2. SITE CONSIDERATIONS

2.1 Criteria

The greatest opportunity to realize the economy and benefit of using the CON/SPAN System is during the conceptual stage of a project. Parameters established during this phase are important to ensure an effective design. Right-of-way restrictions, hydraulic requirements, road geometry, safety requirements and soil conditions must all be addressed during this process. Some sites require special sensitivity to environmental issues and these must be addressed during the planning phase to ensure that the designs selected are appropriate for the sites. The procedure outlined below identifies some of the important steps that may be followed when siting a CON/SPAN installation. Fig. 2-1 illustrates key geometric features that need to be considered in siting a CON/SPAN installation.

2.2 Procedure

1. Alignments

Begin with horizontal and vertical alignments of the roadway and streambed.

2. Footing Depth

Establish bottom of footing elevation based on scour, frost and geotechnical considerations.

3. Culvert Size & Number of Cells

Determine size of the structure based on:

- Hydraulic capacity requirements
- Culvert width and height limits governed by site restraints
- High water elevation and freeboard requirements
- Economics of shape (i.e. span vs rise, footing thickness, pedestal walls, etc.)

4. Elevations & Slopes

Define roadway width and berm lines, supported with spot elevations.
Define toe of stream bank, supported with spot elevations.
Define cross slopes of roadway embankment and stream bank.

5. Length of Culvert

Determine length of structure. This will be dictated by berm elevation, headwall elevation and roadway embankment slope. It is desirable to make length of structure an even increment of unit lengths. In most situations it is important to extend the culvert to beyond the roadway embankment using a maximum height between top of footing and top of headwall of 4.0 m. Reducing the length of the culvert by using higher headwalls and wingwalls is usually not an economical option. The costs of constructing higher headwalls and wingwalls with larger foundations must be compared to the costs of installing additional precast culvert units for a slightly longer culvert.

6. Wingwalls

Determine lengths and slopes of wingwalls. Note that when a culvert must be sloped with the grade of the stream, wingwall footings must be constructed on the same plane as culvert footings. In such a case ends of the culvert and face of headwalls will not be vertical, unless the end units or wingwalls and headwalls are specially modified to accommodate this feature.

7. Headwall

Determine top of headwall elevations from height and slope of structure. For installations on strip footings, the structure should be kept level if the stream grade permits to ease construction and installation.

8. Depth of Cover

Ensure the culvert has adequate depth of cover. A minimum of 600 mm cover from top of culvert to top of pavement is recommended to provide a favourable wheel load distribution and also for pavement performance considerations. More shallow cover can be accommodated, but under these conditions, the culvert is subjected to a less favourable wheel load distribution and it becomes necessary to provide a "distribution slab" over the culvert. Protection of the culvert reinforcing steel also becomes important with shallow cover. Shallow cover over culverts are evaluated and given special consideration on a site-specific basis. Higher cover will yield better pavement performance. Frost protection requirements, where applicable, must also be met.

The geometry, thickness of precast concrete component and amount of reinforcing steel limit the maximum depth of cover for the various span configurations. The recommended depth of cover for each span are presented in Table 2.1. Consideration can be given to maximize these design depths.

Span (mm)	Maximum Depth of Cover (mm)
4880	6000
6100	5000
7315	4000
8535	5000
9755	4000
10957	3000

Table 2.1: Depth of Cover Limitations

Details associated with guide rail provisions may also affect depth of cover requirements, see Fig. 2-2.

9. Skews

To accommodate skewed culvert ends, consideration may be given to increasing the length of culvert while maintaining square end units. This simplifies structural details and provides cost savings through the use of shorter headwalls and wingwalls. Skewed end units can be accommodated to a limited degree. Limitations pertaining to culverts with skewed ends are discussed in Section 7.

10. Curved Alignment

If the culvert is set on a curved horizontal alignment, the CON/SPAN units can be modified to incorporate skew units to match the required curvature, see Fig. 7-2.

11. Additional Considerations

Additional considerations may include: Established Right of Ways and Live Loading Effects.

2.3 Supporting Information

With the general arrangement complete, the design process cannot proceed further without the necessary supporting information of a soils report. The information provided by a soils report is commonly based on boreholes located at the CON/SPAN site that extend well below the anticipated bottom of footing. For design purposes, ideal information expected by a soils report, in no particular order, is listed below.

1. Bearing capacity of the soil at Serviceability Limit States (SLS) and Ultimate Limit States (ULS).

2. A recommended footing elevation and expected footing types, such as spread footings being acceptable, or alternatively, that a pile foundation is recommended.

3. Friction Factor against sliding for the underside of the footing for SLS and ULS.

4. Coefficient of Horizontal Earth Pressure (Ko) to be used for design, along with a value for the density of the soil.

5. Groundwater is not usually a design issue due to the free-draining characteristics of the CON/SPAN System, however, the soils report may suggest recommendations otherwise.

6. Anticipated type of backfill for the arches and wingwalls, and the required compaction. If applicable, this information can be transferred to shop drawings from the CON/SPAN manufacturer to reflect the requirements of the contract.

7. Plan showing the location of where the boreholes were taken relative to the CON/SPAN.

8. For precast wingwalls, the type of backfill must be specified, the Angle of Internal Friction (q), and Wall Friction Angle (D).

9. Other pertinent information the soils consultant thinks is relevant, such as location of bedrock, etc.