Design of Anchoring Systems for Public Utilities on Bridges

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Scope of Presentation

- Historical Background
- CERIU's Mandate
- Public Utilities Management Dynamics
- Project Chart
- Scope of Work
- Value Engineering Analysis
- End Results
- Conclusion

Historical Backround

- **Technical aspects:**
  - Bridge Owners do not want P.U.'s on bridges
  - P.U.'s do not want to be on bridges
  - Accelerated deteriorations observed on structures
  - Inspection and maintenance activities harder to achieve
  - Rehabilitation works more complex

Historical Backround (cont'd)

- **Management aspect**
  - P.U.'s legally bound to deliver services
  - P.U.'s legally allowed to use Public Right-of-Ways
  - P.U.'s obliged to obtain Public Authority's Consent
  - Overcosts for everyone

CERIU's Mandate

- Public Utilities Work Group animation since 1995
- 1996: Official partnership with MTQ, Cities, Hydro-Québec, Bell, Gaz Metro, Videotron, Electrical Commission of Montreal
- 1998: Publication of « Management Guide for Public Utilities in Public Right-of-Ways»
- 2002: Creation of Public Utilities Permanent Advisory Committee

Management Guide for Public Utilities in Public Right-of-Ways

- **Consultation Processes**
  - General Planning
  - Networks Design
  - Joint Construction
  - Maintenance

CERIU's Mandate (cond't)

« Course of activities show that in presence of…

- A common situation or problem
- A real spirit of partnership
- A common will of putting the real problem on the table and
- A common will of finding the best solution

…everything is possible »

