OBJECTIVES

Develop theoretical expressions for a bore advancing over wet and dry beds.

- –Velocity
- –Bore Height
- –Slope of leading edge

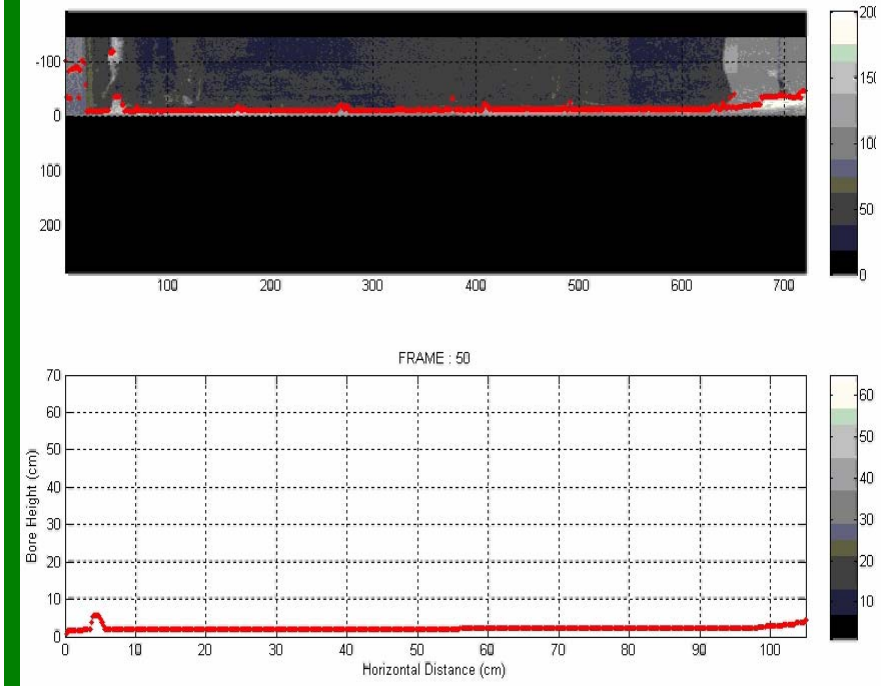
Comparing the shapes of bores generated by a solitary wave and dam break experiments.

OBSERVATIONS AND CONCLUSIONS

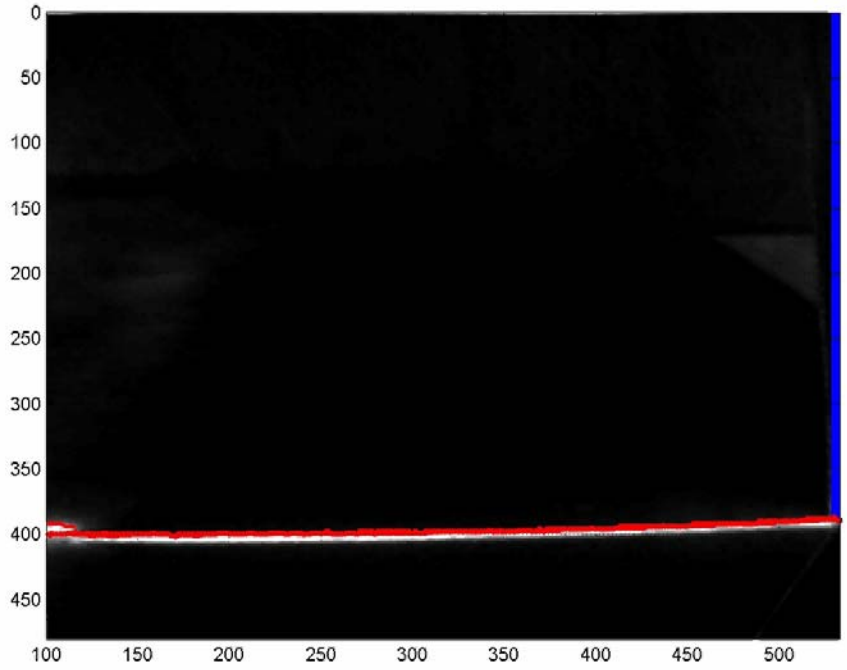
- Steeper bore slopes observed for wet bed cases.
- Characteristics of bores generated by dam breaks and solitary waves are similar, once the bore stabilize.
- Hydraulic theory predicts the bore characteristics for the wet bed cases very well.
  - Advancing bore over a wet bed can be modeled as a hydraulic jump.
  - Given the relative water depths on either side of the bore, the theory can predict the bore velocity.
- Based on the experimental results we can develop a relationship between the Froude number and the slope of the leading edge of the bore.
- For dry bed cases, theoretical expressions show bore speed as a function of bed friction (C_F).

