

Univerzitet u Beogradu

Građevinski Fakultet

Doktorske studije

PREDMET: Mehanika fluida-napredni kurs

Modeliranje uticaja dužine bočnog zida prepreke na ribljoj stazi primjenom softverskog paketa iRIC NaysCUBE

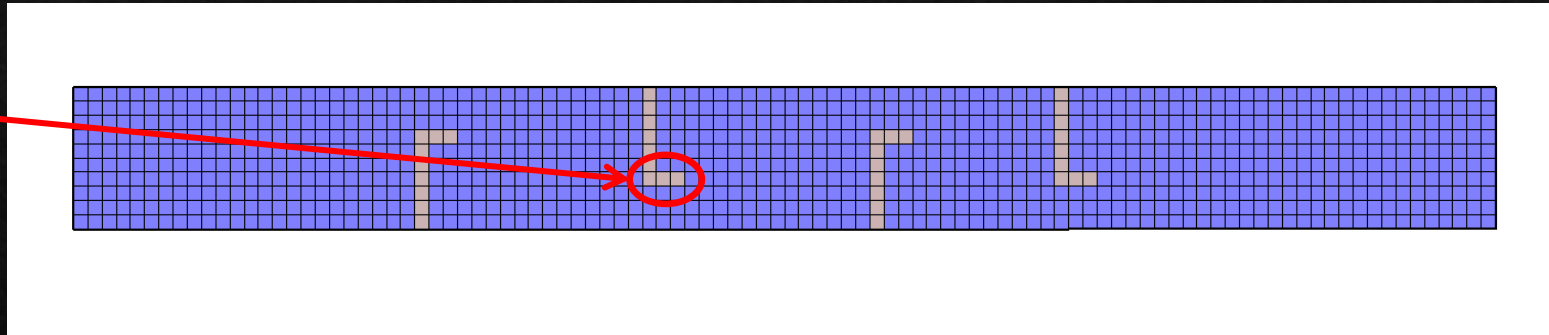
Žana Topalović, dipl. inž. građ.

16. Jun 2014.god.

Postavka zadatka

Zadatak: uticaj promjene širine bočnog zida prepreke na ribljoj stazi na brzine i turbulenciju toka

- ◇ Riblja staza 1m širine i 10m dužine
- ◇ 4 prepreke širine 70cm
- ◇ Bočni zid-varijabilna širina L_p
- ◇ Razmak između prepreka 1,5m
- ◇ Udaljenost prve prepreke 2,5m
- ◇ Mreža 10x10cm



Problemi

- ◆ Prvi problem sa vrijednošću proticaja-zadato 150l/s je bilo suviše malo (dubine on nekoliko cm). Proticaj je povećan na 2m³/s
- ◆ Sa bilo kakvom prvobitnom postavkom (Δt , gustina mreže, proticaj, minimalna dubina, nizvodna granična dubina, itd.) solver nije dolazio do rješenja
- ◆ Tip greške: Q takes NaN values!
- ◆ Rješenje je bilo u postavljanju pitanja na forumu <http://i-ric.org/en/forum/84>
- ◆ Autor je poslao novu verziju solvera i proračun je uspio

I'm working fish path for homework on my PhD studies and this suppose to be very easy project to establish, but it turned to be impossible to initialize successful run. Does anybody had problem with this error and what can be solution? I tried different dt and also grid size and other conditions, but nothing helps. Also, after run in fish path geometry, downstream some nodes are "running" and obstacles (defined periodic walls) are missing even they are properly defined before run (this can be viewed in 3D post-processing window). Thanks in advance!



Author:ztopalovic | Date Posted:2014/4/26 17:24

Re: Error in calculation: Q takes NaN values!

The NaysCUBE has a bag at the downstream outlet in case of mirror periodic boundary condition. I uploaded the corrected solver. Please download it form the following link.

https://dl.dropboxusercontent.com/u/56067609/naysCUBE_v3.00.3.zip

Unzip it and the put the folder "naysCUBE_v3.00.3_64bit_2011XE" at the "solver" folder of the iRIC instlation place.

Usually, the "solver" folder locates at:

C:\Program Files\iRIC 2.2(x64)\solvers

In case of 64bit version. If you need 32bit version solver, please let me know.

Ichiro Kimura, Hokkaido University.

Author:i-kimu2 | Date Posted:2014/5/2 15:34

Re: Error in calculation: Q takes NaN values!

Your computational conditions are very tough for NaysCUBE. Because it contains super-critical flow as well as jump. NaysCUBE uses boundary fitted coordinate and cannot capture such sudden big change of the water surface profile. So, some special settings are necessary.

-set delta t mall (=0.0001sec).

-use Upwind scheme instead TVD Muscl

-use Linear k-e model instead Non-linear k-e model

-do not set the donwstream water level based on the unifrom flow.

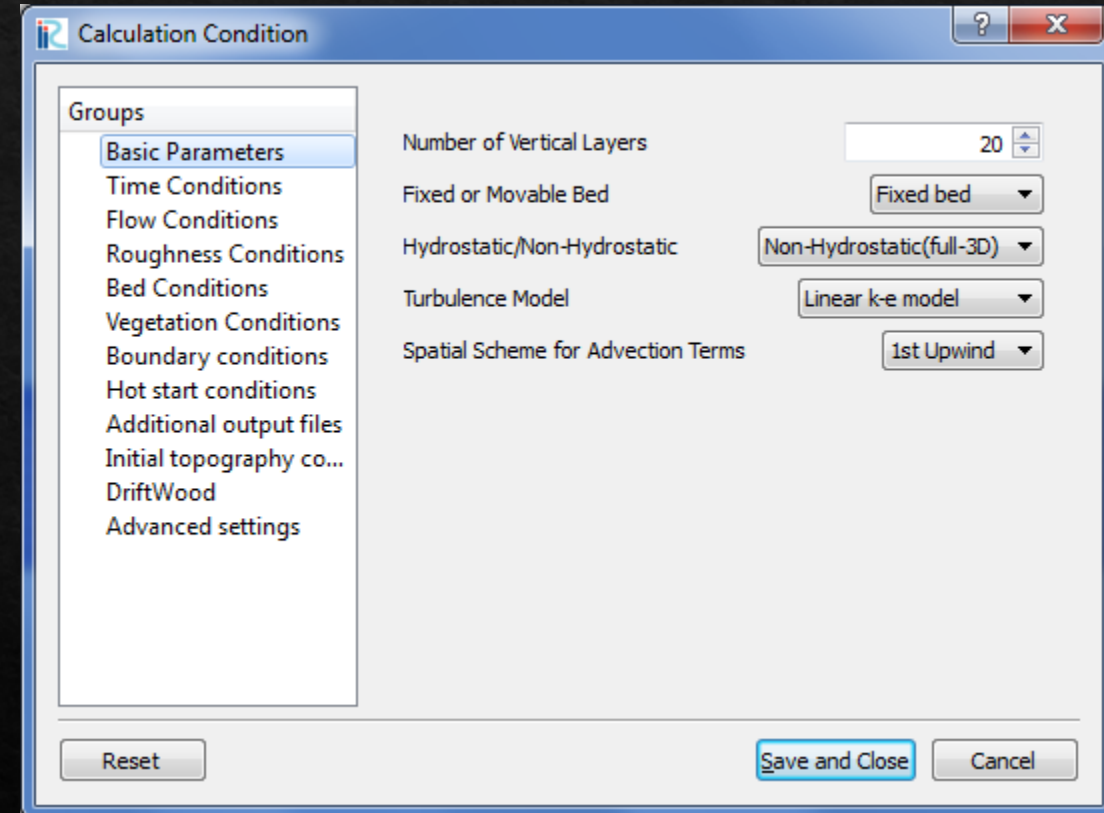
Instead, set a large value (=4.0m) directly. After the computation start, the depth is adjusted automatically.

-increase the surface tension to stabilize the surface oscillation. To do so, "calclation condition"->"advanced settings"->"Coef of surface tension"

set the value 1000. (please use the new solver, which I inform you in the previous comment.)

