MTO and Gravity Pipe

Provincial Highways:

- Approximately 16,500 km make up the provincial highway network
- Use pipes to drain runoff from the highway surface through storm sewers
- Ensure highway base is adequately drained through sub drain pipes
- Pass river, stream and overland flows under highways through culverts
- Convey flow in roadside ditches under entrances and ramps with culverts
Major Pipe Materials Used on Highway Projects.

- Concrete Pipe
- Steel Pipe
- HDPE Pipe
- PVC Pipe

Performance of Pipe Materials

**END RESULT:** COSTLY REPAIRS, HIGHWAY CLOSURES, ROAD USER INCONVENIENCE, DAMAGE TO THE ENVIRONMENT, ETC.
Why the Need for Gravity Pipe Design Guidelines?

- Address and define owner requirements and product life expectations.
- Provide a consistent design process and methodology to apply to all drainage system designs.
- Ensure that a fair and equitable assessment for all pipe materials is based on:
  - Appropriateness of Pipe Material for:
    - Site Conditions;
    - Performance Expectations; and
    - Service Life Expectancy.
  - Hydraulic Design Requirements;
  - Structural Design Requirements; and
  - Life Cycle Cost benefits for alternative solutions.

Why the Need for Gravity Pipe Design Guidelines?

- Recognize the advances made by all industries to introduce new products to meet the challenges and needs of road authorities, which include:
  - Sulphur resistant concrete mixes;
  - Higher grade plastic pipe materials;
  - Aluminized and polymer laminated galvanized steel pipes; and
  - Larger diameter plastic pipes.
- Recognize and use the right material to meet environmental challenges affecting each type of pipe material.
- Ensure that all pipe materials are used appropriately on highway projects.
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- New guidelines address the issues as identified.
- Was developed with the assistance of industry representatives from the 4 major pipe producers in the province.
- Sets a framework for new pipe products, in the future, to be introduced for use on highway networks in the province.

The new design process is built on the basis of elimination rather than choice. All acceptable pipe materials are the final output. (Chapter 1)
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The process of elimination was developed based on:

- **Design Service Life (DSL) – Owner Requirements**
- **Pipe Material Size – Hydraulic Requirements**
- **Estimated Service Life (EMSL) – Durability Requirements**
- **Cover Availability – Structural Requirements**
- **Cost Assessment – Life Cycle Cost Assessment (LCCA) Requirements**
- **Final Pipe Selection – Fair and Equitable Assessment Requirements**

### Owner Requirements

**Owner Requirements**: Design Service Life (DSL) expected for various types of facilities. Set by designer at initial stages of the project. (Chapter 1, 2, Appendix C)

<table>
<thead>
<tr>
<th>Application</th>
<th>Gravity Pipe Systems (Storm Sewers and Culverts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway Facility</td>
<td>Freeway</td>
</tr>
<tr>
<td>Design Service Life (years)</td>
<td>75</td>
</tr>
</tbody>
</table>

DSL is determined at the onset of the project. The DSL value that is selected should be based on the type of project, future changes in the area or to the facility itself. In addition, replacement options may be deemed to be appropriate and should be set at this time.
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**HYDRAULIC REQUIREMENTS:** Pipe size availability (Chapter 5)

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Table 1: Concrete Pipe Schedule Availability</th>
<th>Table 2: Steel Pipe Schedule Availability</th>
<th>Table 3: PVC Pipe Schedule Availability</th>
</tr>
</thead>
</table>

### STEEL

- HDPE
- OPSICO
- PVC

**DURABILITY REQUIREMENTS:** Estimated Material Service Life (EMSL) for each type of pipe material given site conditions. HDPE and PVC have been accepted for 75 years EMSL. (Chapters 3, 4 and 7, Appendices B, C and D)

- pH, resistivity, hardness, soil reduction of acidity
DURABILITY REQUIREMENTS: Estimated Material Service Life (EMSL) for each type of pipe material given site conditions. HDPE and PVC have been accepted for 75 years EMSL. (Chapters 3, 4 and 7, Appendices B,C and D)

STRUCTURAL REQUIREMENTS: Defines the maximum and minimum fill heights required for each pipe material. (Chapter 6)
LCCA REQUIREMENTS: Defines how to undertake a Life Cycle Cost Analysis which was defined during Owner Requirements. (Chapter 8)

\[ \text{PVLCC} = \text{PVIC} + \sum (\text{PVM} + \text{PVN} + \text{PVR}) - \text{PVT} \]

Where
- \( \text{PVLCC} \) = present value life cycle cost
- \( \text{PVIC} \) = present value initial cost
- \( \text{PVM} \) = present value operation and maintenance cost
- \( \text{PVN} \) = present value rehabilitation cost
- \( \text{PVR} \) = present value replacement cost
- \( \text{PVT} \) = present value terminal value

This analysis required when alternatives with EMSL < DSL criteria are being considered.

EXAMPLES: Worked examples have been provided to assist the designer in using the new process on their own projects. (Appendix A)

EXAMPLE 1

- [Description of the example, including relevant equations and calculations]
**MTO and Gravity Pipe**

**EXAMPLES:** Worked examples have been provided to assist the designer in using the new process on their own projects. (Appendix A)

<table>
<thead>
<tr>
<th>Station</th>
<th>12+250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>85.0 m</td>
</tr>
<tr>
<td>Design</td>
<td>900.0 mm</td>
</tr>
<tr>
<td>Diameter</td>
<td>900.0 mm</td>
</tr>
</tbody>
</table>

**FINAL PIPE SELECTION:** Fair and equitable process provides a complete list of acceptable pipes from which contractor may select from.

<table>
<thead>
<tr>
<th>Smooth Inside Wall</th>
<th>Corrugated Inside Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
<td><strong>Diameter # Barrels</strong></td>
</tr>
<tr>
<td>HDPE</td>
<td>900.0 1.0</td>
</tr>
<tr>
<td>HDPE</td>
<td>910.0 1.0</td>
</tr>
</tbody>
</table>
This is all very nice information you’re telling me, but most of my work deals with petition drains, municipal drainage works and other such projects, not doing drainage system designs for provincial highways. What good are these MTO Gravity Pipe Design Guidelines to me and the type of work that I’m in?

Benefits of New Gravity Pipe Design Guidelines

- Substitute appropriate DSL requirements for your own projects and follow the process;
- Able to meet DSL requirements of other owner’s infrastructure that you may intersect with (MTO highways);
- Supported by the 4 major pipe producers in the province;
- First comprehensive design document that incorporates hydraulic, structural and durability analysis into the design product, along with LCCA;
- Promotes healthy competition in the pipe material manufacturing marketplace leading to value priced drainage systems; or
- Provides a framework to assist in the introduction of new pipe products designed to meet the challenges of the future.
That sounds great. Where can I get my copy of the MTO Gravity Pipe Design Guidelines? I’d like to start using it on some of the projects that I’m currently involved with.

Status of the Guidelines
- In final stages of approval to be published (Nov/Dec 2005);
- Will only be available on the MTO public government website in the Drainage Management area;
- A download option will be made available should one desire a hard copy;
- Implementation into MTO’s planning and design practices in early 2006
- The second phase of the project, which is the software design component, will begin shortly and is anticipated to be completed by the end of 2006 or early 2007.
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- Alex Sandovski, PVC, IPEX Inc.