EXPERIMENTS AND PROCEDURES

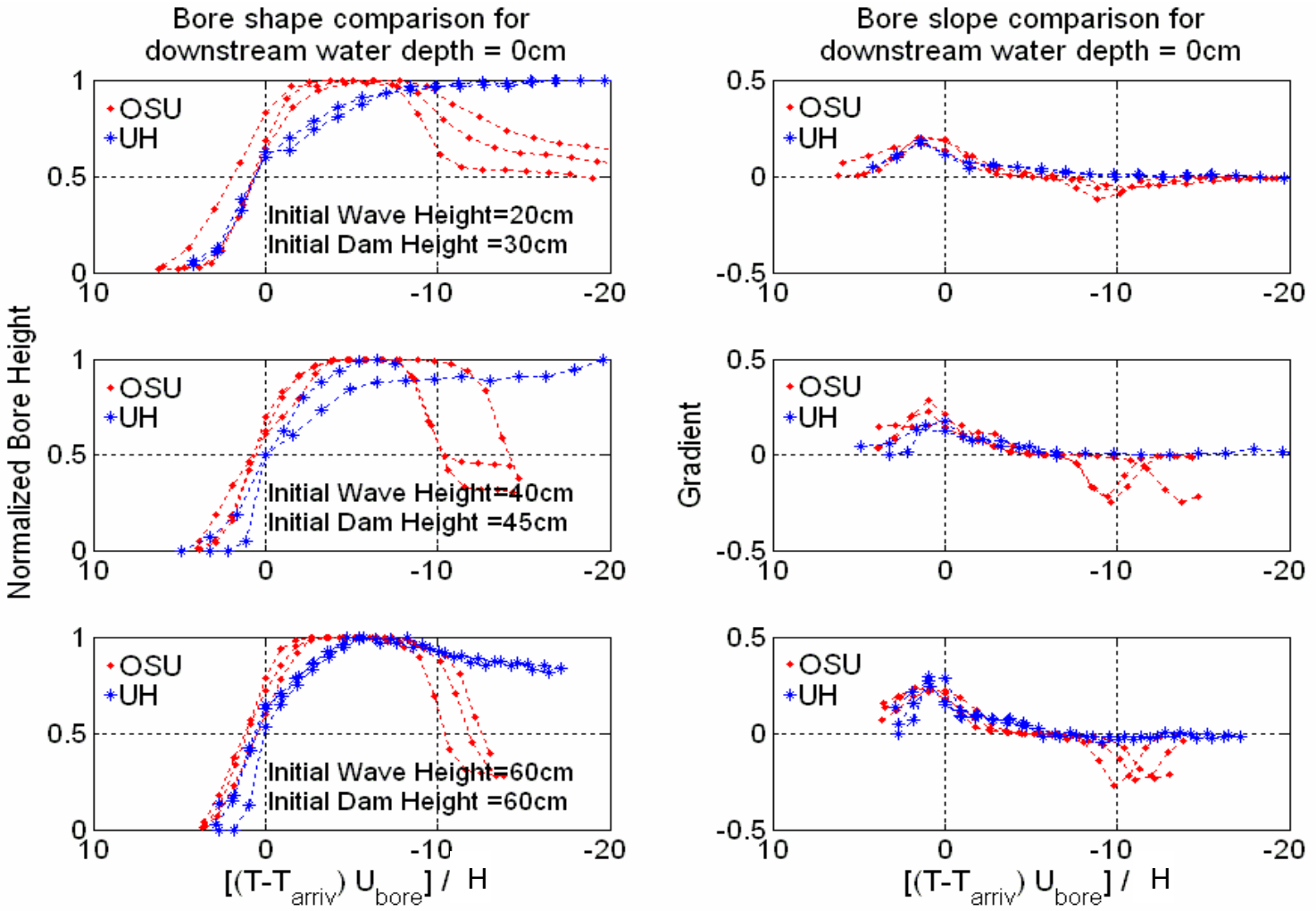
UH Dam Break Surface tracking



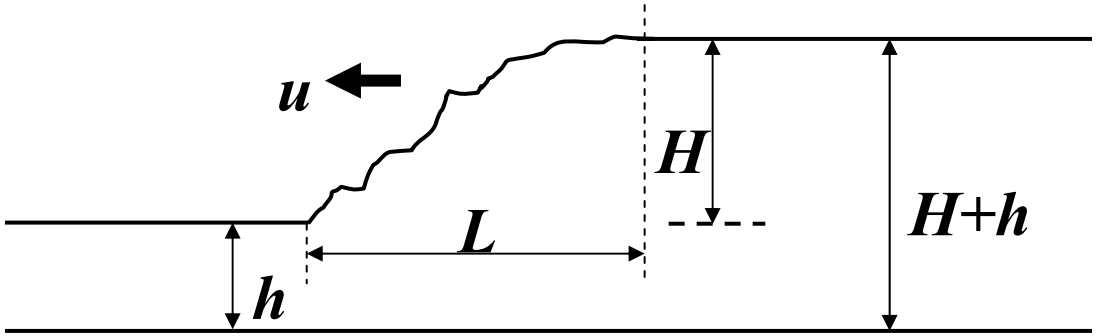
OSU Solitary wave Surface tracking



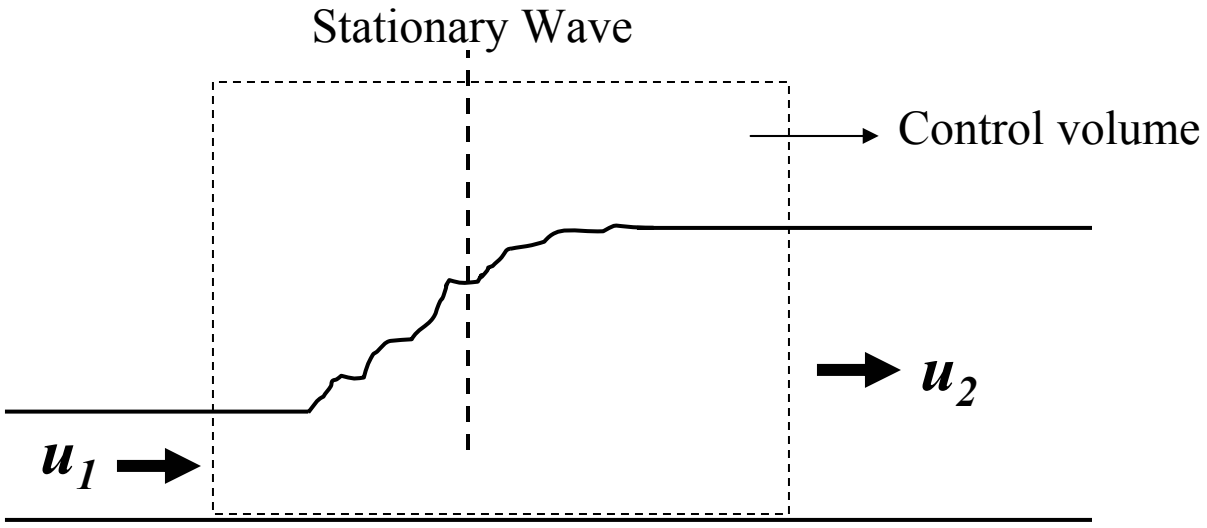
BORE SHAPE COMPARISON – DRY BED
DAM BREAK & SOLITARY WAVE BORES



DEFINITION SKETCH OF BORE



H = Bore Height
h = Downstream water level
H+h = Total water depth
u = Bore speed
L= Bore Length