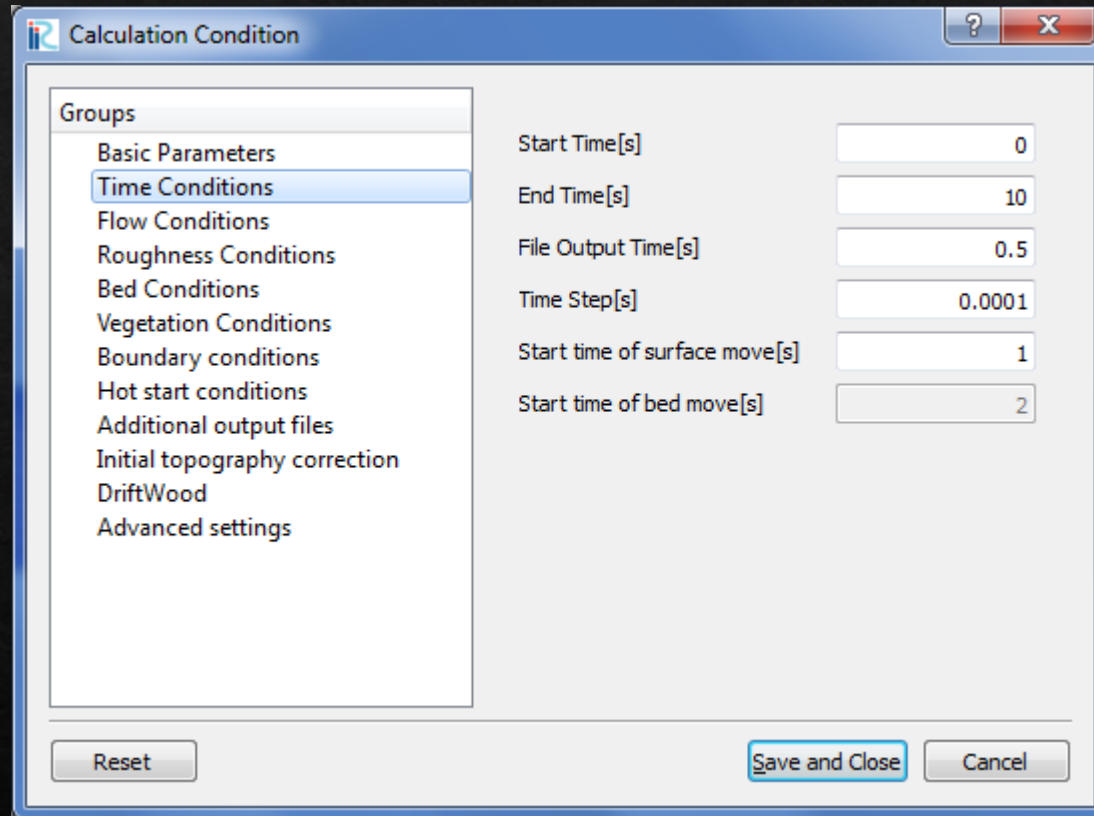
Uslovi proračuna-osnovni parametri

- ◇ Mreža 5x5cm-solver rješava neuspješno!
- ◇ $\Delta t > 0.0001s$ -solver rješava neuspješno!
- ◇ Usvojeno $\Delta t = 0.0001s$...manji korak nema mnogo smisla jer simulacija onda traje oko 15h
- ◇ Broj vertikalnih slojeva 20
- ◇ Ne-hidrostatske, pune 3D jednačine
- ◇ Model turbulencije je linearni k- ϵ model
- ◇ Prostorna šema za advektivne članove je 1st upwind



Uslovi proračuna-karakteristični vremenski koraci

- ◇ Trajanje proračuna 10s
- ◇ Početak kretanja površine je 1s
- ◇ Vremenski korak je 0.0001s
- ◇ Vremenski korak rezultata 0.5s



Uslovi proračuna-proticaj

- ◆ Protok je povećan od zadatog na $2\text{m}^3/\text{s}$
- ◆ Nizvodna dubina je varirana u opsegu $0.5\text{m}-4\text{m}$. Najkritičniji rezultati su za 1m što je usvojeno
- ◆ Minimalna dubina 0.1m

Calculation Condition

Groups

- Basic Parameters
- Time Conditions
- Flow Conditions
- Roughness Conditions
- Bed Conditions
- Vegetation Conditions
- Boundary conditions
- Hot start conditions
- Additional output files
- Initial topography co...
- DriftWood
- Advanced settings

