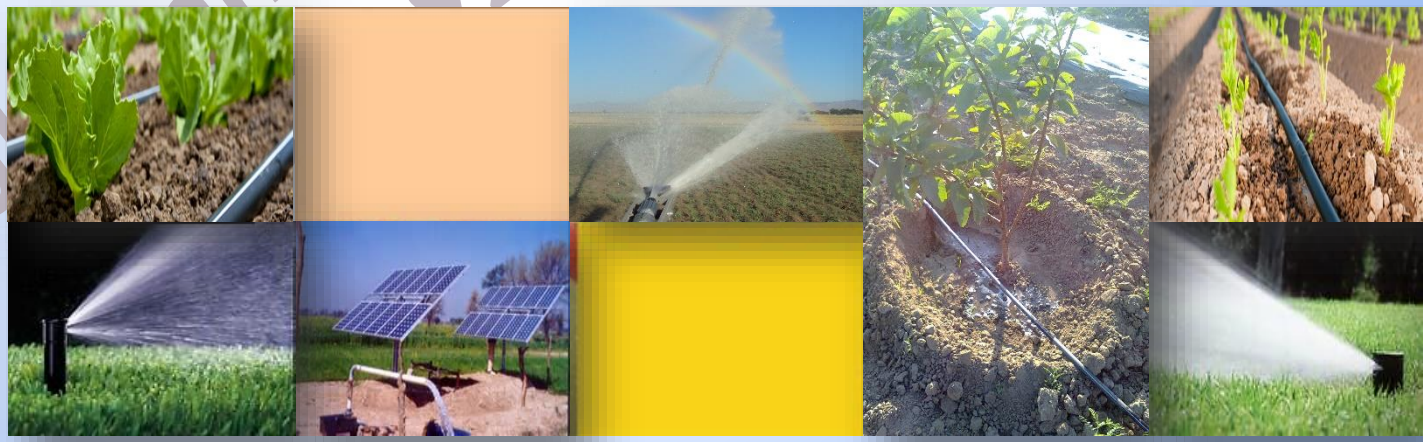
Rabail Technologies
Sprinkler, Drip Irrigation & Solar Tube Wells

WETRC
Water & Energy Training & Research Center

بسم الله الرحمن الرحيم



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Pipe Hydraulics - Pressurized Irrigation

Sizing, Head Losses, TDH

Speaker

Engr Muhammad Nasir Jamal
(Gold Medalist)

Director,

Water, Energy Training &
Research Center (WETRC)
(Project of Rabail Technologies)

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Who am I

- CEO and Director, Rabail Technologies, WETRC
- Working in Different Sectors of HEIS (since 2005), Like
  - Project Management
  - Marketing, Designing, Installation, After Sales Services
  - Manufacturing of HEIS Components, especially Filters
- Consultant for HEIS and Water Courses, NesPak
- Master Trainer on HEIS at:
  - Food and Agriculture Organization of United Nations, (FAO, UN)
  - On Farm Water Management (OFWM), Punjab, Sindh, KPK
  - Swiss HELVETAS, Inter-Cooperation.
  - UET, Peshawar
  - Water Management Training Institute (WMTI), Lahore
  - University of Peshawar, Center of Excellence in Geology
  - Nos. of Private Organizations.

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What are We……

THREE DIVISION

Water, Energy Training & Research Center (WETRC)

High Efficiency Irrigation System (HEIS)

