IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Design of Sewer Collection System for a Zone in Sagar City

[1]Shubham Patel, [2]Dr. Rakesh Mehar, [3] Prof. Deepak Sharma

[1]ME Scholar SATI Vidisha, [2]Assistant Professor SATI Vidisha, [3] Assistant Professor SATI Vidisha

[1]Department of Civil Engineering,

[1]SATI Vidisha, India

Abstract: Urbanization is a defining feature of the 21st century, with a rapidly growing global population increasingly gravitating towards cities. The allure of urban life is undeniable, offering economic opportunities, cultural richness, and a high standard of living. However, this relentless urban expansion brings with it a multitude of challenges, chief among them being the efficient management of municipal services, particularly the handling and treatment of wastewater.

The design of a sewer system is a cornerstone of urban infrastructure, integral to the health, well-being, and environmental sustainability of a community. It is a complex and multifaceted endeavor that demands meticulous planning, engineering ingenuity, and a deep commitment to safeguarding both public health and the environment. The modern sewer system is far removed from its historical counterparts, having evolved into a sophisticated network of conveyance and treatment facilities designed to mitigate the risks posed by untreated wastewater and stormwater runoff.

This thesis embarks on a comprehensive exploration of the design and optimization of a sustainable urban sewer system. It delves into the intricacies of a sewer system's components, from its initial planning and hydraulic modeling to the selection of materials and treatment technologies. The central focus is not just on functionality but on the integration of environmentally conscious and resource-efficient principles, aligning with the imperatives of our times.

As we stand at the intersection of rapid urbanization, climate change, and resource scarcity, the need for innovative, adaptable, and sustainable sewer systems has never been more pressing. This thesis seeks to contribute to the growing body of knowledge and practice in urban infrastructure design, offering insights and solutions that not only meet the current needs of our cities but also pave the way for resilient, eco-friendly, and forward-looking sewer systems capable of serving generations to come.

Index Terms – Sewer, Waste Water, Designing.

Introduction

Designing a sewer system is essential for several reasons, and it plays a crucial role in modern urban infrastructure and public health. Here are some of the primary needs and benefits of designing a sewer system:

Public Health Protection: Properly designed sewer systems help remove and transport wastewater, including human waste and industrial effluents, away from populated areas. This reduces the risk of waterborne diseases, which can be deadly and have widespread health consequences.

Environmental Protection: Sewer systems prevent the discharge of untreated or inadequately treated wastewater into natural water bodies, which can harm ecosystems, pollute surface and groundwater, and disrupt aquatic life. They play a critical role in preserving the environment and maintaining water quality.

Hygiene and Sanitation: Sewer systems contribute to improved sanitation by safely disposing of human waste and preventing its accumulation in communities. This is essential for maintaining cleanliness and hygiene in urban areas.

Urban Development: Effective sewer systems enable urban development and expansion. They provide the necessary infrastructure to support growing populations in cities and towns. Without proper sewage systems, urban areas can become unsanitary and unpleasant places to live.

Economic Benefits: A well-designed sewer system can lead to economic benefits by attracting businesses, investors, and residents to an area. It enhances the overall quality of life, which can stimulate economic growth and property values.

Flood Prevention: Properly designed sewer systems help manage stormwater runoff during heavy rainfall events, reducing the risk of flooding in urban areas.

Long-Term Planning: Designing a sewer system involves considering future growth and development. Well-designed systems can accommodate population increases and expansion, reducing the need for costly retrofits in the future.

Compliance with Regulations: Many countries and regions have regulations and standards in place that require the proper management and treatment of wastewater. Designing a sewer system that complies with these regulations is necessary to avoid legal issues and penalties.

Resource Recovery: Some sewer systems incorporate technologies for resource recovery, such as extracting energy from wastewater or harvesting nutrients for agricultural use. These innovations can contribute to sustainability and resource efficiency.

Reducing Environmental Impact: Proper sewer system design can help minimize the environmental impact of wastewater treatment facilities and sewage discharges, making them more energy-efficient and environmentally friendly.

