

ANEXO 01:
FICHA PARA AFORO DE TRÁNSITO Y VELOCIDAD
MEDIANTE OBSERVACIÓN SIMPLE

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 25/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	4	0	2	18	2	7	0	0	15
06:15 - 06:30	0	6	0	1	15	2	10	0	2	26
06:30 - 06:45	1	5	0	0	26	2	9	0	3	22
06:45 - 07:00	1	2	0	2	15	3	9	0	1	29
07:00 - 07:15	0	9	0	0	26	3	16	0	1	25
07:15 - 07:30	0	4	0	2	20	2	16	0	3	29
07:30 - 07:45	1	5	0	0	18	3	14	0	3	26
07:45 - 08:00	1	3	0	1	15	3	18	0	1	22
08:00 - 08:15	2	7	0	0	26	1	10	0	2	16
08:15 - 08:30	2	12	0	0	22	3	18	0	4	18
08:30 - 08:45	0	7	0	1	16	2	25	0	2	15
08:45 - 09:00	2	10	0	1	25	3	19	0	5	26
09:00 - 09:15	2	10	0	1	29	1	20	0	6	22
09:15 - 09:30	0	5	0	2	26	4	13	0	2	26
09:30 - 09:45	2	9	0	3	22	5	14	0	5	20
09:45 - 10:00	3	8	0	0	18	3	15	0	1	18
10:00 - 10:15	1	10	0	0	15	5	16	0	3	15
10:15 - 10:30	4	9	0	2	26	0	21	0	0	16
10:30 - 10:45	2	9	0	1	22	0	30	0	1	16
10:45 - 11:00	2	13	0	1	29	1	31	0	0	16
11:00 - 11:15	0	13	0	0	26	2	20	0	3	29
11:15 - 11:30	0	12	0	0	22	1	14	0	1	15
11:30 - 11:45	5	14	0	0	16	4	20	0	2	26
11:45 - 12:00	2	11	0	0	12	4	14	0	0	17
12:00 - 12:15	0	15	0	1	22	4	22	0	1	18
12:15 - 12:30	1	11	0	2	26	3	15	0	1	15
12:30 - 12:45	0	8	0	0	20	0	11	0	2	22
12:45 - 13:00	2	10	0	1	18	3	12	0	0	18
13:00 - 13:15	2	9	0	0	15	0	16	0	1	23
13:15 - 13:30	0	9	0	0	16	2	10	0	1	18
13:30 - 13:45	3	11	0	2	20	2	16	0	2	30
13:45 - 14:00	0	11	0	0	29	0	13	0	0	22
14:00 - 14:15	1	6	0	0	15	5	14	0	2	18
14:15 - 14:30	3	6	0	0	14	0	11	0	0	15
14:30 - 14:45	2	13	0	0	20	1	13	0	1	26
14:45 - 15:00	3	12	0	1	18	1	6	0	0	22
15:00 - 15:15	3	12	0	2	23	4	22	0	1	29
15:15 - 15:30	3	12	0	1	18	1	10	0	0	26
15:30 - 15:45	1	10	0	0	15	2	23	0	0	17
15:45 - 16:00	2	11	0	1	26	1	12	0	1	15
16:00 - 16:15	2	12	0	1	21	0	17	0	0	16
16:15 - 16:30	1	13	0	0	26	1	9	0	0	20
16:30 - 16:45	2	17	0	0	22	0	18	0	1	20
16:45 - 17:00	4	25	0	0	16	2	16	0	0	18
17:00 - 17:15	5	25	0	1	18	4	17	0	1	15
17:15 - 17:30	5	30	0	0	15	2	9	0	2	16
17:30 - 17:45	5	26	0	1	26	2	11	0	0	20
17:45 - 18:00	4	24	0	1	22	2	6	0	0	29

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE
ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 26/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	0	7	0	2	26	2	7	0	1	25
06:15 - 06:30	2	10	0	0	22	3	8	0	1	29
06:30 - 06:45	0	6	0	8	21	3	11	0	2	26
06:45 - 07:00	2	5	0	2	26	1	2	0	0	25
07:00 - 07:15	1	8	0	1	20	0	14	0	3	26
07:15 - 07:30	2	14	0	2	18	3	14	0	3	27
07:30 - 07:45	2	11	0	0	15	4	18	0	3	15
07:45 - 08:00	3	14	0	1	16	3	10	0	1	26
08:00 - 08:15	3	13	0	0	25	3	15	0	4	20
08:15 - 08:30	1	10	0	2	29	5	13	0	4	18
08:30 - 08:45	3	9	0	3	26	5	13	0	3	30
08:45 - 09:00	3	16	0	3	25	6	20	0	1	26
09:00 - 09:15	2	11	0	4	26	5	23	0	1	22
09:15 - 09:30	2	16	0	4	17	0	11	0	4	29
09:30 - 09:45	3	12	0	0	18	2	22	0	1	26
09:45 - 10:00	1	12	0	6	25	2	9	0	5	22
10:00 - 10:15	2	12	0	1	15	1	17	0	1	16
10:15 - 10:30	3	12	0	2	16	2	18	0	2	12
10:30 - 10:45	0	18	0	1	16	2	18	0	5	26
10:45 - 11:00	2	13	0	0	22	1	12	0	4	22
11:00 - 11:15	0	15	0	2	16	3	9	0	3	28
11:15 - 11:30	0	13	0	6	25	1	18	0	3	21
11:30 - 11:45	0	15	0	3	29	1	19	0	1	26
11:45 - 12:00	1	5	0	1	26	1	11	0	2	20
12:00 - 12:15	0	12	0	4	22	3	13	0	2	18
12:15 - 12:30	0	9	0	1	18	1	9	0	0	15
12:30 - 12:45	2	12	0	2	15	1	16	0	5	22
12:45 - 13:00	3	17	0	0	26	0	20	0	3	29
13:00 - 13:15	3	15	0	1	22	1	12	0	3	25
13:15 - 13:30	1	11	0	1	29	2	15	0	3	29
13:30 - 13:45	2	9	0	3	29	1	14	0	2	26
13:45 - 14:00	1	9	0	1	26	0	6	0	7	22
14:00 - 14:15	1	11	0	1	22	1	26	0	4	16
14:15 - 14:30	4	17	0	2	18	3	15	0	3	18
14:30 - 14:45	2	21	0	5	15	4	19	0	1	15
14:45 - 15:00	4	28	0	1	26	1	23	0	4	26
15:00 - 15:15	3	23	0	2	22	1	21	0	3	22
15:15 - 15:30	0	16	0	2	29	2	20	0	2	26
15:30 - 15:45	3	14	0	3	26	2	24	0	3	20
15:45 - 16:00	1	17	0	2	22	3	32	0	4	18
16:00 - 16:15	1	16	0	3	16	2	14	0	3	15
16:15 - 16:30	1	17	0	5	12	3	15	0	1	16
16:30 - 16:45	1	20	0	3	22	2	20	0	1	16
16:45 - 17:00	5	15	0	2	18	0	9	0	4	29
17:00 - 17:15	5	13	0	0	15	4	10	0	2	26
17:15 - 17:30	1	25	0	4	16	3	14	0	5	22
17:30 - 17:45	2	16	0	3	16	1	8	0	3	16
17:45 - 18:00	5	14	0	3	16	2	16	0	2	12

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 27/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	4	9	0	2	16	4	10	0	3	26
06:15 - 06:30	5	8	0	1	15	3	9	0	2	20
06:30 - 06:45	0	13	0	5	8	3	20	0	2	18
06:45 - 07:00	3	12	0	3	25	2	11	0	3	25
07:00 - 07:15	4	8	0	1	29	3	16	0	2	26
07:15 - 07:30	1	10	0	0	26	1	16	0	2	20
07:30 - 07:45	2	11	0	1	22	8	14	0	0	18
07:45 - 08:00	2	17	0	1	18	8	22	0	4	15
08:00 - 08:15	4	14	0	2	15	1	19	0	2	26
08:15 - 08:30	3	8	0	1	26	3	25	0	0	22
08:30 - 08:45	3	18	0	6	22	0	20	0	1	16
08:45 - 09:00	2	11	0	3	29	2	17	0	3	25
09:00 - 09:15	2	14	0	0	26	0	22	0	1	29
09:15 - 09:30	0	10	0	5	22	2	13	0	1	15
09:30 - 09:45	0	13	0	3	16	2	15	0	1	16
09:45 - 10:00	2	13	0	2	12	2	14	0	4	25
10:00 - 10:15	2	18	0	0	9	0	15	0	3	29
10:15 - 10:30	2	14	0	2	22	0	11	0	5	26
10:30 - 10:45	1	15	0	1	29	2	14	0	3	25
10:45 - 11:00	2	10	0	8	19	0	11	0	6	26
11:00 - 11:15	0	10	0	5	16	1	15	0	5	17
11:15 - 11:30	1	8	0	1	18	0	15	0	12	18
11:30 - 11:45	1	27	0	1	15	2	14	0	4	16
11:45 - 12:00	1	12	0	6	26	1	7	0	8	16
12:00 - 12:15	2	17	0	1	22	1	10	0	3	29
12:15 - 12:30	4	14	0	3	26	2	11	0	4	15
12:30 - 12:45	1	15	0	2	20	2	13	0	5	26
12:45 - 13:00	0	13	0	4	18	2	17	0	1	17
13:00 - 13:15	1	11	0	5	15	1	10	0	2	18
13:15 - 13:30	0	15	0	4	16	1	18	0	5	15
13:30 - 13:45	1	11	0	2	22	3	10	0	2	22
13:45 - 14:00	4	20	0	5	21	1	16	0	4	18
14:00 - 14:15	1	17	0	5	26	0	18	0	4	23
14:15 - 14:30	3	12	0	4	20	0	8	0	3	18
14:30 - 14:45	1	10	0	4	18	2	11	0	1	22
14:45 - 15:00	2	16	0	2	15	0	19	0	5	16
15:00 - 15:15	0	12	0	1	16	3	10	0	5	25
15:15 - 15:30	0	10	0	4	25	4	14	0	7	29
15:30 - 15:45	2	9	0	6	29	0	14	0	2	26
15:45 - 16:00	1	14	0	4	26	3	17	0	0	22
16:00 - 16:15	0	15	0	3	25	2	15	0	1	18
16:15 - 16:30	1	12	0	2	26	3	13	0	2	15
16:30 - 16:45	1	10	0	0	17	2	13	0	4	26
16:45 - 17:00	1	8	0	4	18	2	14	0	2	26
17:00 - 17:15	3	8	0	0	25	5	12	0	2	22
17:15 - 17:30	5	11	0	0	15	2	10	0	2	18
17:30 - 17:45	0	15	0	1	15	2	8	0	1	15
17:45 - 18:00	1	17	0	2	16	2	12	0	2	26

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE
ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 28/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	8	0	4	26	1	12	0	2	18
06:15 - 06:30	3	7	0	4	20	1	10	0	3	15
06:30 - 06:45	3	11	0	3	22	3	13	0	0	26
06:45 - 07:00	5	6	0	5	29	4	12	0	2	22
07:00 - 07:15	0	10	0	1	25	1	9	0	1	29
07:15 - 07:30	5	6	0	2	29	4	16	0	0	26
07:30 - 07:45	4	15	0	1	12	6	24	0	8	14
07:45 - 08:00	1	15	0	3	22	4	13	0	6	15
08:00 - 08:15	2	9	0	3	16	3	13	0	3	26
08:15 - 08:30	4	7	0	3	25	3	10	0	1	22
08:30 - 08:45	3	16	0	6	29	2	19	0	1	20
08:45 - 09:00	1	13	0	0	26	5	18	0	1	18
09:00 - 09:15	1	26	0	0	22	3	17	0	4	15
09:15 - 09:30	0	8	0	3	18	3	22	0	4	16
09:30 - 09:45	6	9	0	0	15	2	17	0	3	25
09:45 - 10:00	2	16	0	3	26	1	21	0	3	29
10:00 - 10:15	6	9	0	3	22	1	15	0	3	26
10:15 - 10:30	1	11	0	2	29	1	17	0	8	25
10:30 - 10:45	3	17	0	6	23	2	15	0	1	26
10:45 - 11:00	2	13	0	1	22	1	16	0	5	17
11:00 - 11:15	1	14	0	4	16	2	16	0	5	18
11:15 - 11:30	0	8	0	0	18	0	14	0	2	25
11:30 - 11:45	1	16	0	1	15	2	12	0	3	29
11:45 - 12:00	2	8	0	4	26	2	23	0	8	26
12:00 - 12:15	2	16	0	7	22	2	12	0	3	25
12:15 - 12:30	1	12	0	2	26	0	13	0	2	26
12:30 - 12:45	3	6	0	2	20	2	8	0	3	17
12:45 - 13:00	1	17	0	1	18	2	14	0	2	27
13:00 - 13:15	1	9	0	3	15	3	12	0	4	15
13:15 - 13:30	2	13	0	2	16	2	10	0	2	26
13:30 - 13:45	3	23	0	4	13	3	14	0	2	20
13:45 - 14:00	2	14	0	1	16	0	12	0	2	18
14:00 - 14:15	2	24	0	1	15	3	16	0	1	30
14:15 - 14:30	1	12	0	4	8	4	14	0	6	26
14:30 - 14:45	1	22	0	3	25	2	16	0	0	22
14:45 - 15:00	3	14	0	1	29	5	20	0	0	29
15:00 - 15:15	1	15	0	2	26	1	7	0	2	26
15:15 - 15:30	0	21	0	2	22	3	16	0	1	22
15:30 - 15:45	3	16	0	2	18	0	17	0	6	16
15:45 - 16:00	1	17	0	3	15	3	10	0	1	12
16:00 - 16:15	7	19	0	2	26	2	16	0	0	26
16:15 - 16:30	1	16	0	1	22	1	9	0	0	22
16:30 - 16:45	0	15	0	0	29	2	10	0	1	28
16:45 - 17:00	2	14	0	1	26	6	15	0	0	21
17:00 - 17:15	3	15	0	0	29	0	8	0	0	26
17:15 - 17:30	7	14	0	0	15	2	13	0	2	25
17:30 - 17:45	1	12	0	2	26	1	14	0	1	29
17:45 - 18:00	1	16	0	3	17	2	10	0	1	26

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 29/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	6	0	2	28	1	8	0	3	25
06:15 - 06:30	2	7	0	1	21	2	10	0	3	29
06:30 - 06:45	3	11	0	4	26	1	9	0	1	26
06:45 - 07:00	2	5	0	6	20	5	11	0	3	22
07:00 - 07:15	0	13	0	1	18	1	18	0	4	18
07:15 - 07:30	1	17	0	2	15	3	16	0	0	20
07:30 - 07:45	2	14	0	1	22	0	19	0	2	26
07:45 - 08:00	3	14	3	4	22	4	22	0	2	12
08:00 - 08:15	1	12	3	0	26	9	20	0	0	20
08:15 - 08:30	3	15	0	4	17	4	13	0	1	18
08:30 - 08:45	0	17	0	4	18	3	10	0	3	30
08:45 - 09:00	4	14	0	3	15	2	16	0	1	26
09:00 - 09:15	4	12	0	1	22	4	21	0	4	22
09:15 - 09:30	2	13	0	1	18	0	15	0	3	29
09:30 - 09:45	4	23	0	4	29	3	20	0	6	26
09:45 - 10:00	2	16	0	4	26	1	20	0	1	13
10:00 - 10:15	0	11	0	3	22	1	16	0	5	17
10:15 - 10:30	3	15	0	4	12	0	10	0	8	18
10:30 - 10:45	1	10	0	1	26	0	9	0	3	16
10:45 - 11:00	1	18	0	3	20	0	17	0	3	16
11:00 - 11:15	3	20	0	4	18	2	12	0	2	29
11:15 - 11:30	2	6	0	3	25	3	10	0	3	15
11:30 - 11:45	1	10	0	2	26	0	14	0	4	26
11:45 - 12:00	1	10	0	5	20	2	10	0	1	17
12:00 - 12:15	2	18	0	2	26	1	14	0	2	18
12:15 - 12:30	1	15	0	3	20	1	10	0	5	15
12:30 - 12:45	4	12	0	2	22	5	15	0	5	22
12:45 - 13:00	2	8	0	2	29	1	8	0	2	18
13:00 - 13:15	1	16	0	4	25	4	11	0	3	25
13:15 - 13:30	1	11	0	3	29	2	9	0	0	29
13:30 - 13:45	2	10	0	3	12	3	9	0	2	12
13:45 - 14:00	1	12	0	4	22	1	14	0	5	22
14:00 - 14:15	0	15	0	5	16	2	21	0	5	16
14:15 - 14:30	3	11	0	2	25	1	15	0	4	25
14:30 - 14:45	1	16	0	2	29	0	13	0	2	29
14:45 - 15:00	1	13	0	3	26	2	13	0	2	26
15:00 - 15:15	4	14	0	2	12	1	11	0	1	22
15:15 - 15:30	1	18	0	2	15	0	15	0	6	18
15:30 - 15:45	3	10	0	2	22	0	17	0	3	15
15:45 - 16:00	0	11	0	3	29	1	13	0	2	26
16:00 - 16:15	2	14	0	2	25	0	16	0	2	22
16:15 - 16:30	4	15	0	4	29	2	14	0	1	29
16:30 - 16:45	3	10	0	2	26	3	10	0	3	23
16:45 - 17:00	2	12	0	2	22	4	12	0	2	22
17:00 - 17:15	2	12	0	1	16	4	13	0	1	16
17:15 - 17:30	1	16	0	0	18	0	13	0	0	12
17:30 - 17:45	1	11	0	1	15	1	10	0	0	9
17:45 - 18:00	1	10	0	3	26	2	8	0	1	22

