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Ausbau Eisenbahnachse München-Verona

BRENNER BASISTUNNEL

Ausführungsplanung

Potenziamento asse ferroviario Monaco-Verona

GALLERIA DI BASE DEL BRENNERO

Progettazione esecutiva

D0700: Baulos Mauls 2-3

D0700: Lotto Mules 2-3

Projekteinheit

WBS

Haupttunnel

Gallerie principali

Dokumentenart

Tipo Documento

Statische Berechnung

Calcolo statico

Titel

Titolo

Statische Berechnung CT1 e FdE-C(01-06) - T2/T4

Relazione di calcolo CT1 e FdE-C(01-06) - T2/T4



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Projekt-kilometer /
Chilometro
progetto

von / da 32.0+88
bis / a 54.0+15
bei / al

Projekt-kilometer /
Chilometro
opera

von / da 44.3+52
bis / a 46.7+69
bei / al

Status
Dokument /
Stato
documento

Massstab /
Scala

-

Staat
Stato

Los
Lotto

Einheit
Unità

Nummer
Numero

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1 EINFÜHRUNG

Das vorliegende Dokument beinhaltet die Erläuterung zur Bemessung der Außen- und Innenschalen der Querschläge des Typs CT1 (44/2; 45/3; 46/1; 46/2; 46/3) und der Verbindungsstollen im Bereich der Nothaltestelle (FdE-C 01-06), welche konventionell zwischen km 44.3+33.0 und 46.6+67.0 (Oströhre) vorgetrieben werden.

Gemäß den geomechanischen Längenprofilen [3]-[5], liegen die Querschläge CT1 und FdE-C vorwiegend innerhalb der Paraschiefer und der Amphibolite (geomechanische Homogenzonen 14 - 25 [6]) sowie im Bereich des Bündnerschieferkomplexes (geomechanische Homogenzone 11 - 13 [6]) mit variabler Überdeckung zwischen 600m und 1200m.

Der vorliegende Bericht befasst sich mit der Bemessung der Regelprofiltypen FdE-C T2/T4 und CT1 T2/T4.

Die Profile CT1 T2 und FdE-C T2 sind durch einen Ausbruchsquerschnitt von 26.36 bzw. 26.38m² charakterisiert. Es werden radiale Anker des Typs Superswellex Pm 16 (3+4), mit einer Länge von 3m, Querabstand 1.8m und Längsabstand 1.5m und einer Spritzbetonschale von 15cm vorgesehen.

Die Regelprofile CT1 T3 und FdE-C T3 sind durch einen Ausbruchsquerschnitt von 26.36 bzw. 26.38m² charakterisiert. Es werden radiale Anker des Typs Superswellex Pm 16 (6+7), mit einer Länge von 3m, Querabstand 1.8m und Längsabstand 1.5m und einer Spritzbetonschale von 15cm vorgesehen.

Die Regelprofile CT1 T4 und FdE-C T4 sind durch einen Ausbruchsquerschnitt von 32.75 bzw. 33.17m² charakterisiert. Es werden radiale Selbstbohranker des Typs R38N oder des Typs Dywidag SNØ28, mit Querabstand 1.5m und Längsabstand 1.5m, mit eventueller Baugrundvergütung durch radiale Selbstbohranker Typ R38N oder SuperSwellex Pm24, mit eventuellen Selbstbohrankern Typ R38N an der Ortsbrust und/oder mit lokaler Verstärkung (eventuell) durch Anker Typ SuperSwellex Pm 24 und einer Spritzbetonschale von 25cm vorgesehen.

Die Innenschale der Regelprofile FdE-C/CT1 T2 und FdE-C/CT1 T3 ist unbewehrt und wird aus Beton C30/37 ausgeführt. Die Mindeststärke, welche die Bautoleranzen berücksichtigen, misst sowohl in der Kalotte als auch in der Sohlplatte 30 cm.

Die Innenschale der Regelprofile FdE-C/CT1 T4 ist bewehrt und wird aus Beton C30/37 ausgeführt. Die Mindeststärken, welche die Bautoleranzen berücksichtigen, beträgt im Bereich der Kalotte 35cm. Das Sohlgewölbe hingegen wird auf Grund seiner massiven Struktur im Berechnungsmodell als fiktiver

1 INTRODUZIONE

La seguente relazione riporta il dimensionamento dei rivestimenti di prima fase e definitivi dei cunicoli trasversali tipo CT1 (44/2; 45/3; 46/1; 46/2; 46/3) e dei cunicoli trasversali all'interno della Fermata di Emergenza (FdE-C 01-06), realizzati mediante avanzamento in scavo tradizionale tra le progr. 44.3+33.0 e 46.6+67.0 (Canna Est).

Secondo il profilo geomeccanico [3]-[5], i cunicoli trasversali CT1 e i cunicoli FdE-C si sviluppano all'interno del complesso dei Parascisti e delle Anfiboliti (zone geomeccaniche omogenee 14 - 25 [6]) e all'interno del complesso dei calcescisti (zone geomeccaniche omogenee 11 - 13 [6]) con coperture variabili da 600 m a 1200 m.

Il presente rapporto concerne il dimensionamento dei profili tipo FdE-C T2/T4 e CT1 T2/T4.

I profili CT1 T2 e FdE-C T2 sono caratterizzati da una sezione di scavo rispettivamente di 26.36/26.38 m², da chiodature radiali costituite da Superswellex Pm 16 (3+4), di lunghezza 3 m, con passo trasversale 1.8 m e longitudinale 1.5 m e uno spessore di betoncino proiettato totale di 15 cm.

I profili CT1 T3 e FdE-C T3 sono caratterizzati da una sezione di scavo di 26.36/26.38 m², da chiodature radiali costituite da Superswellex Pm 16 (6+7), di lunghezza 3 m, con passo trasversale 1.8 m e longitudinale 1.5 m e uno spessore di betoncino proiettato totale di 15 cm.

I profili CT1 T4 e FdE-C T4 sono caratterizzati da una sezione di scavo rispettivamente di 32.75/33.17 m², da chiodature radiali costituite da barre autoperforanti R38N o ancoraggi tipo Dywidag SNØ28 con passo trasversale 1.5 m e longitudinale 1.5 m, da eventuale consolidamento al contorno mediante chiodature al contorno barre autoperforanti tipo R38N o SuperSwellex Pm24, da eventuali ancoraggi al fronte costituiti da barre autoperforanti tipo R38N e/o rinforzo localizzato (eventuale) con ancoraggi tipo SuperSwellex Pm24 e uno spessore totale di betoncino proiettato di 25 cm.

Il rivestimento definitivo per i profili tipo FdE-C/CT1 T2 e FdE-C/CT1 T3 non è armato ed è costituito da calcestruzzo C30/37 con spessori minimi, che tengono conto delle tolleranze in fase di costruzione pari a 30 cm sia in calotta sia in platea di fondazione.

Il rivestimento definitivo per il profili tipo FdE-C/CT1 T4 è armato ed è costituito da calcestruzzo C30/37 con spessori minimi, che tengono conto delle tolleranze in fase di costruzione, pari a 35 cm in calotta, mentre per l'arco rovescio, data la sua massività, si ipotizza nella modellazione

Bogen im Bereich des Spannungsverlaufs mit einer Dicke von 90cm angenommen.

una fascia fittizia corrispondente andamento delle pressioni pari a 90 cm.

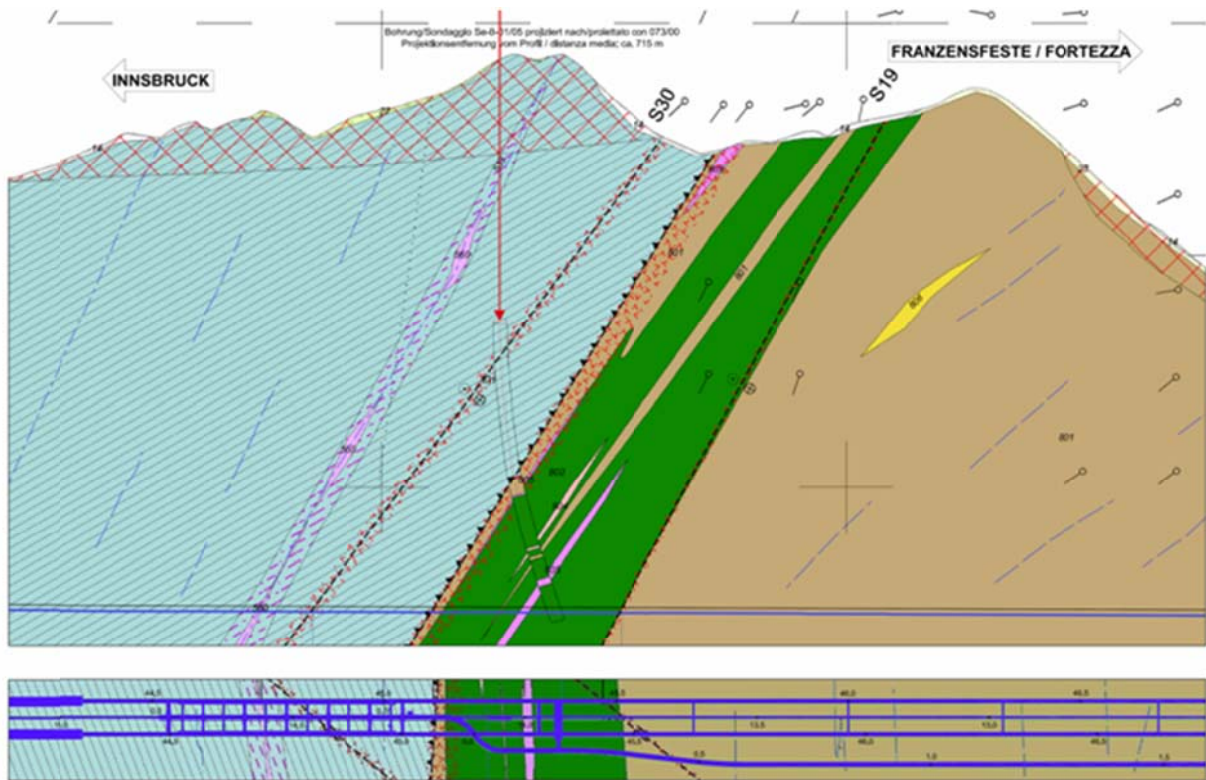


Abbildung 1: Auszug aus dem geomechanischen Längsprofil und des geologischen Lageplans [3]-[5] mit Angabe des Untersuchungsgebietes.

Figura 1: Estratto del profilo geomeccanico longitudinale e della planimetria geologica [3]-[5] dell'area di studio.

2 MATERIALKENNWERTE

2.1 SPRITZBETON

Für die Bemessung der Spritzbetonaußenschale ist in der Regel ein Beton der Festigkeitsklasse C25/30 mit folgenden Eigenschaften zu berücksichtigen:

$$E_{cm} = 32000 \text{ MPa}$$

$$f_{ck} = 30 \text{ MPa}$$

Hierbei sind:

- E_{cm} = Mittelwert Sekantenmodul
- f_{ck} = charakteristische Druckfestigkeit Spritzbeton nach 28 Tagen

2 MATERIALI

2.1 BETONCINO PROIETTATO

Per il dimensionamento del rivestimento di prima fase in betoncino proiettato si considera un calcestruzzo con classe di resistenza C30/37 con le seguenti caratteristiche:

Dove:

- E_{cm} è il valore medio del modulo elastico secante
- f_{ck} è la resistenza caratteristica a compressione del betoncino proiettato a 28 giorni

2.2 ANKER

Es wird der Einsatz von Anker des Typs SuperSwellex Pm 16, Sleibstbohranker Typ R38N und Anker Typ Dywidag SNØ28 mit folgenden Eigenschaften vorgesehen:

$$E_s = 210000 \text{ MPa}$$

$$N_y = 140 \text{ kN (Pm16)}$$

$$N_y = 400 \text{ kN (R38N)}$$

$$N_y = 413 \text{ kN (Dywidag SNØ28)}$$

Wobei:

- E_s = Elastizitätsmodul
- N_y = Ermüdungslast der Niete

2.2 ANCORAGGI

Si prevede l'utilizzo di ancoraggi tipo Superswellex Pm 16, barre autoperforanti R38N e ancoraggi tipo Dywidag SNØ28 aventi le seguenti caratteristiche:

Dove:

- E_s è il modulo elastico
- N_y è il carico di snervamento del chiodo

2.3 BETON

Für die Bemessung der Innenschale ist in der Regel ein Beton der Festigkeitsklasse C30/37 mit folgenden Eigenschaften zu berücksichtigen:

$$E_{cm} = 32000 \text{ MPa}$$

$$f_{ck} = 30 \text{ MPa}$$

Hierbei sind:

- E_{cm} = Mittelwert Sekantenmodul
- f_{ck} = charakteristische Druckfestigkeit des Betons nach 28 Tagen

2.3 CALCESTRUZZO

Per il dimensionamento del rivestimento definitivo si considera un calcestruzzo con classe di resistenza C30/37 con le seguenti caratteristiche:

Dove:

- E_{cm} è il valore medio del modulo elastico
- f_{ck} è la resistenza a compressione caratteristica del calcestruzzo dopo 28 giorni

2.4 BEWEHRUNGSSTAHL

Für die Bemessung der Innenschale wurde Betonstahl der Güte B450C angenommen:

$$E_s = 210000 \text{ MPa}$$

$$f_{yk} = 450 \text{ MN/m}^2$$

Hierbei ist:

- E_s = Sekantenmodul
- f_{yk} = charakteristischer Wert der Streckgrenze des Betonstahls

2.4 ACCIAIO DA ARMATURA

Per il dimensionamento dell'anello si utilizza l'acciaio tipo B450C:

dove:

- E_s = modulo elastico
- f_{yk} = tensione caratteristica di snervamento acciaio per cemento armato

3 GEOTECHNISCHES MODELL

3.1 GEOLOGIE UND GEOMECHANIK

Die Verbindungsstollen FdE-C und die Querschläge Ct1 zwischen km 44.3+33.0 und 46.6+67.0 (Oströhre) werden konventionelle vorgetrieben und liegen vorwiegend innerhalb des Paragneiss (geomechanischer Bereich 15 [6]) und der Amphibolite (geomechanischer Bereich 14 [6]) sowie im Bereich des Bündnerschieferkomplexes (geomechanischer Bereich 13 [6]) mit variabler Überdeckung zwischen 640m und 1200m.

Nachfolgend sind die Informationen zu durchhörten Homogenzonen gemäß Dokument [6] aufgeführt.

Zone number	Zone initial pk (approx.)	Zone final pk (approx.)	Zone length	Zone max overburden	Zone min overburden	Rock mass name	Rock mass Length	
	[km]	[km]	[m]	[m]	[m]		% of zone length	[m]
11	43.8	44.6	335	1060	905	GA-BST-KS-8f	100%	335
12	44.6	44.7	75	1080	1060	GA-BST-KPH-8f	87%	65.25
						GA-T-R-8f	0-13%	0-9.75
						GA-T-A-8f	0-13%	0-9.75
13	44.7	45.1	346	1115	1025	GA-BST-KS-8f	100%	346
14	45.1	45.5	390	1200	1095	GA-BCA-A-10g	85%	331.5
						GA-BCA-GS-10g	15%	58.5
15	45.5	47.0	1540	1135	590	GA-BCA-GS-10g	90%	1386
						GA-BCA-A-10g	10%	154

Tabelle 1 Homogenbereich

3 MODELLO GEOTECNICO

3.1 GEOLOGIA E GEOMECCANICA

I cunicoli trasversali FdE-C e CT1 tra le progressive 44.3+33.0 e 46.6+67.0 (Canna Est) sono scavati in tradizionale e si sviluppano nel complesso degli Paragneiss (zona geomeccanica 15 [6]) e nel complesso delle Anfiboliti (zona geomeccanica 14 [6]) e in una breve tratta nel complesso dei calcescisti (zona geomeccanica 13 [6]) con coperture variabili da 640 m a 1200 m.

Nel seguito si riportano i dati delle tratte omogenee interessate dallo scavo secondo il documento [6].

Tabella 1: Zone geomeccaniche omogenee

Folgende Tabellen zeigen die geomechanischen Grundparameter für die Definition der geomechanischen homogenen Zonen und die Wahrscheinlichkeitsverteilung nach Bieniawski [6] der unterschiedlichen Klassen.

Le seguenti tabelle riportano i parametri geomeccanici di base che caratterizzano ciascuna zona geomeccanica omogenea e la distribuzione probabilistica delle diverse classi secondo la classificazione di Bieniawski [2].

Zone number	11			12			13			14			15		
Rock mass name	GA-BST-KS-8f	GA-BST-KPH-8f	GA-T-R-8f	GA-T-A-8f	GA-BST-KS-8f	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-GS-10g	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g
γ [kN/m ³]	26.6	27.3	25	28.2	26.6	27.8	27.3	27.3	27.3	27.3	27.8	27.3	27.3	27.8	
$\gamma(\sigma)$ [kN/m ³]	0.36	0.04	0.5	0.45	0.36	0.52	1.49	1.49	1.49	1.49	0.52	1.49	1.49	0.52	
σ_{ci} [MPa]	41	54	15	48	41	140	75	75	75	75	140	75	75	140	
$\sigma_{ci}(\sigma)$ [MPa]	18	13	10	16	18	48	5	5	5	5	48	5	5	48	
m_i [m]	12	8	7	13	12	20	17	17	17	17	20	17	17	20	
$m_i(\sigma)$	2	1	2	2	2	6	3	3	3	3	6	3	3	6	
Ei [GPa]	43	39	5	46	43	53	56	56	56	56	53	56	56	53	
Ei(σ) [GPa]	11.1	5.5	3	1.3	11.1	8	10.9	10.9	10.9	10.9	8	10.9	10.9	8	
RMR(m)	60	45	30	60	60	70	60	60	60	60	70	60	60	70	
RMR(σ)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
GSI(m)	50	40	25	60	50	65	50	50	50	50	65	50	50	65	
GSI(σ)	5	5	5	10	5	10	5	5	5	5	10	5	5	10	

Zone number	11			12			13			14			15		
Rock mass name	GA-BST-KS-8f ^(**)	GA-BST-KPH-8f ^(*)	GA-T-R-8f ^(*)	GA-T-A-8f ^(*)	GA-BST-KS-8f ^(**)	GA-BCA-A-10g	GA-BCA-GS-10g ^(*)	GA-BCA-GS-10g ^(*)	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g	GA-BCA-GS-10g	GA-BCA-A-10g
p(class I)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
p(class II)	-	-	-	-	-	100%	-	-	-	-	100%	-	-	-	100%
p(class III)	100%	100%	-	100%	100%	-	100%	100%	-	100%	-	100%	100%	-	-
p(class IV)	-	-	100%	-	-	-	-	-	-	-	-	-	-	-	-
p(class V)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabelle 2: Charakterisierung des Gebirges jeder homogenen Zone und Wahrscheinlichkeitsverteilung der unterschiedlichen Klassen (die mit [*] angegebenen Gebirge haben vorgesehene Längen von unter ca. 100m, während für die mit [**] angegebenen Gebirge stellte sich heraus, dass die Literaturwechselbeziehungen zwischen RMR und nicht gültig sind; in beiden Fällen wurden die RMR und GSI Mittelwerte angewandt).

Tabella 2: Caratterizzazione degli ammassi di ciascuna zona omogenea e distribuzione probabilistica delle diverse classi (gli ammassi indicati con [*] hanno lunghezze previste inferiori a circa 100m, mentre per quelli indicati con [**] non risultano valide le correlazioni da letteratura tra RMR e GSI; in entrambi i casi sono stati adottati i valori medi di RMR e GSI).

Wobei:

- γ = spezifisches Gewicht des Gebirges

Dove:

- γ è il peso di volume naturale dell'ammasso roccioso.

- σ_{ci} = einaxiale Druckfestigkeit der Gesteinsmatrix
- m_i = Krümmungsparameter aus triaxialem Druckversuch des Gebirgsmaterial
- E_i = Verformungsmodul der Gesteinsmatrix
- RMR = *Rock Mass Rating 1989*
- GSI = *Geological Strength Index*

Die typischen Verformungs- und Festigkeitsparameter jeder Strecke wurden gemäß dem Bruchkriterium nach Hoek & Brown [24] berechnet, welches im allgemeinen geomechanischen Bericht [1] näher beschrieben wird.

- σ_{ci} è la resistenza a compressione monoassiale di matrice.
- m_i è un parametro di curvatura dell'involuppo di rottura triassiale del materiale roccia.
- E_i è il modulo di deformazione di matrice.
- RMR è il *Rock Mass Rating 1989*.
- GSI è il *Geological Strength Index*.

I parametri di deformabilità e di resistenza caratteristici di ciascuna tratta sono stati calcolati in accordo al principio di linearizzazione dell'involuppo di rottura proposto da Hoek & Brown [24] e esplicitato nella relazione geomeccanica generale [1].

Zone number	Rock mass name	Class [-]	Zone max overburden [m]	γ [kN/m ³]	φ_{peak} [°]	φ_{res} [°]	c_{peak} [MPa]	c_{res} [MPa]	E_{rm} [MPa]	ψ [°]
11	GA-BST-KS-8f	III	1060	26.6	28.07	21.47	2.127	1.349	11135	3.5
12	GA-BST-KPH-8f	III	1080	27.3	24.81	20.18	1.892	1.314	5787	3.1
	GA-T-R-8f	IV		25.0	12.65	11.32	0.685	0.557	209	0.0
	GA-T-A-8f	III		28.2	32.69	23.42	2.943	1.644	23582	6.1
13	GA-BST-KS-8f	III	1115	26.6	27.69	21.15	2.193	1.392	11504	3.5
14	GA-BCA-A-10g	II	1200	27.8	42.21	33.15	4.887	2.900	21074	6.86
	GA-BCA-GS-10g	III		27.3	36.23	28.85	3.535	2.274	15528	4.53
15	GA-BCA-GS-10g	III	1135	27.3	36.67	29.26	3.415	2.195	15528	4.58
	GA-BCA-A-10g	II		27.8	42.65	33.57	4.725	2.797	21074	6.93

Tabelle 3: Geomechanische Homogenbereiche

Tabella 3: Parametri caratteristici dell'ammasso nelle diverse zone e classi

Wobei:

- φ_{peak} ist der Reibungswinkel am Peak
- φ_{res} ist der Restreibungswinkel
- c_{peak} ist die Kohäsion am Peak
- c_{res} ist die Restkohäsion
- E_{rm} ist der Gebirgsmodul
- ψ ist die Dilatanz

3.2 TRENFLÄCHENORIENTIERUNG

Auf Grund der verfügbaren Daten der Regelplanung [7] und [8] wurden die Diskontinuitäten aus Tabelle 4 berücksichtigt. Auf der sicheren Seite liegend wurde ein größerer Datensatz von Trennflächen berücksichtigt, die innerhalb der Bündnerschiefer angetroffen wurden, wobei auch die Gebirge GA-BST-KS-8e, GA-BS-GM-8e, GA-T-A-8e, GA-BST-M-8e, GA-BST-KPH-8e einbezogen wurden.

Dove:

- Φ_{peak} è l'angolo d'attrito di picco.
- Φ_{res} è l'angolo d'attrito residuo.
- c_{peak} è la coesione di picco.
- c_{res} è la coesione residua.
- E_{rm} è il modulo d'ammasso.
- ψ è la dilatanza.

3.2 ORIENTAMENTO DELLE DISCONTINUITÀ

Sulla base dei dati disponibili dalla progettazione di sistema [7] e [8] sono state considerate le discontinuità riportate in Tabella 4. In via cautelativa è stato considerato un più ampio data-set di discontinuità riscontrate all'interno del complesso dei calcescisti considerando anche i parametri degli ammassi GA-BST-KS-8e, GA-BS-GM-8e, GA-T-A-8e, GA-BST-M-8e, GA-BST-KPH-8e.

Rock mass name	ID Joint	Dip direction [°]	Dip [°]	Max Persistence [m]
GA-T-A-8f GA-BST-KS-8f <i>Doc. [13]</i>	SC	355	60	10
	RTF2w	285	85	1
	RTF5	110	75	1
	RTF6	050	65	10
GA-BST-KS-8e GA-BS-GM-8e GA-T-A-8e GA-BST-M-8e GA-BST-KPH-8e <i>Doc. [14]</i>	SC	350	70	10
	RTF1	180	85	1
	RTF2e	085	80	3
	RTF3	320	80	3
	RTF6	220	80	3
	SC	345	45	3
GA-BCA-A-10g GA-BCA-GS-10g <i>Doc. [13]</i>	RTF1	160	80	1
	RTFw	255	75	1
	RTF3	300	85	1
	RTF6	020	80	3
	SC	345	45	3

Tabelle 4: Lage der Trennflächen im Bündnerschieferkomplex

Tabella 4: Giacitura delle discontinuità nel complesso dei calcescisti

3.2.1 Trennflächenparameter

Im Falle von ebenen glatten Harnischflächen (Chloritisierung) oder auch bei tonigen Füllungen mit Präsenz von Wasser o.ä. sollten zur Sicherheit folgende Scherparameter auf Trennflächen berücksichtigt werden:

- $\Phi = 20^\circ$
- $c = 0 \text{ MPa}$

3.2.1 Parametri delle discontinuità

Si adottano parametri conservativi per tenere in considerazione eventuali condizioni sfavorevoli delle discontinuità (superfici planari e lisce, riempimenti argillosi e presenza d'acqua, ecc.):

- $\Phi_k = 20^\circ$
- $c_k = 0 \text{ MPa}$

4 GEBIRGSVERHALTEN

Die Ermittlung der Gebirgslast sowie die Ermittlung der Lastableitung von der Außen- auf die Innenschale erfolgt in Abhängigkeit des Gebirgsverhaltens:

- Bei spannungsdominiertem Gebirgsverhalten werden die Gebirgslasten durch die numerische Modellierung der Interaktion zwischen Gebirge und Ausbau ermittelt.
- Bei trennflächendominiertem Gebirgsverhalten ermitteln sich die Gebirgslasten in erster Linie aus Blockanalysen.

Zur Einschätzung des Gebirgsverhaltens und zur Differenzierung zwischen den beiden Gebirgsverhalten wurde das Kennlinienverfahren angewandt.

4.1 ABSCHÄTZUNG DES GEBIRGSVERHALTENS

Zur Abschätzung des Gebirgsverhaltens wurden die Dokumente [2] und [7]-[8] berücksichtigt. Für weitere Details verweist man auf den Bericht [2]. In der folgenden Tabelle werden die aus dem Gebirgskennlinienverfahren resultierenden Ergebnisse aufgezeigt.

Die Tabelle 7 fasst die Hinweise zusammen, die durch die Methoden von Jehtwa, Bhasin, Hoek und Panet zur Überprüfung des Risikos von hohen Verformungen des Gebirges (*squeezing*) und von Instabilität an der Ortsbrust erhalten wurden, sowie die Hinweise zu möglichem Spröbruch (*rock burst*) durch die Methoden von Tao Zhen-Yu und Hoek.

Zone number	Rock mass name	Class	Zone max overburden	c_f	c_a	c_r	F_{plf}	F_{pla}	c_f/R	F_{plf}/R	c_r/R	F_{pla}/R
				[cm]	[cm]	[cm]	[m]	[m]	[%]	[-]	[%]	[-]
11	GA-BST-KS-8f	III	1060	6.06	20.20	14.14	6.12	13.95	1.25%	1.26	2.91%	2.87
12	GA-BST-KPH-8f	III	1080	17.56	58.53	40.97	8.82	18.84	3.61%	1.81	8.43%	3.88
	GA-T-R-8f	IV		119863	399543	279680	328	603	247	67	575	124
	GA-T-A-8f	III		2.06	6.87	4.81	3.57	9.07	0.42%	0.73	0.99%	1.87
13	GA-BST-KS-8f	III	1115	6.68	22.26	15.58	6.58	14.79	1.37%	1.35	3.21%	3.04
14	GA-BCA-A-10g	II	1200	0.66	2.22	1.55	0.00	2.39	0.14%	0.00	0.32%	0.49
	GA-BCA-GS-10g	III		1.39	4.62	3.23	0.96	4.61	0.29%	0.20	0.67%	0.95
15	GA-BCA-GS-10g	III	1135	1.25	4.16	2.91	0.82	4.36	0.26%	0.17	0.60%	0.90
	GA-BCA-A-10g	II		0.61	2.02	1.41	0.00	2.25	0.12%	0.00	0.29%	0.46

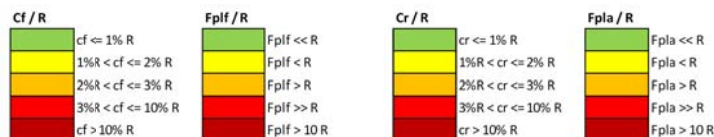


Tabelle 5: Ergebnisse Kennlinienverfahren. c_f = Ortsbrustkonvergenz, c_a = absolute Konvergenz am natürlichen Gleichgewicht, c_r = relative Konvergenz am natürlichen Gleichgewicht, F_{plf} = plastische Zone an der Ortsbrust, F_{pla} = plastische Zone Gleichgewicht, R = Ausbruchradius (mit 4.86m angenommen).

4 COMPORAMENTO DELLA ROCCIA

Il calcolo del carico dell'ammasso e il calcolo del trasferimento del carico dal rivestimento esterno al rivestimento definitivo dipendono dal comportamento dell'ammasso:

- in caso di comportamenti dell'ammasso di tipo spingente, i carichi si calcolano tramite modellazione numerica dell'interazione fra ammasso e rivestimento;
- in caso di ammasso altamente fratturato, i carichi si calcolano mediante l'analisi dei blocchi.

Per la valutazione del comportamento dell'ammasso e per la differenziazione tra i due comportamenti si utilizza il metodo delle curve caratteristiche.

4.1 VALUTAZIONE DEL COMPORAMENTO DELLA ROCCIA

Per la valutazione del comportamento dell'ammasso roccioso in esame sono stati presi in considerazione i documenti [2] e [7]-[8]. Rimandando al Rapporto per [2] maggiori dettagli, si riportano nella tabella seguente i risultati ottenuti dalle linee caratteristiche.

All'interno della Tabella 7 sono riassunte le indicazioni ottenute dai metodi di Jehtwa, Bhasin, Hoek e Panet per quanto riguarda la valutazione del rischio di elevate deformazioni dell'ammasso (*squeezing*) e di instabilità del fronte, insieme a quelle ottenute dai metodi di Tao Zhen-Yu e Hoek per il rischio di rottura fragile (*rock burst*).

Tabella 5: Risultati del metodo delle Linee Caratteristiche. c_f = convergenza al fronte, c_a = convergenza assoluta all'equilibrio naturale, c_r = convergenza relativa all'equilibrio naturale, F_{plf} = fascia plastica al fronte, F_{pla} = fascia plastica all'equilibrio naturale, R = raggio di scavo (assunto pari a 4.86m).

Zone number	Rock mass name	Class	Zone max overburden	Empirical methods						
				Squeezing and face stability				Rock burst		
				Jehtwa	Bhasin	Hoek	Panet		Tao Zhen-Yu	Hoek
							Face behaviour	Face condition		
11	GA-BST-KS-8f	III	1060	HS	HS	SS	P	US		
12	GA-BST-KPH-8f	III	1080	HS	HS	VSS	P	US		
	GA-T-R-8f	IV		HS	HS	ES	P	US		
	GA-T-A-8f	III		HS	HS	MS	P	STS		
13	GA-BST-KS-8f	III	1115	HS	HS	VSS	P	US		
14	GA-BCA-A-10g	II	1200	MiS	MS	FP	PP	STS	MRB	SSp
	GA-BCA-GS-10g	III		MoS	MS	FP	PP	STS		
15	GA-BCA-GS-10g	III	1135	MoS	MS	FP	PP	STS		
	GA-BCA-A-10g	II		MiS	MS	FP	PP	STS	MRB	SSp

Jehtwa NS No squeezing MiS Mildly squeezing MoS Moderately squeezing HS Highly squeezing	Bhasin NS No squeezing MS Mild to moderate squeezing HS Highly squeezing	Hoek (Squeezing) FP Few stability problems MS Minor squeezing problems SS Severe squeezing problems VSS Very severe squeezing and face stability problems ES Extreme squeezing problems
Panet E Elastic PP Partially plastic P Plastic S Stable STS Stable (only short-term) US Unstable	Tao Zhen-Yu NRB No rockbursting LRB Low rockbursting activity MRB Moderate rockbursting activity HRB High rockbursting activity	Hoek (Rock burst) S Stability Sp Spalling SSp Severe spalling - slabbing ISM Need of important stabilization measures RB Cavity collapse (rock burst)

Tabelle 6: Ergebnisse empirische Berechnungsmethoden

Tabella 6: Risultati dei metodi empirici.

Die Tabelle 7 gibt ein Annahmekriterium [22]-[23] wieder, durch das das Verhalten der Ortsbrust in Funktion der Berechnungsergebnisse aus dem Gebirgskennlinienverfahren eingeschätzt wird (Konvergenz an der Ortsbrust und Ausdehnung der plastischen Zone an der Ortsbrust).

In Tabella 7 si riporta un criterio [22]-[23] per stimare il comportamento del fronte di scavo in funzione dei risultati delle analisi con le linee caratteristiche (convergenza al fronte e estensione della fascia plastica al fronte).

Fronte stabile	Fronte stabile a breve termine	Tendenza all'instabilità del fronte	Fronte instabile
$c_f < 1\% R_{scavo}$	$1\% R_{scavo} < c_f < 2\% R_{scavo}$	$2\% R_{scavo} < c_f < 3\% R_{scavo}$	$c_f > 3\% R_{scavo}$
$F_{plf} \ll R_{scavo}$	$F_{plf} < R_{scavo}$	$F_{plf} \geq R_{scavo}$	$F_{plf} \gg R_{scavo}$

Tabelle 7: Vorgeschlagene Stabilitätskriterien in [24] [25]; c_f = Ortsbrustkonvergenz; F_{plf} = Umfang des plastischen Streifens an der Ortsbrust; R_{scavo} = r_{eq} = entsprechender Aushebungsradius.

Tabella 7: Criteri di stabilità proposti in [22] [23]; c_f = convergenza al fronte; F_{plf} = estensione della fascia plastica al fronte; R_{scavo} = r_{eq} = raggio equivalente di scavo.

Aus dem Kennlinienverfahren geht hervor, dass für die Gebirge GA-BCA-A-10g und GA-BCA-GS-10g mit begrenzten Verformungsproblemen (< 5 cm) und Stabilitätsproblemen zu rechnen ist. Man erwartet sich daher hauptsächlich ein elastisches Verhalten des Hohlraums mit einer plastifizierten Zone an der Ortsbrust, dessen Ausmaß geringer als der Ausbruchradius ausfällt. Die Ortsbrust ist nahezu stabil. Diese Gebirgstypen werden für die Bemessung der Regelprofile FdE-C T2/T3 e CT1 T2/T3 herangezogen.

Dall'analisi si evidenzia come per gli ammassi GA-BCA-A-10g e GA-BCA-GS-10g cui si possono attendere basse problematicità deformative (< 5 cm) e di stabilità. Il comportamento del cavo atteso è di tipo sostanzialmente elastico con fascia plastica, inferiore al raggio di scavo, e il fronte si presenta pressoché stabile. Questi ammassi vengono considerati per il dimensionamento dei profili tipo FdE-C T2/T3 e CT1 T2/T3.

Beim Gebirge GA-BST-KS-8f (Gebirge im Bereich der Nothaltestelle) wird auf das druckhafte Verhalten aufmerksam gemacht. Es mit elasto-plastischem Gebirgsverhalten zu rechnen mit einer plastischen Zone an der Ortsbrust, dessen Ausmaß dem Ausbruchradius entspricht. Die Ortsbrust ist

Per quanto riguarda l'ammasso GA-BST-KS-8f (ammasso prevalente all'interno della fermata di emergenza), si evidenzia un comportamento spingente. Il comportamento del cavo atteso è di tipo sostanzialmente elasto-plastico con fascia plastica al fronte circa pari al raggio di scavo, e il fronte si presenta stabile a breve termine. Questo ammasso viene

kurzfristig standfest. Dieser Gebirgstyp wird für die Bemessung der Regelprofile FdE-C T4 e CT1 T4 verwendet.

Der Vortrieb im Gebirge des Typs GA-T-R-8f ist durch nachbrüchiges Verhalten charakterisiert, es ist mit ausgedehnten Auflockerungen und Plastifizierungen in Zusammenhang mit großen Verformungen (siehe geomechanische Karten im Anhang 1). Gemäss Dokumente [2] und [3]-[5], hat diese Gebirgsformation eine begrenzte Länge von 0 bis ca. 10m. Aus diesem Grund wird keine spezifische Bemessung in diesem Bereich durchgeführt und es wird auf das *Risikomanagement* (02-H61-GD-040-KTB-D0700-22102) verwiesen. Diese Vorgaben sind im Bereich von Stör-/Verwerfungszonen mit schlechteren geologischen Eigenschaften, als in den Dokumenten [2] und [3]-[5] vorgesehen, anzuwenden.

Auf Grund des Anhydrithgehaltes der Gebirge, gemäß den Angaben in den Dokumenten [2] und [3]-[5], kann es langfristig mit quellendem Gebirgsverhalten zu rechnen. Im Zuge der Vortriebsarbeiten wird das Phenomän untersucht und eventuelle Auswirkungen auf die Innenschale können berücksichtigt werden. Die Bemessung der Innenschale auf Quelldruck ist im Anhang aufgeführt. Im Anhang 1 sind die geomechanischen Karten der untersuchten Gebirge enthalten.

considerato per il dimensionamento del profilo tipo FdE-C T4 e CT1 T4.

Per quanto riguarda lo scavo all'interno dell'ammasso GA-T-R-8f composto da formazioni incoerenti, sono attesi allentamenti e plasticizzazioni profonde connesse a deformazioni elevate (vedasi schede geomeccaniche riportate in Appendice 1). Secondo i documenti [2] e [3]-[5], questa formazione ha una lunghezza limitata variabile da 0 a circa 10 m. Per questo motivo non verrà eseguito un dimensionamento specifico per questa formazione ma valgono le prescrizioni contenute nel Rapporto *Procedura di gestione del rischio* (02-H61-GD-040-KTB-D0700-22102). Tali prescrizioni possono ritenersi valide per la presenza di zone disturbate/ di faglia con caratteristiche geologiche peggiori rispetto a quanto previsto nei documenti [2] e [3]-[5].

Per la possibile presenza di anidrite all'interno degli ammassi in esame secondo le indicazioni dei documenti [2] e [3]-[5] è possibile che ci siano problemi di rigonfiamento a lungo termine. Sulla base del riscontro dello scavo verrà valutato il fenomeno e saranno considerati eventuali influssi sul rivestimento definitivo; il dimensionamento dell'anello interno soggetto al carico di rigonfiamento è riportato in Appendice. Nell'Appendice 1 sono riportate le schede geomeccaniche per gli ammassi in esame.

5 AUßENSCHALE

Bei der nachfolgende Bemessung der Innenschale (Kapitel 6) für das Profil T3, wurden zwei unterschiedliche Berechnungsarten angewandt, um zu unterscheiden, ob die Last, die aus der Loslösung eines Felsblocks (Kapitel 5.1) resultiert, ungünstiger wirkt, als die Last aus dem Auflockerungsdruck (Kapitel 5.2). Für das Profil T4 wurde ausschließlich der Auflockerungsdruck berücksichtigt.

5.1 BRUCHKÖRPERANALYSE

5.1.1 Gebirgslast bei trennflächendominiertem Gebirgsverhalten

Die Größe der Blöcke bestimmt die Lasten, die für die Bemessung der Inneschale relevant sind. Eine beispielhafte Ableitung der im Modell des gebetteten Stabzugmodells anzusetzende Last ist nachfolgend dargestellt.

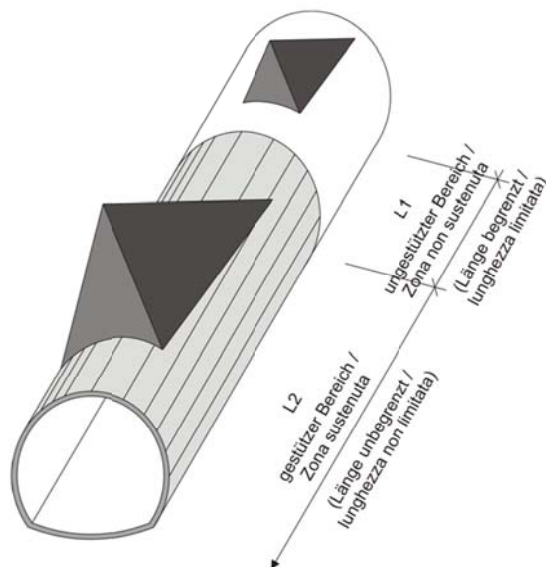


Abbildung 2: Qualitative Darstellung der Einwirkung aus dem Gebirge auf die Schale bei trennflächendominiertem Gebirgsverhalten

5.1.2 Nachweisverfahren

Gemäß NTC 2008 ist das Teilsicherheitskonzept zu berücksichtigen. Demnach ist die Einwirkungsseite mit $\gamma_G = 1,30$ zu erhöhen und die Widerstandsseite mit $\gamma_c = 1,50$ bzw. $\gamma_s = 1,15$ zu reduzieren.