In summary, designing a sewer system is essential for protecting public health, safeguarding the environment, promoting urban development, and ensuring the overall well-being of communities. It is a critical component of modern urban infrastructure that contributes to improved quality of life and sustainable growth.

I. Study Area

The Study has been carried out in a specific zone of Sagar District of Madhya Pradesh. Sagar District is a district in the Indian state of Madhya Pradesh. It is in the northern part of the state and is known for its historical and cultural significance, as well as its natural beauty. Sagar District is situated in the Bundelkhand region of Madhya Pradesh. It is characterized by a mix of rocky terrain, forests, and fertile plains. The district is crossed by several rivers, including the Sonar River and the Bina River, which are tributaries of the Yamuna River.

II. Population Projection

The zone under study cover ward No. 1 and 2 of Sagar Municipal Corporation. The population of these wards are projected for next 30 years considering the rate of growth of population as 20% per decade i.e the growth rate of Madhya Pradesh. The Total population of this zone was 7442 according to 2011 Census. The Pipes for sewer collection system are designed for 30 years i.e 2055. The population so projected is shown in the below Table:

Table 01 : Population Forecasting

Year	Population
2011	7442
2025	9466.224
2040	12645.446
2055	16666.27

III. Load Calculations:

The total designed population has been referred as total load. the pipes are designed for designed period of 30 years. total load for our zone is 16666 and for safe calculation it is taken as 17000. the load on each manhole has been detailed in below table:

Label	Stop Node	Length (Scaled) (m)	Load on Each Manhole
CO-1	MH-1	32.5	53.7723
CO-2	MH-2	31.2	51.6214
CO-3	MH-3	31	51.2905
CO-4	MH-4	14.7	24.3216
CO-5	MH-5	29	47.9815
CO-6	MH-6	40.4	66.8432
CO-7	MH-7	30.9	51.1251
CO-8	MH-8	27.5	45.4997
CO-9	MH-9	35.1	58.0741
CO-10	MH-10	10.4	17.2071
CO-11	MH-11	19.1	31.6016
CO-12	MH-12	9.4	15.5526
CO-13	MH-13	29.7	49.1396
CO-14	MH-14	32.5	53.7723
CO-15	MH-15	30.1	49.8015
CO-16	MH-16	12.1	20.0199
CO-17	MH-17	14.2	23.4944
CO-18	MH-18	11.1	18.3653
CO-19	MH-19	19.5	32.2634
CO-20	MH-20	18.7	30.9398
CO-21	MH-21	22	36.3997
CO-22	MH-22	17.6	29.1198
CO-23	MH-23	21.6	35.7379
CO-24	MH-24	23.3	38.5506
CO-25	MH-25	9.6	15.8835
CO-26	MH-26	24.7	40.867
CO-27	MH-27	15.9	26.3071
CO-28	MH-28	20.6	34.0834
CO-29	MH-29	28.7	47.4851
CO-30	MH-30	4.2	6.94904
CO-31	MH-31	9.1	15.0563
CO-32	MH-32	5.2	8.60357
CO-33	MH-33	27.4	45.3342
CO-34	MH-34	10	16.5453
CO-35	MH-35	21.3	35.2416
CO-36	MH-36	9.3	15.3872
CO-37	MH-37	32.1	53.1105
CO-38	MH-38	23.7	39.2124
CO-39	MH-39	29	47.9815
CO-40	MH-40	33.2	54.9305
CO-41	MH-41	16.9	27.9616
CO-42	MH-42	26.1	43.1833
CO-43	MH-43	22.3	36.8961
CO-44	MH-44	17.2	28.458
CO-45	MH-45	18.5	30.6089
CO-46	MH-46	20.2	33.4216
CO-47	MH-47	18.8	31.1052
CO-48	MH-48	28.9	47.816
CO-49	MH-49	13.4	22.1707
CO-50	MH-50	24.1	39.8743
CO-51	MH-51	31.3	51.7869

