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

Mehanika fluida – napredni kurs

MODELIRANJE TEČENJA U KANALU SA SUŽENJEM PRIMENOM SOFTVERA IRIC NAYSCUBE

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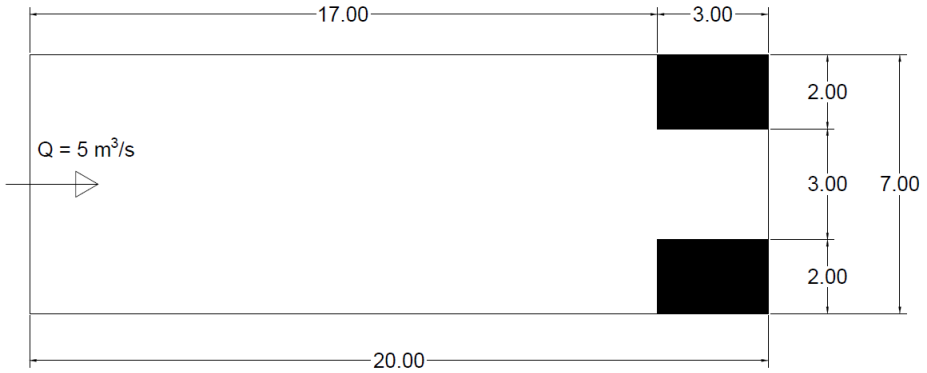
Opis problema

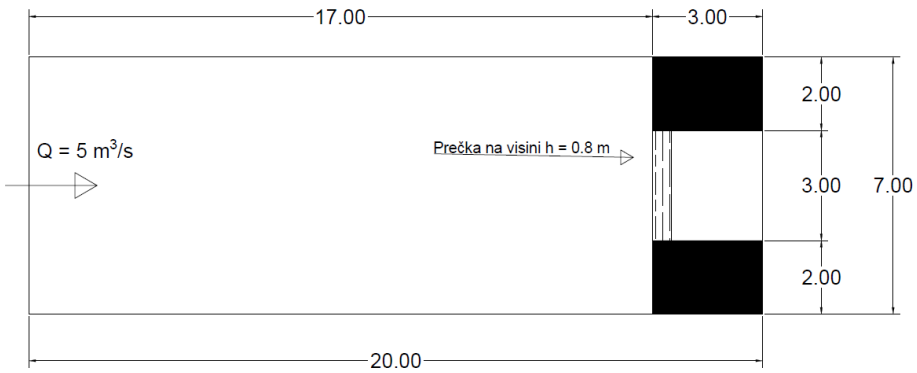
Analiza strujanja u kanalu sa suženjem

Kritična dubina u suženju iznosi: 0.656 m i ona se koristi kao granični uslov.

Varijanta 1:



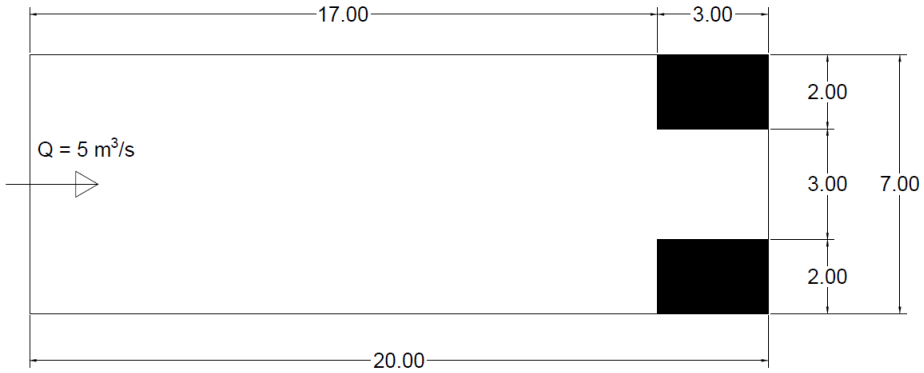
Varijanta 2:



Opis problema

Rezultati analize varijante 1 (u okviru NaysCUBE paketa) će biti upoređeni sa istim slučajem analiziranim u okviru TELEMAC-MASCARET softverskog paketa.

Varijanta 1:



IRIC

iRIC – International River Interface Cooperative

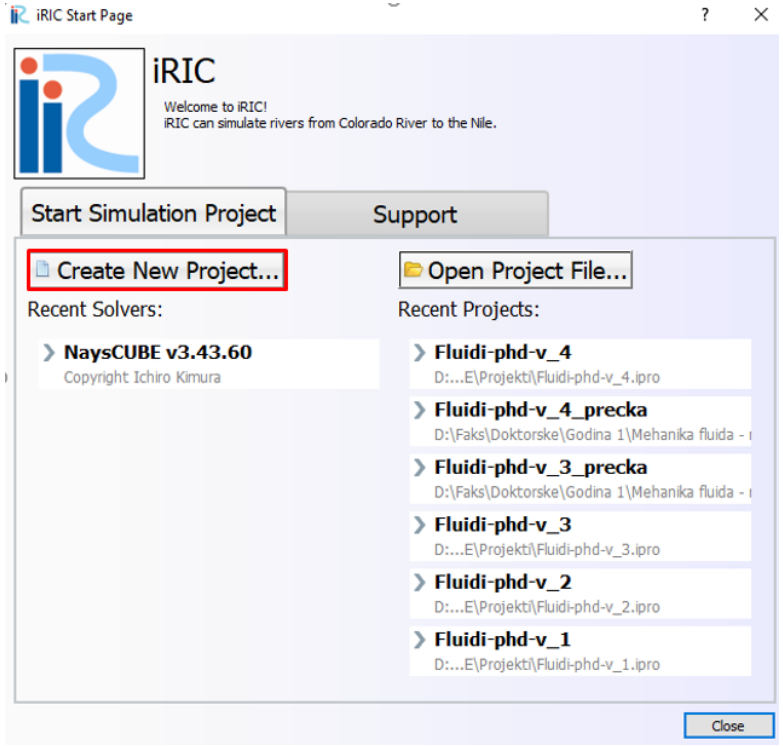
iRIC softver podrazumeva besplatnu platformu koja podržava veliki broj „solver“-a za probleme iz vodnog inženjeringa.

iRIC softver je pogodan za upotrebu zbog jednostavnog korisničkog interfejsa.

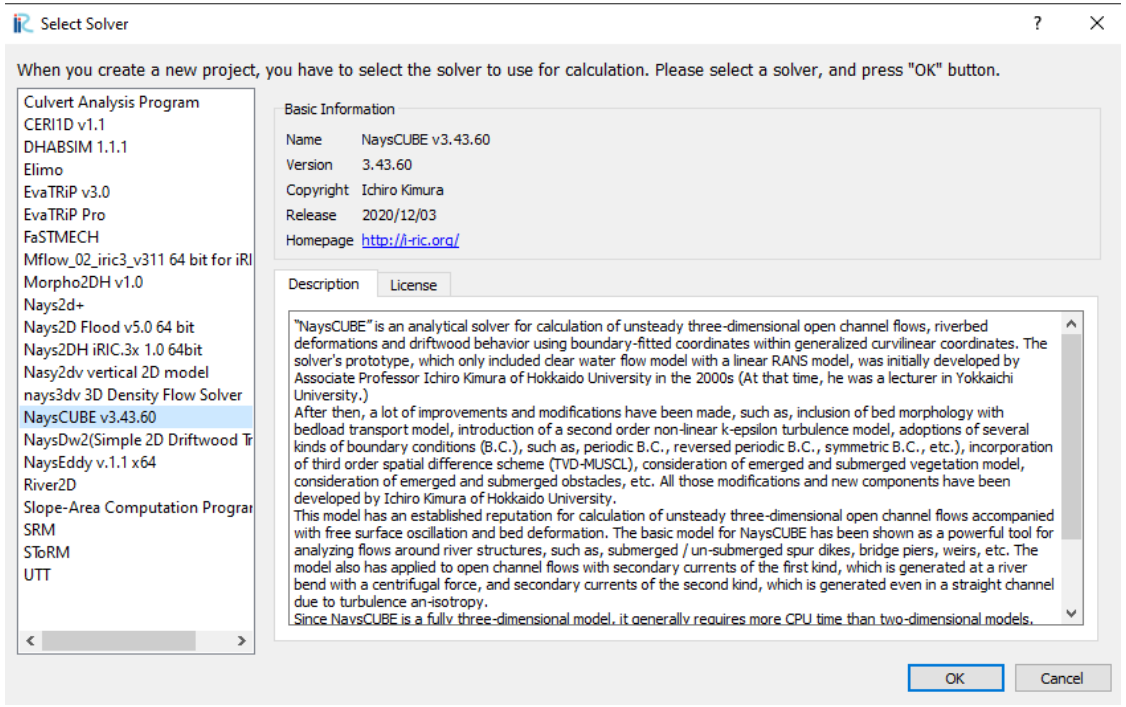
U okviru iRIC softvera, koristiće se NaysCUBE solver.