Discharge[m3/s] 2

How to give outlet water level? Given directly

Downstream Water Level[m] 1

Minimum Depth[m] 0.1

How to give initial surface slope? Given by initial average bed slope

Initial surface slope 0.0001

Q gradual increase Q given directly

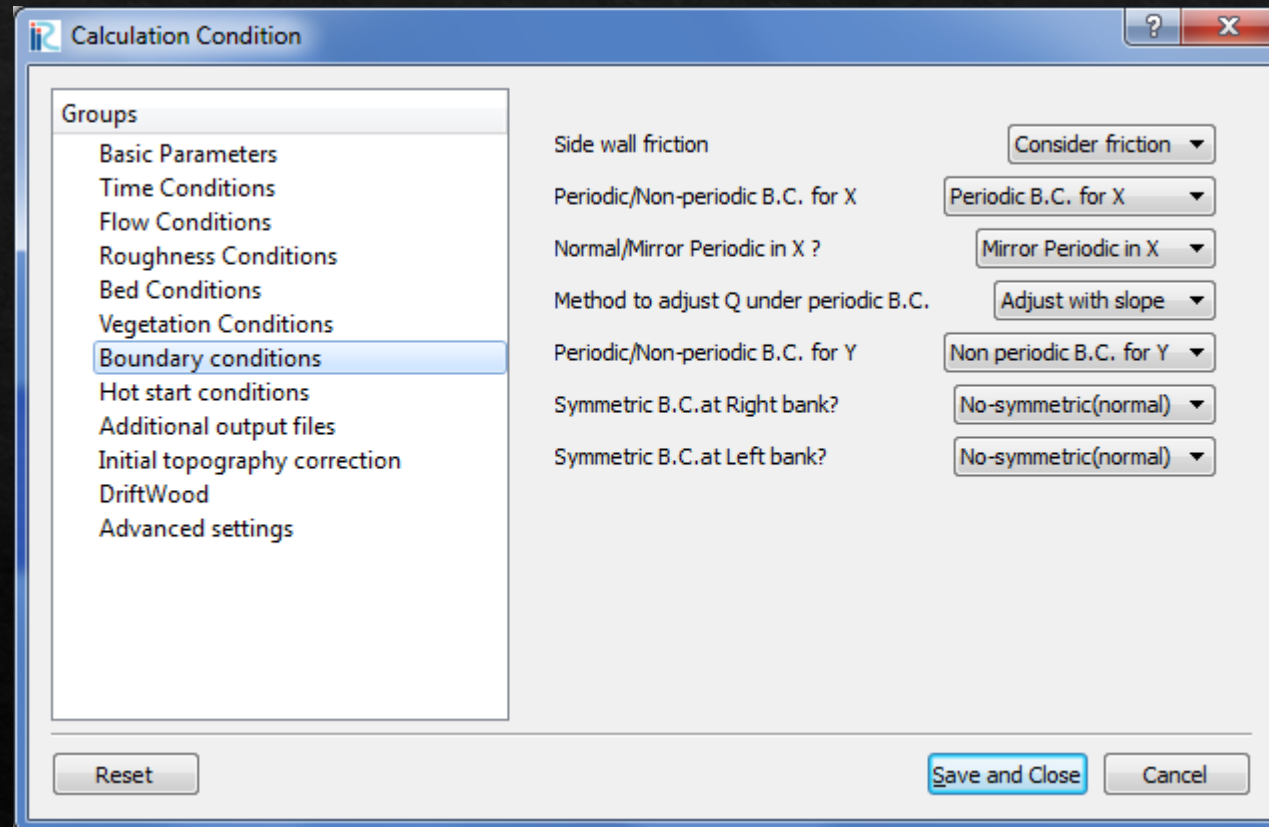
Initial Q rate 0.1

Time for Q slope[s] 10

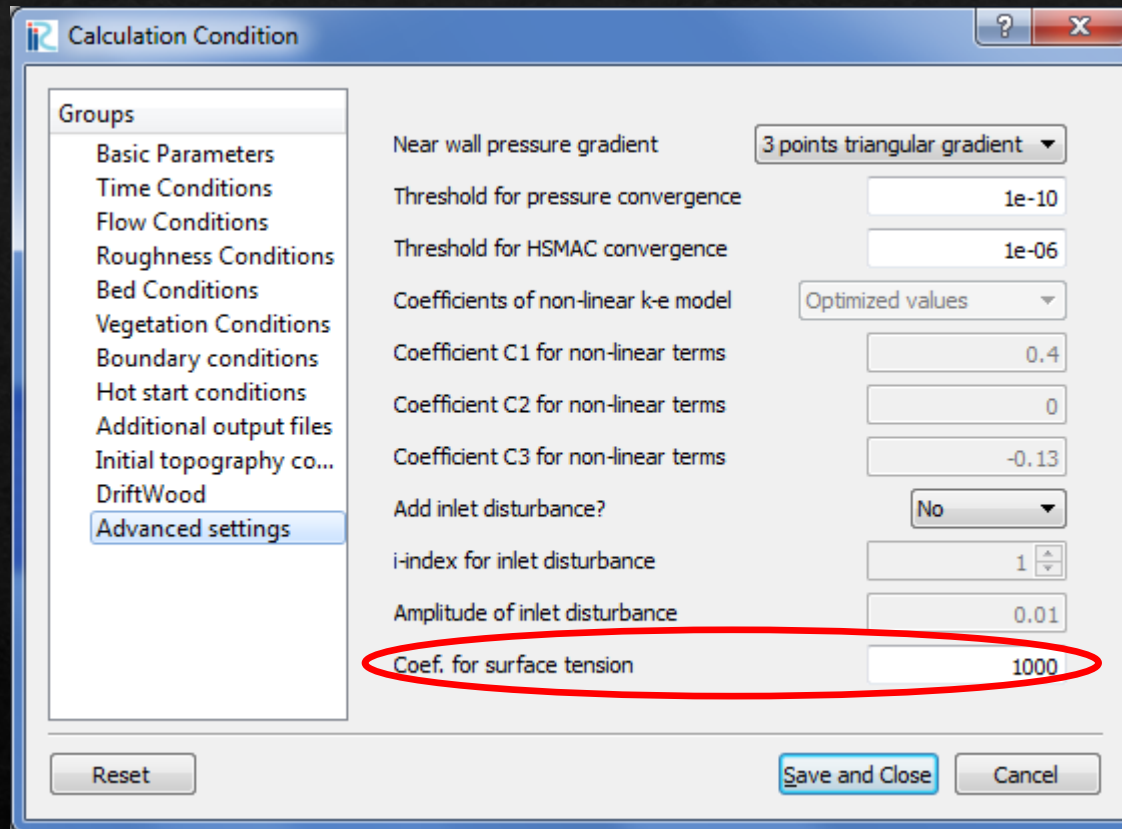
Reset Save and Close Cancel

Uslovi proračuna-granični uslovi

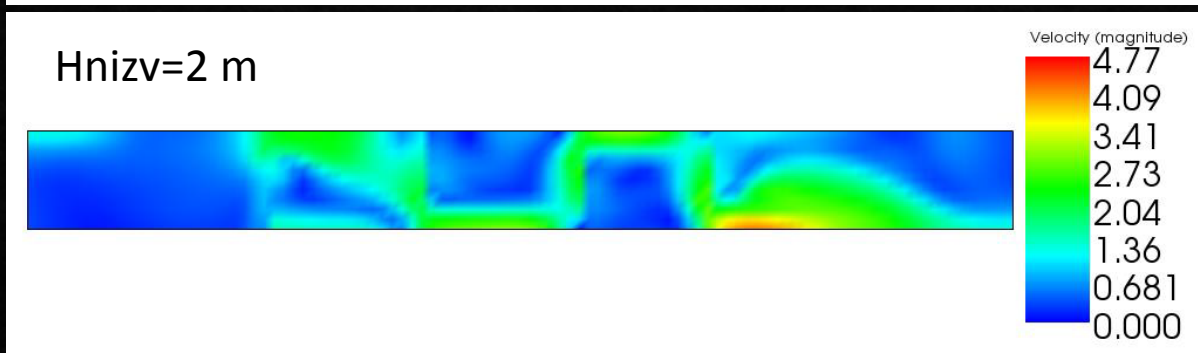
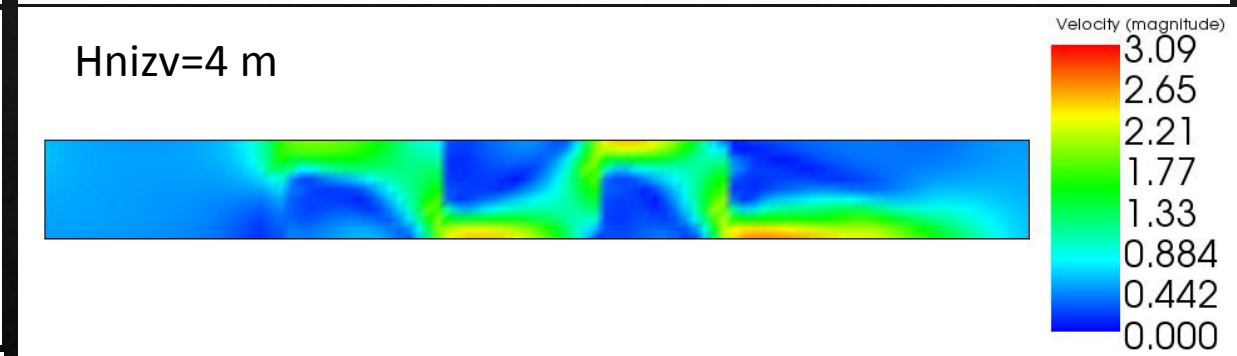
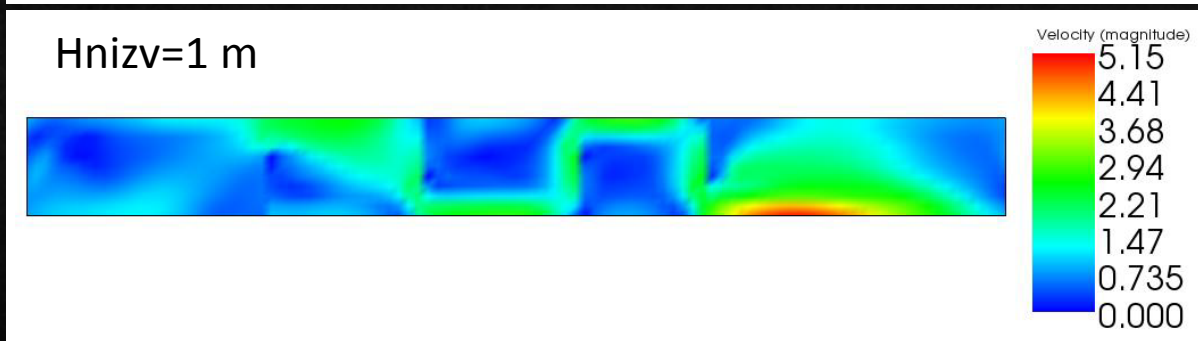
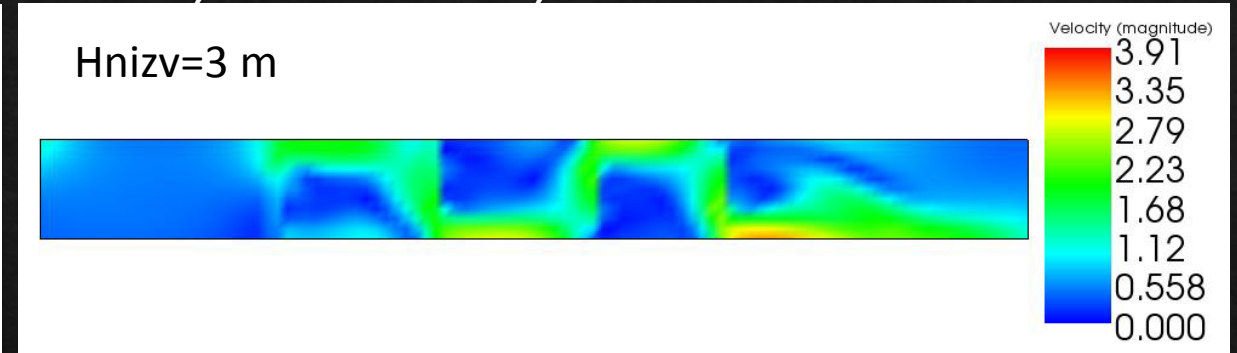
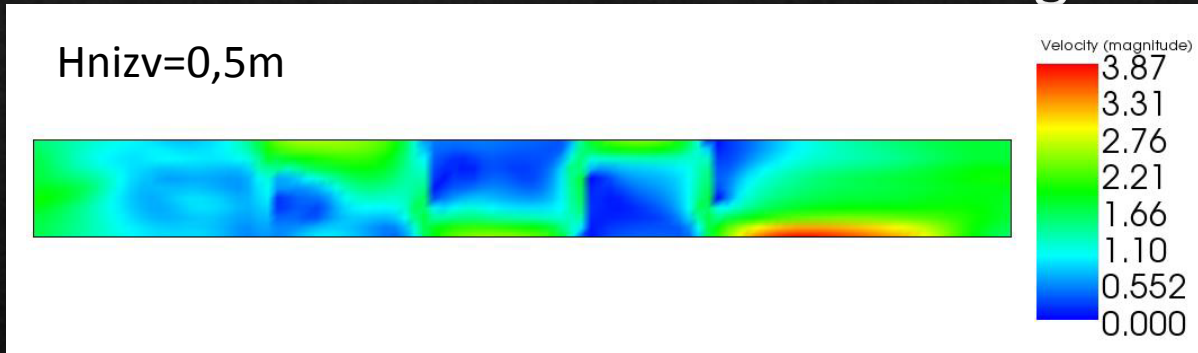
- ◆ Periodični granični uslovi u X pravcu-prema uputstvu za solver tipično za riblju stazu



Uslovi proračuna-napredne postavke



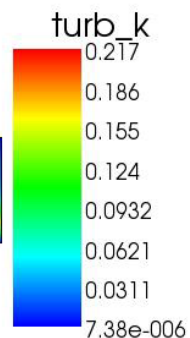
Pregled brzina u osnovi za različite zadane nizvodne dubine -dužina bočnog zida 10cm, z=10 i t=2,5s-



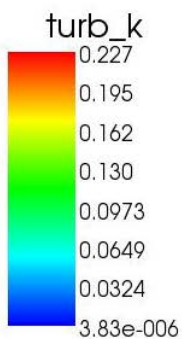
- Date brzine su za 10-i sloj (otprilike polovina dubine) visine vode i za karakterističan vremenski trenutak t=2,5s
- Poređenje je vršeno na početnoj odabranoj dužini bočnog zida od 10cm

Pregled vrijednosti K u osnovi za različite zadane nizvodne dubine -dužina bočnog zida 10cm, z=10 i t=5s-

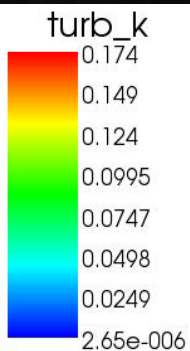
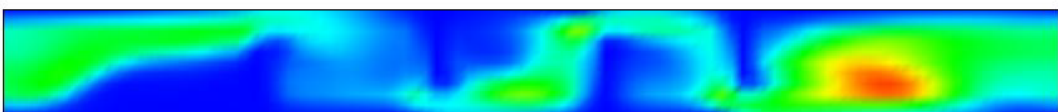
Hnizv=0,5m



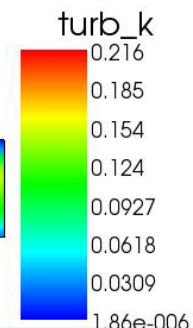
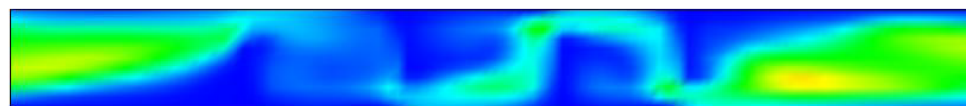
Hnizv=1 m



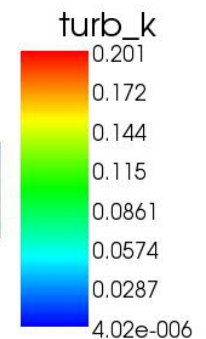
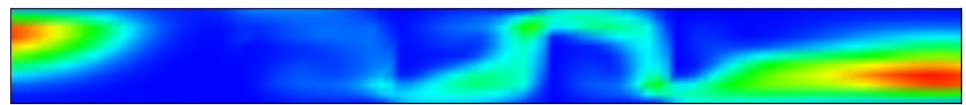
Hnizv=2 m



