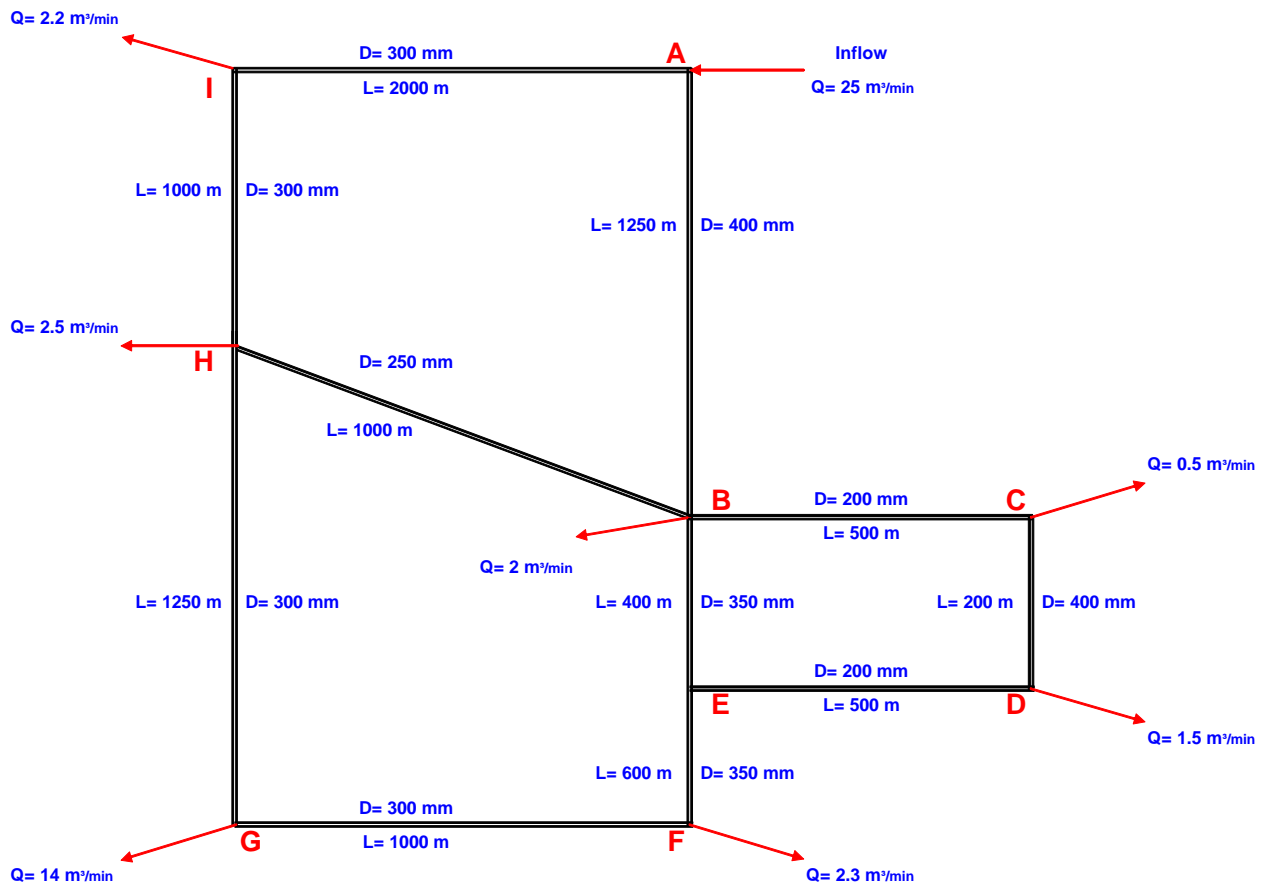


Second Example (Loop System)

Design the network of pipes? $C = 100$



Second Example Solution

The solution is by using the Hardy Cross Method of Analysis.

$$\Delta = - \frac{\sum hL}{1.85 * \sum \frac{hL}{Q}}$$

Where :