Solar Tube Well System

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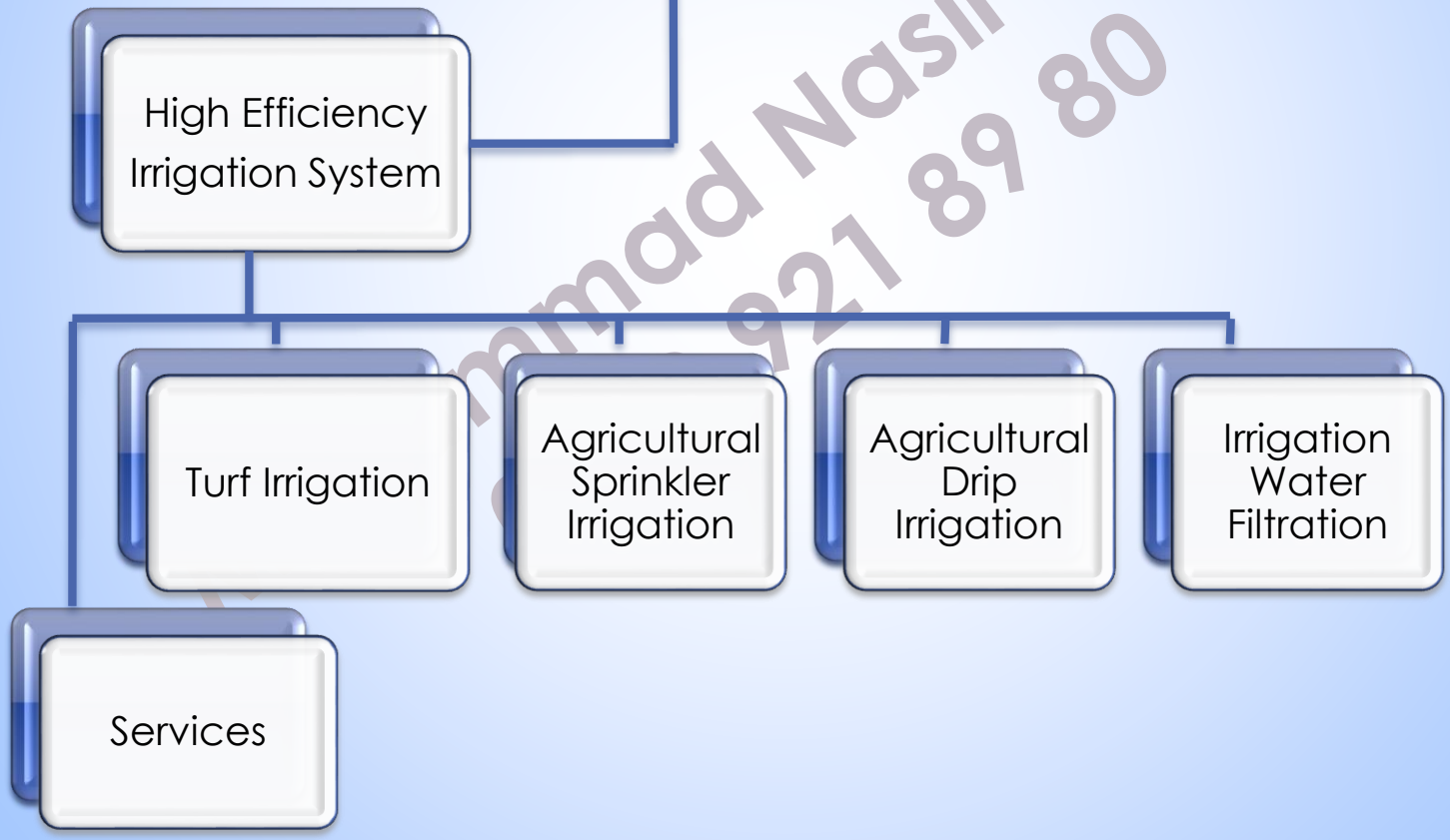
High Efficiency Irrigation System (HEIS)



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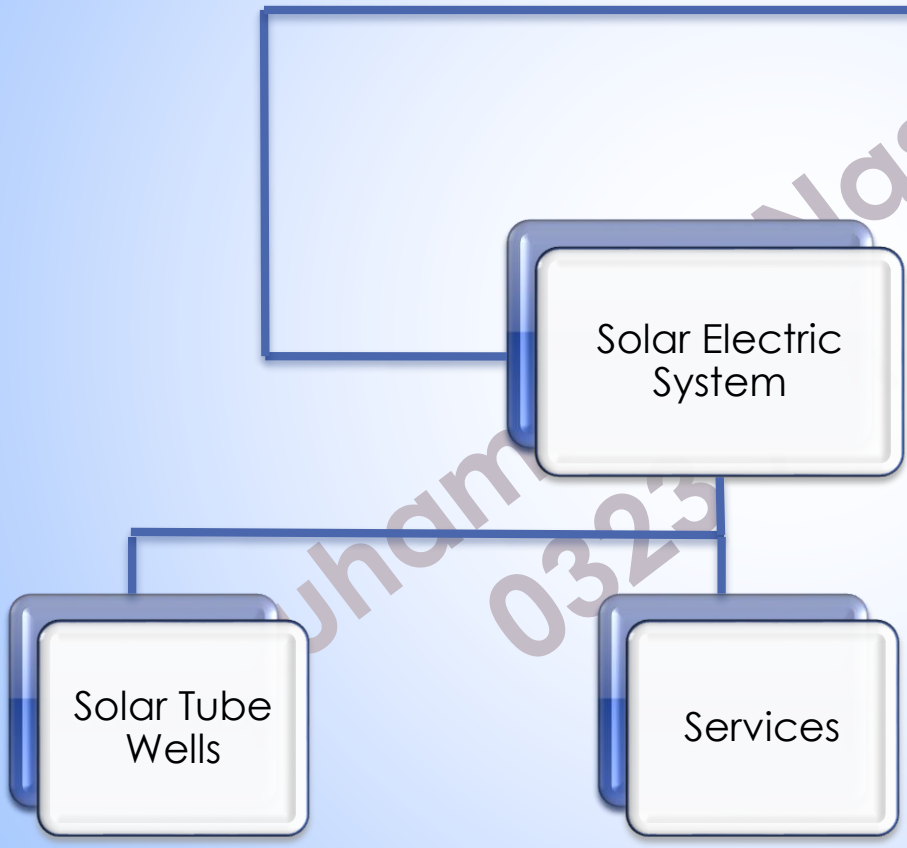
Solar Tube Well System