Die Trennflächenparameter c' und ϕ' gehen als charakteristische Größen, wie aus Absatz 3.2.1., in die Berechnung ein.

Für den Nachweis mittels Bruchkörperanalyse ist folgendes Sicherheitskonzept zu berücksichtigen.

$$E_d \leq R_d$$

5 RIVESTIMENTO DI PRIMA FASE

Per il successivo dimensionamento dell'anello interno (paragrafo 6) per il profilo tipo T3, sono stati implementati due differenti tipologie di analisi al fine di valutare se il carico dovuto al distacco di un blocco (paragrafo 5.1) fosse più o meno gravoso del carico di allentamento dell'ammasso (paragrafo 0). Per il profilo T4 invece è stato considerato solamente lo scenario di carico allentamento.

5.1 ANALISI DEI BLOCCHI

5.1.1 Carichi dell'ammasso fratturato

Le dimensioni dei blocchi definiscono i carichi da considerare per il dimensionamento del rivestimento definitivo. La seguente figura illustra l'esempio di una trasposizione del carico da applicare al modello statico appoggiato su un letto di molle.

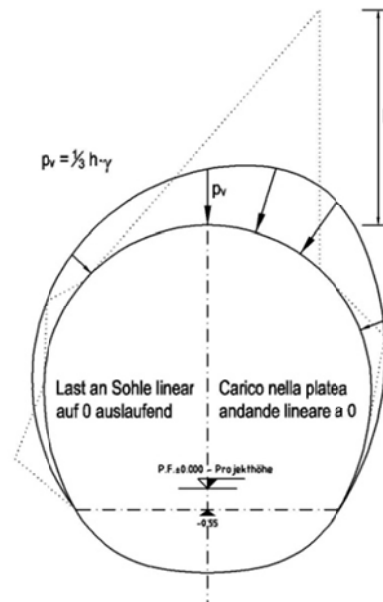


Figura 2: Rappresentazione qualitativa degli effetti dell'ammasso sul rivestimento, in caso di ammasso altamente fratturato

5.1.2 Procedura di verifica

In conformità alle NTC 2008 sono stati considerati i fattori parziali di sicurezza secondo i quali le azioni vengono aumentate di $\gamma_G = 1,30$ e le resistenze ridotte di $\gamma_c = 1,50$ ovvero $\gamma_s = 1,15$.

Per l'analisi, si adottano i valori caratteristici c' e ϕ' riportati al paragrafo 3.2.1.

Per la verifica basata sull'analisi dei blocchi deve essere considerato il seguente criterio di sicurezza.

Hierbei ist:

- R_d = Bemessungswert Widerstand
- E_d = Bemessungswert Einwirkung

5.1.3 Ergebnisse

Der Nachweis wurde mit dem Berechnungsprogramm UNWEDGE 3.0 durchgeführt. Dabei wird die Wirksamkeit der Anker in Abhängigkeit von deren Neigung, Rutschrichtung der Felsblöcke und in Hinblick auf die Scherfestigkeit der Kluffüllungen untersucht.

Auf der sicheren Seite liegend wurde der Ausbruchsquerschnitt CT1-T2 aufgrund der in Tabelle 4 aufgezeigten Diskontinuitäten analysiert. Die Ergebnisse gelten auch für den Ausbruchsquerschnitt CT1-T3.

Es werden zwei Arten von Nachweisen durchgeführt:

- Sektor L1: die Länge des Berechnungsmodells entspricht der Abschlagslänge (4.5 m), welche aus Sicherheitsgründen um 0.5 Meter verlängert und ohne Spritzbeton berücksichtigt wurde. Um die Stabilität der Felsblöcke sicherzustellen, ist ein Netz aus Ankern des Typs Superswellex Pm 16 ($N_{yd} = 140$ kN) von 3.0 Meter Länge mit Raster 1.80 m (längs) x 1.50 m (quer) vorgesehen.
- Sektor L2: Das Berechnungsmodell ist unendlich lang mit einer 10 cm dicken Spritzbetonschale und mit Ankern des Typs Superswellex Pm 16 ($N_{yd} = 140$ kN) von 3.0 Meter Länge mit Raster 1.80 m (längs) x 1.50 m (quer).

Blöcke mit geringer Größe (<100 kN) sind für die Berechnung nicht maßgebend und falls sie nicht schon durch die Sprengung abgebrochen sein sollten, müssen sie vor Ort vom Geotechnik-Fachmann geprüft und mit einzelnen Ankern gesichert werden.

Mit Verweis auf Anhang 3 und den Berechnungsergebnissen, wird darauf aufmerksam gemacht, dass mit der geplanten Ausbruchsicherung ein Sicherheitsfaktor von 1.3 und somit gleich γ_G erreicht wird.

Aus der Nachweisführung geht hervor, dass das maximale Gewicht eines Felsblockes ca. 48 kN beträgt (maximale Höhe gleich 2.74 m). Die agierende Fläche beträgt ca. 1.56 m² und der maximale Druck des Blocks mit dreieckigem Verlauf beträgt:

$$P_v \approx 30.6 \text{ kPa}$$

Dove:

- R_d = Valore della resistenza di progetto
- E_d = Valore di progetto dell'effetto delle azioni

5.1.3 Casi analizzati e risultati

Le analisi sono state effettuate con il programma di calcolo UNWEDGE 3.0 considerando l'efficacia dei chiodi in funzione della loro inclinazione rispetto al direzione di scivolamento dei blocchi e considerando la resistenza a taglio degli inclusi.

In via cautelativa è stata analizzata la sezione CT1-T2 sulla base delle discontinuità riportate in Tabella 4. I risultati ottenuti sono validi anche per la sezione CT1-T3.

Vengono eseguite due tipologie di analisi:

- settore L1: lunghezza di analisi pari allo sfondo di abbattimento (4.5 m) aumentato cautelativamente di 0.5 metri con assenza di betoncino proiettato. Per garantire la stabilità dei cunei rocciosi si prevede una rete di ancoraggi Superswellex Pm 16 ($N_{yd} = 140$ kN) di lunghezza 3.0 metri e maglia 1.80 m (longitudinale) x 1.50 m (trasversale).
- settore L2: lunghezza di analisi illimitata con presenza di uno strato di betoncino proiettato di 10 cm e ancoraggi Superswellex Pm 16 ($N_{yd} = 140$ kN) di lunghezza 3.0 metri e maglia 1.80 m (longitudinale) x 1.50 m (trasversale).

I blocchi che hanno una dimensione ridotta (< 100 kN) non sono rappresentativi per l'analisi e, qualora non si siano già distaccati a seguito del brillamento, devono essere esaminati sul luogo dall'esperto geotecnico ed assicurati con bulloni singoli.

Rimandando all'Appendice 3 per la sintesi dei risultati, si evidenzia che con i provvedimenti di messa in sicurezza previsti si raggiunge sempre un fattore di sicurezza maggiore di 1.3, uguale a γ_G .

Dall'analisi risulta che il peso massimo del blocco è di 48 kN (altezza massima pari a 2.74 m) con superficie agente di ca. 1.56 m². La pressione esercitata del blocco con andamento triangolare, ha un valore massimo di:

$$P_v \approx 30.6 \text{ kPa}$$

5.2 ANALYSE DER AUSBRUCHPHASEN

Um abzuschätzen, welcher Lastfall, der Gebirgsdruck oder das plötzliche Loslösen eines Bruchkörpers (Absatz 5.1), maßgebend ist, wurde eine Finite-Elemente-Berechnung mit dem Programm MIDAS GTS [32] durchgeführt. Dieses erlaubt es, die Lastentwicklung und das spannungs-verformende Verhalten des Gebirges während der einzelnen Bauphasen zu verfolgen.

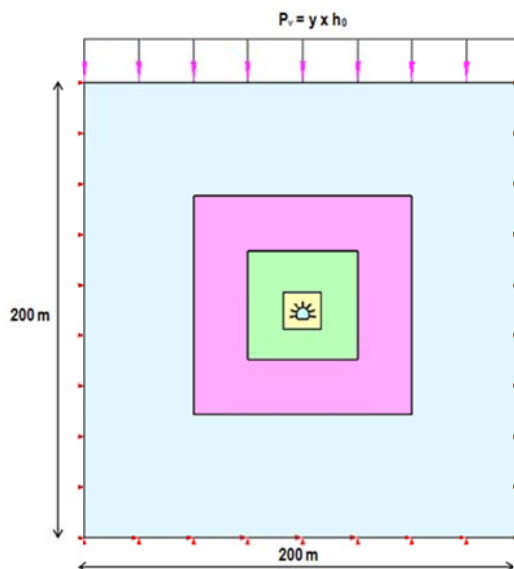
Die Modellierungen erfolgen im ebenen Verformungszustand, d.h.:

- Das geotechnische Bezugsmodell stellt einen Querschnitt orthogonal zur Tunnelachse dar;
- Die Definition des Spannungs-Verformungs-Verhaltens und der Festigkeit des Gebirges ist vom Ausbruch abhängig;
- Die Definition des Spannungszustands im Gebirge, vor dem Tunnelvortrieb ist erforderlich;
- Die einzelnen Ausbruchphasen sowie die entsprechende Ausbruchsicherung werden modelliert.

5.2.1 Untersuchte Ausbruchquerschnitte CT1 T3 und FdE-C T3

5.2.1.1 Modellgeometrie

Für die Bemessung der Regelprofile CT1 T3 und FdE-C T3 wurde der Querschnitt mit der höchsten Überdeckung (1135m CT1 46/2) im Bereich der geomechanischen Zonen 14-15 berücksichtigt. Auf Grund der sehr ähnlichen Ausbruchquerschnitte wird nur ein Berechnungsmodell für den größeren Querschnitt (FdE-C T3, Ausbruchsfläche 26.38 m²) erstellt.



5.2 ANALISI DELLE FASI DI SCAVO

Al fine di valutare se il carico d'ammasso è più o meno gravoso del carico dovuto al distacco di un blocco (paragrafo 5.1), è stata condotta un'analisi mediante il programma agli elementi finiti MIDAS GTS [32]. Quest'ultimo consente di seguire la storia di carico e il comportamento tensio-deformativo dell'ammasso roccioso durante tutte gli step per la realizzazione dell'opera.

Le analisi, condotte nell'ipotesi di deformazioni piane, comportano:

- La definizione del modello geotecnico di riferimento che rappresenta una sezione trasversale all'asse della galleria;
- La definizione delle leggi sforzo-deformazione e di resistenza dell'ammasso roccioso interessato dagli scavi;
- La definizione dello stato tensionale presente nell'ammasso prima dello scavo della galleria;
- La simulazione delle fasi di scavo e di messa in opera dei sostegni.

5.2.1 Sezioni di scavo CT1 T3 e FdE-C T3

5.2.1.1 Geometria del modello

Per il dimensionamento della sezione CT1 T3 e FdE-C T3 si è considerata la sezione con la massima copertura (1135m CT1 46/2) all'interno della zona geomeccaniche 14-15. Visto che le sezioni di scavo tra i due profili tipo sono pressoché identiche, viene sviluppato un unico modello, considerando la sezione maggiore (FdE-C T3, superficie di scavo pari a 26.38 m²).

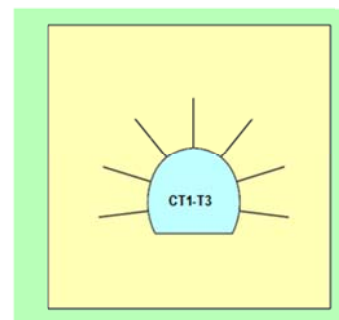


Abbildung 3: Berechnungsquerschnitt CT1-T3

Das Berechnungsmodell, der Problemsymmetrie zufolge, erstreckt sich 100m in der Breite an den Enden des Hohlraums, 200m in der Höhe, von denen sich 100m unter und 100m über der Schienenoberkante befinden. Durch die gewählten Modellabmessungen kann davon ausgegangen werden, dass eventuelle Randeinflüsse vernachlässigbar sind. Das Gebirge wurde mittels zweidimensionaler, quadratischer Elemente mit Abmessungen von ca. 200x200 cm diskretisiert. In der Nähe des Tunnels wird die Mesh verdichtet und die Elemente erreichen Abmessungen von 50x50 cm. Die gewählten Randbedingungen verhindern eine Verschiebung in beide Richtungen am unteren Modellrand und blockieren Verschiebungen in horizontaler Richtung an den vertikalen Modellrändern. Am oberen Modellrand wurde ein Druck aufgebracht, welcher der vorhandenen Bodenauflast (von Tunnel bis Geländeoberkante) entspricht.

5.2.1.2 Gebirgsmodell und Ausgangsspannungslage

Das Gebirge wurde als ein kontinuierlich elastisch-plastisches Medium modelliert mit Widerstandskriterium des Typs Hoek-Brown [24] und Restparameter, die gemäß der Cai et. al [31] Theorie bewertet werden und im Bericht [1] wiedergegeben sind. Im Besonderen wurden die elastischen (Verformungsmodul und Poisson-Beiwert), elastisch-plastischen (m_b , s mit Peak- und Restwerte) und physischen (Dichte und einaxiale Druckfestigkeit) Eigenschaften der vom Ausbruch betroffenen Felsen bestimmt.

Aufgrund der im Abs. 3.1 aufgezeigten Bemerkungen, werden die geomechanischen Parameter des Gebirges GA-BCA-A-10g e GA-BCA-GS-10g berücksichtigt.

Figura 3: Sezione di analisi CT1-T3

Il modello di calcolo, in virtù della simmetria del problema, si estende per 100 m in larghezza agli estremi della cavità, 200 m in altezza, di cui 100 m al di sotto del piano del ferro e 100 m al di sopra di quest'ultimo. Tali limiti sono sufficienti per ritenere trascurabili gli effetti di bordo. L'ammasso è stato discretizzato mediante elementi bidimensionali quadrati di dimensioni pari a circa 200x200 cm, infittiti in prossimità della galleria, dove assumono dimensioni pari a circa 50x50 cm. Le condizioni di vincolo al contorno del modello prevedono spostamenti impediti in entrambe le direzioni lungo il boundary inferiore e spostamenti impediti in direzione orizzontale lungo i boundary verticali. Sul boundary superiore è applicata una pressione pari al peso del terreno presente in sito fino alla quota del piano campagna.

5.2.1.2 Modello costitutivo dell'ammasso e stato tensionale iniziale

L'ammasso è stato modellato come un mezzo continuo elasto-plastico avente criterio di resistenza di tipo Hoek-Brown [24] con parametri residui valutati sulla base della teoria di Cai et. al [31] e riportata nel Rapporto [1]. In particolare sono state assegnate le caratteristiche elastiche (modulo di deformazione e coefficiente di Poisson), elasto-plastiche (m_b , s con valori di picco e residuo) e fisiche (densità e resistenza a compressione monoassiale) proprie delle rocce interessate dallo scavo.

Sulla base delle considerazioni riportate nel Par 3.1, vengono considerati i parametri geomeccanici degli ammassi GA-BCA-A-10g e GA-BCA-GS-10g:

Zone max overburden [m]	GSI	GSI _{res}	γ [kN/m ³]	E_{rm} [MPa]	σ_{ci} [MPa]	σ_{cm} [MPa]	m_i [-]	$m_{b, peak}$ [-]	$m_{b, res}$ [-]	$s_{, peak}$ [-]	$s_{, res}$ [-]
1135	50	25.59	27.3	15528	72.5	15.60	15.5	2.599	1.087	0.0039	0.0003

Tabelle 8: Berücksichtigte geomechanische Parameter

Tabella 8: Parametri geomeccanici considerati

Ähnliche geomechanische Parameter gelten unter der Annahme von optimistischen Werten gemäß Bericht [2] für den Gebirgstyp GA-BST-KS-8f.

Parametri geomeccanici simili possono essere validi per l'ammasso GA-BST-KS-8f, considerando valori ottimistici all'interno dei campi di variabilità indicati nel Rapporto [2].

Der vorherrschende Spannungszustand wurde anhand der nachfolgenden Gleichungen bestimmt:

Lo stato di sforzo in sito è stato valutato secondo le seguenti relazioni:

$$\sigma_y = \gamma \cdot z$$

$$\sigma_x = K_0 \cdot \sigma_z$$

Wobei:

Dove

- Z = Abstand des allgemeinen Elements von der Geländeoberkante

- Z rappresenta la distanza del generico elemento dal piano campagna

- K_0 = Beiwert des horizontal wirkenden Erddrucks, gleich 0.75 angenommen.

- K_0 è il coefficiente di spinta orizzontale, assunto pari a 0.75.

5.2.1.3 Eigenschaften der Außenschale

Folgende Tabelle zeigt die Eigenschaften der Sicherheitsmaßnahmen für das Profil CT1-T3 auf:

	Anker Chiodature						Spritzbeton Betoncino proiettato		
	Typ Tipo	N_y [kN]	L [m]	i_{long} [m]	i_{trasv} [m]	n° [-]	Classe [-]	s_{nom} [cm]	s_{min} [cm]
CT1 T3	Pm16	140	3.0	1.5	1.8	6+7	C30/37	15	9

Tabelle 9: Charakteristiken der Außenschale CT1-T3

5.2.1.3 Caratteristiche dei rivestimenti di prima fase

La seguente tabella riporta le caratteristiche dei provvedimenti di messa in sicurezza per il profilo CT1-T3:

Tabella 9: Caratteristiche rivestimenti di prima fase CT1-T3

Die Anker werden ins Modell eingefügt und zwar mit einem Grenzwiderstand, der ihrer Streckgrenze entspricht, die um den Widerstandsbeiwert ($\gamma_R = 1.15$) und der Reibung ($\gamma_R = 1.3$) faktorisiert wird, so wie mit BBT SE abgesprochen.

I chiodi vengono inseriti nel modello con una resistenza limite pari alla loro resistenza a snervamento fattorizzata per il coefficiente sulle resistenze ($\gamma_R = 1.15$) e sull'aderenza di ($\gamma_R = 1.3$) come concordato con BBT SE.

Die Anker werden mit spezifischen eindimensionalen Elementen (Truss) nachgebildet, welche perfekt plastisch-elastischem Verhalten (Abbildung 4) aufweisen und das Von Mises Bruchkriterium ($N_{yd} = N_{yk}/1.15 = 174$ kN) befolgen. Sie sind mit den Gitterknoten über eine Schnittstelle verbunden, wobei Vorsichtswerte des Querwiderstands (100 kN/m) und der tangentialen Steifigkeit (10 MN/m/m) [30] berücksichtigt werden.

Gli ancoraggi sono stati riprodotti con specifici elementi monodimensionali (Truss) aventi comportamento elastico perfettamente plastico (Figura 4) con criterio di rottura alla Von Mises ($N_{yd} = N_{yk}/1.15 = 174$ kN) collegati ai nodi della griglia mediante un'interfaccia considerando valori cautelativi di resistenza a taglio (100 kN/m) e rigidità tangenziale (10 MN/m/m) [30].

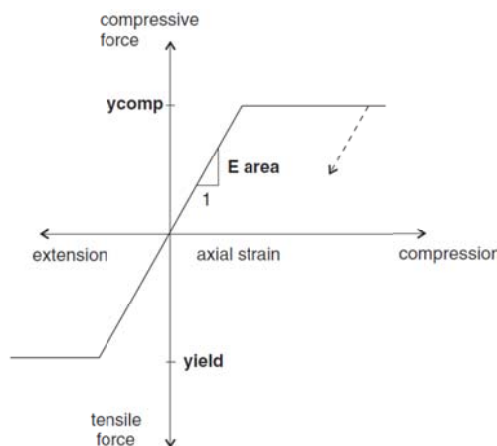


Abbildung 4: Spannungs-Verformungsverhalten der Anker-Elemente. Auf der sicheren Seite liegend wird die Außenschale in Spritzbeton vernachlässigt, da diese als konstruktive Maßnahme gegen das Loslösen von kleinen Gebirgsvolumen (siehe Anhang 3) betrachtet wird.

Figura 4: Comportamento sforzo-deformazione per gli ancoraggi. In via cautelativa il rivestimento di prima fase in betoncino proiettato viene trascurato in quanto considerato come un provvedimento costruttivo atto a garantire la sicurezza nei confronti di distacchi di piccoli volumi di roccia (vedasi Appendice 3).

5.2.1.4 Laststufe

Nach einer ersten Phase der Modellinitialisierung zur Berechnung des Ausgangsgleichgewichts, wird der Ausbruch der FdE-MM mittels fiktiver Ausbruch-Kräfte (nachfolgend FFS genannt) simuliert. Der Prozentsatz dieser Kräfte an der Ortsbrust wird aufgrund der Ergebnisse des

5.2.1.4 Step di carico

Dopo una prima fase di inizializzazione del modello, necessaria per calcolare l'equilibrio iniziale, lo scavo del CT1-T3 viene simulato mediante l'utilizzo delle Forze Fittizie di Scavo, di seguito denominate FFS. La percentuale di tali forze al fronte è definita sulla base dei risultati delle Linee

Kennlinienverfahrens bestimmt (Anhang 2).

Caratteristiche (vedasi Appendice 2).

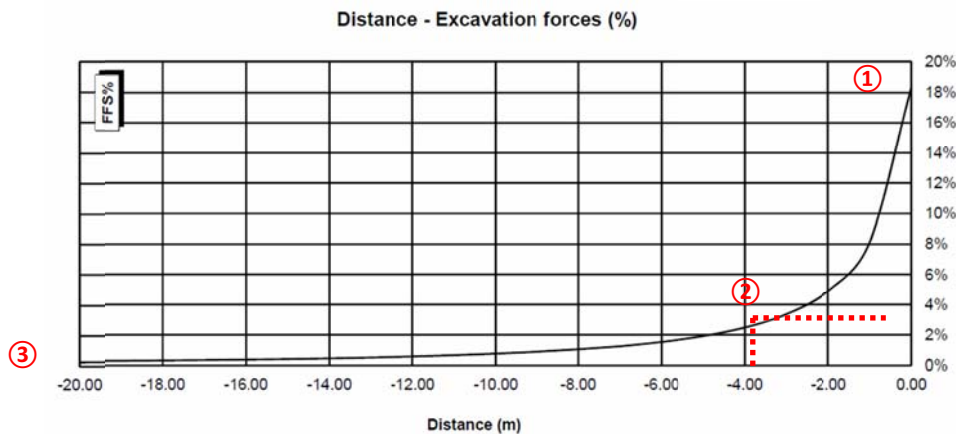


Abbildung 5: FFS an der Ortsbrust und bei Einsetzung der Anker

Figura 5: FFS al fronte e all'installazione delle chiodature

Nachfolgend sind die Berechnungsstufen zusammengefasst:

Di seguito sono riassunti gli step di calcolo:

- 0) Geostatische Ausgangslage mit Bestimmung der Geometrie, der Randbedingungen, der Stratigraphie und der geostatischen Ausgangsspannungen;
- 1) Annullierung der Zonen im ausgebrochenen Bereich und Reduktion der FFS bis zum Wert, den sie an der Ortsbrust einnehmen (FFS =18%);
- 2) Reduktion der FFS bis zum Wert, den sie beim Einbau der Außenschale einnehmen (3.0 m ab Ortsbrust) (FFS =3%);
- 3) Modellierung im numerischen Modells der Ausbruchsicherung und Annullierung der FFS (FFS =0%);
- 4) Entfernung der Außenschale und Simulation der Langzeitkonfiguration mit Einbau der Innenschale. Diese ist mit der Mesh mittels eines Schnittstellenelements mit einer dem Gebirge entsprechenden normaler Steifigkeit und tangentialer Steifigkeit gleich Null, verbunden. Dieses Schnittstellenelement ermöglicht es, neben den Einwirkungen auf die Innenschale auch die Wirkung der Abdichtungsschicht zwischen den zwei Schalen zu berücksichtigen, indem es die tangentialen Spannungen annulliert.

- 0) Condizione geostatica iniziale con definizione della geometria, delle condizioni al contorno, della stratigrafia e delle tensioni geostatiche iniziali;
- 1) Annullamento delle zone all'interno dello scavo e riduzione delle forze FFS, fino al valore che assumono al fronte (FFS=18%);
- 2) Riduzione delle FFS fino al valore che assumono nel momento di installazione del rivestimento di I fase (3.0 m dal fronte) (FFS=3%);
- 3) Introduzione nel modello numerico dei sostegni di I fase e annullamento delle FFS (FFS=0%).
- 4) Rimozione del rivestimento di prima fase e simulazione della configurazione a lungo termine con l'installazione del rivestimento definitivo. Quest'ultimo è collegato alla mesh mediante un elemento interfaccia avente rigidità normale pari a quella dell'ammasso e rigidità tangenziale nulla. Quest'ultimo elemento, oltre a consentire di valutare le pressioni che agiscono sul rivestimento definitivo, consente di considerare l'effetto del pacchetto di impermeabilizzazione presente tra i due rivestimenti, annullando le tensioni tangenziali.

5.2.1.5 Nachweisverfahren

Gemäß den NTC 2008 werden die Einwirkungen auf die Außenschale, die dem FEM Modell entnommen sind, um $\gamma_G = 1,30$ erhöht und die Widerstände des strukturellen Abschnitts um $\gamma_c = 1,50$ reduziert, das heißt $\gamma_s = 1,15$.

Die Nachweise gelten erfüllt, wenn folgende Ungleichung verifiziert ist:

$$E_d \leq R_d$$

5.2.1.5 Procedura di verifica

In conformità alle NTC 2008 le azioni ricavate dal modello FEM sul rivestimento di prima fase sono aumentate di $\gamma_G = 1,30$ e le resistenze della sezione strutturale sono ridotte di $\gamma_c = 1,50$ ovvero $\gamma_s = 1,15$.

Le verifiche risultano soddisfatte se è verificata la seguente disuguaglianza:

Hierbei ist:

- R_d = Bemessungswert Widerstand
- E_d = Bemessungswert Einwirkung

Da im FEM Modell der Spritzbeton vernachlässigt wurde, wie in Abs. 5.2.3. angeführt, wird nachgewiesen, dass die Anker, welche ihre Streckgrenze erreichen ($N_{yd} = 174$ kN), nicht die axiale Verformungsgrenze, die vorsichtshalber auf 5% gesetzt wurde, überschreiten.

5.2.1.6 Ergebnisse

Die im Anhang 4 aufgezeigten Analysen bestätigen, dass das Gebirgsverhalten durch geringe Konvergenzen (< 50 mm) und durch die Bildung eines plastischen Streifens mit maximaler Ausdehnung von ca. 2 m gekennzeichnet ist.

Die Anker erreichen die Streckgrenze ($N_{yd} = 122$ kN), aber nicht die Verformungsgrenze des Stahls ($\epsilon < 5\%$).

Der vom Gebirge ausgeübte Druck auf die Innenschale, beim Entfallen der Anker, beträgt 40 kPa.

5.2.2 Untersuchte Ausbruchquerschnitte CT1 T4 e FdE-C T4

5.2.2.1 Modellgeometrie

Für die Bemessung der Regelprofile CT1-T4/FdE-C T4 wurde der Querschnitt mit maximaler Überdeckung (1115m CT1 46/2) im Bereich der geomechanischen Zonen 11-13 herangezogen.

Das Berechnungsmodell, der Problemsymmetrie zufolge, erstreckt sich 100 m in der Breite an den Enden des Hohlraums, 200 m in der Höhe, von denen sich 100 m unter und 100 m über der Schienenoberkante befinden. Durch die gewählten Modellabmessungen kann davon ausgegangen werden, dass eventuelle Randeinflüsse vernachlässigbar sind. Das Gebirge wurde mittels zweidimensionaler, quadratischer Elemente mit Abmessungen von ca. 200x200 cm diskretisiert. In der Nähe des Tunnels wird die Mesh verdichtet und die Elemente erreichen Abmessungen von 50x50 cm. Die gewählten Randbedingungen verhindern eine Verschiebung in beide Richtungen am unteren Modellrand und blockieren Verschiebungen in horizontaler Richtung an den vertikalen Modellrändern. Am oberen Modellrand wurde ein Druck aufgebracht, welcher der vorhandenen Bodenauflast (von Tunnel bis Geländeoberkante) entspricht.

Dove:

- R_d = Valore della resistenza di progetto
- E_d = Valore di progetto dell'effetto delle azioni

Essendo stato trascurato nel modello FEM il betoncino proiettato come riportato al Par. 5.2.1.3, si verifica che gli ancoraggi che raggiungono il limite di snervamento ($N_{yd} = 122$ kN) non superino il limite di deformazione assiale posto cautelativamente pari al 5%.

5.2.1.6 Risultati

Le analisi riportate nell'Appendice 4 confermano che comportamento dell'ammasso è caratterizzato da convergenze ridotte (< 50 mm) e dalla formazione di una fascia plastica di estensione massima di ca. 2 m.

Gli ancoraggi raggiungono il limite di snervamento ($N_{yd} = 122$ kN) ma non raggiungono il limite di deformazione dell'acciaio ($\epsilon < 5\%$).

La pressione esercitata dall'ammasso sul rivestimento definitivo, al decadimento delle chiodature, è dell'ordine dei 40 kPa.

5.2.2 Analisi delle sezioni di scavo CT1 T4 e FdE-C T4

5.2.2.1 Geometria del modello

Per il dimensionamento della sezione CT1-T4/FdE-C T4 si è considerata la sezione con la massima copertura (1115m CT1 46/2) all'interno della zone geomeccaniche 11-13.

Il modello di calcolo, in virtù della simmetria del problema, si estende per 100 m in larghezza agli estremi della cavità, 200 m in altezza, di cui 100 m al di sotto del piano del ferro e 100 m al di sopra di quest'ultimo. Tali limiti sono sufficienti per ritenere trascurabili gli effetti di bordo. L'ammasso è stato discretizzato mediante elementi bidimensionali quadrati di dimensioni pari a circa 200x200 cm, infittiti in prossimità della galleria, dove assumono dimensioni pari a circa 50x50 cm. Le condizioni di vincolo al contorno del modello prevedono spostamenti impediti in entrambe le direzioni lungo il boundary inferiore e spostamenti impediti in direzione orizzontale lungo i boundary verticali. Sul boundary superiore è applicata una pressione pari al peso del terreno presente in sito fino alla quota del piano campagna.

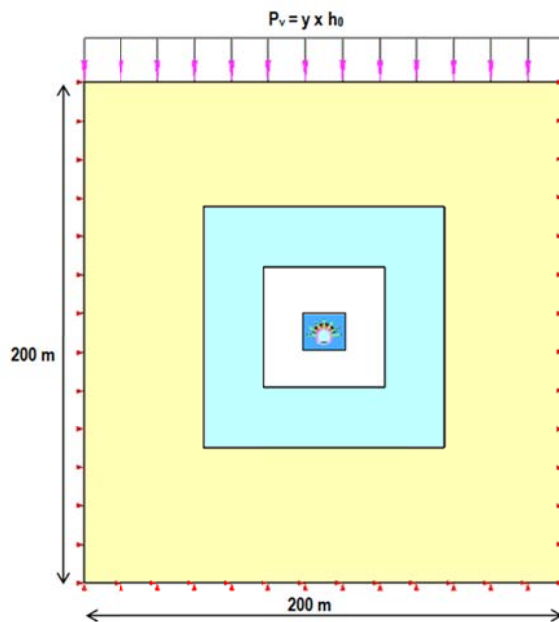


Abbildung 6: Berechnungsquerschnitt FdE-C T4 e CT1-T4

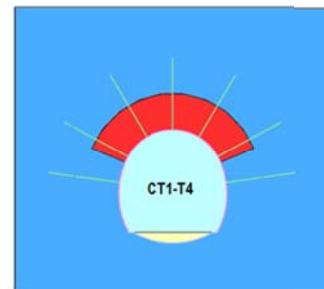


Figura 6: Sezione di analisi FdE-C T4 e CT1-T4

5.2.2.2 Gebirgsmodell und Ausgangsspannungslage

Das Gebirge wurde als ein kontinuierlich elastisch-plastisches Medium modelliert mit Widerstandskriterium des Typs Hoek-Brown mit Restparametern, die gemäß der Cai et. al [31] Theorie bewertet werden und im Bericht [6] aufgeführt sind. Im Besonderen wurden die elastischen (Verformungsmodul und Poisson-Beiwert), elastisch-plastischen (m_b , s mit Peak- und Restwerte) und physischen (Dichte und einaxiale Druckfestigkeit) Eigenschaften der vom Ausbruch betroffenen Gebirge bestimmt.

Aufgrund der im Abs. 3.1 aufgezeigten Bemerkungen, werden die geomechanischen Parameter des Gebirges GA-BST-KS-8f berücksichtigt.

5.2.2.2 Modello costitutivo dell'ammasso e stato tensionale iniziale

L'ammasso è stato modellato come un mezzo continuo elasto-plastico avente criterio di resistenza di tipo Hoek-Brown [24] con parametri residui valutati sulla base della teoria di Cai et. al [31] e riportata nel Rapporto [1]. In particolare sono state assegnate le caratteristiche elastiche (modulo di deformazione e coefficiente di Poisson), elasto-plastiche (m_b , s con valori di picco e residuo) e fisiche (densità e resistenza a compressione monoassiale) proprie delle rocce interessate dallo scavo.

Sulla base delle considerazioni riportate nel Par 3.1, vengono considerati i parametri geomeccanici dell'ammasso GA-BST-KS-8f:

Zone max overburden [m]	GSI	GSI _{res}	γ [kN/m ³]	E_{rm} [MPa]	σ_{ci} [MPa]	σ_{cm} [MPa]	m_i [-]	$m_{b, peak}$ [-]	$m_{b, res}$ [-]	$s_{, peak}$ [-]	$s_{, res}$ [-]
1115	50	25.59	26.6	11135	32	5.84	11	1.844	0.841	0.0039	0.0003

Tabelle 10: Berücksichtigte geomechanische Parameter

Tabella 10: Parametri geomeccanici considerati

Die vorherrschende Gebirgsspannung wird durch folgende Gleichungen bestimmt:

$$\sigma_y = \gamma \cdot z$$

$$\sigma_x = K_0 \cdot \sigma_z$$

Wobei:

Dove:

- Z = Abstand des allgemeinen Elements von der Geländeoberkante
- K_0 = Beiwert des horizontal wirkenden Erddrucks, gleich 0.75 angenommen.

- Z rappresenta la distanza del generico elemento dal piano campagna
- K_0 è il coefficiente di spinta orizzontale, assunto pari a 0.75.

5.2.2.3 Eigenschaften der Außenschale

Folgende Tabelle zeigt die Eigenschaften der Ausbruchssicherung für das Profil FdE-C T4 und CT1 T4 auf:

5.2.2.3 Caratteristiche dei rivestimenti di prima fase

La seguente tabella riporta le caratteristiche dei provvedimenti di messa in sicurezza per il profilo FdE-C T4 e CT1 T4:

CT1 T4 FdE-C T4	Anker Ancoraggi							Spritzbeton Betoncino proiettato			Stahlbogen Centine	
	Position Posizione	Typ Tipo	N_y [kN]	L [m]	$i_{\text{long}}/$ long [m]	$i_{\text{quer}}/$ trasv [m]	n° [-]	Klasse Classe [-]	s_{nom} [cm]	s_{min} [cm]	Typ Tipo	i [m]
	Radial Radiali	R38N/ Dywidag SN28	400 413	4	1.5	1.5	7	C30/37	25	21	2 IPN 180	0.75 - 1.5
Umriß Contorno	R38N	400	6	3.0	0.75	10						

Tabelle 11: Charakteristiken der Außenschale FdE-C T4 e CT1-T4

Tabella 11: Caratteristiche rivestimenti di prima fase FdE-C T4 e CT1-T4

Die Anker werden ins Modell eingefügt und zwar mit einem Grenzwiderstand, der ihrer Streckgrenze entspricht, die, wie mit BBT SE vereinbart, um den Widerstandsbeiwert ($\gamma_R = 1.15$) und der Reibung ($\gamma_R = 1.3$) faktorisiert wird.

I chiodi vengono inseriti nel modello con una resistenza limite pari alla loro resistenza a snervamento fattorizzata per il coefficiente sulle resistenze ($\gamma_R = 1.15$) e sull'aderenza di ($\gamma_R = 1.3$) come concordato con BBT SE.

Die Anker werden mit spezifischen eindimensionalen Elementen (Truss) nachgebildet, mit perfekt plastisch-elastischem Verhalten (Abbildung 4) und Von Mises Bruchkriterium ($N_{yd} = N_{yk}/1.15 = 348$ kN) mit Scherwiderstands (190 kN/m) und der tangentialen Steifigkeit (15 MN/m/m) [30].

Gli ancoraggi sono stati riprodotti con specifici elementi monodimensionali (Truss) aventi comportamento elastico perfettamente plastico (Figura 4) con criterio di rottura alla Von Mises ($N_{yd} = N_{yk}/1.15 = 348$ kN) di resistenza a taglio (190 kN/m) e rigidità tangenziale (15 MN/m/m) [30].

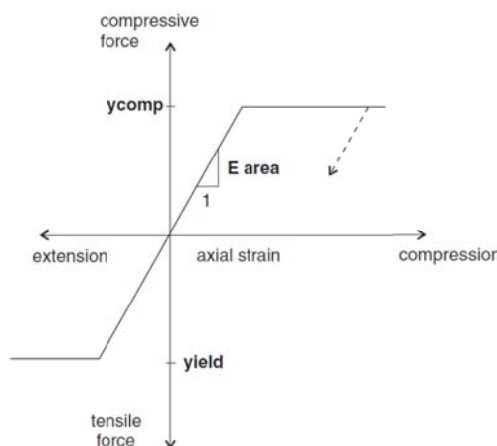


Abbildung 7: Kraft-Verformungsverhalten der Anker-Elemente

Figura 7: Comportamento sforzo-deformazione per gli ancoraggi

Die Spritzbetonschale wurde mittels monodimensionaler Stabelemente (beam) mit elastischen Verhalten modelliert. Auf der sicheren Seite liegend wurden zwei Untersuchungen angestellt: eine Berechnung mit $E = 5$ GPa zur Maximierung der Verformungen und eine Berechnung mit $E = 15$ GPa zur

Per la modellazione dello spritzbeton si sono assunti elementi monodimensionali beam con comportamento elastico. In via cautelativa si sono eseguite due analisi: una con $E = 5$ GPa per massimizzare le deformazioni e una con $E = 15$ GPa per massimizzare le sollecitazioni. Il valore di $E = 15$ GPa,

Maximierung der Einwirkungen. Der Wert $E = 15 \text{ GPa}$ entspricht ca. 50% der Steifigkeit eines ausgehärteten Betons mittlerer Klasse; auf diese Weise ist es möglich das typische Verhalten der viskosen Verformung und des Schwindens zu berücksichtigen.

Aufgrund des konservativen Ansatzes wurden in der numerische Berechnung die Stahlbögen nicht diskretisiert. Diese wurden nur bei den Querschnittsbemessungen in Anlage 5 berücksichtigt.

5.2.2.4 Laststufe

Nach einer ersten Phase der Modellinitialisierung zur Berechnung des Ausgangsgleichgewichts, wird der Ausbruch der mittels fiktiver Ausbruch-Kräfte (nachfolgend FFS genannt) simuliert. Der Prozentsatz dieser Kräfte an der Ortsbrust wird aufgrund der Ergebnisse des Kennlinienverfahrens bestimmt (Anhang 2).

corrisponde a circa il 50% della rigidezza di un calcestruzzo indurito di classe media; in questo modo è possibile considerare il caratteristico comportamento di deformazione viscosa e il ritiro.

Nella modellazione numerica, secondo un approccio conservativo, le centine non sono state modellate ma vengono considerate nelle verifiche sezionali (Appendice 5).

5.2.2.4 Step di carico

Dopo una prima fase di inizializzazione del modello, necessaria per calcolare l'equilibrio iniziale, lo scavo viene simulato mediante l'utilizzo delle Forze Fittizie di Scavo, di seguito denominate FFS, definita sulla base dei risultati delle Linee Caratteristiche (vedasi Appendice 2).

