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Sitomeca

Site : R5-287-A1 Venette

Maître d'ouvrage : Sitomeca
Réalisation : Peter Globevnik, Ludo Van Schepdael
Rapport no. : r_750-1
Version : 1
Date : 05-01-2007

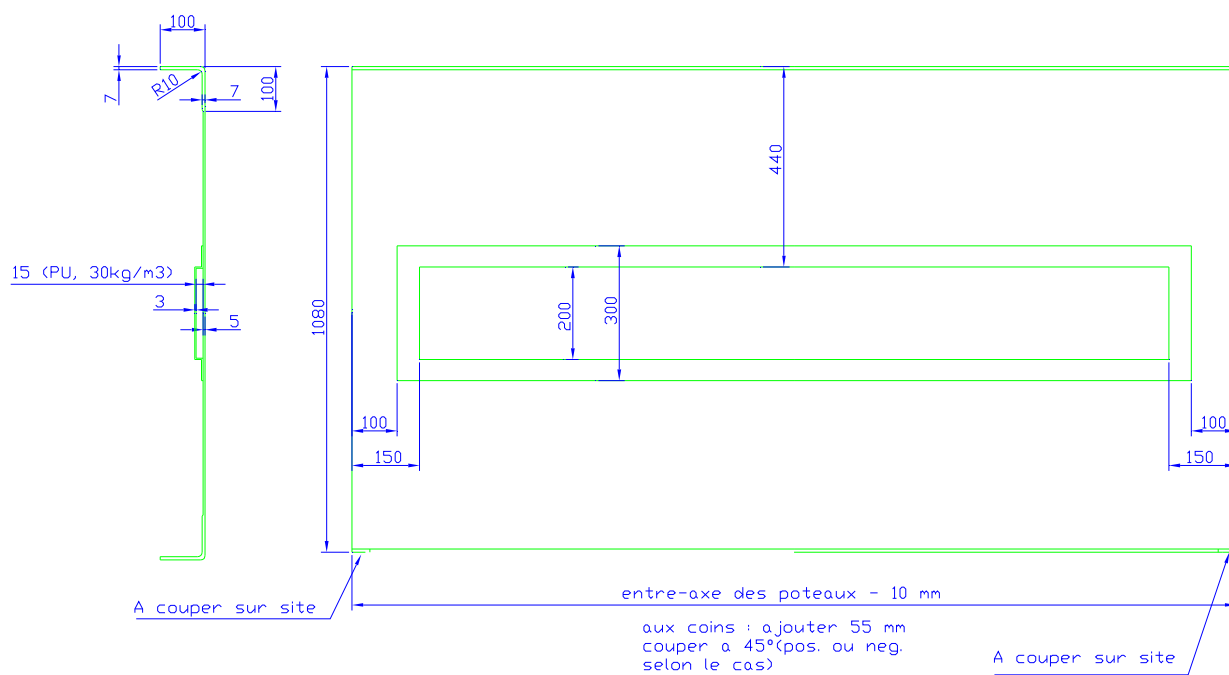
1. Introduction

Ce rapport décrit la vérification de la structure du bardage pour le site R5-287-A1 Venette.

2. Dessins

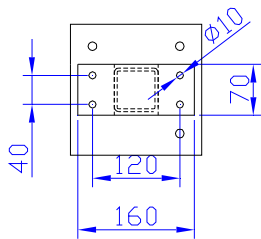
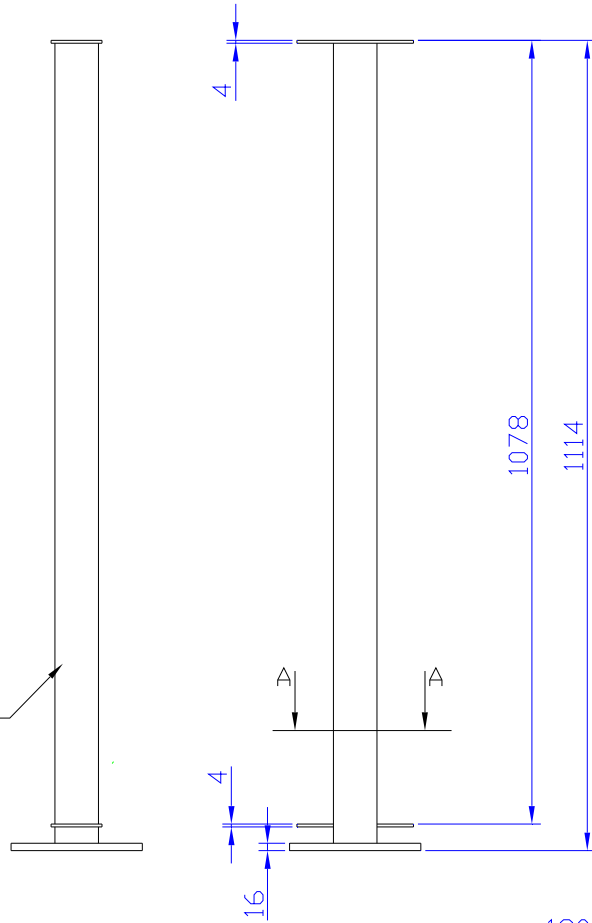
Distance maximale entre poteaux : 2000 mm.

