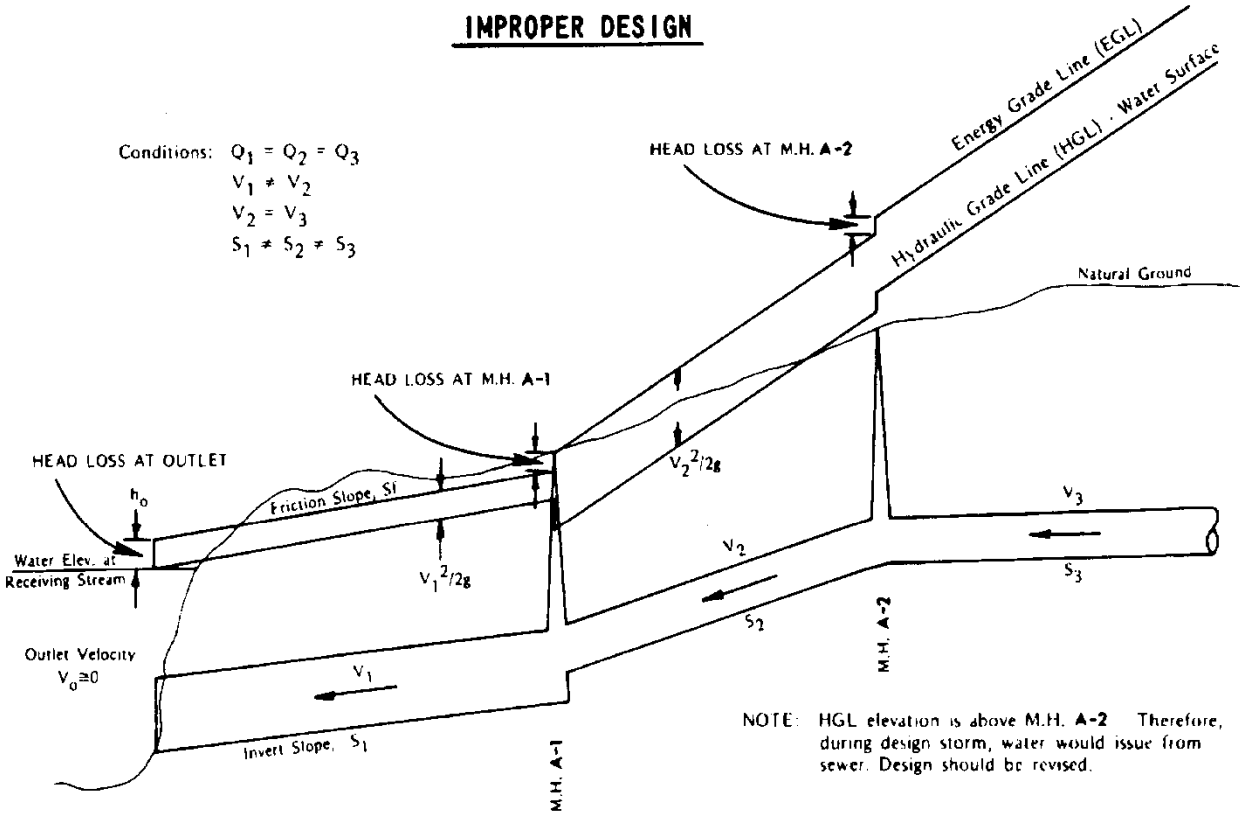
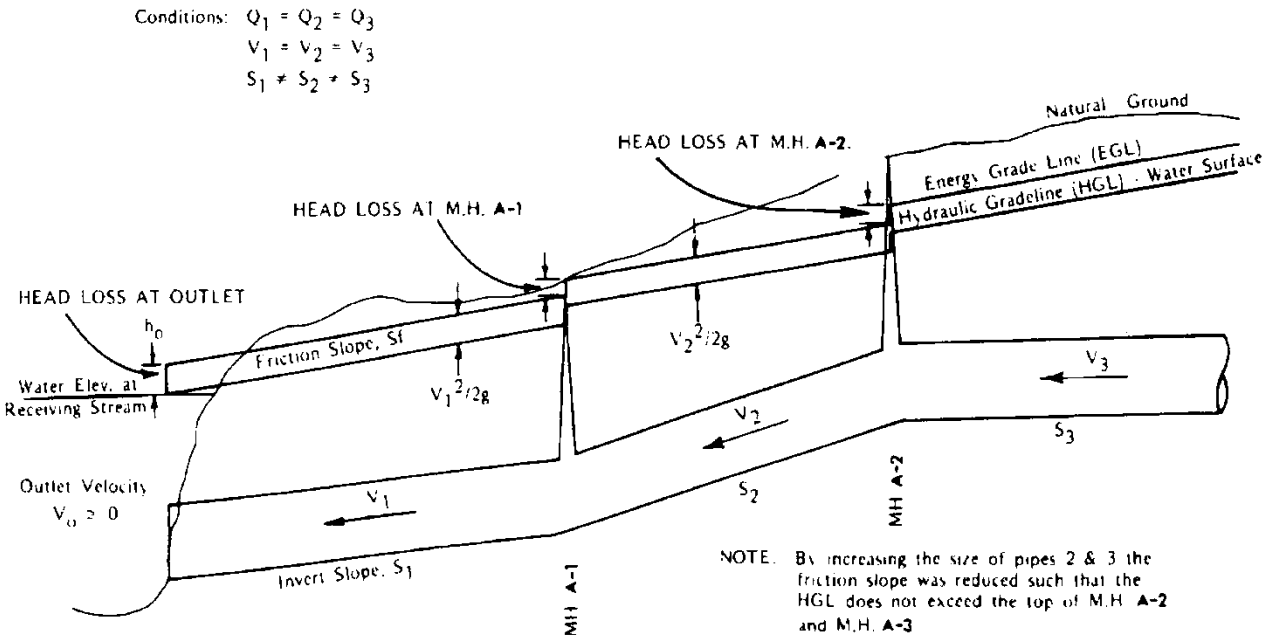
# Energy and Hydraulic Grade Lines for a Properly and Improperly Designed Storm Sewer