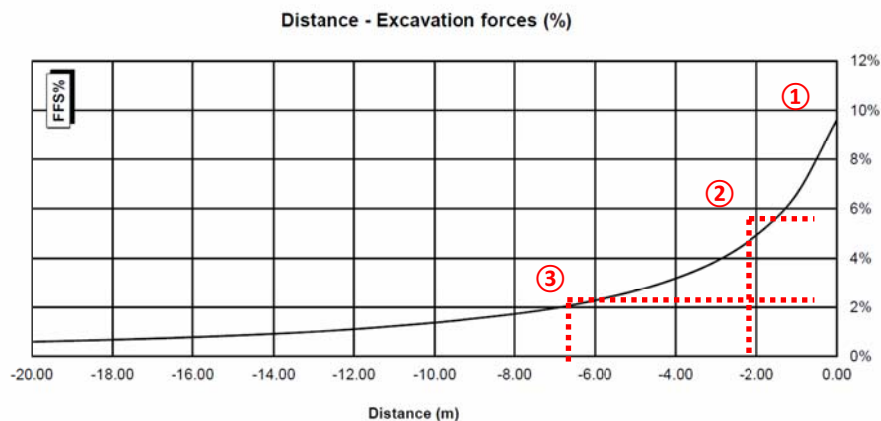


Abbildung 8: FFS an der Ortsbrust und bei Einbau der Spritzbetonschale

Figura 8: FFS al fronte e all'installazione del rivestimento di prima fase

Nachfolgend sind die Berechnungsstufen zusammengefasst:

Di seguito sono riassunti gli step di calcolo:

- | | |
|---|---|
| <ol style="list-style-type: none"> 5) Geostatische Ausgangslage mit Bestimmung der Geometrie, der Randbedingungen, der Stratigraphie und der geostatischen Ausgangsspannungen; 6) Modellierung der vergüteten Zonen am Ausbruchrand und Verringerung der FFS bis zum Wert, den sie an der Ortsbrust annehmen (FFS =10%); 7) Reduktion der FFS bis zum Wert, den sie beim Einbau der Außenschale einnehmen (1.5 m von der Ortsbrust) (FFS =5.5%); 8) Modellierung der radialen Anker im Bereich der Kalotte und Reduktion der FFS auf ca. 2% (6m ab der Ortsbrust, ca. 1 Durchmesser); | <ol style="list-style-type: none"> 5) Condizione geostatica iniziale con definizione della geometria, delle condizioni al contorno, della stratigrafia e delle tensioni geostatiche iniziali; 6) Inserimento zona consolidata al contorno e riduzione delle forze FFS, fino al valore che assumono al fronte (FFS=10%); 7) Riduzione delle FFS fino al valore che assumono nel momento di installazione del rivestimento di prima fase (1.5 m dal fronte) (FFS=5.5%); 8) Introduzione nel modello numerico degli ancoraggi radiali in calotta e riduzione delle FFS a ca. 2% (1 diametro, ca. 6 metri); |
|---|---|

9) Aufbringen des Spritzbetons (Kalotte $s_{tot} = 21$ cm, $E = 15$ GPa; Gegengewölbe $s_{tot} = 23$ cm, $E = 15$ GPa) und Aufhebung der FFS (FFS = 0%);

10) Entfernung der Außenschale und Simulation der Langzeitkonfiguration mit Einbau der Innenschale. Letztere ist mit der Mesh mittels eines Schnittstellenelements mit normaler, dem Gebirge entsprechenden Steifigkeit und tangentialer Steifigkeit gleich Null verbunden. Dieses Schnittstellenelement ermöglicht es, neben der Bestimmung der Einwirkungen auf die Innenschale, die Wirkung der Abdichtungsschicht zwischen den zwei Schalen zu berücksichtigen, indem es die tangentialen Spannungen annulliert.

9) Attivazione del calcestruzzo proiettato (calotta $s_{tot} = 21$ cm, $E = 15$ GPa; platea $s_{tot} = 23$ cm, $E = 15$ GPa) e annullamento delle FFS (FFS=0%).

10) Rimozione del rivestimento di prima fase e simulazione della configurazione a lungo termine con l'installazione del rivestimento definitivo. Quest'ultimo è collegato alla mesh mediante un elemento interfaccia avente rigidità normale pari a quella dell'ammasso e rigidità tangenziale nulla. Quest'ultimo elemento, oltre a consentire di valutare le pressioni che agiscono sul rivestimento definitivo, consente di considerare l'effetto del pacchetto di impermeabilizzazione presente tra i due rivestimenti, annullando le tensioni tangenziali.

5.2.2.5 Nachweisverfahren

Gemäß den NTC 2008 werden die Einwirkungen auf die Außenschale, die dem FEM Modell entnommen sind, um $\gamma_G = 1,30$ erhöht und die Widerstände des strukturellen Abschnitts um $\gamma_c = 1,50$ reduziert, das heißt $\gamma_s = 1,15$.

Die Nachweise gelten erfüllt, wenn folgende Ungleichung verifiziert ist:

$$E_d \leq R_d$$

Hierbei ist:

- R_d = Bemessungswert Widerstand
- E_d = Bemessungswert Einwirkung

5.2.2.5 Procedura di verifica

In conformità alle NTC 2008 le azioni ricavate dal modello FEM sul rivestimento di prima fase sono aumentate di $\gamma_G = 1,30$ e le resistenze della sezione strutturale sono ridotte di $\gamma_c = 1,50$ ovvero $\gamma_s = 1,15$.

Le verifiche risultano soddisfatte se è verificata la seguente disuguaglianza:

Dove:

- R_d = Valore della resistenza di progetto
- E_d = Valore di progetto dell'effetto delle azioni

5.2.2.6 Ergebnisse

Die in Anhang 4 aufgezeigten Analysen bestätigen, dass das Verhalten des Gebirges durch ein druckhaftes Verhalten gekennzeichnet ist. Es geht hervor, dass die Konvergenz kleiner als das Übermaß (< 10 cm) ist und dass sich eine plastische Zone von maximal ca. 4 m Ausmaß bildet.

Die Anker erreichen die Streckgrenze ($N_{yd} = 348$ kN), aber nicht die Verformungsgrenze des Stahls ($\epsilon < 5\%$).

Der vom Gebirge ausgeübte Druck auf die Innenschale, beim Entfallen der Anker, beträgt 230 kPa.

5.2.2.6 Risultati

Le analisi riportate nell'Appendice 4 confermano che il comportamento dell'ammasso è caratterizzato da un comportamento spingente con convergenze inferiori all'extrascavo (< 10 cm) e dalla formazione di una fascia plastica di estensione di ca. 4 m.

Gli ancoraggi raggiungono il limite di snervamento ($N_{yd} = 348$ kN) ma non raggiungono il limite di deformazione dell'acciaio ($\epsilon < 5\%$).

La pressione esercitata dall'ammasso sul rivestimento definitivo, al decadimento delle chiodature, è dell'ordine dei 230 kPa.

5.3 UNTERSUCHUNG DER STANDSICHERHEIT DER ORTBRUST

5.3.1 Nachweisverfahren

Für die Durchführung der Ortsbrustnachweise werden die

5.3 ANALISI DELLA STABILITÀ DEL FRONTE

5.3.1 Procedura di verifica

Per l'esecuzione dei calcoli di stabilità del fronte vengono

charakteristischen Werte der geotechnischen Parameter mit folgenden Faktoren abgemindert:

applicati i valori caratteristici dei parametri geotecnici ridotti con i seguenti fattori:

Parameter / Parametri	Symbol / Simbolo	Faktor / Fattore
Effektiver Reibungswinkel / Angolo di attrito effettivo ^a	γ_{φ}'	1.25
effektive Kohäsion / Coesione effettiva	γ_c'	1.25
undrainierte Scherfestigkeit / Resistenza a taglio non drenata	γ_{cu}	1.4
einaxiale Druckfestigkeit / Resistenza a compressione monoassiale	γ_{qu}	1.6
Wichte / Peso specifico	γ_{γ}	1
^a Dieser Faktor wird auf $\tan \varphi'$ angewendet / valore applicato alla tangente dell'angolo		

Tabelle 12: Teilsicherheitsfaktoren Ortsbrustnachweis

Tabella 12: Fattori parziali di sicurezza per la verifica di stabilità del fronte di scavo

5.3.2 Ergebnisse

5.3.2.1 Bruchkörperanalyse

Die Bruchkörperanalyse, die mit der Software Unwedge durchgeführt wurde, zeigt, dass das Volumen der abbrechenden Felsblöcke unter 0.5 m³ liegt und deshalb können sie, wenn sie nicht schon bei der Sprengung abgebrochen sind, auf Anordnung des geotechnischen Fachmann abgelöst werden.

Bei längerem Aufenthalt an der Ortsbrust ist zum Ortsbrustschutz der Einsatz einer faserverstärkten Spritzbetonschicht von mindestens 10 cm Stärke vorgesehen.

5.3.2.2 Axialsymmetrischesverfahren

Aus der axialsymmetrische Analyse, welche ohne Ausbau und mit Abschlügen von 1.5 m durchgeführt wurde, geht hervor, dass die Ortsbrustextrusion ca. 50 mm beträgt mit absoluter radialer Konvergenz von 120 mm, während der plastifizierte Bereich sich auf ca. 4 m vor der Ortsbrust und 5 m am Ausbruchsrund ausdehnt. Die Ortsbrustanker bewirken eine Reduktion der Ortsbrustextrusion auf ca. 40mm und die Ausbreitung der plastifizierten Zone an der Ortsbrust (3.5m) und am Ausbruchsrund (4m).

Im Zuge des Beobachtungsverfahrens, wird das tatsächliche Verhalten des Gebirges überprüft und die Anzahl der Ortsbrustanker dementsprechend angepasst.

5.3.2 Risultati

5.3.2.1 Analisi a blocchi

L'analisi dei blocchi, eseguita mediante il software Unwedge mostra come i blocchi distaccabili hanno un volume inferiore a 0.5 m³ e pertanto, se non già distaccati durante il brillamento, possono essere disgiunti su indicazione dell'esperto geotecnico.

In caso di sosta prolungata delle attività di scavo si prevede di installare uno strato di betoncino proiettato fibrorinforzato a protezione del fronte di spessore minimo 10 cm.

5.3.2.2 Analisi assialsimmetriche

L'analisi assialsimmetrica eseguita in assenza dei rivestimenti e secondo sfondi di 1.5m, evidenzia che l'estrusione del fronte è pari a circa 50 mm, con convergenza radiale assoluta di 120 mm, mentre la zona plasticizzata si estende per circa 4 m davanti al fronte e di 5 m al contorno. Gli interventi al fronte consentono di limitare l'estrusione al fronte a circa 40 mm, l'estensione della zona plasticizzata davanti al fronte (3.5 m) e al contorno (4 m).

Nell'ottica di un approccio osservazionale, si dovrà valutare l'effettivo comportamento dell'ammasso e conseguentemente ridurre o aumentare l'intensità degli ancoraggi al fronte.

6 INNENSCHALE

6.1 STABWERKSMODELLE

Die Beanspruchungen der Innenschale sind durch das informatische Rechenprogramm MIDAS Gen2013, das auf die Finite-Elementen-Methode (FEM) basiert, berechnet worden.

Für die Berechnung wird ein Abschnitt des Tunnels mit einheitlicher Tiefe (1 m) berücksichtigt und ein Strukturmodell festgelegt und zwar mittels ebenen Finite-Strabelemente (beam). Die Tunnelschale ist durch Elemente schematisiert, die kürzer als 0.5 m sind und die reelle Stärken des berücksichtigten strukturellen Elements besitzen (Kalotte, Widerlager, Sohlgewölbe/Sohlplatte).

Die strukturelle Steifigkeit der Träger Elemente wird als $E'_c \times I_y$ des nicht gerissenen Schnitts berechnet. Das Trägheitsmoment I_g wird im Verhältnis zur Schnittachse aus Beton berechnet, wobei der Stahl, wo vorhanden, ausgelassen wird. Im Falle von ebener Verformung der Elastizitätsmodul E'_c wie folgt ermittelt:

$$E'_c = \frac{E_c}{1 - \nu^2}$$

mit:

- E_c = Elastizitätsmodul des Betons
- ν = Poissonszahl (0.2);

Zur Modellierung des unbewehrten Betons wird ein elastisch-lineares Materialmodell verwendet. Die Neuverteilung der Belastungen werden laut Absatz 12.5 des EC2 berechnet, falls die abschnittsweise Steifigkeit durch die Bildung von Rissen, dort wo die Betonzugfestigkeit überschritten wurde (Bildung von plastischen Gelenken), verloren gegangen ist. Die Modellierung der plastischen Gelenke erfolgt durch den Einsatz von Torsionsfedern, deren Steifigkeit iterativ mit der Pöttler-Methode [28], [29] berechnet wird.

6.2 MODELLIERUNG DER BETTUNG

Die Zusammenwirkung Boden-Struktur wird mit dem Einsatz von Point Support Elementen simuliert, die an die Modellknoten gesetzt werden. Nur bei Komprimierung übertragen diese Elemente den Knoten eine Reaktion, die dem Kontaktdruck Boden-Struktur entspricht. Die Steifigkeit der genannten Elemente wird unter Berücksichtigung des Reaktionsmoduls des Bodens k und der Schnittstelle, welche sich aus dem Paket der Abdichtung - Drainageschicht ergibt, bestimmt. Die erste wird laut den nachfolgend angeführten Relationen bestimmt und zwar jeweils für gekrümmte und gradlinige Oberflächen (Abs. 6.2.1 und 6.2.2). Die zweite

6 RIVESTIMENTO DEFINITIVO

6.1 METODO DELLE REAZIONI IPERSTATICHE

Le sollecitazioni nel rivestimento definitivo sono state calcolate mediante il programma di calcolo informatico MIDAS Gen2013, basato sul Metodo degli Elementi Finiti (FEM).

Per il calcolo si considera un concio di galleria con profondità unitaria (1m) e si definisce un modello della struttura mediante elementi finiti piani di tipo trave (beam). Il rivestimento della galleria è schematizzato con elementi di lunghezza inferiore a 0.5 m aventi gli spessori reali dell'elemento strutturale considerato (calotta, piedritto, arco rovescio/platea).

La rigidezza strutturale degli elementi trave è calcolata come $E'_c \times I_y$ della sezione non fessurata. Il momento d'inerzia I_y è calcolato rispetto all'asse della sezione in calcestruzzo, trascurando la presenza dell'acciaio ove presente. Il modulo elastico E'_c , in condizioni di deformazioni piane, vale:

dove:

- E_c = modulo di elasticità del calcestruzzo;
- ν = rapporto di Poisson (0.2);

Per la modellazione del calcestruzzo non armato si utilizza un modello costitutivo del materiale elastico-lineare. Viene presa in considerazione la redistribuzione delle sollecitazioni in seguito alla perdita di rigidezza sezionale causata dall'apertura di fessure laddove venga superata la resistenza a trazione del calcestruzzo (formazione di cerniere plastiche), in accordo con il paragrafo 12.5 dell'EC2. La modellazione delle cerniere plastiche avviene mediante l'inserimento di molle torsionali la cui rigidezza è calcolata iterativamente mediante il metodo di Pöttler [28][29].

6.2 INTERAZIONE TERRENO-STRUTTURA

L'interazione terreno-struttura viene simulata mediante l'utilizzo di elementi point support posti in corrispondenza dei nodi del modello. Tali elementi trasmettono ai nodi, solo se compressi, una reazione pari alla pressione di contatto terreno-struttura. La rigidezza degli elementi citati è determinata tenendo conto del modulo di reazione del terreno k e dell'interfaccia data dal pacchetto impermeabilizzazione-strato drenante. La prima è definita secondo le relazioni di seguito descritte (paragrafo 6.2.1 e 6.2.2), rispettivamente per superfici curve e rettilinee. La seconda è stata assunta pari a 60'000 kN/m³ in virtù delle caratteristiche del pacchetto

wurde mit 60'000 kN/m³ aufgrund der Eigenschaften des Abdichtungsstreifens angenommen. Letztere zählt für Verschiebungen von weniger als 0.5 cm. Werden diese Verschiebungen überschritten, entspricht die Schnittstellensteifigkeit der des Gebirges.

Die tangentielle Steifigkeit wurde aufgrund des Vorhandenseins des Abdichtungsbahn an der Schnittstelle Boden-Struktur vernachlässigt.

d'impermeabilizzazione. Quest'ultima ha valenza per spostamenti inferiori a 0.5 cm. Superati tali spostamenti, la rigidezza dell'interfaccia diventa quella dell'ammasso.

La rigidezza tangenziale è stata trascurata in virtù della presenza del manto di impermeabilizzazione nell'interfaccia terreno-struttura.

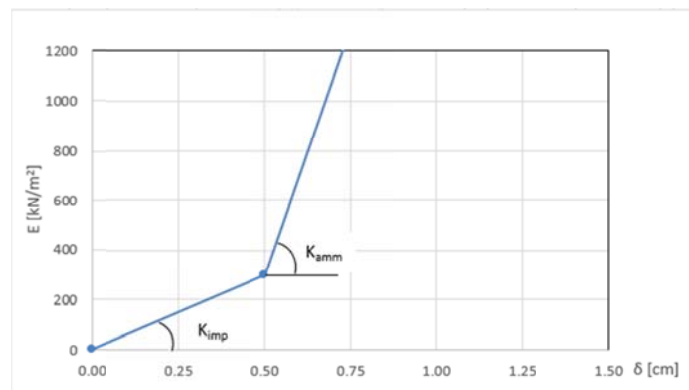


Abbildung 9: Schematisierung der Schnittstelle

Figura 9: Schematizzazione dell'interfaccia

6.2.1 Modellierung der Bettung

Die radiale Bettung der Innenschale im Gebirge/Boden ermittelt sich in der Regel unter Berücksichtigung des Elastizitätsmoduls E und der Querdehnzahl ν des Gebirges/Bodens sowie der Systemlinie des entsprechenden Innenschalenradius R wie folgt:

$$K_R = E \times \frac{(1 - \nu)}{(1 + \nu)(1 - 2 \times \nu) \times R} = \frac{E_S}{R}$$

Hierbei ist:

- K_R = radiale Bettung Innenschale – Gebirge [MN/m³]
- E = Elastizitätsmodul des umliegenden Bodens/Gebirges
- E_S = Steifemodul des umliegenden Bodens/Gebirges
- ν = Querdehnzahl des Bodens/Gebirges
- R = Tunnelradius Systemlinie

6.2.1 Rigidezza radiale

Per la definizione della rigidezza del letto di molle radiali in materiale sciolto, si tiene conto del modulo elastico E, del coefficiente di Poisson ν dell'ammasso roccioso e del raggio interno R della galleria.

Dove:

- K_R = rigidezza del letto di molle radiali a contatto con l'anello interno [MN/m³]
- E = modulo elastico dell'ammasso roccioso
- E_S = modulo edometrico dell'ammasso roccioso
- ν = coeff. di Poisson dell'ammasso roccioso
- R = raggio della galleria – linea di riferimento

6.2.2 Federkonstanten Auflagerbereich/Sohle

Das Widerlager der Konstruktion mit Sohlplatte bzw. offener Sohle (Querschläge) wird durch Federn mit zugehöriger Steifigkeit in Abhängigkeit der dazugehörigen Einflussbreite „b“ modelliert. Die Federkonstanten sind wie folgt zu ermitteln:

Federkonstante c_v – vertikal

6.2.2 Costante della molla nelle zone di appoggio / fondo

L'appoggio della costruzione con platea oppure con fondo aperto viene modellato con molla con rigidezza relativa all'area di influenza della singola molla "b". La costante della molla si calcola come segue:

Costante della molla c_v – verticale

- $c_v = E_{\text{Geb.}} \cdot 0,5 \cdot b$

Federkonstante c_h – horizontal

- $c_h = 0,5 \cdot c_v$

6.3 EINWIRKUNGEN

Im Folgenden werden folgende Kürzel für die Einwirkungen herangezogen:

- G = ständige Einwirkungen
- Q = vorübergehende Einwirkungen
- A = außergewöhnliche Einwirkungen (z.B. Brand, Anprall, Explosion)
- E = Erdbeben

6.3.1 Eigengewicht G1

Die für die Berechnung des Eigengewichts verwendete Querschnittsfläche pro Tunnelmeter basiert auf den Planmaßen der Konstruktion.

Das spezifische Eigengewicht des Stahlbetons ist mit $\gamma = 25 \text{ kN/m}^3$ zu berücksichtigen.

6.3.2 Oberleitung G2

Die Oberleitungslasten werden laut Abbildung auf der sicheren Seite liegend für eine maximale Spannweite von 50 m angesetzt. Aus diesen Lasten ergeben sich die am Aufhängepunkt anzusetzenden Lasten:

- Moment von 3,80 kNm
- Horizontallast von 0,70 kN
- Vertikallast von 2,50 kN

- $c_v = E_{\text{Geb.}} \cdot 0,5 \cdot b$

Costante della molla c_h – orizzontale

- $c_h = 0,5 \cdot c_v$

6.3 ANALISI DEI CARICHI

Per le azioni si utilizzano le seguenti abbreviazioni:

- G = Azioni permanenti
- Q = Azioni variabili
- A = Azioni eccezionali (per es. incendio, urto, esplosione)
- E = Azioni sismiche

6.3.1 Peso proprio G1

Il volume utilizzato per il calcolo del peso proprio si basa sulle dimensioni effettive della struttura.

Il peso specifico del calcestruzzo viene assunto pari $\gamma = 25 \text{ kN/m}^3$.

6.3.2 Catenaria G2

Le catenarie vengono applicate per sicurezza su una distanza massima di 50 m, come nella Illustrazione. Da questi carichi derivano quelli da applicare al punto di sospensione:

- Momento di 3,80 kNm
- Carico orizzontale di 0,70 kN
- Carico verticale di 2,50 kN

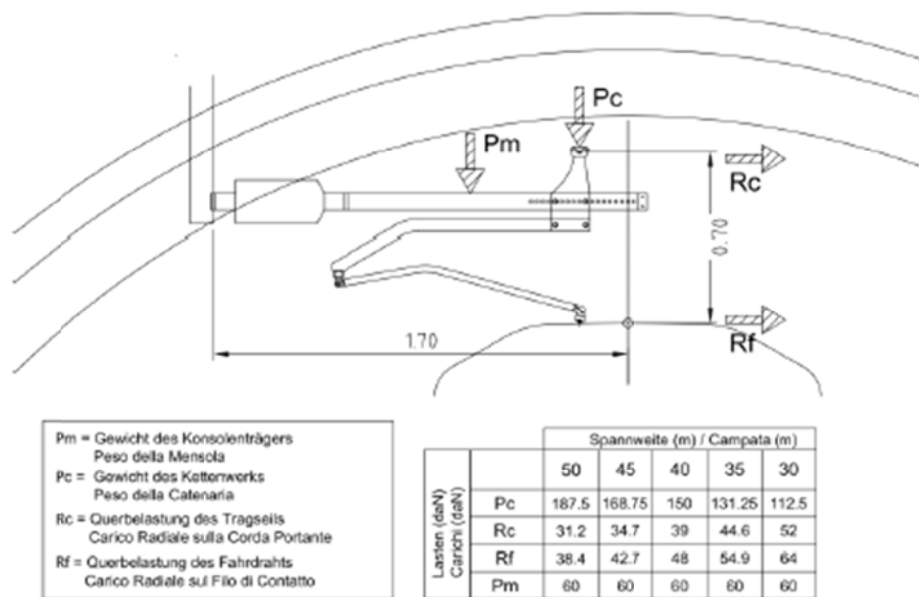


Abbildung 10: Lasten der Oberleitung

Figura 10: Carichi della catenaria

6.3.3 Auffüllung über dem Sohlgewölbe G3

Das für die Berechnung des Eigengewichts verwendete Volumen basiert auf dem Planmaß der Konstruktion.

Das spezifische Gewicht des unbewehrten Betons wird mit $\gamma_{c,na} = 24 \text{ kN/m}^3$ angenommen.

Das spezifische Gewicht des Stahlbetons wird mit $\gamma_{c,ar} = 25 \text{ kN/m}^3$ angenommen.

6.3.4 Wasserdruck G4

Für druckentlastete (drainierte) Tunnel wird der Wasserdruck, bei Regelquerschnitten mit Sohlgewölbe, nur bis in Höhe der Ulmenlängsdrainage berücksichtigt. Die Wasserlasten sind dann wie folgt anzusetzen:

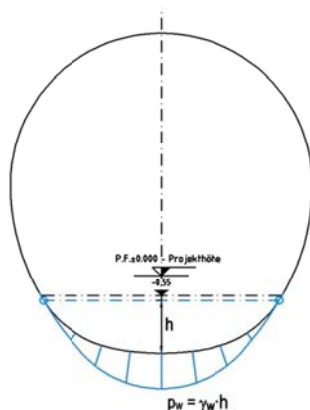


Abbildung 11: Lastbild Wasserdruck – drainierter Regelquerschnitt

6.3.3 Riempimento in cls al di sopra dell'arco rovescio G3

Il volume utilizzato per il calcolo del peso proprio si basa sulle dimensioni effettive della struttura.

Il peso specifico del calcestruzzo non armato viene assunto pari a $\gamma_{c,na} = 24 \text{ kN/m}^3$.

Il peso specifico del calcestruzzo armato viene assunto pari a $\gamma_{c,ar} = 25 \text{ kN/m}^3$.

6.3.4 Pressione idraulica G4

Per il caso di galleria drenata (senza pressione) nelle sezioni tipo con arco rovescio, il carico idraulico viene considerato solo dal vertice inferiore al di sotto dell'arco rovescio fino all'altezza del drenaggio sul piedritto. Il carico idraulico viene applicato secondo il seguente schema:

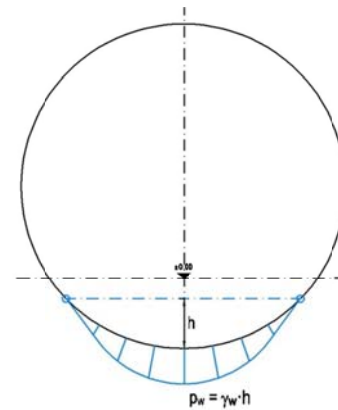


Figura 11: Pressione idrostatica - Sezione tipo drenata

6.3.5 Gebirgslast G5

Die Gebirgslast für die Vortriebsklasse II und III entspricht dem größten Wert zwischen der Einwirkung, welche aus der Bruchkörperanalyse resultiert und jener Last der Finiten Differenzen Methode die auf die Innenschale bei kompletten Ausfall der fiktiven Ausbruch-Kräfte angesetzt wird (letzter Berechnungsschritt FEM-Analyse). Da das Ausmaß der beiden Lasten nicht im Voraus bekannt ist, werden beide Lastfälle untersucht.

Die Gebirgspass, welche auf die Innenschale im Regelprofil T4 wirkt geht ausschließlich aus der FEM-Berechnung hervor.

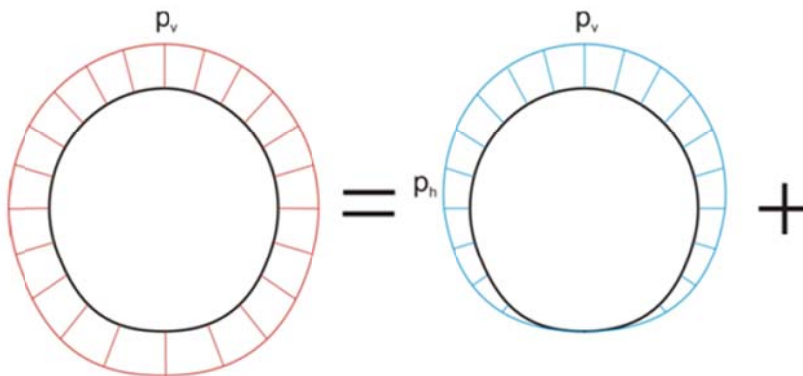


Abbildung 12: Qualitative Darstellung der numerisch ermittelten Normalspannungen (rot), der aktiven Gebirgslast (blau) und der passiven Bettungsreaktion (grün)

6.3.6 Kriechen und Schwinden des Betons G6

Das Schwindmaß des Betons wird gemäß NTC 2008 Kap. 11.2.10.6 ermittelt.

Die Kriechzahl ϕ wird gemäß dem NTC 2008 Kap. 11.2.10.7 unter Berücksichtigung des Spannungszustandes aus einer Einwirkungskombination ständiger Lasten (G1 (Eigengewicht) + G2 (Kettenwerk)) ermittelt.

Kriechen und Schwinden des Betons bewirken eine Längenänderung Δl (Endschwindmaß), auf die die Berechnung basieren muss, und zwar in Form einer gleichmäßigen Temperaturabkühlung.

Für alle Abschnitte die höher als 25 cm sind und aus Beton C30/37 bestehen, ergibt sich eine Durchschnittsverformung durch autogenes zeitlich unendliches Schwinden von 0.27‰. Bei der Bemessung wurde gemäß Norm 50% des Schwindens angenommen, was durch eine gleichmäßige Temperaturabkühlung von -13.4°C simulierbar ist. Diese Abkühlung muss, z. B., mittels Einsatz eines funktionstüchtigen Superverflüssigungsmittels (Typ MasterGlenium von BASF), nicht-kalkhaltigen Zuschlagstoffen und Zugabe eines Expansionsmittels (Typ MasterLife SRA100 von BASF) bewirkt werden. Das angewandte System muss auf der Baustelle durch Eignungsprüfungen nachgewiesen

6.3.5 Carico dell'ammasso G5

Il carico d'ammasso per le classi di scavo II e III è pari al maggiore tra il carico scaturito dall'analisi a blocchi ed il carico che agisce sul rivestimento definitivo nelle analisi alle differenze finite, al completo decadimento delle forze fittizie di scavo (ultimo step delle analisi FEM). Non potendo definire a priori il carico più gravoso le analisi sono state effettuate con entrambe le distribuzioni di carico.

Il carico d'ammasso che agisce sul rivestimento definitivo per il profilo T4 deriva unicamente da calcoli svolti mediante analisi agli elementi finiti.

Figura 12: Rappresentazione qualitativa delle tensioni normali (rosso), ottenute dal calcolo numerico, del carico attivo dell'ammasso (blu) e della reazione assestamento del terreno (verde)

6.3.6 Viscosità e ritiro del calcestruzzo G6

a deformazione dovuta al ritiro del calcestruzzo si calcola in base al paragrafo 11.2.10.6 delle NTC 2008.

Il coefficiente di viscosità ϕ si calcola ai sensi delle NTC 2008 par. 11.2.10.7, considerando la condizione tensionale derivante dalla combinazione di azioni permanenti (G1 (peso proprio) + G2 (catenaria)).

Viscosità e ritiro del calcestruzzo comportano un cambiamento in lunghezza Δl (valore finale del ritiro), su cui deve essere basato il calcolo, in forma di diminuzione uniforme della temperatura.

Per tutte le sezioni con altezza maggiore di 25 cm e calcestruzzo con classe di resistenza C30/37 risulta una deformazione media per ritiro autogeno a tempo infinito pari a 0.27‰. Nel dimensionamento si è assunto il 50% del ritiro imposto dalla Normativa, simulabile mediante l'applicazione di un abbassamento uniforme della temperatura di -13.4°C . Tale riduzione dovrà essere ottenuta, ad esempio, mediante l'utilizzo di un superfluidificante performante (tipo MasterGlenium della BASF), di inerti non calcarei e tramite l'aggiunta di un espansivo (tipo MasterLife SRA100 della BASF). Il sistema adottato dovrà essere verificato con prove preventive in cantiere.

werden.

Bei der Modellierung der Innenschale, insbesondere bezüglich Absatz 4.1.1.1 des NTC08, wendet man eine gleichmäßige Temperaturabkühlung von -6.7°C für den GZT und von -8.9°C für den GZG an.

6.3.7 Squeezing und swelling G7

Quellversuch auf den Gesteinsproben der Bohrung Vi-B-0/01 haben einen Quelldruck zwischen 0.1 und 0.3 MPa ergeben. Aus Sicherheitsgründen wird ein Druck, der von unten wirkt, von 0.3 MPa angenommen.

Da von einem mäßigem Prozentsatz der quellfähigen Tonmineralen ausgegangen wird, wurden für die Bemessung der Innenschale im Regelprofil IV sowohl mit der Belastungen durch Quellwirkung als auch ohne berechnet.

6.3.8 Temperatur Q1

Die Bemessung der Innenschale ist unter Berücksichtigung der Temperatureinwirkung gemäß der nachfolgenden Tabelle entsprechend dem Abstand zum Portal erfolgt.

Abstand Portal / Distanza dall'imbocco [km]	3,0 - 10,0	
Temperaturgradient / gradiente della temperatura ΔT / [$^{\circ}\text{C}$]	2	
ΔT_{eff} [$^{\circ}\text{C}$]	Winter / Inverno	Sommer / Estate
	-10	10

Tabelle 13: Temperatureinwirkung Innenschale

Der Temperaturgradient ΔT gibt die Temperaturdifferenz zwischen Innenkante und Außenkante Innenschale wieder.

Temperaturbeanspruchungen während des Baus der Innenschale können vernachlässigt werden.

Die von der Temperatur ausgehenden Einwirkungen in Folge Brand sind Gegenstand des Absatzes 6.3.12.

6.3.9 Erdbebeneinwirkung E1

Im Gegensatz zu den anderen Lastkombinationen hat die Erdbebenlast einen geringen Einfluss und wird deshalb nicht berücksichtigt.

6.3.10 Druck / Sog infolge Zugfahrt A1

Die Be- und Entlastungsvorgänge, welche aus der Zugverkehr resultieren sind in Dokument D0118-064 „Aerodynamik – Klima – Lüftung“ festgelegt. Dem Dokument kann entnommen werden, dass im Extremfall (außergewöhnliche Einwirkung) im

Nella modellazione del rivestimento definitivo, con particolare riferimento al paragrafo 4.1.1.1 dell'NTC08, si procede applicando un abbassamento uniforme della temperatura di -6.7°C agli SLU e di -8.9°C agli SLE.

6.3.7 Squeezing e swelling G7

Prove di rigonfiamento su campioni di roccia del sondaggio Vi-B-0/01 hanno rilevato pressioni di rigonfiamento nell'ordine di grandezza tra 0.1 e 0.3 MPa. In via cautelativa si considera una pressione agente dal basso pari a 0.3 MPa.

Poiché la presenza di minerali argillosi rigonfiabili è prevista in percentuali moderate, nel dimensionamento dei rivestimenti definitivi con profilo tipo IV si è proceduto analizzando separatamente sia le sollecitazioni agenti sull'anello nel caso in cui il rigonfiamento è presente sia quando tale fenomeno è assente.

6.3.8 Temperatura Q1

Per il dimensionamento dei rivestimenti definitivi si considerano azioni termiche, in conformità alla seguente tabella, secondo la distanza dall'imbocco.

Tabella 13: Variazione termica

Il gradiente della temperatura ΔT indica la differenza di temperatura tra le superfici interna ed esterna del rivestimento in conci.

Le sollecitazioni derivanti dalla temperatura durante la costruzione dell'anello vengono trascurate.

Le azioni derivanti dalle alte temperatura a seguito di incendio sono oggetto del paragrafo 6.3.12.

6.3.9 Azione sismica E1

Il carico sismico rappresenta una condizione poco influente rispetto alle altre combinazioni di carico e pertanto non viene considerata.

6.3.10 Pressione aerodinamica A1

I processi di carico e scarico tensionale a seguito del passaggio dei treni sono definiti nel documento D0118-064 „Aerodinamica – clima – ventilazione“. Dal documento si deduce che in casi estremi (azioni eccezionali) si presentano

Tunnel aerodynamische Einwirkungen von $\Delta p_{\text{Druck}} = + 11 \text{ kN/m}^2$ und $\Delta p_{\text{Sog}} = - 9 \text{ kN/m}^2$ auf. Da diese Einwirkungen, auch unter Berücksichtigung der entsprechend angepassten Teilsicherheitsfaktoren die maßgebende Einwirkung darstellen, werden gemäß den Vorgaben im Anhang die aerodynamischen Einwirkungen nur in Kombination von Einwirkungen bei außergewöhnlicher Bemessungssituation nachgewiesen.

6.3.11 Anpralllast A2

Die Einwirkung Anprall Schienenfahrzeuge ist nur in den Verzweigungsbauwerken und Portalen zu berücksichtigen. Aus diesem Grund wurde im betreffenden Abschnitt, diesbezüglich keine Untersuchungen angestellt.

6.3.12 Brand A3

Die Dimensionierung im Brandfall wird gemäß den Vorschriften der EN 1992-1-2 ausgeführt.

Gemäß den Vorschriften des MD 28/10/2005 Sicherheit in den Eisenbahntunnels, wird die Stabilität aller Bauwerke in Hinblick auf die Temperatur-Zeit Kurve laut UNI 11076 gemäß D0118-04326 "Sicherheit gegen die Brandexplosionen" gewährleistet.

Die bewehrten und unbewehrten Abschnitte sind hinsichtlich eines Brandes gemäß den Kriterien des spezifischen Berichts [6] geprüft worden. Hier beschränkt man sich darauf hinzuweisen, dass, einvernehmlich mit der Tabelle D.6.3 des D.M. 16.02.2007 "Klassifizierung der Feuerbeständigkeit der Bauprodukte und -elemente für Bauwerke", folgende Bedingungen ausreichend zur Gewährleistung der REI 120 Klasse sind:

- Stärke 's' der tragenden Bauteile größer als 160 mm;
- Betondeckung 'a' (Achsabstand der Bewehrung von der ausgesetzten Oberfläche) größer als 35 mm.

Beide Voraussetzungen sind erfüllt.

6.4 EINWIRKUNGSKOMBINATIONEN

Die zu untersuchenden Einwirkungskombinationen sind gemäß NTC 2008 mit den entsprechenden Kombinationsbeiwerten ψ zu berücksichtigen.

Die für die Dimensionierung der Innenschale des Regelprofil IV entsprechenden maßgebenden Einwirkungskombinationen gemäß Tabelle 15, sind in Abhängigkeit von den in-situ vorherrschenden Randbedingungen zu wählen:

in galleria azioni aerodinamiche di $\Delta p_{\text{pressione}} = + 11 \text{ kN/m}^2$ e $\Delta p_{\text{aspirazione}} = - 9 \text{ kN/m}^2$. Poiché si tratta di azioni rilevanti, anche in considerazione dei relativi coefficienti parziali di sicurezza adottati, le azioni aerodinamiche si considerano solo associate in combinazione con le azioni derivanti dalla situazione di dimensionamento eccezionale.

6.3.11 Urto A2

Il carico da urto è da considerare solo nelle caverne di diramazione e ai portali. Nella zona in oggetto non è pertanto considerato.

6.3.12 Incendio A3

Il dimensionamento in caso di incendio si esegue in conformità alle prescrizioni della EN 1992-1-2.

In accordo con le prescrizioni del DM 28/10/2005 Sicurezza gallerie ferroviarie viene garantita la stabilità di tutte le opere in considerazione della curva temperatura-tempo secondo la UNI 11076 in conformità a D0118-04326 "Sicurezza contro le esplosioni di incendio".

Le sezioni, armate e non, sono state verificate nei confronti dell'incendio secondo i criteri esposti nella relazione specifica [6]. In questa sede ci si limita ad osservare che in accordo alla tabella D.6.3 del D.M. 16.02.2007 "Classificazione di resistenza al fuoco di prodotti ed elementi costruttivi di opere da costruzione" condizioni sufficienti affinché la classe di resistenza REI 120 sia garantita sono:

- spessore 's' degli elementi strutturali maggiore di 160mm;
- copriferro 'a' (distanza dell'asse delle armature dalla superficie esposta) maggiore di 35mm.

Entrambi i requisiti sono soddisfatti.

6.4 COMBINAZIONE DI CARICO

Le combinazioni delle azioni da analizzare devono essere considerate in conformità alle NTC 2008, con i relativi coefficienti di combinazione ψ .