Panneaux

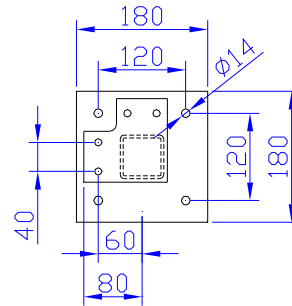


Poteaux

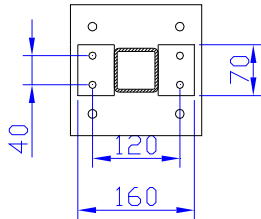
Poteau 60x60x4



vue du haut

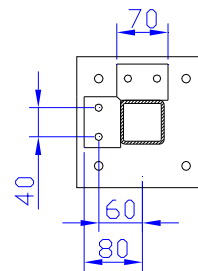


vue du haut



vue A-A

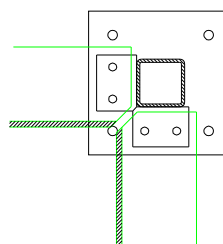
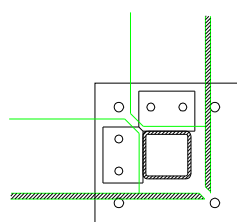
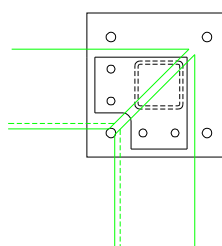
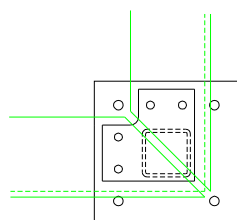
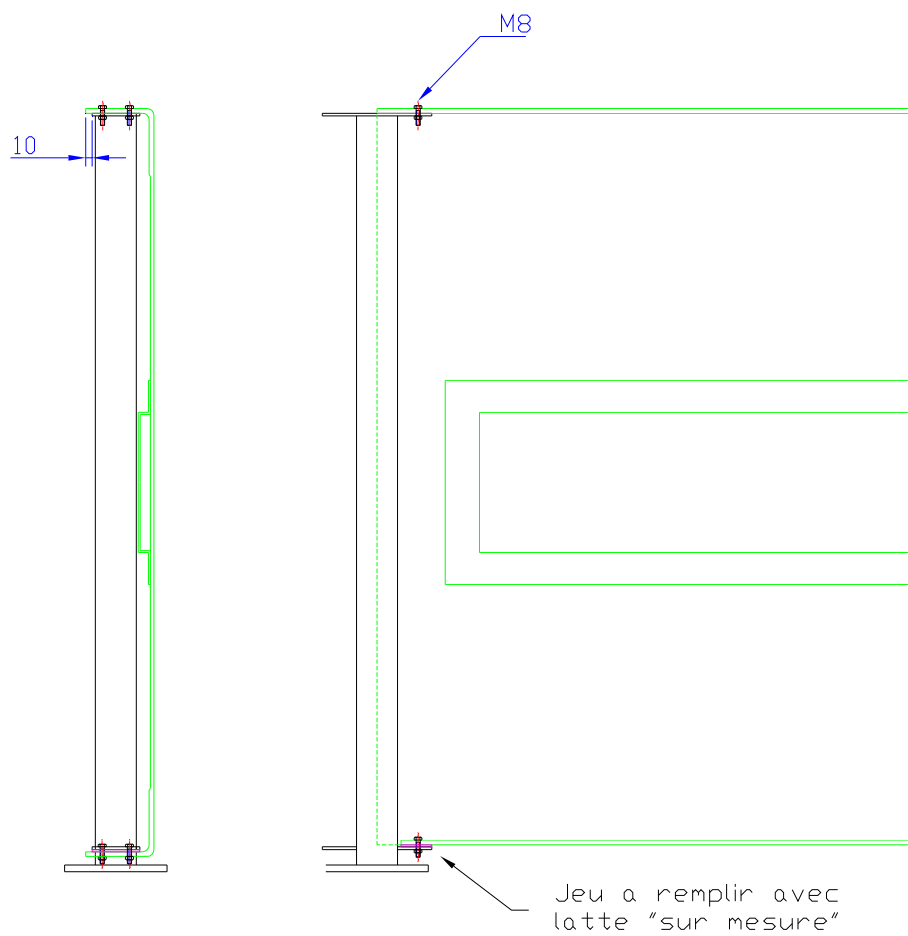
Poteau
intermediaire



