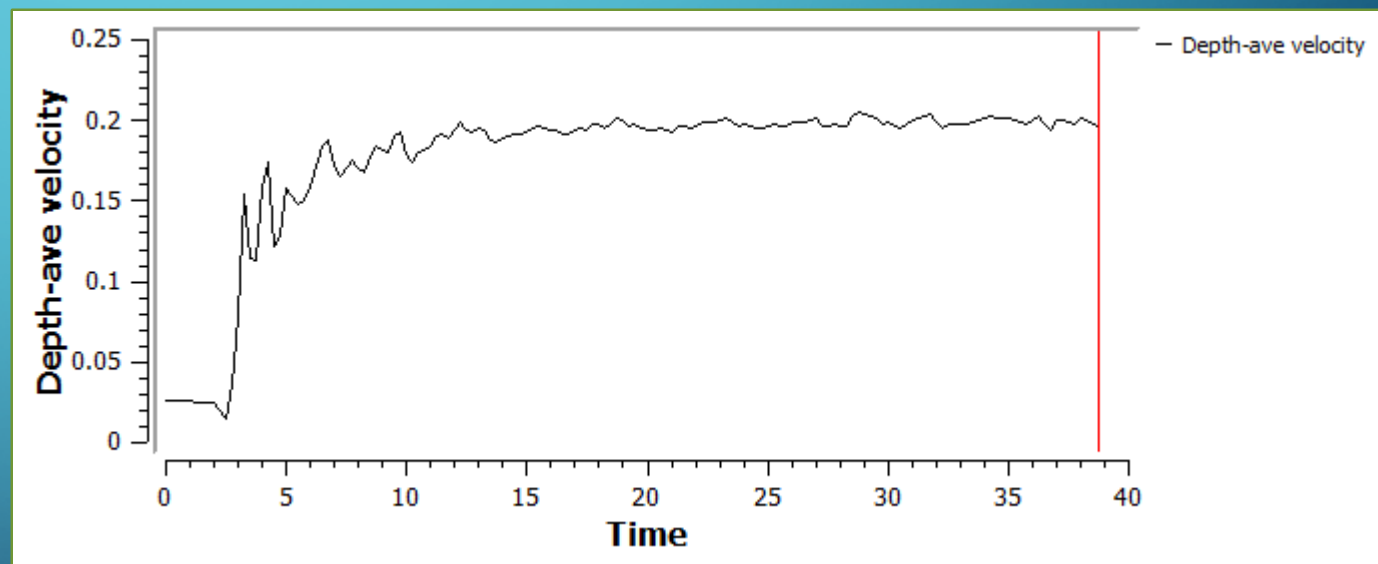
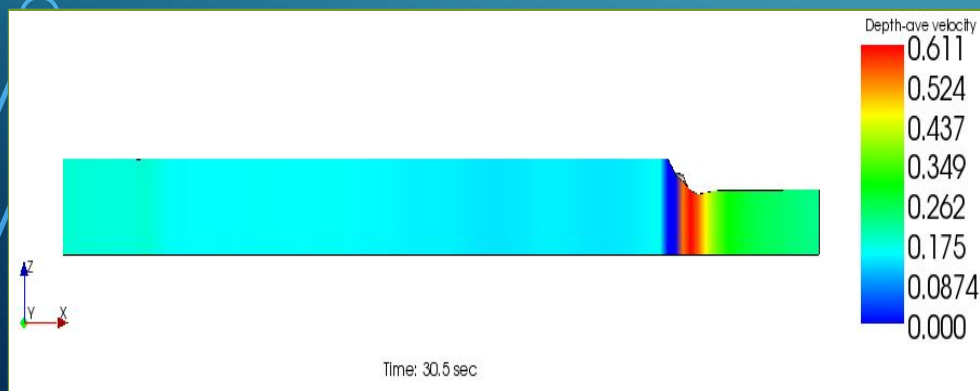
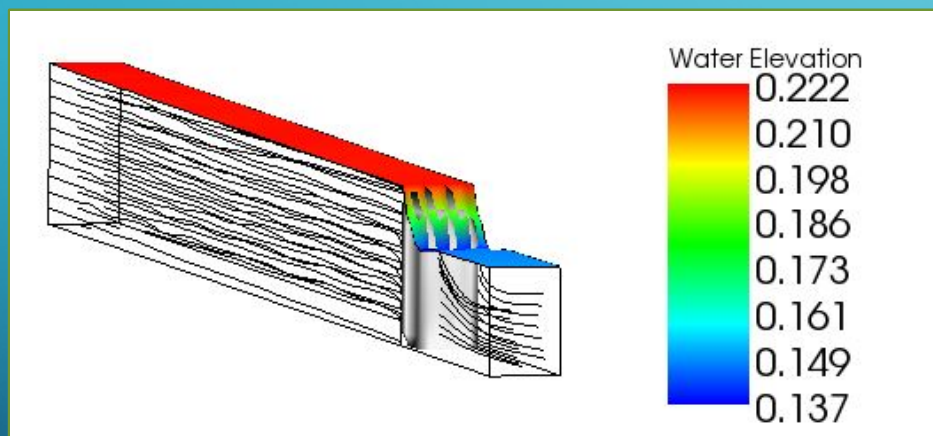
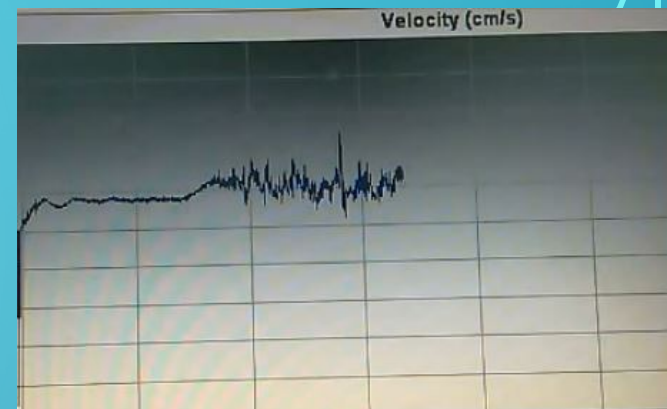
# REZULTATI