Le combinazioni delle azioni rilevanti per il dimensionamento dell'anello interno sono di seguito riportate nella Tabella 14 per i profili tipo II e III e nella Tabella 15 per il profilo tipo IV:

Lastfall / Caso di carico Einwirkungs- kombination /Combinazioni	ständig / permanenti						vorübergehend / variabeli			außergewöhnlich / eccezionali		
	Eigengewicht	Oberleitung	Sohibeton	Wasserdruck	Gebirgslast ohne Auftrieb	Kriechen und Schwinden	Temperatur (Sommer)	Temperatur (Winter)	Verkehrslast (Zugfahrt)	Brand	Druck infolge Zugfahrt	Sog infolge Zugfahrt
	Peso proprio	Catenaria	Carichi permanenti sull'arco rovescio	Carico idraulico	Carichi della roccia in condizioni asciutte	Ritiro e rilassamento	Temperatura (Estate)	Temperatura (inverno)	Carico ferroviario	Fuoco	Carico aerodinamico (pressione)	Carico aerodinamico (aspirazione)
	G1	G2	G3	G4	G5	G6	Q1	Q1	Q2	A3	A1	A1
druckentlastet / sistema drenato	1	1.35						1.50				
		1.00						1.00				
	2	1.35					1.00		1.50			
		1.00					1.00		1.00			
	5	1.35	1.35	1.00	1.35	1.35			1.50			
		1.00	1.00	1.00	1.00	1.00			1.00			
	6	1.35	1.35	1.00	1.35	1.35	1.00		1.50			
		1.00	1.00	1.00	1.00	1.00	1.00		1.00			
	11	1.00	1.00	1.00					0.60		1.00	
	12	1.00	1.00	1.00			1.00		0.60			1.00
	21	1.00	1.00	1.00	1.00	1.00			0.60		1.00	
	22	1.00	1.00	1.00	1.00	1.00	1.00		0.60		1.00	

Tabelle 14: Einwirkungskombinationen

Tabella 14: Combinazioni di carico

Lastfall / Caso di carico Einwirkungs- kombination /Combinazioni	ständig / permanenti							vorübergehend / variabeli			außergewöhnlich / eccezionali		
	Eigengewicht	Oberleitung	Sohibeton	Wasserdruck	Gebirgslast ohne Auftrieb	Kriechen und Schwinden	Quell-druck	Temperatur (Sommer)	Temperatur (Winter)	Verkehrslast (Zugfahrt)	Brand	Druck infolge Zugfahrt	Sog infolge Zugfahrt
	Peso proprio	Catenaria	Carichi permanenti sull'arco rovescio	Carico idraulico	Carichi della roccia in condizioni asciutte	Ritiro e rilassamento	Swelling- Squeezing	Temperatura (Estate)	Temperatura (inverno)	Carico ferroviario	Fuoco	Carico aerodinamico (pressione)	Carico aerodinamico (aspirazione)
	G1	G2	G3	G4	G5	G6	G7	Q1	Q1	Q2	A3	A1	A1
druckentlastet / sistema drenato	1	1.35							1.50				
		1.00							1.00				
	2	1.35					1.00			1.50			
		1.00					1.00			1.00			
	3	1.35	1.35	1.00					1.50				
		1.00	1.00	1.00					1.00				
	4	1.35	1.35	1.00			1.00			1.50			
		1.00	1.00	1.00			1.00			1.00			
	5	1.35	1.35	1.00	1.35	1.35			1.50				
		1.00	1.00	1.00	1.00	1.00			1.00				
	6	1.35	1.35	1.00	1.35	1.35	1.00			1.50			
		1.00	1.00	1.00	1.00	1.00	1.00			1.00			
	7	1.35	1.35	1.00	1.35	1.35		1.35	1.50				
		1.00	1.00	1.00	1.00	1.00		1.00	1.00				
	8	1.35	1.35	1.00	1.35	1.35	1.00	1.35		1.50			
		1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00			
	9	1.35	1.35	1.00				1.35	1.50				
		1.00	1.00	1.00				1.00	1.00				
	10	1.35	1.35	1.00			1.00	1.35		1.50			
		1.00	1.00	1.00			1.00	1.00		1.00			
	11	1.00	1.00	1.00					0.60			1.00	
	12	1.00	1.00	1.00			1.00		0.60				1.00
	21	1.00	1.00	1.00	1.00	1.00			0.60			1.00	
	22	1.00	1.00	1.00	1.00	1.00	1.00		0.60			1.00	
23	1.00	1.00	1.00	1.00	1.00		1.00	0.60			1.00		
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.60			1.00		

Tabelle 15: Einwirkungskombinationen für Regelprofil IV

Tabella 15: Combinazioni di carico per il profilo tipo IV

6.5 NACHWEISVERFAHREN

Für den Nachweis des Grenzzustandes der Tragsicherheit und der Gebrauchstauglichkeit der Innenschale wurden die Vorgaben aus NTC2008, Abs. 2.5.3 berücksichtigt.

6.5.1 Grenzzustand der Tragfähigkeit (GZT)

6.5.1.1 Teilsicherheitsfaktoren Einwirkungen

Die zu berücksichtigenden Teilsicherheitsfaktoren variieren in Abhängigkeit der Kombinationsregeln und den Bedingungen. Folgende Teilsicherheitsfaktoren sind gemäß NTC2008 für ständige / vorübergehende / außergewöhnliche Bemessungssituationen zu berücksichtigen:

6.5 VERIFICHE

Per la verifica allo stato limite ultimo ed allo stato limite di esercizio dell'anello interno sono state considerate le combinazioni delle azioni in conformità delle prescrizioni del paragrafo 2.5.3 delle NTC2008.

6.5.1 Stati Limite Ultimi (SLU)

6.5.1.1 Coefficienti parziali di sicurezza per le azioni

I coefficienti parziali di sicurezza da considerare variano in funzione delle combinazioni e del tipo di azioni. In conformità alle NTC2008, per le situazioni di dimensionamento standard, temporanee ed eccezionali sono da considerarsi i seguenti coefficienti parziali di sicurezza:

$$\begin{aligned} \gamma_{Gj,inf} \text{ günstig/favorevole} &= 1,00 / 1,00 / 1,00 \\ \gamma_{Gj,sup} \text{ ungünstig/sfavorevole} &= 1,35 / 1,20 / 1,00 \\ \gamma_{Q,1,sup} / \gamma_{Q,i,sup} \text{ günstig/favorevole} &= 0,00 / 0,00 / 0,00 \\ \gamma_{Q,1,sup} / \gamma_{Q,i,sup} \text{ ungünstig/sfavorevole} &= 1,50 / 1,30 / 1,00 \end{aligned}$$

Werden die Einwirkungen aus dem Schwinden für den Nachweis im Grenzzustand der Tragfähigkeit berücksichtigt, ist gemäß EC2, Teil 1, Abs. 2.4.2.1 der Teilsicherheitsbeiwert $\gamma_{SH} = 1,0$ zu berücksichtigen.

Considerando le azioni derivanti dal ritiro, per la verifica allo stato limite ultimo, si è considerato, in conformità all'EC2, parte 1, paragrafo 2.4.2.1 il coefficiente parziale di sicurezza $\gamma_{SH} = 1,0$.

6.5.1.2 Kombinationsbeiwerte Einwirkungen

Folgende Kombinationsbeiwerte sind gemäß EN 1990 bzw. NTC2008 zu berücksichtigen:

6.5.1.2 Coefficienti di combinazione delle azioni

In conformità alla EN 1990 ovvero alla NTC2008 devono essere utilizzati i seguenti coefficienti di combinazione:

Einwirkung /	Ψ_0	Ψ_1	Ψ_2
Druck / Sog infolge Zugfahrt A1 / Pressione aerodinamica A1	0,8	0,5	0,0
Temperatur Q1 / Forze termiche Q1	0,6	0,6	0,5

Tabelle 16: Kombinationsbeiwerte

Tabella 16: Coefficienti di combinazione

6.5.1.3 Einwirkungskombinationen

Die zu untersuchenden Einwirkungskombinationen sind gemäß NTC 2008 mit den entsprechenden Kombinationsbeiwerten ψ zu berücksichtigen.

Die für die Dimensionierung der Innenschale entsprechenden maßgebenden Einwirkungskombinationen sind in Abhängigkeit von den in-situ vorherrschenden Randbedingungen auszuwählen.

6.5.1.3 Combinazione delle azioni

Le combinazioni delle azioni da analizzare devono essere considerate in conformità alle NTC 2008, con i relativi coefficienti di combinazione ψ .

Le combinazioni delle azioni rilevanti per il dimensionamento dell'anello devono essere scelte in funzione delle effettive condizioni al contorno in situ.

6.5.1.4 Teilsicherheitsfaktoren Widerstand

Die Teilsicherheitsfaktoren der Widerstände bei einer ständigen und vorübergehenden Bemessungssituation sind, wie mit BBT SE vereinbart, unter Berücksichtigung der Lebensdauer des Bauwerkes von 200 Jahren wie folgt zu berücksichtigen:

Stahlbeton

- Teilsicherheitskoeffizient für den Betonwiderstand $\gamma_c = 1,60$
- Abminderungsbeiwert zur Berücksichtigung der Langzeitwirkung der Betondruckfestigkeit: $\alpha_{cc} = 0,85$
- Teilsicherheitskoeffizient für Stahlwiderstand $\gamma_s = 1,20$

Unbewehrter Beton

- Teilsicherheitskoeffizient für den Betonwiderstand $\gamma_c = 1,60$
- Abminderungsbeiwert zur Berücksichtigung der

6.5.1.4 Coefficienti parziali di sicurezza per le resistenze

I coefficienti parziali di sicurezza per le resistenze in fase permanente e temporanea vanno considerati, come concordato con BBT SE, come segue tenendo conto della vita utile dell'opera di 200 anni:

Calcestruzzo armato

- Coefficiente parziale di sicurezza per la resistenza del calcestruzzo $\gamma_c = 1,60$
- Coefficiente riduttivo della resistenza a compressione del calcestruzzo di lunga durata: $\alpha_{cc} = 0,85$
- Coefficiente parziale di sicurezza γ_s per la resistenza dell'acciaio $\gamma_s = 1,20$

Calcestruzzo non armato

- Coefficiente parziale di sicurezza per la resistenza del calcestruzzo $\gamma_c = 1,60$
- Coefficiente riduttivo della resistenza a compressione e a trazione del calcestruzzo di lunga durata: $\alpha_{cc,pl}/$

Langzeitwirkung der Betondruck- bzw. -zugfestigkeit:
 $\alpha_{cc,pl} / \alpha_{ct,pl} = 0,80$

$\alpha_{ct,pl} = 0,80$

Für den Nachweis der außergewöhnlichen Bemessungssituation sind die Teilsicherheitsfaktoren mit $\gamma_c = 1,2$ und $\gamma_s = 1,0$ zu berücksichtigen. Der Abminderungsbeiwert der Betondruckfestigkeit α bleibt unverändert.

Per le verifiche nella situazione di dimensionamento eccezionale i fattori parziali di sicurezza devono essere considerati con $\gamma_c = 1,20$ e $\gamma_s = 1,00$. Il coefficiente di riduzione della resistenza a compressione del calcestruzzo α resta invariato.

6.5.1.5 Bemessung auf Biegung und Längskraft

Die Bemessung des Stahlbetons erfolgt gemäß den Vorgaben des NTC2008, Abs. 4.1.2.1.2.

Der Nachweis des unbewehrten Betons erfolgt gemäß dem NTC2008, Kapitel 4.1.11.1.

Bei den unbewehrten Abschnitten mit hoher Exzentrizität, berücksichtigt man gemäß EC2 (§12.3.1) die Betonzugfestigkeit bis zum Bemessungswert f_{ctd} . Der Nachweis gilt als erwiesen, wenn:

6.5.1.5 Verifica a pressoflessione

Per il calcestruzzo armato il calcolo segue le indicazioni delle NTC2008, par. 4.1.2.1.2.

Per il calcestruzzo non armato si seguono le NTC 2008, par. 4.1.11.1.

Nelle sezioni non armate con un'elevata eccentricità, in accordo con l'EC2 (§12.3.1) si considera la resistenza a trazione del calcestruzzo fino al valore di progetto f_{ctd} . La verifica risulta soddisfatta se:

$$\sigma_{1,2} = \frac{N_{Ed}}{A} \pm \frac{M_{Ed}}{J} \cdot (h/2) \leq \begin{cases} f_{cd} \\ f_{ctd} \end{cases} \alpha$$

6.5.1.6 Querkraftbemessung

Die Bemessung des Stahlbetons erfolgt gemäß den Vorgaben des NTC2008, Abs. 4.1.2.1.3.

Der Nachweis bei der unbewehrten Innenschale erfolgt gemäß den NTC2008 unter Nachweis der folgenden Ungleichung:

6.5.1.6 Verifica a taglio

Per il calcestruzzo armato il calcolo segue le indicazioni delle NTC2008, par. 4.1.2.1.3.

Per il rivestimento interno non armato si seguono le NTC 2008, verificando la seguente disuguaglianza:

$$V_{Ed} \leq V_{Rd} = f_{cvt} \cdot \frac{b \cdot x}{1.5}$$

$$f_{cvt} = \sqrt{f_{ctd}^2 + \sigma_c \cdot f_{ctd}} \quad \text{per } \sigma_c \leq \sigma_{c \text{ lim}}$$

$$f_{cvt} = \sqrt{f_{ctd}^2 + \sigma_c \cdot f_{ctd} - \delta^2/4} \quad \text{per } \sigma_c > \sigma_{c \text{ lim}}$$

$$\delta = \sigma_c - \sigma_{c \text{ lim}}$$

$$\sigma_{c \text{ lim}} = f_{cd} - 2 \cdot \sqrt{f_{ctd}^2 + f_{cd} \cdot f_{ctd}}$$

Bei den überwiegend komprimierten Abschnitten wird die Durchschnittsbelastung der Druckspannung σ_c als Durchschnitt der Komprimierungen im reagierenden Abschnittteil 'x' berechnet:

Nelle sezioni prevalentemente compresse, lo sforzo medio di compressione σ_c è calcolato come media delle compressioni nella porzione di sezione reagente 'x':

$$\sigma_c = \frac{N_{Ed}}{x} = \frac{N_{Ed}}{h - 2 \cdot e}$$

In den Abschnitten mit hoher Exzentrizität, bei Annahme der Betonzugfestigkeit bis f_{ctd} , wird der Querkraftwiderstand des Abschnitts ausgewertet, indem der ganze Abschnitt als reagierend ($x=h$) betrachtet wird und die Spannung σ_c als Durchschnittsspannung des ganzen Abschnitts, sowohl unter Druck- als auch unter Zugbelastung.

Nelle sezioni con un'elevata eccentricità, coerentemente con l'assunzione di considerare la resistenza a trazione del calcestruzzo fino al valore di f_{ctd} , la resistenza a taglio della sezione viene valutata considerando reagente l'intera sezione ($x=h$) e valutando la tensione σ_c come tensione media nell'intera sezione, sia compressa che tesa.

$$\sigma_c = \frac{\sigma_1 + \sigma_2}{2}$$

6.5.2 Grenzzustände der Gebrauchstauglichkeit (GZG)

6.5.2.1 Teilsicherheitsfaktoren Einwirkungen

Im Nachweis der Gebrauchstauglichkeit sind gemäß den Kombinationsregeln die charakteristischen Einwirkungen zu berücksichtigen.

6.5.2.2 Kombinationsbeiwerte Einwirkungen

Die in den Einwirkungskombinationen zu berücksichtigen Kombinationsbeiwerte sind in Tabelle 14 aufgeführt. Die Kombinationsbeiwerte sind gemäß Tabelle 16 zu berücksichtigen.

6.5.2.3 Einwirkungskombinationen

Die zu untersuchenden Einwirkungskombinationen sind gemäß NTC 2008 mit den entsprechenden Kombinationsbeiwerten ψ zu berücksichtigen.

6.5.2.4 Teilsicherheitsfaktoren Widerstand

Für den Nachweis der Gebrauchstauglichkeit der unbewehrten Querschnitt sind die charakteristischen Werte der Widerstände zu berücksichtigen. Für die bewehrten Querschnitte gelten die Vorgaben aus Abs. 4.1.22.5 der NTC08.

6.5.2.5 Ermittlung der Schnittgrößen und Verformungen

Die Ermittlung der Systemverformung erfolgt im Grenzzustand der Gebrauchstauglichkeit (GZG) unter Berücksichtigung der Kombinationsregeln mit den charakteristischen Einwirkungen sowie den entsprechenden Kombinationsbeiwerten.

6.5.2.6 Begrenzung der Rissbreiten

Im Grenzzustand der Gebrauchstauglichkeit ist für die maßgebenden Einwirkungskombinationen unter Berücksichtigung der Teilsicherheitsfaktoren und Abminderungsfaktoren ψ laut Tabelle 14 die maximale Rissweite w_{kal} unter Berücksichtigung NTC2008 nachzuweisen. Die zulässige Rissbreite für Normalbeton ohne besondere Anforderung der Dichtigkeit oder bei Existenz einer Abdichtung ist auf $w_{kal} \leq 0,3$ mm zu begrenzen.

Bei besonderer Anforderung an die Dichtigkeit der Betoninnenschale oder bei aggressiven oder sehr aggressiven

6.5.2 Stati Limite Esercizio (SLE)

6.5.2.1 Coefficienti parziali di sicurezza delle azioni

Nella verifica agli stati limite di esercizio devono essere considerate le azioni caratteristiche con le loro combinazioni.

6.5.2.2 Coefficienti di combinazione delle azioni

In Tabella 14 si trovano i coefficienti da considerare nelle combinazioni delle azioni. I coefficienti di combinazione sono da considerare come in Tabella 16.

6.5.2.3 Combinazioni delle azioni

Le combinazioni delle azioni da analizzare devono essere considerate in conformità alle NTC 2008, con i relativi coefficienti di combinazione ψ .

6.5.2.4 Coefficienti parziali di sicurezza per le resistenze

Per la verifica agli stati limite di esercizio delle sezioni non armate si devono considerare i valori caratteristici delle resistenze, per le sezioni armate valgono le prescrizioni al paragrafo 4.1.22.5 della norma NTC08.

6.5.2.5 Calcolo delle deformazioni

Il calcolo delle deformazioni del sistema si esegue allo SLE in considerazione delle regole di combinazione con i carichi caratteristici e dei relativi coefficienti di combinazione.

6.5.2.6 Limitazione dello spessore delle fessure

In considerazione delle NTC2008, si controlla allo SLE lo spessore massimo delle fessure w_{kal} per le combinazioni di carico rilevanti, in considerazione dei fattori parziali di sicurezza e dei coefficienti di riduzione ψ secondo Tabella 14. La larghezza delle fessure ammessa per il cls normale senza particolari requisiti di spessore o in presenza di impermeabilizzazione è limitata a $w_{kal} \leq 0,3$ mm.

In caso di particolari requisiti di spessore del rivestimento interno o di condizioni ambientali aggressive o molto

Umgebungsbedingungen ist die maximale Rissweite auf $w_{kal} \leq 0,2$ mm zu begrenzen.

6.6 BAULICHE DURCHBILDUNG

6.6.1 Expositionsklasse und Mindestbetondeckung

Gemäß UNI 11104 ist bei der Expositionsklasse XC3 die Verwendung von Beton C28/35, bei der Expositionsklasse XC4 Beton C32/40 vorgesehen.

Die Berechnung der Mindestbetondeckung zur Gewährleistung der Bauwerklebensdauer >100 Jahren erfolgt laut NTC2008:

	XC3	XC4
Festigkeitsklasse (UNI 11104)	28/35	32/40
Umweltbedingungen	Normal	Aggressiv
C_{min} [mm]	20	30
Nutzbare Lebenszeit > 100 Jahre [mm]	+10	+10
Bauliche Toleranz [mm]	+10	+10

C_{nom} [mm]	40	50
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Tabelle 17: Mindestbetondeckung

Um die Stärke zu vereinheitlichen, ist eine Betondeckung entlang des ganzen Tunnels von 5 cm vorgesehen.

6.6.2 Mindestbewehrung

Ist eine bewehrte Innenschale vorgesehen, wird die Mindestbewehrung gemäß NTC 2008, Punkt 4.1.6.1.1 ermittelt.

Die Querschnittsfläche der Längszugbewehrung darf nicht geringer sein als:

$$A_{S,min} = 0.26 \frac{f_{ctm}}{f_{yk}} \times b \times d$$

und jedenfalls nicht geringer als $0,0013 \times b \times d$,

wobei:

- b die mittlerer Breite der Zugzone;
- d die Nutzhöhe des Querschnitts;
- f_{ctm} der Mittelwert der Zugfestigkeit des Betons;
- f_{yk} der charakteristische Wert der Streckengrenze des Betonstahls ist.

aggressive la larghezza massima è limitata a $w_{kal} \leq 0,2$ mm.

6.6 STRUTTURA COSTRUTTIVA

6.6.1 Classe di esposizione e copriferro minimo

In accordo alle UNI 11104, in classe di esposizione XC3 è previsto l'utilizzo di calcestruzzo C28/35 mentre in classe di esposizione XC4 è previsto l'utilizzo di calcestruzzo C32/40.

Il calcolo del copriferro minimo al fine di garantire una vita utile dell'opera >100anni è condotto in accordo alle NTC2008:

	XC3	XC4
Cl. di resistenza (UNI 11104)	28/35	32/40
Cond. ambientali	Normali	Aggressive
C_{min} [mm]	20	30
Vita utile > 100anni [mm]	+10	+10
Tolleranza costruttiva [mm]	+10	+10

C_{nom} [mm]	40	50
----------------	-----------	-----------

Tabella 17: Copriferro minimo.

Per omogeneità si prevede un copriferro netto di 5 cm lungo tutto lo sviluppo delle gallerie.

6.6.2 Armatura minima

In caso il rivestimento necessiti di armatura il quantitativo minimo di armatura da inserire viene definito al punto 4.1.6.1.1 delle NTC 2008.

L'area dell'armatura longitudinale in zona tesa non deve essere inferiore a:

e comunque non minore di $0,0013 \times b \times d$,

dove:

- b rappresenta la larghezza media della zona tesa;
- d è l'altezza utile della sezione;
- f_{ctm} è il valore medio della resistenza a trazione del calcestruzzo;
- f_{yk} è il valore caratteristico della resistenza a trazione dell'armatura ordinaria.

6.7 ERGEBNISSE

Die in Anhang 5 aufgezeigten Analysen zeigen, dass das FEM-Modell zur Simulation des Auflockerungsdrucks im Gebirge und das plötzliche Loslösen der Felsblöcke für das Profil II und III keine Biegebewehrung erfordert.

Das Berechnungsmodell für den Lastfall des Auflockerungsdrucks erfordert zwar keine Biegebewehrung aber weist die Bildung von 3 plastischen Gelenken auf: Ein Gelenk in der Mitte der Kalotte und 2 im Anschlussbereich zwischen Widerlager und Sohle.

Auch das Berechnungsmodell für den Lastfall des plötzlichen Loslösen eventueller Felsblöcke weist die Bildung von 3 plastischen Gelenken auf: eines im Bereich der höchsten Spannung des Elementarblocks sowie im Anschlussbereich zwischen Widerlager und Sohle.

Die Nachweise der unbewehrten Querschnitte im GZT zeigen die Bildung von 3 plastischen Gelenken, welche durch die Überschreitung des Designwerts der Betonzugfestigkeit und die daraus resultierende Bildung von Rissen und der Reduktion des Trägheitsmomentes bedingt sind. Das Einfügen der plastischen Gelenke im Berechnungsmodell ermöglicht die korrekte Spannungsumlagerung im nachzuweisenden Querschnitt. Die Statik des Struktur ist dabei durch die Kontrolle der maximalen Anzahl an plastischen Gelenken (max. 3) und deren maximale Breite ($< 1.0\text{mm}$) sichergestellt. Die Nachweise GZG zeigen, dass die Anforderungen an die Dauerhaftigkeit des Bauwerks erfüllt sind.

Die Berechnungen aus Anlage 6 zeigen, dass im FEM Modell für den Lastfall des Auflockerungsdrucks der Klasse T4 eine Biegebewehrung von $\Phi 12$ alle 150mm in der Kalotte, $\Phi 14$ alle 150mm entlang der Paramente und $\Phi 16$ alle 150 im Sohlgewölbe erforderlich sind. Die Lastverteilungseisen bestehen aus $\Phi 10$ alle 200mm.

Im Fall von quellendem Gebirgsverhalten wird eine Schubbewehrung, bestehend aus 2 Bügeln $\Phi 12$ alle 150mm pro Laufmeter Tunnel, im Anschlussbereich zwischen Widerlager und Sohlgewölbe notwendig.

Die Ergebnisse aus den statischen Berechnungen wurden mit jenen aus vereinfachten Berechnungsmethoden und durch ähnliche Berechnungen an vergleichbaren Strukturen auf ihre Richtigkeit geprüft. Die erhaltenen Ergebnisse sind daher als akzeptabel und richtig zu erachten.

6.7 RISULTATI

Le analisi riportate in Appendice 5 mostrano che il modello FEM per la simulazione degli effetti indotti dal carico d'allentamento dell'ammasso e del distacco di blocchi elementari per i profili tipo II e III non necessita l'impiego di armatura flessionale.

Il modello di calcolo con il carico d'allentamento dell'ammasso converge senza la necessità di predisporre dell'armatura, ma mostra la formazione di 3 cerniere plastiche: una in corrispondenza del centro della calotta e due alla base della connessione tra murette e platea.

Il modello di calcolo con il carico dell'ammasso derivante dall'analisi a blocchi mostra anch'esso la formazione di 3 cerniere plastiche: una in corrispondenza del picco di pressione del blocco e altre due alla base della connessione tra murette e platea.

Le verifiche svolte sulle sezioni non armate secondo lo SLU mostrano la formazione di 3 cerniere plastiche, causate dal superamento della resistenza a trazione di progetto del calcestruzzo con conseguente fessurazione e perdita d'inerzia localizzata della sezione. L'inserimento di tali cerniere nei modelli di calcolo consente di verificare correttamente la redistribuzione delle sollecitazioni agenti nelle sezioni di verifica. La staticità della struttura è garantita attraverso il controllo del numero di cerniere plastiche che si vengono a formare (massimo 3) e dall'ampiezza ($< 1.0\text{mm}$). Le verifiche svolte allo SLE dimostrano che le esigenze di durabilità prescritte sono opportunamente rispettate.

Le analisi riportate in Appendice 6 mostrano che il modello FEM per la simulazione del carico d'allentamento per la classe T4 necessita l'impiego di armatura flessionale $\Phi 12$ passo 150 in calotta, $\Phi 14$ passo 150 lungo i paramenti e $\Phi 16$ passo 150 nell'arco rovescio. L'armatura di ripartizione è costituita da $\Phi 10$ passo 200.

Nel caso si presentino fenomeni di rigonfiamento risulta necessario predisporre dell'armatura a taglio nella zone di connessione tra murette e arco rovescio. Tale armatura consiste in 2 staffe $\Phi 12$ passo 150 per metro di galleria.

I risultati emersi dall'analisi statica condotta sono stati validati mediante confronto con metodi di calcolo semplificati e attraverso raffronti con altre analisi svolte su opere paragonabili. I risultati ottenuti sono pertanto ritenuti accettabili e corretti.

7 VERZEICHNISSE

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7.4 REFERENZDOKUMENTE

7.4.1 Eingangsdokumente

7.4.1.1 Ausführungsprojekt Baulos Mauls 2-3

- [1] 02_H61_GD_992_GTB_D0700_13018 - Brenner Basistunnel - Ausführungsplanung - D0700: Baulos Mauls 2-3 - Gesamtbauwerke - Technischer Bericht - Allgemeiner geomechanischer Bericht
- [2] 02_H61_GD_040_GTB_D0700_22001 - Brenner

7.3 ELENCO APPENDICI

- APPENDICE 1 - SCHEDE GEOMECCANICHE
- APPENDICE 2 - CURVE CARATTERISTICHE
- APPENDICE 3 – ANALISI DEI BLOCCHI
- APPENDICE 4 - ANALISI FEM DEL RIVESTIMENTO DI PRIMA FASE CT1-T3/FdE-C-T3
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7.4 DOCUMENTI DI RIFERIMENTO

7.4.1 Documenti in ingresso

7.4.1.1 Progetto Esecutivo Lotto Mules 2-3

- [1] 02_H61_GD_992_GTB_D0700_13018 - Galleria di Base del Brennero - Progettazione esecutiva - D0700: Lotto Mules 2-3 - Opere generali - Relazione tecnica - Relazione geomeccanica generale
- [2] 02_H61_GD_040_GTB_D0700_22001 - Galleria di

Basistunnel - Ausführungsplanung - D0700: Baulos
Mauls 2-3 - Gesamtbauwerke Teil 2 -
Geomechanischer Detailbericht

- [3] 02_H61_GD_040_GLS_D0700_22002 - Brenner
Basistunnel - Ausführungsplanung - D0700: Baulos
Mauls 2-3 - Gesamtbauwerke Teil 2 -
Geomechanischer und Planungsvorprofil - GL-T, FdE-
GL-T, FdE-GL-TT, GL-CM Ost - von km 44+192 bis km
46+769
- [4] 02_H61_GD_040_GLS_D0700_22003 - Brenner
Basistunnel - Ausführungsplanung - D0700: Baulos
Mauls 2-3 - Gesamtbauwerke Teil 2 -
Geomechanischer und Planungsvorprofil - GL-T, FdE-
GL-T, FdE-GL-TT, GL-CM West - von km 44+155 bis
km 46+732
- [5] 02_H61_GD_040_GLS_D0700_22004 - Brenner
Basistunnel - Ausführungsplanung - D0700: Baulos
Mauls 2-3 - Gesamtbauwerke Teil 2 -
Geomechanischer und Planungsvorprofil - GA-T, FdE-
CCT-T
- [6] 02_H61_EG_995_KTB_D0700_15003 - Brenner
Basistunnel - Ausführungsplanung - D0700: Baulos
Mauls 2-3 – Sicherheit bzgl. Feuerexposition ...

7.4.1.2 Technische Projektaufbereitung

- [7] Geomechanischer Bericht Haupttröhren Mauls PMF
Trens“
- [8] Geomechanischer Bericht Erkundungsstollen Mauls-
Brenner

7.4.1.3 Ausführungsprojekt Erweiterung Baulos Mauls 1

- [9] D0755/02-V04-OP.EN 01.01 - Relazione statica
rivestimento di prima fase - Galleria di linea km
46+800/47+800

7.4.2 Normen und Richtlinien

- [10] Technische Konstruktionsnormen 2008 – NTC 2008;
- [11] Leitfaden N.617, Vorgehenweise für technische
Konstruktionsnormen, Ausgabe Januar 2008
- [12] DM 28/10/2005 Sicherheit für Bahntunnel
- [13] UNI EN1990:2006 - Eurocodice 0 – Grundlage für
Konstruktion und Dokumentation zur nationalen
Umsetzung ;
- [14] UNI EN 1991-1; Eurocode 1 – Actions on structures –

Base del Brennero - Progettazione esecutiva -
D0700: Lotto Mules 2-3 - Opere generali Parte 2 -
Relazione geomeccanica di dettaglio

- [3] 02_H61_GD_040_GLS_D0700_22002 - Galleria di
Base del Brennero - Progettazione esecutiva -
D0700: Lotto Mules 2-3 - Opere generali Parte 2 -
Profilo geomeccanico e progettuale di previsione -
GL-T, FdE-GL-T, FdE-GL-TT, GL-CM Est - da km
44+192 a km 46+769
- [4] 02_H61_GD_040_GLS_D0700_22003 - Galleria di
Base del Brennero - Progettazione esecutiva -
D0700: Lotto Mules 2-3 - Opere generali Parte 2 -
Profilo geomeccanico e progettuale di previsione -
GL-T, FdE-GL-T, FdE-GL-TT, GL-CM Ovest - da km
44+155 a km 46+732
- [5] 02_H61_GD_040_GLS_D0700_22004 - Galleria di
Base del Brennero - Progettazione esecutiva -
D0700: Lotto Mules 2-3 - Opere generali Parte 2 -
Profilo geomeccanico e progettuale di previsione -
GA-T, FdE-CCT-T
- [6] 02_H61_EG_995_KTB_D0700_15003 - Galleria di
Base del Brennero - Progettazione esecutiva -
D0700: Lotto Mules 2-3 - Sicurezza nei riguardi di
esposizione al fuoco D0700-22312 "Sezioni tipo FdE-
GL-T (T3)"

7.4.1.2 Elaborazione tecnica del progetto

- [7] Relazione geomeccanica Canne principali Mules
PMF Trens
- [8] Relazione geomeccanica Cunicolo esplorativo Mules-
Brennero

7.4.1.3 Progetto Esecutivo Estensione Lotto Mules 1

- [9] D0755/02-V04-OP.EN 01.01 - Relazione statica
rivestimento di prima fase - Galleria di linea km
46+800/47+800

7.4.2 Normativa

- [10] Norme Tecniche delle Costruzioni 2008 – NTC 2008;
- [11] Circolare n.617, Istruzioni per l'applicazione delle
"Nuove norme tecniche per le costruzioni" di cui al
DM 14 gennaio 2008
- [12] DM 28/10/2005 , Sicurezza nelle gallerie ferroviarie.
- [13] UNI EN1990:2006 - Eurocodice 0 – Basi per la
progettazione strutturale e documento di applicazione
nazionale3
- [14] UNI EN 1991-1; Eurocode 1 – Actions on structures

2010/2011

- [15] UNI EN 1992:2005 - Eurocodice 2 – Planung von für Stahlbetonbauwerke und Dokumente zur nationalen Umsetzung;
- [16] UNI EN 1997:2005 - Eurocodice 7 – Geotechnik und Dokumente zur nationalen Umsetzung
- [17] UNI EN 1992-1-2:2005 "Progettazione delle strutture in calcestruzzo Parte 1-2: Regole generali - Progettazione strutturale contro l'incendio"
- [18] UNI 11076 del 1 luglio 2003, "Modalità di prova per la valutazione del comportamento di protettivi applicati a soffitti di opere sotterranee, in condizioni di incendi".
- [19] D.M. 16.02.2007 "Classificazione di resistenza al fuoco di prodotti ed elementi costruttivi di opere da costruzione"

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- [22] Gamble J.C. – Durability-plasticity classification of shales. Ph. D. Thesis, University of Illinois, 1971.
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- [28] Pöttler, R. Die unbewehrte Innenschale im Felstunnelbau - Standsicherheit und Verformung im Reißbereich, Beton und Stahlbetonbau Heft 6, 1993
- [29] Pöttler, R. Standsicherheitsnachweis unbewehrter Innenschalen, Bautechnik 67, 1990
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- [16] UNI EN 1997:2005 - Eurocodice 7 – Progettazione geotecnica e documento di applicazione nazionale
- [17] UNI EN 1992-1-2:2005 "Progettazione delle strutture in calcestruzzo Parte 1-2: Regole generali - Progettazione strutturale contro l'incendio"
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- [19] D.M. 16.02.2007 "Classificazione di resistenza al fuoco di prodotti ed elementi costruttivi di opere da costruzione"

7.4.3 Letteratura

- [20] Ribacchi R., Riccioni R. – Stato di sforzo e di deformazione intorno ad una galleria circolare. Gallerie e grandi opere sotterranee, 1977.
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- [31] Cai M., Kaiser P.K., Tasaka Y., Minami M. - Determination of residual strength parameters of jointed rock masses using the GSI system. *International Journal of Rock Mechanics and Mining Sciences* 44 pag. 247-256, 2007
- [32] MIDAS GTS Manual
- [33] Hoek, E. (2007). *Practical Rock Engineering*. Toronto: Rocscience, e-book.

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- [31] Cai M., Kaiser P.K., Tasaka Y., Minami M. - Determination of residual strength parameters of jointed rock masses using the GSI system. *International Journal of Rock Mechanics and Mining Sciences* 44 pag. 247-256, 2007
- [32] MIDAS GTS Manual
- [33] Hoek, E. (2007). *Practical Rock Engineering*. Toronto: Rocscience, e-book.

ANHANG 1 – GEOMECHANISCHE KARTEN

Nachfolgend werden die geomechanischen Karten der Gebirge GA-T-A-8f, GA-BST-KS-8f, GA-BCA-A-10g laut den Dokument [7]-[8] angeführt.

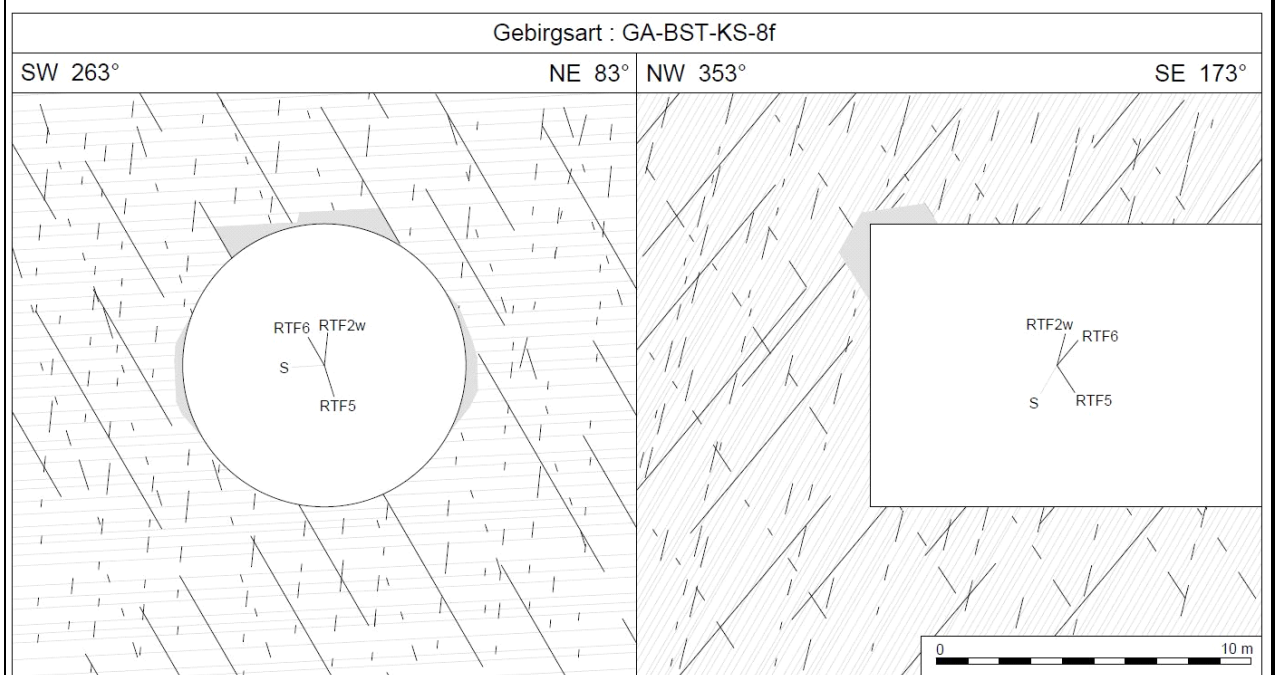
APPENDICE 1 - SCHEDE GEOMECCANICHE

Di seguito sono riportate le schede geomeccaniche per gli ammassi rocciosi GA-T-A-8f, GA-BST-KS-8f, GA-BCA-A-10g e GA-BCA-GS-10g secondo il Documento [7]-[8].