vue A-A

Poteau
du coin

Assemblage



3. Standard de calculs

- NV 65-1999 : Norme française, règles Neige et Vent
- ENV 1991-1 : Bases du calcul et actions sur les structures : bases du calcul
- ENV 1991-2-4 : Bases du calcul et actions sur les structures : actions du vent
- Eurocomp : Design Code and Handbook
- DIN 18820 : Laminate aus textilglasverstärkten ungesättigten Polyester- und Phenacrylatharzen für tragende Bauteile (GF-UP,GF-PHA)

3.1. Action du vent

Région : Nord, France,

Hauteur : 13 m

Région de vent : 2

Pression de base normal : 600 Pa

Pression de base extrême : 1050 Pa

Coefficient de site q_s : 1 (site normal)

Coefficient de hauteur q_h : 1.06

$Q_{we, normal}$: 637 Pa

$Q_{we, extrême}$: 1115 Pa

Coefficient de pression sur bardage : ± 2.0

3.2. Garde corps

$q = 600 \text{ N/m}$ (;toit de maintenance ; voir "12515 M BA 021006 SPIE NDC V1 garde-corps périphérique.pdf" de 02-10-2006).

3.3. Facteur de sécurité

Facteur de sécurité suivant ENV 1991-1 :

- Charge permanente normal/extrême γ_{Gsup} : 1.35 / 1.0
- Charge variable normal/extrême γ_Q : 1.50 / 1.0

L'action du vent et la force de garde-corps sont considérés comme une charge variable.

3.4. Matériaux

3.4.1. *Fibres de verre/polyester : laminât de projection*

Propriétés suivant norme DIN 18820

Résine : polyester

% en poids : 30 %

Module de flexion	7800	MPa
Module de cisaillement	2300	MPa
Résistance en traction/compression	70	MPa
Résistance en flexion	90	MPa
Résistance au cisaillement 'in-plane'	50	MPa
Résistance au cisaillement 'inter laminaire'	8	MPa
Résistance 'pin bearing'	150	MPa
Coefficient de Poisson	0.3	
Densité	1471	kg/m ³

Résistance des matériaux : coefficients de réduction

La résistance des matériaux en 'état limite ultime' pour fibre de verres/polyester est décrite dans la norme DIN 18820 :

$$K = K_t \cdot K_U \cdot K_v = 1.5 \cdot 1.0 \cdot 1.0 = 1.5$$

3.4.2. *Profils en acier*

Propriétés suivant norme EN 10025 : S235JRG2

4. Calculs de vérification

4.1. Panneaux en polyester

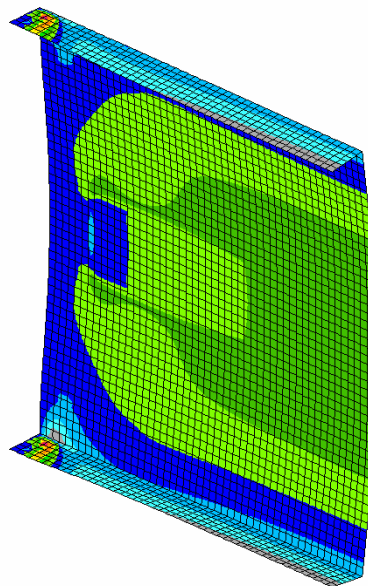
Le calcul des contraintes dans les panneaux en polyester, est fait par un modèle aux élément finis.