CO-52	MH-52	36.5	60.3905
CO-53	MH-53	33.8	55.9232
CO-54	MH-54	19.6	32.4289
CO-55	MH-55	25.2	41.6942
CO-56	MH-56	26.6	44.0106
CO-57	MH-57	32.7	54.1032
CO-58	MH-58	35.7	59.0668
CO-59	MH-59	39.1	64.6923
CO-60	MH-60	10.7	17.7035
CO-61	MH-61	33.6	55.5923
CO-62	MH-62	31.6	52.2833
CO-63	MH-63	32	52.9451
CO-64	MH-64	31.5	52.1178
CO-65	MH-65	37.3	61.7141
CO-66	MH-66	32.7	54.1032
CO-67	MH-67	19.9	32.9252
CO-68	MH-68	35.5	58.7359
CO-69	MH-69	35.4	58.5705
CO-70	MH-70	14.8	24.4871
CO-71	MH-71	23.4	38.7161
CO-72	MH-72	29	47.9815
CO-73	MH-73	29.7	49.1396
CO-74	MH-74	30.5	50.4633
CO-75	MH-75	25.3	41.8597
CO-76	MH-76	31.6	52.2833
CO-77	MH-77	23	38.0543
CO-78	MH-78	18.9	31.2707
CO-79	MH-79	30.5	50.4633
CO-80	MH-80	27.7	45.8306
CO-81	MH-81	31.5	52.1178
CO-82	MH-82	40.5	67.0086
CO-83	MH-83	7.2	11.9126
CO-84	MH-84	24.5	40.5361
CO-85	MH-85	18.1	29.9471
CO-86	MH-86	27	44.6724
CO-87	MH-87	25	41.3633
CO-88	MH-88	19.9	32.9252
CO-89	MH-89	38.8	64.1959
CO-90	MH-90	15.5	25.6453
CO-91	MH-91	21.2	35.0761
CO-92	MH-92	20.7	34.2488
CO-93	MH-93	30.1	49.8015
CO-94	MH-94	28.7	47.4851
CO-95	MH-95	31.4	51.9523
CO-96	MH-96	28.9	47.816
CO-97	MH-97	16.9	27.9616
CO-98	MH-98	30.8	50.9596
CO-99	MH-99	18.9	31.2707
CO-100	MH-100	26.1	43.1833
CO-101	MH-101	39.4	65.1886
CO-102	MH-102	23.3	38.5506
CO-103	MH-103	22.8	37.7234
CO-104	MH-104	26.6	44.0106
CO-105	MH-105	22.2	36.7306
CO-106	MH-106	31.7	52.4487
CO-107	MH-107	29.6	48.9742

