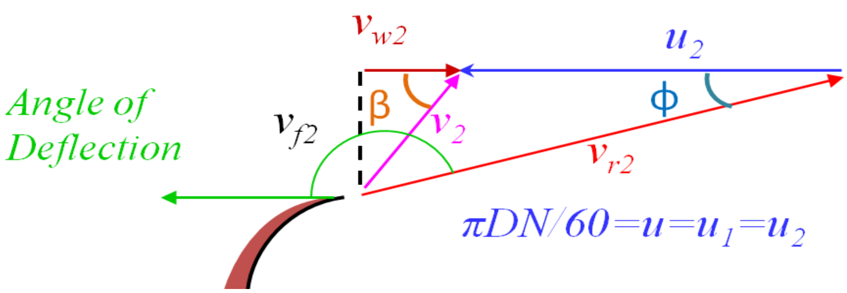
A pelton wheel having semi-circular buckets functions under a head of 150 m and consumes 50 liter per second of water. If 60 cm diameter wheel turns 600 revolutions per minute, make calculations for the power available at the nozzle and the hydraulic efficiency of the wheel. Presume coefficient of velocity Kv is unity and friction factor at bucket as 0.95.

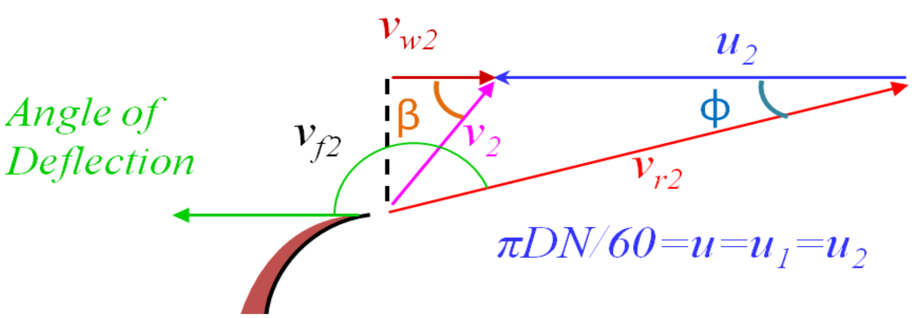
Q=	50	lit/s	0.05	m3/s
H=	150	m		
Kv	1			
diameter	60	cm	0.6	m3/s
speed	600	rpm		
jet deflect through	180	°		
K (assume)	0.95			



Power available in the nozzle=	73575	W	*ρgQH
velocity of jet V=	54.25	m/s	***V1=Vw1 =Kv√(2gH)**
Tangential velocity of the wheel u =	18.85	m/s	*** u=πDN /60**
blade to speed ratio , ρ=u/V	0.35		
Φ =	0	°	
hydraulic efficiency ηh=	0.884		*** ηh=2(ρ-ρ^2)(1+KcosΦ)**

A Pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at the rate of 750 lit/s under a head of 35 m. If the buckets deflect the jet through an angle 160º, find the power and the efficiency of the turbine neglecting friction in bucket. Take the coefficient of velocity as 0.98.

u1=	12	m/s
Q=	750	lit/s
H =	35	m
flow deflects =	**160**	°
coefficient of velocity Kv =	0.98	* flow ratio
ρ=	1000	
blade outlet angle Φ =	20	°



V1 =	25.68	m/s	***V1=Vw1 =Kv√(2gH)**
Vr1 =	13.68	m/s	*** V1-U1**
Vr2 =	13.68	m/s	*** neglecting friction, K=1, Vr1=Vr2**
$Vw_2=Vr_2\cos\Phi-u_2$	0.86	m/s	
Work done at runner / sec =	238832.78	Nm/sec	***ρQ(Vw1+Vw2)*u1**
Power developed =	238.83	kW	
Power input =	257.51	kW	
η =	0.927		

In a hydroelectric power plant, water available under a head of 250 m is delivered to the power house through three pipes having 2500 m length. Through these pipes, friction loss is estimated to be 20 m. The project is required to produce a total shaft output of 13.25 MW by installing a number of single jet Pelton wheels whose specific speed is not exceeding 38.5. It is given as wheel speed is 650 rpm, ratio of bucket to jet speed is 0.46, overall efficiency of the wheel is 85 %, nozzle Cd is 0.94 and Kv is 0.97. Pipe friction coefficient is also given as 0.005. Determine (i) the number of Pelton wheel to be used (ii) jet diameter (iii) diameter of the supply pipes.

head available=	250	m		
friction loss =	20	m		
specific speed=	38.5			
wheel speed=	650	rpm		
Total shaft output=	13.25	MW		
Kv=	0.97			
ratio of bucket to jet speed =	0.46			
overall efficiency ηo=	85	%		
Cd=	0.94			
friction factor=	0.005			
pipe length=	2500	m		

Net available head=	230	m		
Power available=	2814.6	kW	(from specific speed)	
Number of Machines=	4.71	kW	**5** approx	5
velocity of jet V=Kv(2gH)^0.5=	65.16	m/s		
tangential /periferal velocity of bucket u=	29.97	m/s		
Diameter of the wheel D=	0.881	m	(from u=pi*D*N/60)	
Discharge through each wheel, Q=	1.38	m^3/s	(Power available from turbine, P=γQHη)	
jet diameter, d=	0.167	m	(from Q=Cd(2gH)^0.5*area of jet)	
total discharges from machines=	6.91	m^3/s		
discharges per pipe=	2.3	m^3/s		
diameter of the pipe =	0.274	m	(from darcy weisback equation hf=flV^2/(2gd)=> d=16*flQ^2/(2g*pi^2))	

It is desired to generate 1000 kW of power. Survey reveals that 450 m of static head and a minimum flow of 0.3 m3/s are available. Comment whether the task can be accomplished by installing a Pelton when that turns 1000 revolutions per minute and has an efficiency of 80 %. Further design Pelton wheel (i.e. width, depth, radial length and number of bucket) by assuming suitable data for coefficient of velocity, speed ratio and velocity coefficient for the jet.

Power to be developed =	1000	kW	
Static head =	450	m	
Q =	**0.3**	m^3/s	
Pelton wheel speed	1000	rpm	
ηo =	80	%	
Assume			
coeff of vel Kv =	**0.98**	(0.97 to 0.99)	
speed ratio Ku =	**0.46**	(0.45 to 0.47)	
Cd=	**0.94**		

Design pelton wheel

P=		1059.48	kW	**possible**
Velocity of jet V =		92.08	m/s	
Tangential velocity of wheel u =		43.22	m/s	
D =		0.826	m	
Nozzle diameter d=	(m=D/d=11 to 15)	0.0658	m	
				Water flow rate throug
turbine design				Q = Cd*sqrt(2gH)*pi/4
width of bucket =	**3.5** (3 to 4)times jet diameter d	23	cm	
Depth of bucket =	**1** (0.8 to 1.2)times jet diameter d	7	cm	
length of bucket =	**2.5** (2 to 3) times jet diameter d	16	cm	
no of bucket z=		21.28	approx	

ȝh turbine
*d^2