- Pojačana turbulencija za 5 %



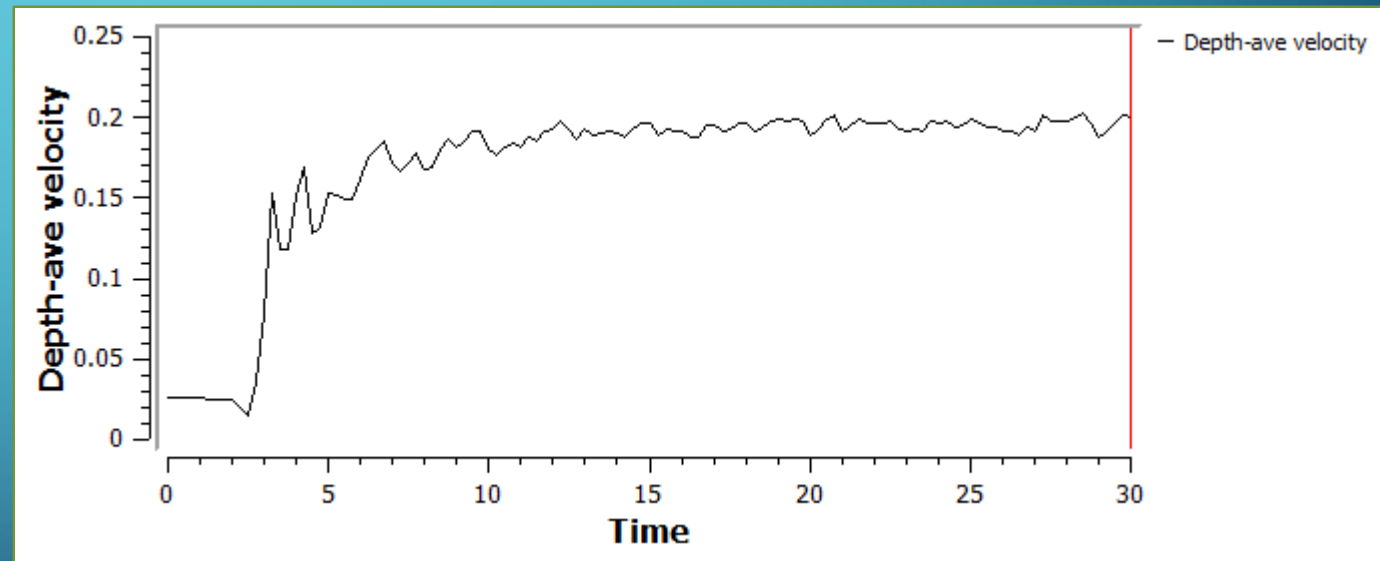
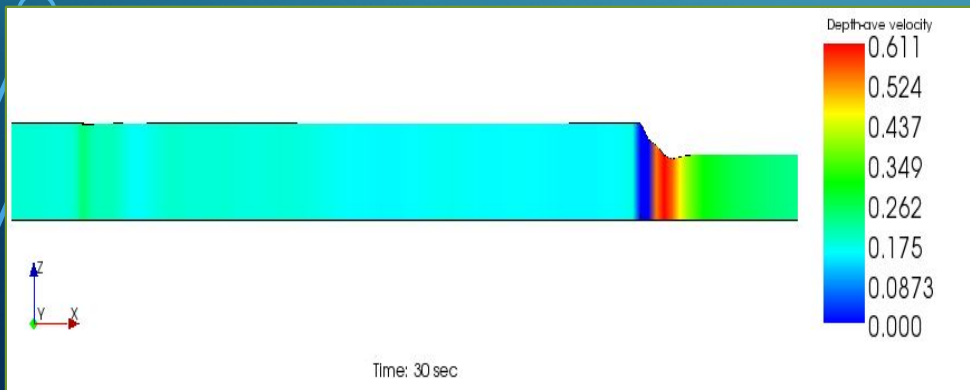
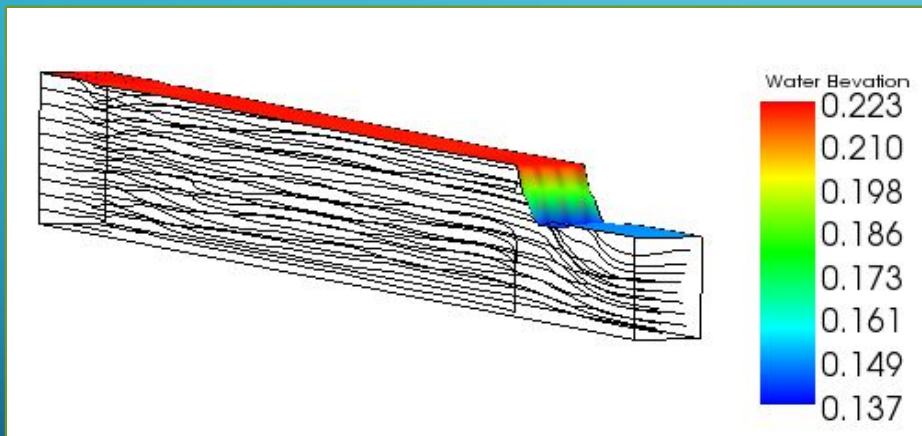
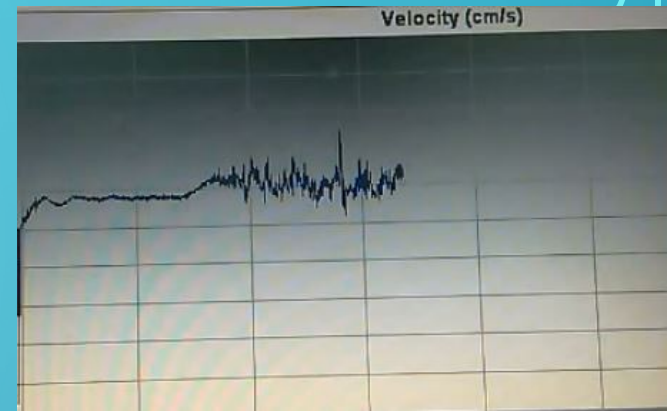
# REZULTATI