Hnizv=3 m



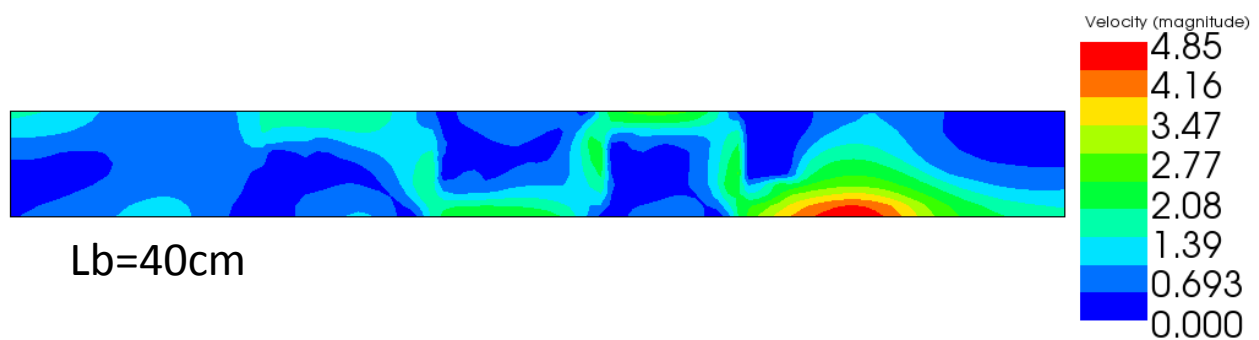
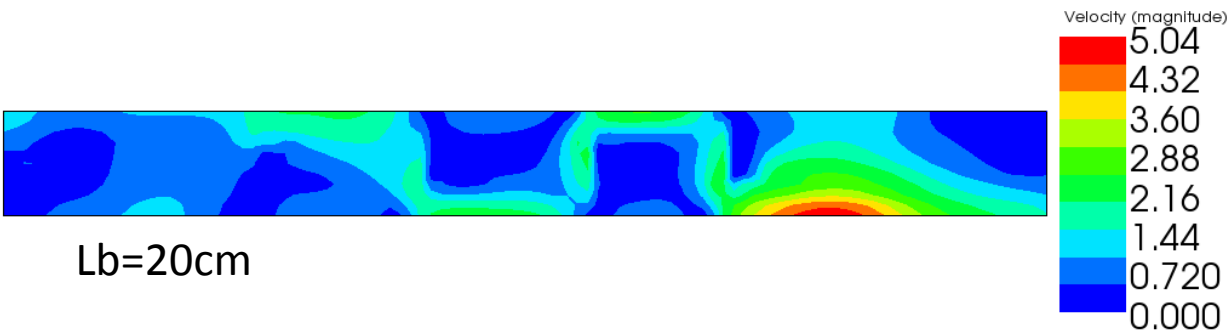
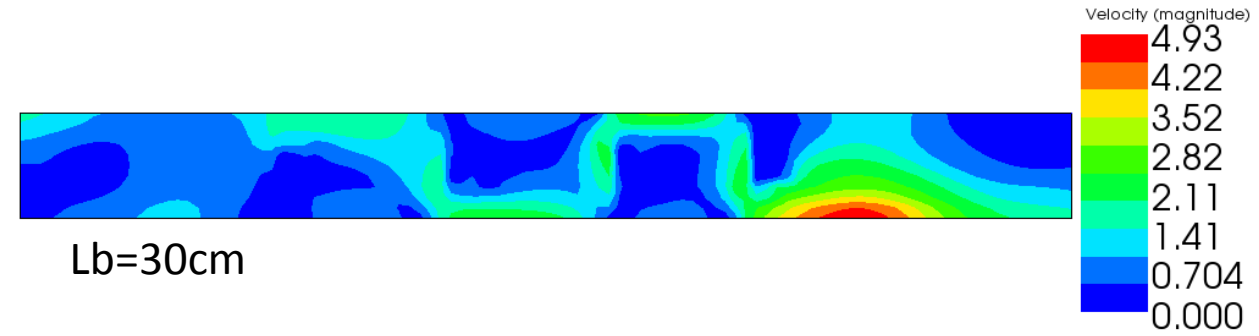
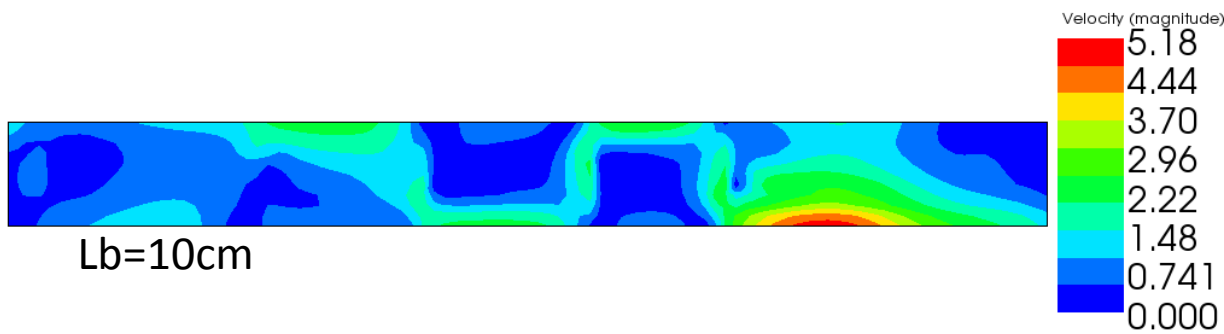
Hnizv=4 m



- Date vrijednosti koeficijenta k su za 10-i sloj (otprilike polovina dubine) visine vode i za karakterističan vremenski trenutak t=5s
- Poređenje je vršeno na početnoj odabranoj dužini bočnog zida od 10cm

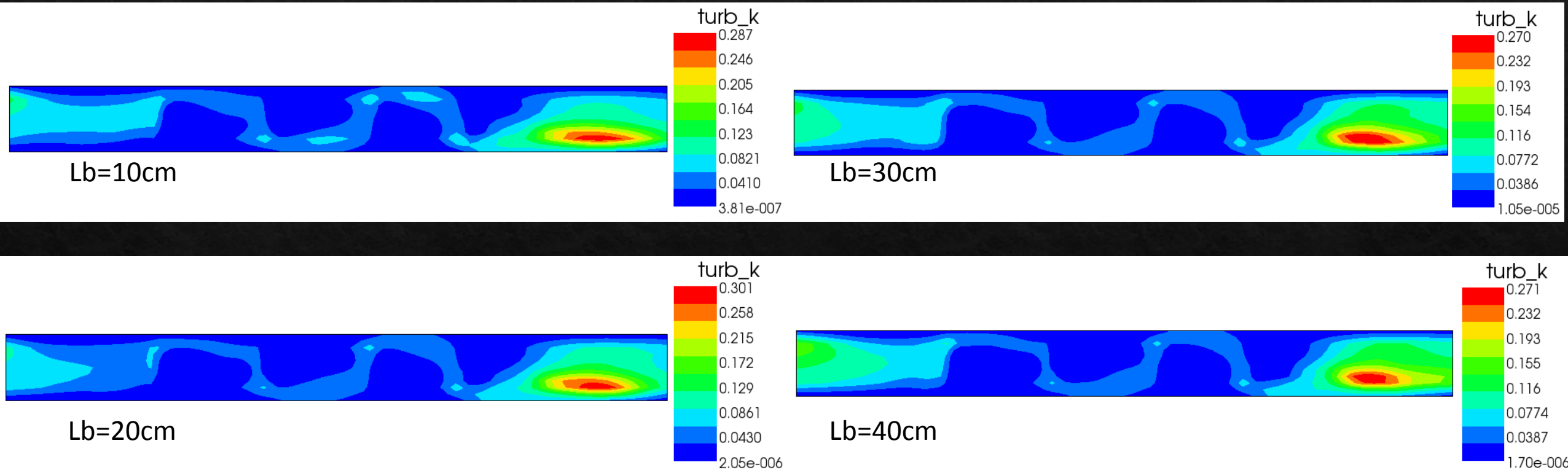
Pregled brzina u osnovi za različite dužine bočnog zida, $z=10$ i $t=3s$ -

- Date brzine su za 10-i sloj (otprilike polovina dubine) visine vode i za karakterističan vremenski trenutak $t=3s$



