

# ADAPTIVE HYDRAULICS

A TWO-DIMENSIONAL MODELING SYSTEM  
DEVELOPED BY THE COASTAL AND HYDRAULICS LABORATORY  
ENGINEER RESEARCH AND DEVELOPMENT CENTER  
**A PRODUCT OF THE SYSTEM-WIDE WATER RESOURCES PROGRAM**

## USERS MANUAL

Vessel Movement Library

**AdH REV 5939**

**Compiled by B.C. Berger and J.N. Tate**

AdH has the capability to simulate the effects of a moving vessel on the hydrodynamics of a model. This is done using a pressure field which applies a draft equal to that of the modeled vessel. All vessel characteristics are defined in the boat definition file. An example of such a file is given below.

```
BOAT 1  
FDEF 1 3 185.0 -60.0 0.0  
DRFT 1 10.0  
BLIN 1 30.0  
BWID 1 10.0  
PBOW 1 0.1  
PSTR 1 0.1  
CBOW 1 0.95  
CSTR 1 0.95  
SDEF 1 1 0 135.0 -60.0 5.0  
SDEF 1 2 0 125.0 -50.0 5.0  
SDEF 1 3 0 125.0 -1.0 8.0  
ENDD 0 0
```

This file describes a 30 X 10 boat with a draft of 10.0 moving linearly for one segment, turning right in another segment, and then linearly again for the third and final segment. During linear travel, the vessel moves in the direction of the path. However, during curved segments, the vessel travels tangent to the path. The direction of turn is given as +1.0 for left turns and -1.0 for right turns. This convention follows the "right hand rule" for cartesian coordinate systems. The velocity of the vessel is given at in the field definition and at the end of each segment. Uniform acceleration is assumed throughout the length of the segment. The cards are explained at the end.

**NOTE:** There can be no blank lines in the boat definition file.

## Example problem

Create a simple square mesh whose sides are 100 meters in length. In order to correspond to the given boat file, the corners should have coordinates of (85.23, -100.6), (185.23, -100.6), (185.23, -0.6), and (85.23, -0.6). The mesh should consist of 676 nodes and 1250 elements, 26 nodes per side, and be numbered along the left edge from left to right. The elevation is -20 meters everywhere.

The hotstart file contains depths only and are set such that the initial water level is zero. In other words, the initial depths are 20 meters.

The boundary condition file is set for 2D shallow water with a Manning's "n" of 0.03. The only boundary string specified is a material string including all of the elements. To

this string is applied a Neumann Velocity boundary with a flow of zero. The model is set up to take one second timesteps and complete at 40.0 seconds. The entire boundary condition file is given below.