- Pojačana turbulencija za 10 %



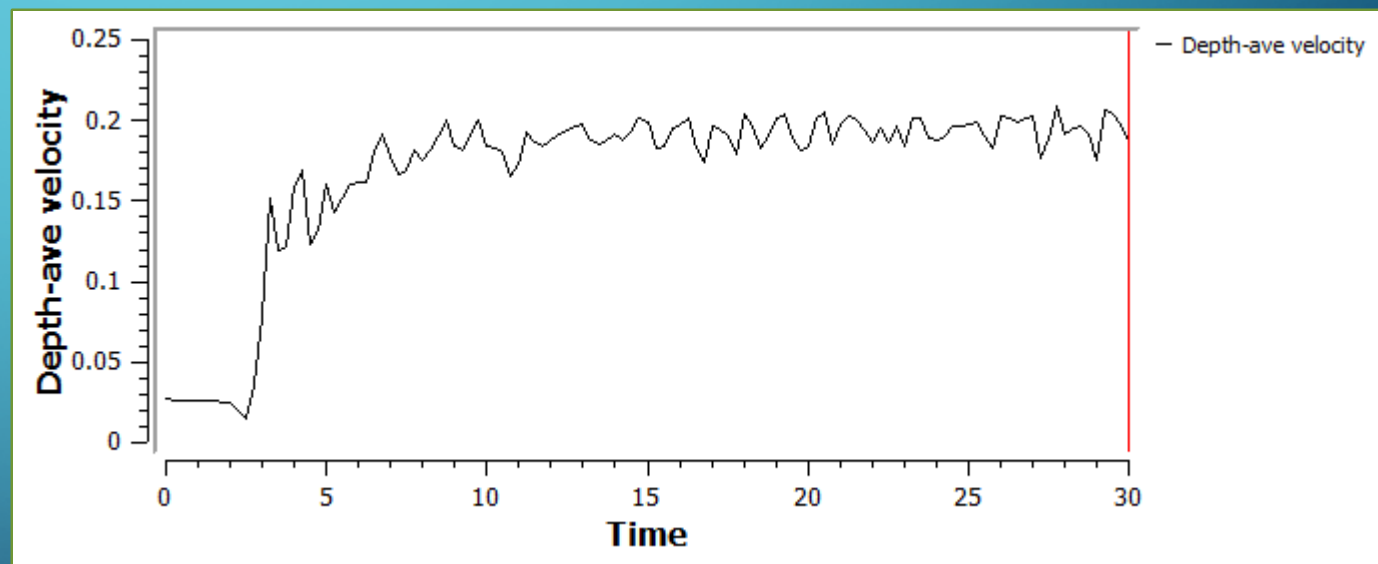
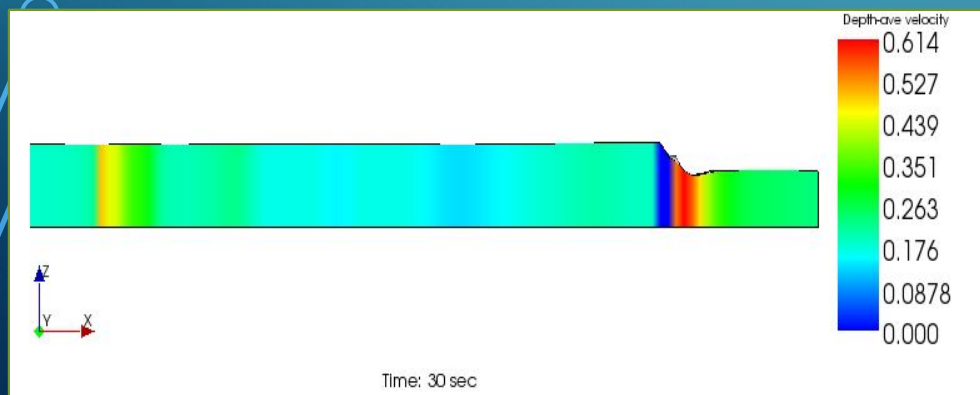