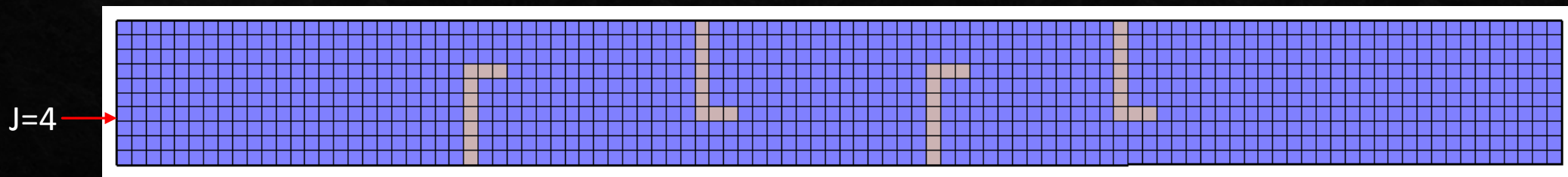
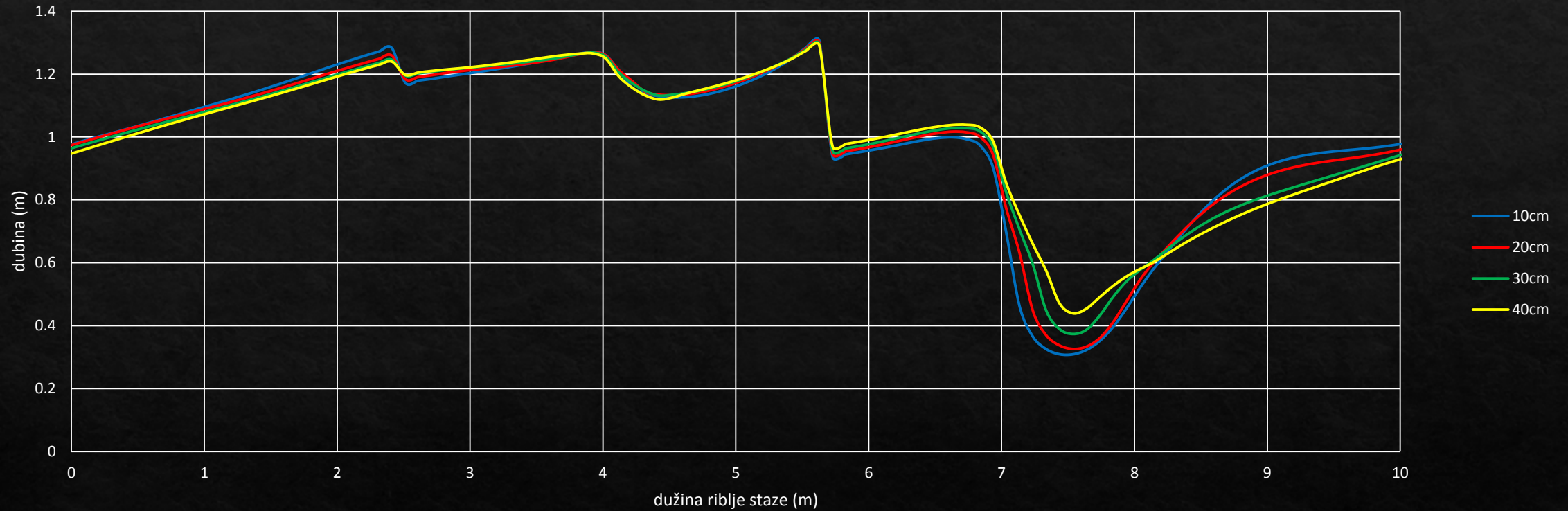
Pregled koeficijenta k u osnovi za različite dužine bočnog zida, $z=10$ i $t=9s$ -

- Date vrijednosti su za 10-i sloj (otprilike polovina dubine) visine vode i za karakterističan vremenski trenutak $t=9s$

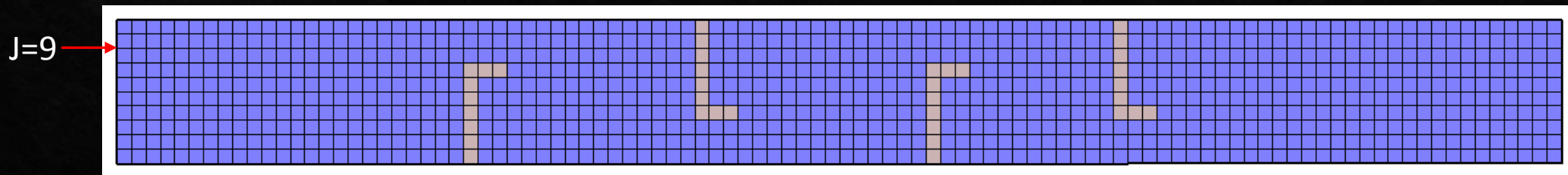
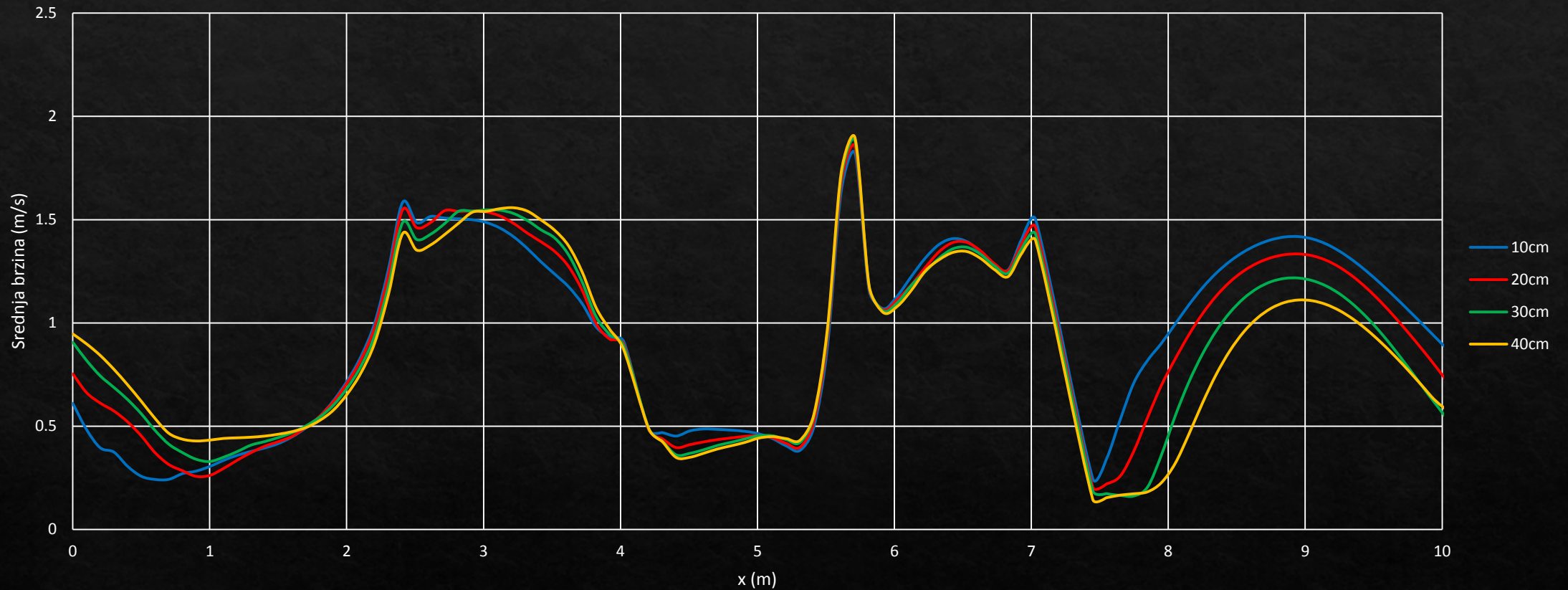


Pregled dubina duž riblje staze

$t=3,5s$; $J=4$

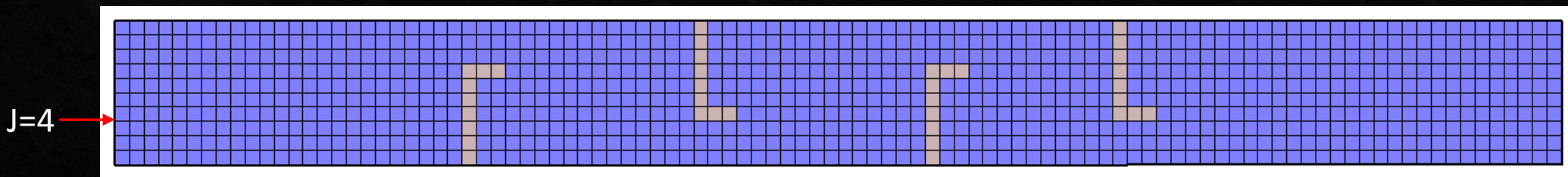
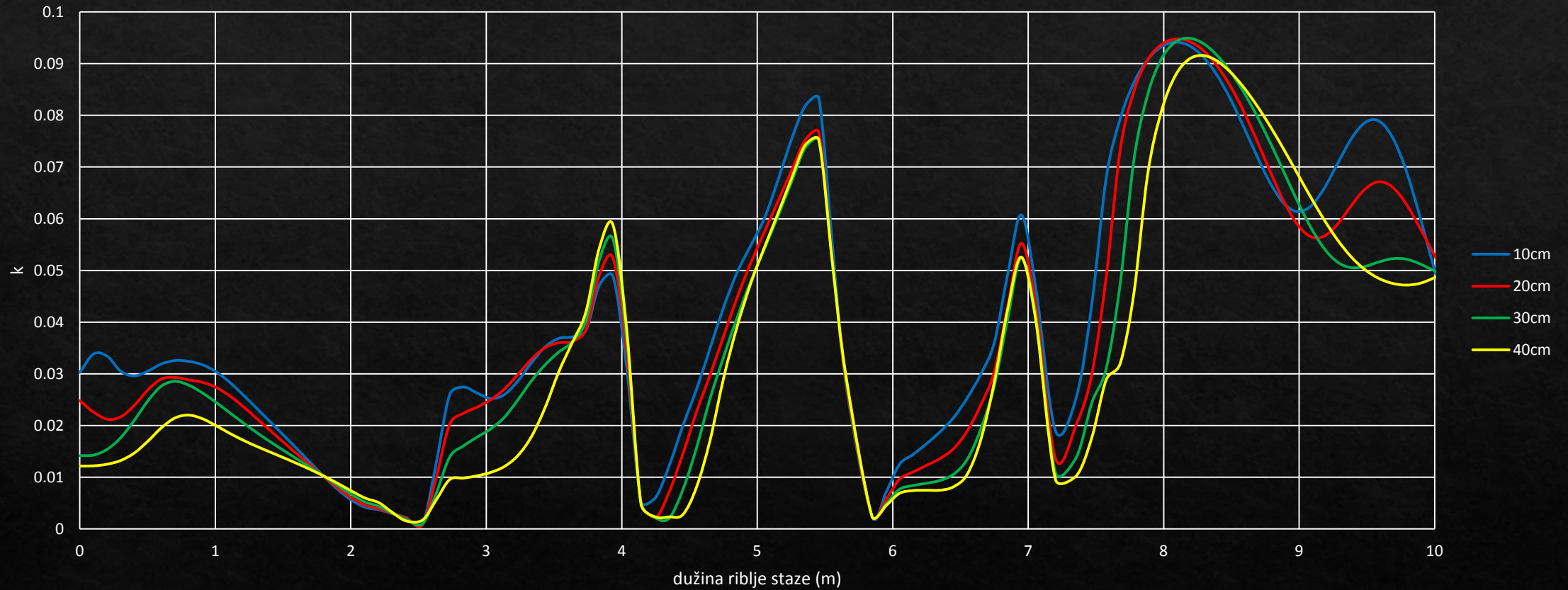