CO-108	MH-108	33.8	55.9232
CO-109	MH-109	31.9	52.7796
CO-110	MH-110	31.2	51.6214
CO-111	MH-111	27.2	45.0033
CO-112	MH-112	31.9	52.7796
CO-113	MH-113	28.1	46.4924
CO-114	MH-114	25.7	42.5215
CO-115	MH-115	37.6	62.2105
CO-116	MH-116	22.7	37.5579
CO-117	MH-117	25.1	41.5288
CO-118	MH-118	23.1	38.2197
CO-119	MH-119	30.9	51.1251
CO-120	MH-120	35.9	59.3977
CO-121	MH-121	32.7	54.1032
CO-122	MH-122	21.3	35.2416
CO-123	MH-123	18.2	30.1125
CO-124	MH-124	26.5	43.8451
CO-125	MH-125	23	38.0543
CO-126	MH-126	29.9	49.4705
CO-127	MH-127	28.4	46.9887
CO-128	MH-128	27	44.6724
CO-129	MH-129	25.5	42.1906
CO-130	MH-130	16.2	26.8034
CO-131	MH-131	15.6	25.8107
CO-132	MH-133	51.9	85.8703
CO-133	MH-134	31.3	51.7869
CO-134	MH-134	54.3	89.8412
CO-135	MH-135	68.4	113.17
CO-136	MH-136	39.8	65.8504
CO-137	MH-137	52.1	86.2012
CO-138	MH-138	19.2	31.767
CO-139	MH-139	24.1	39.8743
CO-140	MH-140	29.4	48.6433
CO-141	MH-141	28.6	47.3197
CO-142	MH-142	21.1	34.9107
CO-143	MH-143	30.5	50.4633
CO-144	MH-144	18.2	30.1125
CO-145	MH-145	15.7	25.9762
CO-146	MH-146	27.3	45.1688
CO-147	MH-147	24.4	40.3706
CO-148	MH-148	18.1	29.9471
CO-149	MH-149	23.7	39.2124
CO-150	MH-150	25.9	42.8524
CO-151	MH-151	22	36.3997
CO-152	MH-152	19.5	32.2634
CO-153	MH-153	16	26.4725
CO-154	MH-154	19.5	32.2634
CO-155	MH-155	18.8	31.1052
CO-156	MH-156	26.5	43.8451
CO-157	MH-157	23	38.0543
CO-158	MH-158	30.3	50.1324
CO-159	MH-159	27.1	44.8379
CO-160	MH-160	29.6	48.9742
CO-161	MH-161	26	43.0179
CO-162	MH-162	28.5	47.1542
CO-163	MH-163	39.2	64.8577

CO-164	MH-164	57	94.3084
CO-165	MH-165	59.8	98.9411
CO-166	MH-166	64	105.89
CO-167	MH-167	46.1	76.274
CO-168	MH-168	60.2	99.6029
CO-169	MH-169	60.7	100.43
CO-170	MH-170	56.7	93.812
CO-171	MH-171	40.2	66.5122
CO-172	MH-172	23	38.0543
CO-173	MH-173	60.8	100.596
CO-174	MH-174	34.8	57.5778
CO-175	MH-175	40.6	67.1741
CO-176	MH-176	30.4	50.2978
CO-177	MH-177	40.7	67.3395
CO-178	MH-178	50.8	84.0503
CO-179	MH-179	27.4	45.3342
CO-180	MH-180	36.1	59.7287
CO-181	MH-181	26.4	43.6797
CO-182	MH-182	37.8	62.5414
CO-183	MH-183	27.3	45.1688
CO-184	MH-184	29.9	49.4705
CO-185	MH-185	62.4	103.243
CO-186	MH-186	9	14.8908
CO-187	MH-187	24.6	40.7015
CO-188	MH-188	21.2	35.0761
CO-189	MH-189	21.5	35.5725
CO-190	MH-190	35.8	59.2323
CO-191	MH-191	19	31.4361
CO-192	MH-192	21.3	35.2416
CO-193	MH-193	23.6	39.047
CO-194	MH-194	19.5	32.2634
CO-195	MH-195	23.3	38.5506
CO-196	MH-196	23.4	38.7161
CO-197	MH-197	18.3	30.278
CO-198	MH-198	18.1	29.9471
CO-199	MH-199	24.4	40.3706
CO-200	MH-200	34.7	57.4123
CO-201	MH-201	19.2	31.767
CO-202	MH-202	22	36.3997
CO-203	MH-203	24.1	39.8743
CO-204	MH-204	24.7	40.867
CO-205	MH-205	27.1	44.8379
CO-206	MH-206	28.3	46.8233
CO-207	MH-207	19	31.4361
CO-208	MH-208	32.9	54.4341
CO-209	MH-209	22.4	37.0615
CO-210	MH-210	34.8	57.5778
CO-211	MH-211	33.2	54.9305
CO-212	MH-212	23	38.0543
CO-213	MH-213	25.9	42.8524
CO-214	MH-214	21.4	35.407
CO-215	MH-215	24.4	40.3706
CO-216	MH-216	23	38.0543
CO-217	MH-217	13.9	22.998
CO-218	MH-218	14.4	23.8253
CO-219	MH-219	16.5	27.2998