Geotechnische Kennwerte	Gebirgsart GA-BST-KS-8f		
Parametri geotecnici	Tipo di ammasso roccioso GA-BST-KS-8f		
Lithologie	Bündnerschieferkomplex: Dünnsschichtige Wechselfolge von Glimmermarmor, Kalzitquarzit und Phyllit, Bereiche mit höherem Phyllitanteil - 531		
Litologia	Complesso dei calcescisti: alternanze poco spesse di calcescisti, quarziti calcitici e filladi, a tratti con presenza elevata di fillade - 531		
Cesteinskennwerte / Mineralogie (Labor)	Mittelwert (M)	Standardabweichung (s)	Versuchsanzahl (n)
Parametri della roccia / Mineralogia (Laboratorio)	Valore medio (M)	Deviazione standard (s)	Numero di prove (n)
γ [MN/m ³]	0,02656	± 0,00036	63
σ_{ci} [MPa] med (F sf)	41	± 18	3
σ_{ci} [MPa] min (F 45° sf)	24	± 9	12
m_i [-] (Hoek&Brown) aus Triax.-Druckversuch / da prova triassiale	12	± 2	4
E [MPa] aus Enax.-Druckversuch / da prova uniassiale	43000	± 11100	15
ν [-] aus Enax.-Druckversuch / da prova uniassiale	0,21	± 0,05	8
CAI [-]	2,7	± 0,4	8
äquiv. Qz-Gehalt / Contenuto equ.di Qz [%]	42	± 9	8
Quellpotential / Potenziale di swelling	keines / assente		
Trennflächeneigenschaften (Kartierung / Bohrungen)	Statistische Auswertung der Orientierungen und Eigenschaften der Trennflächen		
Proprietà delle discontinuità (Rilevamento / Sondaggi)	Elaborazione statistica delle giaciture e delle proprietà delle discontinuità		
Schieferung: Orientierung / Abstand	S: 355/60		
Scistosità: Giacitura / Spaziatura			
Trennflächenorientierung [°] (Vertrauenskegel)	RTF2w: 285/85	RTF6: 050/65	
Giacitura delle discontinuità (Cono di confidenza)	RTF5: 110/75		
Trennflächenabstände [mm]	RTF2w: 200-600	RTF6: 200-600	
Spaziatura delle discontinuità	RTF5: 200-600	S: 60-200	
Trennflächendurchgängigkeit [m]	RTF2w: <1	RTF6: 3-10	
Persistenza delle discontinuità	RTF5: <1	S: 3-10	
Trennflächenöffnung [mm]	RTF2w: 0	RTF6: 0	
Apertura della discontinuità	RTF5: 0	S: 0	
Trennflächenrauigkeit JRC ₀ [-]	RTF2w: 4-8	RTF6: 10-12	
Rugosità delle discontinuità	RTF5: 4-8	S: 4-8	
Trennflächenverwitterung (EN ISO 14689-1)			
Aterazione delle discontinuità			
Trennflächenfüllung (Typ u. %-Anteil)			
Riempimento delle discontinuità (tipo e %)			
Trennflächenkennwerte (Labor)	Bandbreite		Versuchsanzahl (n)
Parametri delle discontinuità (Laboratorio)	Range		Numero di prove (n)
$\Phi_{peak/res} / \Phi_{base}$ [°] (unverw. it. TF / Disc. inalterate)	44 - 46 / 19 - 36 / 30 - 31		3 / 2 / 2
$c_{peak/res}$ [MPa] (unverw. it. TF / Disc. inalterate)	1,7 - 4,1 / 0,27 - 0,47		3 / 2
Gebirgskennwerte in-Situ	Bandbreite		Versuchsanzahl (n)
Parametri dell'ammasso roccioso in sito	Range		Numero di prove (n)
E [MPa] (BLA / Prova dilatometrica): Last/carico 87,8-10,6 MPa	32500-63600		2
Gebirgskennwerte	Statistik der Indexwerte u. berechnete Festigkeits- und Verformungsparameter		
Parametri dell'ammasso roccioso	Statistica dei parametri indice e parametri di resistenza e deformabilità calcolati		
Indexwerte (Kartierung / Bohrungen)	Mittelwert (M)	Standardabweichung (s)	Versuchsanzahl (n)
Parametri indice (Rilevamento / Sondaggi)	Valori medio (M)	Deviazione standard (s)	Numero di prove (n)
RQD [%] (ISRM)	85	±	
RMR [-] (Bieniawski, 1999)	60	±	
GSI [-] (Hoek)	50	-	-
Festigkeits- u. Verformungskennwerte (berechnet)	Kombination 1: M	Kombination 2: M - s	Kombination 3: M + s
Parametri di resistenza e deformabilità (calcolati)	Combinazione 1: M	Combinazione 2: M - s	Combinazione 3: M + s
σ_c [MPa] (Hoek&Brown)	1,5	0,9	2,0
σ_{cm} [MPa] (Hoek&Brown)	4,6	2,9	6,3
c [MPa] (Mohr-Coulomb): $H_{min}=960m / H_{max}=1110m$	1,9 / 2,0	1,6 / 1,7	2,1 / 2,3
ϕ [°] (Mohr-Coulomb): $H_{min}=960m / H_{max}=1110m$	27 / 26	24 / 23	30 / 28
E [MPa] (Boyd/Serafim 1983 / Hoek 2002 / Hoek&Diederichs 2006)	- / (4900) / 13200	- / (3900) / 9800	- / 5700 / 16600
Charakteristische Werte / Valori caratteristici		Inputparameter / Valori di input	
γ_k (Gebirge / ammasso) [kN/m ³]	27,0	GSI [-] - Hoek&Brown	50
$\sigma_{ci,k}$ (Gestein / roccia) [MPa]	33*	RMR [-] - Bienawski	60
$\sigma_{cm,k}$ (Gebirge / ammasso roccioso) [MPa]	6,3	σ_v ($\gamma \cdot H_{min}/max$) [MPa]	25,9 / 30,0
c_k (Gebirge / ammasso roccioso) [MPa] - H_{min}/max	2,1 / 2,3	k_0 [-]	0,8-1,0
ϕ_k (Gebirge / ammasso roccioso) [°] - H_{min}/max	30 / 28		
E_k (Gebirge / ammasso roccioso) [MPa]	5500		
Bemerkungen	*Wert: M+s (F 45° sf)		
Note	*Valore: M+s (F 45° sf)		

GA-BST-KS-8f: Gebirgsverhaltenstyp GVT 3

GA-BST-KS-8f: Comportamento dell'ammasso roccioso TCR 3

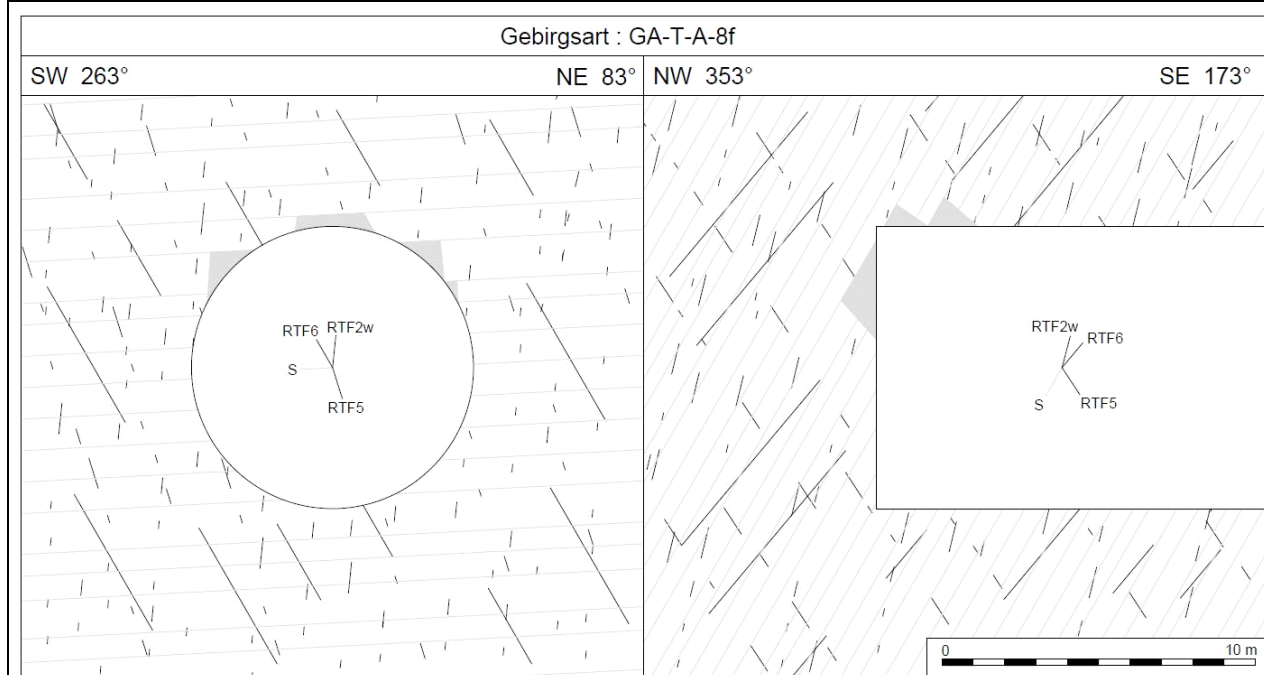


Gebirgsarten	GA-BST-KS-8f: Dünnschichtige Wechselfolge von Glimmermarmor, Kalzitquarzit u. Phyllit
Tipo di ammasso roccioso	GA-BST-KS-8f: Alternanze poco spessi di calcescisti, quarziti calcitici e filladi (531)
Orientierung der Haupttrennflächen	Steil einfallende, schleifend bzw. quer zur Tunnelachse verlaufende Trennflächen; Schieferung: mittelsteil einfallend, senkrecht zur Tunnelachse
Direzione delle discontinuità principali	Discontinuità ad alta inclinazione con direzione subparallela, trasversale e perpendicolare all'AT; Scistosità ad inclinazione media con direzione perpendicolare all'AT
Druckhaftigkeit $\sigma_{cm,k}/\sigma_{max}$ (Hoek 2000)	$\geq 0,21$: mittel druckhaft
Rapporto di sollecitazione $\sigma_{cm,k}/\sigma_{max}$	$\geq 0,21$: mediamente spingente
Einfluss des Bergwassers	vernachlässigbar
Influenza della falda	trascurabile
Quelldruck	keiner
Pressione di rigonfimento	assente
Gebirgsverhalten	GVT 3: Spannungsbedingte Entfestigung in Hohlraumnähe durch Abscheren über Trennflächen Ortsbrust (kurzfristig stabil): lokale Ausbrüche
Comportamento dell'ammasso roccioso	TCR 3: Allentamenti in corrisp. della cavità attraverso rottura a taglio lungo discontinuità dovuto all'alto stato tensionale Fronte di scavo (stabile a breve termine): locali distacchi di blocchi
Radialdeformation	< 15 cm (Kennlinienverfahren)
Deformazione radiale	< 15 cm (Metodo delle curve caratteristiche)
Bemerkungen	Überlagerung: 960 - 1110 m
Note	Coperatura: 960 - 1110 m

Geotechnische Kennwerte	Gebirgsart GA-T-A-8f		
Parametri geotecnici	Tipo di ammasso roccioso GA-T-A-8f		
Lithologie	Anhydrit- und gipsführende Schiefer - (560), 561, 564, 640		
Litologia	Scisti con anidrite e gesso - (560), 561, 564, 640		
Cesteinskennwerte / Mineralogie (Labor)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri della roccia / Mineralogia (Laboratorio)	Valore medio (M)	Deviazione standard (s)	Numero di prove (n)
γ [MN/m ³]	0,02821	$\pm 0,00045$	12
σ_{ci} [MPa] max (F _⊥ sf)			
σ_{ci} [MPa] min (F sf)	48	± 16	2
m _i [-] (Hoek&Brown) aus Triax.-Druckversuch / da prova triassiale	13		1
E [MPa] aus Einax.-Druckversuch / da prova uniaxiale	45750	± 1270	2
ν [-] aus Triax.-Druckversuch / da prova triassiale	0,23		1
CAI [-]	3,2	$\pm 0,4$	4
äquiv. Qz-Gehalt / Contenuto equ.di Qz [%]	31	± 6	3
Quellpotential / Potenziale di swelling	keines / assente		
Trennflächeneigenschaften (Kartierung / Bohrungen)	Statistische Auswertung der Orientierungen und Eigenschaften der Trennflächen		
Proprietà delle discontinuità (Rilevamento / Sondaggi)	Elaborazione statistica delle giaciture e delle proprietà delle discontinuità		
Schieferung: Orientierung / Abstand	S: 355/60		
Scistosità: Giacitura / Spaziatura			
Trennflächenorientierung [°] (Vertrauenskegel)	RTF2w: 285/85	RTF6: 050/65	
Giacitura delle discontinuità (Cono di confidenza)	RTF5: 110/75		
Trennflächenabstände [mm]	RTF2w: 200-600	RTF6: 200-600	
Spaziatura delle discontinuità	RTF5: 200-600	S: 60-200	
Trennflächendurchgängigkeit [m]	RTF2w: <1	RTF6: 3-10	
Persistenz der Discontinuität	RTF5: <1	S: 3-10	
Trennflächenöffnung [mm]	RTF2w: 0	RTF6: 0	
Apertura della discontinuität	RTF5: 0	S: 0	
Trennflächenrauigkeit JRC ₀ [-]	RTF2w: 4-8	RTF6: 10-12	
Rugosità delle discontinuität	RTF5: 4-8	S: 4-8	
Trennflächenverwitterung (EN ISO 14689-1)			
Aterazione delle discontinuität			
Trennflächenfüllung (Typ u. %-Anteil)			
Riempimento delle discontinuität (tipo e %)			
Trennflächenkennwerte (Labor)	Bandbreite		Versuchszahl (n)
Parametri delle discontinuität (Laboratorio)	Range		Numero di prove (n)
$\Phi_{peak/res} / \Phi_{base}$ [°] (unverw. it. TF / Disc. inalterate)	23 / 15 - 19 / 30		1 / 2 / 1
$c_{peak/res}$ [MPa] (unverw. it. TF / Disc. inalterate)	2,23 / 0,18 - 0,6		1 / 2
Gebirgskennwerte in-Situ	Bandbreite		Versuchszahl (n)
Parametri dell'ammasso roccioso in situ	Range		Numero di prove (n)
E [MPa] (BLA / Prova dilatometrica):			
Gebirgskennwerte	Statistik der Indexwerte u. berechnete Festigkeits- und Verformungsparameter		
Parametri dell'ammasso roccioso	Statistica dei parametri indice e parametri di resistenza e deformabilità calcolati		
Indexwerte (Kartierung / Bohrungen)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri indice (Rilevamento / Sondaggi)	Valori medio (M)	Deviazione standard (s)	Numero di prove (n)
RQD [%] (ISRM)	100	\pm	
RMR [-] (Bieniawski, 1999)	60	\pm	
GSI [-] (Hoek)	60	± 10	
Festigkeits- u. Verformungskennwerte (berechnet)	Kombination 1: M	Kombination 2: M - s	Kombination 3: M + s
Parametri di resistenza e deformabilità (calcolati)	Combinazione 1: M	Combinazione 2: M - s	Combinazione 3: M + s
σ_c [MPa] (Hoek&Brown)	5,1	1,9	12,0
σ_{cm} [MPa] (Hoek&Brown)	11,8	6,3	19,9
c [MPa] (Mohr-Coulomb): H _{max} = 1070m	3,3	2,4	4,4
ϕ [°] (Mohr-Coulomb): H _{max} = 1070m	35	29	40
E [MPa] (Boyd/Serafim 1983 / Hoek 2002 / Hoek&Diederichs 2006)	- / 12300 / 23800	- / 5700 / 13700	- / (25300 / 34500)
Charakteristische Werte / Valori caratteristici		Inputparameter / Valori di input	
γ_k (Gebirge / ammasso) [kN/m ³]	28,0	GSI [-] - Hoek&Brown	50
$\sigma_{ci,k}$ (Gestein / roccia) [MPa]	48	RMR [-] - Bienawski	60
$\sigma_{cm,k}$ (Gebirge / ammasso roccioso) [MPa]	9,5	σ_v ($\gamma \cdot H_{min/max}$) [MPa]	30,0
c_k (Gebirge / ammasso roccioso) [MPa] - H _{max}	2,7	k_0 [-]	0,8-1,0
ϕ_k (Gebirge / ammasso roccioso) [°] - H _{max}	32		
E _k (Gebirge / ammasso roccioso) [MPa]	5700		
Bemerkungen	Laborergebnisse der Lithologien 564 und 640		
Note	Risultati delle prove di laboratorio delle litologie 564 e 640		

GA-T-A-8f: Gebirgsverhaltenstyp GVT 3 / (GVT 10-2 möglich)

GA-T-A-8f: Comportamento dell'ammasso roccioso TCR 3 / (TCR 10-2 possibile)



Gebirgsarten	GA-T-A-8e: Anhydrit- und gipsführende Schiefer - (560), 561, 564, 640
Tipo di ammasso roccioso	GA-T-A-8e: Scisti con anidrite e gesso - (560), 561, 564, 640
Orientierung der Haupttrennflächen	Steil einfallende, schiefend, quer bzw. senkrecht zur Tunnelachse verlaufende Trennflächen Schieferung: steil einfallend, senkrecht zur Tunnelachse
Direzione delle discontinuità principali	Discontinuità ad alta inclinazione con direzione subparallela, trasversale e perpendicolare all'AT; Scistosità ad alta inclinazione con direzione perpendicolare all'AT
Druckhaftigkeit $\sigma_{cm,k}/\sigma_{max}$ (Hoek 2000)	$\geq 0,32$: mittel druckhaft
Rapporto di sollecitazione $\sigma_{cm,k}/\sigma_{max}$	$\geq 0,32$: mediamente spingente
Einfluss des Bergwassers	Anhydritschwellen möglich
Influenza della falda	Possibile rigonfiamento di anidrite
Quelldruck	möglich
Pressione di rigonfiamento	possibile
Gebirgsverhalten	GVT 3: Spannungsbedingte Entfestigung in Hohlraumnähe durch Abscheren über TF GVT 10-2: Anhydritschwellen nicht auszuschließen Ortsbrust (kurzfristig stabil): lokale Ausbrüche
Comportamento dell'ammasso roccioso	TCR 3: Allentamenti in corrisp. della cavità attraverso rottura di taglio lungo discontinuità dovuto all'alto stato tensionale TCR 10-2: possibile rigonfiamento di anidrite Fronte di scavo (stabile a breve termine): locali distacchi di blocchi
Radialdeformation	< 15 cm (Kennlinienverfahren)
Deformazione radiale	< 15 cm (Metodo delle curve caratteristiche)
Bemerkungen	Überlagerung (max): 1070 m
Note	Coperatura (max): 1070 m

Geotechnische Kennwerte	Gebirgsart GA-BCA-GS-10g		
Parametri geotecnici	Tipo di ammasso roccioso GA-BCA-GS-10g		
Lithologie	Glimmerschiefer und Paragneis ("Paraschiefer"), untergeordnet Amphibolit, lokal Orthogneis - 801b		
Litologia	Paragneiss e micascisti ("parascisto"), subordinato anfibolite, localmente ortogneiss - 801b		
Gesteinskennwerte / Mineralogie (Labor)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri della roccia / Mineralogia (Laboratorio)	Valore medio (M)	Deviazione standard (s)	Numero di prove (n)
γ [MN/m ³]	0,02731	± 0,00149	4
σ_{ci} [MPa] min (F 45° sf)	75	± 5	4
σ_{ci} [MPa]			
m_i [-] (Hoek&Brow n) geschätzt / stimato	17		
E [MPa] aus Einax.-Druckversuch / da prova uniaxiale	56400	± 10900	4
ν [-] geschätzt / stimato	0,24		
CAI [-]	3,8	± 0,5	4
äquiv. Qz-Gehalt / Contenuto equ.di Qz [%]	80	± 8	3
Quellpotential / Potenziale di swelling	keines / assente		
Trennflächeneigenschaften (Kartierung / Bohrungen)	Statistische Auswertung der Orientierungen und Eigenschaften der Trennflächen		
Proprietà delle discontinuità (Rilevamento / Sondaggi)	Elaborazione statistica delle giaciture e delle proprietà delle discontinuità		
Schieferung: Orientierung / Abstand	S: 345/45		
Scistosità: Giacitura / Spaziatura			
Trennflächenorientierung [°] (Vertrauenskegel)	RTF1: 160/80	RTF3: 300/85	
Giacitura delle discontinuità (Cono di confidenza)	RTF2w: 255/75	RTF6: 020/80	
Trennflächenabstände [mm]	RTF1: 60-200	RTF3: 200-600	S: 60-200
Spaziatura delle discontinuità	RTF2w: 60-200	RTF6: 200-600	
Trennflächendurchgängigkeit [m]	RTF1: <1	RTF3: <1	S: 1-3
Persistenza delle discontinuità	RTF2w: <1	RTF6: 1-3	
Trennflächenöffnung [mm]	RTF1: 0	RTF3: 0	S: 0
Apertura della discontinuità	RTF2w: 0	RTF6: 0	
Trennflächenrauigkeit JRC ₀ [-]	RTF1: 10-12	RTF3: 12-14	S: 4-8
Rugosità delle discontinuità	RTF2w: 8-10	RTF6: 10-12	
Trennflächenverwitterung (EN ISO 14689-1)			
Alterazione delle discontinuità			
Trennflächenfüllung (Typ u. %-Anteil)			
Riempimento delle discontinuità (tipo e %)			
Trennflächenkennwerte (Labor)	Bandbreite		Versuchszahl (n)
Parametri delle discontinuità (Laboratorio)	Range		Numero di prove (n)
ϕ_{res} [°] (unverw.itt. TF / Disc. inalterate)	35 - 40*		
c_{res} [MPa] (unverw.itt. TF / Disc. inalterate)	0,05 - 1,0*		
Gebirgskennwerte in-Situ	Bandbreite		Versuchszahl (n)
Parametri dell'ammasso roccioso in situ	Range		Numero di prove (n)
E [MPa] (BLA / Prova dilatometrica)			
Gebirgskennwerte	Statistik der Indexwerte u. berechnete Festigkeits- und Verformungsparameter		
Parametri dell'ammasso roccioso	Statistica dei parametri indice e parametri di resistenza e deformabilità calcolati		
Indexwerte (Kartierung / Bohrungen)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri indice (Rilevamento / Sondaggi)	Valori medio (M)	Deviazione standard (s)	Numero di prove (n)
RQD [%] (ISRM)	80	±	
RMR [-] (Bieniaw ski, 1999)	60	±	
GSI [-] (Hoek)	50	-	-
Festigkeits- u. Verformungskennwerte (berechnet)	Kombination 1: M	Kombination 2: M - s	Kombination 3: M + s
Parametri di resistenza e deformabilità (calcolati)	Combinazione 1: M	Combinazione 2: M - s	Combinazione 3: M + s
σ_c [MPa] (Hoek&Brow n)	4,5	4,2	4,8
σ_{cm} [MPa] (Hoek&Brow n)	16,9	15,8	18,0
c [MPa] (Mohr-Coulomb): $H_{min}=600m / H_{med}=990m / H_{max}=1200m$	2,4 / 3,3 / 3,7	2,4 / 3,2 / 3,6	2,5 / 3,4 / 3,8
ϕ [°] (Mohr-Coulomb): $H_{min}=600m / H_{med}=990m / H_{max}=1200m$	43 / 39 / 37	42 / 38 / 37	43 / 39 / 38
E [MPa] (Boyd/Serafim 1983 / Hoek 2002 / Hoek&Diederichs 2006)	- / 8700 / 17300	- / 8400 / 14000	- / 8900 / 20700
Charakteristische Werte / Valori caratteristici		Inputparameter / Valori di input	
γ_k (Gebirge / ammasso) [kN/m ³]	27,0	GSI [-] - Hoek&Brow n	50
$\sigma_{ci,k}$ (Gestein / roccia) [MPa]	70	RMR [-] - Bienaw ski	60
$\sigma_{cm,k}$ (Gebirge / ammasso roccioso) [MPa]	15,7	σ_v ($\gamma \cdot H_{min/med/max}$) [MPa]	16,2 / 26,7 / 32,4
c_k (Gebirge / ammasso roccioso) [MPa] - $H_{min/med/max}$	2,4 / 3,2 / 3,6	ko [-]	0,8-1,0
ϕ_k (Gebirge / ammasso roccioso) [°] - $H_{min/med/max}$	42 / 38 / 37		
E_k (Gebirge / ammasso roccioso) [MPa]	8000*		
Bemerkungen	Laborergebnisse Datenblatt 801 a * Daten aus Einreichprojekt		
Note	Risultati prove di laboratorio scheda 801 a * Dati da progetto definitivo		

BCA-GS-10g: Gebirgsverhaltenstyp GVT 2	
BCA-GS-10g: Comportamento dell'ammasso roccioso TCR 2	
Gebirgsart : BCA-GS-10g	
SW 263°	NE 83°
NW 353°	SE 173°
Gebirgsarten	BCA-GS-10g: Glimmerschiefer und Paragneis, untergeordnet Amphibolit, Orthogneis - 801a
Tipo di ammasso roccioso	BCA-GS-10g: Paragneiss e micascisti, subordinato anfibolite, loc. ortogneiss - 801b
Orientierung der Haupttrennflächen	Steil einfallende, schleifend, quer bzw. senkrecht zur Tunnelachse verlaufende Trennflächen Schieferung: mittelsteil einfallend, senkrecht zur Tunnelachse
Direzione delle discontinuità principali	Discontinuità ad alta inclinazione con direzione subparallela, trasversale e perpendicolare all'asse tunnel (AT); Scistosità ad inclinazione media con direzione perpendicolare all'AT
Druckhaftigkeit $\sigma_{cm,k}/\sigma_{max}$ (Hoek 2000)	$\geq 0,48$: nachbrüchig
Rapporto di sollecitazione $\sigma_{cm,k}/\sigma_{max}$	$\geq 0,48$: friabile
Einfluss des Bergwassers	vernachlässigbar
Influenza della falda	trascurabile
Quelldruck	keiner
Pressione di rigonfiamento	assente
Gebirgsverhalten	GVT 2: Oberflächliche Ablösungen und Ausbrüche entlang durchgängiger Trennflächen Ortsbrust stabil
Comportamento dell'ammasso roccioso	TCR 2: Distacchi superficiali e distacchi lungo discontinuità persistenti Fronte di scavo stabile
Radialdeformation	< 10 cm (Kennlinienverfahren)
Deformazione radiale	< 10 cm (Metodo delle curve caratteristiche)
Bemerkungen	Überlagerung: 600 - 1200 m
Note	Coperatura: 600 - 1200m

Geotechnische Kennwerte	Gebirgsart GA-BCA-A-10g		
Parametri geotecnici	Tipo di ammasso roccioso GA-BCA-A-10g		
Lithologie	Amfibolit - 802, untergeordnet Paragneis und Quarzit (805)		
Litologia	Anfibolite - 802, subordinato paragneiss e quarzite (805)		
Gesteinskennwerte / Mineralogie (Labor)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri della roccia / Mineralogia (Laboratorio)	Valore medio (M)	Deviazione standard (s)	Numero di prove (n)
γ [MN/m ³]	0,02778	± 0,00052	33
σ_{ci} [MPa]	140	± 48	11
σ_{ci} [MPa]			
m_i [-] (Hoek&Brown) aus Triax.-Druckversuch / da prova triassiale	20	± 6	8
E [MPa] aus Einax.-Druckversuch / da prova uniassiale	53100	± 8000	11
ν [-] aus Einax.-Druckversuch / da prova uniassiale	0,24	± 0,06	10
CAI [-]	4,33	± 0,39	2
äquiv. Qz-Gehalt / Contenuto equ.di Qz [%]	52	± 2,5	4
Quellpotential / Potenziale di swelling	keines / assente		
Trennflächeneigenschaften (Kartierung / Bohrungen)	Statistische Auswertung der Orientierungen und Eigenschaften der Trennflächen		
Proprietà delle discontinuità (Rilevamento / Sondaggi)	Elaborazione statistica delle giaciture e delle proprietà delle discontinuità		
Schieferung: Orientierung / Abstand	S: 345/45		
Scistosità: Giacitura / Spaziatura			
Trennflächenorientierung [°] (Vertrauenskegel)	RTF1: 160/80	RTF3: 300/85	
Giacitura delle discontinuità (Cono di confidenza)	RTF2w: 255/75	RTF6: 020/80	
Trennflächenabstände [mm]	RTF1: 60-200	RTF3: 200-600	S: 200-600
Spaziatura delle discontinuità	RTF2w: 60-200	RTF6: 200-600	
Trennflächendurchgängigkeit [m]	RTF1: <1	RTF3: <1	S: 1-3
Persistenza delle discontinuità	RTF2w: <1	RTF6: 1-3	
Trennflächenöffnung [mm]	RTF1: 0	RTF3: 0	S: 0
Apertura della discontinuità	RTF2w: 0	RTF6: 0	
Trennflächenrauigkeit JRC ₀ [-]	RTF1: 10-12	RTF3: 12-14	S: 4-8
Rugosità delle discontinuità	RTF2w: 8-10	RTF6: 10-12	
Trennflächenverwitterung (EN ISO 14689-1)			
Alterazione delle discontinuità			
Trennflächenfüllung (Typ u. %-Anteil)			
Riempimento delle discontinuità (tipo e %)			
Trennflächenkennwerte (Labor)	Bandbreite		Versuchszahl (n)
Parametri delle discontinuità (Laboratorio)	Range		Numero di prove (n)
$\varphi_{res} / \varphi_{base}$ [°] (unverw. it. TF / Disc. inalterate)	35 - 39 / 27 - 30		5 / 5
c_{res} [MPa] (unverw. it. TF / Disc. inalterate)	0,03 - 0,53		5
Gebirgskennwerte in-Situ	Bandbreite		Versuchszahl (n)
Parametri dell'ammasso roccioso in sito	Range		Numero di prove (n)
E [MPa] (BLA / Prova dilatometrica)			
Gebirgskennwerte	Statistik der Indexwerte u. berechnete Festigkeits- und Verformungsparameter		
Parametri dell'ammasso roccioso	Statistica dei parametri indice e parametri di resistenza e deformabilità calcolati		
Indexwerte (Kartierung / Bohrungen)	Mittelwert (M)	Standardabweichung (s)	Versuchszahl (n)
Parametri indice (Rilevamento / Sondaggi)	Valori medio (M)	Deviazione standard (s)	Numero di prove (n)
RQD [%] (ISRM)	90	±	
RMR [-] (Bieniawski, 1999)	70	±	
GSI [-] (Hoek)	65	± 10	-
Festigkeits- u. Verformungskennwerte (berechnet)	Kombination 1: M	Kombination 2: M - s	Kombination 3: M + s
Parametri di resistenza e deformabilità (calcolati)	Combinazione 1: M	Combinazione 2: M - s	Combinazione 3: M + s
σ_c [MPa] (Hoek&Brown)	19,9	7,4	46,8
σ_{cm} [MPa] (Hoek&Brown)	46,7	20,9	88,3
c [MPa] (Mohr-Coulomb): H _{min} =600m / H _{med} =990m / H _{max} =1200m	4,5 / 5,8 / 6,5	2,8 / 3,7 / 4,2	7,0 / 8,8 / 9,7
φ [°] (Mohr-Coulomb): H _{min} =600m / H _{med} =990m / H _{max} =1200m	52 / 49 / 47	44 / 40 / 38	58 / 55 / 54
E [MPa] (Boyd/Serafim 1983 / Hoek 2002 / Hoek&Diederichs 2006)	- / 23700 / 33500	- / 12800 / 18400	- / 42200 / 50700
Charakteristische Werte / Valori caratteristici	Inputparameter / Valori di input		
γ_k (Gebirge / ammasso) [kN/m ³]	28,0	GSI [-] - Hoek&Brown	55
$\sigma_{ci,k}$ (Gestein / roccia) [MPa]	92*	RMR [-] - Bienawski	70
$\sigma_{cm,k}$ (Gebirge / ammasso roccioso) [MPa]	24,8	σ_v ($\gamma \cdot H_{min}/med/max$) [MPa]	16,8 / 27,8 / 33,6
c_k (Gebirge / ammasso roccioso) [MPa] - H _{min} /med/max	3,0 / 4,1 / 4,6	k_0 [-]	0,8-1,0
φ_k (Gebirge / ammasso roccioso) [°] - H _{min} /med/max	47 / 43 / 41		
E_k (Gebirge / ammasso roccioso) [MPa]	12000		
Bemerkungen	*Wert: M-s		
Note	*Valore: M-s		

BCA-A-10g: Gebirgsverhaltenstyp GVT 2	
BCA-A-10g: Comportamento dell'ammasso roccioso TCR 2	
Gebirgsart : BCA-A-10g	
SW 263°	NE 83° NW 353° SE 173°
Gebirgsarten	BCA-A-10g: Amphibolit - 802, untergeordnet Paragneis und Quarzit (805)
Tipo di ammasso roccioso	BCA-A-10g: Anfibolite - 802, subordinato paragneiss e quarzite (805)
Orientierung der Haupttrennflächen	Steil einfallende, schleifend, quer bzw. senkrecht zur Tunnelachse verlaufende Trennflächen Schieferung: mittelsteil einfallend, senkrecht zur Tunnelachse
Direzione delle discontinuità principali	Discontinuità ad alta inclinazione con direzione subparallela, trasversale e perpendicolare all'AT; Scistosità ad inclinazione media con direzione perpendicolare all'AT
Druckhaftigkeit $\sigma_{cm,k}/\sigma_{max}$ (Hoek 2000)	$\geq 0,74$: nachbrüchig
Rapporto di sollecitazione $\sigma_{cm,k}/\sigma_{max}$	$\geq 0,74$: friabile
Einfluss des Bergwassers	vernachlässigbar
Influenza della falda	trascurabile
Quelldruck	keiner
Pressione di rigonfiamento	assente
Gebirgsverhalten	GVT 2: Oberflächliche Ablösungen und Ausbrüche entlang durchgängiger Trennflächen Ortsbrust stabil
Comportamento dell'ammasso roccioso	TCR 2: Distacchi superficiali e distacchi lungo discontinuità persistenti Fronte di scavo stabile
Radialdeformation	< 10 cm (Kennlinienverfahren)
Deformazione radiale	< 10 cm (Metodo delle curve caratteristiche)
Bemerkungen	Überlagerung: 990 - 1200 m
Note	Coperatura: 990 - 1200 m

ANHANG 2 - KENNLINIENVERFAHREN

Nachfolgend werden die Kennlinien wiedergegeben, durch die Folgendes bestimmt werden kann:

- Radialer Druck - Konvergenz
- Konvergenz - Entfernung von Ortsbrust
- Radialer Druck - Ausdehnung des plastischen Streifens jenseits des Abbruchprofils
- Entfernung von Ortsbrust - Ausdehnung des plastischen Streifens jenseits des Abbauprofils
- Entfernung von Ortsbrust - fiktive Aushubkräfte

Das Verfahren wurde auf den Gebirgen GA-BCA-GS-10g und GA-BST-KS-8f für die Querschnitte CT1-T3 und CT1-T4 angewandt. Das Materialmodell ist elastisch-plastisch mit softening und nicht damit verbundenem Fließen des Materials Gestein laut Mohr-Coulomb und unter Berücksichtigung der Formel von Ribacchi [20].

Die Kurve "Konvergenz - Entfernung von Ortsbrust" wurde durch ein vereinfachtes, analytisches Verfahren ermittelt, das die Relationen von Nguyen, Minh et al. [21] verwendet

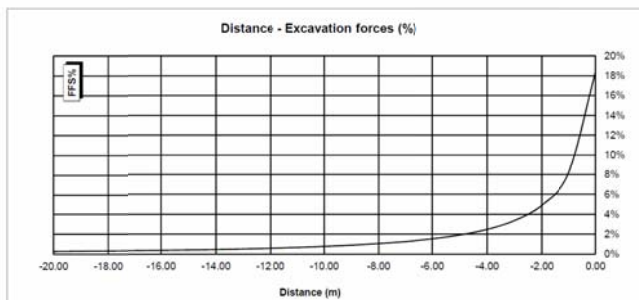
APPENDICE 2 - CURVE CARATTERISTICHE

Di seguito sono riportate le curve caratteristiche, mediante le quali è stato possibile valutare:

- Pressione Radiale – Convergenza.
- Convergenza – Distanza dal Fronte.
- Pressione Radiale – Estensione della Fascia Plastica oltre il profilo di scavo.
- Distanza dal fronte – Estensione della Fascia Plastica oltre il profilo di scavo.
- Distanza dal Fronte – Forze Fittizie di Scavo

L'analisi è stata eseguita per gli ammassi GA-BCA-GS-10g e GA-BST-KS-8f rispettivamente per il CT1-T3 e CT1-T4, assumendo un modello costitutivo elasto-plastico con softening e flusso non associato del materiale roccia secondo Mohr-Coulomb, nella formulazione proposta da Ribacchi [20].

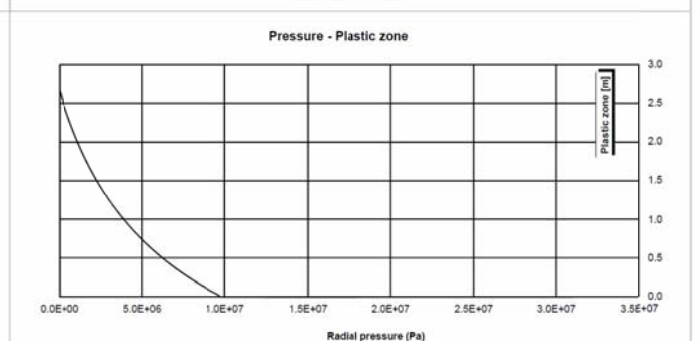
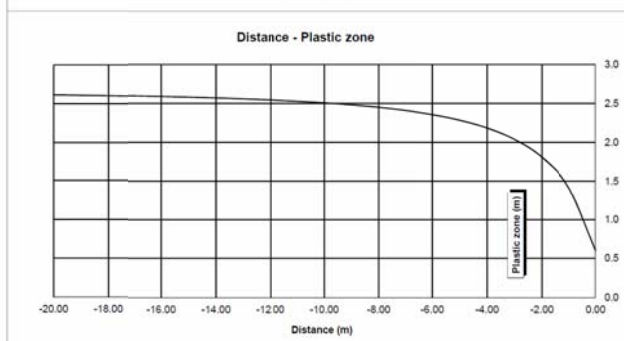
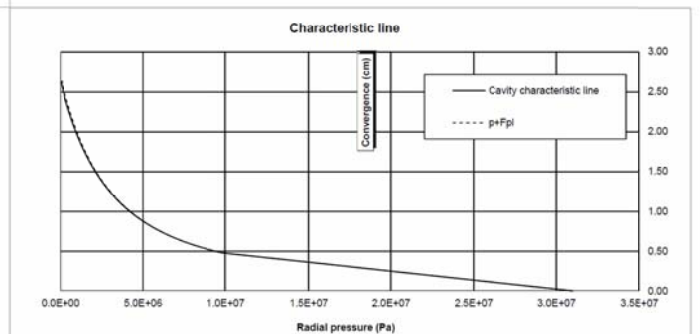
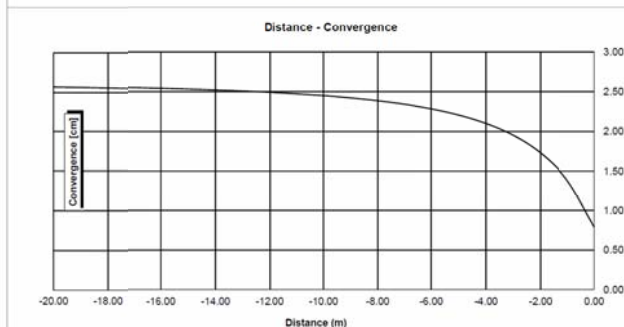
La curva "Convergenza – Distanza dal fronte" è stata ricavata attraverso un procedimento analitico semplificato che sfrutta le relazioni proposte da Nguyen, Minh et al. [21].



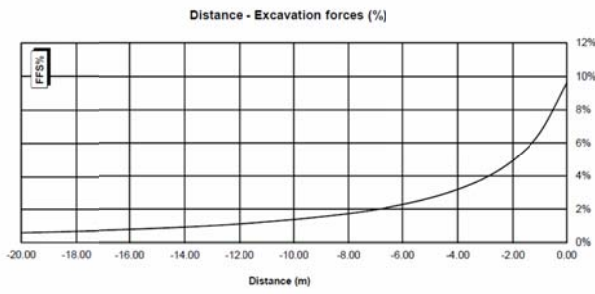
CT1-T3_GA-BCA-GS-10g

INPUT DATA		RESULTS	
Weight [N/mc]	27300	At final equilibrium	
Overburden [m]	1135	Total convergence [cm]	2.6
Excavation radius [m]	2.90	Convergence after excavation [cm]	1.8
		Plastic zone thickness [m]	2.7
Peak internal friction angle [°]	36.23	Equilibrium at excavation face	
Post peak internal friction angle [°]	28.85	Convergence [cm]	0.8
Peak cohesion [Pa]	3535000	t - (deconfinement ratio) [%]	18.3%
Post peak cohesion [Pa]	2274000		
Deformation modulus [Pa]	1.55E+10		
Poisson's ratio [-]	0.21		
Dilation angle [°]	4.53		

c(face) / Radius	0.27 [%]
c(total) / Radius	0.91 [%]
c(after excav.) / Radius	0.64 [%]
Pl.thick. (face) / Radius	20.8 [%]
Pl.thick. (total) / Radius	92.1 [%]

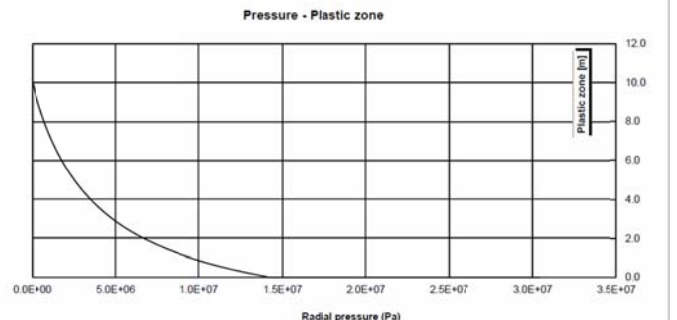
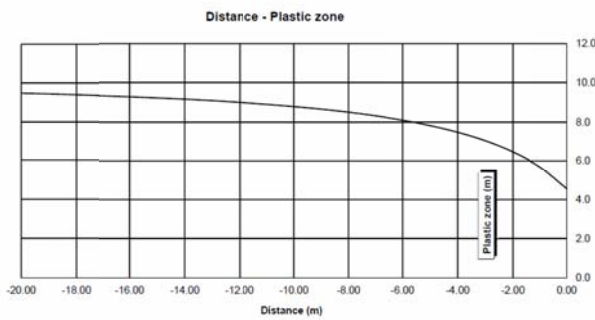
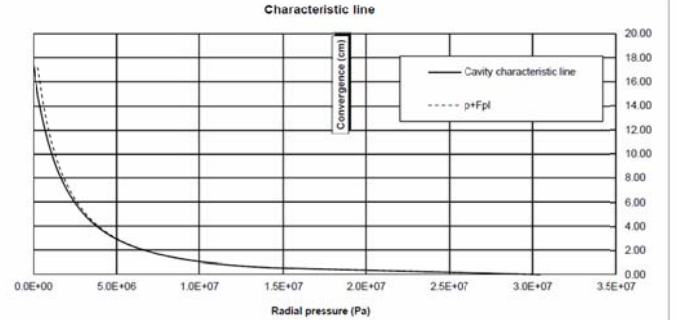
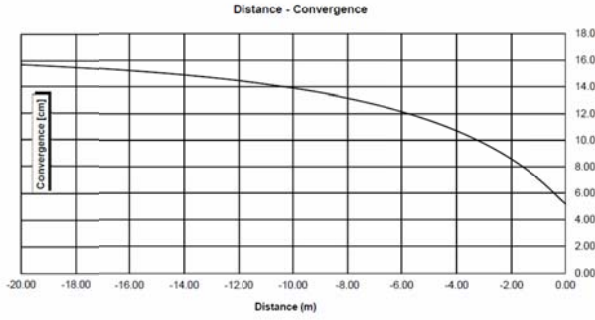


CT1-T4_GA-BST-KS-8f



INPUT DATA		RESULTS	
Weight [N/mc]	27300	At final equilibrium	
Overburden [m]	1115	Total convergence [cm]	17.3
Excavation radius [m]	3.20	Convergence after excavation [cm]	12.1
		Plastic zone thickness [m]	10.0
Peak internal friction angle [°]	28.07	Equilibrium at excavation face	
Post peak internal friction angle [°]	21.47	Convergence [cm]	5.2
Peak cohesion [Pa]	2127000	1 - (deconfinement ratio) [%]	9.6%
Post peak cohesion [Pa]	1349000		
Deformation modulus [Pa]	1.11E+10		
Poisson's ratio [-]	0.21		
Dilation angle [°]	3.51		

c(face) / Radius	1.62 [%]
c(total) / Radius	5.39 [%]
c(after excav.) / Radius	3.77 [%]
Pl.thick. (face)/Radius	142.4 [%]
Pl.thick. (total)/Radius	313.6 [%]



ANHANG 3 - BRUCHKÖRPERANALYSE

Die Anlage 3 führt die wichtigsten Berechnungsergebnisse der Bruchkörperanalyse, welche mit dem Programm UNWEDGE 3.0 durchgeführt wurde an. Die Tabellen enthalten den minimalen Sicherheitsfaktor für jeweils drei Trennfläche, die die einzelnen Homogenbereiche kennzeichnen. Die Grafiken stellen hingegen nur die jeweils drei ungünstigsten Trennflächen dar.