Pregled brzina osrednjenih po dubini za različite dužine bočnog zida pregrade; $J=9$, $t=6s$



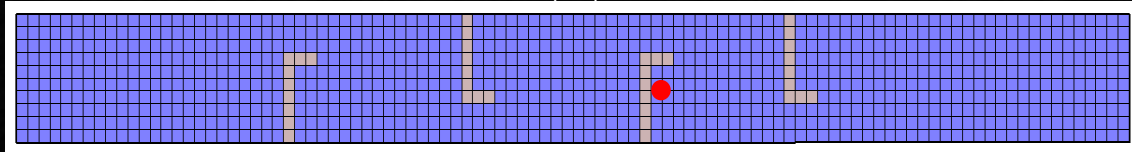
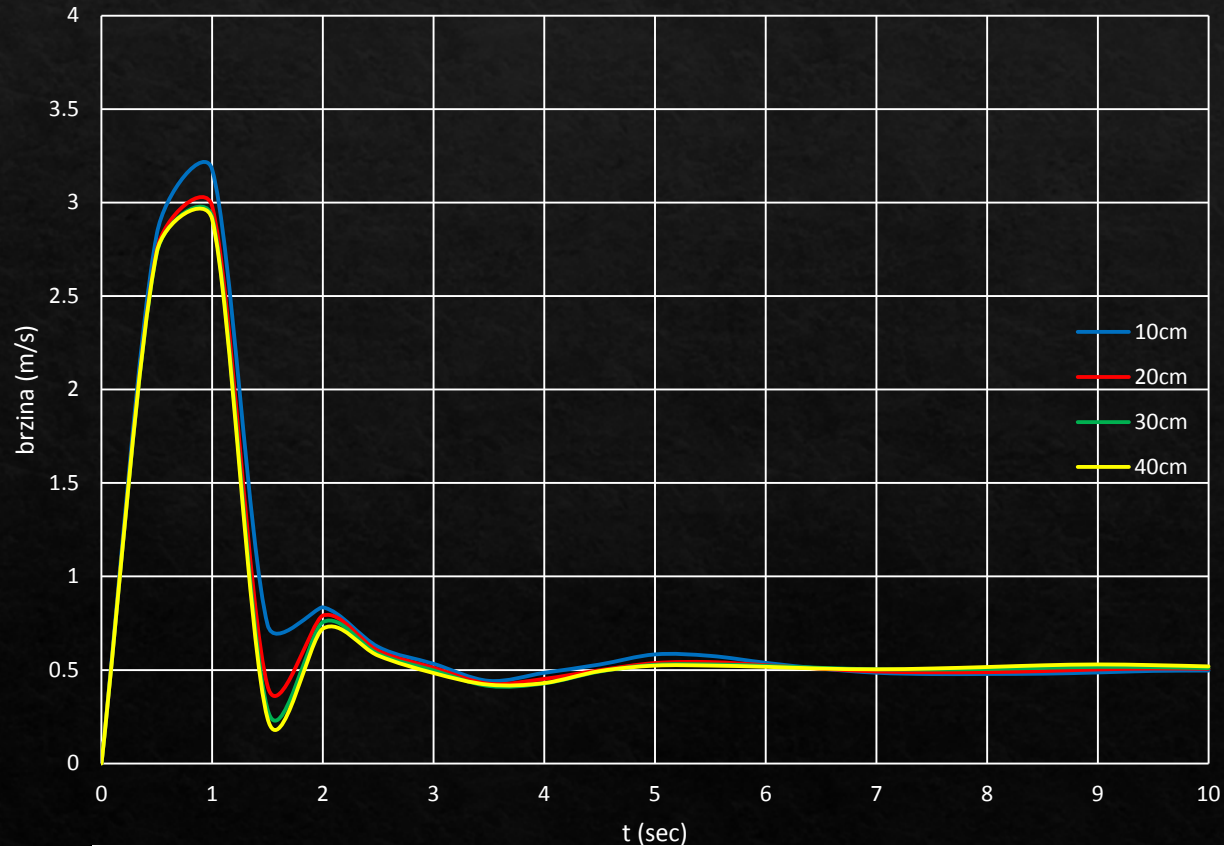
Pregled turbulentnog k duž riblje staze

$t=2.5s; J=4$

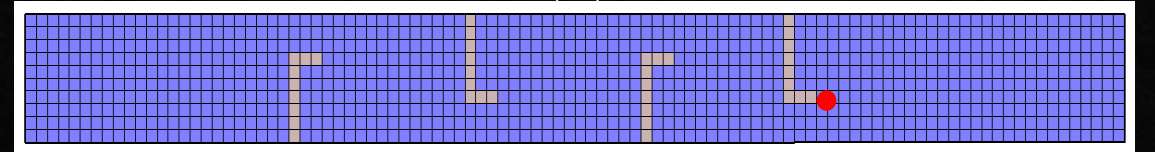
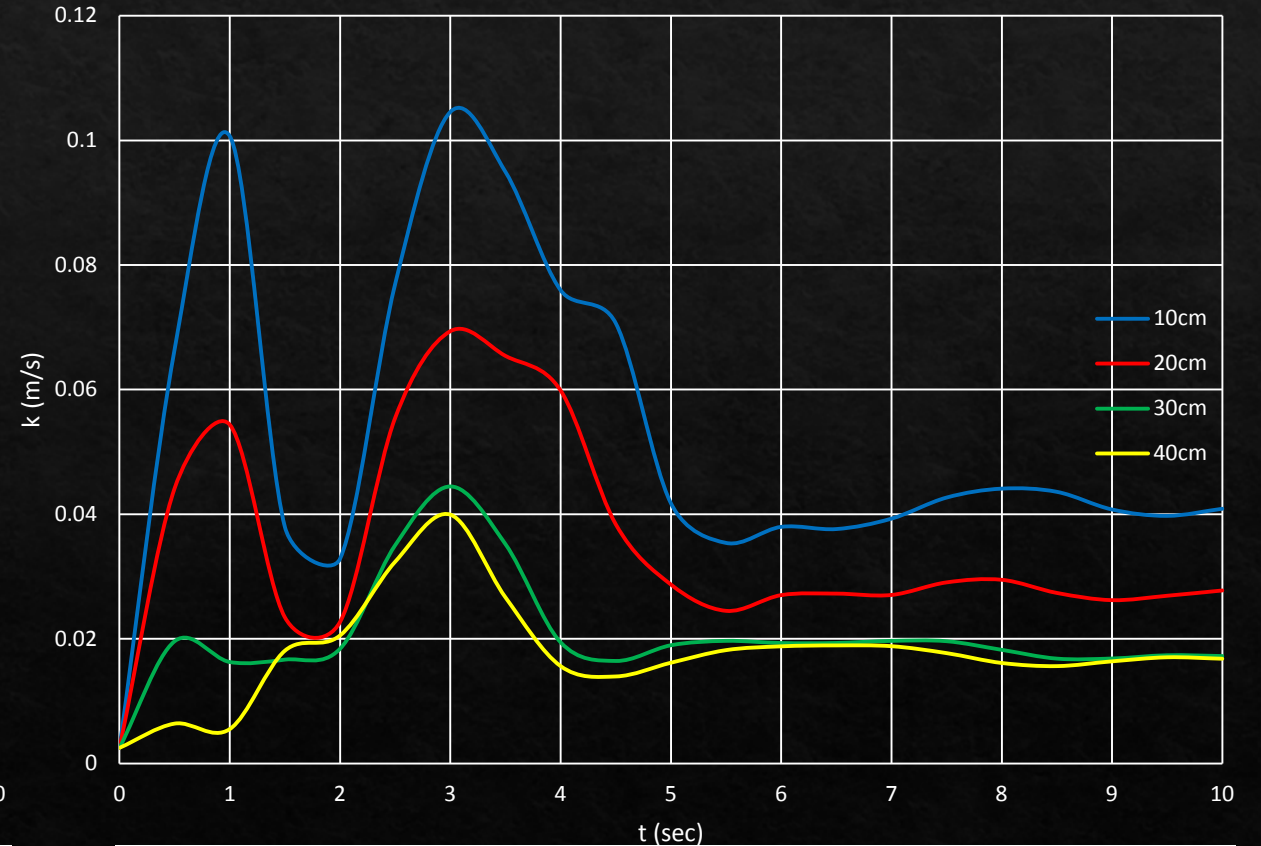


Intenziteti brzine i vrijednost k na karakterističnom mjestu za različite dužine bočnog zida

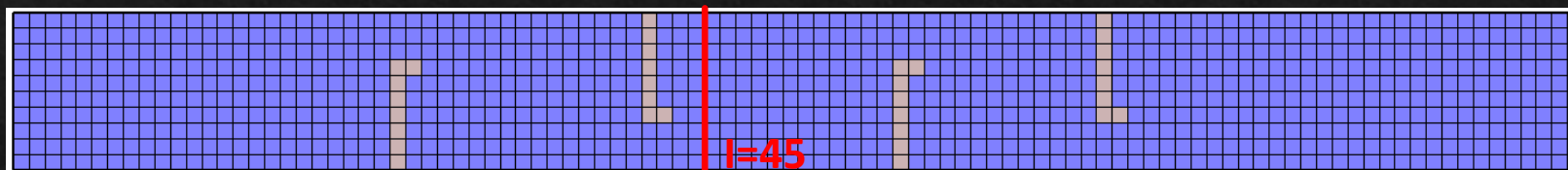
Zavisnost intenziteta brzina od vremena na mjestu I=58, J=5 | K=12