Postupak izrade modela

Prozor pri pokretanju programa



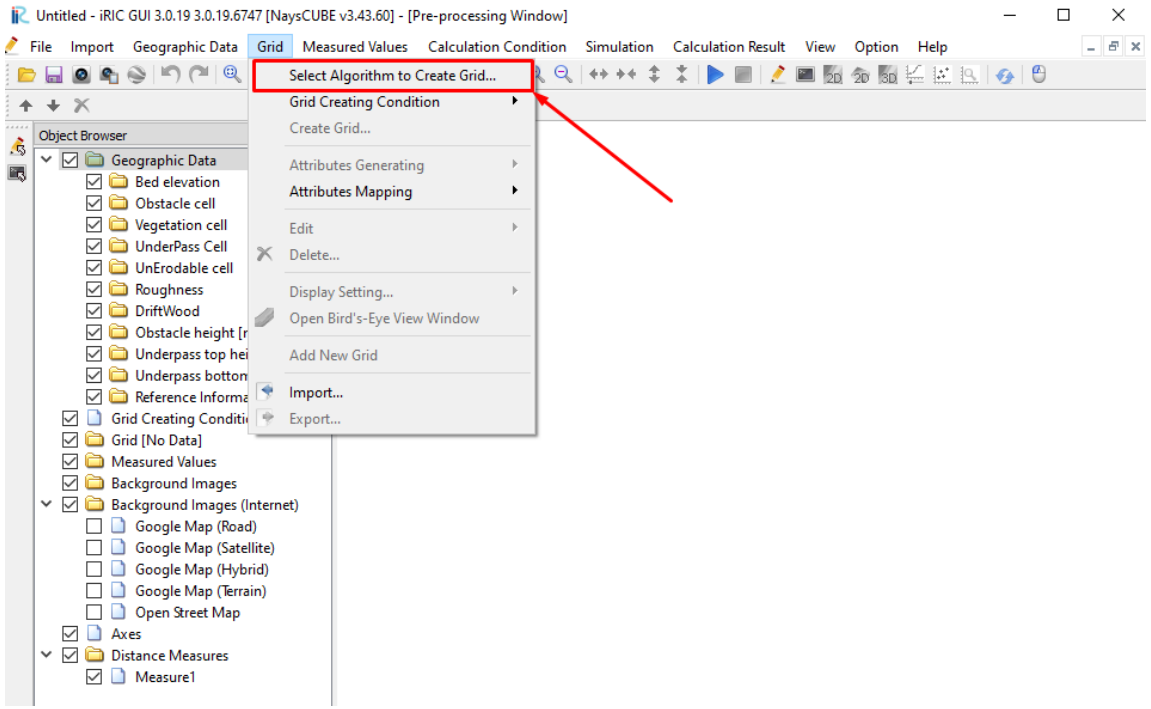
Odabir solvera



Postupak izrade modela

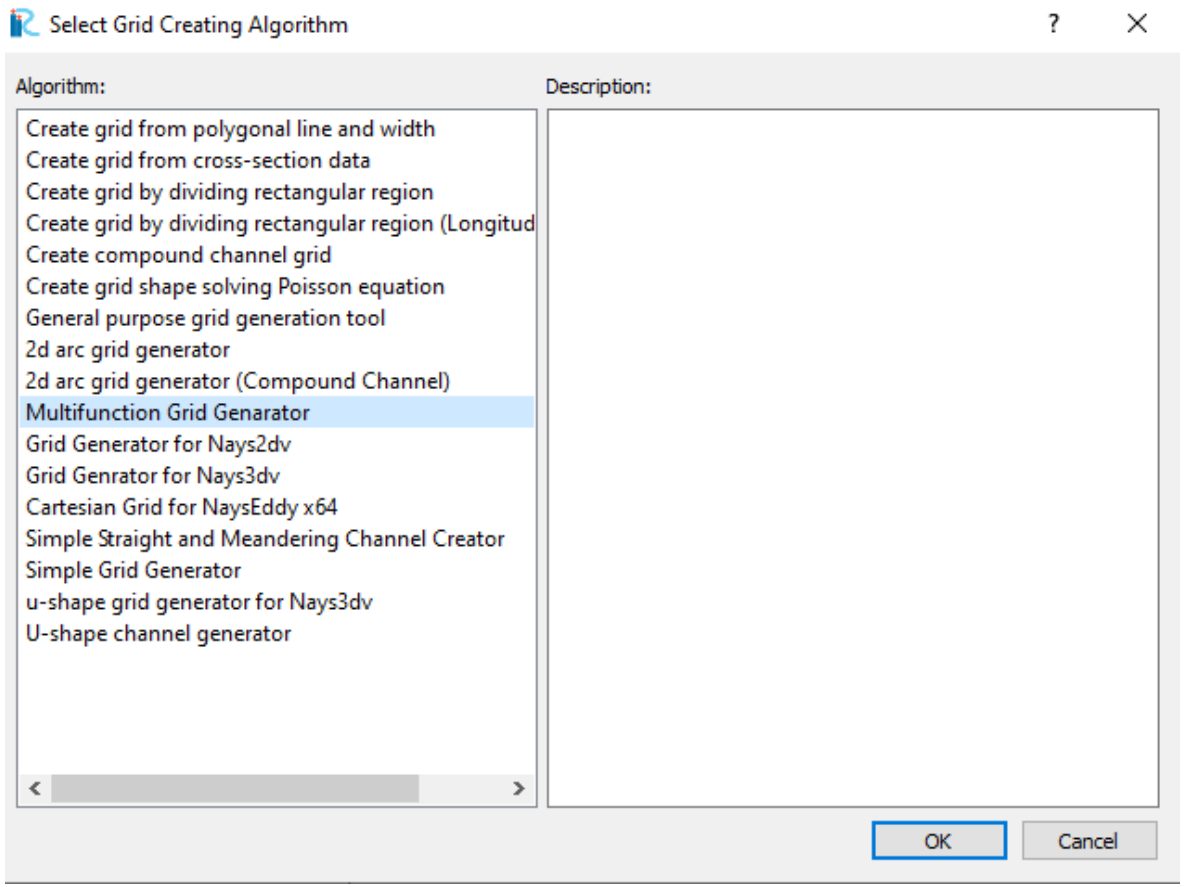
NaysCUBE solver diskretizuje prostor korišćenjem kvadratnih ćelija, dimenzije tih ćelija je moguće podešavati.

Prvo se bira algoritam kreiranja mreže.



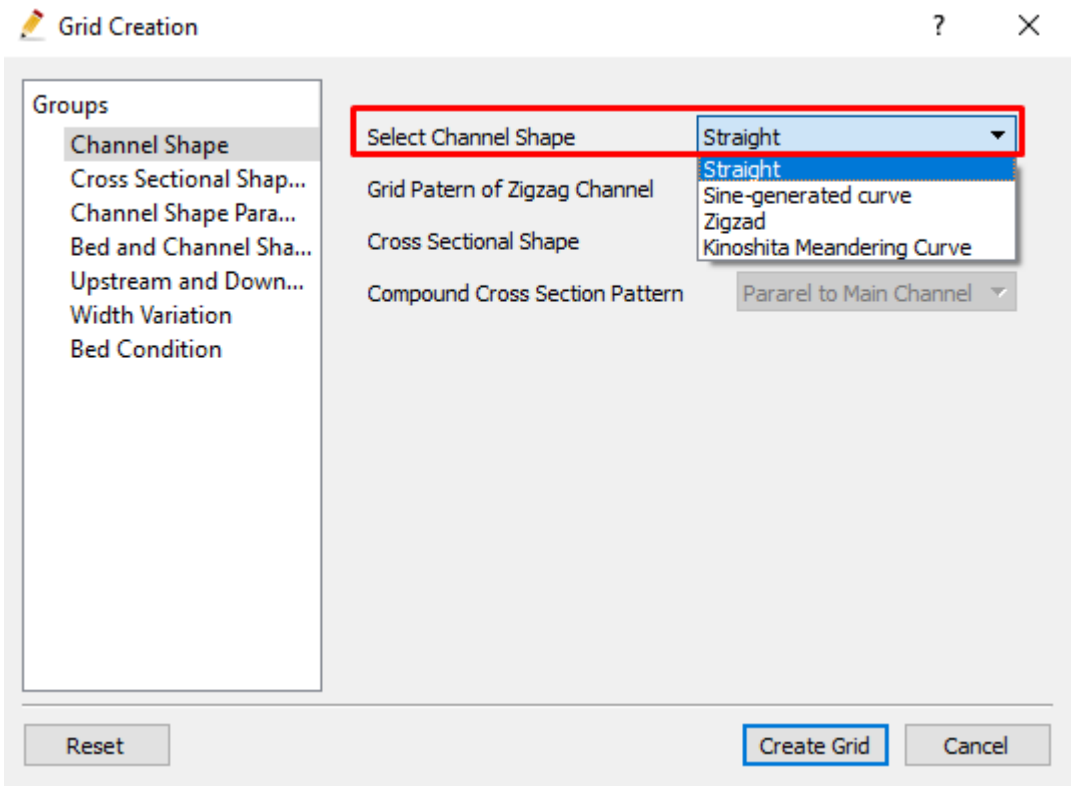
Postupak izrade modela

Iako je formalno moguće koristiti više algoritama za rešavanje zadatog problema, „Multifunction grid generator“ daje najviše slobode u podešavanju mreže korisniku.

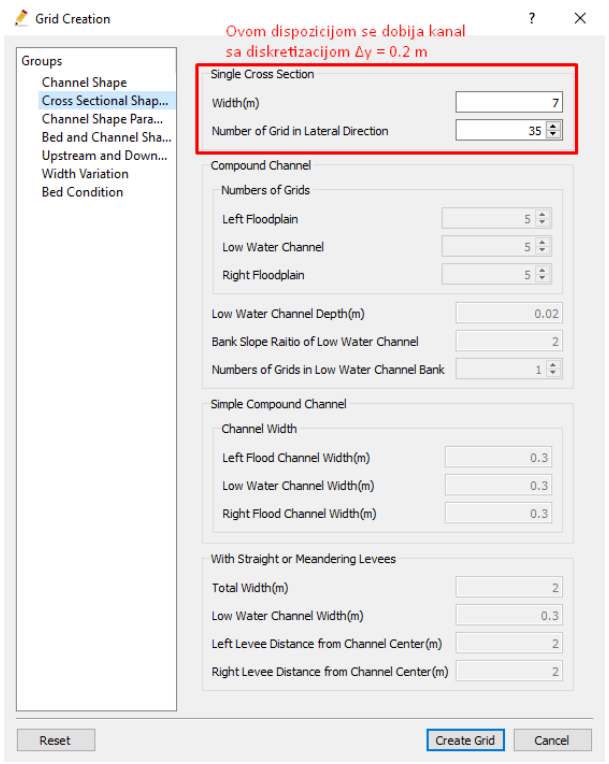


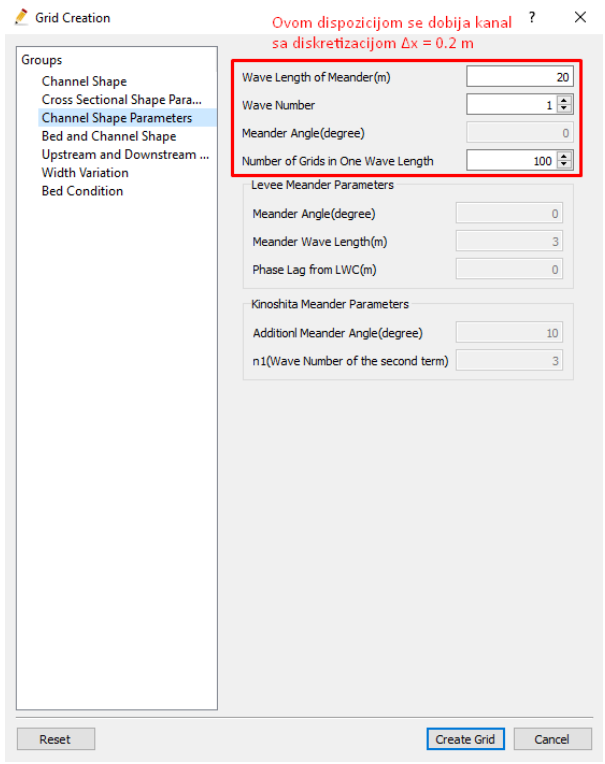
Postupak izrade modela

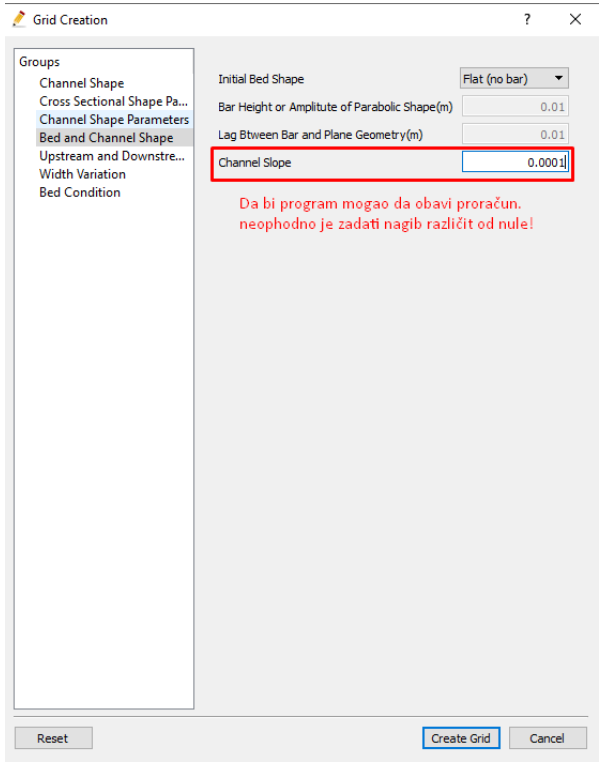
Channel Shape „Straight“ podrazumeva prizmatičan kanal.