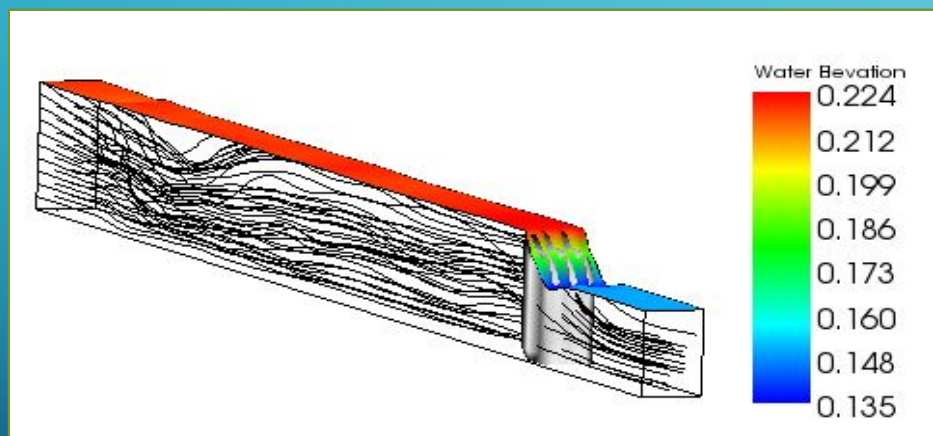
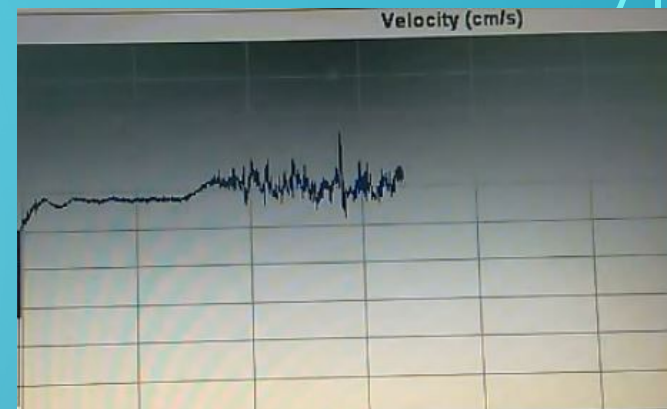
# REZULTATI