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Business Partners

Sprinklers irrigation

- K Rain, USA.
  - Pop Up Sprinklers
  - Automation Systems
- Ducar, Turkey.
  - Wide Range Rainguns

Drip irrigation

- Euro Drip.
  - Online Drippers
  - Drip Lateral
- Irritec
  - Drip Line
  - Filters

مفہومِ حدیثِ نبوی ﷺ

علم مومن کی گمشدہ میراث ہے،

جہاں سے ملے حاصل کرلو

Pascal Law

Pressure applied by fluid will be equal in every direction and will be at right angle to the surface.

Pressure (P) = Force (F)/Area (A)

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Continuity Law

Mass of flowing water in a conduit will remain the same, regardless the cross sectional area.

$$A_1 V_1 = A_2 V_2$$

$A_1 > A_2$

$V_1 < V_2$

$Q = A_1 V_1 = A_2 V_2$

A: X-sec Area; V: Velocity; Q: Flow

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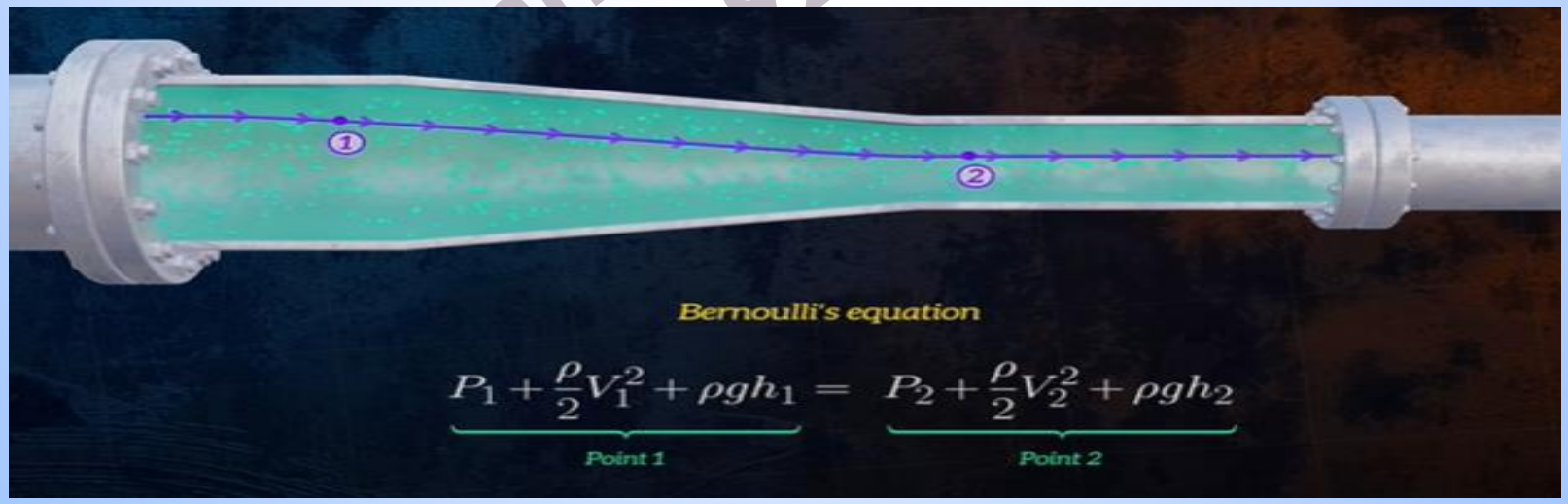
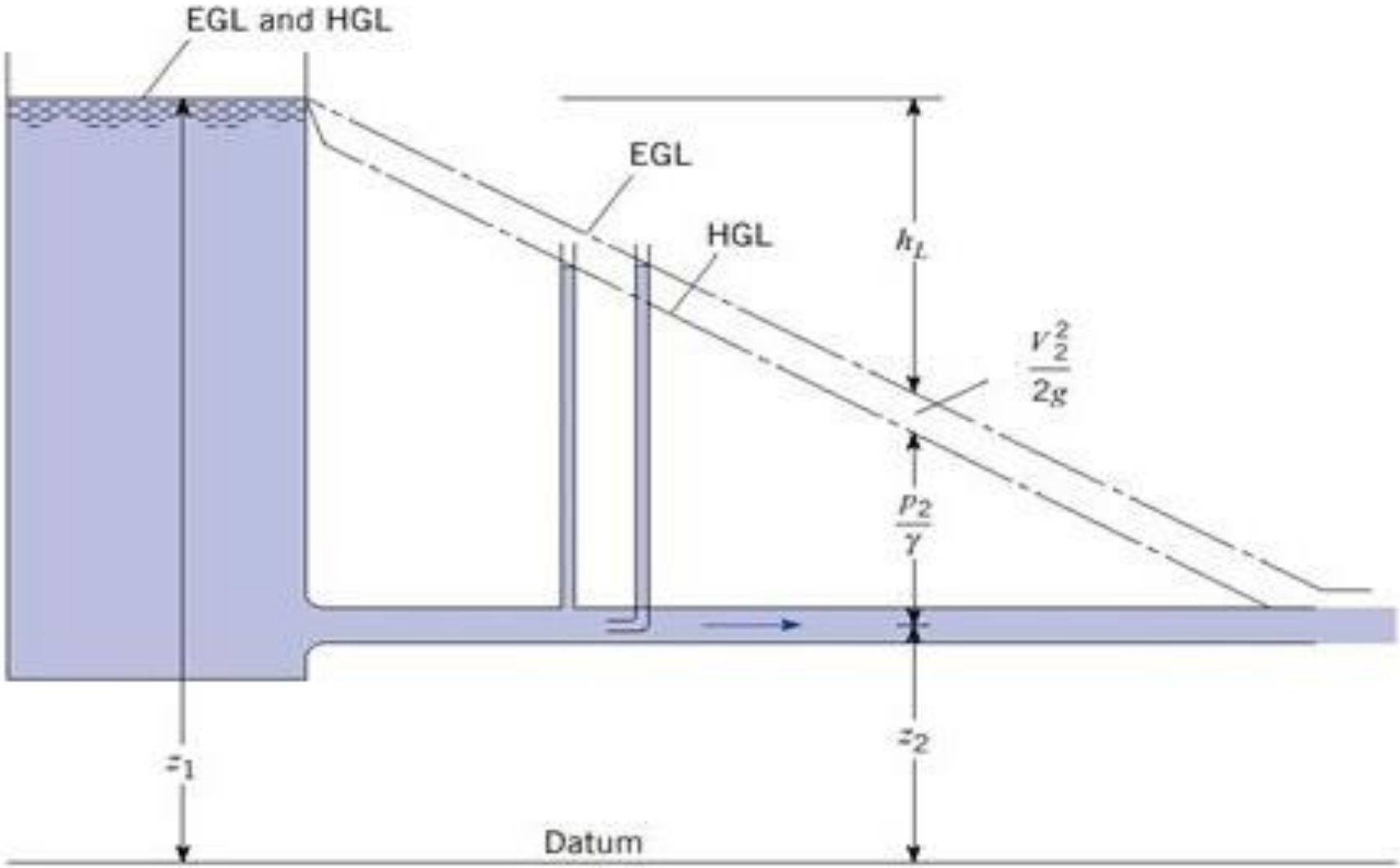
Bernoulli Law

An Increase in Velocity,

must be accompanied by a

Decrease in Pressure




EGL and HGL
EGL
HGL
h_L
$\frac{V_2^2}{2g}$
$\frac{P_2}{\gamma}$
z_1
z_2
Datum

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Calculating Flow Through Pipe

$$Q = A_1V_1 = A_2V_2 = AV$$

$$A = 3.14 * D^2/4 \quad ; \quad D = ID = (OD - 2t)$$

$$Q = (3.14 * D^2/4) * V$$

$$Q_{(LPH)} = 2.82357 * D_{(mm)} * V_{(m/s)}$$

$$Q_{(LPH)} = 37{,}878 \text{ LPH}; \quad D_{(81.9\ mm)}; \quad V_{(2\ m/s)}$$

NPS 3; CL B, BS 3505

In HEIS, V<=1.5 m/s

Hazzan William Friction Loss Formula

$$h_f \text{ (m)} = 3188.788711 \times (Q \text{ (LPH)}/C)^{1.85} \times L \text{ (m)} \times ID^{-4.87} \text{ (mm)}$$