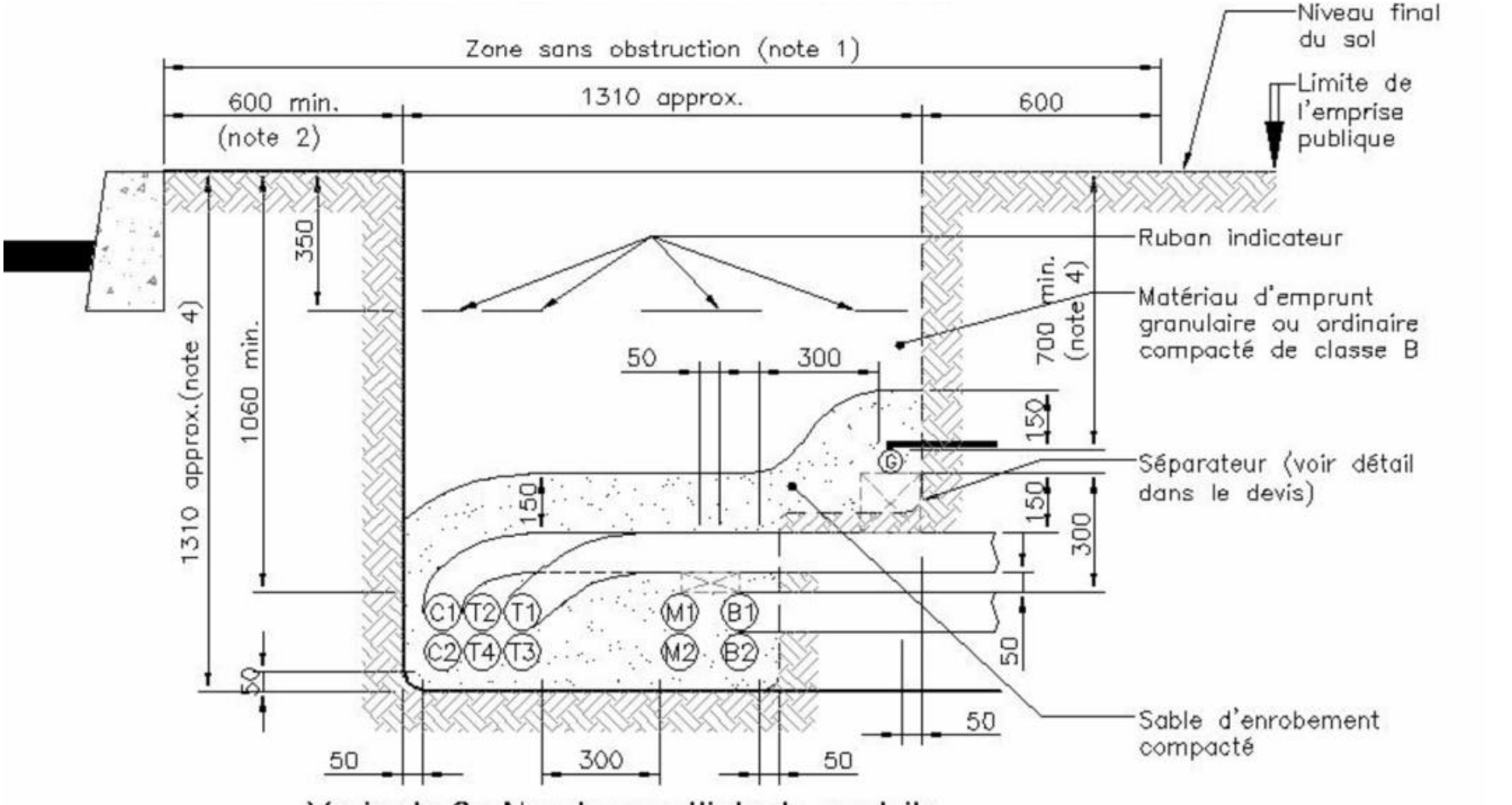
Public Utilities Management Dynamics

- Annual Action Plan According to Partnership Priorities
- 2002-2003 Public Utilities Action Plan
- Anchoring Systems for Public Utilities on Bridges
  - Projet Chart

2002-2003 Public Utilities Action Plan

- Common Trenches
- Joint Distribution Pole
- Provincial Specs for Excavation and Backfilling P.U.’s
- Anchoring Systems of Public Utilities on Bridges

Common Trenches



Variante 2 : Nombre multiple de conduits

Joint Distribution Pole

Project Chart

- Goal
  - Improve practices related to installation and maintenance of Public Utility’s ducts and pipes on bridges

Project Chart (cont'd)

- Objectives
  - To create a joint engineering process
  - To introduce innovations towards best practices of all partners
  - Standardize practices on the subject

Project Chart (cont'd)

- Benefits
  - Improve life-span performance of bridges through less and better interventions such as ducts displacements and overall works around them
  - Reduce treatment for installation requests of Public Utilities on bridges

Scope of Work

- Identification of Issues
- Technological Research
- Functional Analysis
  - Identification of Functions
  - Identification of Evaluation Criteria
  - Identification of Flexibility Index
- Weighting of Criteria
- Preliminary Identification of Existing Systems
- Systems Evaluation
- Official Fonctionnal Chart
- Joint Engineering Process
- Report

Technological Research

- Quebec, Canada, USA and Europe
- 40 pertinent documents
  - 19 - Guides and Standards
  - 3 - Value Engineering
  - 15 - Plans and Project Reports
  - 3 - Suppliers Guide and Manuals

Functional Analysis

1	**Visual Impacts**	- Discretion - Blending in	Flex: 2 Flex: 2
2	**Vandalism**	- Limited access - Damage prevention - Least identification	Flex: 1 Flex: 1 Flex: 1
3	**Lay-Out**	- Unconfined gaz pipe - As straigh as possible - Resist floods load - Respect clearance - Respect CSA standards	Flex: 0 Flex: 1 Flex: 1 Flex: 0 Flex: 0
4	**Type of Ducts**	- Corrosion free - Stain less - Reduce transmission of vibrations - Free damage-less expansion - Weather resistant	Flex: 1 Flex: 1 Flex: 1 Flex: 0 Flex: 0

Functional Analysis (cont'd)