APPENDICE 3 - ANALISI DEI BLOCCHI

L'appendice 3 riporta i risultati delle analisi a blocchi condotte con il programma di calcolo UNWEDGE 3.0. Nelle tabelle è riportato il fattore di sicurezza minimo per ciascuna terna di discontinuità caratterizzanti le singole tratte omogenee mentre in forma grafica sono riportati solo i risultati della terna di discontinuità più gravosa.

Rock mass

GA-BS-GM-8e; GA-T-A-8e; GA-BST-M-8e; GA-BST-KPH-8e; GA-BST-KS-8e

Area L1 - advance per round: 4.5 m (counted with 5 m)

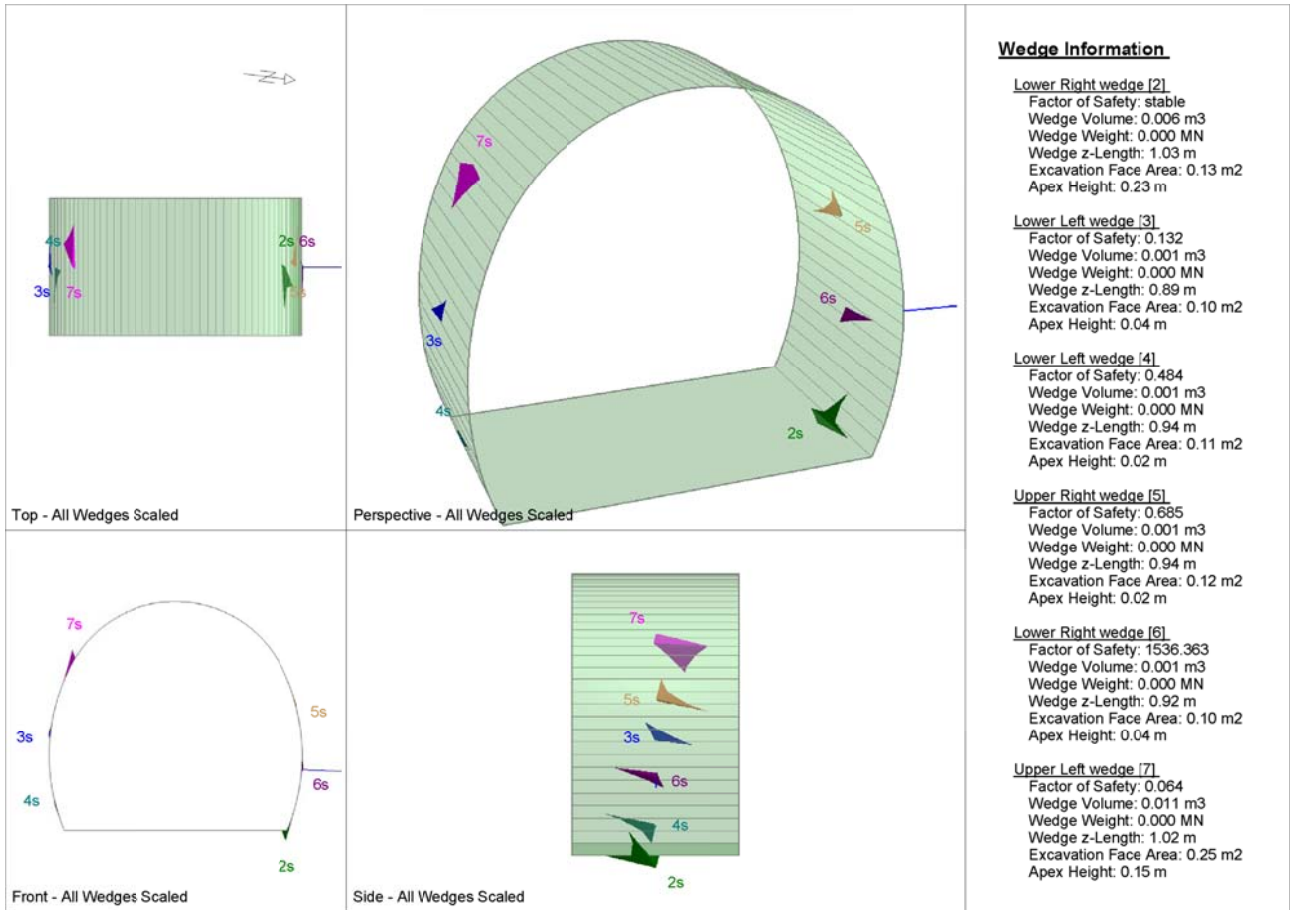
		Joint Orientattions		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	70	350	10	20	0
J2	RTF1	70	180	1	20	0
J3	RTF2e	80	85	3	20	0
J4	RTF3	80	320	3	20	0
J5	RTF6	80	220	3	20	0

Necessary anchorage pattern:

1.8	x	1.5	m
L	=	3.0	m
Swelllex Pm16	N_{yd}	122	kN

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	2	3	0	0	0.009	X1
2	1	3	4	0	0	0	N
3	2	3	5	0	0	0	N
4	1	2	4	0.064	0	0.011	X1
5	1	2	5	0.064	0	0.008	X1
6	1	3	5	0.064	0	0	N
7	1	4	5	0.064	0	0.002	X1
8	2	3	4	0.064	0	0	N
9	2	4	5	0.064	0	0.002	X1
10	3	4	5	0.064	0	0.001	X1



Rock mass

GA-BS-GM-8e; GA-T-A-8e; GA-BST-M-8e; GA-BST-KPH-8e; GA-BST-KS-8e

Area L2

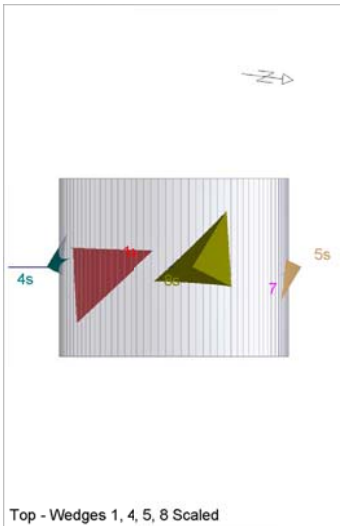
		Joint Orientations		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	70	350	10	20	0
J2	RTF1	70	180	1	20	0
J3	RTF2e	80	85	3	20	0
J4	RTF3	80	320	3	20	0
J5	RTF6	80	220	3	20	0

Necessary anchorage pattern:

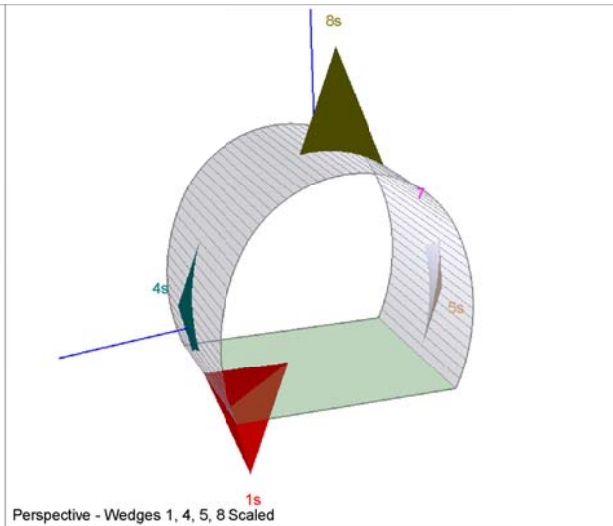
1.8	x	1.5	m
L	=	3.0	m
Swelllex Pm16	N_{yd}	122	kN
Shotcrete lining	10	cm	(Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

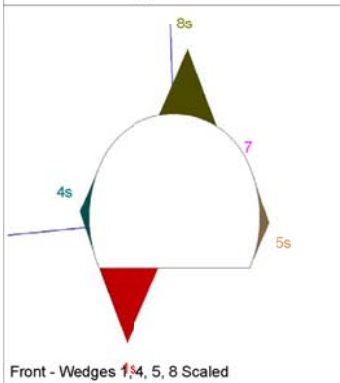
Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment	Apex Height [m]
1	1	3	5	17.645	0.033	1.234	S	2.2
2	3	4	5	20.624	0.026	0.948	S	2.51
3	1	4	5	26.563	0.018	0.681	S	2.54
4	2	3	4	94.7	0.002	0.091	S	0.76
5	2	4	5	100.717	0.001	0.045	S	0.52
6	1	3	4	167.375	0	0.01	S	2.87
7	1	2	3	211.778	0	0.009	S	0.17
8	1	2	4	215.047	0	0.011	S	0.15
9	1	2	5	223.337	0	0.008	S	0.17
10	2	3	5	1798.928	0	0	N	0.35



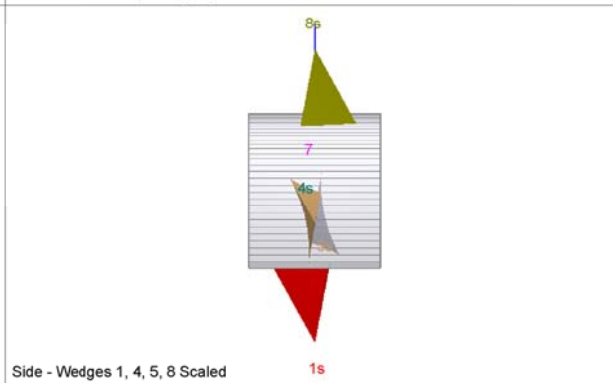
Top - Wedges 1, 4, 5, 8 Scaled



Perspective - Wedges 1, 4, 5, 8 Scaled



Front - Wedges 1, 4, 5, 8 Scaled



Side - Wedges 1, 4, 5, 8 Scaled

Wedge Information

Lower Left wedge [1]
 Factor of Safety: stable
 Wedge Volume: 1.592 m3
 Wedge Weight: 0.043 MN
 Wedge z-Length: 1.91 m
 Excavation Face Area: 1.90 m2
 Apex Height: 2.52 m

Lower Left wedge [4]
 Factor of Safety: 119.313
 Wedge Volume: 0.073 m3
 Wedge Weight: 0.002 MN
 Wedge z-Length: 1.03 m
 Excavation Face Area: 0.89 m2
 Apex Height: 0.32 m

Lower Right wedge [5]
 Factor of Safety: 181.158
 Wedge Volume: 0.074 m3
 Wedge Weight: 0.002 MN
 Wedge z-Length: 1.04 m
 Excavation Face Area: 0.90 m2
 Apex Height: 0.32 m

Upper Right wedge [7]
 Factor of Safety: 14609.459
 Wedge Volume: 0.000 m3
 Wedge Weight: 0.000 MN
 Wedge z-Length: 0.12 m
 Excavation Face Area: 0.00 m2
 Apex Height: 0.00 m

Roof wedge [8]
 Factor of Safety: 17.645
 Wedge Volume: 1.234 m3
 Wedge Weight: 0.033 MN
 Wedge z-Length: 1.89 m
 Excavation Face Area: 1.83 m2
 Apex Height: 2.20 m

Rock mass

GA-BS-GM-8e; GA-T-A-8e; GA-BST-M-8e; GA-BST-KPH-8e; GA-BST-KS-8e

Area tunnel face

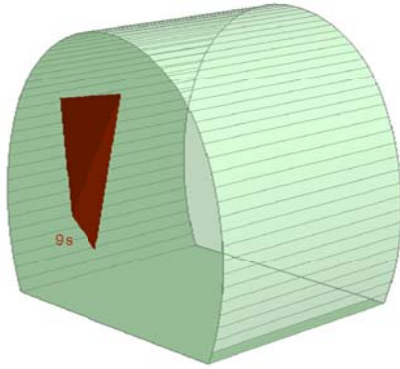
		Joint Orientattions		Joint Properties			
		Dip	Dip Direction	persistence	φ	c	φ_d
		[°]	[°]	[m]	[°]	[kPa]	[°]
J1	SC	70	350	10	20	0	16.23
J2	RTF1	70	180	1	20	0	16.23
J3	RTF2e	80	85	3	20	0	16.23
J4	RTF3	80	320	3	20	0	16.23
J5	RTF6	80	220	3	20	0	16.23

Shotcrete lining 5 cm (Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

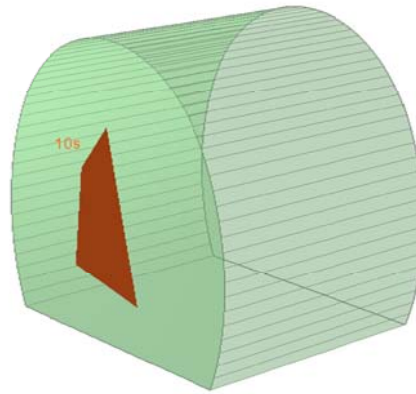
Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	3	5	15.141	0.008	0.281	S
2	3	4	5	21.388	0.005	0.177	S
3	1	2	3	75.226	0	0.014	S
4	1	4	5	83.303	0.002	0.065	S
5	2	3	4	95.054	0	0.009	S
6	1	2	4	115.947	0.003	0.099	S
7	1	3	4	144.666	0	0.008	S
8	2	4	5	648.534	0	0.002	S
9	1	2	5	811.859	0	0.002	S
10	2	3	5	2890.261	0	0	N

Near End wedge [9] Scaled
FS: 36.831



Volume: 0.281 m3, Weight: 0.008 MN, z-Length: 0.00 m, Excavation F

Far End wedge [10] Scaled
FS: 15.141



Volume: 0.281 m3, Weight: 0.008 MN, z-Length: 0.00 m, Excavation

Wedge Information

Near End wedge [9]
Factor of Safety: 36.831
Wedge Volume: 0.281 m3
Wedge Weight: 0.008 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 2.33 m2
Apex Height: 0.36 m

Far End wedge [10]
Factor of Safety: 15.141
Wedge Volume: 0.281 m3
Wedge Weight: 0.008 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 2.33 m2
Apex Height: 0.36 m

Rock mass
GA-BST-KS-8f

Area L1 - advance per round: 4.5 m (counted with 5 m)

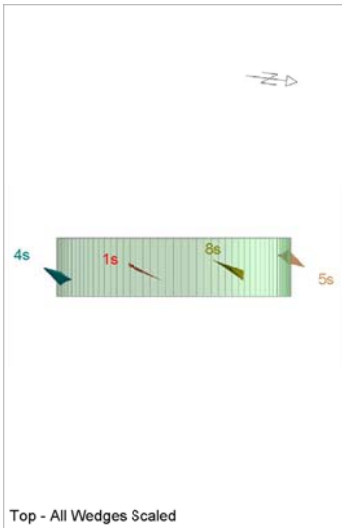
		Joint Orientattions		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	60	355	10	20	0
J2	RTF2w	85	285	1	20	0
J3	RTF5	75	110	1	20	0
J4	RTF6	65	50	10	20	0

Necessary anchorage pattern:

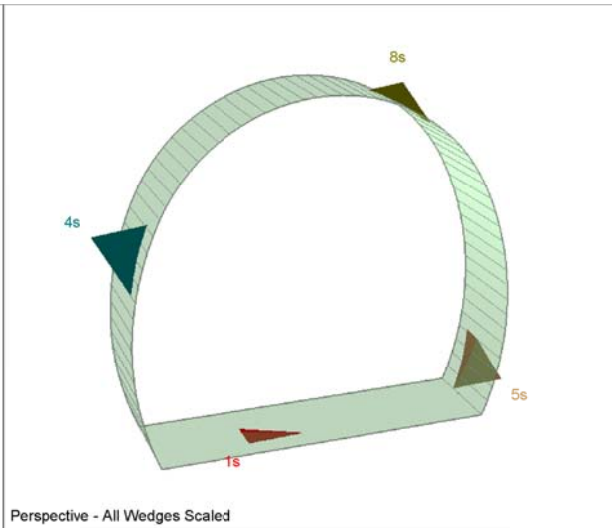
1.8	x	1.5	m
L	=	3.0	m
Swelllex Pm16	N_{yd}	122	kN

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

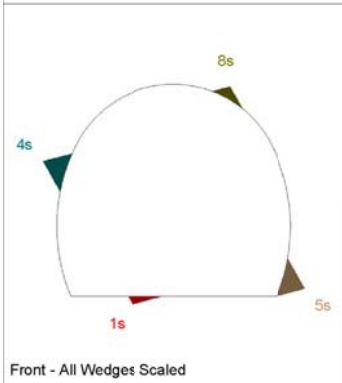
Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	2	3	0	0	0.009	X1
2	2	3	4	0	0	0.007	X1
3	1	3	4	0.098	0	0.001	X1
4	1	2	4	0.264	0	0	N



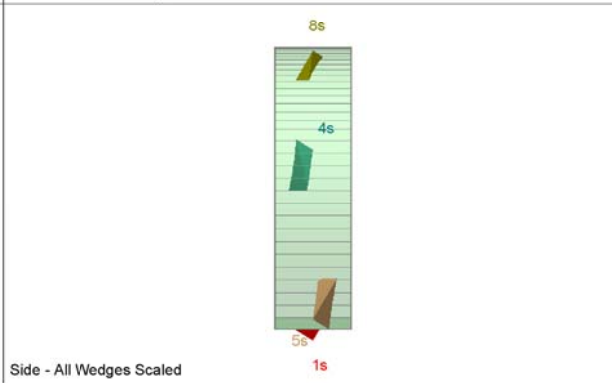
Top - All Wedges Scaled



Perspective - All Wedges Scaled



Front - All Wedges Scaled



Side - All Wedges Scaled

Wedge Information

Floor wedge [1]
 Factor of Safety: stable
 Wedge Volume: 0.003 m3
 Wedge Weight: 0.000 MN
 Wedge z-Length: 0.45 m
 Excavation Face Area: 0.04 m2
 Apex Height: 0.21 m

Upper Left wedge [4]
 Factor of Safety: 0.264
 Wedge Volume: 0.032 m3
 Wedge Weight: 0.001 MN
 Wedge z-Length: 0.34 m
 Excavation Face Area: 0.16 m2
 Apex Height: 0.60 m

Lower Right wedge [5]
 Factor of Safety: 8.260
 Wedge Volume: 0.032 m3
 Wedge Weight: 0.001 MN
 Wedge z-Length: 0.34 m
 Excavation Face Area: 0.17 m2
 Apex Height: 0.60 m

Roof wedge [8]
 Factor of Safety: 0.000
 Wedge Volume: 0.009 m3
 Wedge Weight: 0.000 MN
 Wedge z-Length: 0.51 m
 Excavation Face Area: 0.10 m2
 Apex Height: 0.29 m

Rock mass
GA-BST-KS-8f

Area L2

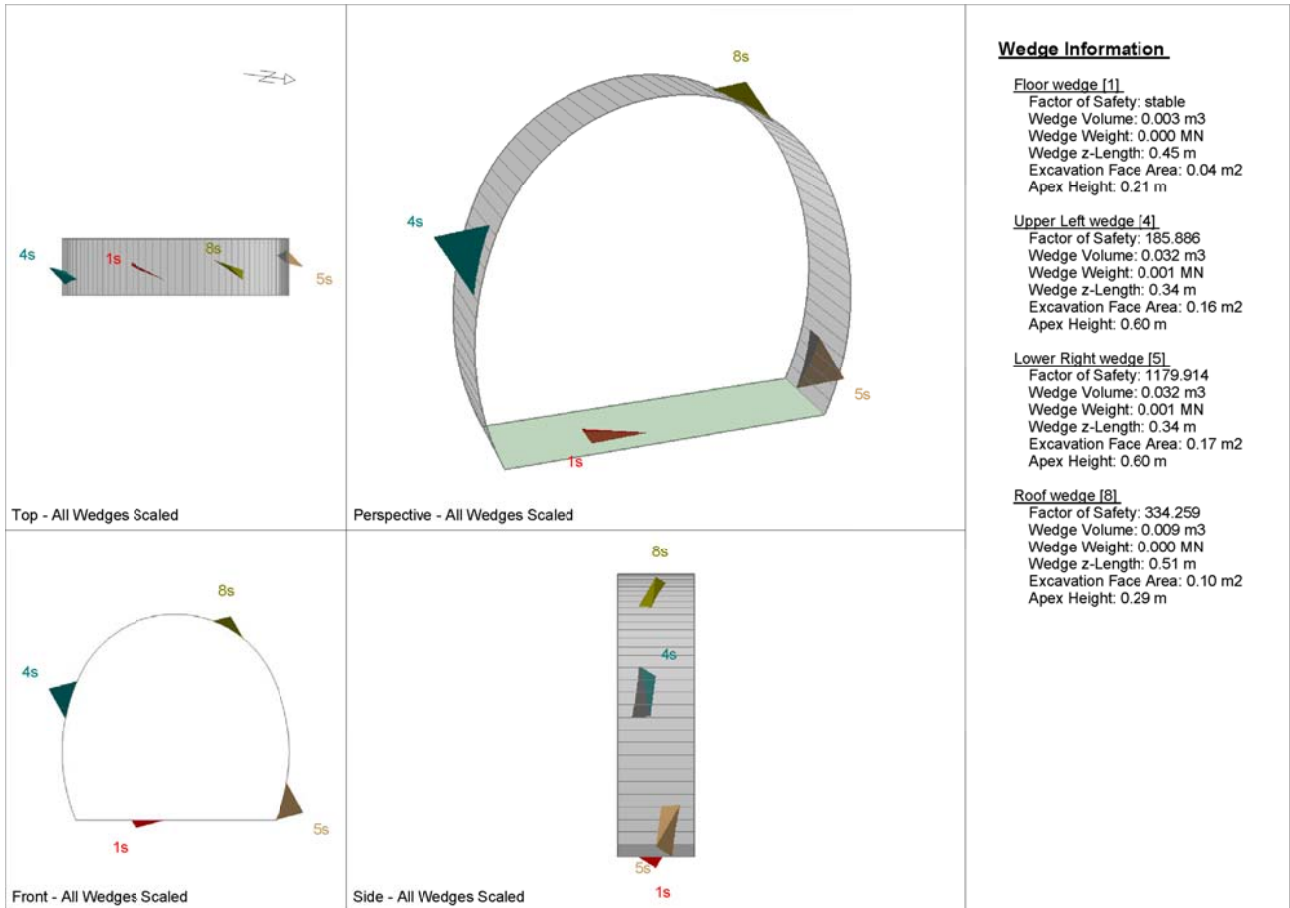
		Joint Orientattions		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	60	355	10	20	0
J2	RTF2w	85	285	1	20	0
J3	RTF5	75	110	1	20	0
J4	RTF6	65	50	10	20	0

Necessary anchorage pattern:

1.8	x	1.5	m
L	=	3.0	m
Swelllex Pm16	N _{vd}	122	kN
Shotcrete lining	10	cm	(Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment	Apex Height [m]
1	1	2	3	185.886	0.001	0.032	S	0.6
2	1	3	4	198.422	0	0.012	S	0.89
3	2	3	4	229.153	0	0.014	S	0.43
4	1	2	4	1763.66	0	0	N	0.89



Rock mass
 GA-BST-KS-8f

Area tunnel face

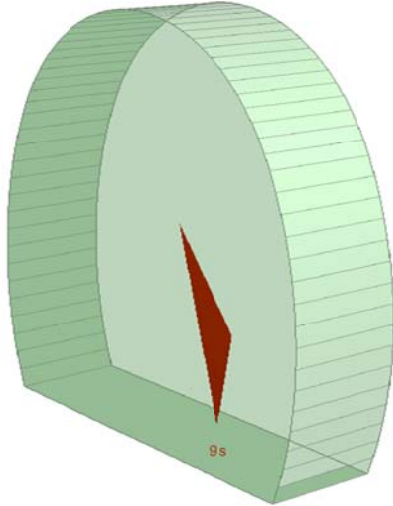
		Joint Orientattions		Joint Properties			
		Dip	Dip Direction	persistence	ϕ	c	ϕ_d
		[°]	[°]	[m]	[°]	[kPa]	[°]
J1	SC	60	355	10	20	0	16.23
J2	RTF2w	85	285	1	20	0	16.23
J3	RTF5	75	110	1	20	0	16.23
J4	RTF6	65	50	10	20	0	16.23

Shotcrete lining 5 cm (Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

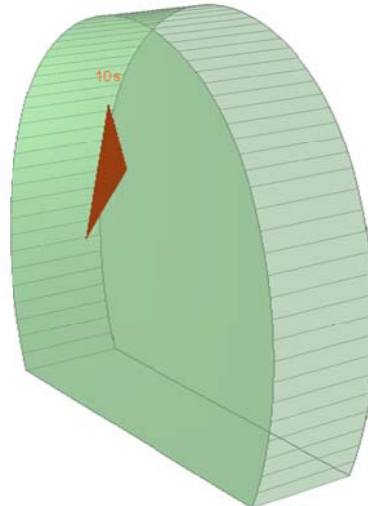
Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	3	4	98.527	0.001	0.027	S
2	2	3	4	167.036	0	0.007	S
3	1	2	3	239.076	0	0.004	S
4	1	2	4	1692.948	0	0	N

Near End wedge [9] Scaled
FS: stable



Volume: 0.027 m3, Weight: 0.001 MN, z-Length: 0.00 m, Excavation F

Far End wedge [10] Scaled
FS: 98.527



Volume: 0.027 m3, Weight: 0.001 MN, z-Length: 0.00 m, Excavation

Wedge Information

Near End wedge [9]

Factor of Safety: stable
Wedge Volume: 0.027 m3
Wedge Weight: 0.001 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 0.21 m2
Apex Height: 0.37 m

Far End wedge [10]

Factor of Safety: 98.527
Wedge Volume: 0.027 m3
Wedge Weight: 0.001 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 0.21 m2
Apex Height: 0.37 m

Rock mass

BCA-A-10g; BCA-GS-10g;

Area L1 - advance per round: 4.5 m (counted with 5 m)

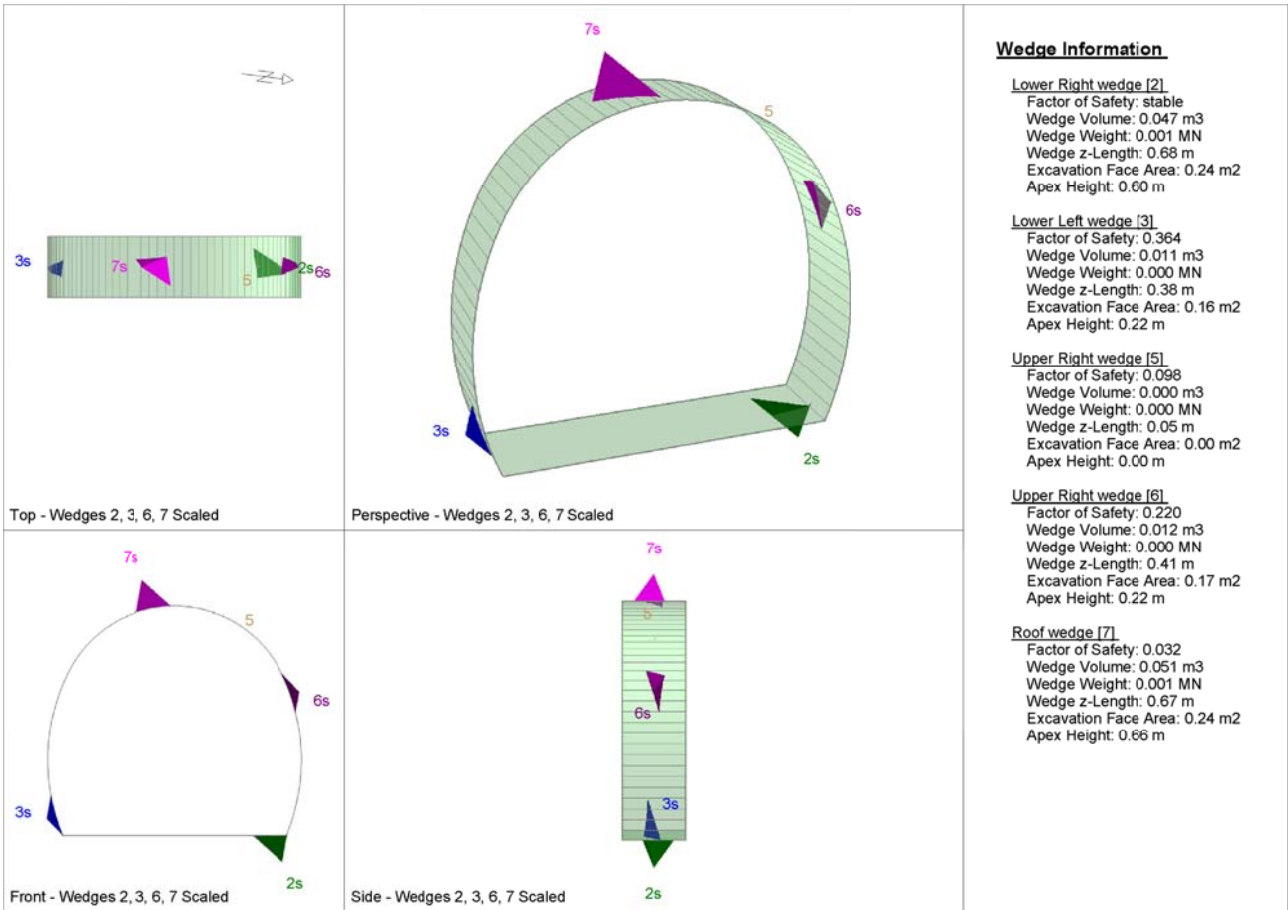
		Joint Orientattions		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	45	345	3	20	0
J2	RTF1	80	160	1	20	0
J3	RTF2w	75	255	1	20	0
J4	RTF3	85	300	1	20	0
J5	RTF6	80	20	3	20	0

Necessary anchorage pattern:

1.8	x	1.5	m
L	=	3.0	m
Swelllex Pm16	N _{yd}	122	kN

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	2	3	0	0	0.008	X1
2	1	2	4	0	0	0.006	X1
3	1	2	5	0	0	0.003	X1
4	1	3	5	0	0	0.001	X1
5	2	4	5	0	0.001	0.035	X1
6	3	4	5	0	0	0	N
7	1	3	4	0.032	0.001	0.051	X1
8	1	4	5	0.032	0	0	N
9	2	3	4	0.032	0	0	N
10	2	3	5	0.064	0	0	N



Rock mass

BCA-A-10g; BCA-GS-10g;

Area L2

		Joint Orientattions		Joint Properties		
		Dip	Dip Direction	persistence	ϕ	c
		[°]	[°]	[m]	[°]	[kPa]
J1	SC	45	345	3	20	0
J2	RTF1	80	160	1	20	0
J3	RTF2w	75	255	1	20	0
J4	RTF3	85	300	1	20	0
J5	RTF6	80	20	3	20	0

Necessary anchorage pattern:

1.8 x 1.5 m

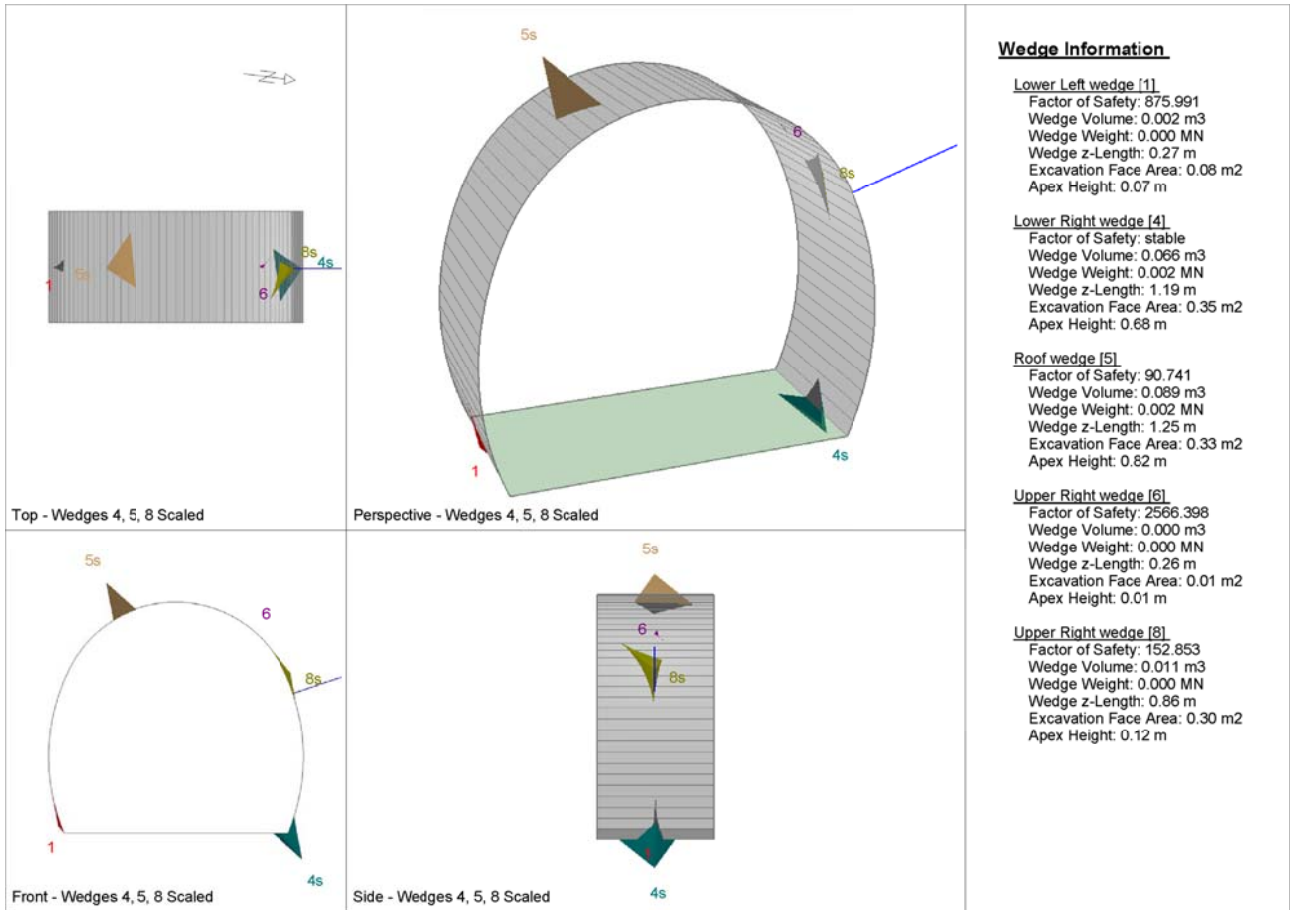
L = 3.0 m

Swellex Pm16 N_{yd} 122 kN

Shotcrete lininđ 10 cm (Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment	Apex Height [m]
1	1	4	5	90.741	0.002	0.089	S	0.82
2	1	3	4	110.381	0.001	0.051	S	0.66
3	2	4	5	119.212	0.001	0.035	S	0.87
4	1	2	5	126.089	0.001	0.029	S	0.22
5	1	3	5	132.801	0.001	0.036	S	0.91
6	3	4	5	149.483	0.001	0.022	S	0.91
7	1	2	3	149.795	0.001	0.022	S	0.18
8	2	3	5	161.943	0.001	0.054	S	0.89
9	1	2	4	190.711	0	0.016	S	0.18
10	2	3	4	1185.177	0	0	N	0.95



Rock mass
 BCA-A-10g; BCA-GS-10g;

Area tunnel face

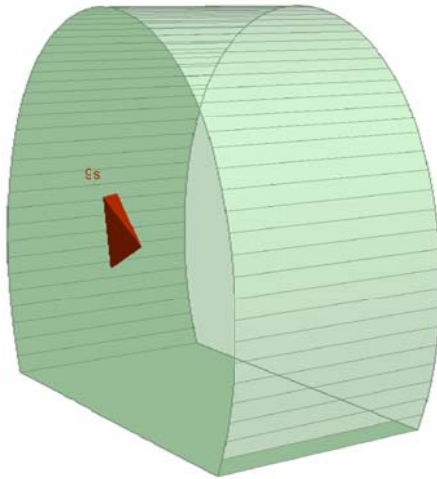
		Joint Orientattions		Joint Properties			
		Dip	Dip Direction	persistence	φ	c	φ_d
		[°]	[°]	[m]	[°]	[kPa]	[°]
J1	SC	45	345	3	20	0	16.23
J2	RTF1	80	160	1	20	0	16.23
J3	RTF2w	75	255	1	20	0	16.23
J4	RTF3	85	300	1	20	0	16.23
J5	RTF6	80	20	3	20	0	16.23

Shotcrete lining 5 cm (Shear strength 0.91 MPa)

X1	Wedges with a maximum high of 0.3 m or a maximum weight of 10 kN
X2	Wedges with a maximum high of 0.5 m or a maximum weight of 100 kN
S	Safety reached
N	Negligible small

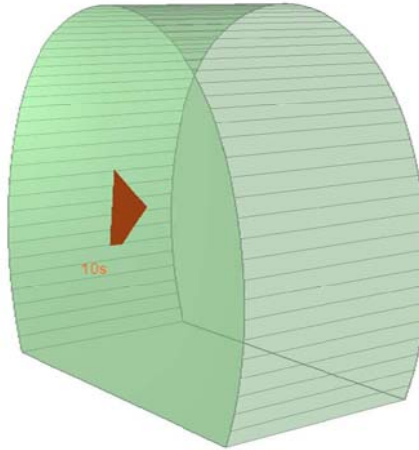
Combination	Joint A	Joint B	Joint C	Factor of Safety [-]	Wedge Weight [MN]	Wedge Volume [m ³]	Comment
1	1	2	3	62.032	0.001	0.025	S
2	1	3	4	77.328	0	0.018	S
3	1	3	5	109.397	0	0.012	S
4	2	3	5	138.349	0	0.008	S
5	1	2	5	145.264	0.001	0.031	S
6	1	2	4	260.65	0	0.008	S
7	3	4	5	543.1	0	0	N
8	1	4	5	544.425	0	0	N
9	2	3	4	565.618	0	0	N
10	2	4	5	604.466	0	0	N

Near End wedge [9] Scaled
FS: 62.032



Volume: 0.025 m3, Weight: 0.001 MN, z-Length: 0.00 m, Excavation F

Far End wedge [10] Scaled
FS: 1609.864



Volume: 0.025 m3, Weight: 0.001 MN, z-Length: 0.00 m, Excavation

Wedge Information

Near End wedge [9]

Factor of Safety: 62.032
Wedge Volume: 0.025 m3
Wedge Weight: 0.001 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 0.33 m2
Apex Height: 0.23 m

Far End wedge [10]

Factor of Safety: 1609.864
Wedge Volume: 0.025 m3
Wedge Weight: 0.001 MN
Wedge z-Length: 0.00 m
Excavation Face Area: 0.33 m2
Apex Height: 0.23 m

ANHANG 4 - FEM- ANALYSEN FÜR DIE AUßENSCHALE SCHNITT CT1-T3/ FDE-C-T3

Diese Anlage führt die wichtigsten Outputs der FEM-Analysen des Schnitts Ct1-T3 / FdE-C-T3 an, die mit dem Rechenprogramm MIDAS GTS durchgeführt wurden.