Le calcul est fait en mode 'non-linéaire', permettant de vérifier une éventuelle instabilité.

Les figures suivantes donnent la contrainte maximale dans les deux cas de charge:

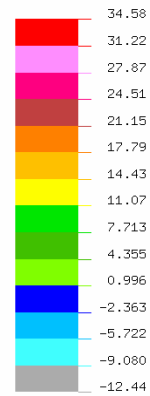
Vent extrême

SOLICO BV



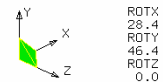
SXX-LAYER STRESS

VIEW : -12.43906
RANGE : 34.58301



EMRC-NISA/DISPLAY

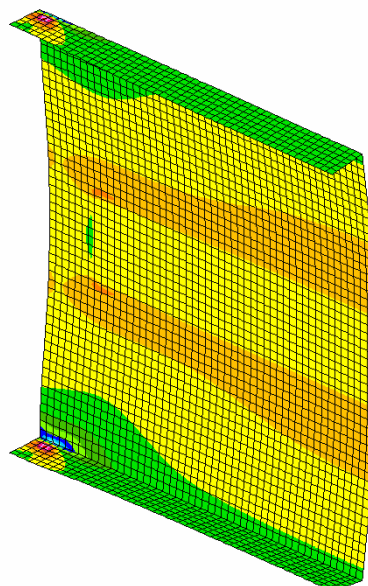
JAN/05/07 16:37:50



ROTX
28.4
ROTY
46.4
ROTZ
0.0

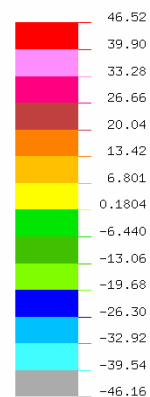


SOLICO BV



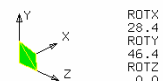
SYY-LAYER STRESS

VIEW : -46.1624
RANGE : 46.52311



EMRC-NISA/DISPLAY

JAN/05/07 16:38:17

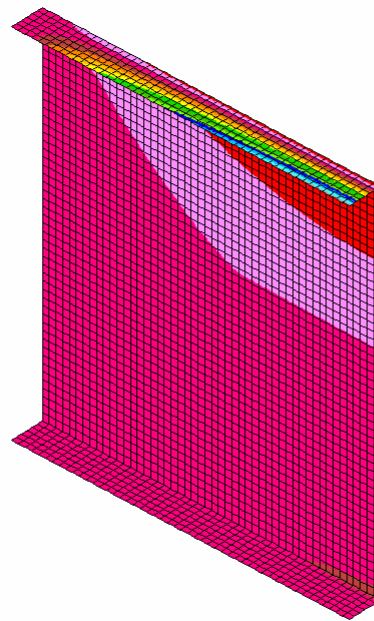


ROTX
28.4
ROTY
46.4
ROTZ
0.0



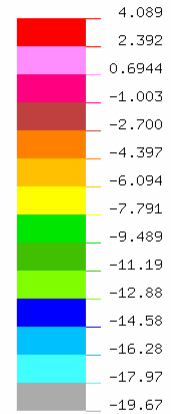
Garde-corps

SOLICO BV



SXX-LAYER STRESS

VIEW : -19.67167
RANGE : 4.088756



ROTX
35.1
ROTY
47.4
ROTZ
0.0



○ Contrôle de résistance des panneaux

La contrainte maximale dans les panneaux est 46 MPa

$$\text{Contrôle : } 46 \text{ MPa} \leq \frac{\sigma_{flexion}}{\gamma_M} = \frac{90}{1.5} = 60 \text{ MPa}$$

4.2. Connexion des panneaux

La force horizontale par connexion est 1226 N.

La connexion se fait par 2 boulons M8.