- Pojačana turbulencija za 20 %



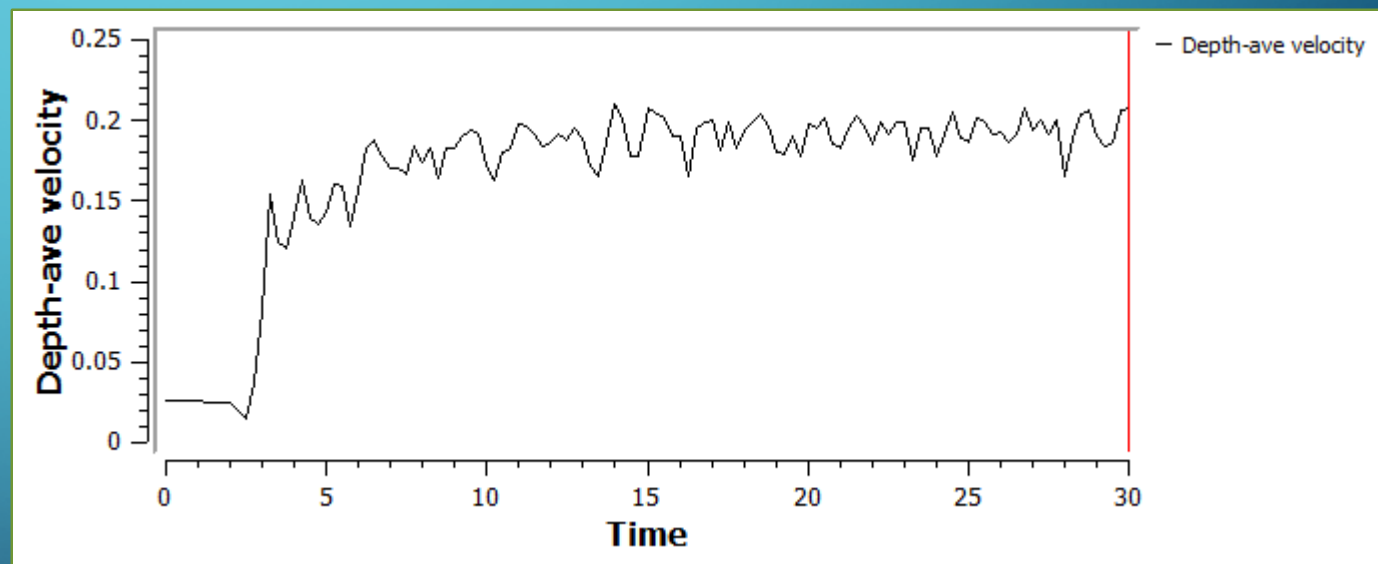
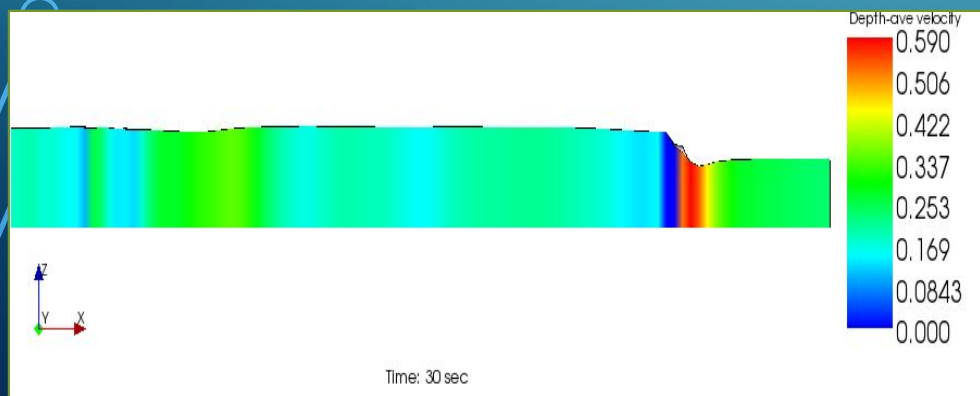
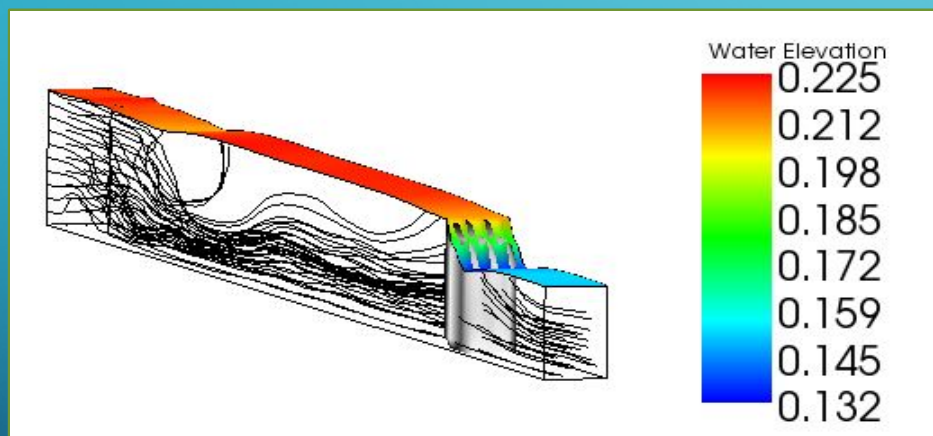
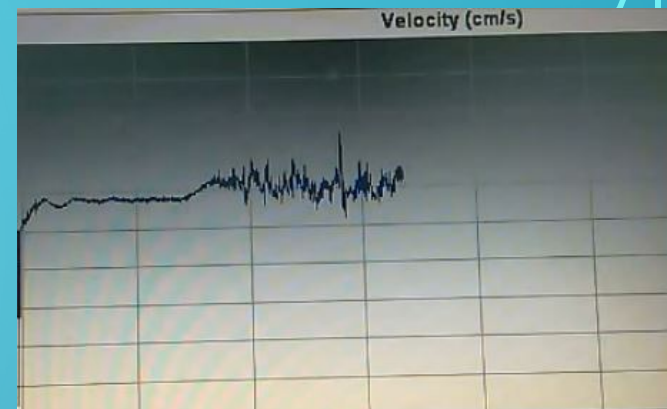
# REZULTATI