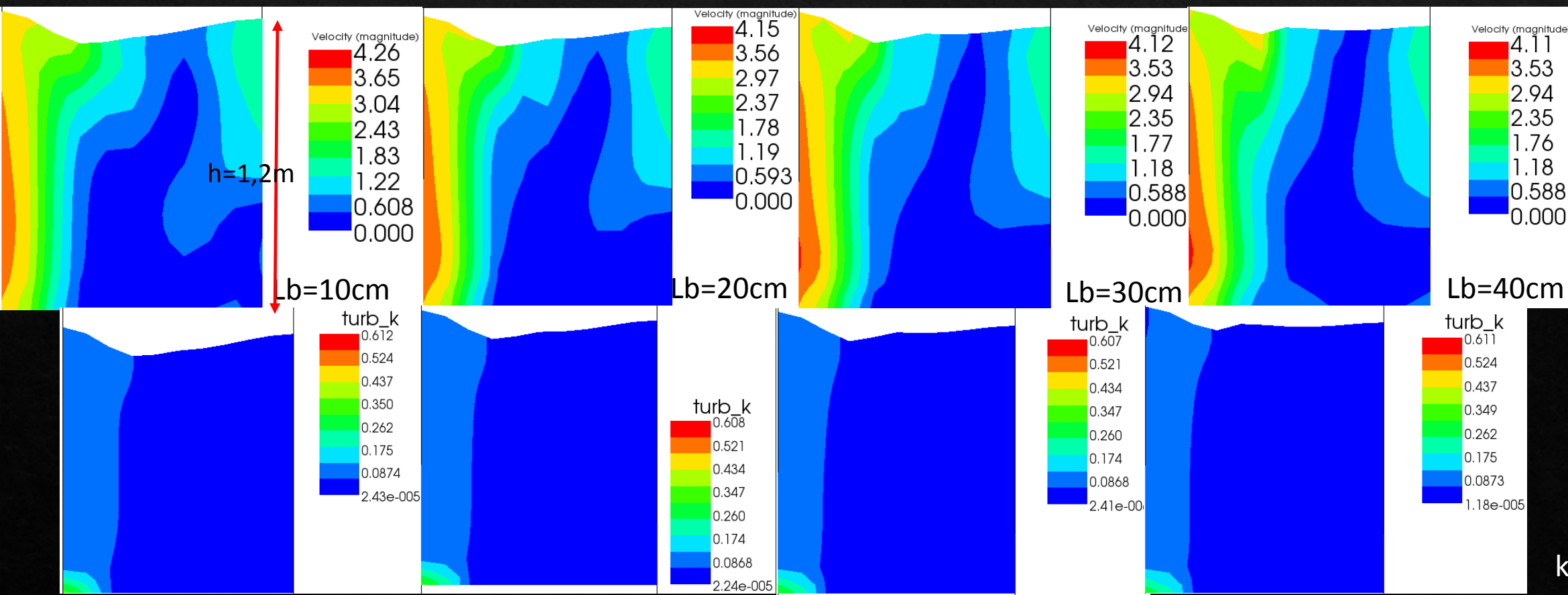
Zavisnost k od vremena na mjestu I=74, J=4 | K=11



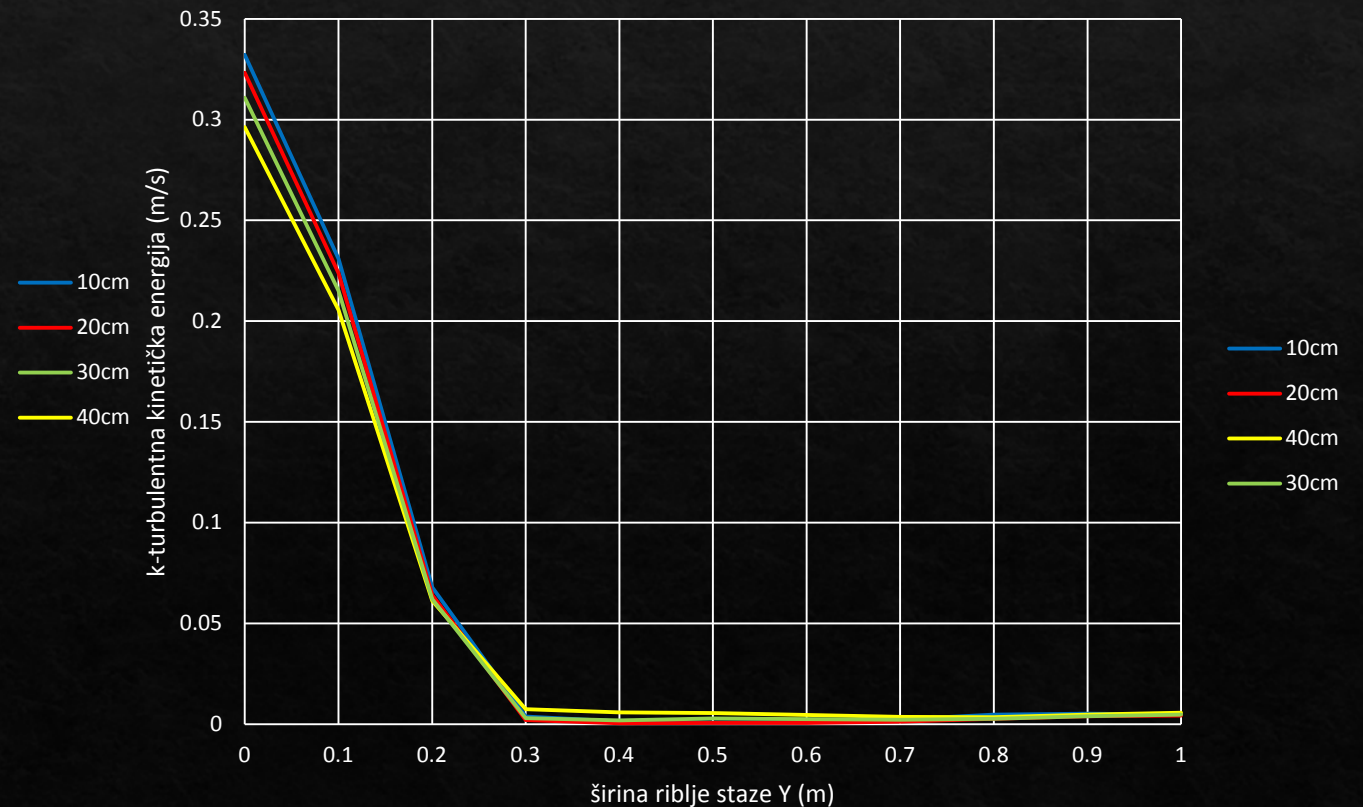
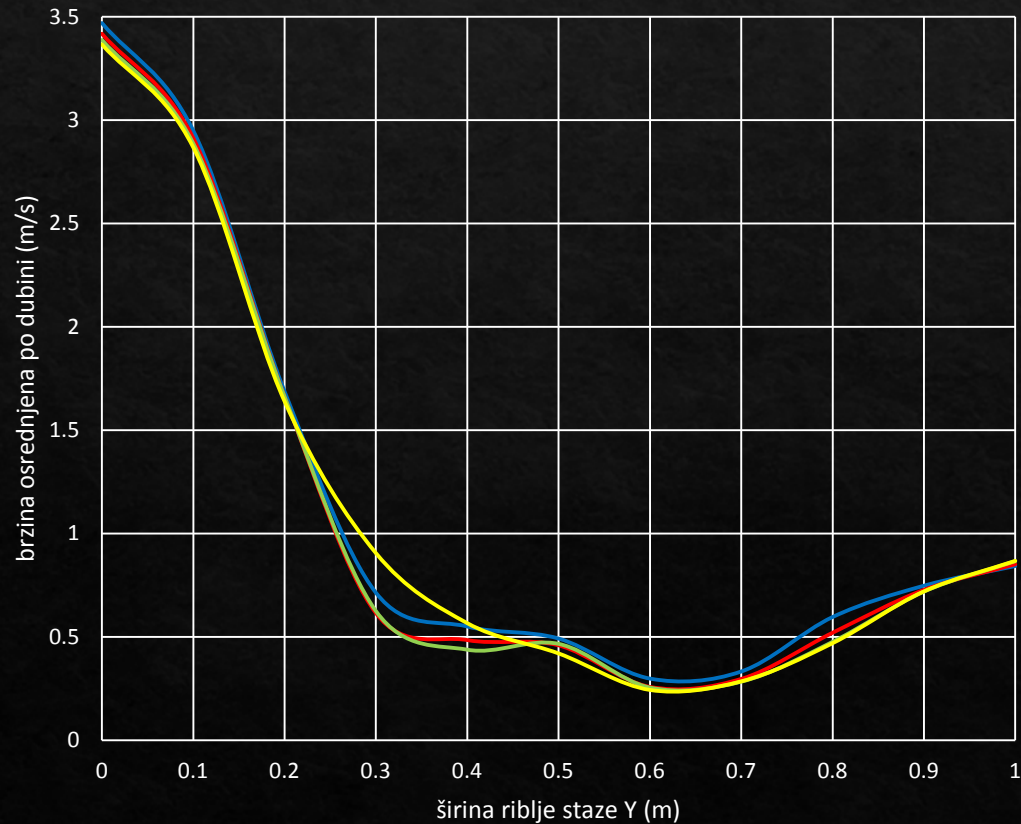
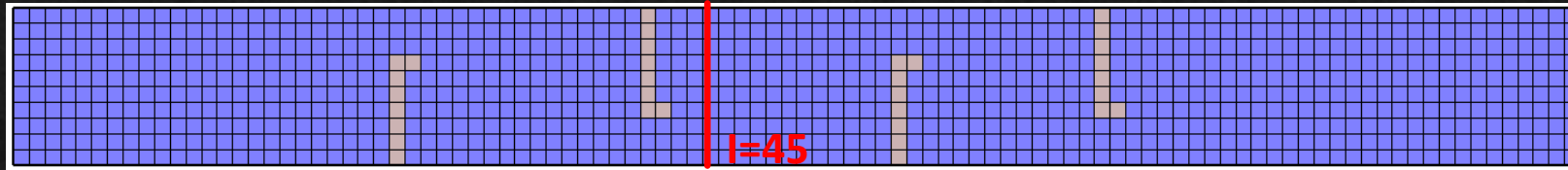
Brzine i vrijednosti turbulentne kinetičke brzine k u ravni Y-Z, na mjestu $l=45$, $t=2\text{sec}$