La contrainte 'pin bearing' = 11 MPa (1226 N / (2 * 7 mm * 8 mm))

$$\text{Résistance 'pin bearing' } 11 \text{ MPa} \leq \frac{\sigma_{pin}}{\gamma_M} = \frac{150}{1.5} = 100 \text{ MPa}$$

4.3. Poteau

Le moment fléchissant à la base du poteaux est :

$$\text{vent extrême} \quad : \quad M = 2 \cdot 1115 \frac{\text{N}}{\text{m}^2} \cdot 1.1 \text{ m} \cdot 2 \text{ m} \cdot 0.55 \text{ m} = 2700 \text{ Nm}$$

$$\text{garde corps} \quad : \quad M = 1.5 \cdot 600 \frac{\text{N}}{\text{m}} \cdot 2 \text{ m} \cdot 1.1 \text{ m} = 1980 \text{ Nm}$$

Le module de résistance de K60x60x4 est :

$$W = 15400 \text{ mm}^3$$

La contrainte de flexion est :

$$\sigma_f = \frac{M}{W} = \frac{2700000}{15400} = 175 \text{ MPa}$$

$$\text{Contrôle : } 175 \text{ MPa} \leq \frac{\sigma_{\text{flexion}}}{\gamma_M} = \frac{235}{1.1} = 213 \text{ MPa}$$

4.4. Fixations


Platine : 180 x 180 x 16 mm

Cheville : 4 x UPAT 44 Injection UPM 44 + ASTA 12 x 160 (note Fischer en annexe)

Création d'un plot béton tous les 2 m :

Dimensions : 300 x 300 x 150 ht

Ferrailage 4 HA12 scelles dans la dalle + 2 cadres HA8

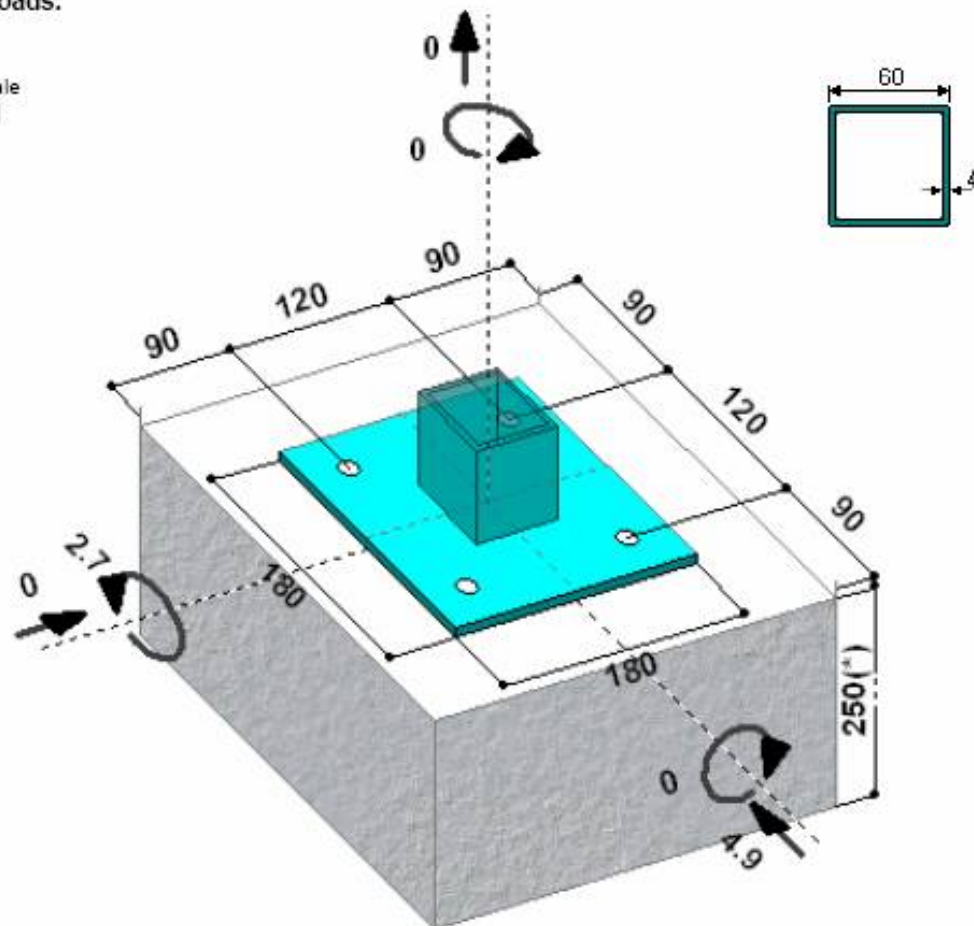
Print sender		fischer  <small>F I V I N G S Y S T E M S</small>
Street		
Postcode / City		COMPUFIX 7.3
Phone		7.3 build 3644/47
Fax		
Project	Venette	Page No 1 of print-out No 11
Application	Anchrage des poteaux	Date: 5-1-2007