THEORETICAL CONSIDERATION-WET BED

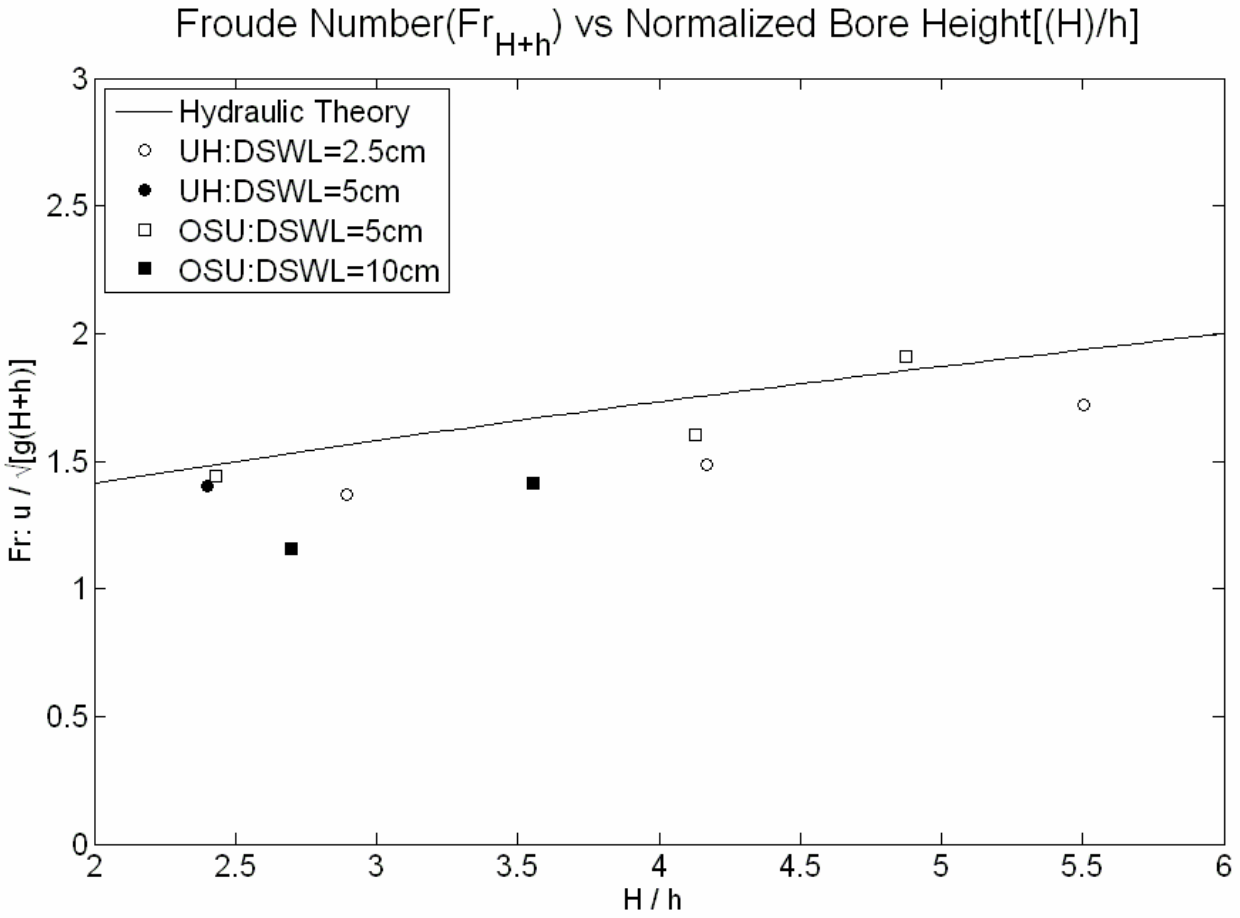
- Using hydraulic jump theory

$$\frac{2(H+h)}{h} = -1 + \sqrt{\left(1 + 8Fr_1^{\,2}\right)} \quad \rightarrow \quad Fr_1^{\,2} = \frac{1}{2}\left(\frac{H+h}{h}\right)^2 + \frac{1}{2}\left(\frac{H+h}{h}\right)$$

$$Fr^2 = Fr_1^{\,2}\left[\frac{\frac{h}{H}}{\left(1+\frac{h}{H}\right)}\right] \quad \rightarrow \quad u = \sqrt{g(H+h)\left[\frac{\frac{h}{H}}{\left(1+\frac{h}{H}\right)}\right]Fr_1^{\,2}}$$