Δ = required flow correction

$$Q_{new} = \text{Sign}(Q_{old}) + \Delta$$

Loop 1

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	13.00	1.72	13.56	1.04		
1	BH	Yes	1	250	1000	100	1811.99	2.00	0.68	3.35	1.68		
1	HI	No	-1	300	1000	100	745.67	-9.80	2.31	-26.11	2.66		
1	IA	No	-1	300	2000	100	1491.33	-12.00	2.83	-75.94	6.33		
										-85.14	11.71	$\Delta 1$	3.929
2	BE	Yes	1	350	400	100	140.79	7.50	1.30	3.01	0.40		
2	EF	No	1	350	600	100	211.19	7.00	1.21	3.97	0.57		
2	FG	No	1	300	1000	100	745.67	4.70	1.11	6.70	1.43		
2	GH	No	-1	350	1250	100	439.97	-9.30	1.61	-13.98	1.50		
2	HB	Yes	-1	250	1000	100	1811.99	-2.00	0.68	-3.35	1.68		
										-3.66	5.57	$\Delta 2$	0.355
3	BC	No	1	200	500	100	2685.83	1.50	0.80	2.92	1.95		
3	CD	No	1	200	400	100	2148.66	1.00	0.53	1.10	1.10		
3	DE	No	-1	200	500	100	2685.83	-0.50	0.27	-0.38	0.76		
3	EB	Yes	-1	350	400	100	140.79	-7.50	1.30	-3.01	0.40		
										0.63	4.21	$\Delta 3$	-0.081

Loop 2

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	16.93	2.25	22.10	1.31		
1	BH	Yes	1	250	1000	100	1811.99	5.57	1.89	22.34	4.01		
1	HI	No	-1	300	1000	100	745.67	-5.87	1.38	-10.12	1.72		
1	IA	No	-1	300	2000	100	1491.33	-8.07	1.90	-36.46	4.52		
										-2.14	11.55	Δ1	0.100
2	BE	Yes	1	350	400	100	140.79	7.94	1.37	3.34	0.42		
2	EF	No	1	350	600	100	211.19	7.35	1.27	4.35	0.59		
2	FG	No	1	300	1000	100	745.67	5.05	1.19	7.67	1.52		
2	GH	No	-1	350	1250	100	439.97	-8.95	1.55	-13.01	1.45		
2	HB	Yes	-1	250	1000	100	1811.99	-5.57	1.89	-22.34	4.01		
										-20.00	7.99	Δ2	1.353
3	BC	No	1	200	500	100	2685.83	1.42	0.75	2.63	1.86		
3	CD	No	1	200	400	100	2148.66	0.92	0.49	0.94	1.03		
3	DE	No	-1	200	500	100	2685.83	-0.58	0.31	-0.51	0.87		
3	EB	Yes	-1	350	400	100	140.79	-7.94	1.37	-3.34	0.42		
										-0.27	4.17	Δ3	0.034

Loop 3

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.03	2.26	22.34	1.31		
1	BH	Yes	1	250	1000	100	1811.99	4.32	1.47	13.95	3.23		
1	HI	No	-1	300	1000	100	745.67	-5.77	1.36	-9.80	1.70		
1	IA	No	-1	300	2000	100	1491.33	-7.97	1.88	-35.63	4.47		
										-9.14	10.71	Δ1	0.461
2	BE	Yes	1	350	400	100	140.79	9.25	1.60	4.43	0.48		
2	EF	No	1	350	600	100	211.19	8.71	1.51	5.94	0.68		
2	FG	No	1	300	1000	100	745.67	6.41	1.51	11.89	1.86		
2	GH	No	-1	350	1250	100	439.97	-7.59	1.32	-9.61	1.27		
2	HB	Yes	-1	250	1000	100	1811.99	-4.32	1.47	-13.95	3.23		
										-1.29	7.51	Δ2	0.093
3	BC	No	1	200	500	100	2685.83	1.45	0.77	2.75	1.89		
3	DC	No	1	200	400	100	2148.66	0.95	0.51	1.01	1.06		
3	DE	No	-1	200	500	100	2685.83	-0.55	0.29	-0.45	0.83		
3	EB	Yes	-1	350	400	100	140.79	-9.25	1.60	-4.43	0.48		
										-1.12	4.26	Δ3	0.143