Equation is valid for single out let, i.e. all the flow that enters the pipe is discharged from a single outlet

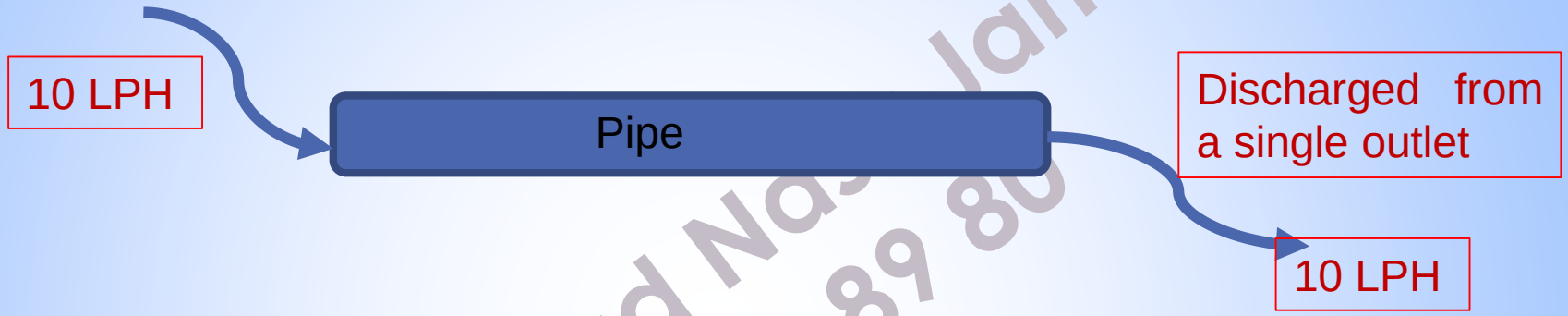
Minor Friction Losses are Approx. 20% of all Major Friction Losses

C : Material Factor (as shown in following Table)

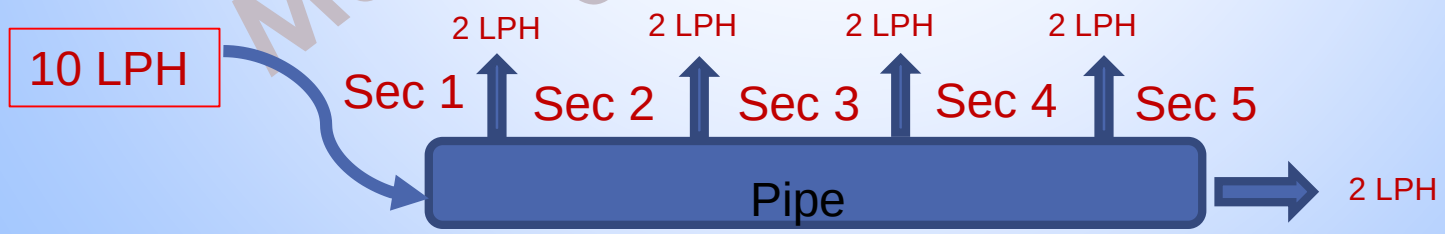
Asbestos-cement	140
Brass	130–140
Brick sewer	100
Cast iron	
New, unlined	130
Old, unlined	40–120
Cement lined	130–150
Bitumastic enamel lined	140–150
Tar-coated	115–135
Concrete or concrete lined	
Steel forms	140
Wooden forms	120
Centrifually spun	135
Copper	130–140

Copper	130–140
Fire hose (rubber lined)	135
Galvanized iron	120
Glass	140
Lead	130–140
Plastic	140–150
Steel	
Coat-tar enamel lined	145–150
New unlined	140–150
Riveted	110
Tin	130
Vitrified clay	100–140

Equation is valid for single out let, i.e. all the flow that enters the pipe is discharged from a single outlet



Discharged from Multiple Outlets



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Friction Losses for Multi Outlet Pipes

Hassan William equation remain valid, only "**F**" factor to be included

$$h_f \text{ (m)} = \mathbf{F} \times 3188.788711 \times (Q \text{ (LPH)}/MF)^{1.85} \times L \text{ (m)} \times ID^{-4.87} \text{ (mm)}$$