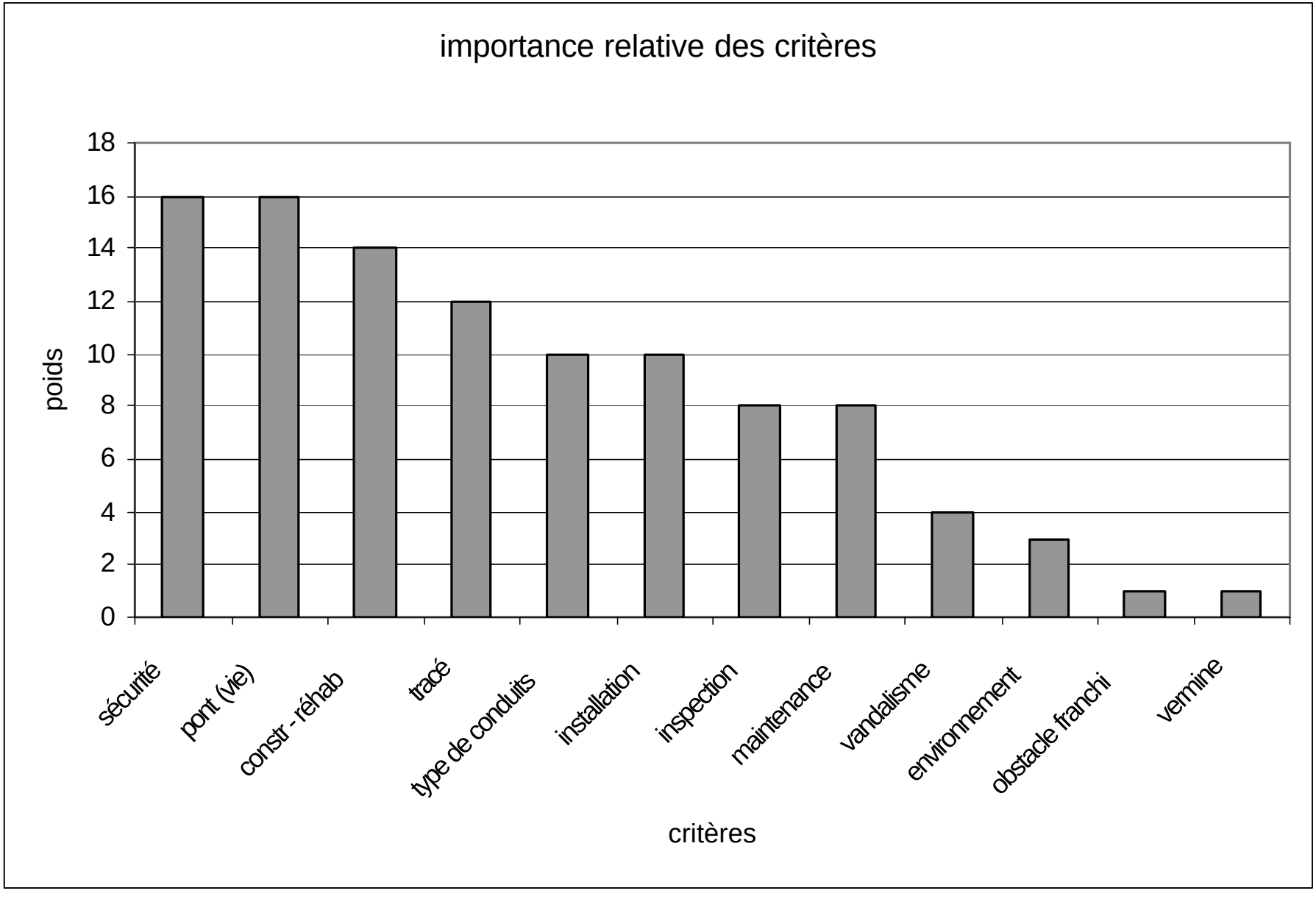
5	**Type of Obstacle Cleared**		Flex: 3
6	**Vermin Control**	- Resist bites and droppings - Reduce nesting	Flex: 1 Flex: 3
7	**Safety Issues**	- Non-interruption of P.U.'s services - No Impact on bridge uses - No Impact on circulation under the bridge	Flex: 1 Flex: 1 Flex: 0
8	**Life Span of Bridge**	- Anchorage holes localization - No welding - Ducts weight < 10% Residual Bridge Capacity - Structural Analysis FCS < 1	Flex: 0 Flex: 1 Flex: 0 Flex: 0

Functional Analysis (cont'd)