Postupak izrade modela

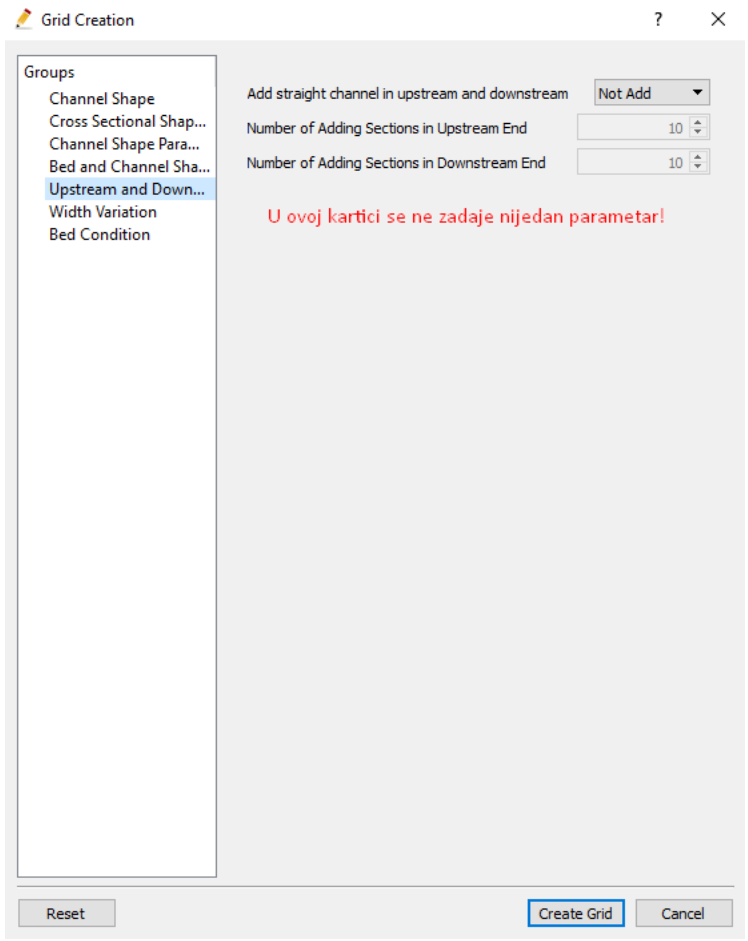


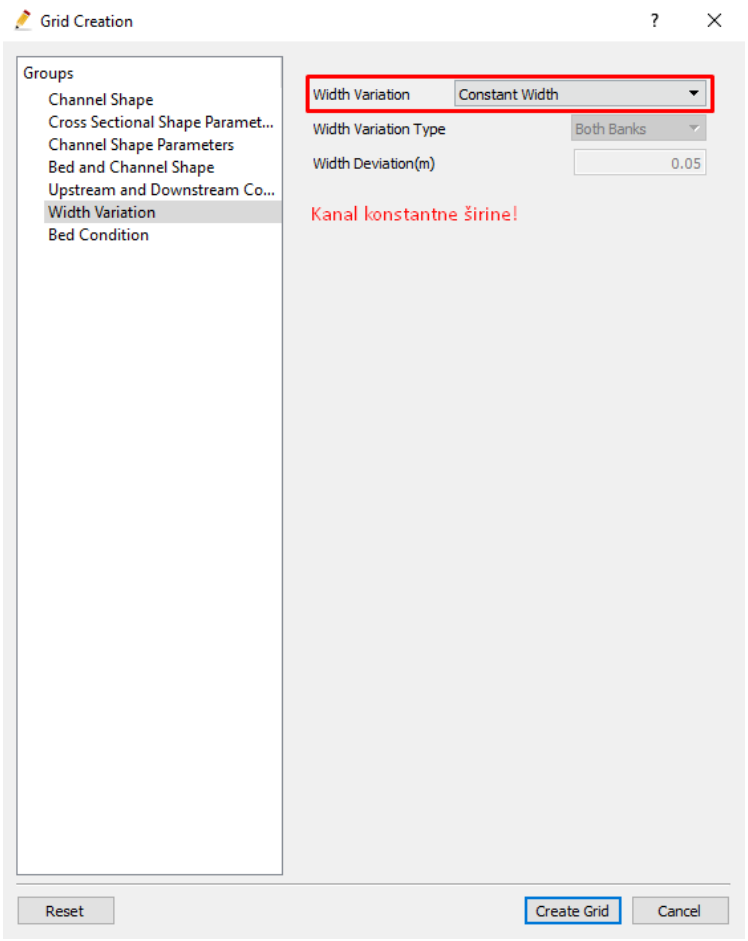


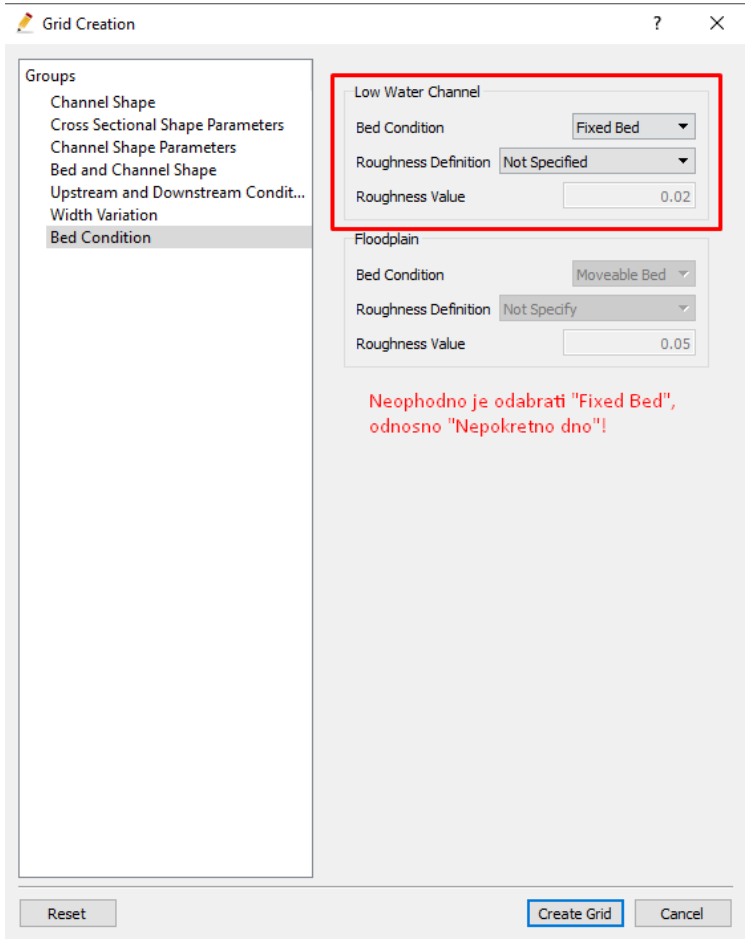


Diskretizacija kvadratnim ćelijama sa stranicama dužine 0.2 m je izabrana radi usaglašavanja sa TELEMAC simulacijom.

Postupak izrade modela

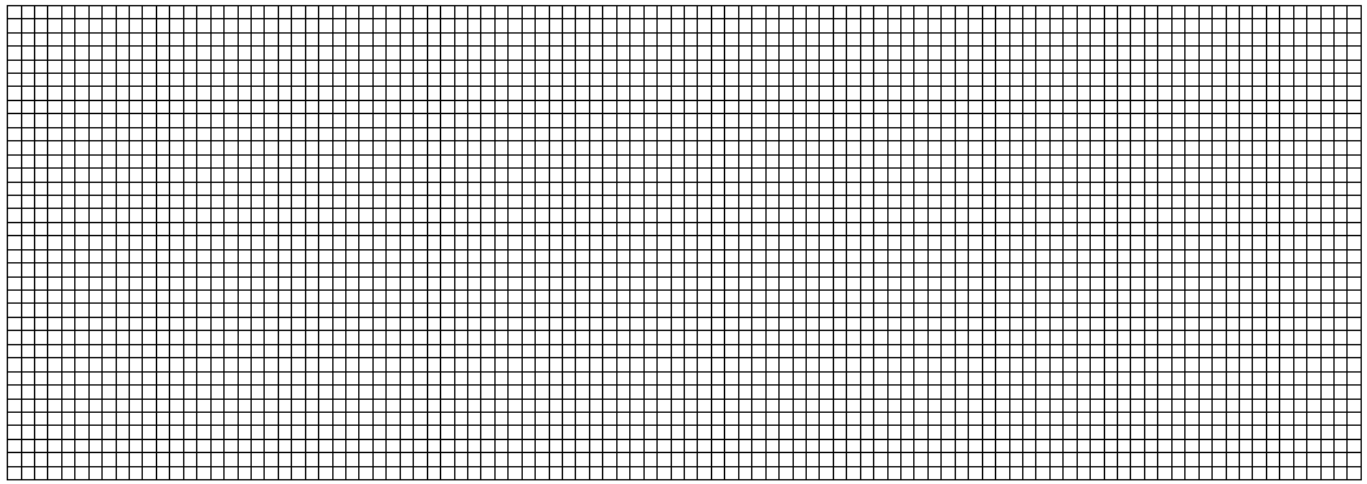




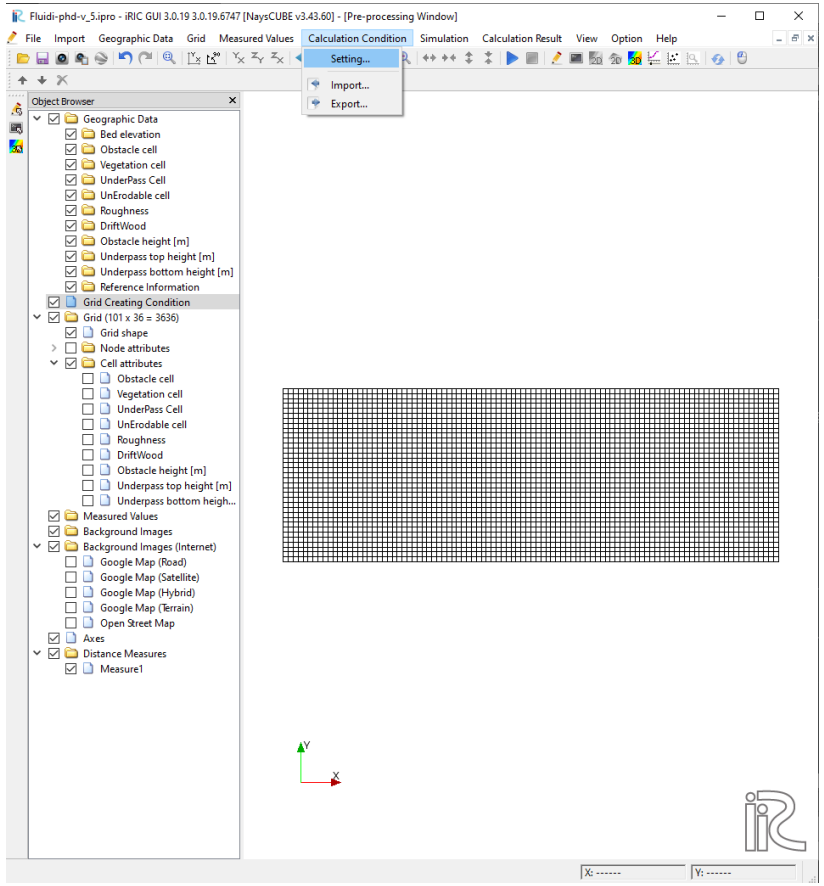


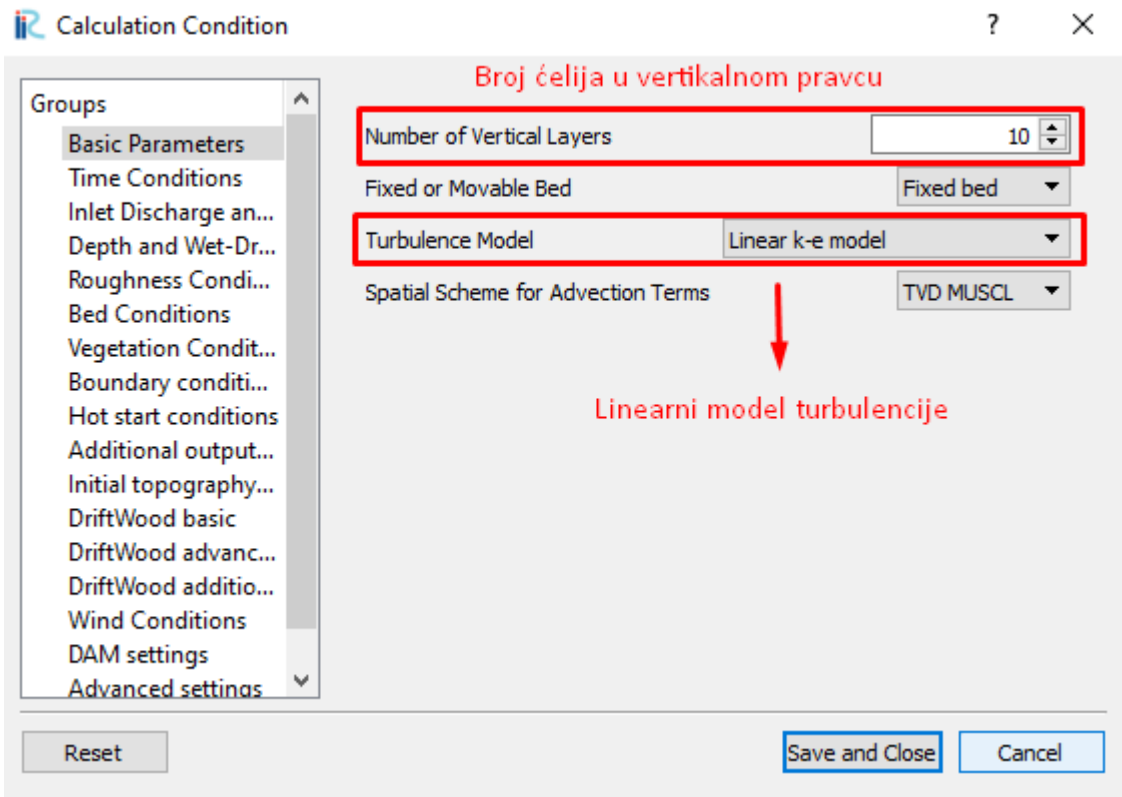
Postupak izrade modela

Zaključno sa prethodnim korakom, pritiskom na dugme „Create Grid“, dobija se sledeća mreža:

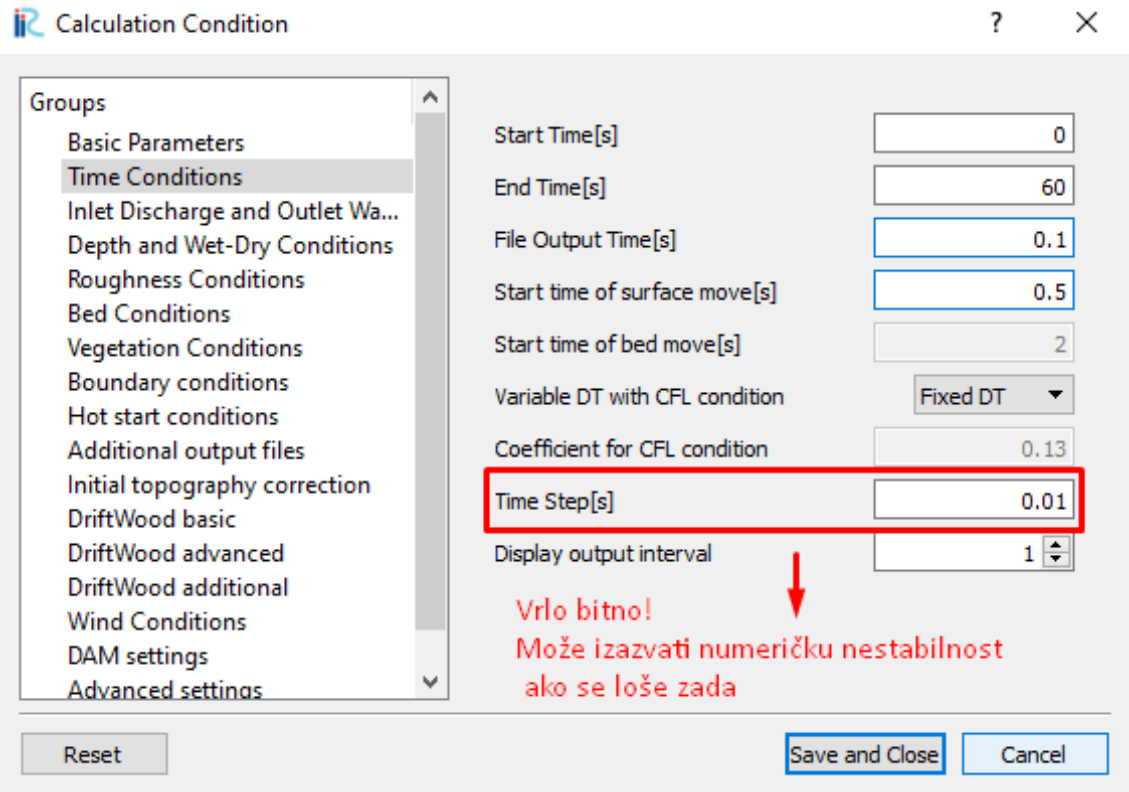


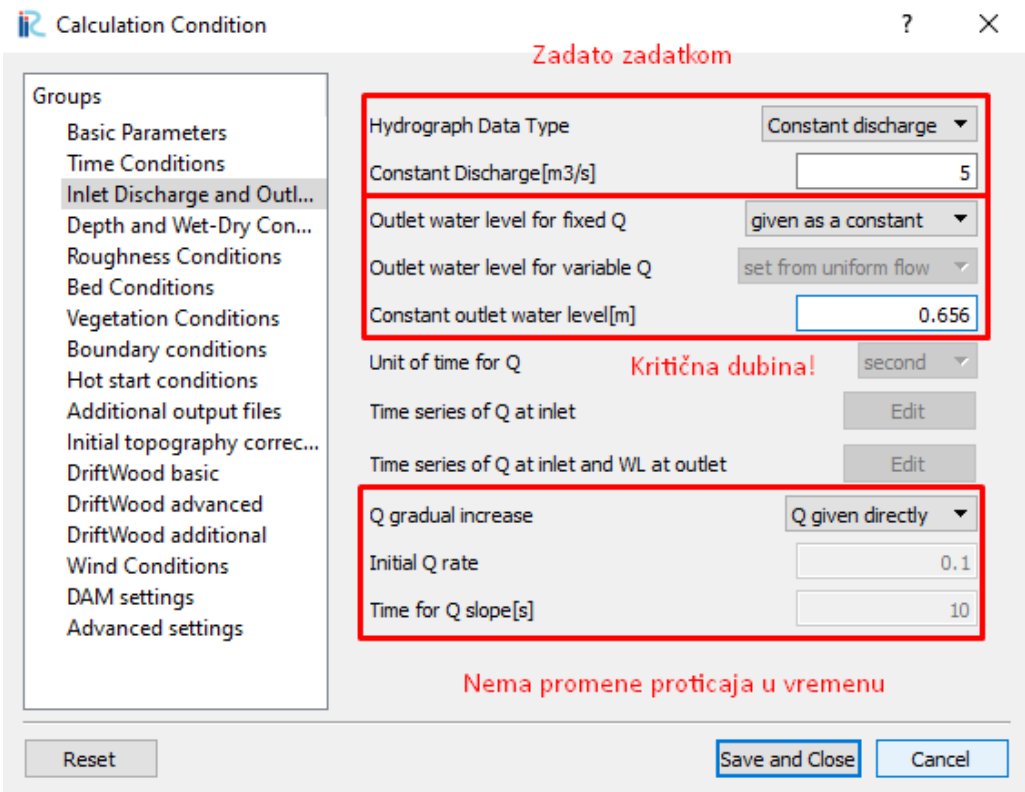
Zadavanje proračunskih parametara



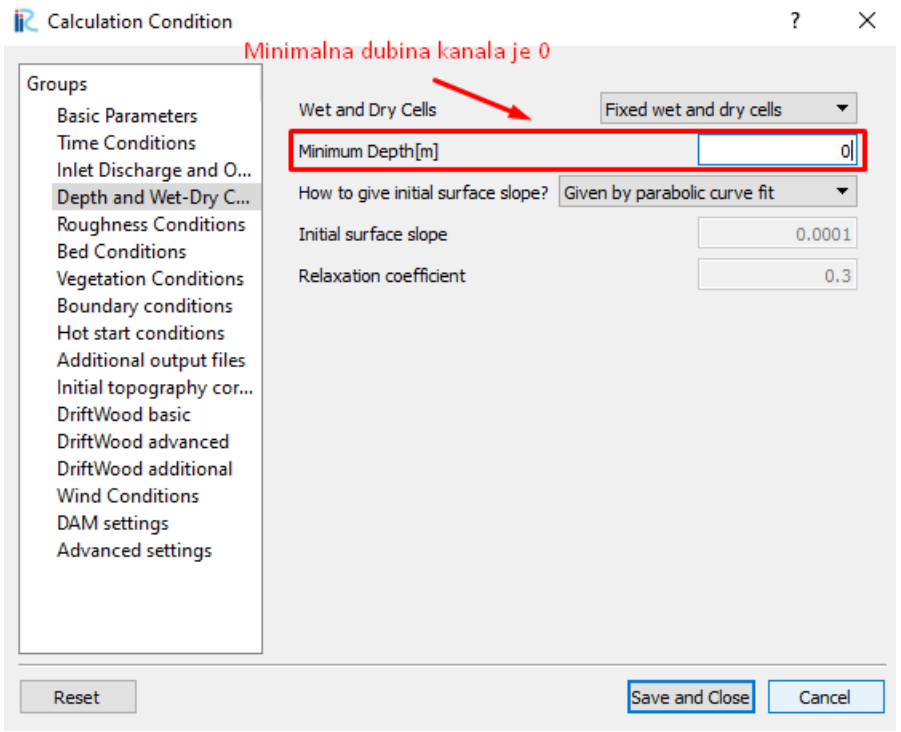


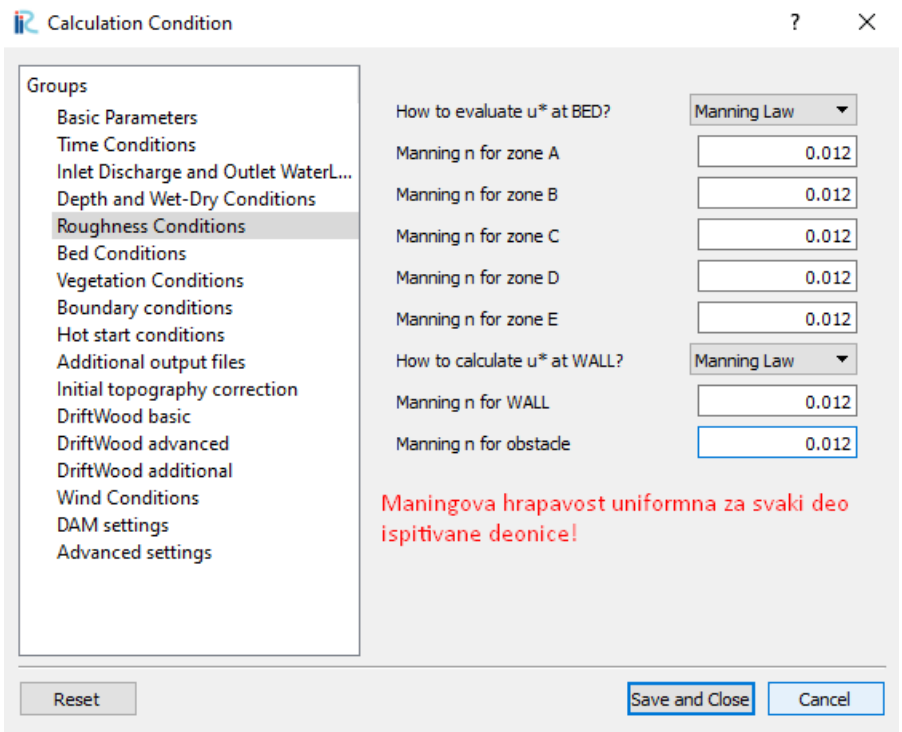
Zadavanje proračunskih parametara





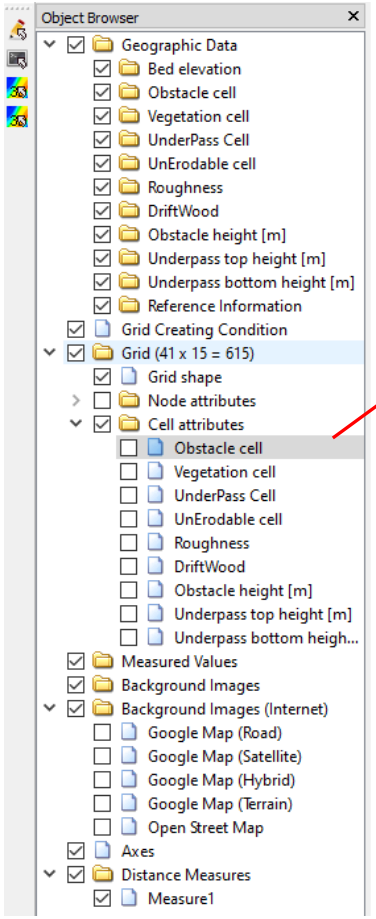
Zadavanje proračunskih parametara





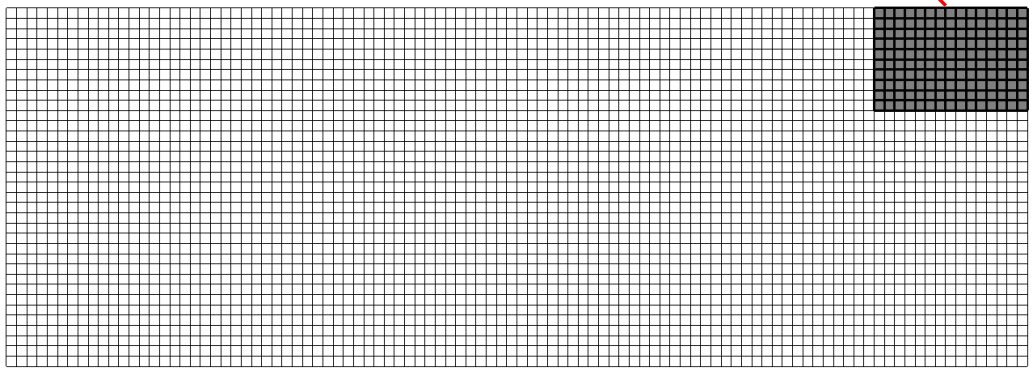
Kako ostale kartice nisu od interesa za ovaj problem, preskaču se.