- Pojačana turbulencija za 30 %



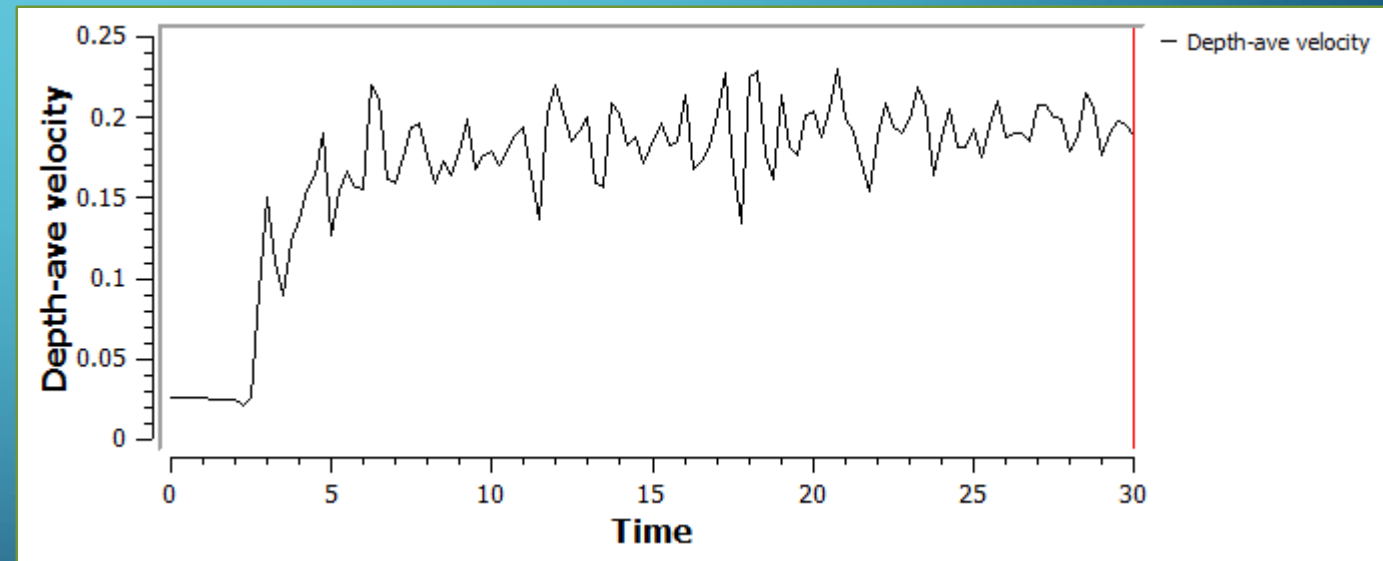
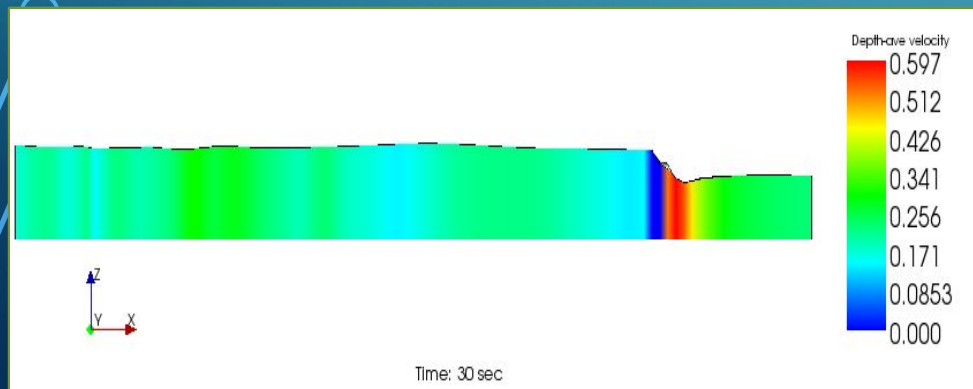
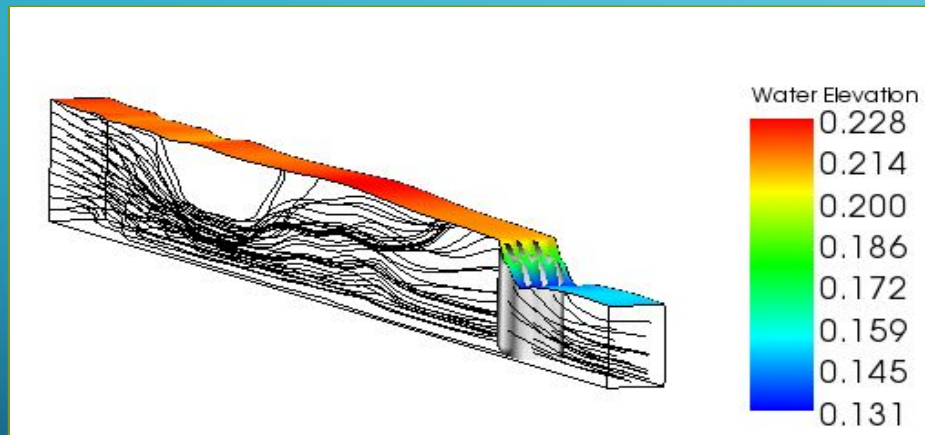
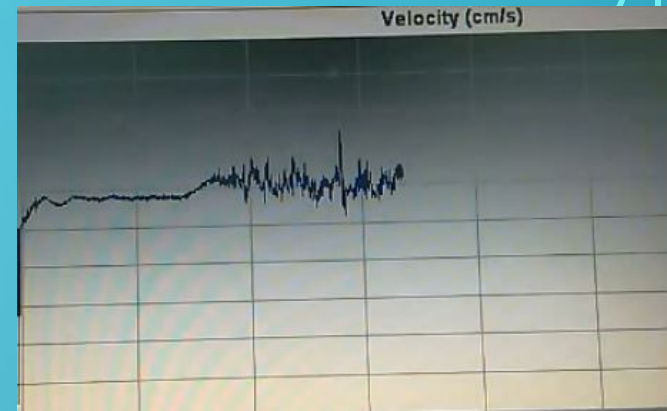
# REZULTATI