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 30/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	10	0	0	26	0	8	0	0	15
06:15 - 06:30	4	11	0	0	20	1	12	0	2	22
06:30 - 06:45	0	5	0	1	22	1	15	0	1	18
06:45 - 07:00	1	13	0	7	16	0	11	0	2	23
07:00 - 07:15	1	9	0	4	25	2	18	0	4	26
07:15 - 07:30	1	14	0	3	29	1	20	0	1	20
07:30 - 07:45	4	11	0	5	22	2	21	0	6	15
07:45 - 08:00	3	13	0	5	16	6	30	0	0	29
08:00 - 08:15	1	13	0	2	25	5	23	0	4	26
08:15 - 08:30	3	17	0	4	29	3	13	0	3	25
08:30 - 08:45	3	13	0	1	26	7	25	0	3	26
08:45 - 09:00	1	15	0	1	12	3	21	0	4	17
09:00 - 09:15	3	15	0	2	26	5	23	0	2	18
09:15 - 09:30	3	17	0	1	20	1	14	0	8	16
09:30 - 09:45	2	16	0	3	18	3	19	0	4	16
09:45 - 10:00	4	14	0	2	25	0	12	0	2	16
10:00 - 10:15	3	14	0	5	25	3	17	0	3	18
10:15 - 10:30	1	17	0	4	15	4	21	0	8	30
10:30 - 10:45	1	14	0	3	16	0	22	0	2	26
10:45 - 11:00	1	11	0	3	13	1	14	0	0	22
11:00 - 11:15	0	20	0	5	16	1	25	0	5	29
11:15 - 11:30	4	11	0	4	15	2	10	0	1	26
11:30 - 11:45	2	14	0	3	8	1	14	0	3	29
11:45 - 12:00	3	14	0	7	25	2	14	0	3	26
12:00 - 12:15	0	14	0	1	29	1	18	0	1	22
12:15 - 12:30	6	13	0	0	25	2	10	0	5	17
12:30 - 12:45	3	15	0	5	29	2	18	0	1	26
12:45 - 13:00	0	13	0	2	26	1	11	0	2	22
13:00 - 13:15	2	11	0	2	25	2	13	0	1	29
13:15 - 13:30	1	11	0	2	26	1	13	0	0	26
13:30 - 13:45	1	12	0	6	17	2	16	0	4	14
13:45 - 14:00	4	22	0	3	15	4	23	0	5	15
14:00 - 14:15	1	17	0	4	26	2	16	0	1	26
14:15 - 14:30	0	20	0	5	22	2	18	0	5	22
14:30 - 14:45	0	13	0	6	20	1	19	0	5	20
14:45 - 15:00	0	21	0	2	18	2	12	0	6	18
15:00 - 15:15	0	19	0	0	15	1	19	0	3	15
15:15 - 15:30	0	9	0	0	16	2	13	0	6	16
15:30 - 15:45	1	14	0	6	25	2	13	0	4	25
15:45 - 16:00	0	16	0	2	29	4	20	0	2	29
16:00 - 16:15	3	16	0	4	17	2	16	0	3	26
16:15 - 16:30	2	20	0	6	18	1	16	0	2	25
16:30 - 16:45	4	18	0	2	16	2	17	0	2	20
16:45 - 17:00	3	25	0	0	16	3	14	0	2	18
17:00 - 17:15	1	8	0	2	29	0	13	0	0	15
17:15 - 17:30	1	21	0	1	15	2	15	0	1	16
17:30 - 17:45	2	9	0	2	26	2	9	0	1	13
17:45 - 18:00	3	18	0	1	17	2	13	0	1	16

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE
ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-36B (Puno - Laraqueri)

FECHA: 31/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	8	0	1	15	1	7	0	1	20
06:15 - 06:30	2	10	0	4	26	3	11	0	2	18
06:30 - 06:45	0	5	0	2	22	1	11	0	0	25
06:45 - 07:00	0	8	0	3	20	4	7	0	3	26
07:00 - 07:15	2	8	0	1	18	4	19	0	4	20
07:15 - 07:30	3	7	0	2	15	1	14	0	4	17
07:30 - 07:45	5	10	0	3	16	3	18	0	4	29
07:45 - 08:00	4	18	0	6	23	3	24	0	4	15
08:00 - 08:15	3	21	0	6	25	1	14	0	0	26
08:15 - 08:30	4	13	0	4	29	3	19	0	2	17
08:30 - 08:45	2	13	0	3	12	1	15	0	7	18
08:45 - 09:00	1	20	0	2	22	5	22	0	3	15
09:00 - 09:15	2	17	0	1	16	2	31	0	3	22
09:15 - 09:30	4	18	0	1	25	3	24	0	1	18
09:30 - 09:45	2	20	0	4	29	0	22	0	0	15
09:45 - 10:00	2	22	0	4	26	4	9	0	5	16
10:00 - 10:15	1	26	0	1	22	2	15	0	3	25
10:15 - 10:30	1	21	0	2	18	2	20	0	5	29
10:30 - 10:45	2	15	0	3	15	1	13	0	7	26
10:45 - 11:00	1	16	0	3	21	0	17	0	1	25
11:00 - 11:15	1	19	0	3	16	3	17	0	4	26
11:15 - 11:30	4	11	0	4	25	3	18	0	3	16
11:30 - 11:45	1	12	0	3	29	0	18	0	2	16
11:45 - 12:00	1	13	0	1	22	1	11	0	3	25
12:00 - 12:15	3	18	0	1	16	2	21	0	2	29
12:15 - 12:30	3	17	0	0	25	1	21	0	0	26
12:30 - 12:45	2	14	0	2	29	2	16	0	3	12
12:45 - 13:00	2	18	0	1	20	0	11	0	1	26
13:00 - 13:15	0	13	0	1	22	3	15	0	2	20
13:15 - 13:30	0	12	0	1	12	4	15	0	2	18
13:30 - 13:45	3	11	0	1	26	1	18	0	3	25
13:45 - 14:00	1	19	0	3	20	0	19	0	0	25
14:00 - 14:15	1	17	0	2	18	3	17	0	2	15
14:15 - 14:30	1	15	0	1	25	2	15	0	1	20
14:30 - 14:45	0	19	0	1	26	4	19	0	4	22
14:45 - 15:00	5	16	0	0	20	1	20	0	1	29
15:00 - 15:15	3	13	0	0	26	1	22	0	3	25
15:15 - 15:30	0	13	0	0	20	2	22	0	3	29
15:30 - 15:45	1	10	0	1	22	4	21	0	0	12
15:45 - 16:00	2	21	0	4	29	2	20	0	1	22
16:00 - 16:15	2	19	0	0	25	2	20	0	4	16
16:15 - 16:30	5	27	0	3	29	1	13	0	0	25
16:30 - 16:45	0	16	0	4	12	2	13	0	1	29
16:45 - 17:00	1	13	0	3	20	1	21	0	1	26
17:00 - 17:15	3	21	0	1	16	0	19	0	2	12
17:15 - 17:30	3	9	0	1	25	1	14	0	3	15
17:30 - 17:45	1	23	0	3	29	5	11	0	1	22
17:45 - 18:00	2	7	0	0	20	2	8	0	2	29

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 25/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	8	0	0	8.5	2	14	0	2	8
06:15 - 06:30	0	10	0	1	9	2	15	0	3	11
06:30 - 06:45	1	9	0	2	8	3	20	0	1	10
06:45 - 07:00	0	12	0	2	12	2	17	0	2	10
07:00 - 07:15	1	14	0	0	5	3	18	0	4	8.3
07:15 - 07:30	1	23	0	3	10	4	30	0	1	10
07:30 - 07:45	1	28	0	0	10	3	34	0	0	8.5
07:45 - 08:00	0	22	0	2	9.5	4	39	0	2	9
08:00 - 08:15	1	23	0	1	12.3	1	35	0	1	8
08:15 - 08:30	2	23	0	2	10	2	49	0	3	12
08:30 - 08:45	2	35	0	0	9	3	47	0	2	8
08:45 - 09:00	0	29	0	1	9	2	53	0	1	11
09:00 - 09:15	0	18	0	1	8	2	43	0	1	12.3
09:15 - 09:30	1	31	0	1	11	6	49	0	3	10
09:30 - 09:45	0	28	0	1	10	2	50	0	2	10
09:45 - 10:00	2	22	0	0	10	2	59	0	3	11.5
10:00 - 10:15	2	29	0	4	12.7	1	66	0	2	7
10:15 - 10:30	0	33	0	1	9	2	60	0	1	10
10:30 - 10:45	0	31	0	0	0	2	55	0	2	8
10:45 - 11:00	1	35	0	3	12	1	48	0	3	12.5
11:00 - 11:15	3	36	0	2	12	1	48	0	1	0
11:15 - 11:30	3	41	0	3	9	6	60	0	2	15
11:30 - 11:45	0	41	0	0	8	0	53	0	1	9
11:45 - 12:00	0	42	0	0	11	4	43	0	3	15
12:00 - 12:15	2	49	0	2	10	1	49	0	1	10
12:15 - 12:30	1	44	0	0	8.5	2	45	0	1	8.5
12:30 - 12:45	1	47	0	1	9	2	51	0	2	9
12:45 - 13:00	1	32	0	1	11	5	55	0	3	12.3
13:00 - 13:15	5	38	0	2	10	0	39	0	2	10
13:15 - 13:30	1	40	5	3	8.5	2	41	0	3	9
13:30 - 13:45	1	26	0	1	11.5	2	41	0	0	9
13:45 - 14:00	6	45	0	2	7	3	57	0	2	8.5
14:00 - 14:15	1	48	0	4	18	0	50	0	4	9
14:15 - 14:30	4	28	0	0	11.5	1	41	0	2	11
14:30 - 14:45	4	32	0	2	7	1	45	0	4	10
14:45 - 15:00	1	35	0	5	10	3	48	0	1	8.5
15:00 - 15:15	0	37	0	1	0	0	46	0	2	11.5
15:15 - 15:30	2	35	0	3	12	0	48	0	3	10
15:30 - 15:45	1	32	0	1	12	1	42	0	5	8.5
15:45 - 16:00	2	28	0	1	9	1	45	0	2	11.5
16:00 - 16:15	3	33	0	1	10	3	55	0	1	10
16:15 - 16:30	1	42	0	1	18	0	70	0	1	7
16:30 - 16:45	2	61	0	2	10	2	53	0	4	8.5
16:45 - 17:00	3	57	0	2	8.5	3	48	0	0	11.5
17:00 - 17:15	5	63	0	1	9	0	42	0	1	7
17:15 - 17:30	4	42	0	1	8	3	55	0	3	18
17:30 - 17:45	1	57	0	7	11.5	2	63	0	4	11.5
17:45 - 18:00	2	76	0	0	7	2	41	0	2	7

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 26/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	35	0	5	11.5	1	50	0	3	12.3
06:15 - 06:30	3	38	0	2	7	0	65	0	0	10
06:30 - 06:45	1	41	0	3	10	2	70	0	3	9
06:45 - 07:00	3	43	0	3	8	3	80	0	6	9
07:00 - 07:15	4	43	0	4	12.5	2	85	0	7	8
07:15 - 07:30	7	37	0	4	12	0	70	0	4	7
07:30 - 07:45	2	35	0	2	8.5	5	59	0	5	12
07:45 - 08:00	3	31	0	3	13	1	84	0	8	17
08:00 - 08:15	3	49	0	10	11	2	69	0	4	10
08:15 - 08:30	2	45	0	4	10	2	90	0	3	10
08:30 - 08:45	1	36	0	7	10	4	84	0	1	11.5
08:45 - 09:00	2	39	0	7	9	2	62	0	3	8
09:00 - 09:15	1	45	0	6	11	2	87	0	5	11
09:15 - 09:30	1	45	0	1	10	1	83	0	3	10
09:30 - 09:45	5	53	0	3	10	2	85	0	4	8.5
09:45 - 10:00	0	47	0	9	25	4	75	0	0	9
10:00 - 10:15	1	28	0	4	5	6	91	0	2	9
10:15 - 10:30	3	51	0	4	10	4	105	0	5	9
10:30 - 10:45	1	43	0	4	10.5	0	86	0	5	8
10:45 - 11:00	2	50	0	4	12.3	2	68	0	7	11
11:00 - 11:15	0	48	0	4	10	2	90	0	7	10
11:15 - 11:30	3	47	0	9	9	0	72	0	6	10
11:30 - 11:45	5	56	0	5	9	1	76	0	6	12.7
11:45 - 12:00	2	47	0	6	8	4	82	0	3	9
12:00 - 12:15	2	53	0	5	11	2	87	0	5	10
12:15 - 12:30	2	50	0	5	10	1	58	0	6	8.5
12:30 - 12:45	5	65	0	7	10	0	40	0	2	11.5
12:45 - 13:00	1	46	0	4	12.7	1	62	0	4	7
13:00 - 13:15	3	62	0	6	9	2	34	0	1	18
13:15 - 13:30	3	51	0	5	0	1	57	0	4	11.5
13:30 - 13:45	2	55	0	6	12	0	52	0	2	7
13:45 - 14:00	1	58	0	4	12.7	2	60	0	6	10
14:00 - 14:15	1	48	0	3	9	2	56	0	5	10
14:15 - 14:30	4	57	0	9	37	0	66	0	7	8.5
14:30 - 14:45	0	64	0	3	15	1	70	0	5	9
14:45 - 15:00	1	54	0	7	22	3	65	0	3	12.3
15:00 - 15:15	4	66	0	5	10	2	61	0	3	10
15:15 - 15:30	2	68	0	4	8	2	53	0	8	8
15:30 - 15:45	1	70	0	3	12.5	1	53	0	12	11
15:45 - 16:00	3	63	0	5	0	0	56	0	8	10
16:00 - 16:15	3	69	0	6	10	0	70	0	6	15
16:15 - 16:30	2	67	0	5	11	2	58	0	4	10
16:30 - 16:45	5	62	0	8	10	4	48	0	5	8.5
16:45 - 17:00	1	73	0	6	8.5	3	43	0	4	9
17:00 - 17:15	5	88	0	5	11.5	0	55	0	3	12.3
17:15 - 17:30	4	70	0	3	7	2	41	0	6	10
17:30 - 17:45	1	81	0	2	18	1	61	0	9	8
17:45 - 18:00	3	92	0	10	11.5	3	51	0	5	11