CO-220	MH-220	22.1	36.5652
CO-221	MH-221	20	33.0907
CO-222	MH-222	19.4	32.0979
CO-223	MH-223	14.6	24.1562
CO-224	MH-224	18.8	31.1052
CO-225	MH-225	24.9	41.1979
CO-226	MH-226	21.3	35.2416
CO-227	MH-227	21.5	35.5725
CO-228	MH-228	26.4	43.6797
CO-229	MH-229	16.6	27.4653
CO-230	MH-230	34.7	57.4123
CO-231	MH-231	26.5	43.8451
CO-232	MH-232	26.3	43.5142
CO-233	MH-233	20.4	33.7525
CO-234	MH-234	39.7	65.685
CO-235	MH-235	26	43.0179
CO-236	MH-236	30	49.636
CO-237	MH-237	28.5	47.1542
CO-238	MH-238	27.7	45.8306
CO-239	MH-239	33.6	55.5923
CO-240	MH-240	29.2	48.3124
CO-241	MH-241	20.8	34.4143
CO-242	MH-242	26.7	44.176
CO-243	MH-243	17.4	28.7889
CO-244	MH-244	12.1	20.0199
CO-245	MH-245	31.9	52.7796
CO-246	MH-246	30.1	49.8015
CO-247	MH-247	38.5	63.6995
CO-248	MH-248	24.7	40.867
CO-249	MH-249	25.8	42.687
CO-250	MH-250	26.2	43.3488
CO-251	MH-251	26.1	43.1833
CO-252	MH-252	27	44.6724
CO-253	MH-253	25.6	42.3561
CO-254	MH-254	22.3	36.8961
CO-255	MH-255	29	47.9815
CO-256	MH-256	19	31.4361
CO-257	MH-257	33.4	55.2614
CO-258	MH-258	23	38.0543
CO-259	MH-259	22.4	37.0615
CO-260	MH-261	60.3	99.7684
CO-261	MH-262	53.1	87.8557
CO-262	MH-263	58.9	97.452
CO-263	MH-264	31.7	52.4487
CO-264	MH-265	47.4	78.4249
CO-265	MH-266	51	84.3812
CO-266	MH-267	41	67.8359
CO-267	MH-268	59.6	98.6102
CO-268	MH-269	69.1	114.328
CO-269	MH-270	52.2	86.3666
CO-270	MH-271	38	62.8723
CO-271	MH-272	48	79.4176
CO-272	MH-273	59.6	98.6102
CO-273	MH-274	55.7	92.1575
CO-274	MH-275	71.1	117.637
CO-275	MH-276	76	125.745

CO-276	MH-277	30.9	51.1251
CO-277	MH-278	62.9	104.07
CO-278	MH-278	16.3	26.9689
CO-279	MH-279	7.5	12.409
CO-280	MH-280	33.7	55.7578
CO-281	MH-281	25.7	42.5215
CO-282	MH-282	29.3	48.4778
CO-283	MH-283	20.5	33.9179
CO-284	MH-284	24.6	40.7015
CO-285	MH-285	14.9	24.6525
CO-286	MH-286	14.1	23.3289
CO-287	MH-287	26.2	43.3488
CO-288	MH-288	24.1	39.8743
CO-289	MH-289	30.3	50.1324
CO-290	MH-290	9.2	15.2217
CO-291	MH-291	17.4	28.7889
CO-292	MH-292	25.6	42.3561
CO-293	MH-293	42.6	70.4831
CO-294	MH-294	29.6	48.9742
CO-295	MH-295	32.3	53.4414
CO-296	MH-296	29.3	48.4778
CO-297	MH-297	20.8	34.4143
CO-298	MH-298	20.3	33.587
CO-299	MH-299	34	56.2541
CO-300	MH-300	37	61.2177
CO-301	MH-301	33.7	55.7578
CO-302	MH-302	31.8	52.6142
CO-303	MH-303	32.5	53.7723
CO-304	MH-304	33	54.5996
CO-305	MH-305	26.5	43.8451
CO-306	MH-306	19.9	32.9252
CO-307	MH-307	17.2	28.458
CO-308	MH-308	33.1	54.7651
CO-309	MH-309	48.7	80.5758
CO-310	MH-310	38.1	63.0377
CO-311	MH-311	56.5	93.4811
CO-312	MH-312	54.6	90.3375
CO-313	MH-313	61.4	101.588
CO-314	MH-314	39	64.5268
CO-315	MH-315	58.2	96.2938
CO-316	MH-316	46.2	76.4394
CO-317	MH-317	28.2	46.6578
CO-318	MH-318	38.5	63.6995
CO-319	MH-319	12	19.8544
CO-320	MH-321	61.6	101.919
CO-321	MH-322	48.9	80.9067
CO-322	MH-323	38.7	64.0304
CO-323	MH-324	35.3	58.405
CO-324	MH-325	39.3	65.0232
CO-325	MH-326	42	69.4904
CO-326	MH-327	43.7	72.3031
CO-327	MH-328	32.1	53.1105
CO-328	MH-329	33.2	54.9305
CO-329	MH-329	67.3	111.35
CO-330	MH-330	56.5	93.4811
CO-331	MH-331	40.8	67.505