**OP SW2**

**OP INC 40**

**OP TRN 0**

**OP PRE 1**

**OP BLK 1**

**OP BT**

**IP MIT 200**

**IP NIT 8**

**IP NTL 1.0E-5**

**MP ML 1 4**

**MP MUC 1.0**

**MP EEV 1 0.50**

**MP SRT 1 .5**

**MP COR 1 0**

**MP G 9.80**

**MP MU 1.0E-6**

**MP RHO 1000.0**

**MTS 1 1**

**XY1 1 40 0 0**

**1.00 0.0**

**2.00 0.0**

**3.00 0.0**

**4.00 0.0**

**5.00 0.0**

**• •**

**• •**

**• •**

**35.00 0.0**

**36.00 0.0**

**37.00 0.0**

```

38.00 0.0
39.00 0.0
40.00 0.0

XY1 2 2 0 0
0.0 1.0
40.0 1.0

XY1 3 2 0 0
0.0 0.0
40.0 0.0

FR MNG 1 0.03

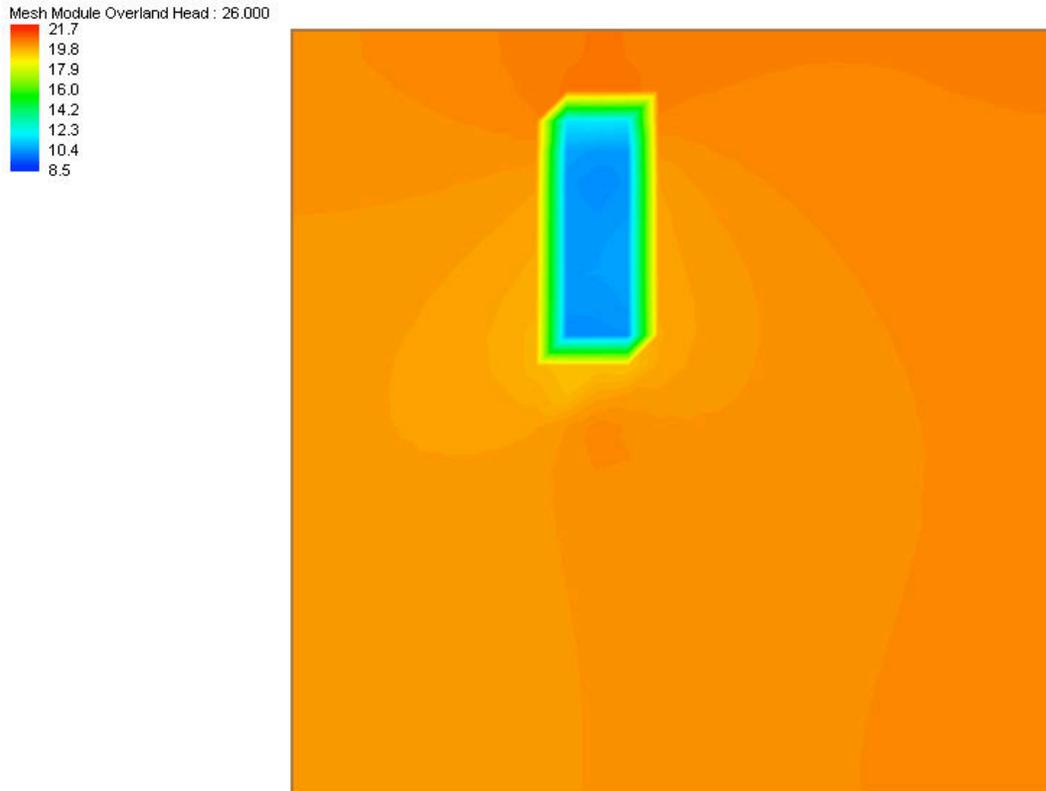
NB OVL 1 3

OC 1

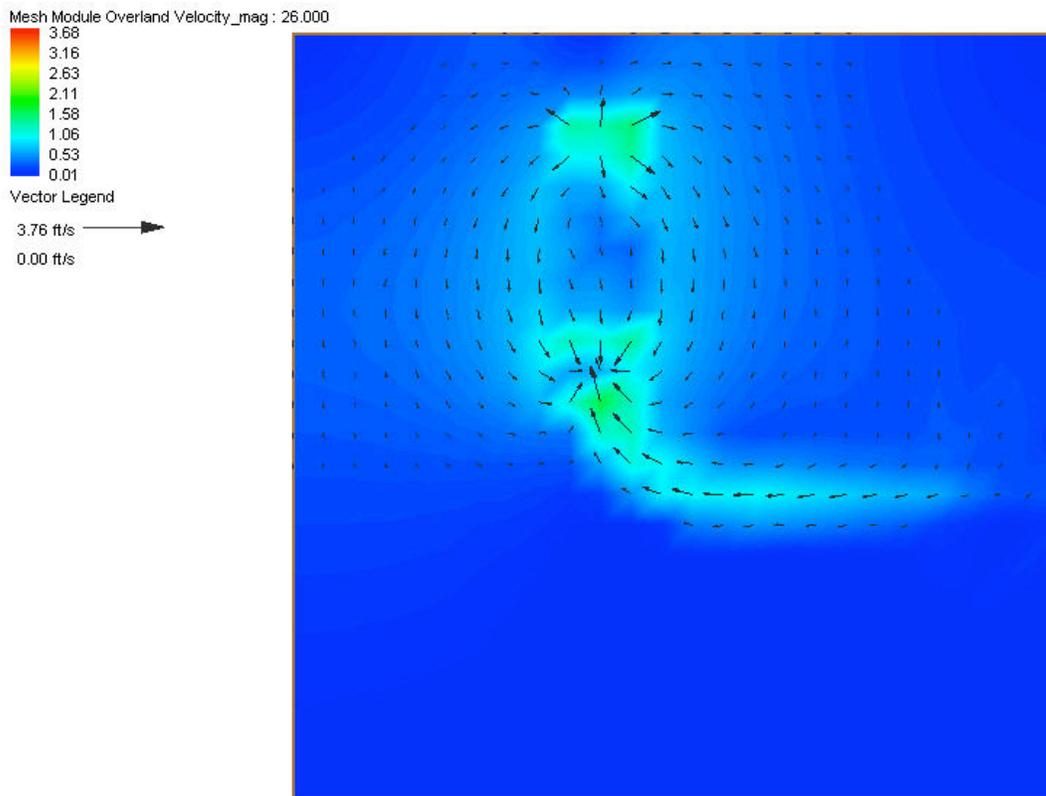
TC T0 0.0
TC IDT 2
TC TF 40.0
END