Postavljanje prepreka

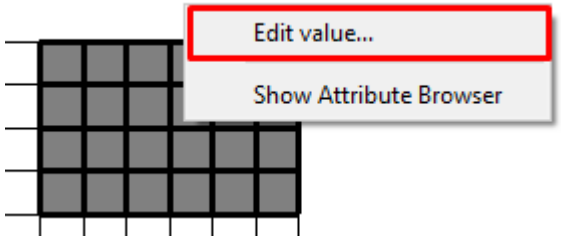


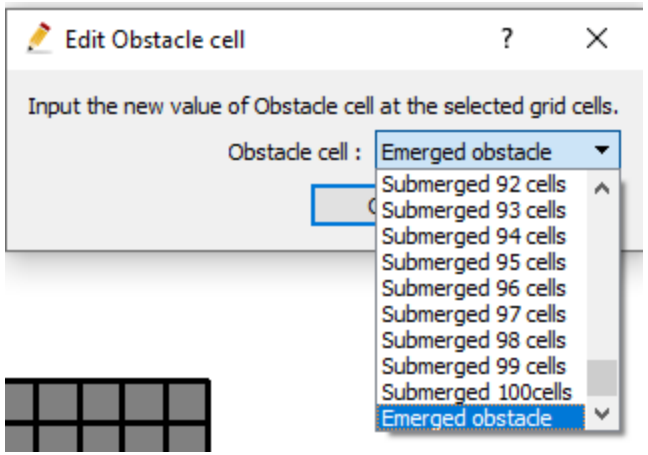
Klikne se na atribut „Obstacle cell“

Obeleži se površina na kojoj se nalazi prepreka



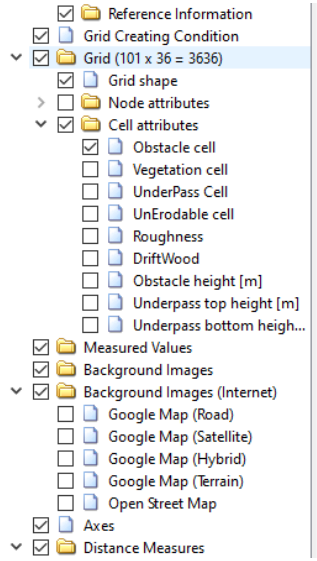
Postavljanje prepreka

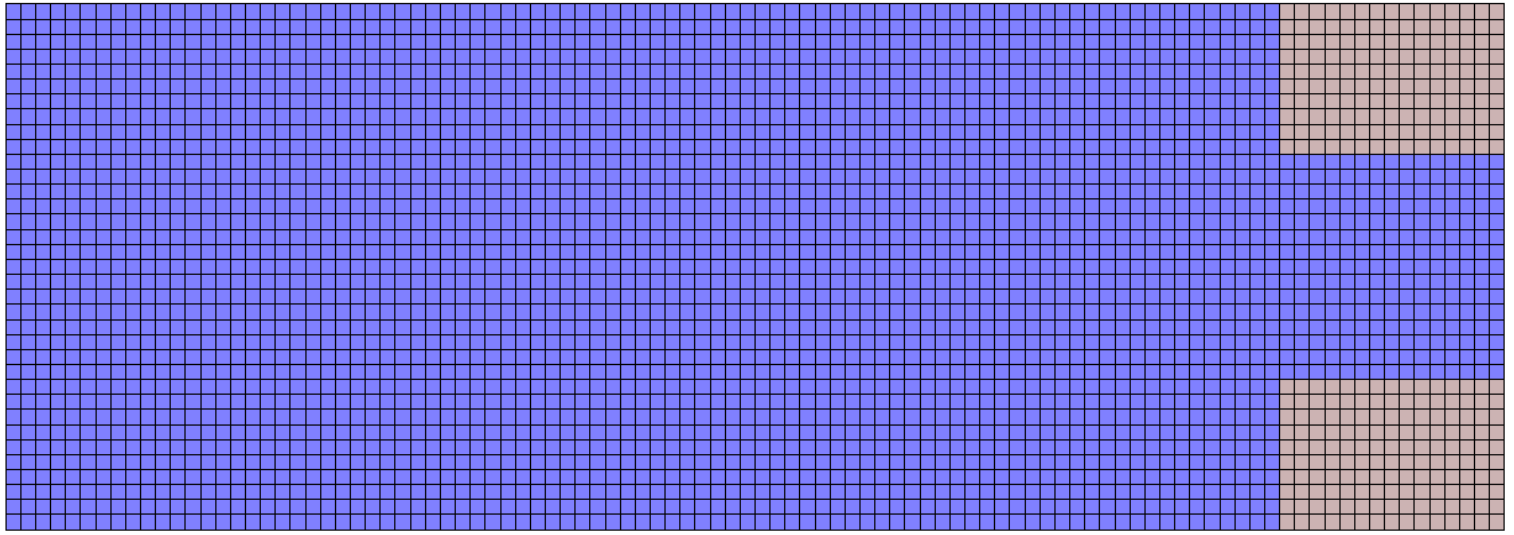




Pojam „Emerged obstacle“ podrazumeva prepreku čija je visina uvek jednaka dubini vode u ćeliji u kojoj se prepreka nalazi

Postavljanje prepreka



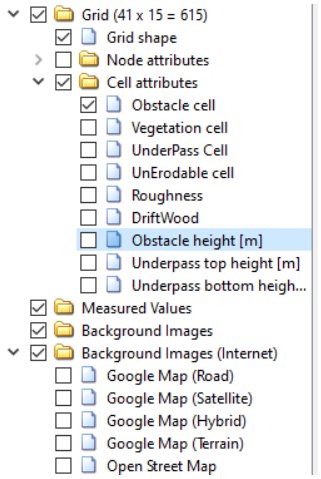


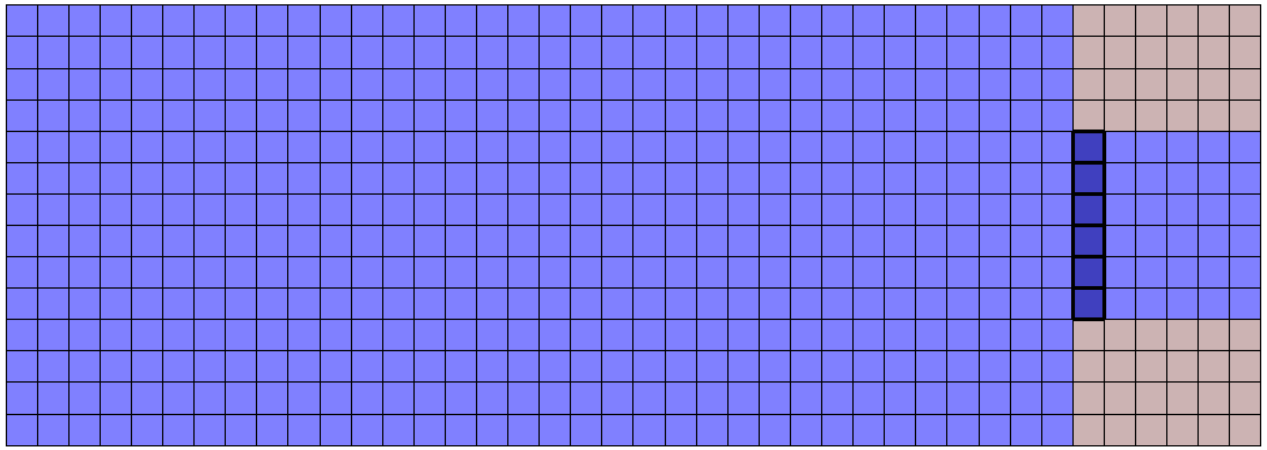
Štikliranjem ćelije „Obstacle cell“ možemo videti koje ćelije u mreži sadrže prepreke.

Sa time, završena je dispozicije varijante 1

Postavljanje prepreka – Varijanta 2

Druga varijanta koja se razmatra ima isto suženje na kraju kanala, sa prečkom debljine 10 cm, koja se nalazi na početku suženja, na visini 80 cm



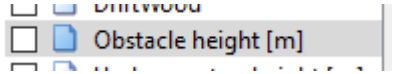


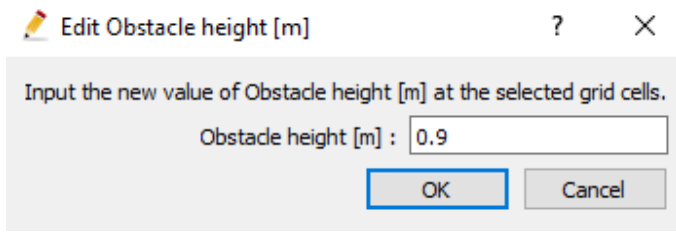
Prvo se obeleže ćelije gde se nalazi prepreka, radi lakše orijentacije, ostala je štiklirana kartica „Obstacle cell“, imajući na umu da se prepreka nalazi u samom suženju.

Napomena: Zbog numeričkih nestabilnosti u proračunu, diskretizacija u ovoj varijanti je promenjena na $\Delta x/\Delta y = 0.5\ m/0.5\ m$