CO-332	MH-332	15.5	25.6453
CO-333	MH-333	28.9	47.816
CO-334	MH-334	29.7	49.1396
CO-335	MH-335	29.1	48.1469
CO-336	MH-336	27.3	45.1688
CO-337	MH-337	28	46.3269
CO-338	MH-338	13.6	22.5017
CO-339	MH-339	17.9	29.6161
CO-340	MH-340	26.1	43.1833
CO-341	MH-341	41.7	68.994
CO-342	MH-342	21.7	35.9034
CO-343	MH-343	21.8	36.0688
CO-344	MH-344	15.4	25.4798
CO-345	MH-345	23.1	38.2197
CO-346	MH-346	29.2	48.3124
CO-347	MH-347	20.5	33.9179
CO-348	MH-348	29.8	49.3051
CO-349	MH-349	29.7	49.1396
CO-350	MH-350	24.8	41.0324
CO-351	MH-351	33.7	55.7578

IV. Result and Conclusion:

Conduit (CO-)- A "conduit" typically refers to the pipes or channels that are used to carry wastewater and sewage away from homes, businesses, and other sources to a treatment facility or disposal site. Sewer conduits play a crucial role in managing sanitation and public health by transporting and containing sewage and wastewater. The total Length of Conduits is 10275 m. The diameter varys from 150 mm to 250 mm. The Conduit used are DWC-HDPE Pipes.

Manhole (MH-)- A manhole in a sewer system is an access point or opening designed to allow personnel to enter, inspect, maintain, and clean the sewer infrastructure below ground. Manholes are an essential component of sewer systems and serve several important purposes. 351 nos. of Manhole are proposed whose depth vary from 0.9 m to 5.9 m.

The "elevation of the ground" refers to the height or altitude of a specific point on the Earth's surface relative to a reference point, often called sea level. It is a fundamental measurement used in geography, geology, civil engineering, and other fields.

The term "invert level" in the context of sewer systems refers to the elevation or height of the inside bottom surface of a pipe or conduit. It is an important measurement used in sewer design and construction because it helps determine the slope or gradient of the sewer pipe, which is crucial for the proper flow of wastewater within the system.

DWC (Double Wall Corrugated) HDPE (High-Density Polyethylene) pipes are commonly used in sewer systems for their durability, corrosion resistance, and cost-effectiveness.

References

[1] Murugesh Katti 2015.comparative study of sewer version 3.0 and sewergems v8i softwares for sanitary sewer network design

[2] Uditi Chaudary 2020 Sanitary Gravity Sewer Design using Sewer GEMS Software Connect Edition for Utsav Vihar, Karala.

[3] Hinal Sopariya 2018 ANALYSIS AND DESIGN OF SEWER NETWORK USING SewerGEMS