Brzine



Brzine osrednjene po dubini i vrijednosti turbulentne kinetičke brzine k u ravni Y-Z, na mjestu $l=45$, $t=2,5\text{sec}$

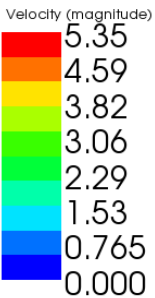
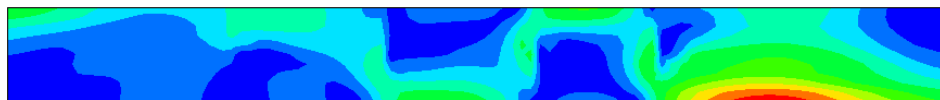


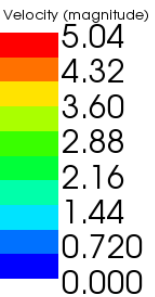
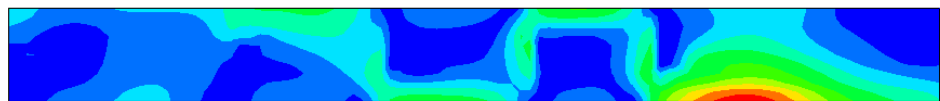
Poređenje karakterističnih rezultata za promjenu širine prepreke

$z=10; t=3s$

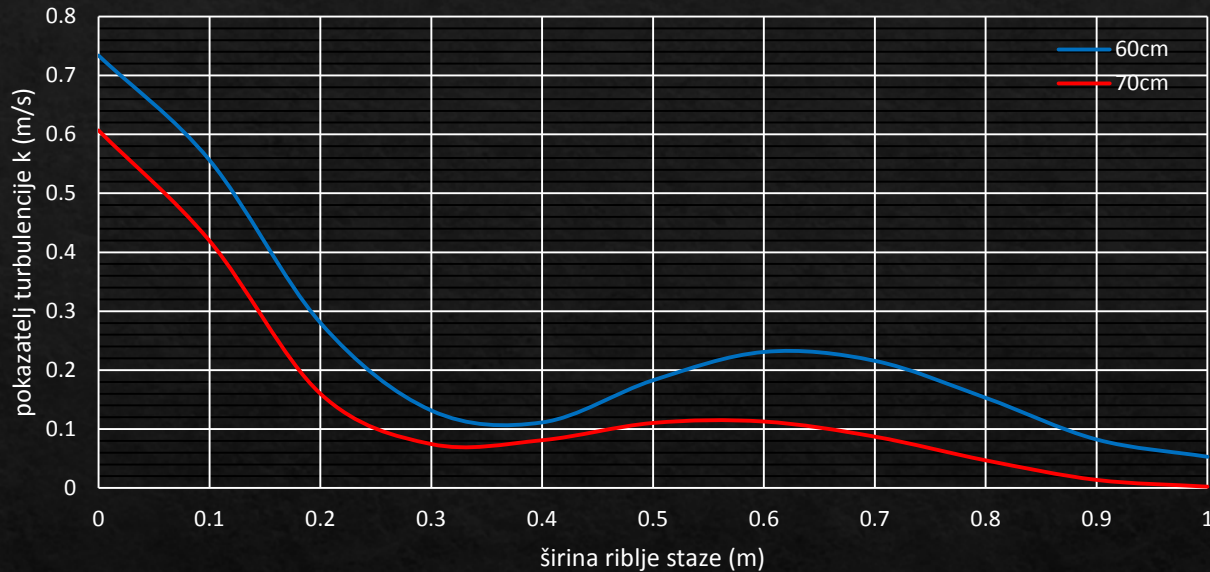
$L_{zida}=60cm$



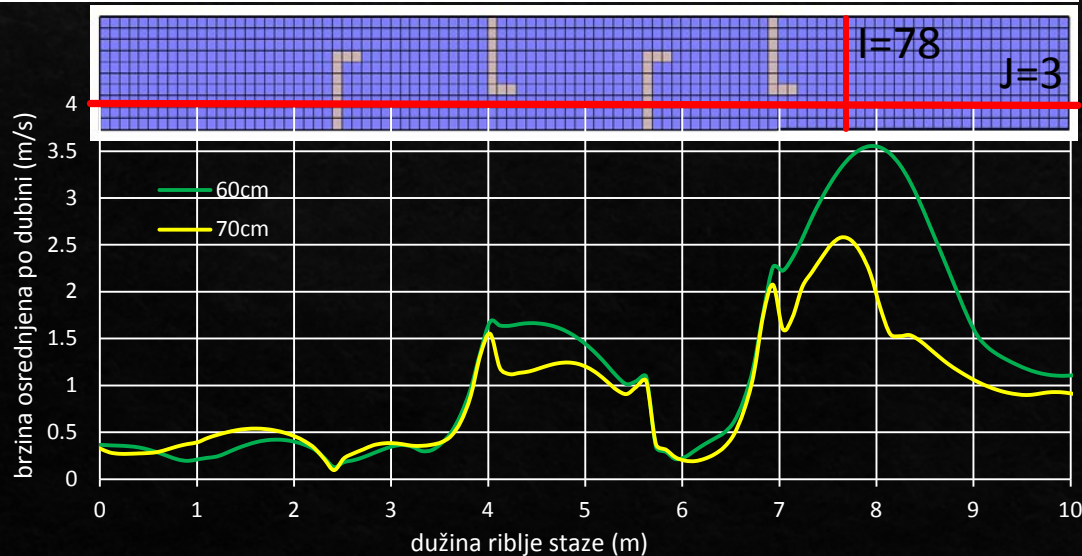
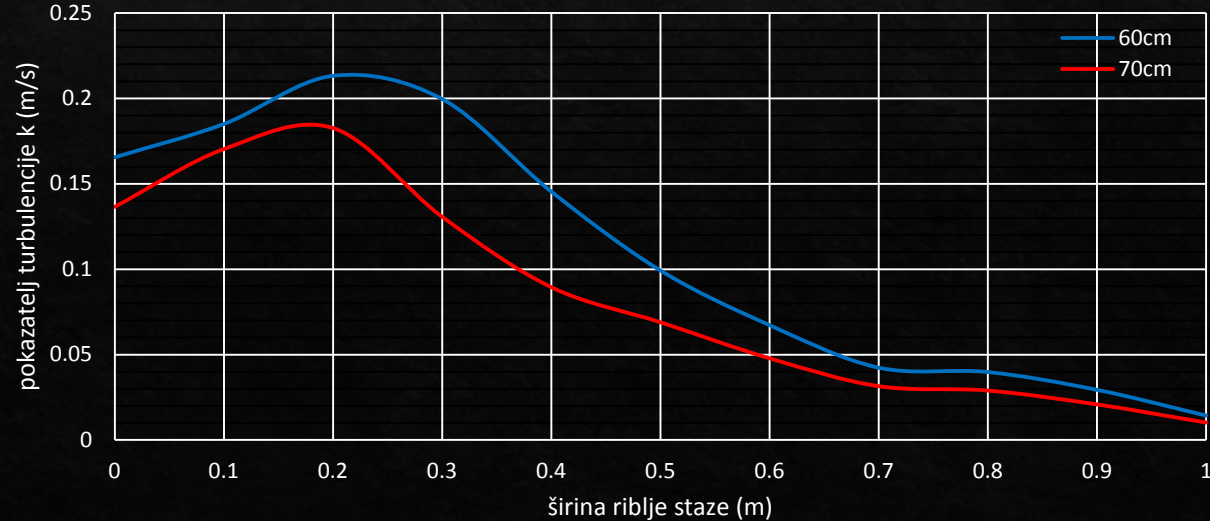
$L_{zida}=70cm$



$z=1$



$z=14$



Zaključci

- ◇ Dubine vode najviše variraju-u opsegu od oko 40 cm-kod hidrauličkog skoka nizvodno od posljednje prepreke. Za duže bočne zidove dubine su veće
- ◇ Nema značajnijih promjena u podužnim i poprečnim brzinama osim na posljednjoj dionici riblje staze, nizvodno od posljednje prepreke ($\Delta V_{sr}=0,7\text{m/s}$)
- ◇ U „odmaralištima“ za ribe, iza prepreke, za duže bočne zidove ostvaruje se nešto veća dubina gdje su brzine manje (ispod 0.5m/s)
- ◇ Pokazatelj turbulencije k ne varira mnogo sa promjenom dužine bočnog zida u poprečnom pravcu
- ◇ Pokazatelj turbulencije k varira u podužnom pravcu-vrijednosti su niže što je dužina bočnog zida veća
- ◇ Ostali rezultati su sa neznatnim razlikama
- ◇ Veća odstupanja daje promjena širine same prepreke (niže vrijednosti i , V_{sr} i k za širu prepreku u poprečnom pravcu)