Distance to the First Sprinkler Equals One-half of the Sprinkler Head Spacing

Number of Sprinkler Heads on Lateral N	For m = 1.85	Number of Sprinkler Heads on Lateral N	For m = 1.85
1	1.000		
2	0.518	16	0.363
3	0.441	17	0.362
4	0.412	18	0.361
5	0.397	19	0.361
6	0.387	20	0.360
7	0.381	22	0.359
8	0.377	24	0.359
9	0.374	26	0.358
10	0.371	28	0.357
11	0.369	30	0.357
12	0.367	35	0.356
13	0.366	40	0.355
14	0.365	50	0.354
15	0.364	100	0.353

the Distance to the First Sprinkler Equals the Sprinkler Head Spacing

Number of Sprinkler Heads on Lateral N	For m = 1.85	Number of Sprinkler Heads on Lateral N	For m = 1.85
1	1.0	16	0.382
2	0.639	17	0.380
3	0.535	18	0.379
4	0.486	19	0.377
5	0.457	20	0.376
6	0.435	22	0.374
7	0.425	24	0.372
8	0.415	26	0.370
9	0.409	28	0.369
10	0.402	30	0.368
11	0.397	35	0.365
12	0.394	40	0.364
13	0.391	50	0.361
14	0.387	100	0.356
15	0.384	More than 100	0.351

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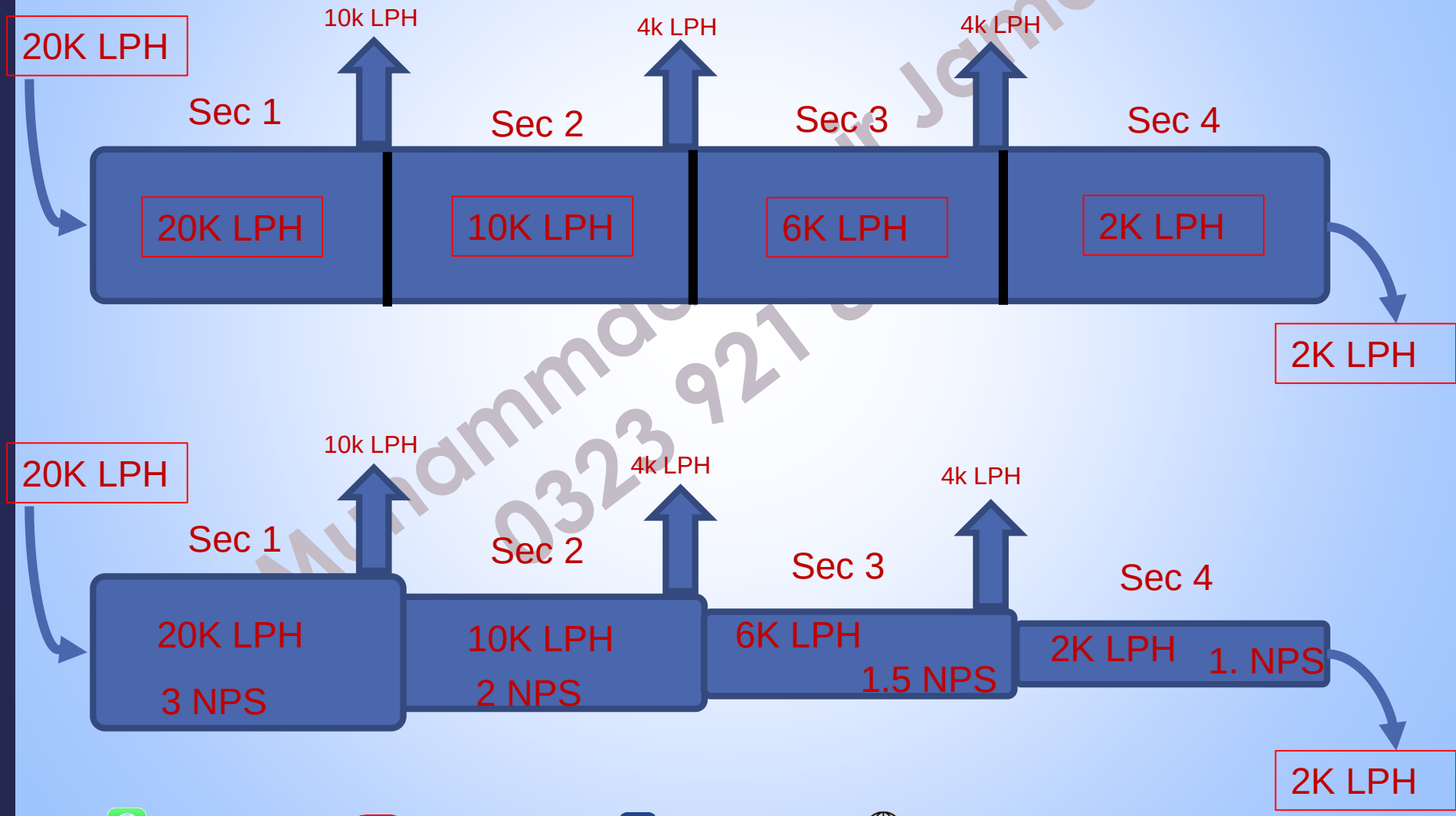
Pipe Telescoping