fischer COMPUFIX: Designed in accordance with ETAG, Annex C


Anchor:	Upat UPM 44 Injectionssystem UPM 44 + ASTA 12 x 160 (Art. Nr. 7832) made from zinc plated and passivated steel + UPM 44 Chemical mortar (Art.-No. 00856) or UPM 44 950 ml Chemical mortar (Art.-No. 00921)
Accessory:	UPM Dispenser (Art.-No. 00501) for UMV Vario chemical mortar UMV Vario 345 and UPM Chemical mortar, UPM "Magnum" dispenser (Art.-No. 00922) for big cartridges (UPM 44 950 ml Chemical mortar), Static mixer (Art.-No. 00521), Cleaning brush for concrete (Art.-No. 78180) for M 12, Push-through element M 12 x 4 (Art.-No. 78233) (for push-through installation), Push-through element M 12 x 10 (Art.-No. 78234) (for push-through installation)
Base material:	Non-cracked concrete, normal reinforcement Concrete compressive strength class: C 20/25
Edge Reinforcement:	No influence
Anchor bending:	Unavailable
temperature:	Max long term temperature: 50°C, Max short term temperature: 80°C
Anchor plate:	Min. thickness of anchor plate: 16 mm, Steel strength of anchor plate: S235 (St37) Profile type: Square hollow profile, Profile: 60 x 60 x 4,0


Dimensions/loads:

Design actions
 (*) Not true to scale
 [mm], [kN], [kNm]



Print sender				 F I X I N G S Y S T E M S	
Project		Venette			
Application		Anchrage des poteaux			
Anchor		Upat UPM 44 Injectionsystem UPM 44 + ASTA 12 x 160			
Page No 2 of print-out No 11					
<p>Important:</p> <ul style="list-style-type: none"> The design utilises specific values for each anchor. When alterations will be made, even for similar products, a new design calculation is required. As a pre-condition the anchor plate is assumed to be flat when subjected to the actions. Therefore, the plate must be sufficiently stiff and sit flat against the surface of the concrete or, onto an appropriate mortar bed. With slotted holes the design is carried out under the assumption that the anchor is located in the centre of the hole. Please check that the fixing thickness of the fixing is adequate. Maximum hole diameter in the attachment: 14 mm. To ensure the structural component's capacity, the proofs in accordance with Section 7 of ETAG Annex C must be observed. All additional conditions of the Approvals are to be observed. Close to the edge a longitudinal reinforcement with a diameter of at least 6 mm shall be provided in the area of the anchorage depth. 					
Tensile load, Steel failure:			Shear load, Steel failure:		
		S_d			S_d
$N_{Rk,s}$	[kN]	44.00	$V_{Rk,s}$	[kN]	21.00
γ_{Me}	[-]	1.50	γ_{Me}	[-]	1.25
$N_{Ed,s}$	[kN]	29.33	$V_{Ed,s}$	[kN]	16.80
$N_{B,s}$	[kN]	9.84	$V_{B,s}$	[kN]	1.23
$\beta_{N,s}$	[-]	0.34	$\beta_{V,s}$	[-]	0.07
Tensile load, Concrete cone failure:			Shear load, Concrete failure on the opposing side of the load:		
		S_d			S_d
$N_{Rk,c}^0$	[kN]	28.64	$N_{B,c}^0$	[kN]	28.64
$A_{c,N}$	[cm ²]	540.00	$A_{c,N}$	[cm ²]	900.00
$A_{c,N}^0$	[cm ²]	324.00	$A_{c,N}^0$	[cm ²]	324.00
$A_{c,N} / A_{c,N}^0$	[-]	1.67	$A_{c,N} / A_{c,N}^0$	[-]	2.78
$\psi_{s,N}$	[-]	1.00	$\psi_{s,N}$	[-]	1.00
$\psi_{ec1,N}$	[-]	1.00	$\psi_{ec1,N}$	[-]	1.00
$\psi_{ec2,N}$	[-]	1.00	$\psi_{ec2,N}$	[-]	1.00
$\psi_{rn,N}$	[-]	1.00	$\psi_{rn,N}$	[-]	1.00
$\psi_{cor,N}$	[-]	1.00	$\psi_{cor,N}$	[-]	1.00
$N_{Rk,c}$	[kN]	47.73	k	[-]	2.00
γ_{Mc}	[-]	1.80	$V_{Rk,op}$	[kN]	159.09
$N_{Ed,c}$	[kN]	26.52	$\gamma_{Mc,op}$	[-]	1.50
$N_{B,c}$	[kN]	19.68	$V_{Ed,op}$	[kN]	106.06
$\beta_{N,c}$	[-]	0.74	$V_{B,c}$	[kN]	4.90
			$\beta_{V,op}$	[-]	0.05
Tensile load, Pull-out:			Shear load, Concrete edge failure:		
		S_d			S_d
$N_{Rk,p}$	[kN]	35.00	$V_{Rk,c}^0$	[kN]	10.86
γ_{Mp}	[-]	1.80	$A_{c,v}$	[cm ²]	405.00
$N_{Ed,p}$	[kN]	19.44	$A_{c,v}^0$	[cm ²]	364.50
$N_{B,p}$	[kN]	9.84	$A_{c,v} / A_{c,v}^0$	[-]	1.11
$\beta_{N,p}$	[-]	0.51	$\psi_{s,v}$	[-]	0.90
			$\psi_{h,v}$	[-]	1.00
			$\psi_{o,v}$	[-]	1.00
			$\psi_{ec,v}$	[-]	1.00
			$\psi_{cor,v}$	[-]	1.40
			$V_{Rk,c}$	[kN]	15.20
			γ_{Mc}	[-]	1.50
			$V_{Ed,c}$	[kN]	10.13
			$V_{B,c}$	[kN]	4.90
			$\beta_{V,c}$	[-]	0.48