9	**Maintenance and Rehab.**	- Allow replacement of slab - Allow replacement of sidewalk - Reduce ducts displacements - Ease temporary displacements	Flex: 0 Flex: 1 Flex: 1 Flex: 1
10	**Anchorage System Installation**	- Repeatable - Respect standards - Offer spare spaces - Regroup ducts & pipes	Flex: 2 Flex: 0 Flex: 1 Flex: 1
11	**Inspection**	- Allow "Finger on the spot" P.U.'s inspections - Allow "Finger on the spot" bridge inspections - Ergonomics considerations	Flex:1 Flex:1 Flex:1
12	**Standards**	- Respect all CSA S6 standards	Flex:0

		vandalisme	tracé	type de conduits	obstacle franchi	vermine	sécurité	pont (vie)	constr - réhab	installation	inspection	maintenance	normes	RÉSULTAT	%	POIDS
E	environnement	2V	3T	3C	2E	2E	3S	3P	3CR	3IN	2IP	2M		4	2,7%	3
V	vandalisme		2T	3C	2V	2V	3S	3P	3CR	3IN	3IP	3M		6	4,1%	4
T	tracé			3T	3T	3T	1S	2P	2CR	1T	1T	1T		17	11,6%	12
C	type de conduits				3C	3C	1S	2P	2CR	1C	1C	1C		15	10,2%	10
O	obstacle franchi					1O	3S	3P	3CR	3IN	3IP	3M		1	0,7%	1
VE	vermine						3S	3P	3CR	3IN	3IP	3M		0	0,0%	1
S	sécurité							1S	1S	2S	3S	2S		23	15,6%	16
P	pont (vie)								1P	2P	3P	2P		24	16,3%	16
CR	constr - réhab									2CR	1CR	1CR		20	13,6%	14
IN	installation										1IN	1IN		14	9,5%	10
IP	inspection											1M		11	7,5%	8
M	maintenance													12	8,2%	8
N	normes	CONDITION SINE QUA NON													100,0%	

TOT 147


importance relative des critères
poids
18
16
14
12
10
8
6
4
2
0
sécurité
pont (vie)
constr - réhab
tracé
type de conduits
installation
inspection
maintenance
vandalisme
environnement
obstacle franchi
vermine
critères

Systems Evaluation

- **Preliminary Selection**
  - 11 systems selected
  - Evaluation According to Functions