APPENDICE 4 - ANALISI FEM DEL RIVESTIMENTO DI PRIMA FASE CT1-T3/ FDE-C-T3

Nella presente appendice sono riportati i principali output delle analisi agli elementi finiti della sezione CT1-T3 / FdE-C-T3 effettuate con il programma di calcolo MIDAS GTS.

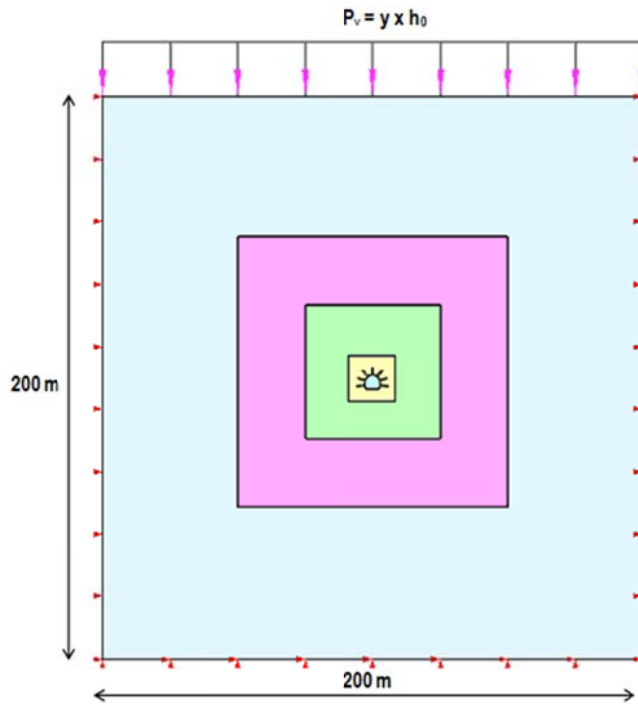


Abbildung 1: Numerischer Modell

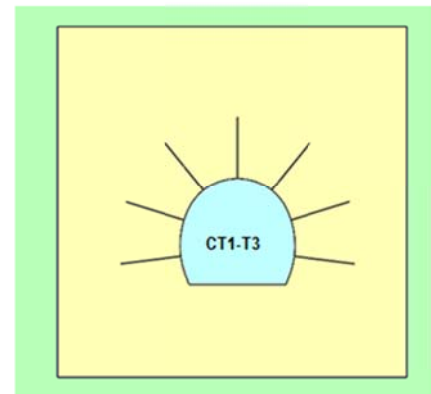


Illustrazione 1: Modello numerico

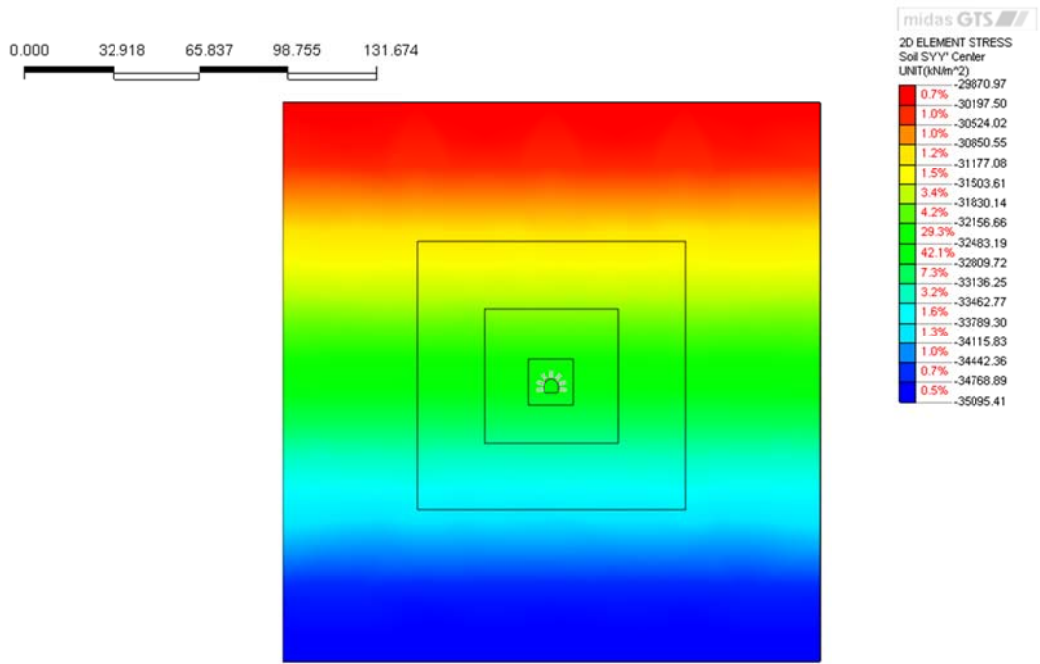


Abbildung 2: Momente an der Außenschale [kN/m²]

Illustrazione 2: Fase litostatica - tensioni verticali [kN/m²]

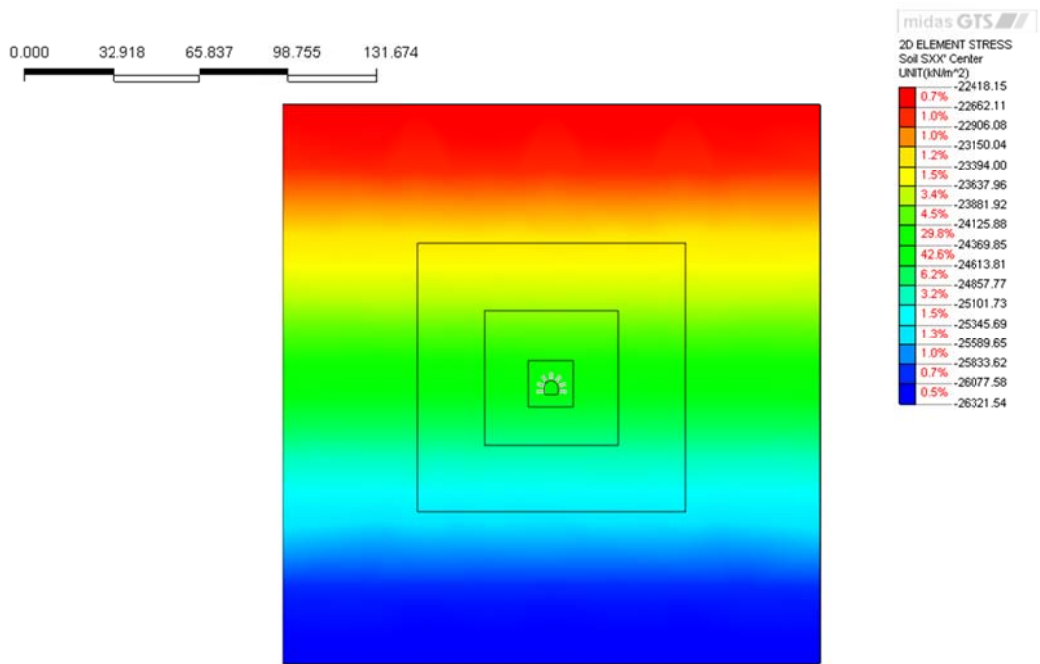


Abbildung 3: Horizontalspannungen [kN/m²]

Illustrazione 3: Fase litostatica - tensioni orizzontali [kN/m²]

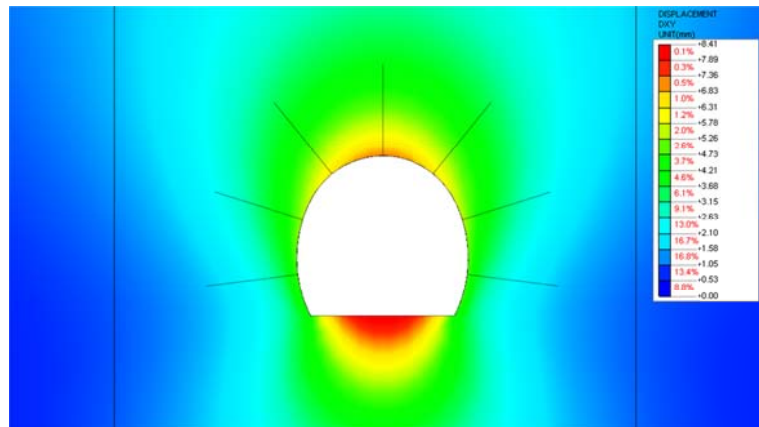


Abbildung 4: Verschiebungen xy [mm] 3.0m an der CT1-T3/ FdE-C-T3

Illustrazione 4: Spostamenti xy [mm] a 3.0m dal fronte CT1-T3/ FdE-C-T3

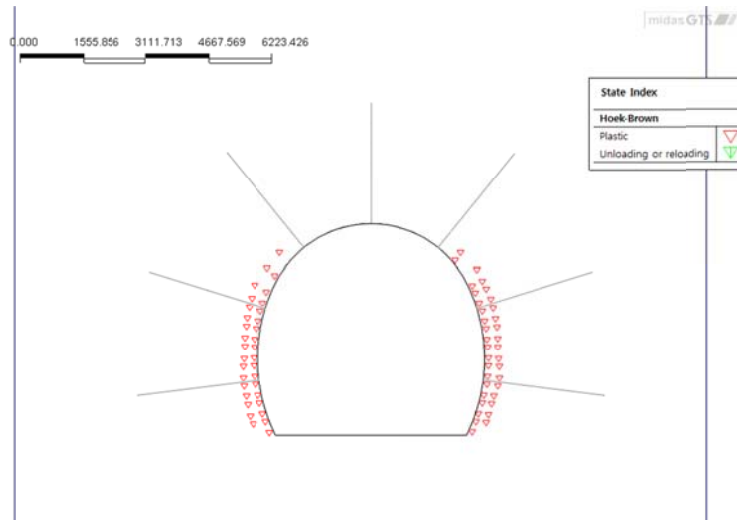


Abbildung 5: Plastifizierung an der Ortsbrust 3.0m CT1-T3/FdE-C-T3

Illustrazione 5: Plasticizzazioni a 3.0m dal fronte CT1-T3/FdE-C-T3

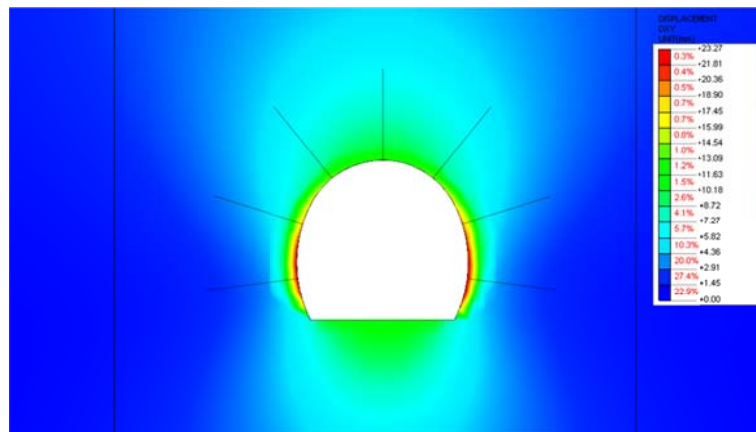


Abbildung 6: Verschiebungen xy [mm] Ende des Vortriebs FdE-C T3/ CT1-T3

Illustrazione 6: Spostamenti xy [mm] fine scavo FdE-C T3/ CT1-T3

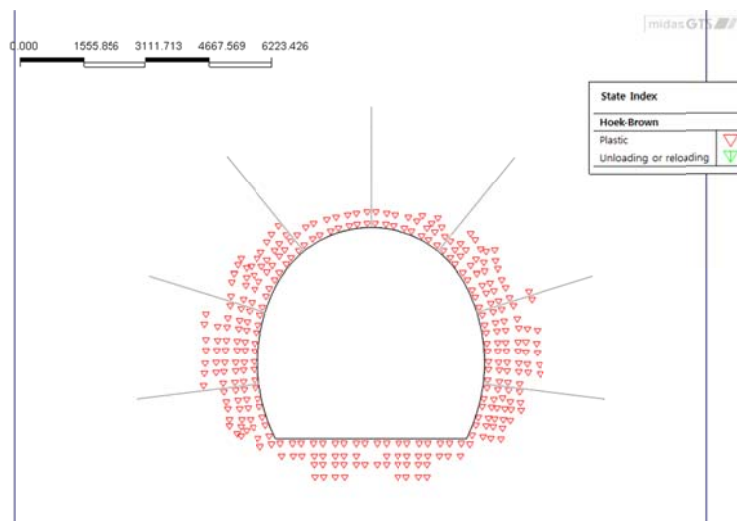


Abbildung 7: Plastifizierung Ende des Vortriebs FdE-C T3/ CT1-T3

Illustrazione 7: Plasticizzazioni fine scavo FdE-C T3/ CT1-T3

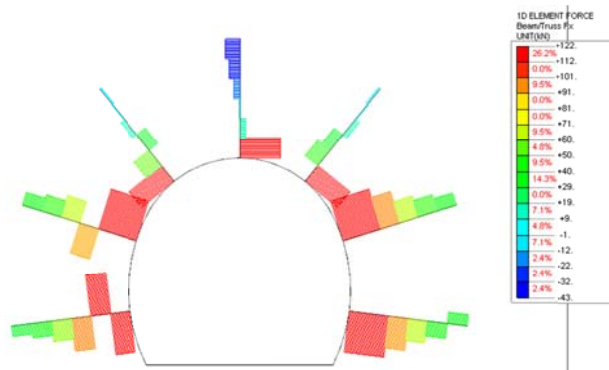


Abbildung 8: Normalkraft Anker [kN]

Illustrazione 8: Azione assiale nei chiodi [kN]

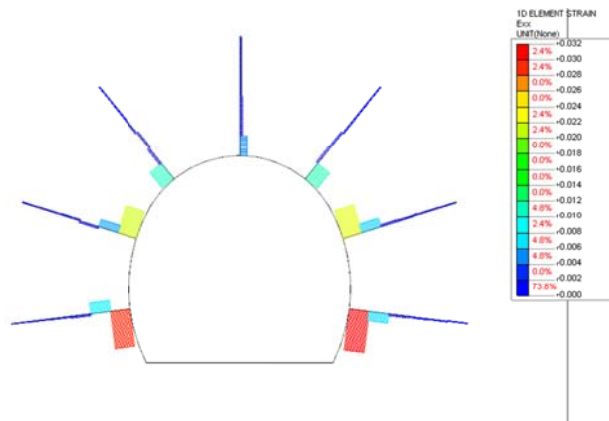


Abbildung 9: Lockerungslast an der Außenschale [-]

Illustrazione 9: Deformazione assiale nei chiodi [-]

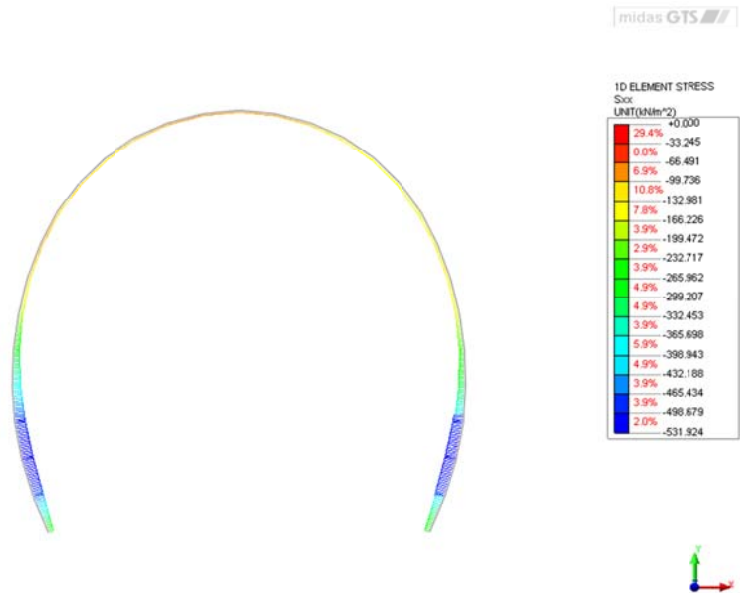


Abbildung 10: Normalspannungen Innenschale CT1-T3/FdE-C-T3

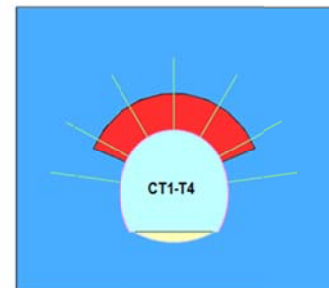
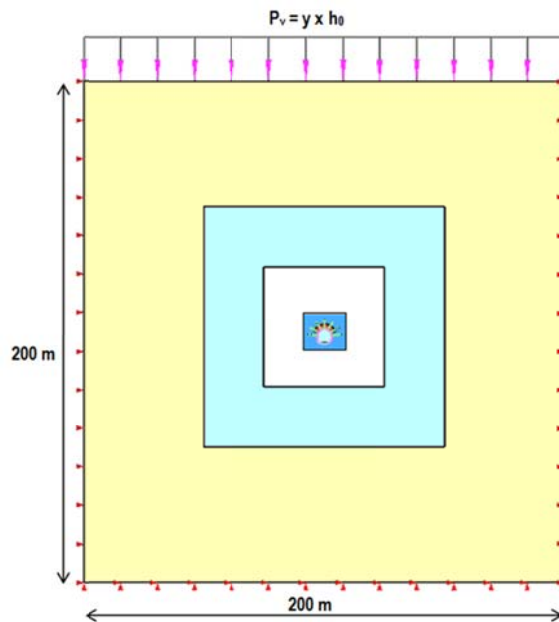
Illustrazione 10: Pressioni normali sul rivestimento definitivo CT1-T3/FdE-C-T3

ANHANG 5 - FEM- ANALYSEN FÜR DIE AUßENSCHALE SCHNITT CT1-T4/ FdE-C-T4

Diese Anlage führt die wichtigsten Outputs der FEM-Analysen des Schnitts CT1-T4 /FdE-C-T4 an, die mit dem Rechenprogramm MIDAS GTS durchgeführt wurden.

APPENDICE 5 - ANALISI FEM DEL RIVESTIMENTO DI PRIMA FASE CT1-T4/ FdE-C-T4

Nella presente appendice sono riportati i principali output delle analisi agli elementi finiti della sezione CT1-T4 /FdE-C-T4 effettuate con il programma di calcolo MIDAS GTS.



A5.1 OUTPUT FEM MODELL

A5.1 OUTPUT MODELLO FEM

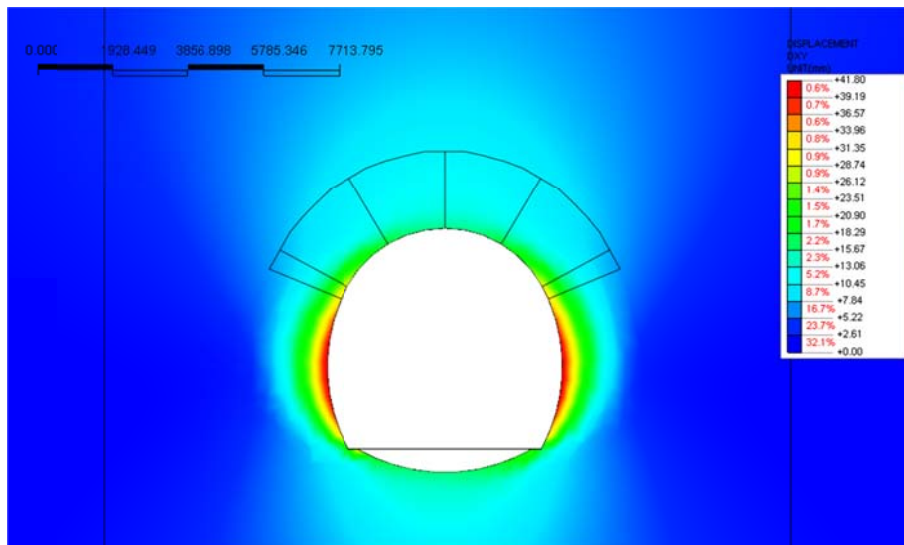


Abbildung 11: Verschiebungen xy [mm] – Ortsbrust CT1-T4 /FdE-C-T4 Illustrazione 11: Spostamenti xy [mm] - fronte CT1-T4 /FdE-C-T4

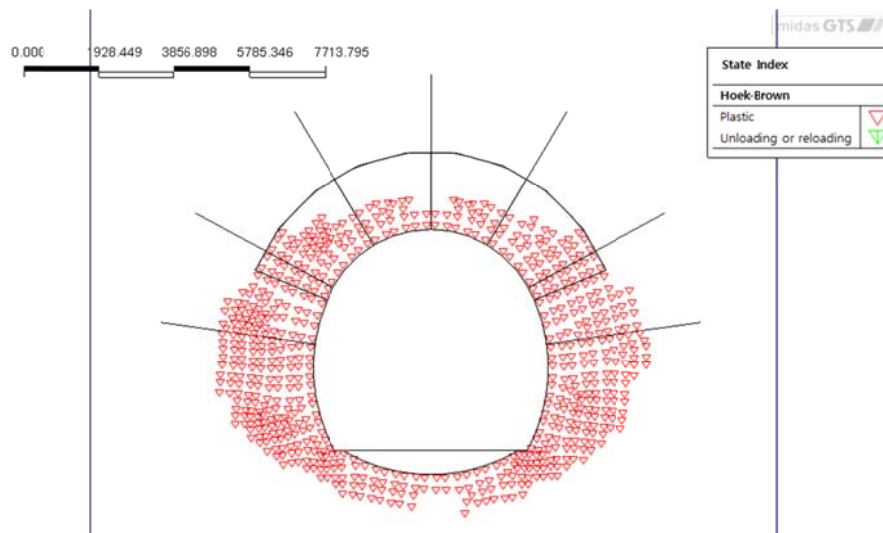


Abbildung 12: Plastifizierung – Ortsbrust CT1-T4 /FdE-C-T4

Illustrazione 12: Plasticizzazioni - fronte CT1-T4 /FdE-C-T4

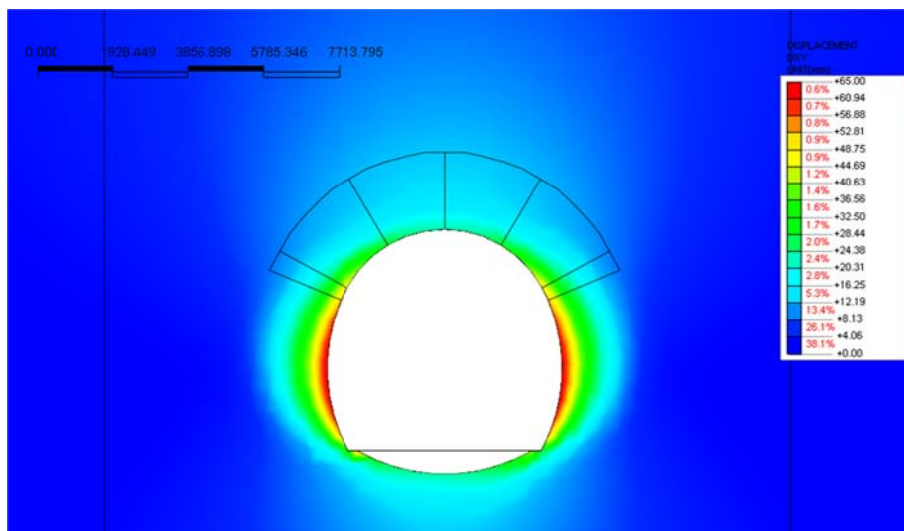


Abbildung 13: Verschiebungen xy [mm], Abstand 1.5m zur Ortsbrust CT1-T4 /FdE-C-T4

Illustrazione 13: Spostamenti xy [mm] a 1.5m fronte CT1-T4 /FdE-C-T4

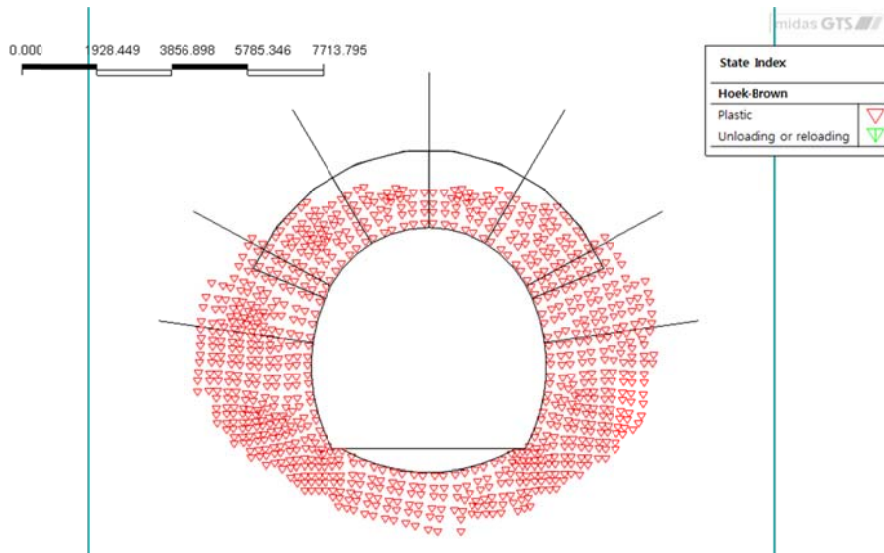


Abbildung 14: Plastifizierung], Abstand 1.5m zur Ortsbrust CT1-T4 /FdE-C-T4

Illustrazione 14: Plasticizzazioni a 1.5m dal fronte CT1-T4 /FdE-C-T4

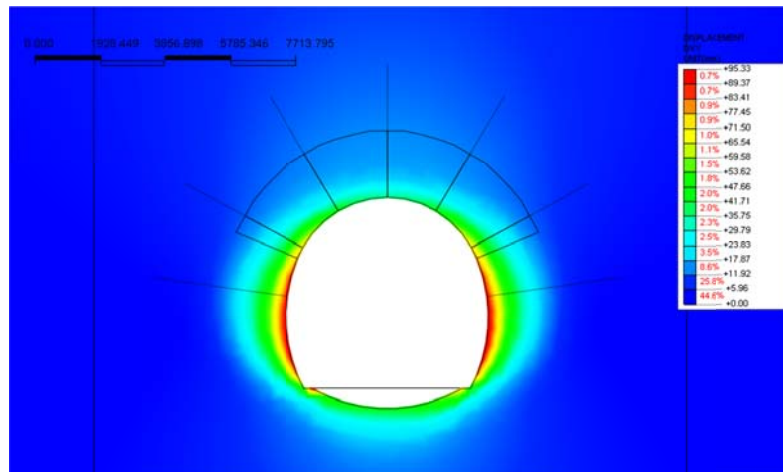


Abbildung 15: Verschiebungen xy [mm] am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 15: Spostamenti xy [mm] fine scavo CT1-T4 /FdE-C-T4

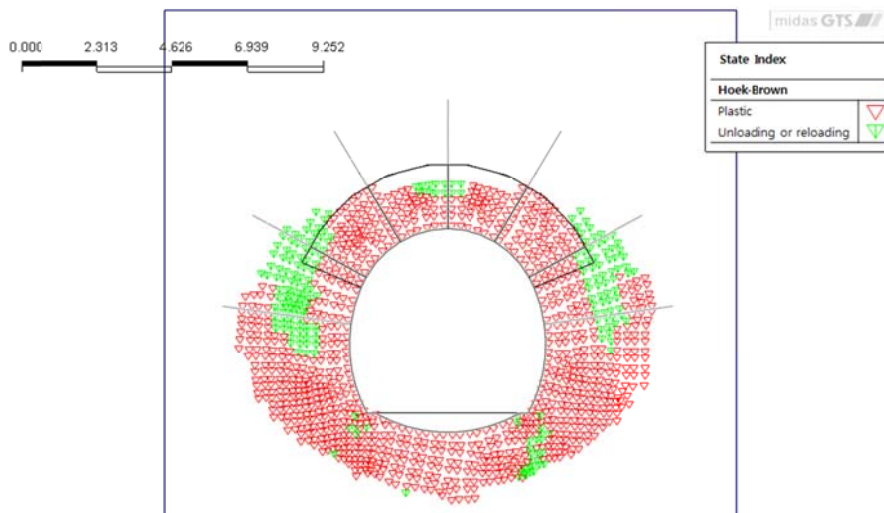


Abbildung 16: Plastifizierung [-] am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 16: Plasticizzazione [-] fine scavo CT1-T4 /FdE-C-T4

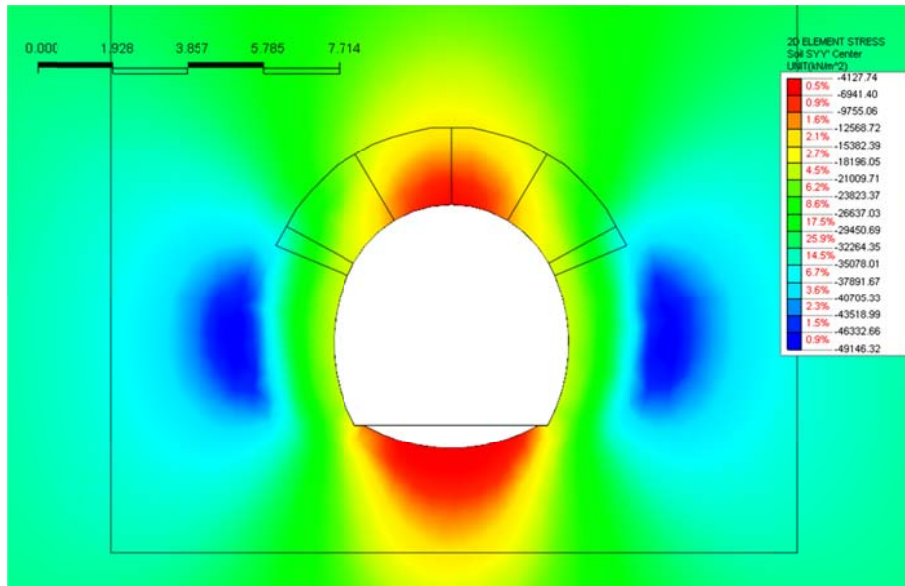


Abbildung 17: Vertikale Spannungen σ_{yy} [N/mm²] - am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 17: Tensioni verticali σ_{yy} [N/mm²] - fine scavo CT1-T4 /FdE-C-T4

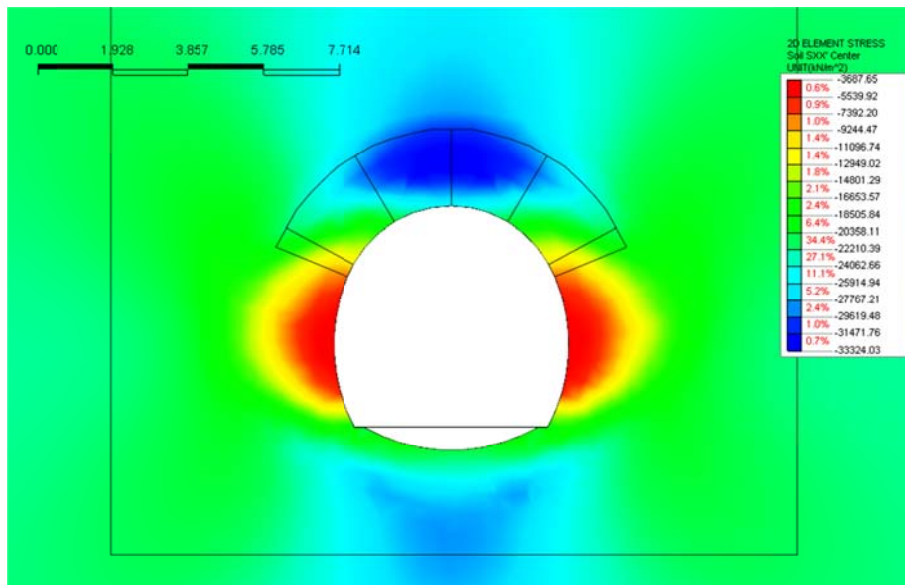


Abbildung 18: Horizontale Spannungen σ_{xx} [N/mm²] - am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 18: Tensioni orizzontali σ_{xx} [N/mm²] - fine scavo CT1-T4 /FdE-C-T4

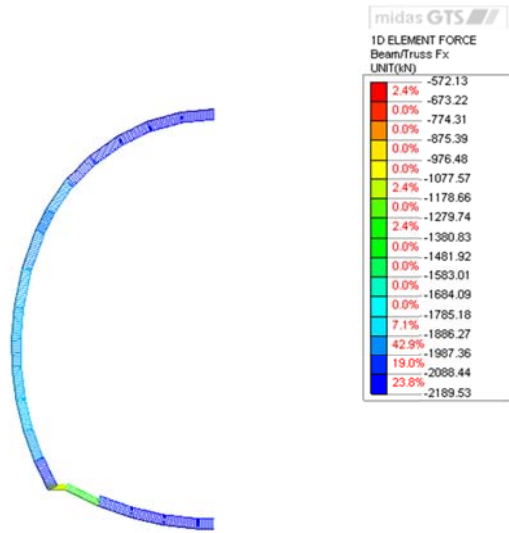


Abbildung 19: Normale Belastungen an der Außenschale [kN] - am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 19: Sollecitazioni normali sul rivestimento di prima fase [kN] - fine scavo CT1-T4 /FdE-C-T4

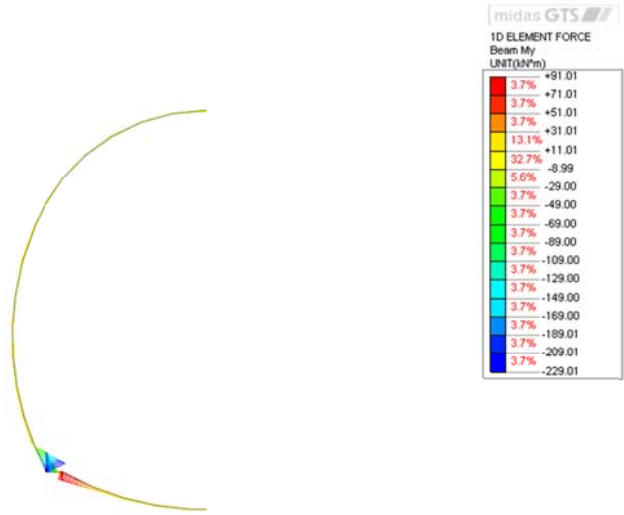


Abbildung 20: Momente an der Außenschale [kNm] - am Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 20: Momenti sul rivestimento di prima fase [kNm] - fine scavo CT1-T4 /FdE-C-T4

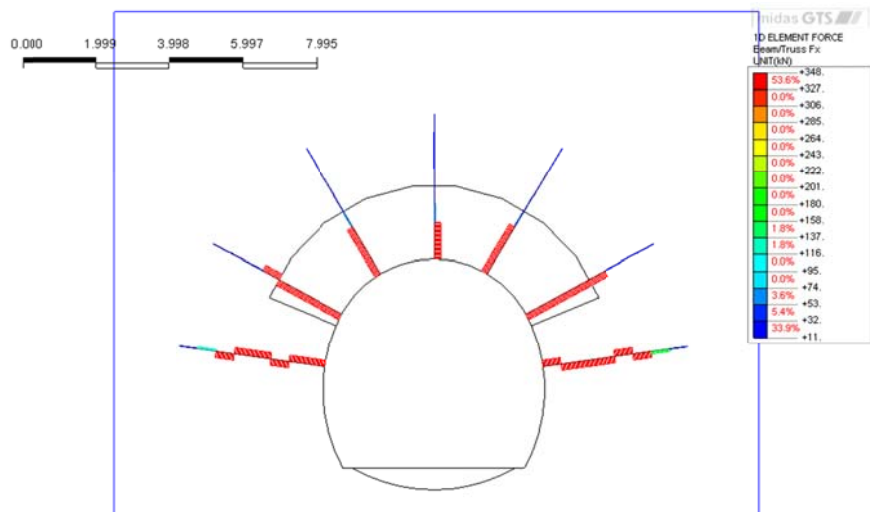


Abbildung 21: Normalkraft Anker [-] – Ende des Ausbruchs CT1-T4 /FdE-C-T4

Illustrazione 21: Sollecitazioni assiali nei chiodi [-] - fine scavo CT1-T4 /FdE-C-T4

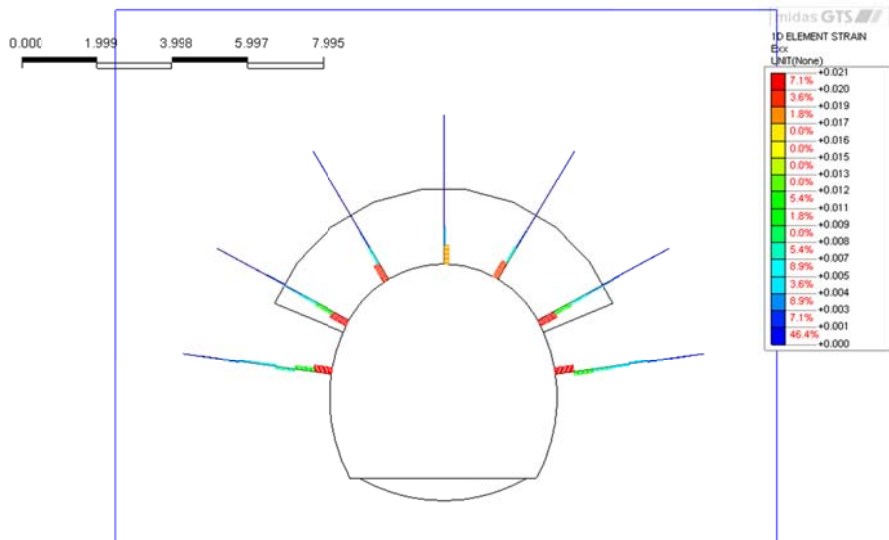


Abbildung 22: Axiale Verformungen [-] – Ende Ausbruch CT1-T4 /FdE-C-T4

Illustrazione 22: Deformazioni assiali nei chiodi [-] - fine scavo CT1-T4 /FdE-C-T4

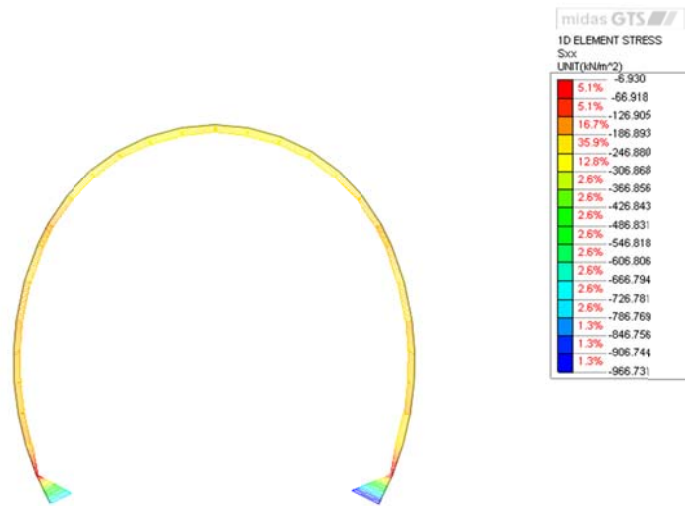


Abbildung 23: Auflockerungsdruck auf Innenschale – Ende Ausbruch CT1-T4 /FdE-C-T4

Illustrazione 23: Carico di allentamento sul rivestimento interno - fine scavo CT1-T4 /FdE-C-T4