COMPARISON TO THEORY

Comparison of theory to experimental data – Wet bed cases



Experimental data follows the theory reasonably well

Can predict the bore speed → given bore height and DSWL

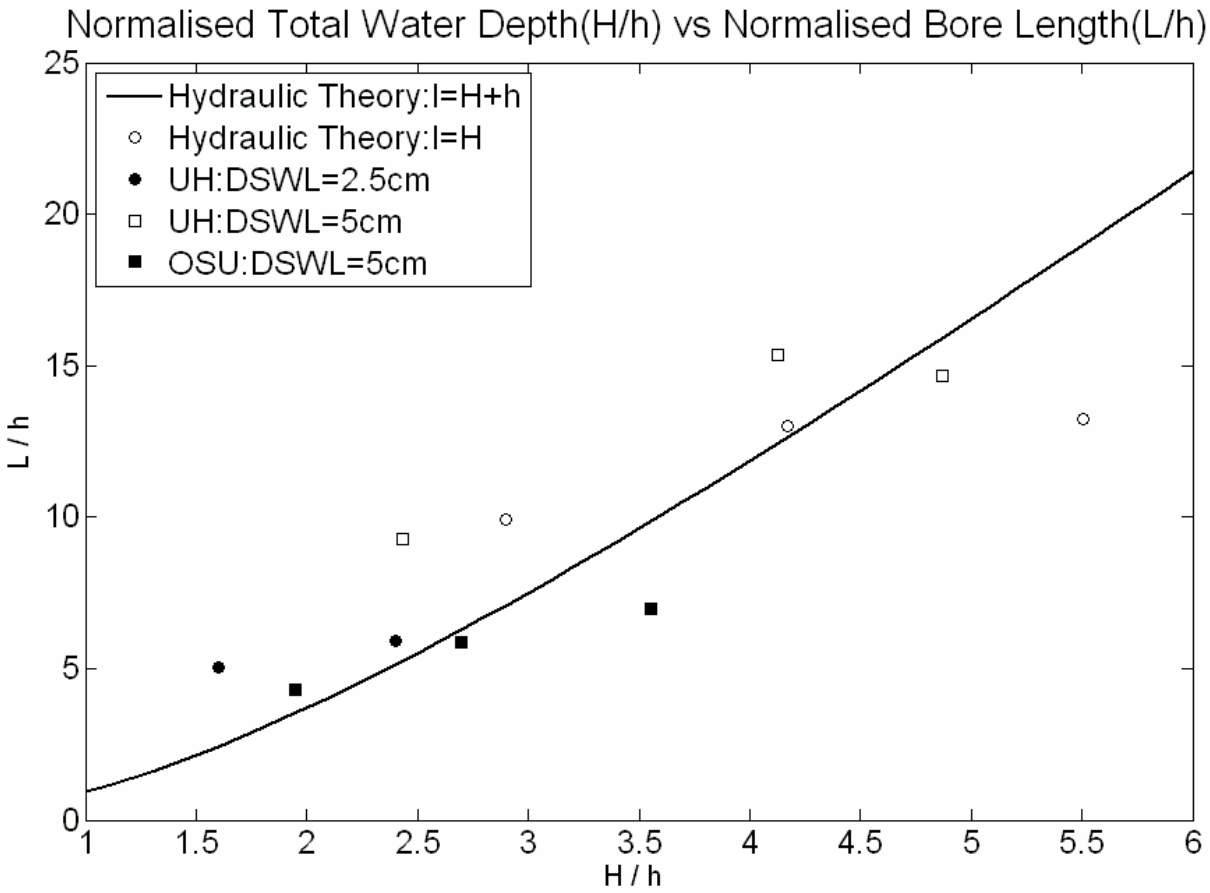
THEORETICAL CONSIDERATION-WET BED

- Relating the energy in large scale turbulence to head loss in hydraulic jump

$$\frac{L}{H} = K_w \left(\frac{H}{h} \right)^2 \frac{1}{4(1 + H/h)} \frac{1}{Fr^2}$$

COMPARISON TO THEORY

Comparison of theory to experimental data – Wet bed cases



Theoretical expression obtained for bore length predicts the bore length reasonably well

THEORETICAL CONSIDERATION-DRY BED

- Relating the force balance between pressure gradient force and friction force, we get:

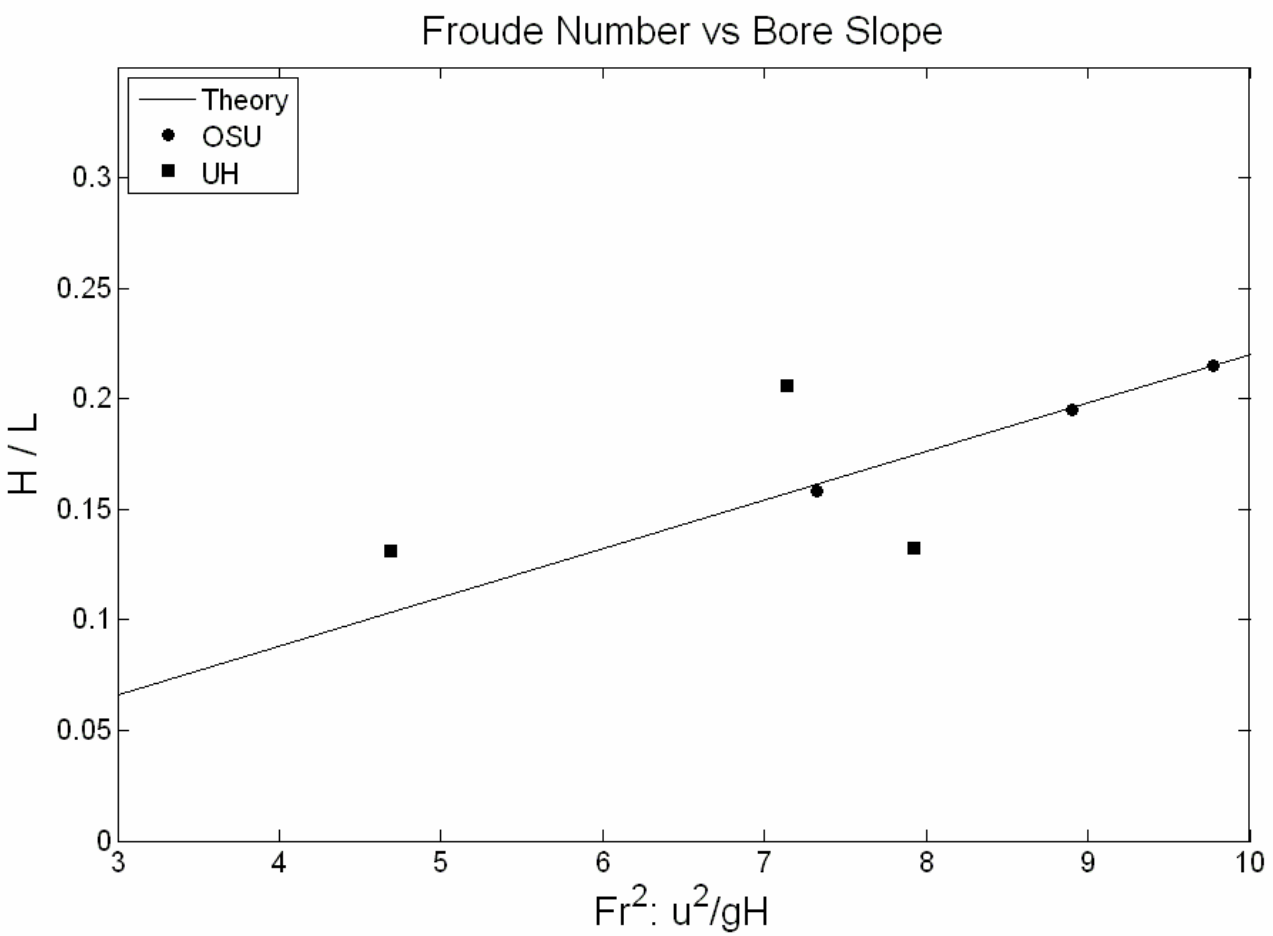
$$Fr^2 = \frac{1}{2C_F}\frac{H}{L}$$

- Combining this with turbulent energy dissipation across the bore gives:

$$u^2 = gH\left[\frac{1}{2K_D C_F} - 1\right]$$

COMPARISON TO THEORY

Comparison of theory to experimental data – Dry bed cases

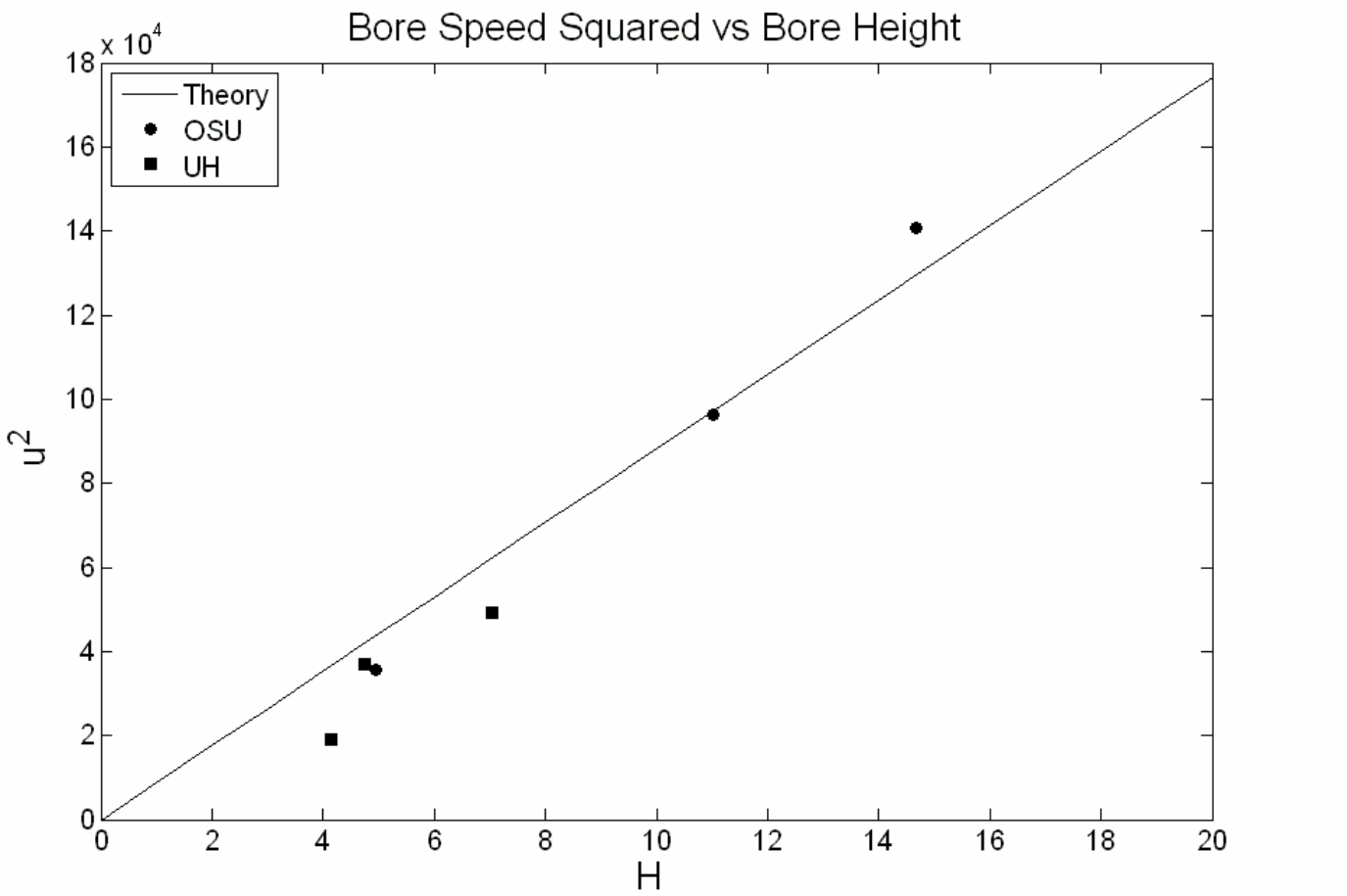


Constant, C_F , determined from curve fitting

For our experiments - $C_F \sim 0.011$

COMPARISON TO THEORY

Comparison of theory to experimental data – Dry bed cases



Constant, $K_D C_F$, determined from curve fitting

For our experiments – $K_D C_F \sim 0.05$

THANK YOU

QUESTIONS?