```

Once all of the files - the boundary condition file, the hotstart file, the geometry file, and the the boat file - have been completed and named appropriately, Pre\_ADH and ADH can be run as previously instructed and the results will show the effects of the boat on the depths and velocities as it moves within the model. See figures 6.1 and 6.2.



**Figure 6.1:** Overland head contours for the vessel movement example.



**Figure 6.2:** Overland velocity vectors and contours for the vessel movement example.

## Boat control cards

### BOAT

#### NUMBER OF VESSELS

Field	Type	Value	Description
1	char	BOAT	Card type
2	int	> 0	Number of vessels to be modeled

### FDEF

#### SAILING LINE AND INITIAL VESSEL POSITION

Field	Type	Value	Description
1	char	FDEF	Card type
2	int	> 0	Vessel number sailing line being defined
3	int	> 0	Number of segments in sailing line
4	real	#	x-coordinate of the vessel's initial position
5	real	#	y-coordinate of the vessel's initial position
6	real	#	Initial velocity magnitude of the vessel

### DRFT

#### VESSEL DRAFT

Field	Type	Value	Description
1	char	DRFT	Card type
2	int	> 0	Vessel number
3	real	#	Vessel draft

### BLEN

#### VESSEL LENGTH

Field	Type	Value	Description
1	char	BLEN	Card type
2	int	> 0	Vessel number
3	real	> 0	Vessel length

### BWID

#### VESSEL WIDTH

Field	Type	Value	Description
1	char	BWID	Card type
2	int	> 0	Vessel number
3	real	> 0	Vessel width

## PBOW

### BOW TO LENGTH RATIO

Field	Type	Value	Description
1	char	PBOW	Card type
2	int	> 0	Vessel number
3	real	> 0	Ratio of bow length to the vessel length

## PSTR

### STERN TO LENGTH RATIO

Field	Type	Value	Description
1	char	PSTR	Card type
2	int	> 0	Vessel number
3	real	> 0	Ratio of stern length to the vessel length

## CBOW

### FRACTION OF DRAFT APPLIED TO PBOW

Field	Type	Value	Description
1	char	CBOW	Card type
2	int	> 0	Vessel number
3	real	> 0	Bow draft ratio

## CSTR

### FRACTION OF DRAFT APPLIED TO PSTR

Field	Type	Value	Description
1	char	CSTR	Card type
2	int	> 0	Vessel number
3	real	> 0	Stern draft ratio

## PROP

### PROPELLER PARAMETERS

Field	Type	Value	Description
1	char	PROP	Card type
2	int	> 0	Vessel number
3	int	1 or 2	Propeller type (1=open wheel; 2=Kort nozzle)
4	real	> 0	Propeller diameter
5	real	> 0	Distance between the centers of the propellers
6	real	> 0	Tow boat length
7	real	> 0	Distance from the propellers to the stern of the tow boat

## SDEF

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### SAILING LINE SEGMENT DEFINITION

Field	Type	Value	Description
1	char	SDEF	Card type
2	int	> 0	Vessel number
3	int	> 0	Sailing line segment number
4	int	0 or 1	Type of segment (0=line;1=arc)
5	real	#	x-coordinate of segment end
6	real	#	y-coordinate of segment end
7	real	#	Vessel velocity at segment end
8	real	#	If segment is an arc, the x-coordinate of the arc center
9	real	#	If segment is an arc, the y-coordinate of the arc center
10	real	$\pm 1.0$	If segment is an arc, the direction of turn (+1.0 for left turns and -1.0 for right turns)

## ENDD

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### END OF FILE

Field	Type	Value	Description
1	char	ENDD 0 0	Card type