Print sender		 <small>FIXING SYSTEM</small>	
Project	Venette		
Application	Anchrage des poteaux		
Anchor	Upat UPM 44 Injectionsystem UPM 44 + ASTA 12 x 160		
		Page No 3 of print-out No 11	
Tensile load, Splitting:			
		S_d	
$N_{Rk,c}^0$	[kN]	28.64	
$A_{c,N}$	[cm ²]	540.00	
$A_{c,N}^0$	[cm ²]	324.00	
$A_{c,N} / A_{c,N}^0$	[-]	1.67	
$\psi_{s,N}$	[-]	1.00	
$\psi_{ec1,N}$	[-]	1.00	
$\psi_{ec2,N}$	[-]	1.00	
$\psi_{re,N}$	[-]	1.00	
$\psi_{vor,N}$	[-]	1.00	
$\psi_{h,ep}$	[-]	1.00	
$N_{Rk,ep}$	[kN]	47.73	
$\gamma_{M,ep}$	[-]	1.80	
$N_{Rd,ep}$	[kN]	26.52	
N_{S_d}	[kN]	19.68	
$\beta_{N,ep}$	[-]	0.74	
Combined tensile and shear load:			
Load combination: design actions		$(\beta_N)^{1.5} + (\beta_V)^{1.5}$	= 0.98 ≤ 1.00
Tensile load	Used capacity	Shear load	Used capacity
Steel failure:	33.5 %	Steel failure:	7.3 %
Concrete cone failure:	74.2 %	Concrete edge failure:	48.4 %
Pull-through / pull-out:	50.6 %	Concrete failure on the opposing side of the load:	4.6 %
Splitting:	74.2 %		
Result: Proof of anchor was successful			

Print sender		fischer 	
Project	Venette	FIXING SYSTEM	
Application	Anchrage des poteaux	Page No 4 of print-out No 11	
Anchor	Upat UPM 44 Injectionsystem UPM 44 + ASTA 12 x 160		
Installation details			
Fixing thickness t_{ef}		[mm]	25
Thread diameter M		[mm]	12
Anchorage depth h_{ef}		[mm]	110
Drill diameter d_0		[mm]	14
Drill hole depth t		[mm]	110
Setting torque M_0		[Nm]	40
Hole diameter in the attachment d_e		[mm]	14