    (weight X score) = merit
  - Individual Evaluation

Rapport d'évaluation des systèmes d'ancrages sélectionnés

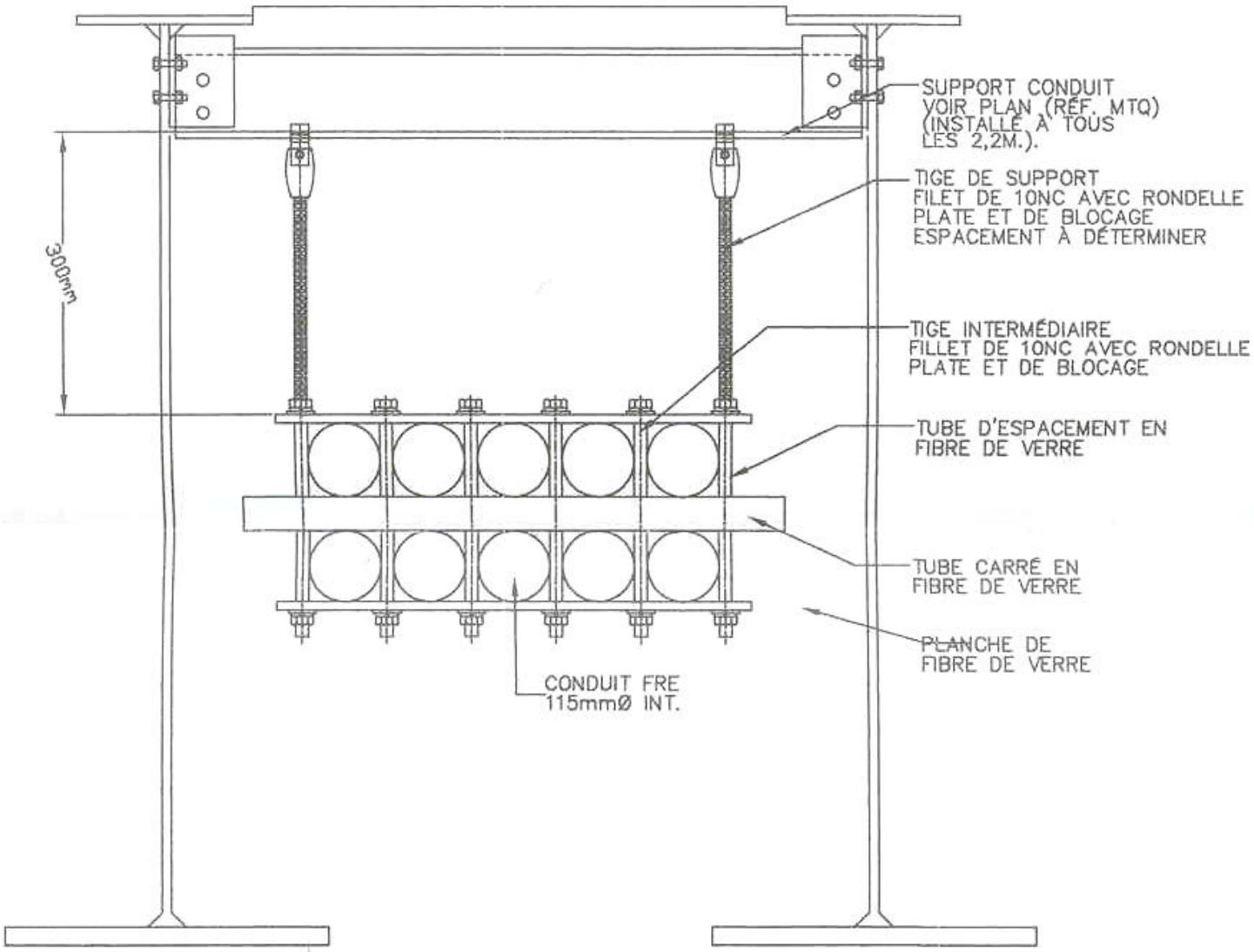
	Système A	Système B	Système C	Système D	Système E	Système F	Système G	Système H	Système I	Système J	Système K
H-Q	537	746	726	744	780	740	821	844	712	809	728
Bell	700	741	741	784	734	633	808	784	784	826	819
Gaz	579	904	825	776	722	337	818	776	608	718	623
MTQ	681	888	547	993	302	413	873	993	343	694	887
MTQ	813	668	656	933	433	415	845	908	487	698	782
Montréal	702	742	716	810	721	658	782	785	595	707	635
CSEM	518	672	637	873	651	476	681	800	763	783	716
Total	4530	5361	4848	5913	4343	3672	5628	5890	4312	5235	5190
Moyenne	647	766	693	845	620	525	804	842	616	748	742
note + basse	518	668	547	744	302	337	681	776	343	694	623
note + haute	813	904	825	993	780	740	873	993	784	826	887
Total (2)	3199	3789	3476	4176	3261	2595	4074	4121	3185	3715	3680
Moyenne (2)	640	758	695	835	652	519	815	824	637	743	736