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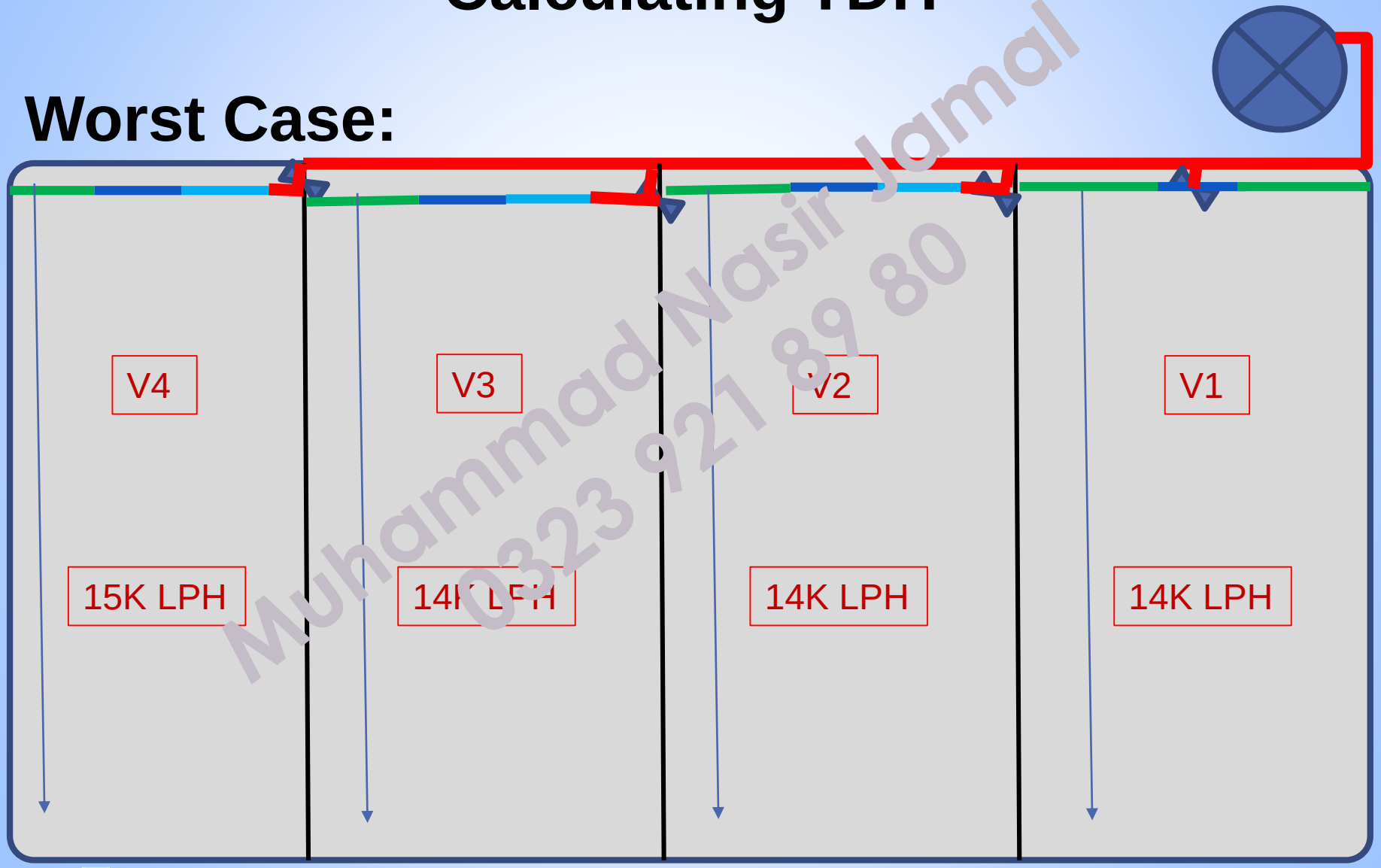
Calculating TDH

Worst Case:



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Worst Case:

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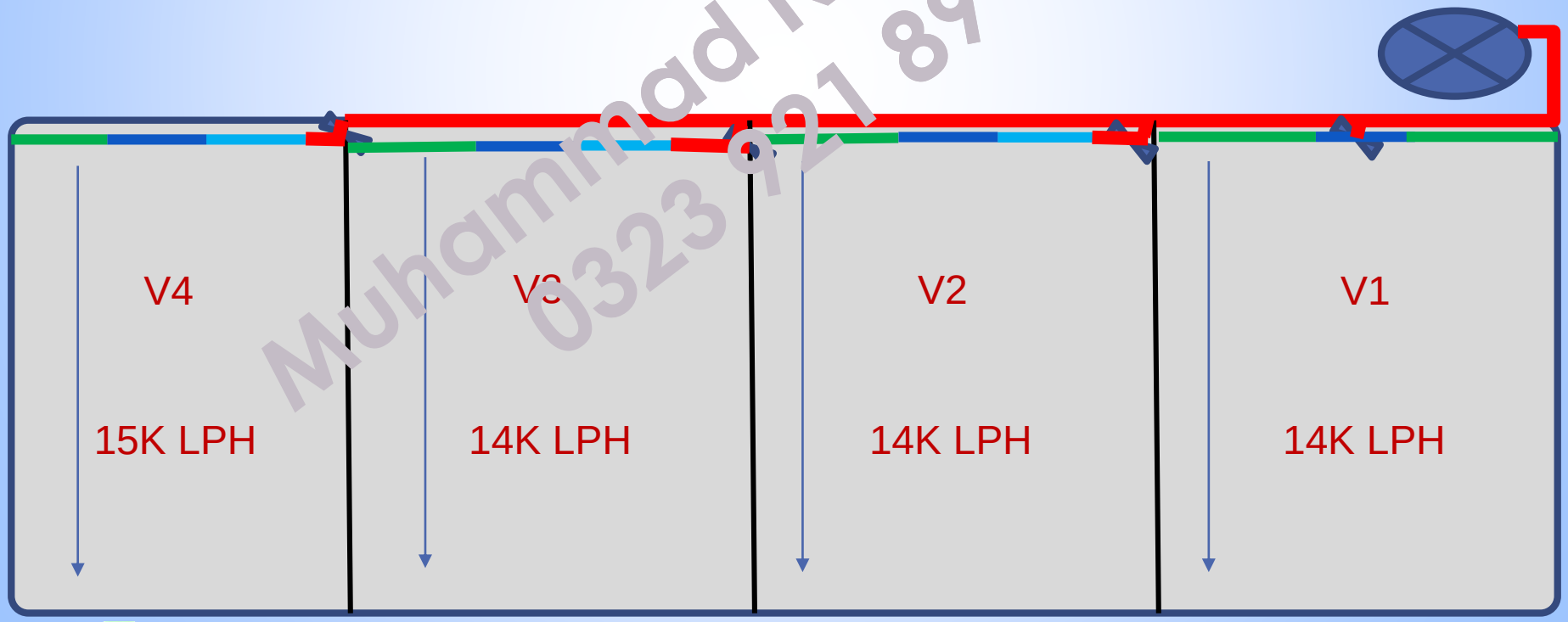
Worst Case: V4, Most Remote and High Flow Rate

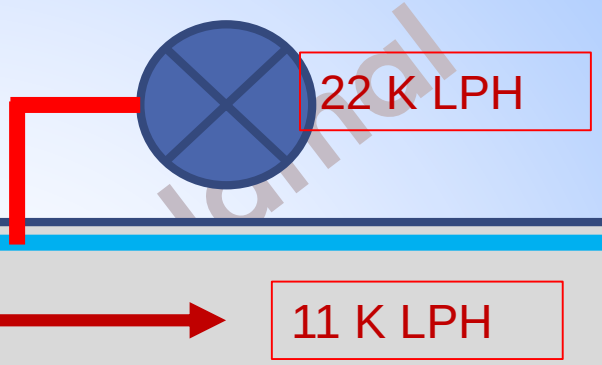
Calculate friction losses for V4, with 15k LPH flow and length of main line (RED)

Calculate friction losses for V4, for other 3 colors and Lateral Losses

Sum up all losses and add another 20% of its sum (Minor losses)



Loop System



For friction losses, take half the length of loop and half the flow

Main line pressure remain the same. Used where mainline is very long and/or where loop with lower dia pipe can reduce cost

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TDH =

Major Friction losses + Minor Friction losses + Suction Head

Nozzle Head + Elevation Differences + Any other Loss

Pump Duty Point = Flow Rate × TDH

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Any Question Please

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