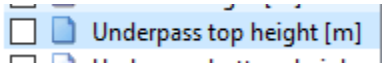
Postavljanje prepreka – Varijanta 2

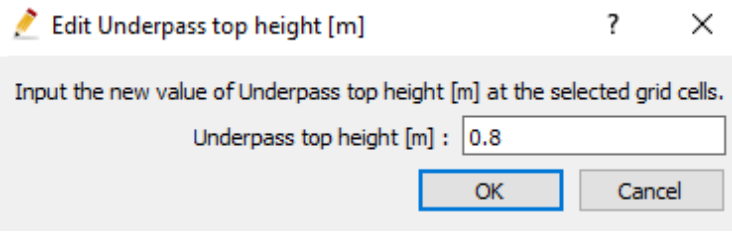
1



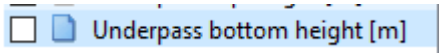


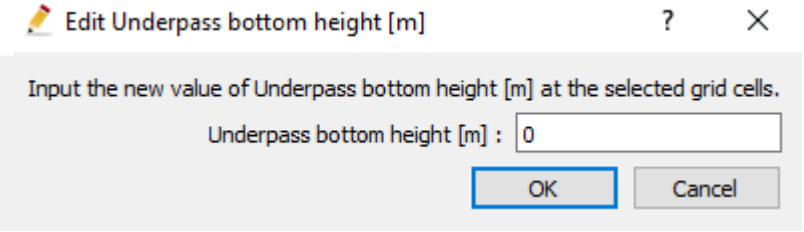
2





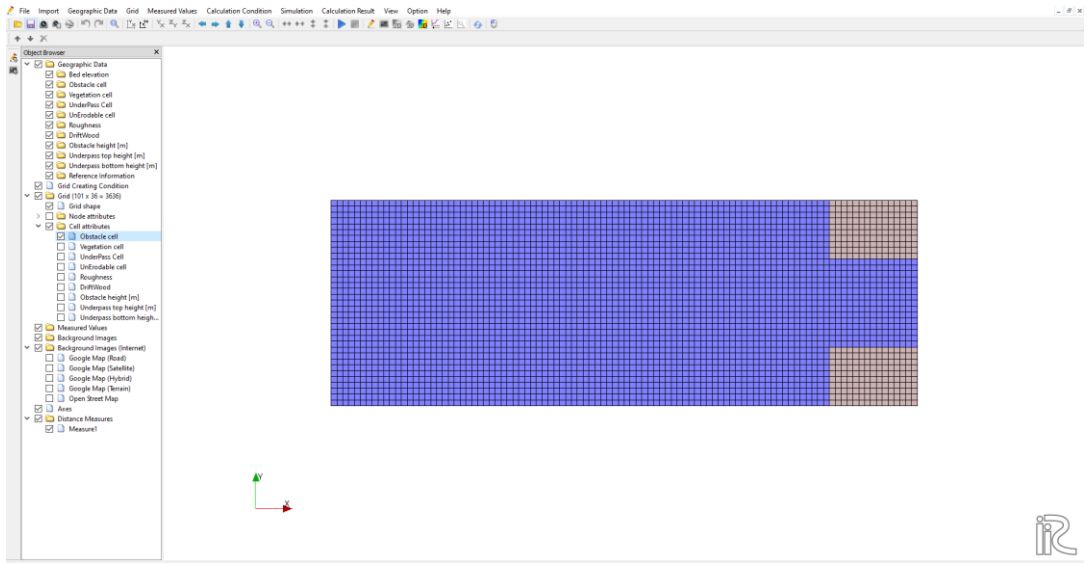
3

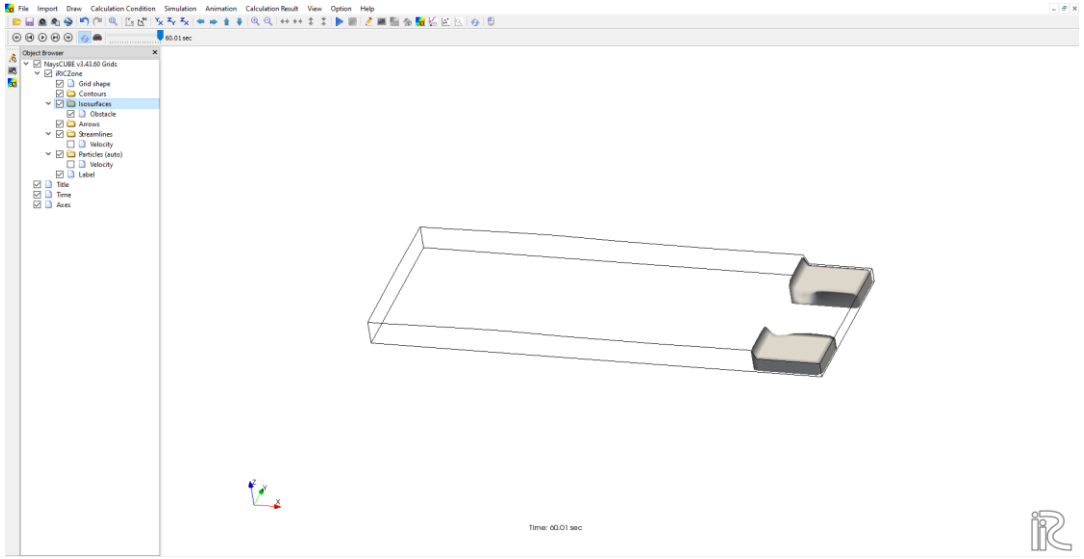




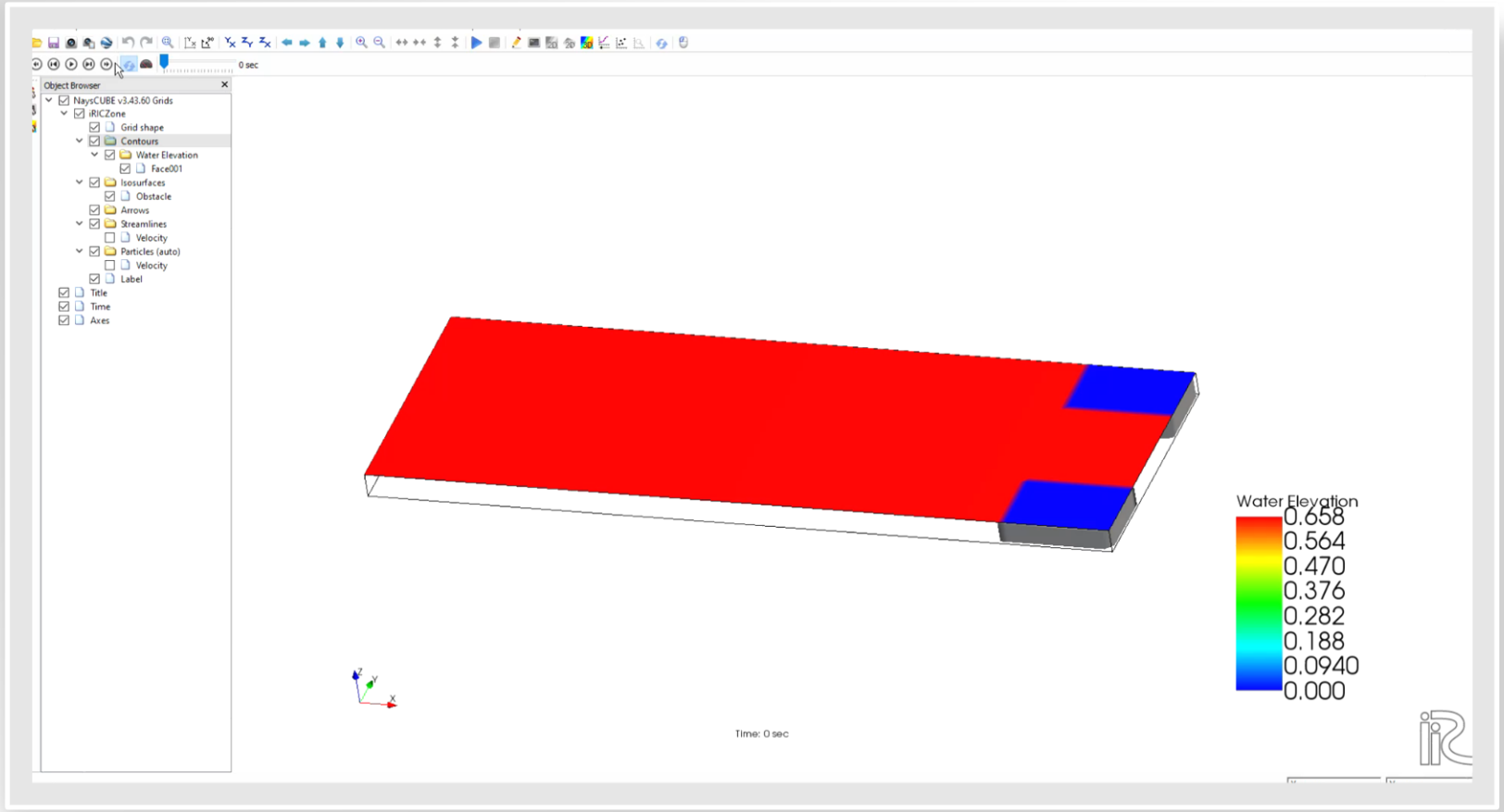
Zaključno sa ovim, postavljena je prečka iz varijante 2