(2) en enlevant les notes les + basse et + haute

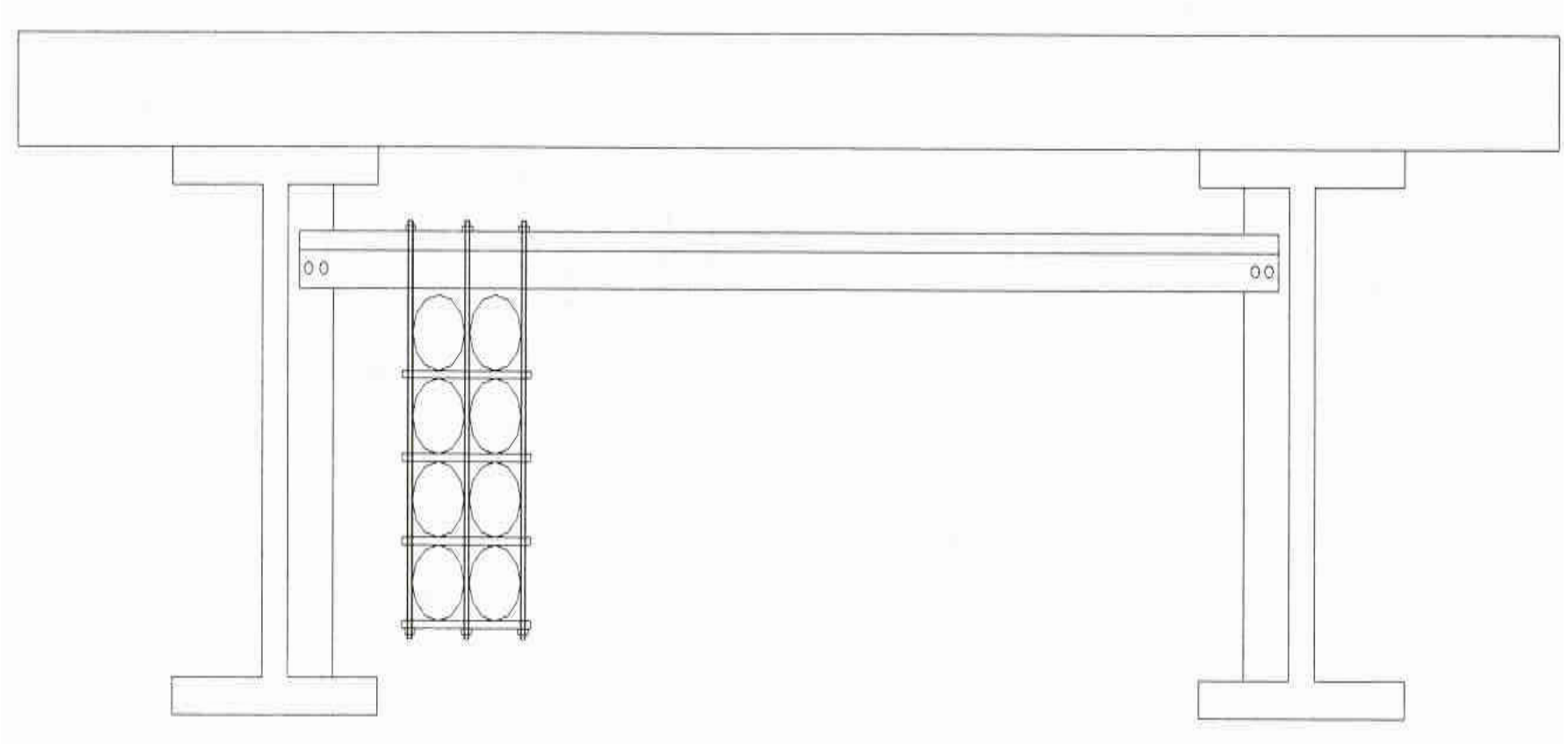
Classement	9	4	7	1	8	11	3	2	10	5	6

Remarques: Le système B aurait une meilleure note en modifiant le type d'ancrage

System D - Pinces poutres d’acier -



System H - Ajout de cornières -

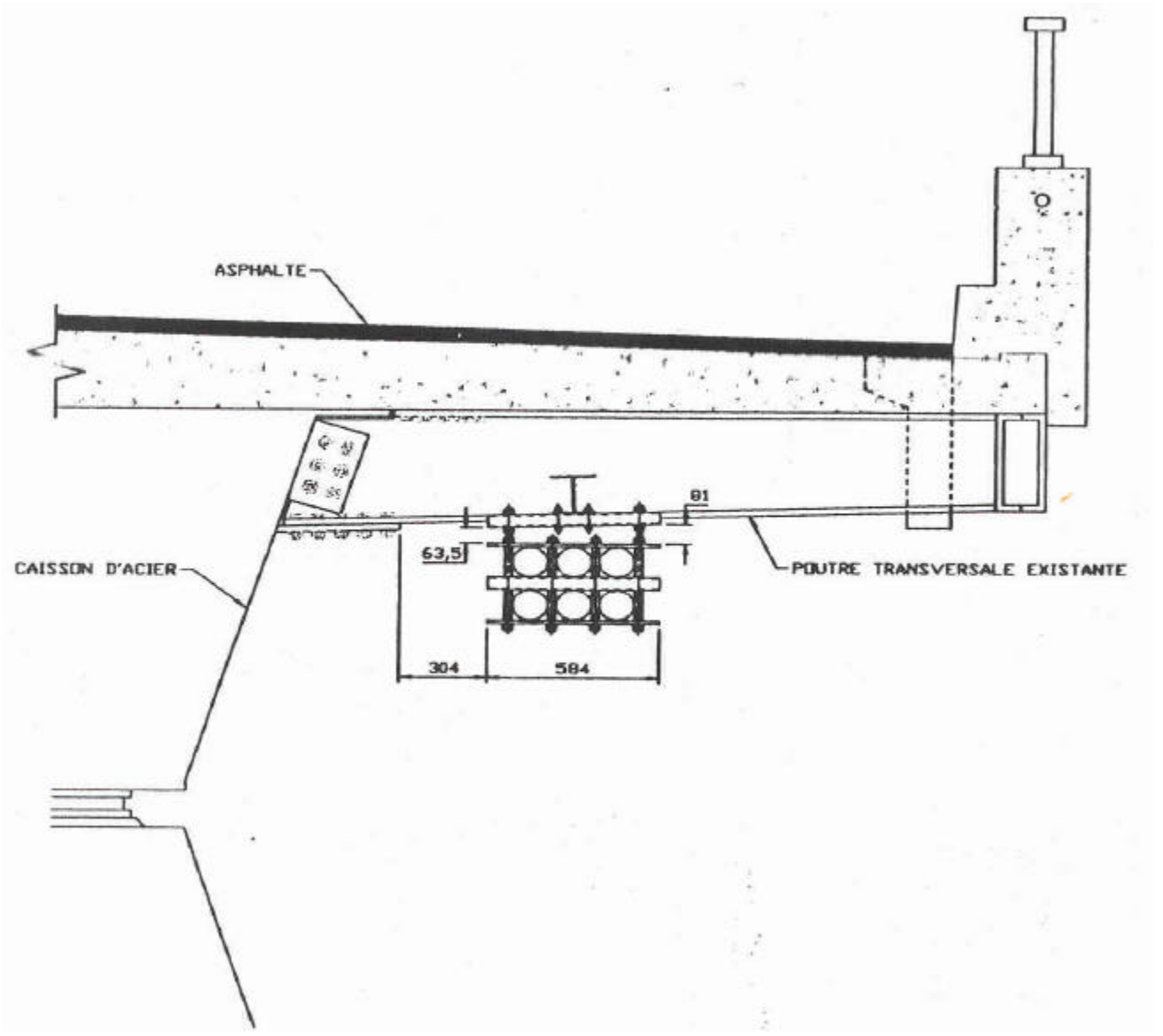


Caracteristiques :

• Utiliser avec les poutres en forme de I

• Peu de matériel nécessaire pour le système d’ancrage

System G - Pont à caisson -



Official Functionnal Chart (Content)

- Issues at Stake
- Functionnal Presentation of the Needs
- Call for Identification of Potential Systems
- Functionnal Analysis
- Listing of Functionnal Priorities
- Technical Innovations

Communication Chart for P.U.'s installation requests

- First notice
- Joint Enginneering Process
- Issuing the Permit
- Construction
- Inspection and Acceptance of Works
- Post Installation Services

Communication Chart for P.U.'s displacements requests

- First notice
- Joint Enginneering Process
- Agreement to displacements
- Agreement to Costs and Delays
- Construction
- Inspection of Works
- Post displacements Services

Conclusion

- **Value engineering was the most important tool to achieve these results**
  - Forces a common approach
  - Provides an objective analysis framework
  - Facilitates comparative evaluation of systems on a functions basis as opposed to technical
  - Ends up into standardization of approaches
  - Results in a major improvement of partner relationships

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