Loop 4

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.49	2.32	23.47	1.34		
1	BH	Yes	1	250	1000	100	1811.99	4.69	1.59	16.23	3.46		
1	HI	No	-1	300	1000	100	745.67	-5.31	1.25	-8.40	1.58		
1	IA	No	-1	300	2000	100	1491.33	-7.51	1.77	-31.91	4.25		
										-0.60	10.63	Δ1	0.031
2	BE	Yes	1	350	400	100	140.79	9.20	1.59	4.39	0.48		
2	EF	No	1	350	600	100	211.19	8.80	1.52	6.06	0.69		
2	FG	No	1	300	1000	100	745.67	6.50	1.53	12.21	1.88		
2	GH	No	-1	350	1250	100	439.97	-7.50	1.30	-9.39	1.25		
2	HB	Yes	-1	250	1000	100	1811.99	-4.69	1.59	-16.23	3.46		
										-2.96	7.76	Δ2	0.206
3	BC	No	1	200	500	100	2685.83	1.60	0.85	3.27	2.05		
3	DC	No	1	200	400	100	2148.66	1.10	0.58	1.31	1.19		
3	DE	No	-1	200	500	100	2685.83	-0.40	0.21	-0.26	0.64		
3	EB	Yes	-1	350	400	100	140.79	-9.20	1.59	-4.39	0.48		
										-0.07	4.36	Δ3	0.008

Loop 5

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.52	2.32	23.55	1.34		
1	BH	Yes	1	250	1000	100	1811.99	4.51	1.53	15.12	3.35		
1	HI	No	-1	300	1000	100	745.67	-5.28	1.24	-8.31	1.57		
1	IA	No	-1	300	2000	100	1491.33	-7.48	1.76	-31.67	4.23		
										-1.30	10.50	Δ1	0.067
2	BE	Yes	1	350	400	100	140.79	9.40	1.63	4.57	0.49		
2	EF	No	1	350	600	100	211.19	9.01	1.56	6.32	0.70		
2	FG	No	1	300	1000	100	745.67	6.71	1.58	12.94	1.93		
2	GH	No	-1	350	1250	100	439.97	-7.29	1.26	-8.92	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.51	1.53	-15.12	3.35		
										-0.21	7.69	Δ2	0.015
3	BC	No	1	200	500	100	2685.83	1.60	0.85	3.31	2.06		
3	DC	No	1	200	400	100	2148.66	1.10	0.59	1.32	1.20		
3	DE	No	-1	200	500	100	2685.83	-0.40	0.21	-0.25	0.63		
3	EB	Yes	-1	350	400	100	140.79	-9.40	1.63	-4.57	0.49		
										-0.18	4.37	Δ3	0.023

Loop 6

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.59	2.33	23.72	1.35		
1	BH	Yes	1	250	1000	100	1811.99	4.57	1.55	15.45	3.38		
1	HI	No	-1	300	1000	100	745.67	-5.21	1.23	-8.12	1.56		
1	IA	No	-1	300	2000	100	1491.33	-7.41	1.75	-31.14	4.20		
										-0.09	10.49	Δ1	0.005
2	BE	Yes	1	350	400	100	140.79	9.39	1.63	4.56	0.49		
2	EF	No	1	350	600	100	211.19	9.02	1.56	6.34	0.70		
2	FG	No	1	300	1000	100	745.67	6.72	1.58	12.99	1.93		
2	GH	No	-1	350	1250	100	439.97	-7.28	1.26	-8.88	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.57	1.55	-15.45	3.38		
										-0.44	7.72	Δ2	0.031
3	BC	No	1	200	500	100	2685.83	1.63	0.86	3.39	2.09		
3	DC	No	1	200	400	100	2148.66	1.13	0.60	1.38	1.22		
3	DE	No	-1	200	500	100	2685.83	-0.37	0.20	-0.22	0.60		
3	EB	Yes	-1	350	400	100	140.79	-9.39	1.63	-4.56	0.49		
										-0.01	4.39	Δ3	0.002

Loop 7

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.59	2.33	23.73	1.35		
1	BH	Yes	1	250	1000	100	1811.99	4.54	1.54	15.29	3.37		
1	HI	No	-1	300	1000	100	745.67	-5.21	1.23	-8.10	1.56		
1	IA	No	-1	300	2000	100	1491.33	-7.41	1.75	-31.11	4.20		
										-0.19	10.47	Δ1	0.010
2	BE	Yes	1	350	400	100	140.79	9.42	1.63	4.58	0.49		
2	EF	No	1	350	600	100	211.19	9.05	1.57	6.38	0.71		
2	FG	No	1	300	1000	100	745.67	6.75	1.59	13.10	1.94		
2	GH	No	-1	350	1250	100	439.97	-7.25	1.26	-8.82	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.54	1.54	-15.29	3.37		
										-0.03	7.72	Δ2	0.002
3	BC	No	1	200	500	100	2685.83	1.63	0.86	3.40	2.09		
3	DC	No	1	200	400	100	2148.66	1.13	0.60	1.38	1.22		
3	DE	No	-1	200	500	100	2685.83	-0.37	0.20	-0.22	0.59		
3	EB	Yes	-1	350	400	100	140.79	-9.42	1.63	-4.58	0.49		
										-0.03	4.39	Δ3	0.003