Rezultati – Varijanta 1





Rezultati – Varijanta 1

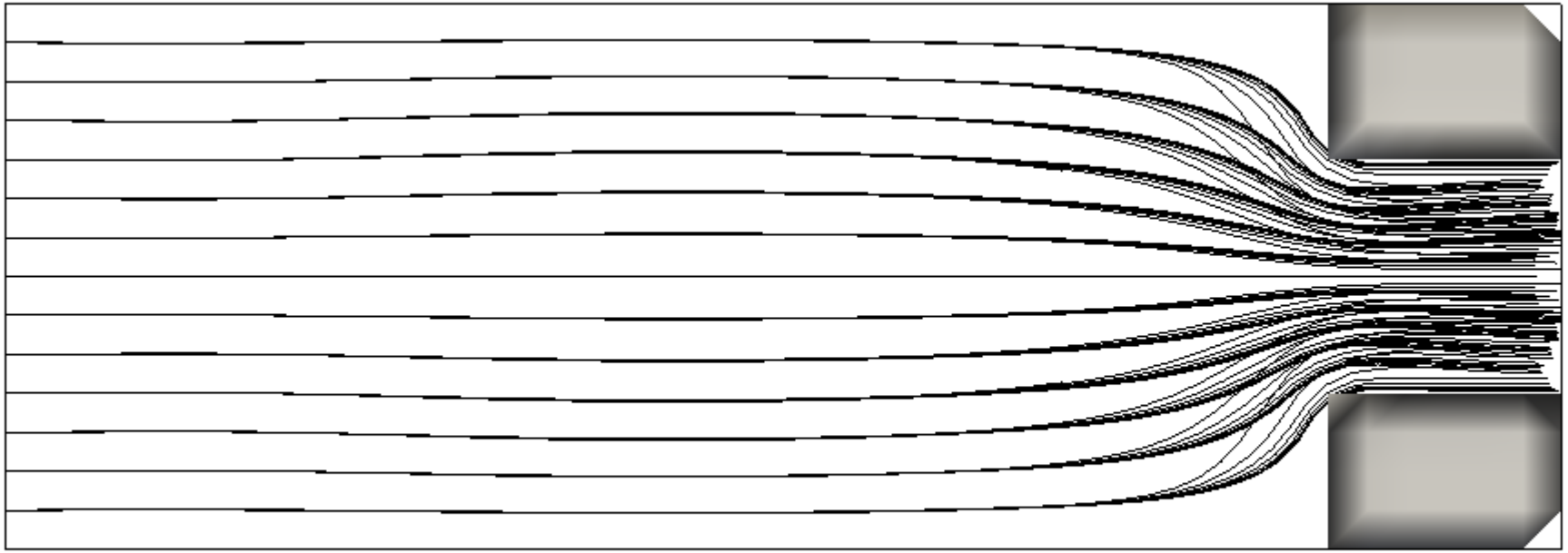


Rezultati – Varijanta 1

Strujnice u t = 30s

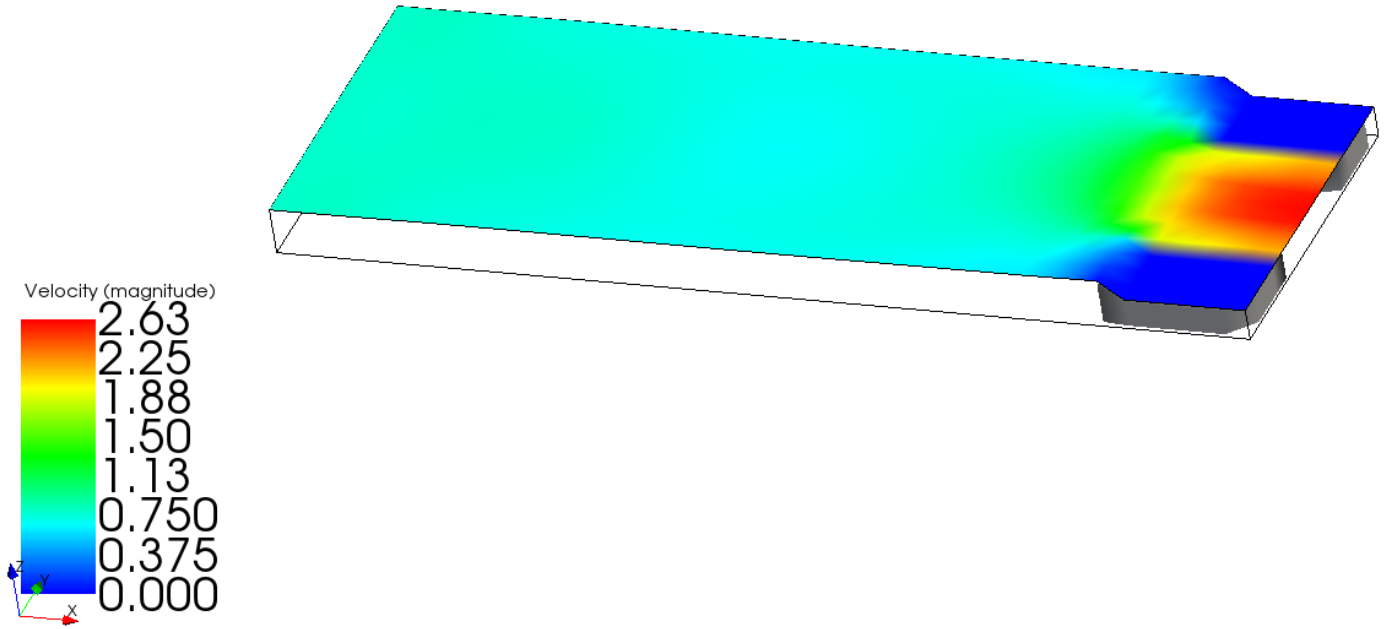
Rezultati – Varijanta 1

Strujnice na kraju simulacije od 60s



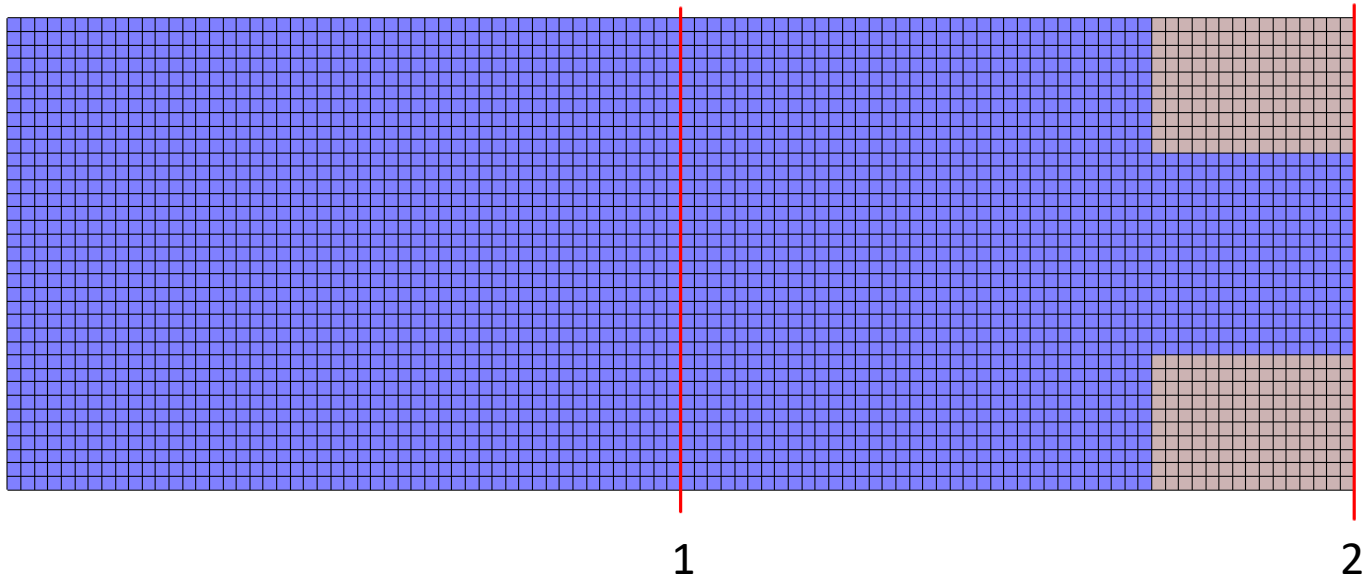
Rezultati – Varijanta 1

Colormap brzina na kraju simulacije



Rezultati – Varijanta 1

Proračun lokalnog koeficijenata gubitka



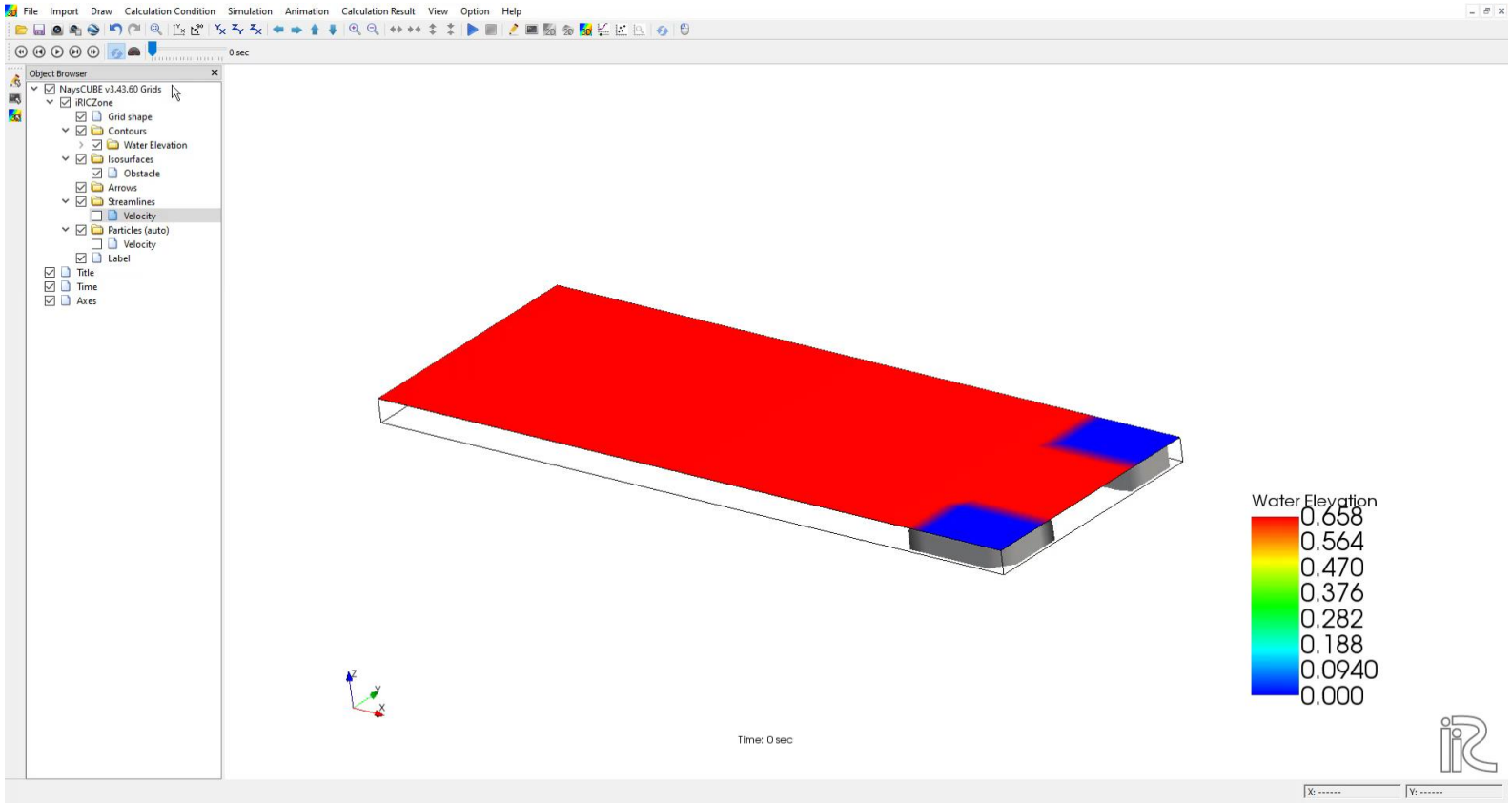
Razmatrani preseci se nalaze x = 10 m i x = 20 m

Korišćenjem srednje profilske brzine, moguće je pomoću energetske jednačine izračunati lokalni koeficijent gubitka između tih preseka

Prilikom proračuna, korišćena je osrednjena dubina duž izabranog preseka

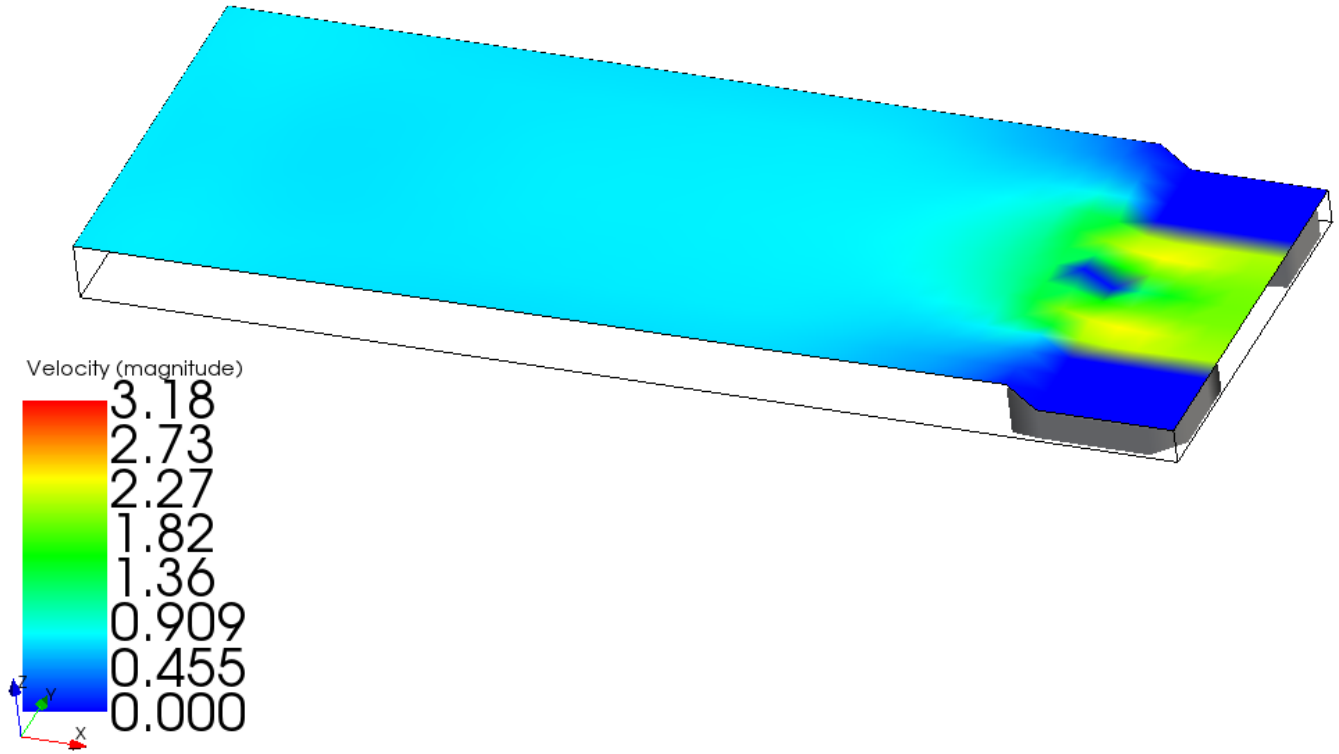
Koeficijent lokalnog gubitka za ovu varijantu iznosi: $\xi = 0.297$