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 27/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	10	0	3	11	2	15	0	2	9
06:15 - 06:30	1	15	0	3	12.3	1	20	0	1	9
06:30 - 06:45	1	14	0	4	10	0	28	0	1	9
06:45 - 07:00	0	16	0	5	10	0	35	0	3	8
07:00 - 07:15	3	37	0	3	11.5	4	49	0	2	11
07:15 - 07:30	8	44	0	9	10.5	3	66	0	10	10
07:30 - 07:45	7	42	0	5	10	1	55	0	3	10
07:45 - 08:00	2	49	0	6	10	2	46	0	3	12.7
08:00 - 08:15	2	42	0	9	8	2	34	0	3	9
08:15 - 08:30	0	48	0	13	18.5	2	65	0	1	8
08:30 - 08:45	2	49	0	9	15	2	59	0	6	11
08:45 - 09:00	1	50	0	6	12	3	70	0	0	7
09:00 - 09:15	3	53	0	8	12.3	4	64	0	7	8
09:15 - 09:30	1	56	0	10	10	1	51	0	5	7
09:30 - 09:45	1	57	0	9	9	2	60	0	2	12
09:45 - 10:00	5	62	0	5	10	3	50	0	9	17
10:00 - 10:15	2	61	0	4	12.7	1	68	0	7	10
10:15 - 10:30	1	48	0	9	9	4	57	0	8	10
10:30 - 10:45	3	44	0	4	0	1	61	0	6	11.5
10:45 - 11:00	2	51	0	6	12	1	49	0	2	8
11:00 - 11:15	1	41	0	3	12	2	59	0	3	11
11:15 - 11:30	4	37	0	9	9	0	54	0	7	10
11:30 - 11:45	6	37	0	6	8	2	53	0	3	8.5
11:45 - 12:00	2	42	0	5	11	2	58	0	6	9
12:00 - 12:15	3	54	0	6	10	2	61	0	1	10
12:15 - 12:30	2	29	0	6	8.5	0	54	0	3	10
12:30 - 12:45	1	52	0	5	9	0	59	0	8	9.5
12:45 - 13:00	2	38	0	4	11	1	60	0	4	12.3
13:00 - 13:15	2	39	0	7	12.5	4	44	0	6	10
13:15 - 13:30	1	31	0	4	12	2	44	0	6	9
13:30 - 13:45	0	33	0	6	8.5	0	51	0	3	9
13:45 - 14:00	3	61	0	11	13	4	53	0	6	8
14:00 - 14:15	2	41	0	2	11	2	49	0	7	11
14:15 - 14:30	1	37	0	7	10	2	57	0	7	10
14:30 - 14:45	1	52	0	3	10	4	55	0	6	10
14:45 - 15:00	3	42	0	7	9	3	54	0	5	12.7
15:00 - 15:15	0	46	0	8	11	2	50	0	6	9
15:15 - 15:30	2	40	0	3	10	0	61	0	13	0
15:30 - 15:45	1	47	0	7	10	6	58	0	9	12
15:45 - 16:00	4	45	0	3	25	1	51	0	6	12
16:00 - 16:15	3	56	0	6	5	2	78	0	5	9
16:15 - 16:30	1	49	0	5	10	1	45	0	9	8
16:30 - 16:45	1	51	0	3	10.5	1	50	0	5	9
16:45 - 17:00	0	63	0	9	8	5	45	0	11	8
17:00 - 17:15	2	49	0	4	11	0	46	0	4	11
17:15 - 17:30	1	45	0	0	10	2	51	0	6	10
17:30 - 17:45	1	53	0	11	15	5	45	0	5	10
17:45 - 18:00	0	33	0	7	14	4	27	0	3	12.7

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 28/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	21	0	2	10	1	29	0	2	10
06:15 - 06:30	3	29	0	1	10	2	34	0	3	12.7
06:30 - 06:45	3	30	0	3	25	3	44	0	3	9
06:45 - 07:00	2	35	0	5	5	3	51	0	6	10
07:00 - 07:15	4	31	0	2	10	5	56	0	0	8.5
07:15 - 07:30	5	42	0	13	10.5	0	57	0	6	11.5
07:30 - 07:45	5	44	0	7	12.3	2	65	0	7	7
07:45 - 08:00	1	52	0	10	10	2	56	0	5	18
08:00 - 08:15	5	40	0	8	9	4	60	0	5	11.5
08:15 - 08:30	0	57	0	7	9	1	69	0	7	7
08:30 - 08:45	5	39	0	3	8	2	67	0	2	10
08:45 - 09:00	4	47	0	11	11	2	72	0	5	10
09:00 - 09:15	3	49	0	10	10	1	63	0	4	8.5
09:15 - 09:30	1	45	0	5	10	2	65	0	5	9
09:30 - 09:45	0	64	0	8	12.7	0	61	0	4	12.3
09:45 - 10:00	1	52	0	7	9	3	63	0	6	10
10:00 - 10:15	0	55	0	8	0	2	56	0	6	8.3
10:15 - 10:30	0	39	0	8	12	5	66	0	3	10
10:30 - 10:45	2	48	0	5	11	2	61	0	6	8.5
10:45 - 11:00	1	61	0	3	12.3	3	59	0	7	9
11:00 - 11:15	8	41	0	0	10	5	60	0	5	13
11:15 - 11:30	3	51	0	6	10	2	56	0	7	10
11:30 - 11:45	1	48	0	10	11.5	2	54	0	6	11.5
11:45 - 12:00	1	57	0	5	10.5	0	57	0	5	8
12:00 - 12:15	0	39	0	3	10	2	55	0	2	11
12:15 - 12:30	2	38	0	10	10	1	35	0	5	10
12:30 - 12:45	4	48	0	9	8	0	62	0	5	8.5
12:45 - 13:00	1	56	0	8	18.5	0	56	0	3	9
13:00 - 13:15	1	37	0	4	15	2	64	0	7	9
13:15 - 13:30	3	43	0	6	12	2	54	0	2	9
13:30 - 13:45	2	49	0	5	12.3	1	54	0	12	8
13:45 - 14:00	3	51	0	6	10	2	62	0	2	11
14:00 - 14:15	3	39	0	4	9	2	67	0	7	10
14:15 - 14:30	1	44	0	10	10	1	60	0	8	10
14:30 - 14:45	2	49	0	3	12.7	4	68	0	12	12.7
14:45 - 15:00	5	57	0	5	11.5	2	62	0	5	9
15:00 - 15:15	4	41	0	8	7	2	67	0	8	10
15:15 - 15:30	4	47	0	10	10	1	53	0	8	8.5
15:30 - 15:45	2	50	0	3	8	1	58	0	7	12
15:45 - 16:00	0	36	0	4	12.5	1	35	0	4	17
16:00 - 16:15	1	60	0	15	0	1	66	0	7	10
16:15 - 16:30	1	55	0	5	15	2	60	0	4	10
16:30 - 16:45	2	47	0	2	9	2	52	0	5	11.5
16:45 - 17:00	1	78	0	5	15	4	55	0	4	8
17:00 - 17:15	4	56	0	9	10	4	66	0	5	11
17:15 - 17:30	0	21	0	0	8.5	0	23	0	4	10
17:30 - 17:45	1	25	0	7	9	1	25	0	3	8.5
17:45 - 18:00	5	30	0	5	12.3	1	20	0	3	9

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 29/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	33	0	5	11.5	2	40	0	4	9
06:15 - 06:30	1	35	0	5	7	1	41	0	6	10
06:30 - 06:45	1	34	0	8	10	2	54	0	5	8.5
06:45 - 07:00	1	37	0	4	8	0	56	0	5	11.5
07:00 - 07:15	1	38	0	2	12.5	4	49	0	5	7
07:15 - 07:30	3	54	0	8	12	1	73	0	6	18
07:30 - 07:45	6	64	0	5	8.5	0	63	0	5	9
07:45 - 08:00	2	60	0	9	13	4	86	0	3	9
08:00 - 08:15	3	69	0	9	11	2	63	0	4	9
08:15 - 08:30	3	68	0	9	10	5	66	0	3	8
08:30 - 08:45	4	69	0	11	10	5	74	0	5	11
08:45 - 09:00	2	66	0	5	9	4	81	0	6	10
09:00 - 09:15	1	59	0	7	11	5	64	0	9	9
09:15 - 09:30	1	69	0	11	10	1	88	0	5	9
09:30 - 09:45	1	40	0	2	10	3	92	0	7	8
09:45 - 10:00	3	90	0	11	25	4	61	0	5	11
10:00 - 10:15	1	80	0	11	5	3	71	0	8	10
10:15 - 10:30	2	75	0	4	10	3	82	0	8	10
10:30 - 10:45	1	68	0	3	10.5	0	83	0	7	12.7
10:45 - 11:00	2	45	0	7	12.3	1	65	0	10	9
11:00 - 11:15	1	61	0	6	10	2	71	0	5	9
11:15 - 11:30	4	59	0	8	9	2	57	0	10	8
11:30 - 11:45	1	67	0	4	9	0	57	0	9	11
11:45 - 12:00	2	58	0	11	8	0	65	0	6	10
12:00 - 12:15	3	76	0	6	11	1	58	0	8	10
12:15 - 12:30	3	67	0	6	10	1	65	0	6	12.7
12:30 - 12:45	1	54	0	9	10	2	63	0	9	9
12:45 - 13:00	1	49	0	12	12.7	3	61	0	10	0
13:00 - 13:15	2	46	0	7	9	2	88	0	9	12
13:15 - 13:30	2	70	0	9	0	2	78	0	3	11
13:30 - 13:45	0	61	0	8	12	3	82	0	7	12.3
13:45 - 14:00	0	64	0	6	12.7	1	73	0	11	10
14:00 - 14:15	1	66	0	5	9	2	74	0	3	10
14:15 - 14:30	2	65	0	5	37	3	91	0	3	10.5
14:30 - 14:45	2	49	0	8	15	2	70	0	7	12.3
14:45 - 15:00	1	48	0	1	22	1	81	0	5	10
15:00 - 15:15	0	57	0	10	10	1	53	0	5	9
15:15 - 15:30	0	60	0	6	8	2	85	0	11	12.3
15:30 - 15:45	2	46	0	10	12.5	4	89	0	10	10
15:45 - 16:00	1	61	0	3	0	2	75	0	9	9
16:00 - 16:15	0	50	0	7	10	3	60	0	8	10
16:15 - 16:30	2	47	0	6	11	3	54	0	6	12.7
16:30 - 16:45	2	32	0	4	10	2	52	0	6	11.5
16:45 - 17:00	1	65	0	4	8.5	0	68	0	2	7
17:00 - 17:15	0	48	0	8	11.5	1	48	0	3	10
17:15 - 17:30	0	42	0	3	7	2	35	0	4	8
17:30 - 17:45	3	39	0	4	18	0	36	0	4	12.5
17:45 - 18:00	0	38	0	6	11.5	3	37	0	2	0

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 30/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	2	40	0	3	10	0	41	0	5	9
06:15 - 06:30	1	42	0	2	12.7	1	46	0	5	0
06:30 - 06:45	1	40	0	5	9	0	50	0	7	12
06:45 - 07:00	1	46	0	4	0	1	52	0	5	11
07:00 - 07:15	2	21	0	9	12	5	48	0	3	12.3
07:15 - 07:30	8	34	0	7	12.7	3	64	0	8	10
07:30 - 07:45	3	39	0	5	9	1	57	0	6	10
07:45 - 08:00	1	42	0	8	37	4	51	0	7	11.5
08:00 - 08:15	4	39	0	8	15	2	55	0	4	10.5
08:15 - 08:30	0	36	0	11	22	1	55	0	3	10
08:30 - 08:45	1	46	0	10	10	1	71	0	5	10
08:45 - 09:00	1	39	0	4	8	3	62	0	6	8
09:00 - 09:15	0	61	0	8	12.5	1	78	0	8	18.5
09:15 - 09:30	2	55	0	11	0	1	66	0	7	15
09:30 - 09:45	1	33	0	4	5	1	73	0	4	9
09:45 - 10:00	0	42	0	7	10	1	77	0	4	9
10:00 - 10:15	3	46	0	12	10.5	0	88	0	6	8
10:15 - 10:30	2	37	0	11	12.3	2	91	0	9	11
10:30 - 10:45	2	48	0	13	10	2	77	0	6	10
10:45 - 11:00	2	41	0	6	9	2	72	0	4	10
11:00 - 11:15	0	65	0	11	9	1	61	0	12	12.7
11:15 - 11:30	1	59	0	9	15	1	61	0	9	9
11:30 - 11:45	1	45	0	7	22	1	63	0	6	10
11:45 - 12:00	1	50	0	4	10	0	62	0	5	8.5
12:00 - 12:15	3	67	0	10	8	3	74	0	12	12
12:15 - 12:30	0	65	0	7	12.5	1	49	0	7	8.5
12:30 - 12:45	4	47	0	7	0	1	60	0	7	9
12:45 - 13:00	3	50	0	9	10	4	63	0	10	12.3
13:00 - 13:15	0	45	0	8	11	1	68	0	6	10
13:15 - 13:30	1	45	0	7	10	4	58	0	8	8.3
13:30 - 13:45	2	46	0	5	8.5	1	64	0	4	10
13:45 - 14:00	2	37	0	6	10	3	63	0	9	8.5
14:00 - 14:15	0	50	0	13	8.5	1	62	0	10	9
14:15 - 14:30	1	39	0	2	9	3	73	0	6	13
14:30 - 14:45	0	55	0	7	9	2	73	0	7	10
14:45 - 15:00	3	60	0	4	9	1	84	0	17	11.5
15:00 - 15:15	3	45	0	5	8	3	92	0	9	8
15:15 - 15:30	1	42	0	3	11	5	83	0	10	11
15:30 - 15:45	2	57	0	7	10	1	60	0	6	10
15:45 - 16:00	2	56	0	2	10	2	62	0	11	8.5
16:00 - 16:15	1	47	0	12	12.7	2	76	0	12	9
16:15 - 16:30	0	46	0	1	9	0	55	0	11	9
16:30 - 16:45	5	60	0	7	10	5	70	0	8	9
16:45 - 17:00	0	58	0	4	25	3	52	0	7	8
17:00 - 17:15	0	46	0	5	5	0	50	0	13	9
17:15 - 17:30	0	66	0	6	10	0	52	0	15	10
17:30 - 17:45	2	44	0	4	10.5	0	63	0	11	12.7
17:45 - 18:00	5	60	0	6	12.3	3	46	0	10	11.5

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Juliaca)

FECHA: 31/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	1	10	0	3	10	0	20	0	5	8
06:15 - 06:30	0	17	0	3	8.3	1	28	0	5	11
06:30 - 06:45	1	18	0	4	10	0	27	0	5	10
06:45 - 07:00	3	19	0	6	8.5	5	35	0	4	10
07:00 - 07:15	1	36	0	6	9	3	55	0	5	12.7
07:15 - 07:30	2	45	0	13	13	0	68	0	10	9
07:30 - 07:45	1	31	0	11	10	2	61	0	6	0
07:45 - 08:00	4	43	0	8	11.5	1	58	0	4	12
08:00 - 08:15	2	33	0	9	8	4	40	0	7	12.7
08:15 - 08:30	3	37	0	6	11	0	66	0	4	9
08:30 - 08:45	2	38	0	3	10	3	55	0	15	37
08:45 - 09:00	0	50	0	8	8.5	1	62	0	6	15
09:00 - 09:15	3	39	0	7	9	1	51	0	6	22
09:15 - 09:30	3	39	0	6	9	1	60	0	7	10
09:30 - 09:45	1	46	0	13	9	3	54	0	5	8
09:45 - 10:00	0	35	0	6	8	2	60	0	6	12.5
10:00 - 10:15	2	37	0	5	11	2	80	0	7	0
10:15 - 10:30	1	48	0	5	10	5	51	0	5	10
10:30 - 10:45	0	46	0	5	25	5	73	0	6	8.5
10:45 - 11:00	2	46	0	5	5	4	51	0	9	11.5
11:00 - 11:15	3	45	0	7	10	2	67	0	12	7
11:15 - 11:30	2	40	0	10	10.5	5	62	0	3	18
11:30 - 11:45	3	41	0	6	12.3	2	71	0	6	9
11:45 - 12:00	2	42	0	8	10	1	60	0	6	9
12:00 - 12:15	2	49	0	11	9	2	72	0	6	9
12:15 - 12:30	1	61	0	5	9	3	60	0	6	8
12:30 - 12:45	1	54	0	4	8	4	40	0	8	11
12:45 - 13:00	1	47	0	4	10	4	66	0	6	10
13:00 - 13:15	1	54	0	9	10	3	55	0	7	9
13:15 - 13:30	7	48	0	3	10.5	2	65	0	6	9
13:30 - 13:45	0	51	0	9	12.3	1	56	0	8	8
13:45 - 14:00	1	47	0	5	10	5	54	0	7	11
14:00 - 14:15	4	41	0	2	9	1	83	0	9	10
14:15 - 14:30	1	49	0	5	12.3	4	73	0	8	12
14:30 - 14:45	0	60	0	8	10	0	60	0	6	11
14:45 - 15:00	2	47	0	5	9	2	50	0	5	12.3
15:00 - 15:15	0	47	0	8	10	3	53	0	3	10
15:15 - 15:30	6	45	0	5	12.7	2	68	0	11	10
15:30 - 15:45	2	50	0	2	11.5	2	63	0	9	11.5
15:45 - 16:00	2	40	0	4	8.5	1	64	0	7	10.5
16:00 - 16:15	1	59	0	4	9	3	58	0	11	10
16:15 - 16:30	2	47	0	5	9	2	71	0	8	10
16:30 - 16:45	1	57	0	4	9	2	61	0	6	8
16:45 - 17:00	2	52	0	2	8	2	54	0	8	18.5
17:00 - 17:15	4	46	0	6	11	2	54	0	6	15
17:15 - 17:30	2	67	0	3	10	2	49	0	8	9
17:30 - 17:45	1	55	0	4	10	3	51	0	5	9
17:45 - 18:00	3	48	0	4	12.7	1	42	0	2	8