- Pojačana turbulencija za 40 %



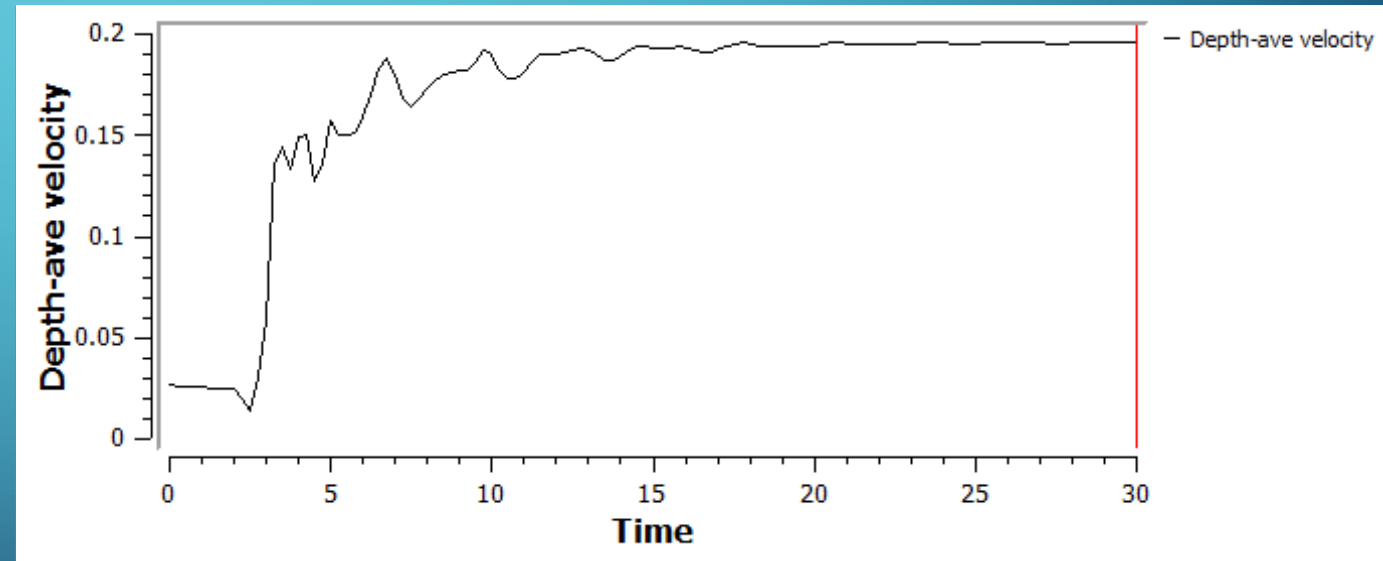
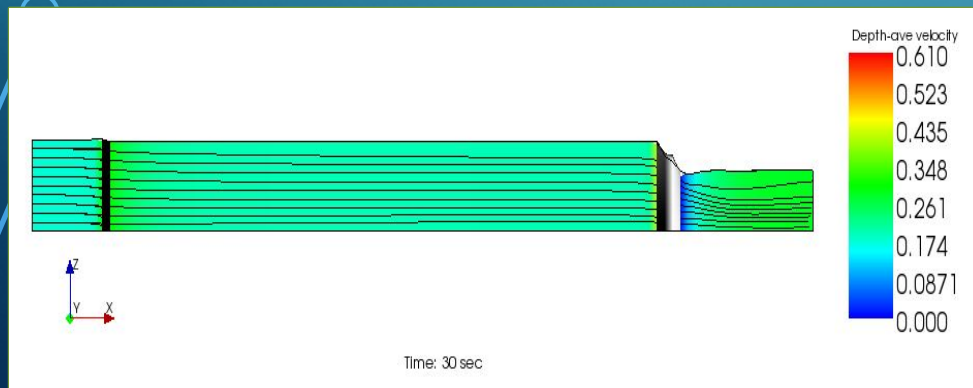
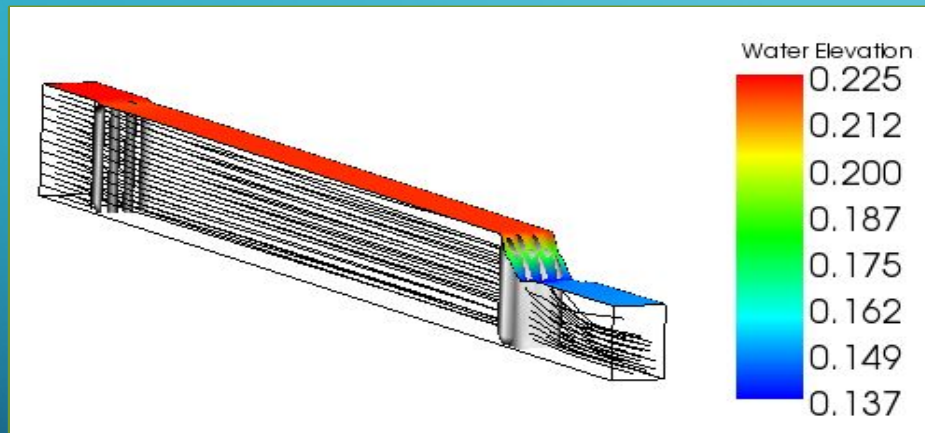
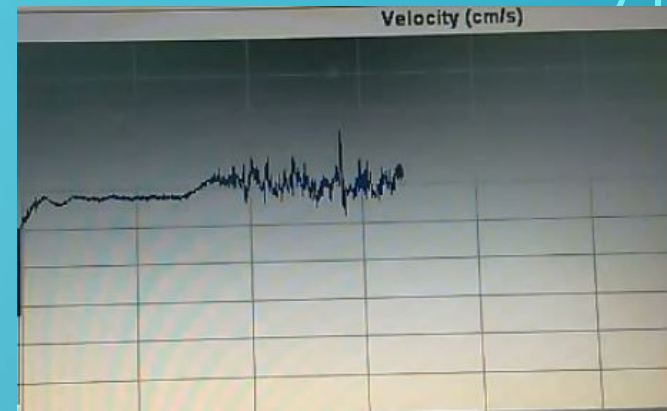
# REZULTATI

- Pojačana turbulencija za 50 %



# REZULTATI

- Pojačana turbulencija postavljanjem prepreke na uzv. kraju



# ZAKLJUČAK

- Zbog stabilnosti proračuna (CFL uslov) i praktičnosti bolje je usvojiti redju mrežu (100x10x10) za razliku od samog zahteva u zadatku (250x20x20)
- Zadavanje turbulencije kao G.U. utiče na brzine u tački A.
- Povećanje turbulencije za 5 i 10 % ne daje neke značajne promene, dok se povećanjima za 30, 40 i 50% značajno utiče na rezultate
- Zbog ograničenja iRIC softvera, nije u potpunosti reprezentovano stanje oko prepreka pa je potrebno naći bolji način za to



The background is a blue gradient with white circuit-like lines in the corners. The lines consist of straight segments and small circles, resembling a network or data flow diagram.

HVALA NA PAŽNJI