Loop 8

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.60	2.33	23.75	1.35		
1	BH	Yes	1	250	1000	100	1811.99	4.55	1.54	15.33	3.37		
1	HI	No	-1	300	1000	100	745.67	-5.20	1.23	-8.07	1.55		
1	IA	No	-1	300	2000	100	1491.33	-7.40	1.74	-31.03	4.19		
										-0.01	10.47	Δ1	0.001
2	BE	Yes	1	350	400	100	140.79	9.42	1.63	4.58	0.49		
2	EF	No	1	350	600	100	211.19	9.05	1.57	6.39	0.71		
2	FG	No	1	300	1000	100	745.67	6.75	1.59	13.11	1.94		
2	GH	No	-1	350	1250	100	439.97	-7.25	1.26	-8.81	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.55	1.54	-15.33	3.37		
										-0.06	7.72	Δ2	0.005
3	BC	No	1	200	500	100	2685.83	1.63	0.87	3.41	2.09		
3	DC	No	1	200	400	100	2148.66	1.13	0.60	1.39	1.23		
3	DE	No	-1	200	500	100	2685.83	-0.37	0.20	-0.22	0.59		
3	EB	Yes	-1	350	400	100	140.79	-9.42	1.63	-4.58	0.49		
										0.00	4.39	Δ3	0.000

Loop 9

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.60	2.33	23.76	1.35		
1	BH	Yes	1	250	1000	100	1811.99	4.54	1.54	15.31	3.37		
1	HI	No	-1	300	1000	100	745.67	-5.20	1.23	-8.07	1.55		
1	IA	No	-1	300	2000	100	1491.33	-7.40	1.74	-31.02	4.19		
										-0.03	10.47	Δ1	0.001
2	BE	Yes	1	350	400	100	140.79	9.43	1.63	4.59	0.49		
2	EF	No	1	350	600	100	211.19	9.06	1.57	6.39	0.71		
2	FG	No	1	300	1000	100	745.67	6.76	1.59	13.13	1.94		
2	GH	No	-1	350	1250	100	439.97	-7.24	1.25	-8.80	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.54	1.54	-15.31	3.37		
										0.00	7.72	Δ2	0.000
3	BC	No	1	200	500	100	2685.83	1.63	0.87	3.41	2.09		
3	DC	No	1	200	400	100	2148.66	1.13	0.60	1.39	1.23		
3	DE	No	-1	200	500	100	2685.83	-0.37	0.20	-0.22	0.59		
3	EB	Yes	-1	350	400	100	140.79	-9.43	1.63	-4.59	0.49		
										0.00	4.39	Δ3	0.001

Loop 10

Loop No.	Pipe Line	Combined Pipe	Sign	Diameter (mm)	Pipe Length (m)	C	k	Assumed Discharge (m ³ /min)	Velocity (m/sec)	Total Head Loss (m)	hL / Q		
1	AB	No	1	400	1250	100	229.62	17.61	2.33	23.76	1.35		
1	BH	Yes	1	250	1000	100	1811.99	4.55	1.54	15.32	3.37		
1	HI	No	-1	300	1000	100	745.67	-5.19	1.22	-8.07	1.55		
1	IA	No	-1	300	2000	100	1491.33	-7.39	1.74	-31.01	4.19		
										0.00	10.47	Δ1	0.000
2	BE	Yes	1	350	400	100	140.79	9.43	1.63	4.59	0.49		
2	EF	No	1	350	600	100	211.19	9.06	1.57	6.39	0.71		
2	FG	No	1	300	1000	100	745.67	6.76	1.59	13.13	1.94		
2	GH	No	-1	350	1250	100	439.97	-7.24	1.25	-8.80	1.22		
2	HB	Yes	-1	250	1000	100	1811.99	-4.55	1.54	-15.32	3.37		
										-0.01	7.72	Δ2	0.001
3	BC	No	1	200	500	100	2685.83	1.63	0.87	3.41	2.09		
3	DC	No	1	200	400	100	2148.66	1.13	0.60	1.39	1.23		
3	DE	No	-1	200	500	100	2685.83	-0.37	0.19	-0.22	0.59		
3	EB	Yes	-1	350	400	100	140.79	-9.43	1.63	-4.59	0.49		
										0.00	4.39	Δ3	0.000