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 25/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	3	20	0	2	20	5	54	0	2	20
06:15 - 06:30	7	30	0	2	22	7	51	0	1	23
06:30 - 06:45	10	28	0	3	22	7	48	0	4	20
06:45 - 07:00	8	36	0	5	23	8	45	0	4	10
07:00 - 07:15	6	38	0	4	20	6	56	0	5	20
07:15 - 07:30	7	33	0	4	23	4	57	0	5	18
07:30 - 07:45	4	35	0	2	20	5	63	0	6	18
07:45 - 08:00	7	44	0	1	10	6	85	0	3	20
08:00 - 08:15	10	49	0	6	20	5	82	0	4	18
08:15 - 08:30	7	41	0	4	18	6	66	0	6	20
08:30 - 08:45	4	67	0	6	18	10	88	0	2	25
08:45 - 09:00	9	52	0	4	20	5	104	0	5	18
09:00 - 09:15	7	56	0	3	18	14	82	0	4	24
09:15 - 09:30	8	51	0	8	18	11	101	0	4	20
09:30 - 09:45	5	58	0	5	20	6	97	0	5	19
09:45 - 10:00	6	67	0	9	22	5	92	0	3	20
10:00 - 10:15	5	69	0	4	22	11	104	0	3	17
10:15 - 10:30	1	71	0	5	23	11	120	0	3	22
10:30 - 10:45	7	74	0	8	20	8	110	0	9	18
10:45 - 11:00	4	64	0	10	23	8	107	0	4	35
11:00 - 11:15	4	65	0	2	19	8	105	0	6	26
11:15 - 11:30	4	80	0	5	20	5	115	0	5	18
11:30 - 11:45	5	83	0	15	17	5	126	0	5	20
11:45 - 12:00	4	77	0	7	22	2	110	0	1	22
12:00 - 12:15	3	78	0	3	18	3	115	0	1	22
12:15 - 12:30	2	61	0	8	35	5	95	0	4	23
12:30 - 12:45	3	70	0	7	26	6	89	0	5	20
12:45 - 13:00	3	82	0	9	22	8	83	0	7	23
13:00 - 13:15	6	60	0	4	19	6	81	0	4	19
13:15 - 13:30	3	77	0	0	20	5	96	0	2	20
13:30 - 13:45	4	70	0	3	17	5	91	0	4	28
13:45 - 14:00	3	69	0	2	22	5	87	0	4	20
14:00 - 14:15	3	71	0	4	18	5	80	0	3	28
14:15 - 14:30	2	76	0	2	35	6	91	0	8	31
14:30 - 14:45	5	84	0	4	26	8	89	0	0	26
14:45 - 15:00	2	85	0	5	18	11	66	0	4	22
15:00 - 15:15	6	81	1	2	20	3	73	0	7	19
15:15 - 15:30	4	97	0	5	17	2	72	0	6	20
15:30 - 15:45	11	88	0	4	22	4	89	0	2	17
15:45 - 16:00	6	80	0	3	19	9	70	0	0	23
16:00 - 16:15	3	130	0	1	19	1	74	0	1	19
16:15 - 16:30	6	95	0	5	20	1	71	0	2	20
16:30 - 16:45	4	109	0	2	17	2	74	0	6	17
16:45 - 17:00	1	145	0	9	22	3	55	0	3	22
17:00 - 17:15	1	136	0	14	60	0	46	0	3	18
17:15 - 17:30	0	120	0	5	18	0	47	0	1	35
17:30 - 17:45	0	137	0	0	20	0	60	0	1	26
17:45 - 18:00	7	136	0	3	22	4	66	0	1	22

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 26/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	4	45	0	3	20	3	35	0	1	18
06:15 - 06:30	9	58	0	2	19	6	50	0	2	20
06:30 - 06:45	6	62	0	2	25	1	40	0	0	25
06:45 - 07:00	16	64	0	4	20	5	37	0	4	20
07:00 - 07:15	15	61	0	3	18	8	37	0	2	22
07:15 - 07:30	6	55	0	3	15	5	40	0	3	22
07:30 - 07:45	9	65	0	8	22	13	49	0	4	20
07:45 - 08:00	16	63	0	6	22	4	48	0	6	20
08:00 - 08:15	11	67	0	9	23	12	51	0	4	20
08:15 - 08:30	11	59	0	6	20	10	54	0	5	23
08:30 - 08:45	13	50	0	4	23	4	55	0	6	25
08:45 - 09:00	15	63	0	4	19	8	44	0	5	15
09:00 - 09:15	5	67	0	8	20	8	49	0	5	24
09:15 - 09:30	12	54	0	5	28	7	50	0	5	20
09:30 - 09:45	6	77	0	4	20	11	58	0	4	19
09:45 - 10:00	10	72	0	5	19	8	48	0	9	20
10:00 - 10:15	11	48	0	6	20	6	46	0	8	10
10:15 - 10:30	10	59	0	5	17	11	68	0	5	23
10:30 - 10:45	6	49	0	4	22	7	53	0	6	18
10:45 - 11:00	8	55	0	5	35	4	54	0	4	20
11:00 - 11:15	7	62	0	5	20	8	57	0	4	18
11:15 - 11:30	10	51	0	6	18	10	42	0	2	18
11:30 - 11:45	6	53	0	6	18	9	43	0	4	20
11:45 - 12:00	6	43	0	2	20	6	44	0	8	22
12:00 - 12:15	20	42	0	3	18	4	37	0	4	23
12:15 - 12:30	10	35	0	3	18	4	37	0	8	19
12:30 - 12:45	6	29	0	7	20	11	47	0	3	20
12:45 - 13:00	6	47	0	1	22	11	58	0	6	28
13:00 - 13:15	5	48	0	8	22	10	48	0	3	20
13:15 - 13:30	6	46	0	4	23	10	41	0	2	19
13:30 - 13:45	8	41	0	6	20	5	57	0	5	20
13:45 - 14:00	7	47	0	2	23	7	60	0	8	17
14:00 - 14:15	5	67	0	8	18	10	61	0	5	17
14:15 - 14:30	8	49	0	5	20	4	63	0	4	19
14:30 - 14:45	3	58	0	8	25	5	57	0	8	19
14:45 - 15:00	2	63	0	4	18	11	63	0	5	20
15:00 - 15:15	8	61	0	4	24	10	58	0	7	17
15:15 - 15:30	7	63	0	3	20	11	57	0	2	22
15:30 - 15:45	10	67	0	8	19	12	50	0	2	60
15:45 - 16:00	7	59	0	5	20	6	47	0	4	18
16:00 - 16:15	7	44	0	1	20	8	58	0	3	20
16:15 - 16:30	8	55	0	5	23	8	52	0	8	22
16:30 - 16:45	4	57	0	6	20	8	54	0	6	18
16:45 - 17:00	10	77	0	6	10	7	53	0	8	17
17:00 - 17:15	10	57	0	5	20	9	58	0	6	18
17:15 - 17:30	9	48	0	8	18	6	56	0	4	18
17:30 - 17:45	14	69	0	4	18	11	53	0	11	20
17:45 - 18:00	10	72	0	5	20	16	54	0	4	22

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 27/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	3	38	0	2	18	3	25	0	2	18
06:15 - 06:30	10	54	0	2	18	8	44	0	4	18
06:30 - 06:45	20	61	0	3	20	8	31	0	3	20
06:45 - 07:00	9	60	1	3	22	9	50	0	4	22
07:00 - 07:15	9	50	0	4	22	9	38	0	3	23
07:15 - 07:30	20	78	0	7	23	7	58	0	2	22
07:30 - 07:45	13	64	0	6	20	8	45	0	7	22
07:45 - 08:00	20	65	0	10	23	8	59	0	7	20
08:00 - 08:15	18	70	0	11	16	13	59	0	2	17
08:15 - 08:30	15	93	0	7	20	8	51	0	9	20
08:30 - 08:45	16	60	0	5	23	13	58	0	6	10
08:45 - 09:00	16	60	0	5	20	8	59	0	10	20
09:00 - 09:15	9	49	0	5	10	7	43	0	8	18
09:15 - 09:30	13	64	0	4	20	7	66	0	8	27
09:30 - 09:45	10	83	0	7	18	8	40	0	9	22
09:45 - 10:00	5	56	0	4	18	9	53	0	12	23
10:00 - 10:15	12	71	0	12	25	11	52	0	9	17
10:15 - 10:30	8	40	0	7	40	5	55	0	6	22
10:30 - 10:45	7	59	0	7	20	8	59	0	6	18
10:45 - 11:00	10	50	0	10	10	6	43	0	10	35
11:00 - 11:15	8	52	0	9	20	10	56	0	6	26
11:15 - 11:30	9	42	0	7	18	12	47	0	6	18
11:30 - 11:45	14	41	0	7	18	7	46	0	7	20
11:45 - 12:00	5	52	0	10	20	6	58	0	10	22
12:00 - 12:15	2	46	0	4	18	12	50	0	10	22
12:15 - 12:30	8	47	0	4	19	8	63	0	0	20
12:30 - 12:45	11	43	0	5	25	10	54	0	5	20
12:45 - 13:00	6	51	0	10	20	8	62	0	3	20
13:00 - 13:15	5	49	0	3	18	11	85	0	7	23
13:15 - 13:30	6	38	0	7	15	6	76	0	10	25
13:30 - 13:45	6	70	0	5	22	7	67	0	7	15
13:45 - 14:00	4	56	0	10	22	11	46	0	14	24
14:00 - 14:15	4	57	0	9	23	13	57	0	9	20
14:15 - 14:30	4	43	0	8	20	10	65	0	6	19
14:30 - 14:45	15	60	0	8	23	5	56	0	11	20
14:45 - 15:00	9	56	0	8	19	8	53	0	8	10
15:00 - 15:15	7	48	0	4	20	8	42	0	10	23
15:15 - 15:30	4	50	0	6	28	7	65	0	6	18
15:30 - 15:45	10	72	0	9	20	9	49	0	9	20
15:45 - 16:00	7	64	0	5	19	8	65	0	4	35
16:00 - 16:15	10	69	0	10	20	9	65	0	6	20
16:15 - 16:30	4	91	0	8	17	4	50	0	4	18
16:30 - 16:45	6	58	0	1	22	4	71	0	14	18
16:45 - 17:00	5	65	0	8	35	2	53	0	7	20
17:00 - 17:15	4	69	0	5	20	7	60	0	7	18
17:15 - 17:30	10	91	0	8	18	7	65	0	9	18
17:30 - 17:45	8	97	0	9	18	9	79	0	10	20
17:45 - 18:00	6	93	0	7	20	8	77	0	11	22

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 28/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	5	37	0	4	10	2	39	0	3	20
06:15 - 06:30	8	40	0	5	20	3	48	0	6	23
06:30 - 06:45	13	43	0	7	18	4	47	0	10	25
06:45 - 07:00	13	59	1	4	18	5	47	0	5	15
07:00 - 07:15	18	76	0	4	20	4	61	0	4	24
07:15 - 07:30	10	77	0	8	18	14	61	0	5	20
07:30 - 07:45	16	87	0	7	20	10	56	0	10	19
07:45 - 08:00	12	73	0	3	25	9	77	0	5	20
08:00 - 08:15	14	79	0	7	18	10	49	0	4	10
08:15 - 08:30	11	80	0	7	24	10	67	0	8	23
08:30 - 08:45	12	70	0	7	20	10	61	0	7	18
08:45 - 09:00	11	77	0	6	19	7	61	0	9	20
09:00 - 09:15	9	79	0	9	20	5	74	0	12	27
09:15 - 09:30	9	80	1	5	17	10	58	0	12	16
09:30 - 09:45	5	80	0	7	22	6	59	0	7	30
09:45 - 10:00	6	67	0	8	18	4	43	0	4	20
10:00 - 10:15	4	58	0	7	35	4	55	0	9	18
10:15 - 10:30	7	58	0	9	26	7	66	0	7	20
10:30 - 10:45	6	58	0	3	18	6	60	0	11	28
10:45 - 11:00	5	54	0	4	22	5	47	0	8	10
11:00 - 11:15	13	66	0	11	23	9	53	0	5	20
11:15 - 11:30	4	51	0	8	20	5	66	0	4	18
11:30 - 11:45	9	44	0	7	23	8	54	0	8	18
11:45 - 12:00	5	56	0	7	19	6	49	0	6	25
12:00 - 12:15	7	52	0	5	20	15	68	0	3	40
12:15 - 12:30	7	67	0	8	28	8	53	0	6	20
12:30 - 12:45	6	52	0	10	20	10	63	0	6	10
12:45 - 13:00	5	42	0	5	28	10	65	0	5	20
13:00 - 13:15	8	66	0	4	31	11	66	0	5	18
13:15 - 13:30	5	59	0	7	26	6	67	0	9	18
13:30 - 13:45	5	48	0	6	22	11	54	0	9	20
13:45 - 14:00	6	57	0	5	19	5	71	0	13	18
14:00 - 14:15	4	64	0	5	20	7	61	0	7	19
14:15 - 14:30	6	59	0	7	17	10	59	0	4	25
14:30 - 14:45	8	46	0	5	23	12	60	0	8	20
14:45 - 15:00	5	60	0	6	19	10	82	0	9	18
15:00 - 15:15	10	70	0	11	20	5	54	0	6	15
15:15 - 15:30	13	63	0	4	17	6	83	0	9	22
15:30 - 15:45	5	67	0	9	22	9	60	0	7	22
15:45 - 16:00	10	71	0	8	18	5	67	0	13	23
16:00 - 16:15	13	73	0	6	18	9	84	0	7	17
16:15 - 16:30	14	89	0	10	19	15	65	0	16	22
16:30 - 16:45	9	87	0	7	25	6	90	0	12	18
16:45 - 17:00	8	69	0	12	20	5	79	0	6	35
17:00 - 17:15	6	85	0	19	18	4	89	0	6	26
17:15 - 17:30	5	83	0	9	15	5	56	0	7	18
17:30 - 17:45	2	91	0	6	22	5	86	0	8	20
17:45 - 18:00	6	72	0	9	22	6	82	0	7	22

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 29/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	4	51	0	6	17	4	36	0	7	18
06:15 - 06:30	12	71	0	4	20	5	38	1	5	19
06:30 - 06:45	13	65	0	4	10	15	51	0	4	25
06:45 - 07:00	12	75	0	7	30	11	65	0	6	20
07:00 - 07:15	15	87	0	7	17	12	62	0	11	18
07:15 - 07:30	11	69	0	6	20	9	68	0	6	15
07:30 - 07:45	13	95	0	10	10	13	65	0	7	22
07:45 - 08:00	18	94	0	6	20	10	71	0	2	22
08:00 - 08:15	17	104	0	14	18	4	60	0	5	23
08:15 - 08:30	14	105	0	14	27	12	72	0	5	20
08:30 - 08:45	16	87	0	6	22	3	58	0	7	23
08:45 - 09:00	11	83	0	4	23	10	73	0	8	19
09:00 - 09:15	5	82	0	11	17	6	54	0	5	20
09:15 - 09:30	3	73	0	6	22	3	63	0	8	28
09:30 - 09:45	8	65	0	5	18	10	61	0	7	20
09:45 - 10:00	3	74	1	11	35	6	54	0	7	19
10:00 - 10:15	13	81	0	11	26	4	52	0	6	20
10:15 - 10:30	6	93	0	9	18	3	64	0	11	17
10:30 - 10:45	7	77	0	11	20	3	61	0	8	10
10:45 - 11:00	7	67	0	9	22	8	70	1	7	20
11:00 - 11:15	10	70	0	11	22	7	57	0	8	18
11:15 - 11:30	5	65	0	6	20	7	60	0	9	27
11:30 - 11:45	3	70	0	7	10	4	69	0	6	22
11:45 - 12:00	3	67	0	9	23	10	67	0	10	20
12:00 - 12:15	7	59	0	8	18	3	55	0	10	23
12:15 - 12:30	9	49	0	7	20	6	70	0	9	19
12:30 - 12:45	7	71	0	9	27	9	95	0	12	20
12:45 - 13:00	4	55	0	6	16	9	77	0	9	28
13:00 - 13:15	5	65	0	7	30	5	74	0	11	20
13:15 - 13:30	2	61	0	5	20	5	82	0	9	28
13:30 - 13:45	4	56	0	8	18	6	87	0	8	31
13:45 - 14:00	3	70	0	3	20	6	74	0	10	26
14:00 - 14:15	2	52	0	7	28	8	65	0	6	22
14:15 - 14:30	8	65	0	8	10	8	79	0	9	19
14:30 - 14:45	5	62	0	4	20	10	85	0	14	20
14:45 - 15:00	10	89	0	9	18	8	68	0	10	17
15:00 - 15:15	10	85	0	9	18	10	85	0	3	23
15:15 - 15:30	6	71	0	5	25	4	68	0	9	19
15:30 - 15:45	5	81	1	9	40	7	80	0	8	20
15:45 - 16:00	5	75	0	8	20	2	84	0	4	17
16:00 - 16:15	6	86	0	2	10	7	77	0	3	22
16:15 - 16:30	8	80	0	11	19	8	78	0	9	20
16:30 - 16:45	10	91	0	8	20	11	74	0	6	10
16:45 - 17:00	10	82	0	5	28	11	68	0	6	20
17:00 - 17:15	8	95	0	9	20	5	81	0	7	18
17:15 - 17:30	6	87	0	4	28	7	77	0	5	18
17:30 - 17:45	7	103	0	10	31	8	94	0	12	20
17:45 - 18:00	5	95	0	5	26	6	85	0	8	18