Rezultati – Varijanta 2



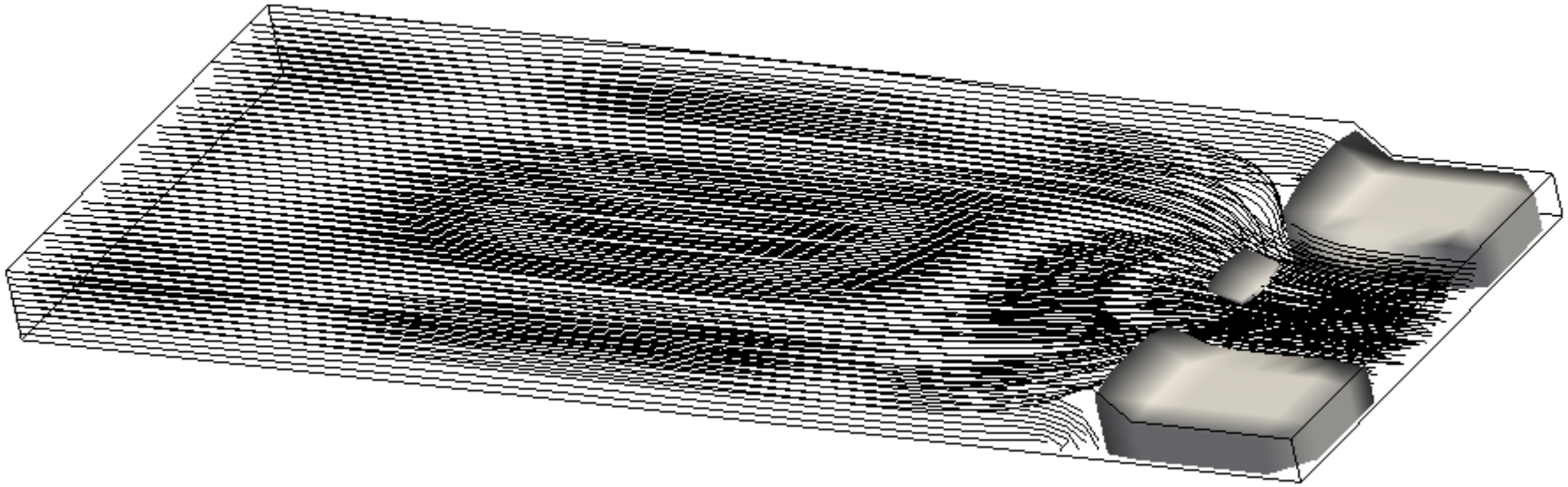
Rezultati – Varijanta 2

Colormap brzina na kraju simulacije



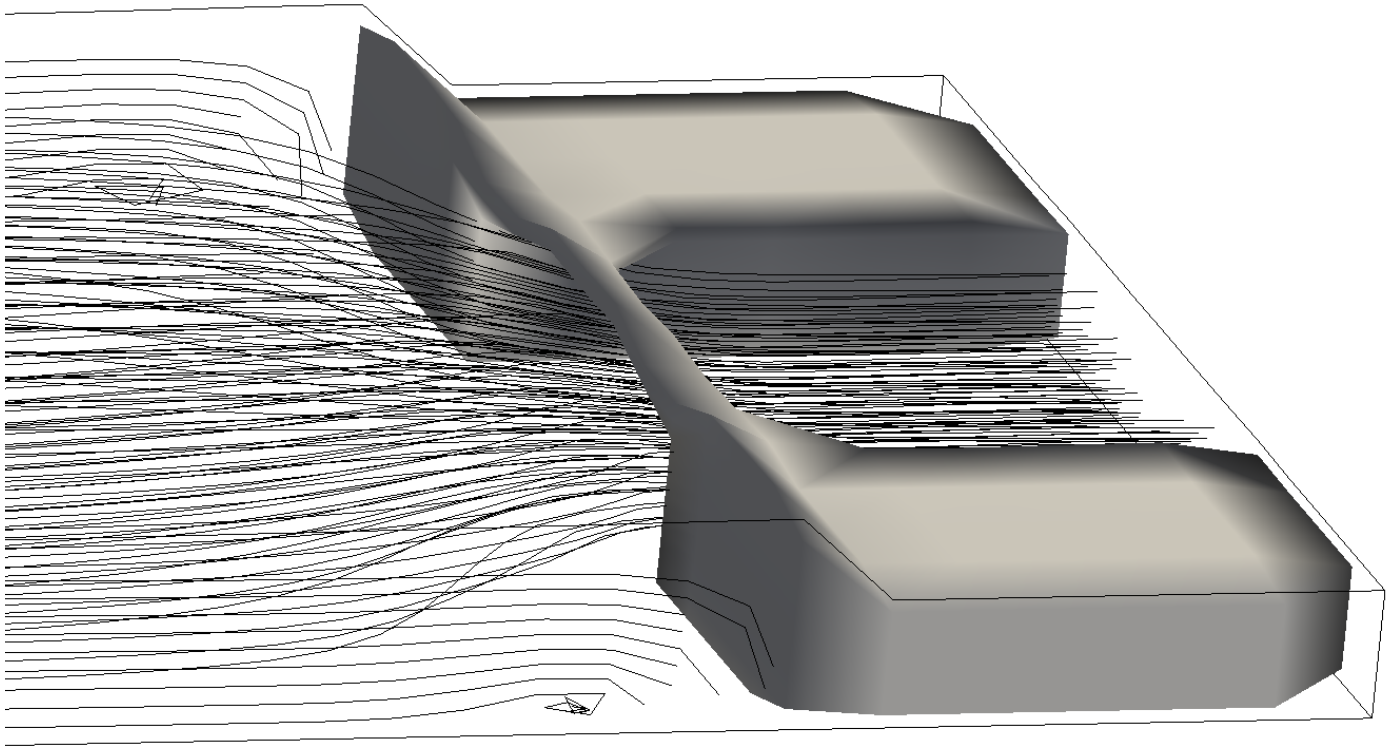
Rezultati – Varijanta 2

Strujnice na kraju simulacije od 60s



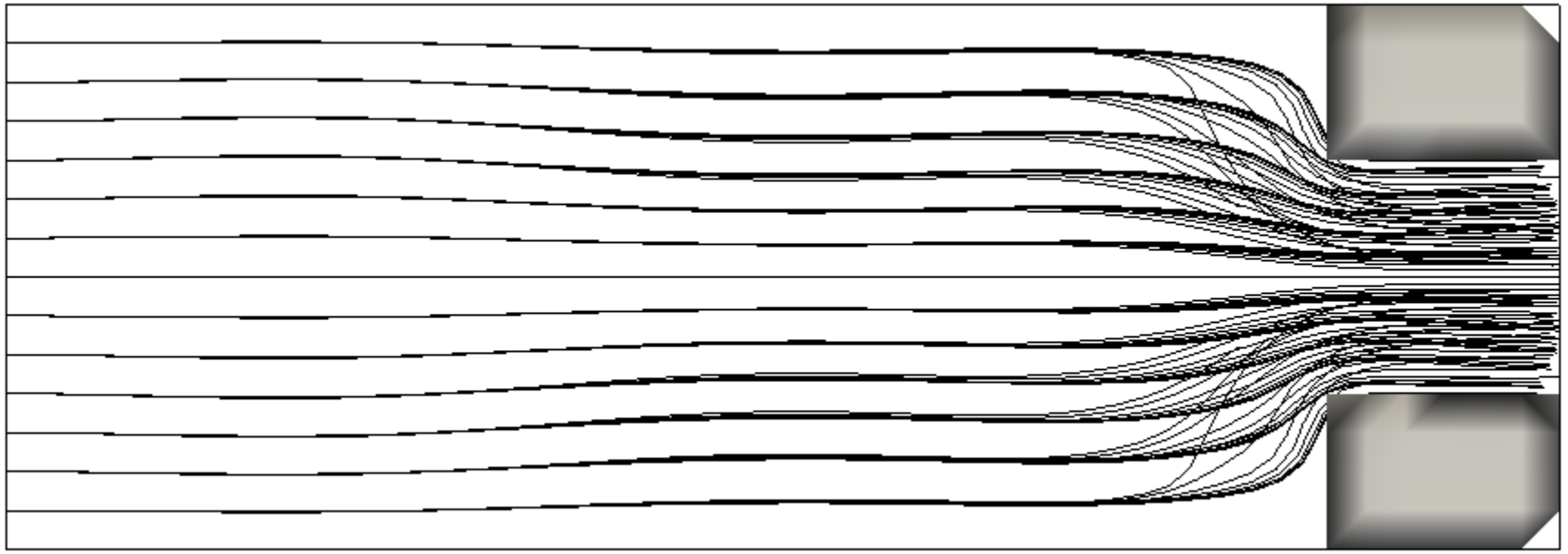
Rezultati – Varijanta 2

Detalj strujnica kod prečke



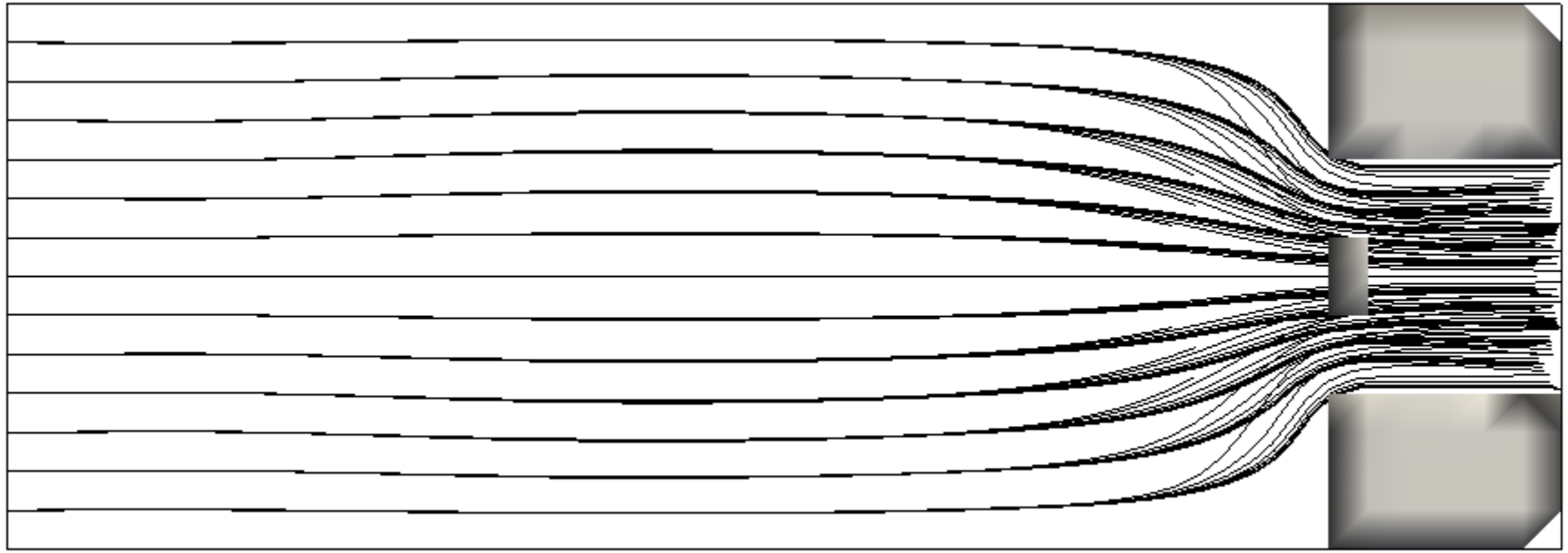
Rezultati – Varijanta 2

Strujnice u t = 30s



Rezultati – Varijanta 2

Strujnice na kraju simulacije od 60s



Rezultati – Varijanta 2

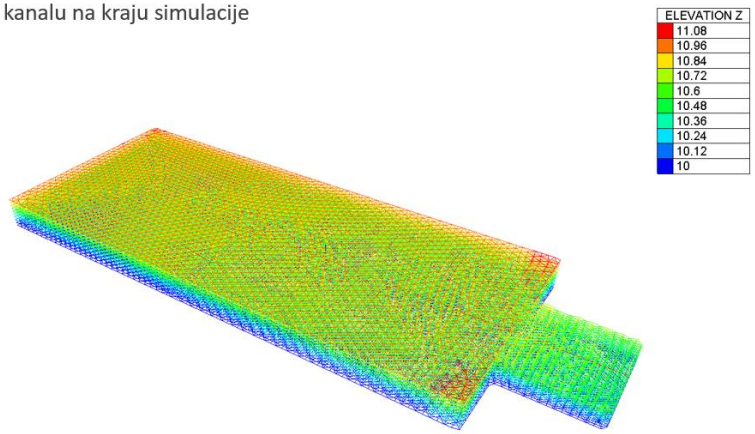
Proračun lokalnog koeficijenata gubitka

Kao i u prethodnom slučaju, razmatrani preseci se nalaze na x = 10 m i x = 20 m

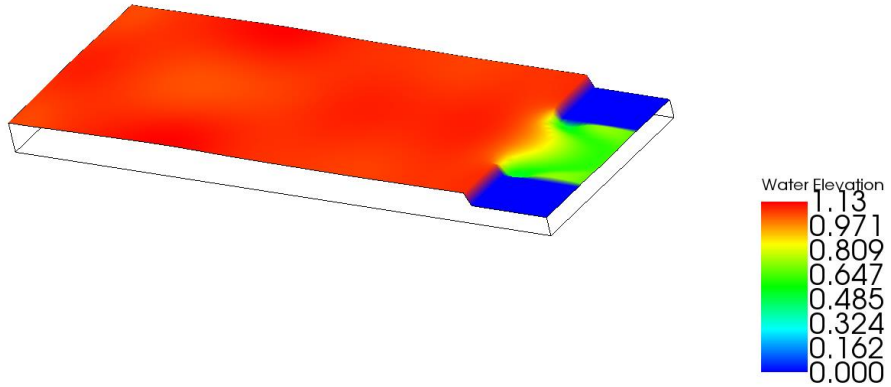
Kao posledica promene nivoa u okolini suženja, odnosno porasta nivoa, vrednost koeficijenta lokalnog gubitka je za ovaj slučaj: $\xi = 0.356$

Rezultati – poređenje sa Telemac-om

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

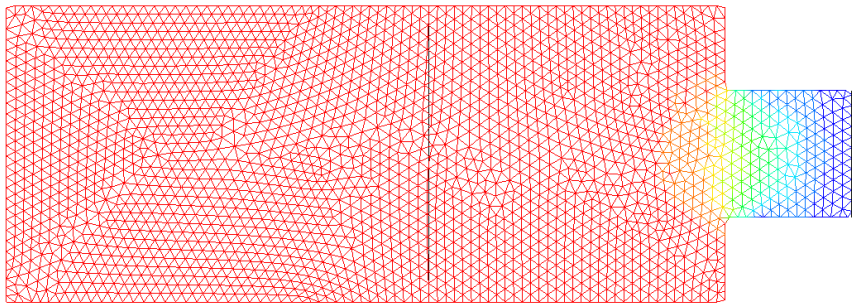


Telemac



NaysCUBE

Rezultati – poređenje sa Telemac-om



Telemac

$\xi = 0.318$

NaysCUBE

$\xi = 0.297$

Razlika u koeficijentima lokalnog gubitka može biti posledica različite prostorne diskretizacije softvera, gde Telemac diskretizuje prostor korišćenjem „trouglova“, dok NaysCUBE diskretizuje prostor kvadratnim ćelijama, takođe može biti posledica različitih vremenskih koraka koji su odabrani. Uzrok te razlike može biti tema nekog narednog rada.

HVALA NA PAŽNJI!