## IMPROPER DESIGN




## PROPER DESIGN



# WORK SHEET FOR STORM SEWER DESIGN

SURCHARGED FLOW

PROJECT_____ ROAD_____ COUNTY_____ DESIGN FREQUENCY _____YR

COMPUTED BY_____ DATE_____ CHECKED BY_____ DATE_____

| Location | | Pipe Data | | | Velocity Head | | | | Pipe Head Losses | | | | Structure Head Losses | | Gradeline Elev. at Structure | | Vertical Control | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station of Structure | Structure Type & No. | Discharge | Pipe Size | Pipe Length | Mean Pipe Velocity | Pipe Velocity Head | Mean Channel Velocity | Channel Velocity Head | Coeff. K Bend Loss | Bend Energy Loss | Friction Slope | Friction Head Loss | Coeff. K Structure | Structure Energy Losses | E.G.L. Down-stream / Up-stream | H.G.L. Down-stream / Up-* stream | Invert Elev. Down-stream / Up-stream | Top of Struc. Elev. | Free-board |
| | | Q | | | $V_1$ | $V_1^2/2g$ | $V_2$ | $V_2^2/2g$ | $K_b$ | | $S_o$ | | K | | | | | | |
| | | cfs | in. | ft. | fps | ft. | fps | ft. | | ft. | ft/ft | ft. | | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| | | | | | | | | | | | | | | | | | | | |
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* water surface elevation in structure.

# SURCHARGED FULL SEWER DESIGN PROBLEM

## WORK SHEET FOR STORM SEWER DESIGN

SURCHARGED FLOW

PROJECT 2400-1-00 ROAD ALMA DRIVE COUNTY MILWAUKEE DESIGN FREQUENCY 10 YR

COMPUTED BY D. J. S. DATE 10-16-78 CHECKED BY F. D. S. DATE 10-17-78

| Location | | Pipe Data | | | Velocity Head | | | | Pipe Head Losses | | | | Structure Head Losses | | Gradeline Elev. at Structure | | Vertical Control | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station of Structure | Structure Type & No. | Discharge | Pipe Size | Pipe Length | Mean Pipe Velocity | Pipe Velocity Head | Mean Channel Velocity | Channel Velocity Head | Coeff. K Bend Loss | Bend Energy Loss | Friction Slope | Friction Head Loss | Coeff. K Structure | Structure Energy Losses | E.G.L. Down-stream / Up-stream | H.G.L. Down-stream / Up-stream* | Invert Elev. Down-stream / Up-stream | Top of Struc. Elev. | Free-board |
| | | Q | | | $V_1$ | $V_1^2/2g$ | $V_2$ | $V_2^2/2g$ | $K_b$ | | $S_o$ | | K | | | | | | |
| | | cfs | in. | ft. | fps | ft. | fps | ft. | | ft. | ft/ft | ft. | | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 29+20 | River Outlet | | | | | | | | | | | | 1.00 | 1.55 | 990.50 / 992.05 | 990.50 / 990.50 | 986.32 / " | | |
| | | 71 | 36 | 220 | 10.0 | 1.55 | - | - | - | - | .0109 | 2.40 | | | | | | | |
| 27+00 | M.H. A-4 | | | | | | | | | | | | 0.71 | 1.10 | 994.45 / 995.55 | 992.90 / 994.47 | 988.74 / " | | |
| | | 59 | 36 | 480 | 8.3 | 1.08 | - | - | - | - | .0077 | 3.70 | | | | | | | |
| 22+20 | M.H. A-3 | | | | | | | | | | | | | | | | | | |
| 29+20 | River Outlet | | | | | | | | | | | | 1.00 | 1.55 | 990.50 / 992.05 | 990.50 / 990.50 | 986.32 / " | | |
| | | 71 | 42 | 220 | 7.4 | 0.85 | - | - | - | - | .0047 | 1.30 | | | | | | | |
| 27+00 | M.H. A-4 | | | | | | | | | | | | 0.30 | 0.26 | 993.88 / 993.34 | 992.23 / 992.26 | 988.74 / " | 994.00 | 1.74 |
| | | 59 | 36 | 480 | 8.3 | 1.08 | - | - | - | - | .0077 | 3.70 | | | | | | | |
| 22+20 | M.H. A-3 | | | | | | | | | | | | 0.71 | 0.77 | 997.04 / 997.81 | 995.96 / 997.09 | 993.06 / " | 998.20 | 1.11 |
| | | 48 | 36 | 480 | 6.8 | 0.72 | - | - | - | - | .0048 | 2.30 | | | | | | | |
| 17+40 | M.H. A-2 | | | | | | | | | | | | 0.71 | 0.51 | 1000.11 / 1000.62 | 999.39 / 999.92 | 997.38 / 998.38 | 1002.3 | (3) |
| | | 21 | 24 | 480 | 6.7 | 0.71 | - | - | - | - | .0081 | 3.89 | | | | | | | |

* water surface elevation in structure.

(1) K Coeff's obtained from Ref. 2, FDM 13-25-35.

(2) Water surface above M H. Cover A-4. Replace downstream pipe with next larger pipe.

(3) Free water surface within conduit. Discontinue calculations or use normal depth of flow within conduit for further calculations.