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 30/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	4	70	0	2	25	3	65	0	6	18
06:15 - 06:30	10	75	0	4	40	6	62	0	8	27
06:30 - 06:45	14	72	0	3	20	9	59	0	10	22
06:45 - 07:00	10	68	0	7	10	5	65	0	6	23
07:00 - 07:15	10	62	0	9	19	4	63	0	7	17
07:15 - 07:30	7	75	0	7	20	10	68	0	12	22
07:30 - 07:45	7	71	0	10	28	6	68	0	9	18
07:45 - 08:00	24	87	0	8	20	13	62	0	8	35
08:00 - 08:15	11	82	0	13	28	8	81	1	14	26
08:15 - 08:30	7	91	0	15	23	9	64	0	9	18
08:30 - 08:45	8	89	0	7	19	10	62	0	14	20
08:45 - 09:00	10	73	0	8	20	12	64	0	10	22
09:00 - 09:15	10	81	0	10	28	6	70	0	7	29
09:15 - 09:30	9	70	0	4	20	11	65	0	8	10
09:30 - 09:45	7	86	0	12	28	10	76	0	11	25
09:45 - 10:00	8	88	0	7	31	8	74	0	15	17
10:00 - 10:15	10	90	0	9	26	3	77	0	6	20
10:15 - 10:30	5	75	0	8	35	9	78	0	12	10
10:30 - 10:45	8	72	0	7	20	9	66	0	9	30
10:45 - 11:00	9	58	0	9	10	10	70	0	11	17
11:00 - 11:15	5	79	0	5	20	11	71	0	8	20
11:15 - 11:30	5	71	0	11	18	7	69	0	8	10
11:30 - 11:45	6	66	0	9	35	13	68	0	17	20
11:45 - 12:00	11	79	0	12	26	7	72	0	10	18
12:00 - 12:15	7	66	0	7	18	9	70	0	13	27
12:15 - 12:30	4	67	0	10	20	9	78	0	10	22
12:30 - 12:45	12	86	0	13	22	8	88	0	5	23
12:45 - 13:00	11	65	0	12	22	10	72	0	12	17
13:00 - 13:15	10	67	0	5	20	15	85	0	6	22
13:15 - 13:30	9	93	0	10	10	10	76	0	5	18
13:30 - 13:45	4	69	0	5	23	9	77	0	6	35
13:45 - 14:00	5	82	0	9	18	9	84	0	7	26
14:00 - 14:15	9	78	0	13	20	11	74	0	11	18
14:15 - 14:30	2	94	0	11	27	6	89	0	10	20
14:30 - 14:45	5	67	0	5	16	7	74	0	11	22
14:45 - 15:00	8	91	0	9	22	2	88	0	5	22
15:00 - 15:15	7	90	0	11	20	3	77	0	7	20
15:15 - 15:30	5	91	0	7	10	11	76	0	4	20
15:30 - 15:45	6	88	0	11	23	9	91	0	8	28
15:45 - 16:00	9	82	0	5	18	4	98	0	8	22
16:00 - 16:15	7	100	0	17	20	4	72	0	14	23
16:15 - 16:30	5	82	0	10	27	9	71	0	6	20
16:30 - 16:45	4	68	0	10	16	10	84	0	10	23
16:45 - 17:00	6	92	0	19	30	6	72	0	15	19
17:00 - 17:15	5	85	0	10	20	7	76	0	8	20
17:15 - 17:30	10	75	0	6	18	9	92	0	6	28
17:30 - 17:45	7	87	0	6	10	5	93	0	6	20
17:45 - 18:00	11	100	0	14	20	3	79	0	12	19

UNIVERSIDAD NACIONAL DEL ALTIPLANO - PUNO

"CONDICIONES OPERATIVAS QUE INCIDEN EN LA CAPACIDAD Y NIVELES DE SERVICIO DE LAS VIAS DE ACCESO A LA CIUDAD DE PUNO PE-36B Y PE-3S - 2022"

Anexo 01: Ficha para aforo de tránsito y velocidad mediante observación simple

RUTA DE ESTUDIO: PE-3S (Puno - Ilave)

FECHA: 31/Diciembre/2022

Periodo de Tiempo	CARRIL DE ENTRADA				CARRIL DE SALIDA					
	Motos	Ligeros	Recreat.	Pesados	Tiempo	Motos	Ligeros	Recreat.	Pesados	Tiempo
06:00 - 06:15	6	64	0	5	16	4	50	0	7	20
06:15 - 06:30	9	75	0	4	30	8	61	0	7	28
06:30 - 06:45	11	80	0	6	20	13	67	0	8	10
06:45 - 07:00	19	83	0	7	18	8	71	0	5	20
07:00 - 07:15	11	103	0	14	20	13	71	0	6	18
07:15 - 07:30	9	75	0	8	28	13	74	0	13	18
07:30 - 07:45	17	100	0	21	10	7	49	0	12	25
07:45 - 08:00	6	89	0	5	20	8	55	0	6	40
08:00 - 08:15	16	89	0	8	18	9	74	0	11	20
08:15 - 08:30	6	93	0	5	18	15	92	0	5	10
08:30 - 08:45	13	91	0	13	25	5	62	0	12	20
08:45 - 09:00	2	90	0	3	40	4	67	0	13	18
09:00 - 09:15	17	96	0	12	20	10	81	0	10	18
09:15 - 09:30	1	73	0	7	10	4	82	0	10	20
09:30 - 09:45	5	78	0	8	20	5	74	0	9	18
09:45 - 10:00	6	96	1	8	18	6	103	0	10	19
10:00 - 10:15	6	105	0	9	18	6	66	0	10	25
10:15 - 10:30	3	88	0	9	20	10	93	0	3	20
10:30 - 10:45	11	96	0	7	18	6	92	0	11	18
10:45 - 11:00	8	93	0	10	19	8	78	0	10	15
11:00 - 11:15	5	92	0	6	25	6	94	0	7	22
11:15 - 11:30	3	83	0	9	20	8	66	0	3	22
11:30 - 11:45	13	92	0	13	18	9	77	0	4	23
11:45 - 12:00	5	59	0	11	15	6	111	0	9	20
12:00 - 12:15	6	75	0	6	10	4	102	0	5	18
12:15 - 12:30	13	89	0	6	20	6	85	0	10	27
12:30 - 12:45	3	71	0	11	18	7	100	0	12	22
12:45 - 13:00	7	71	0	8	18	11	95	0	8	20
13:00 - 13:15	3	75	0	8	20	6	91	1	6	23
13:15 - 13:30	8	70	0	8	18	9	104	0	15	19
13:30 - 13:45	6	76	0	9	20	8	85	0	9	20
13:45 - 14:00	3	76	0	11	25	5	90	0	7	28
14:00 - 14:15	4	73	0	7	18	5	116	0	11	20
14:15 - 14:30	5	104	0	6	24	4	100	0	4	28
14:30 - 14:45	7	82	0	10	20	10	74	0	5	31
14:45 - 15:00	5	108	0	11	19	5	100	0	14	26
15:00 - 15:15	5	91	0	7	20	8	90	0	9	22
15:15 - 15:30	8	99	0	7	17	6	108	0	2	23
15:30 - 15:45	2	98	0	9	22	7	92	0	7	25
15:45 - 16:00	2	121	0	9	18	7	89	0	6	15
16:00 - 16:15	9	99	0	7	35	6	106	0	14	24
16:15 - 16:30	9	79	0	5	26	4	81	0	5	20
16:30 - 16:45	13	119	0	11	20	7	102	0	6	19
16:45 - 17:00	4	120	0	7	19	12	99	1	6	20
17:00 - 17:15	6	116	0	8	20	5	102	0	10	20
17:15 - 17:30	5	117	0	8	17	6	105	0	9	28
17:30 - 17:45	2	105	0	7	10	3	97	0	5	31
17:45 - 18:00	7	121	0	5	20	4	92	0	7	26

ANEXO 02:
**ANÁLISIS HCM 2016 PARA LA VÍA PE-36B (PUNO –
LARAQUERI)**

Anexo 02 - Análisis HCM 2016 para la vía PE-36B (Puno - Laraqueri) - Condiciones Reales

VIA PE-36B (SALIDA A LARAQUERI)			Día en análisis	30/12/2022	VIE
CARRETERA DE DOS CARRILES CLASE II			Máx demanda	61	
	C. Entrada	C. Salida	Hora máx. demanda	13:00	
Vehiculos Ligeros	26	27	1er Intervalo	13:00 - 13:15	31
Vehiculos Recreativos	0	0	2do intervalo	13:15 - 13:30	28
Vehiculos Pesados	3	5	3er intervalo	13:30 - 13:45	41
Ancho de carril (ft)	11.25	11.15	4to intervalo	13:45 - 14:00	61
Ancho de Berma (ft)	5.84	4.20	Volumen horario total	$V = 31 + 28 + 41 + 61 = 161$	
Pendiente (%)	-2.73	2.73	Demanda de circ. punta	$Q15 = 4 \times 61 = 244$	
% restricción de adelantamiento	40.00	30.00	Factor de Hora Pico	$FHP = V/Q15 = 161/244$ 0.66	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 39.9 \text{ mi/h}$$

$$FFS = 39.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 116$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.1(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.926$$

$$V_{E.ATS} = \frac{116}{0.66 \times 1.00 \times 0.926}$$

$$V_{E.ATS} = 190 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.5$$

$$ATS_E = 39.9 - 0.00776(190 + 219) - 1.5$$

$$ATS_E = 35.2 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 31.9 \text{ mi/h}$$

$$FFS = 31.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 128$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.16(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.887$$

$$V_{S.ATS} = \frac{128}{0.66 \times 1.00 \times 0.887}$$

$$V_{S.ATS} = 219 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.2$$

$$ATS_E = 31.9 - 0.00776(219 + 190) - 1.2$$

$$ATS_E = 27.5 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.1(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.990$$

$$V_{E,PTSF} = \frac{116}{0.66 \times 1.00 \times 0.990}$$

$$V_{E,PTSF} = 178 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.16(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.984$$

$$V_{S,PTSF} = \frac{128}{0.66 \times 1.00 \times 0.984}$$

$$V_{S,PTSF} = 197 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

$$f_{np,PTSF} = 51.2$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_E = 100(1 - e^{(-0.0014 \times 178^{0.973})})$$

$$BPTSF_E = 19.5 \quad \%$$

$$PTSF_E = 19.5 + (51.2 \times 178) / (178 + 197)$$

$$PTSF_E = 43.8 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

Distribución porcentual del trafico (E/S) = 48/52

$$f_{np,PTSF} = 44.9$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_S = 100(1 - e^{(-0.0014 \times 197^{0.973})})$$

$$BPTSF_S = 21.3 \quad \%$$

$$PTSF_S = 21.3 + (44.9 \times 197) / (197 + 178)$$

$$PTSF_S = 44.9 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{35.2}{39.9}$$

$$PFFS = 88.2 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{27.5}{31.9}$$

$$PFFS = 86.2 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.1(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.1(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 48.00\%$$

$$\% \text{ Carril}_S = 52.00\%$$

$$C_E = 1536$$

$$C_S = 1664$$

$$C_T = 3200$$

$$N. S. = B$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.16(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.16(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{S.PTSF} = 1700$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 52.00\%$$

$$\% \text{ Carril}_E = 48.00\%$$

$$C_E = 1536$$

$$C_S = 1664$$

$$C_T = 3200$$

$$N. S. = B$$

Anexo 02 - Análisis HCM 2016 para la vía PE-36B (Puno - Laraqueri) - Sin vehículos pesados

VIA PE-36B (SALIDA A LARAQUERI)			Día en análisis	30/12/2022	VIE
CARRETERA DE DOS CARRILES CLASE II			Máx demanda	61	
	C. Entrada	C. Salida	Hora máx. demanda	13:00	
Vehículos Ligeros	29	32	1er Intervalo	13:00 - 13:15	31
Vehículos Recreativos	0	0	2do intervalo	13:15 - 13:30	28
Vehículos Pesados	0	0	3er intervalo	13:30 - 13:45	41
Ancho de carril (ft)	11.25	11.15	4to intervalo	13:45 - 14:00	61
Ancho de Berma (ft)	5.84	4.20	Volumen horario total	V = 31 + 28 + 41 + 61 = 161	
Pendiente (%)	-2.73	2.73	Demanda de circ. punta	Q15 = 4 x 61 = 244	
% restricción de adelantamiento	40.00	30.00	Factor de Hora Pico	FHP = V/Q15 = 161/244 0.66	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 39.9 \text{ mi/h}$$

$$FFS = 39.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 116$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 1$$

$$V_{E.ATS} = \frac{116}{0.66 \times 1.00 \times 1.000}$$

$$V_{E.ATS} = 176 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.5$$

$$ATS_E = 39.9 - 0.00776(176 + 194) - 1.5$$

$$ATS_E = 35.5 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 31.9 \text{ mi/h}$$

$$FFS = 31.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 128$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 1.000$$

$$V_{S.ATS} = \frac{128}{0.66 \times 1.00 \times 1.000}$$

$$V_{S.ATS} = 194 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.2$$

$$ATS_E = 31.9 - 0.00776(194 + 176) - 1.2$$

$$ATS_E = 27.8 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 1.000$$

$$V_{E,PTSF} = \frac{116}{0.66 \times 1.00 \times 1.000}$$

$$V_{E,PTSF} = 176 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 1.000$$

$$V_{S,PTSF} = \frac{128}{0.66 \times 1.00 \times 1.000}$$

$$V_{S,PTSF} = 194 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

$$f_{np,PTSF} = 50.1$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_E = 100(1 - e^{(-0.0014 \times 176^{0.973})})$$

$$BPTSF_E = 19.3 \quad \%$$

$$PTSF_E = 19.3 + (50.1 \times 176) / (176 + 194)$$

$$PTSF_E = 43.1 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

Distribución porcentual del trafico (E/S) = 48/52

$$f_{np,PTSF} = 44.7$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_S = 100(1 - e^{(-0.0014 \times 194^{0.973})})$$

$$BPTSF_S = 21 \quad \%$$

$$PTSF_S = 21 + (44.7 \times 194) / (194 + 176)$$

$$PTSF_S = 44.4 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{35.5}{39.9}$$

$$PFFS = 89 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{27.8}{31.9}$$

$$PFFS = 87.1 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 48.00\%$$

$$\% \text{ Carril}_S = 52.00\%$$

$$C_E = 1536$$

$$C_S = 1664$$

$$C_T = 3200$$

$$N. S. = B$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{S.PTSF} = 1700$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 52.00\%$$

$$\% \text{ Carril}_E = 48.00\%$$

$$C_E = 1536$$

$$C_S = 1664$$

$$C_T = 3200$$

$$N. S. = B$$

Anexo 02 - Análisis HCM 2016 para la vía PE-36B (Puno - Laraqueri) - Reparto por sentidos ideal

VIA PE-36B (SALIDA A LARAQUERI)			Día en análisis	30/12/2022	VIE
CARRETERA DE DOS CARRILES CLASE II			Máx demanda	61	
	C. Entrada	C. Salida	Hora máx. demanda	13:00	
Vehiculos Ligeros	26.5	26.5	1er Intervalo	13:00 - 13:15	31
Vehiculos Recreativos	0	0	2do intervalo	13:15 - 13:30	28
Vehiculos Pesados	4	4	3er intervalo	13:30 - 13:45	41
Ancho de carril (ft)	11.25	11.15	4to intervalo	13:45 - 14:00	61
Ancho de Berma (ft)	5.84	4.20	Volumen horario total	V = 31 + 28 + 41 + 61 = 161	
Pendiente (%)	-2.73	2.73	Demanda de circ. punta	Q15 = 4 x 61 = 244	
% restricción de adelantamiento	40.00	30.00	Factor de Hora Pico	FHP = V/Q15 = 161/244 0.66	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 39.9 \text{ mi/h}$$

$$FFS = 39.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 122$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.13(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.906$$

$$V_{E.ATS} = \frac{122}{0.66 \times 1.00 \times 0.906}$$

$$V_{E.ATS} = 204 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.6$$

$$ATS_E = 39.9 - 0.00776(204 + 204) - 1.6$$

$$ATS_E = 35.1 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 31.9 \text{ mi/h}$$

$$FFS = 31.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 122$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.13(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.906$$

$$V_{S.ATS} = \frac{122}{0.66 \times 1.00 \times 0.906}$$

$$V_{S.ATS} = 204 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.3$$

$$ATS_E = 31.9 - 0.00776(204 + 204) - 1.3$$

$$ATS_E = 27.4 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.13(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.987$$

$$V_{E,PTSF} = \frac{122}{0.66 \times 1.00 \times 0.987}$$

$$V_{E,PTSF} = 187 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.13(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.987$$

$$V_{S,PTSF} = \frac{122}{0.66 \times 1.00 \times 0.987}$$

$$V_{S,PTSF} = 187 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

$$f_{np,PTSF} = 52.8$$

$$BPTSF_d = 100(1 - e^{a(V_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_E = 100(1 - e^{(-0.0014 \times 187^{0.973})})$$

$$BPTSF_E = 20.3 \quad \%$$

$$PTSF_E = 20.3 + (52.8 \times 187) / (187 + 187)$$

$$PTSF_E = 46.7 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

Distribución porcentual del trafico (E/S) = 50/50

$$f_{np,PTSF} = 46.2$$

$$BPTSF_d = 100(1 - e^{a(V_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_S = 100(1 - e^{(-0.0014 \times 187^{0.973})})$$

$$BPTSF_S = 20.3 \quad \%$$

$$PTSF_S = 20.3 + (46.2 \times 187) / (187 + 187)$$

$$PTSF_S = 43.4 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{35.1}{39.9}$$

$$PFFS = 88 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{27.4}{31.9}$$

$$PFFS = 85.9 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.13$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.13(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.13(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{E.ATS} = 1700}$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{E.PTSF} = 1700}$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 50.00\%$$

$$\% \text{ Carril}_S = 50.00\%$$

$$\mathbf{C_E = 1600}$$

$$\mathbf{C_S = 1600}$$

$$\mathbf{C_T = 3200}$$

$$\mathbf{N. S. = B}$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.13(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.13(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{S.ATS} = 1700}$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{S.PTSF} = 1700}$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 50.00\%$$

$$\% \text{ Carril}_E = 50.00\%$$

$$\mathbf{C_E = 1600}$$

$$\mathbf{C_S = 1600}$$

$$\mathbf{C_T = 3200}$$

$$\mathbf{N. S. = B}$$

Anexo 02 - Análisis HCM 2016 para la vía PE-36B (Puno - Laraqueri) - Sin restricción de adelantamiento

VIA PE-36B (SALIDA A LARAQUERI)			Día en análisis	30/12/2022	VIE
CARRETERA DE DOS CARRILES CLASE II			Máx demanda	61	
	C. Entrada	C. Salida	Hora máx. demanda	13:00	
Vehiculos Ligeros	26	27	1er Intervalo	13:00 - 13:15	31
Vehiculos Recreativos	0	0	2do intervalo	13:15 - 13:30	28
Vehiculos Pesados	3	5	3er intervalo	13:30 - 13:45	41
Ancho de carril (ft)	11.25	11.15	4to intervalo	13:45 - 14:00	61
Ancho de Berma (ft)	5.84	4.20	Volumen horario total	V = 31 + 28 + 41 + 61 = 161	
Pendiente (%)	-2.73	2.73	Demanda de circ. punta	Q15 = 4 x 61 = 244	
% restricción de adelantamiento	0.00	0.00	Factor de Hora Pico	FHP = V/Q15 = 161/244 0.66	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 39.9 \text{ mi/h}$$

$$FFS = 39.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 116$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.1(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.926$$

$$V_{E.ATS} = \frac{116}{0.66 \times 1.00 \times 0.926}$$

$$V_{E.ATS} = 190 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.9$$

$$ATS_E = 39.9 - 0.00776(190 + 219) - 0.9$$

$$ATS_E = 35.8 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación directa en campo

$$FFS = 31.9 \text{ mi/h}$$

$$FFS = 31.9 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 128$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_T = 1.8$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.16(1.8 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.887$$

$$V_{S.ATS} = \frac{128}{0.66 \times 1.00 \times 0.887}$$

$$V_{S.ATS} = 219 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.8$$

$$ATS_E = 31.9 - 0.00776(219 + 190) - 0.8$$

$$ATS_E = 27.9 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.1(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.990$$

$$V_{E,PTSF} = \frac{116}{0.66 \times 1.00 \times 0.990}$$

$$V_{E,PTSF} = 178 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{hv,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.16(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 0.984$$

$$V_{S,PTSF} = \frac{128}{0.66 \times 1.00 \times 0.984}$$

$$V_{S,PTSF} = 197 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

$$f_{np,PTSF} = 16$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_E = 100(1 - e^{(-0.0014 \times 178^{0.973})})$$

$$BPTSF_E = 19.5 \quad \%$$

$$PTSF_E = 19.5 + (16 \times 178) / (178 + 197)$$

$$PTSF_E = 27.1 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

Distribución porcentual del tráfico (E/S) = 48/52

$$f_{np,PTSF} = 16$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0014$$

$$b = 0.973$$

$$BPTSF_S = 100(1 - e^{(-0.0014 \times 197^{0.973})})$$

$$BPTSF_S = 21.3 \quad \%$$

$$PTSF_S = 21.3 + (16 \times 197) / (197 + 178)$$

$$PTSF_S = 29.7 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{35.8}{39.9}$$

$$PFFS = 89.7 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{27.9}{31.9}$$

$$PFFS = 87.5 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.10$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.16$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.1(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.1(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{E.ATS} = 1700}$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{E.PTSF} = 1700}$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 48.00\%$$

$$\% \text{ Carril}_S = 52.00\%$$

$$\mathbf{C_E = 1536}$$

$$\mathbf{C_S = 1664}$$

$$\mathbf{C_T = 3200}$$

$$\mathbf{N. S. = A}$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.16(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.16(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{S.ATS} = 1700}$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$\mathbf{C_{S.PTSF} = 1700}$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 52.00\%$$

$$\% \text{ Carril}_E = 48.00\%$$

$$\mathbf{C_E = 1536}$$

$$\mathbf{C_S = 1664}$$

$$\mathbf{C_T = 3200}$$

$$\mathbf{N. S. = A}$$

ANEXO 03:
**ANÁLISIS HCM 2016 PARA LA VÍA PE-3S (PUNO –
JULIACA)**

Anexo 03 - Análisis HCM 2016 para la vía PE-3S (Puno - Juliaca) - Condiciones Reales

VIA PE-3S (SALIDA A JULIACA)			Día en análisis	29/12/2022	JUE
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	175	
	C. Entrada	C. Salida	Hora máx. demanda	09:00	
Vehiculos Ligeros	70	89	1er Intervalo	09:00 - 09:15	145
Vehiculos Recreativos	0	0	2do intervalo	09:15 - 09:30	175
Vehiculos Pesados	11	5	3er intervalo	09:30 - 09:45	145
Ancho de carril (ft)	11.25	11.34	4to intervalo	09:45 - 10:00	174
Ancho de Berma (ft)	2.95	6.56	Volumen horario total	V = 145 + 175 + 145 + 174 = 639	
Pendiente (%)	3.61	-3.61	Demanda de circ. punta	Q15 = 4 x 175 = 700	
% restricción de adelantamiento	50.00	50.00	Factor de Hora Pico	FHP = V/Q15 = 639/700 0.91	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 31.9 \text{ mi/h}$$

$$f_{HV,ATS} = 0.867$$

$$FFS = 31.9 + 0.00776 \times (476.4 / 0.867)$$

$$FFS = 36.2 \text{ mi/h}$$

$$FFS = 36.2 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 36.5 \text{ mi/h}$$

$$f_{HV,ATS} = 0.952$$

$$FFS = 36.5 + 0.00776 \times (476.4 / 0.952)$$

$$FFS = 40.4 \text{ mi/h}$$

$$FFS = 40.4 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 324$$

$$f_{gATS} = 0.85$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 2.1$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 376$$

$$f_{gATS} = 0.88$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 2.0$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

$$f_{hvATS} = \frac{1}{1 + 0.14(2.1 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.867$$

$$V_{E.ATS} = \frac{324}{0.91 \times 0.85 \times 0.867}$$

$$V_{E.ATS} = 483 \quad \text{vl/h}$$

$$f_{hvATS} = \frac{1}{1 + 0.05(2 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.952$$

$$V_{S.ATS} = \frac{376}{0.91 \times 0.88 \times 0.952}$$

$$V_{S.ATS} = 493 \quad \text{vl/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.1$$

$$ATS_E = 36.2 - 0.00776(483 + 493) - 1.1$$

$$ATS_E = 27.5 \quad \text{mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.1$$

$$ATS_E = 40.4 - 0.00776(493 + 483) - 1.1$$

$$ATS_E = 31.7 \quad \text{mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.86$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 1.7$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.14(1.7 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.911$$

$$V_{E.PTSF} = \frac{324}{0.91 \times 0.86 \times 0.911}$$

$$V_{E.PTSF} = 454 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.89$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.6$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.05(1.6 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.971$$

$$V_{S.PTSF} = \frac{376}{0.91 \times 0.89 \times 0.971}$$

$$V_{S.PTSF} = 478 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 46/54

$$f_{np.PTSF} = 36.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0026$$

$$b = 0.902$$

$$BPTSF_E = 100(1 - e^{(-0.0026 \times 454^{0.902})})$$

$$BPTSF_E = 47.7 \quad \%$$

$$PTSF_E = 47.7 + (36.4 \times 454) / (454 + 478)$$

$$PTSF_E = 65.4 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 36.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0025$$

$$b = 0.909$$

$$BPTSF_S = 100(1 - e^{(-0.0025 \times 478^{0.909})})$$

$$BPTSF_S = 49.4 \quad \%$$

$$PTSF_S = 49.4 + (36.4 \times 478) / (478 + 454)$$

$$PTSF_S = 68.1 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{27.5}{36.2}$$

$$\text{PFFS} = 76 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{31.7}{40.4}$$

$$\text{PFFS} = 78.5 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.14(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.14(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.96$$

$$f_{hv,PTSF} = 1$$

$$C_{E,ATS} = 1700 \times 1.00 \times 0.960$$

$$C_{E,ATS} = 1632$$

$$C_{E,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{E,PTSF} = 1700$$

$$C_E = 1632$$

$$\% \text{ Carril}_E = 46.00\%$$

$$\% \text{ Carril}_S = 54.00\%$$

$$C_E = 1413$$

$$C_S = 1659$$

$$C_T = 3072$$

$$N. S. = C$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.05(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.99$$

$$f_{hv,PTSF} = 1$$

$$C_{S,ATS} = 1700 \times 1.00 \times 0.990$$

$$C_{S,ATS} = 1683$$

$$C_{S,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{S,PTSF} = 1700$$

$$C_S = 1683$$

$$\% \text{ Carril}_S = 54.00\%$$

$$\% \text{ Carril}_E = 46.00\%$$

$$C_E = 1413$$

$$C_S = 1659$$

$$C_T = 3072$$

$$N. S. = C$$

Anexo 03 - Análisis HCM 2016 para la vía PE-3S (Puno - Juliaca) - Cero pendiente

VIA PE-3S (SALIDA A JULIACA)			Día en análisis	29/12/2022	JUE
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	175	
	C. Entrada	C. Salida	Hora máx. demanda	09:00	
Vehiculos Ligeros	70	89	1er Intervalo	09:00 - 09:15	145
Vehiculos Recreativos	0	0	2do intervalo	09:15 - 09:30	175
Vehiculos Pesados	11	5	3er intervalo	09:30 - 09:45	145
Ancho de carril (ft)	11.25	11.34	4to intervalo	09:45 - 10:00	174
Ancho de Berma (ft)	2.95	6.56	Volumen horario total	V = 145 + 175 + 145 + 174 = 639	
Pendiente (%)	0.00	0.00	Demanda de circ. punta	Q15 = 4 x 175 = 700	
% restricción de adelantamiento	50.00	50.00	Factor de Hora Pico	FHP = V/Q15 = 639/700 0.91	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 31.9 \text{ mi/h}$$

$$f_{HV,ATS} = 0.947$$

$$FFS = 31.9 + 0.00776 \times (476.4 / 0.947)$$

$$FFS = 35.8 \text{ mi/h}$$

$$FFS = 35.8 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 36.5 \text{ mi/h}$$

$$f_{HV,ATS} = 0.985$$

$$FFS = 36.5 + 0.00776 \times (476.4 / 0.985)$$

$$FFS = 40.3 \text{ mi/h}$$

$$FFS = 40.3 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 324$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 1.4$$

$$E_R = 1.0$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 376$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.3$$

$$E_R = 1.0$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

$$f_{hvATS} = \frac{1}{1 + 0.14(1.4 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.947$$

$$V_{E.ATS} = \frac{324}{0.91 \times 1.00 \times 0.947}$$

$$V_{E.ATS} = 376 \quad \text{vl/h}$$

$$f_{hvATS} = \frac{1}{1 + 0.05(1.3 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.985$$

$$V_{S.ATS} = \frac{376}{0.91 \times 1.00 \times 0.985}$$

$$V_{S.ATS} = 419 \quad \text{vl/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.2$$

$$ATS_E = 35.8 - 0.00776(376 + 419) - 1.2$$

$$ATS_E = 28.4 \quad \text{mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.4$$

$$ATS_E = 40.3 - 0.00776(419 + 376) - 1.4$$

$$ATS_E = 32.7 \quad \text{mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.14(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.986$$

$$V_{E.PTSF} = \frac{324}{0.91 \times 1.00 \times 0.986}$$

$$V_{E.PTSF} = 361 \quad \text{vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.05(1.1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.995$$

$$V_{S.PTSF} = \frac{376}{0.91 \times 1.00 \times 0.995}$$

$$V_{S.PTSF} = 415 \quad \text{vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 46/54

$$f_{np.PTSF} = 40.9$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.0023$$

$$b = 0.919$$

$$BPTSF_E = 100(1 - e^{-(0.0023 \times 361^{0.919})})$$

$$BPTSF_E = 40.3 \quad \%$$

$$PTSF_E = 40.3 + (40.9 \times 361) / (361 + 415)$$

$$PTSF_E = 59.3 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 40.9$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.002$$

$$b = 0.933$$

$$BPTSF_S = 100(1 - e^{-(0.002 \times 415^{0.933})})$$

$$BPTSF_S = 42.5 \quad \%$$

$$PTSF_S = 42.5 + (40.9 \times 415) / (415 + 361)$$

$$PTSF_S = 64.4 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{28.4}{35.8}$$

$$\text{PFFS} = 79.3 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{32.7}{40.3}$$

$$\text{PFFS} = 81.1 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R,ATS} = 1.0$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.14(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.14(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 1$$

$$f_{hv,PTSF} = 1$$

$$C_{E,ATS} = 1700 \times 1.00 \times 1.000$$

$$C_{E,ATS} = 1700$$

$$C_{E,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{E,PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 46.00\%$$

$$\% \text{ Carril}_S = 54.00\%$$

$$C_E = 1448$$

$$C_S = 1700$$

$$C_T = 3148$$

$$N. S. = C$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.0$$

$$E_{R,ATS} = 1.0$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 1$$

$$f_{hv,PTSF} = 1$$

$$C_{S,ATS} = 1700 \times 1.00 \times 1.000$$

$$C_{S,ATS} = 1700$$

$$C_{S,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{S,PTSF} = 1700$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 54.00\%$$

$$\% \text{ Carril}_E = 46.00\%$$

$$C_E = 1448$$

$$C_S = 1700$$

$$C_T = 3148$$

$$N. S. = C$$

Anexo 03 - Análisis HCM 2016 para la vía PE-3S (Puno - Juliaca) - Sin vehículos pesados

VIA PE-3S (SALIDA A JULIACA)			Día en análisis	29/12/2022	JUE
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	175	
	C. Entrada	C. Salida	Hora máx. demanda	09:00	
Vehículos Ligeros	81	94	1er Intervalo	09:00 - 09:15	145
Vehículos Recreativos	0	0	2do intervalo	09:15 - 09:30	175
Vehículos Pesados	0	0	3er intervalo	09:30 - 09:45	145
Ancho de carril (ft)	11.25	11.34	4to intervalo	09:45 - 10:00	174
Ancho de Berma (ft)	2.95	6.56	Volumen horario total	V = 145 + 175 + 145 + 174 = 639	
Pendiente (%)	3.61	-3.61	Demanda de circ. punta	Q15 = 4 x 175 = 700	
% restricción de adelantamiento	50.00	50.00	Factor de Hora Pico	FHP = V/Q15 = 639/700 0.91	

Sentido de entrada

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 31.9 \text{ mi/h}$$

$$f_{HV,ATS} = 1$$

$$FFS = 31.9 + 0.00776 \times (476.4 / 1)$$

$$FFS = 35.6 \text{ mi/h}$$

$$FFS = 35.6 \text{ mi/h}$$

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 36.5 \text{ mi/h}$$

$$f_{HV,ATS} = 1$$

$$FFS = 36.5 + 0.00776 \times (476.4 / 1)$$

$$FFS = 40.2 \text{ mi/h}$$

$$FFS = 40.2 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 324$$

$$f_{gATS} = 0.85$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 2.1$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 376$$

$$f_{gATS} = 0.88$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 2.0$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

$$f_{hvATS} = \frac{1}{1 + 0(2.1 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 1.000$$

$$V_{E.ATS} = \frac{324}{0.91 \times 0.85 \times 1.000}$$

$$V_{E.ATS} = 419 \quad vl/h$$

$$f_{hvATS} = \frac{1}{1 + 0(2 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 1.000$$

$$V_{S.ATS} = \frac{376}{0.91 \times 0.88 \times 1.000}$$

$$V_{S.ATS} = 470 \quad vl/h$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.1$$

$$ATS_E = 35.6 - 0.00776(419 + 470) - 1.1$$

$$ATS_E = 27.6 \quad mi/h$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.2$$

$$ATS_E = 40.2 - 0.00776(470 + 419) - 1.2$$

$$ATS_E = 32.1 \quad mi/h$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.86$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.7$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0(1.7 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{E.PTSF} = \frac{324}{0.91 \times 0.86 \times 1.000}$$

$$V_{E.PTSF} = 414 \quad vl/h$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.89$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.6$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0(1.6 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{S.PTSF} = \frac{376}{0.91 \times 0.89 \times 1.000}$$

$$V_{S.PTSF} = 464 \quad vl/h$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 46/54

$$f_{np.PTSF} = 37.8$$

$$BPTSF_d = 100(1 - e^{aV_d^b})$$

$$a = -0.0026$$

$$b = 0.906$$

$$BPTSF_E = 100(1 - e^{(-0.0026 \times 414^{0.906})})$$

$$BPTSF_E = 45.7 \quad \%$$

$$PTSF_E = 45.7 + (37.8 \times 414) / (414 + 464)$$

$$PTSF_E = 63.5 \quad \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 37.8$$

$$BPTSF_d = 100(1 - e^{aV_d^b})$$

$$a = -0.0023$$

$$b = 0.919$$

$$BPTSF_S = 100(1 - e^{(-0.0023 \times 464^{0.919})})$$

$$BPTSF_S = 47.7 \quad \%$$

$$PTSF_S = 47.7 + (37.8 \times 464) / (464 + 414)$$

$$PTSF_S = 67.7 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{27.6}{35.6}$$

$$\text{PFFS} = 77.5 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{32.1}{40.2}$$

$$\text{PFFS} = 79.9 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.3$$

$$E_{R.ATS} = 1.1$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.000$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 46.00\%$$

$$\% \text{ Carril}_S = 54.00\%$$

$$C_E = 1448$$

$$C_S = 1700$$

$$C_T = 3148$$

$$N. S. = C$$

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.3$$

$$E_{R.ATS} = 1.1$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.000$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{S.PTSF} = 1700$$

$$C_S = 1700$$

$$\% \text{ Carril}_S = 54.00\%$$

$$\% \text{ Carril}_E = 46.00\%$$

$$C_E = 1448$$

$$C_S = 1700$$

$$C_T = 3148$$

$$N. S. = C$$

Anexo 03 - Análisis HCM 2016 para la vía PE-3S (Puno - Juliaca) - Distribucion por sentidos ideal

VIA PE-3S (SALIDA A JULIACA)			Día en análisis	29/12/2022	JUE
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	175	
	C. Entrada	C. Salida	Hora máx. demanda	09:00	
Vehiculos Ligeros	79.5	79.5	1er Intervalo	09:00 - 09:15	145
Vehiculos Recreativos	0	0	2do intervalo	09:15 - 09:30	175
Vehiculos Pesados	8	8	3er intervalo	09:30 - 09:45	145
Ancho de carril (ft)	11.25	11.34	4to intervalo	09:45 - 10:00	174
Ancho de Berma (ft)	2.95	6.56	Volumen horario total	V = 145 + 175 + 145 + 174 = 639	
Pendiente (%)	3.61	-3.61	Demanda de circ. punta	Q15 = 4 x 175 = 700	
% restricción de adelantamiento	50.00	50.00	Factor de Hora Pico	FHP = V/Q15 = 639/700 0.91	

Sentido de entrada

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ veh\u00edculos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 31.9 \text{ mi/h}$$

$$f_{HV,ATS} = 0.91$$

$$FFS = 31.9 + 0.00776 \times (476.4 / 0.91)$$

$$FFS = 36 \text{ mi/h}$$

$$FFS = 36 \text{ mi/h}$$

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ veh\u00edculos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 36.5 \text{ mi/h}$$

$$f_{HV,ATS} = 0.91$$

$$FFS = 36.5 + 0.00776 \times (476.4 / 0.91)$$

$$FFS = 40.6 \text{ mi/h}$$

$$FFS = 40.6 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 350$$

$$f_{gATS} = 0.87$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_T = 2.1$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 350$$

$$f_{gATS} = 0.87$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_T = 2.1$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

$$f_{hvATS} = \frac{1}{1 + 0.09(2.1 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.910$$

$$V_{E.ATS} = \frac{350}{0.91 \times 0.87 \times 0.910}$$

$$V_{E.ATS} = 486 \text{ vi/h}$$

$$f_{hvATS} = \frac{1}{1 + 0.09(2.1 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.910$$

$$V_{S.ATS} = \frac{350}{0.91 \times 0.87 \times 0.910}$$

$$V_{S.ATS} = 486 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.1$$

$$ATS_E = 36 - 0.00776(486 + 486) - 1.1$$

$$ATS_E = 27.4 \text{ mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 1.1$$

$$ATS_E = 40.6 - 0.00776(486 + 486) - 1.1$$

$$ATS_E = 32 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.88$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_T = 1.7$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.09(1.7 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.941$$

$$V_{E.PTSF} = \frac{350}{0.91 \times 0.88 \times 0.941}$$

$$V_{E.PTSF} = 464 \text{ vi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.88$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_T = 1.7$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.09(1.7 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.941$$

$$V_{S.PTSF} = \frac{350}{0.91 \times 0.88 \times 0.941}$$

$$V_{S.PTSF} = 464 \text{ vi/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 38.6$$

$$BPTSF_d = 100(1 - e^{a(V_d^b)})$$

$$a = -0.0026$$

$$b = 0.906$$

$$BPTSF_E = 100(1 - e^{(-0.0026 \times 464^{0.906})})$$

$$BPTSF_E = 49.2 \%$$

$$PTSF_E = 49.2 + (38.6 \times 464) / (464 + 464)$$

$$PTSF_E = 68.5 \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 50/50

$$f_{np.PTSF} = 38.6$$

$$BPTSF_d = 100(1 - e^{a(V_d^b)})$$

$$a = -0.0026$$

$$b = 0.906$$

$$BPTSF_S = 100(1 - e^{(-0.0026 \times 464^{0.906})})$$

$$BPTSF_S = 49.2 \%$$

$$PTSF_S = 49.2 + (38.6 \times 464) / (464 + 464)$$

$$PTSF_S = 68.5 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{27.4}{36}$$

$$\text{PFFS} = 76.1 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{32}{40.6}$$

$$\text{PFFS} = 78.8 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.09(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.09(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.97$$

$$f_{hv,PTSF} = 1$$

$$C_{E,ATS} = 1700 \times 1.00 \times 0.970$$

$$C_{E,ATS} = 1649$$

$$C_{E,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{E,PTSF} = 1700$$

$$C_E = 1649$$

$$\% \text{ Carril}_E = 50.00\%$$

$$\% \text{ Carril}_S = 50.00\%$$

$$C_E = 1552$$

$$C_S = 1552$$

$$C_T = 3104$$

$$N. S. = C$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.09$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.09(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.09(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.97$$

$$f_{hv,PTSF} = 1$$

$$C_{S,ATS} = 1700 \times 1.00 \times 0.970$$

$$C_{S,ATS} = 1649$$

$$C_{S,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{S,PTSF} = 1700$$

$$C_S = 1649$$

$$\% \text{ Carril}_S = 50.00\%$$

$$\% \text{ Carril}_E = 50.00\%$$

$$C_E = 1552$$

$$C_S = 1552$$

$$C_T = 3104$$

$$N. S. = C$$

Anexo 03 - Análisis HCM 2016 para la vía PE-3S (Puno - Juliaca) - Sin restriccion de adelantamiento

VIA PE-3S (SALIDA A JULIACA)			Día en análisis	29/12/2022	JUE
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	175	
	C. Entrada	C. Salida	Hora máx. demanda	09:00	
Vehiculos Ligeros	70	89	1er Intervalo	09:00 - 09:15	145
Vehiculos Recreativos	0	0	2do intervalo	09:15 - 09:30	175
Vehiculos Pesados	11	5	3er intervalo	09:30 - 09:45	145
Ancho de carril (ft)	11.25	11.34	4to intervalo	09:45 - 10:00	174
Ancho de Berma (ft)	2.95	6.56	Volumen horario total	V = 145 + 175 + 145 + 174 = 639	
Pendiente (%)	3.61	-3.61	Demanda de circ. punta	Q15 = 4 x 175 = 700	
% restricción de adelantamiento	0.00	0.00	Factor de Hora Pico	FHP = V/Q15 = 639/700 0.91	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 31.9 \text{ mi/h}$$

$$f_{HV,ATS} = 0.867$$

$$FFS = 31.9 + 0.00776 \times (476.4 / 0.867)$$

$$FFS = 36.2 \text{ mi/h}$$

$$FFS = 36.2 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 40021 \text{ vehículos}$$

$$v = 476.4 \text{ v/h}$$

$$S_{FM} = 36.5 \text{ mi/h}$$

$$f_{HV,ATS} = 0.952$$

$$FFS = 36.5 + 0.00776 \times (476.4 / 0.952)$$

$$FFS = 40.4 \text{ mi/h}$$

$$FFS = 40.4 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 324$$

$$f_{gATS} = 0.85$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 2.1$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 376$$

$$f_{gATS} = 0.88$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} \quad \text{ó}$$

$$f_{hvATS} = \frac{1}{1 + P_{TC} \times P_T(E_{TC} - 1) + (1 - P_{TC})P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 2.0$$

$$E_R = 1.1$$

$$P_{TC} = -$$

$$E_{TC} = -$$

$$vel_{(ralenti)} = -$$

$$f_{hvATS} = \frac{1}{1 + 0.14(2.1 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.867$$

$$V_{E.ATS} = \frac{324}{0.91 \times 0.85 \times 0.867}$$

$$V_{E.ATS} = 483 \text{ vl/h}$$

$$f_{hvATS} = \frac{1}{1 + 0.05(2 - 1) + 0(1.1 - 1)}$$

$$f_{hvATS} = \frac{1}{-}$$

$$f_{hvATS} = 0.952$$

$$V_{S.ATS} = \frac{376}{0.91 \times 0.88 \times 0.952}$$

$$V_{S.ATS} = 493 \text{ vl/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.7$$

$$ATS_E = 36.2 - 0.00776(483 + 493) - 0.7$$

$$ATS_E = 27.9 \text{ mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.7$$

$$ATS_E = 40.4 - 0.00776(493 + 483) - 0.7$$

$$ATS_E = 32.1 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.86$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_T = 1.7$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.14(1.7 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.911$$

$$V_{E.PTSF} = \frac{324}{0.91 \times 0.86 \times 0.911}$$

$$V_{E.PTSF} = 454 \text{ vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{hv.PTSF}}$$

$$f_{g.PTSF} = 0.89$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.6$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.05(1.6 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 0.971$$

$$V_{S.PTSF} = \frac{376}{0.91 \times 0.89 \times 0.971}$$

$$V_{S.PTSF} = 478 \text{ vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 14.3$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.0026$$

$$b = 0.902$$

$$BPTSF_E = 100(1 - e^{-(0.0026 \times 454^{0.902})})$$

$$BPTSF_E = 47.7 \%$$

$$PTSF_E = 47.7 + (14.3 \times 454) / (454 + 478)$$

$$PTSF_E = 54.7 \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 46/54

$$f_{np.PTSF} = 14.3$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.0025$$

$$b = 0.909$$

$$BPTSF_S = 100(1 - e^{-(0.0025 \times 478^{0.909})})$$

$$BPTSF_S = 49.4 \%$$

$$PTSF_S = 49.4 + (14.3 \times 478) / (478 + 454)$$

$$PTSF_S = 56.7 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{27.9}{36.2}$$

$$\text{PFFS} = 77.1 \quad \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$\text{PFFS} = \frac{\text{ATS}_d}{\text{FFS}}$$

$$\text{PFFS} = \frac{32.1}{40.4}$$

$$\text{PFFS} = 79.5 \quad \%$$

Capacidad y Nivel de Servicio

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.14$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.14(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.14(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.96$$

$$f_{hv,PTSF} = 1$$

$$C_{E,ATS} = 1700 \times 1.00 \times 0.960$$

$$C_{E,ATS} = 1632$$

$$C_{E,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{E,PTSF} = 1700$$

$$C_E = 1632$$

$$\% \text{ Carril}_E = 46.00\%$$

$$\% \text{ Carril}_S = 54.00\%$$

$$C_E = 1413$$

$$C_S = 1659$$

$$C_T = 3072$$

$$N. S. = C$$

$$C_{d,ATS} = 1700 \times f_{g,ATS} \times f_{hv,ATS}$$

$$C_{d,PTSF} = 1700 \times f_{g,PTSF} \times f_{hv,PTSF}$$

$$f_{g,ATS} = 1.00$$

$$f_{g,PTSF} = 1.00$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_{T,ATS} = 1.3$$

$$E_{R,ATS} = 1.1$$

$$E_{T,PTSF} = 1.0$$

$$E_{R,PTSF} = 1.0$$

$$f_{hv,ATS} = \frac{1}{1 + 0.05(1.3 - 1) + 0(1.1 - 1)}$$

$$f_{hv,PTSF} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv,ATS} = 0.99$$

$$f_{hv,PTSF} = 1$$

$$C_{S,ATS} = 1700 \times 1.00 \times 0.990$$

$$C_{S,ATS} = 1683$$

$$C_{S,PTSF} = 1700 \times 1.00 \times 1.000$$

$$C_{S,PTSF} = 1700$$

$$C_S = 1683$$

$$\% \text{ Carril}_S = 54.00\%$$

$$\% \text{ Carril}_E = 46.00\%$$

$$C_E = 1413$$

$$C_S = 1659$$

$$C_T = 3072$$

$$N. S. = C$$

ANEXO 04:
**ANÁLISIS HCM 2016 PARA LA VÍA PE-3S (PUNO –
ILAVE)**

Anexo 04 - Análisis HCM 2016 para la vía PE-36B (Puno - Ilave) - Condiciones Reales

VIA PE-3S (SALIDA A ILAVE)			Día en análisis	31/12/2022	SÁB
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	258	
	C. Entrada	C. Salida	Hora máx. demanda	16:00	
Vehiculos Ligeros	132	109	1er Intervalo	16:00 - 16:15	241
Vehiculos Recreativos	0	0	2do intervalo	16:15 - 16:30	183
Vehiculos Pesados	11	6	3er intervalo	16:30 - 16:45	258
Ancho de carril (ft)	11.80	11.48	4to intervalo	16:45 - 17:00	249
Ancho de Berma (ft)	3.38	4.89	Volumen horario total	V = 241 + 183 + 258 + 249 = 931	
Pendiente (%)	-0.10	0.10	Demanda de circ. punta	Q15 = 4 x 258 = 1032	
% restricción de adelantamiento	0.00	0.00	Factor de Hora Pico	FHP = V/Q15 = 931/1032 0.90	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 0.992$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 0.992)$$

$$FFS = 32.5 \text{ mi/h}$$

$$FFS = 32.5 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 572$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.08$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.08(1.1 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.992$$

$$V_{E,ATS} = \frac{572}{0.90 \times 1.00 \times 0.992}$$

$$V_{E,ATS} = 641 \text{ vi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 0.99$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 0.99)$$

$$FFS = 32.5 \text{ mi/h}$$

$$FFS = 32.5 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 460$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.2$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.05(1.2 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.990$$

$$V_{S,ATS} = \frac{460}{0.90 \times 1.00 \times 0.990}$$

$$V_{S,ATS} = 516 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.6$$

$$ATS_E = 32.5 - 0.00776(641 + 516) - 0.6$$

$$ATS_E = 22.9 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{HV.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.08$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.08(1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{E.PTSF} = \frac{572}{0.90 \times 1.00 \times 1.000}$$

$$V_{E.PTSF} = 636 \text{ vl/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.4$$

$$ATS_E = 32.5 - 0.00776(516 + 641) - 0.4$$

$$ATS_E = 23.1 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{HV.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0.05(1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{S.PTSF} = \frac{460}{0.90 \times 1.00 \times 1.000}$$

$$V_{S.PTSF} = 511 \text{ vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 13.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0028$$

$$b = 0.894$$

$$BPTSF_E = 100(1 - e^{(-0.0028 \times 636^{0.894})})$$

$$BPTSF_E = 59.3 \%$$

$$PTSF_E = 59.3 + (13.4 \times 636) / (636 + 511)$$

$$PTSF_E = 66.7 \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 13.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0035$$

$$b = 0.863$$

$$BPTSF_S = 100(1 - e^{(-0.0035 \times 511^{0.863})})$$

$$BPTSF_S = 53.3 \%$$

$$PTSF_S = 53.3 + (13.4 \times 511) / (511 + 636)$$

$$PTSF_S = 59.3 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{22.9}{32.5}$$

$$PFFS = 70.5 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{23.1}{32.5}$$

$$PFFS = 71.1 \%$$

Capacidad y Nivel de Servicio

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.08$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.08(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.08(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

% Carril._E = 55.00%

% Carril._S = 45.00%

$$C_E = 1700$$

$$C_S = 1391$$

$$C_T = 3091$$

N. S. = D

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.05$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.05(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{S.PTSF} = 1700$$

$$C_E = 1700$$

% Carril._S = 45.00%

% Carril._E = 55.00%

$$C_E = 1700$$

$$C_S = 1391$$

$$C_T = 3091$$

N. S. = D

Anexo 04 - Análisis HCM 2016 para la vía PE-36B (Puno - Ilave) - Composición vehicular ideal

VIA PE-3S (SALIDA A ILAVE)			Día en análisis	31/12/2022	SÁB
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	258	
	C. Entrada	C. Salida	Hora máx. demanda	16:00	
Vehiculos Ligeros	143	115	1er Intervalo	16:00 - 16:15	241
Vehiculos Recreativos	0	0	2do intervalo	16:15 - 16:30	183
Vehiculos Pesados	0	0	3er intervalo	16:30 - 16:45	258
Ancho de carril (ft)	11.80	11.48	4to intervalo	16:45 - 17:00	249
Ancho de Berma (ft)	3.38	4.89	Volumen horario total	V = 241 + 183 + 258 + 249 = 931	
Pendiente (%)	-0.10	0.10	Demanda de circ. punta	Q15 = 4 x 258 = 1032	
% restricción de adelantamiento	0.00	0.00	Factor de Hora Pico	FHP = V/Q15 = 931/1032 0.90	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 1$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 1)$$

$$FFS = 32.4 \text{ mi/h}$$

$$FFS = 32.4 \text{ mi/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 1$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 1)$$

$$FFS = 32.4 \text{ mi/h}$$

$$FFS = 32.4 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 572$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.1$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0(1.1 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 1$$

$$V_{E,ATS} = \frac{572}{0.90 \times 1.00 \times 1.000}$$

$$V_{E,ATS} = 636 \text{ vi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 460$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.2$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0(1.2 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 1.000$$

$$V_{S,ATS} = \frac{460}{0.90 \times 1.00 \times 1.000}$$

$$V_{S,ATS} = 511 \text{ vi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.5$$

$$ATS_E = 32.4 - 0.00776(636 + 511) - 0.5$$

$$ATS_E = 23 \text{ mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E.ATS} + V_{S.ATS}) - f_{np.ATS}$$

$$f_{np.ATS} = 0.4$$

$$ATS_E = 32.4 - 0.00776(511 + 636) - 0.4$$

$$ATS_E = 23.1 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{HV.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0(1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{E.PTSF} = \frac{572}{0.90 \times 1.00 \times 1.000}$$

$$V_{E.PTSF} = 636 \text{ vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i.PTSF} = \frac{V_i}{FHP \times f_{g.PTSF} \times f_{HV.PTSF}}$$

$$f_{g.PTSF} = 1.00$$

$$f_{HV.PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV.PTSF} = \frac{1}{1 + 0(1 - 1) + 0(1 - 1)}$$

$$f_{HV.PTSF} = 1.000$$

$$V_{S.PTSF} = \frac{460}{0.90 \times 1.00 \times 1.000}$$

$$V_{S.PTSF} = 511 \text{ vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

$$f_{np.PTSF} = 13.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0028$$

$$b = 0.894$$

$$BPTSF_E = 100(1 - e^{(-0.0028 \times 636^{0.894})})$$

$$BPTSF_E = 59.3 \%$$

$$PTSF_E = 59.3 + (13.4 \times 636) / (636 + 511)$$

$$PTSF_E = 66.7 \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np.PTSF} \times V_{d.PTSF}) / (V_{d.PTSF} + V_{o.PTSF})$$

Distribución porcentual del trafico (E/S) = 55/45

$$f_{np.PTSF} = 13.4$$

$$BPTSF_d = 100(1 - e^{(aV_d^b)})$$

$$a = -0.0035$$

$$b = 0.863$$

$$BPTSF_S = 100(1 - e^{(-0.0035 \times 511^{0.863})})$$

$$BPTSF_S = 53.3 \%$$

$$PTSF_S = 53.3 + (13.4 \times 511) / (511 + 636)$$

$$PTSF_S = 59.3 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{23}{32.4}$$

$$PFFS = 71 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{23.1}{32.4}$$

$$PFFS = 71.3 \%$$

Capacidad y Nivel de Servicio

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_E = 55.00\%$$

$$\% \text{ Carril}_S = 45.00\%$$

$$C_E = 1700$$

$$C_S = 1391$$

$$C_T = 3091$$

$$N. S. = D$$

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.00$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{S.PTSF} = 1700$$

$$C_E = 1700$$

$$\% \text{ Carril}_S = 45.00\%$$

$$\% \text{ Carril}_E = 55.00\%$$

$$C_E = 1700$$

$$C_S = 1391$$

$$C_T = 3091$$

$$N. S. = D$$

Anexo 04 - Análisis HCM 2016 para la vía PE-36B (Puno - Ilave) - Reparto por sentidos ideal

VIA PE-3S (SALIDA A ILAVE)			Día en análisis	31/12/2022	SÁB
CARRETERA DE DOS CARRILES CLASE III			Máx demanda	258	
	C. Entrada	C. Salida	Hora máx. demanda	16:00	
Vehículos Ligeros	120.5	120.5	1er Intervalo	16:00 - 16:15	241
Vehículos Recreativos	0	0	2do intervalo	16:15 - 16:30	183
Vehículos Pesados	8.5	8.5	3er intervalo	16:30 - 16:45	258
Ancho de carril (ft)	11.80	11.48	4to intervalo	16:45 - 17:00	249
Ancho de Berma (ft)	3.38	4.89	Volumen horario total	V = 241 + 183 + 258 + 249 = 931	
Pendiente (%)	-0.10	0.10	Demanda de circ. punta	Q15 = 4 x 258 = 1032	
% restricción de adelantamiento	0.00	0.00	Factor de Hora Pico	FHP = V/Q15 = 931/1032 0.90	

Sentido de entrada

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 0.986$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 0.986)$$

$$FFS = 32.5 \text{ mi/h}$$

$$FFS = 32.5 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_E = 516$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_T = 1.2$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.07(1.2 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.986$$

$$V_{E,ATS} = \frac{516}{0.90 \times 1.00 \times 0.986}$$

$$V_{E,ATS} = 581 \text{ vl/h}$$

Sentido de salida

Velocidad a Flujo Libre (FFS) (mi/h)

Estimación en alta demanda horaria

$$FFS = S_{FM} + 0.00776 \times (v / f_{HV,ATS})$$

$$VT = 56800 \text{ vehículos}$$

$$v = 676.2 \text{ v/h}$$

$$S_{FM} = 27.2 \text{ mi/h}$$

$$f_{HV,ATS} = 0.986$$

$$FFS = 27.2 + 0.00776 \times (676.2 / 0.986)$$

$$FFS = 32.5 \text{ mi/h}$$

$$FFS = 32.5 \text{ mi/h}$$

Ajuste de la Demanda para ATS

$$V_{iATS} = \frac{V_i}{FHP \times f_{gATS} \times f_{hvATS}}$$

$$V_S = 516$$

$$f_{gATS} = 1.00$$

$$f_{hvATS} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_T = 1.2$$

$$E_R = 1.0$$

$$f_{hvATS} = \frac{1}{1 + 0.07(1.2 - 1) + 0(1 - 1)}$$

$$f_{hvATS} = 0.986$$

$$V_{S,ATS} = \frac{516}{0.90 \times 1.00 \times 0.986}$$

$$V_{S,ATS} = 581 \text{ vl/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E,ATS} + V_{S,ATS}) - f_{np,ATS}$$

$$f_{np,ATS} = 0.6$$

$$ATS_E = 32.5 - 0.00776(581 + 581) - 0.6$$

$$ATS_E = 22.9 \text{ mi/h}$$

Calculo de la Velocidad de Viaje Promedio (ATS)

$$ATS_E = FFS - 0.00776(V_{E,ATS} + V_{S,ATS}) - f_{np,ATS}$$

$$f_{np,ATS} = 0.6$$

$$ATS_E = 32.5 - 0.00776(581 + 581) - 0.6$$

$$ATS_E = 22.9 \text{ mi/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{HV,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.07(1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 1.000$$

$$V_{E,PTSF} = \frac{516}{0.90 \times 1.00 \times 1.000}$$

$$V_{E,PTSF} = 573 \text{ vl/h}$$

Ajuste de la demanda para PTSF

$$V_{i,PTSF} = \frac{V_i}{FHP \times f_{g,PTSF} \times f_{HV,PTSF}}$$

$$f_{g,PTSF} = 1.00$$

$$f_{HV,PTSF} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_T = 1.0$$

$$E_R = 1.0$$

$$f_{HV,PTSF} = \frac{1}{1 + 0.07(1 - 1) + 0(1 - 1)}$$

$$f_{HV,PTSF} = 1.000$$

$$V_{S,PTSF} = \frac{516}{0.90 \times 1.00 \times 1.000}$$

$$V_{S,PTSF} = 573 \text{ vl/h}$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

Distribución porcentual del trafico (E/S) = 50/50

$$f_{np,PTSF} = 14.1$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.0032$$

$$b = 0.877$$

$$BPTSF_E = 100(1 - e^{-(0.0032 \times 573^{0.877})})$$

$$BPTSF_E = 56.8 \%$$

$$PTSF_E = 56.8 + (14.1 \times 573) / (573 + 573)$$

$$PTSF_E = 63.9 \%$$

Cálculo Porcentaje de Tiempo en Demora (PTSF)

$$PTSF_d = BPTSF_d + (f_{np,PTSF} \times V_{d,PTSF}) / (V_{d,PTSF} + V_{o,PTSF})$$

$$f_{np,PTSF} = 14.1$$

$$BPTSF_d = 100(1 - e^{-(aV_d^b)})$$

$$a = -0.0032$$

$$b = 0.877$$

$$BPTSF_S = 100(1 - e^{-(0.0032 \times 573^{0.877})})$$

$$BPTSF_S = 56.8 \%$$

$$PTSF_S = 56.8 + (14.1 \times 573) / (573 + 573)$$

$$PTSF_S = 63.9 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{22.9}{32.5}$$

$$PFFS = 70.5 \%$$

Porcentaje de Velocidad a Flujo Libre (PFFS)

$$PFFS = \frac{ATS_d}{FFS}$$

$$PFFS = \frac{22.9}{32.5}$$

$$PFFS = 70.5 \%$$

Capacidad y Nivel de Servicio

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.07(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.07(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{E.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{E.ATS} = 1700$$

$$C_{E.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{E.PTSF} = 1700$$

$$C_E = 1700$$

% Carril._E = 50.00%

% Carril._S = 50.00%

$$C_E = 1600$$

$$C_S = 1600$$

$$C_T = 3200$$

N. S. = D

$$C_{d.ATS} = 1700 \times f_{g.ATS} \times f_{hv.ATS}$$

$$C_{d.PTSF} = 1700 \times f_{g.PTSF} \times f_{hv.PTSF}$$

$$f_{g.ATS} = 1.00$$

$$f_{g.PTSF} = 1.00$$

$$P_T = 0.07$$

$$P_R = 0.00$$

$$E_{T.ATS} = 1.0$$

$$E_{R.ATS} = 1.0$$

$$E_{T.PTSF} = 1.0$$

$$E_{R.PTSF} = 1.0$$

$$f_{hv.ATS} = \frac{1}{1 + 0.07(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.PTSF} = \frac{1}{1 + 0.07(1.0 - 1) + 0(1.0 - 1)}$$

$$f_{hv.ATS} = 1$$

$$f_{hv.PTSF} = 1$$

$$C_{S.ATS} = 1700 \times 1.00 \times 1.0$$

$$C_{S.ATS} = 1700$$

$$C_{S.PTSF} = 1700 \times 1.00 \times 1.0$$

$$C_{S.PTSF} = 1700$$

$$C_E = 1700$$

% Carril._S = 50.00%

% Carril._E = 50.00%

$$C_E = 1600$$

$$C_S = 1600$$

$$C_T = 3200$$

N. S. = D

ANEXO 05:
PANEL FOTOGRÁFICO

Fotografía 1. *Medición de condiciones de infraestructura (ancho de carril, ancho de berma y pendiente) y control (zonas de no rebase) en la vía PE-36 (Puno – Laraqueri)*



Nota. Elaboración propia.

Fotografía 2. *Medición de condiciones de infraestructura (ancho de carril, ancho de berma y pendiente) y control (zonas de no rebase) en la vía PE-3S (Puno – Juliaca)*



Nota. Elaboración propia.

Fotografía 3. *Medición de condiciones de infraestructura (ancho de carril, ancho de berma y pendiente) y control (zonas de no rebase) en la vía PE-3S (Puno – Ilave)*



Nota. Elaboración propia.

Fotografía 4. *Maniobra de adelantamiento en la vía PE-3S (Puno – Juliaca)*



Nota. Elaboración propia.

Fotografía 5. Cola de circulación generada por la presencia de vehículos pesados en la vía PE-3S



Nota. Elaboración propia.

Fotografía 6. Medición de condición de tránsito (porcentaje de vehículos pesados y reparto por sentidos) mediante aforo en la vía PE-36 (Puno – Laraqueri)



Nota. Elaboración propia.

Fotografía 7. *Medición de condición de tránsito (porcentaje de vehículos pesados y reparto por sentidos) mediante aforo en la vía PE-3S (Puno – Juliaca)*



Nota. Elaboración propia.

Fotografía 8. *Medición de condición de tránsito (porcentaje de vehículos pesados y reparto por sentidos) mediante aforo en la vía PE-3S (Puno – Ilave)*



Nota. Elaboración propia.