A5.2 NACHWEIS AUßENSCHALE

Nachweis Diagramm Wechselwirkung M-N

A5.2 VERIFICHE RIVESTIMENTO PRIMA FASE

Verifiche diagramma di interazione M-N

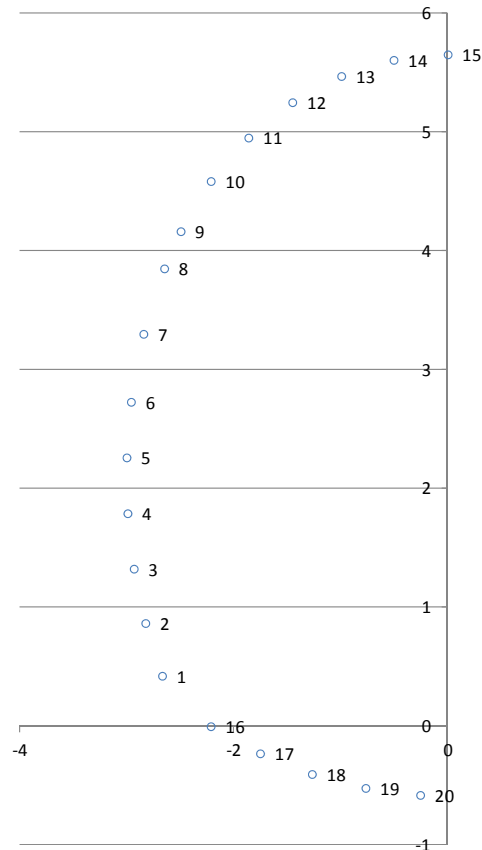
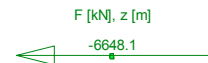
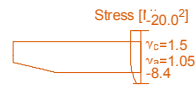
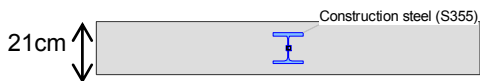
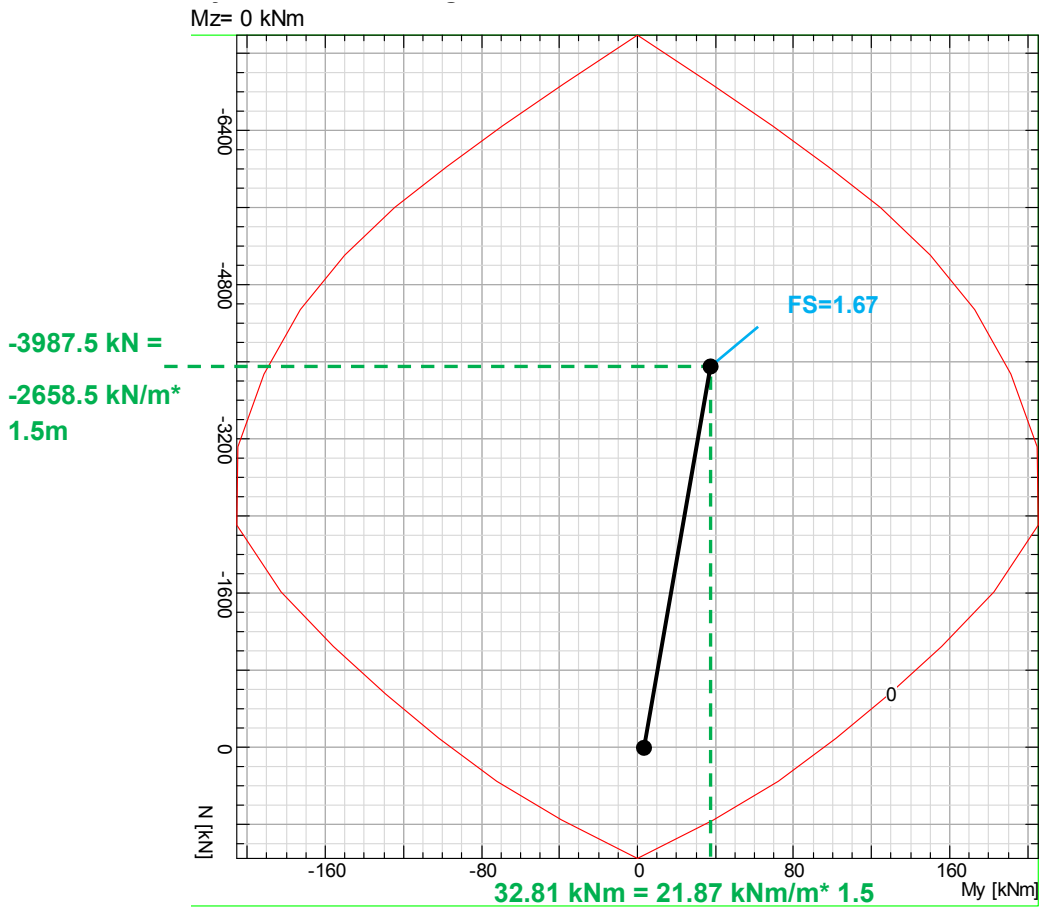


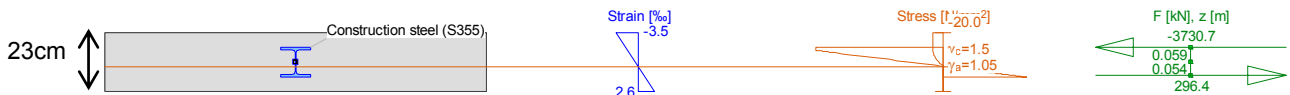
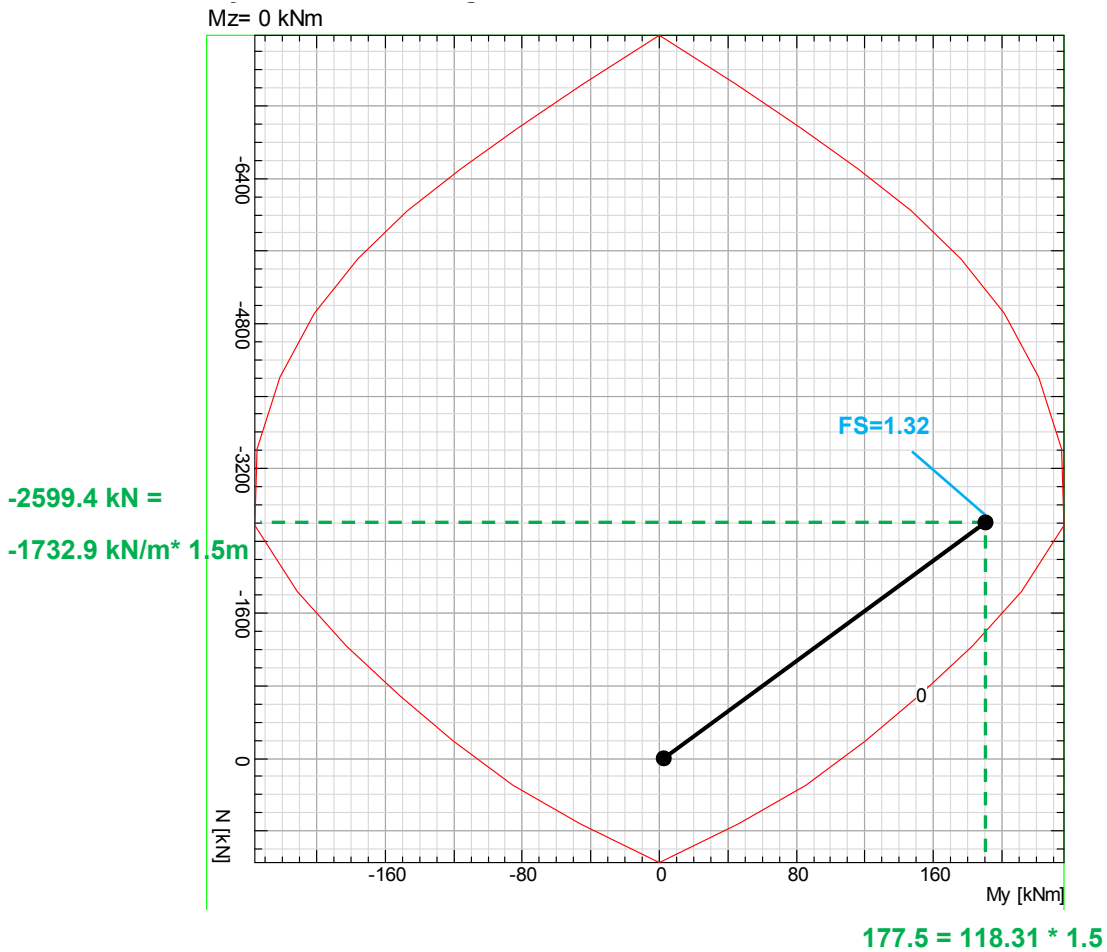
Abbildung 24: Nummerierung der Knoten des numerischen Modells CT1-T4 /FdE-C-T4

Illustrazione 24: Numerazione dei nodi del modello numerico CT1-T4 /FdE-C-T4

	X	Y	N _k	M _k	N _d	M _d	FS
	[m]	[m]	[kN/m]	[kNm/m]	[kN/m]	[kNm/m]	[-]
1	-2.67	0.42	-2045.00	16.82	-2658.50	21.87	1.67
2	-2.83	0.87	-1906.00	14.48	-2477.80	18.82	1.80
3	-2.93	1.33	-1872.00	8.58	-2433.60	11.15	1.91
4	-2.99	1.79	-1885.00	6.88	-2450.50	8.95	1.92
5	-3.00	2.26	-1903.00	8.46	-2473.90	11.00	1.88
6	-2.96	2.73	-1891.00	-4.48	-2458.30	-5.82	1.94
7	-2.85	3.30	-1896.00	8.73	-2464.80	11.35	1.88
8	-2.65	3.85	-1935.00	6.92	-2515.50	9.00	1.87
9	-2.50	4.16	-1943.00	-7.32	-2525.90	-9.51	1.86
10	-2.22	4.59	-1926.00	1.53	-2503.80	1.98	1.95
11	-1.86	4.95	-2038.00	0.95	-2649.40	1.24	1.85
12	-1.45	5.25	-2081.00	-6.42	-2705.30	-8.34	1.75
13	-1.00	5.47	-2104.00	-1.45	-2735.20	-1.89	1.78
14	-0.51	5.61	-2170.00	0.08	-2821.00	0.11	1.74
15	0.00	5.65	-2138.00	-6.86	-2779.40	-8.92	1.7



	X	Y	N _k	M _k	N _d	M _d	FS
	[m]	[m]	[kN/m]	[kNm/m]	[kN/m]	[kNm/m]	[-]
16	-2.216	0	-1333.00	91.01	-1732.90	118.31	1.32
17	-1.7543	-0.2283	-2068.00	27.15	-2688.40	35.30	1.70
18	-1.2697	-0.4021	-2126.00	9.00	-2763.80	11.70	1.83
19	-0.7685	-0.5193	-2152.00	6.37	-2797.60	8.29	1.84
20	-0.2573	-0.5782	-2100.00	4.81	-2730.00	6.25	1.90



A3.3 NACHWEIS STABILITÄT DER ORTSBRUST

Nachfolgend sind die Ergebnisse der axialsymmetrischen Analysen für den Schnitt CT1-T4/FdE-C-T4 aufgeführt.

Analysen ohne Sicherungsmaßnahmen

Die Analyse wurde ohne Sicherungsmaßnahmen an der Ortsbrust und ohne Außenschale sowie für Abschlänge von 1.5 m ausgeführt.

A5.3 VERIFICHE STABILITÀ DEL FRONTE

Nel seguito si riportano i plot delle analisi assialsimmetriche eseguite per la sezione CT1-T4/FdE-C-T4.

Analisi senza interventi di consolidamento

L'analisi è stata eseguita in assenza di interventi di consolidamento del fronte e di assenza dei rivestimenti di prima fase e per tappe di 1.5 metri.

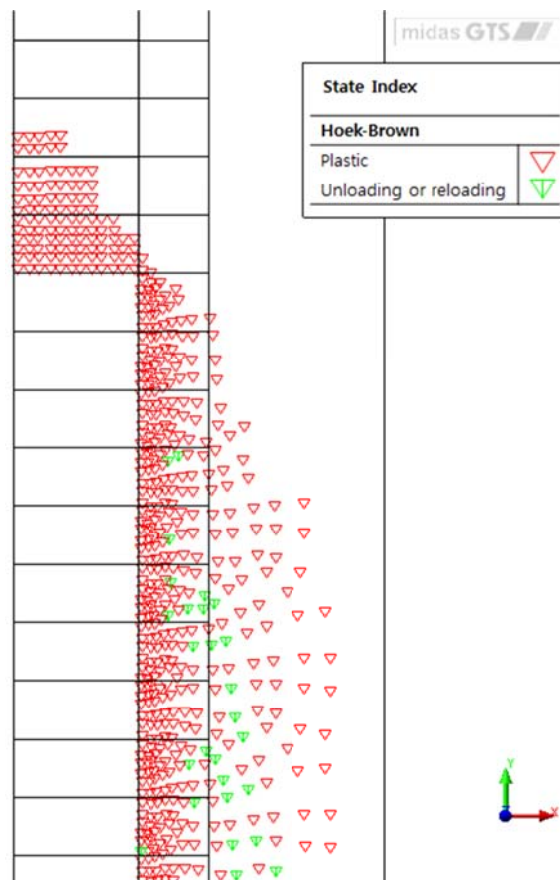
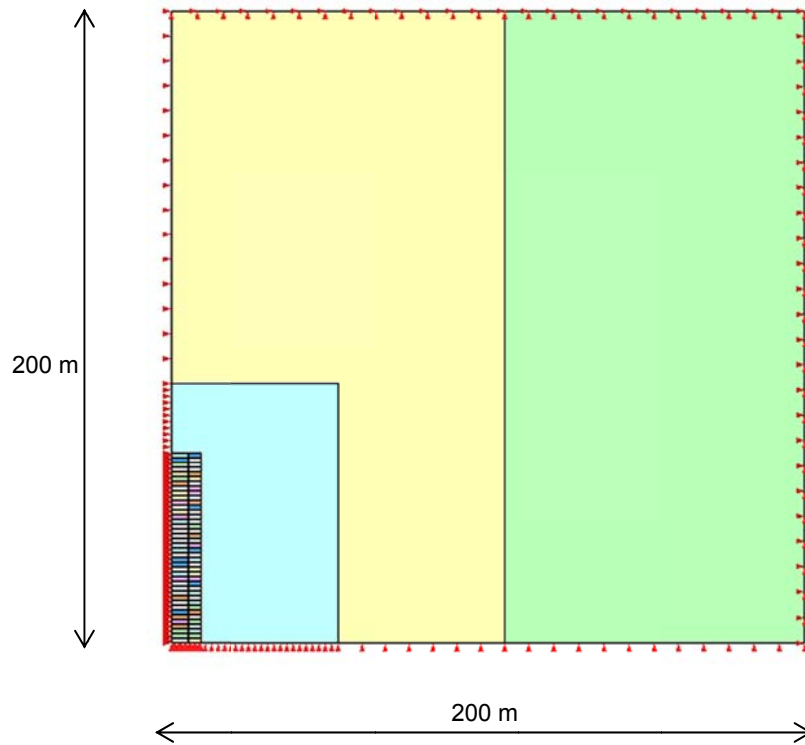


Abbildung 25: Axialsymmetrisches Modell, plastifizierte Zone ohne Ortsbrustanker

Illustrazione 25: Modello assialsimmetrico, Zona plasticizzata in assenza di ancoraggi al fronte

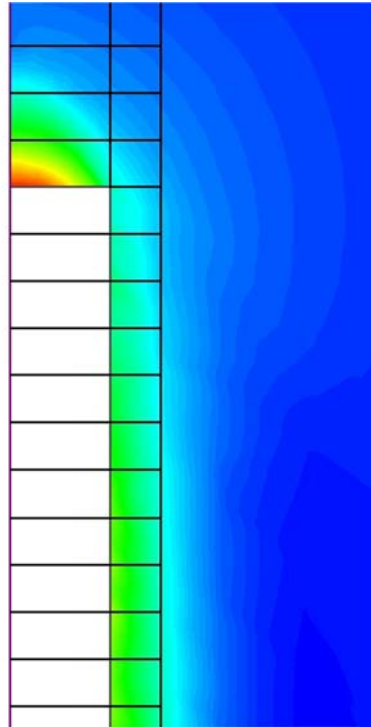
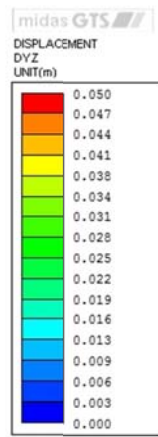


Abbildung 26: Axialsymmetrisches Modell - Extrusion an der Ortsbrust

Illustrazione 26: Modello Assialsimmetrico, Estrusione al fronte

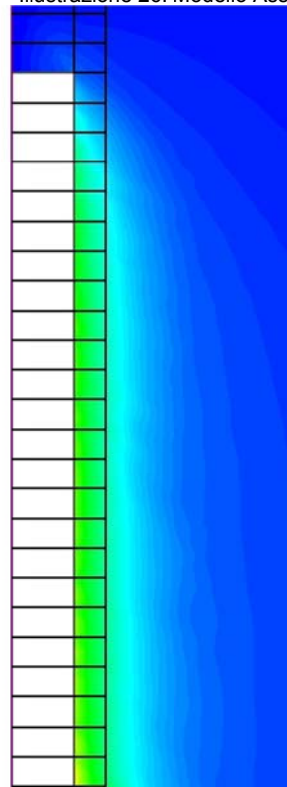
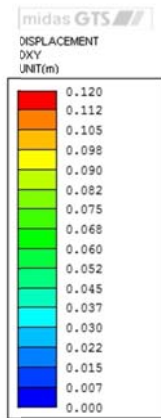


Abbildung 27: Axialsymmetrisches Modell, radiale Konvergenz

Illustrazione 27: Modello assialsimmetrico, convergenza radiale

Analyse mit Sicherungsmaßnahmen

Die Berechnung wurde mit Sicherungsmaßnahmen an der Ortsbrust und am Ausbruchsrund und unter Berücksichtigung der Vortriebsetappen von 1.5m sowie einer Mindestüberlappung der Ortsbrustanker von 6m durchgeführt.

Um den Beitrag der Ausbruchssicherung abzuschätzen, wird eine fiktive Erhöhung der Kohäsion Δc am gesicherten Gebirge vorgenommen, die mit dem Begrenzungsdruck σ_3 (Resultierende der Zugfestigkeit eines Einschlusses dividiert durch Einflussbereich) zusammenhängt:

$$\Delta\sigma_3 = \min\left[T_f = \pi \cdot D \cdot \alpha \cdot L \cdot \tau_a; T_f = \sigma_b \cdot A_b\right] \cdot \left(\frac{N_b}{A_b}\right)$$
$$\Delta c = \frac{\cos \phi}{2(1 - \sin \phi)} \cdot \Delta\sigma_3$$

Mit:

- $\Delta\sigma_3$ = Begrenzungsdruck
- N_b = Anzahl der Anker an Ortsbrust
- A_b = Widerstandsfläche des Ankers
- σ_b = Zug-Bruchfestigkeit
- D = Durchmesser Bohrung
- α = Wulstkoeffizient
- L = Länge Überlappung
- s_l = seitliche Oberfläche des Ankers
- τ_a = Haftfestigkeit zwischen Anker und Mörtel (oder zwischen Mörtel und Boden)

Für die Ausbruchssicherung am Ausbruchsrund wird der Ansatz nach Hoek und Ribacchi, analog zum Dokument [9], angewandt. Dabei wird eine befestigte Zone von 1 m Breite untersucht. Ein Ablauf von gewichteten Durchschnitte mit Bezug auf Fläche und Widerstand der einzelnen Komponenten (Gebirge und Zementinjektion) wird ausgewertet und die äquivalenten Werte des Elastizität- und des Kohäsionsmodul werden berechnet:

$$\sigma_{cm,eq} = \frac{\sigma_{cm} \cdot A_{rock} + R_c \cdot A_c}{A_{TOT}}$$
$$c_{eq} = \sigma_{cm,eq} \cdot \frac{1 - \sin \phi}{2 \cos \phi}$$
$$E_{eq} = \frac{E_{rock} \cdot A_{rock} + E_c \cdot A_c}{A_{TOT}}$$

Mit:

- σ_{cm} Druckfestigkeit des urspr. Gebirges, die der

Analisi con interventi di consolidamento

L'analisi è stata eseguita con la presenza di interventi di consolidamento del fronte e al contorno per tappe di 1.5 metri, tenendo conto della sovrapposizione minima di 3 metri per gli ancoraggi al fronte.

La stima del contributo fornito dai consolidamenti è effettuata applicando un incremento di coesione fittizio Δc all'ammasso consolidato, legato alla pressione di confinamento σ_3 (risultante della resistenza a trazione di un incluso divisa per la sua area d'influenza):

In cui:

- $\Delta\sigma_3$ = pressione di confinamento
- N_b = numero delle barre al fronte
- A_b = area resistente della barra
- σ_b = resistenza di rottura a trazione
- D = diametro di perforazione
- α = coefficiente di sbulbatura
- L = lunghezza di sovrapposizione
- s_l = superficie laterale della barra
- τ_a = tensione di aderenza tra barra e malta (o tra malta e terreno)

Per quanto riguarda il consolidamento del contorno del cavo viene adottato l'approccio di Hoek e Ribacchi analogamente al Doc. [9]. Si considera una porzione di zona consolidata avente dimensione trasversale di 1m e si esegue un processo di medie pesate con riferimento all'area ed alla resistenza di ogni singolo componente (ammasso e iniezione cementizia), calcolando valori equivalenti di modulo elastico e coesione:

Dove:

- σ_{cm} è la resistenza dell'ammasso originario pari alla

einaxialen Druckfestigkeit entspricht;

resistenza a compressione monoassiale;

- A_{rock} Oberfläche des nicht befestigten Gebirges;
- R_c Widerstand der injizierten Mischung;
- A_c von der Injektion betroffene Fläche.

- A_{rock} è la superficie dell'ammasso non consolidato;
- R_c è la resistenza della miscela iniettata;
- A_c è l'area interessata dall'iniezione.

Parametri geotecnici ammasso	Angolo d'attrito di picco	Φ'_p	27.7	°
	Angolo d'attrito residuo	Φ'_r	21.2	°
	Angolo di dilatanza	ψ	3.5	°
	Coesione di picco	c'_p	2.193	MPa
	Coesione residua	c'_r	1.392	MPa
	Resistenza a compressione uniassiale di picco	$\sigma_{cm,p}$	7.255	MPa
	Resistenza a compressione uniassiale residua	$\sigma_{cm,r}$	4.062	MPa
	Pendenza curva σ 1/3	k	2.736	-
	Modulo elastico	Em	11504	MPa
	Coefficiente di Poisson	ν	0.21	-

Parametri tunnel	Raggio tunnel	r_0	3.2	m
	Copertura	h	1115	m
	Peso specifico roccia	γ_r	26.6	kN/m ³
	Pressione idrostatica	p_0	29.66	MPa

Consolidamento al contorno	Passo longitudinale	il	3.0	m
	Passo trasversale	it	0.75	m
	Numero barre / m ²	n	0.444	-
	area barra	Ab	0.015	m ²
	Diametro corona	dc	0.1	m
	Coefficiente sbulatura	α	1.3	-
	Area di iniezione	Ac	0.013	m ²
	Resistenza iniezione	Rc	25	MPa
	Modulo elastico iniezione	Ec	25000	MPa
	Resistenza equivalente picco	$R_{p,eq}$	7.399	MPa
	Resistenza equivalente residua	$R_{r,eq}$	4.207	MPa
	Coesione di picco equivalente	$c_{p,eq}$	2.237	MPa
	Coesione residua equivalente	$c_{r,eq}$	1.441	MPa
	Modulo elastico equivalente	Eeq	11648	MPa

Consolidamento del nucleo	Numero consolidamenti	Nb	14.0	-
	Diametro perforazione	D	0.1	m
	Lunghezza sovrapposizione	L	3.0	m
	Coefficiente sbulatura	α	1	-
	Tensione aderenza barra/malta	τ	0.3	MPa
	Tensione caratteristica SLU	σ_b	400	MPa
	Diametro esterno	de	0.038	m
	Diametro interno	di	0.019	m
	Area resistente	Ab	0.001	m ²
	Area del fronte di scavo	sb	32.17	m ²
	Resistenza a rottura	T1	340.23	kN
	Resistenza a sfilamento	T2	282.74	kN
	Pressione di confinamento longitudinale	$\Delta\sigma_3$	0.123	MPa
	Coesione migliorata	c'	2.274	MPa

Da das Materialmodell nach Hoek-Brown verwendet wurde, wurden die entsprechenden Steigerungen des Parameters s_b aufgrund der Angaben in [33] berücksichtigt.

Essendo stato impiegato il modello costitutivo di Hoek-Brown, sono stati considerati corrispondenti incrementi del parametro s_b , sulla base delle indicazioni contenute in [33].

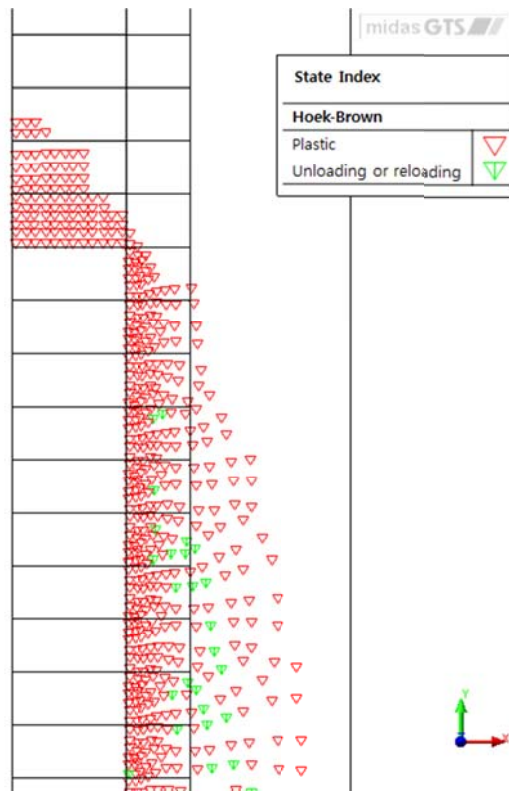


Abbildung 28: Axialsymmetrisches Modell, plastifizierte Zone mit Sicherungsmaßnahmen

Illustrazione 28: Modello Assialsimmetrico, Zona plasticizzata in presenza dei consolidamenti

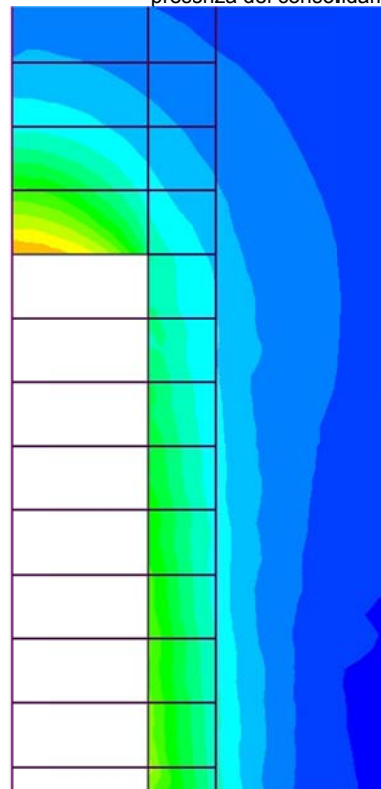
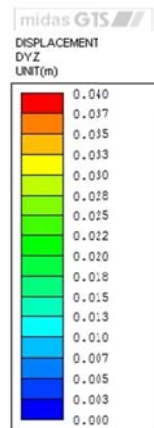


Abbildung 29: Axialsymmetrisches Modell, Extrusion an der Ortsbrust

Illustrazione 29: Modello Assialsimmetrico, Estrusione al fronte

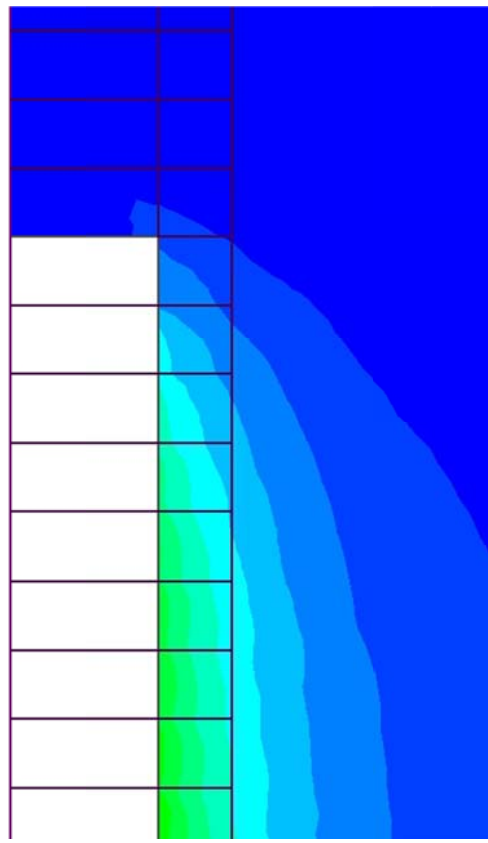
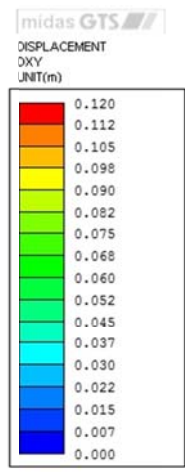


Abbildung 30: Axialsymmetrisches Modell, radiale Konvergenz

Illustrazione 30: Modello assialsimmetrico, convergenza radiale

ANHANG 6 - FEM-ANALYSEN DER INNENSCHALE PROFIL TYP T2 UND T3

Die Anlage 6 führt die grafischen Darstellungen der wichtigsten Inputs- und Outputs der FEM-Analysen für die Innenschale an, die mit dem Rechenprogramm MIDAS Gen. durchgeführt wurden, sowie die Querschnittsnachweise im GZT und GZG.

APPENDICE 6 - ANALISI FEM DEL RIVESTIMENTO DEFINITIVO PROFILI TIPO T2 E T3

L'appendice 6 contiene le rappresentazioni grafiche dei principali input e output dell'analisi del rivestimento definitivo per i profili tipo T3 e T4 condotte con il programma MIDAS Gen, oltre alle opportune verifiche sezionali allo SLU e SLE.

A.6.1. General parameters of structure

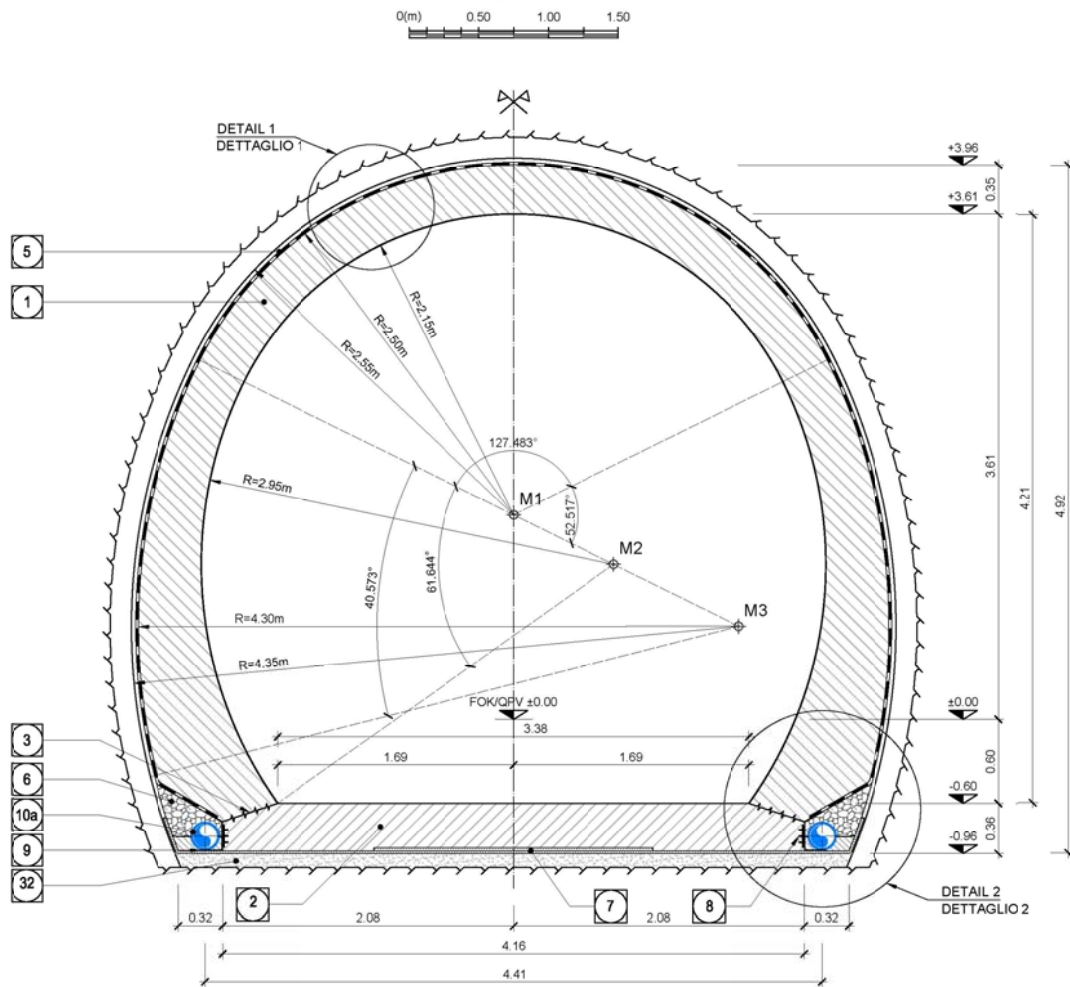


Figure 1 FdE-C01/06; CT1 T2-T3 cross section

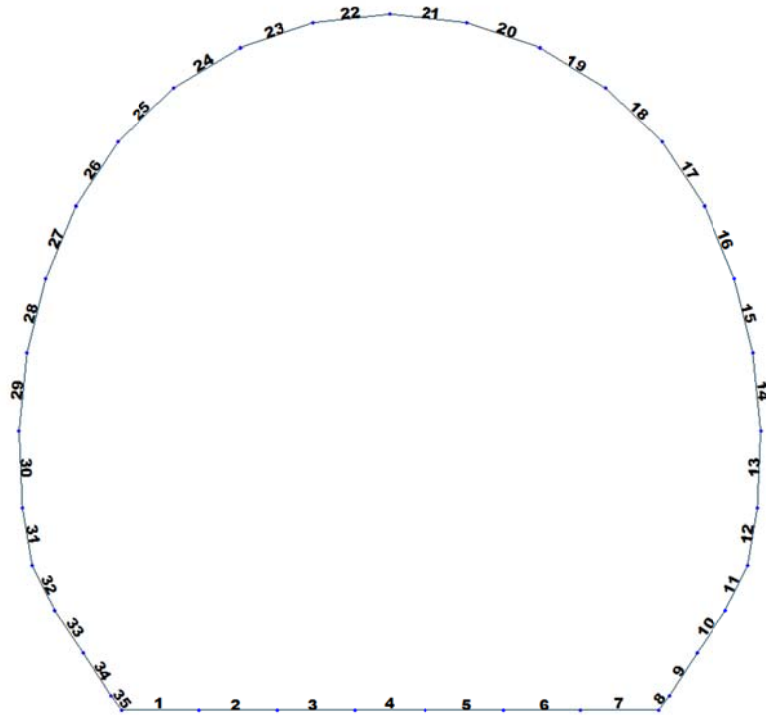


Figure 2 Elements number

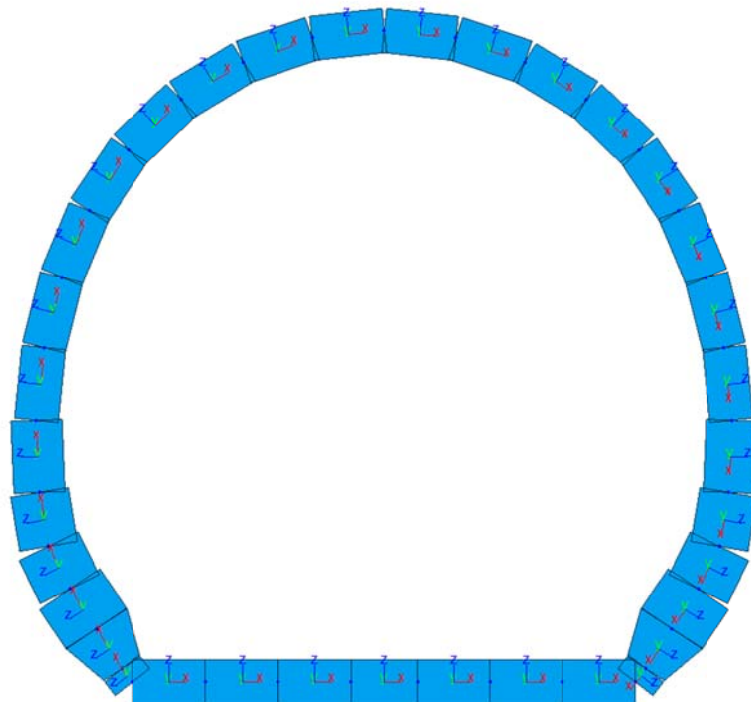


Figure 3 Elements local axis

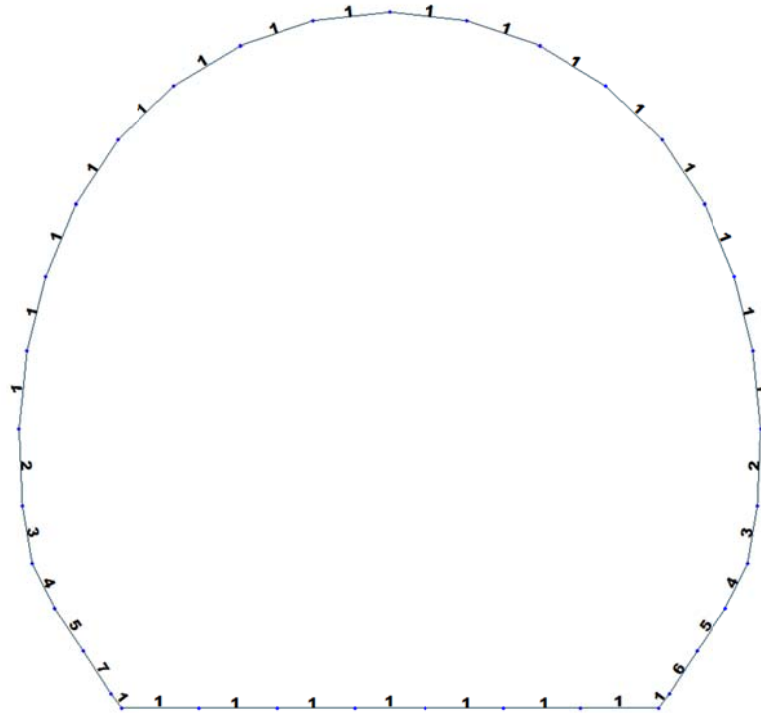


Figure 4 Element section property for T2 and T3 cross section (FdE-C01/06 and CT1 T2-T3)

Table 1 Section properties for T2 and T3 cross section (FdE-C01/06 and CT1 T2-T3)

ID	Name	Area (m ²)	Asy (m ²)	Asz (m ²)	Ixx (m ⁴)	Iyy (m ⁴)	Izz (m ⁴)	Cyp (m)	Cym (m)	Czp (m)	Czm (m)
1	100 x 30	0.3000	0.2500	0.2500	0.073	0.022	0.0250	0.5000	0.5000	0.1500	0.1500
2	100 x 35	0.3500	0.2917	0.2917	0.0111	0.036	0.0292	0.5000	0.5000	0.1750	0.1750
3	100 x 40	0.4000	0.3333	0.3333	0.0160	0.053	0.0333	0.5000	0.5000	0.2000	0.2000
4	100 x 45	0.4500	0.3750	0.3750	0.0218	0.076	0.0375	0.5000	0.5000	0.2250	0.2250
5	100 x 50	0.5000	0.4167	0.4167	0.0286	0.0104	0.0417	0.5000	0.5000	0.2500	0.2500
6	100 x 50/30	0.5000	0.4167	0.4167	0.0286	0.0104	0.0417	0.5000	0.5000	0.2500	0.2500
7	100 x 30/50	0.3000	0.2500	0.2500	0.073	0.022	0.0250	0.5000	0.5000	0.1500	0.1500

Table 2 Material parameters for T2 and T3 cross section (FdE-C01/06 and CT1 T2-T3)

ID	Name	Type	Code	Elasticity (kN/m ²)	Poisson	Thermal (1/[F])	Density (kN/m ³)	Mass Density (kN/m ³ /g)
1	C30/37	Concrete	NTC2008	3.30e+007	0.2	1e-005	2.50e+001	2.5493e+0

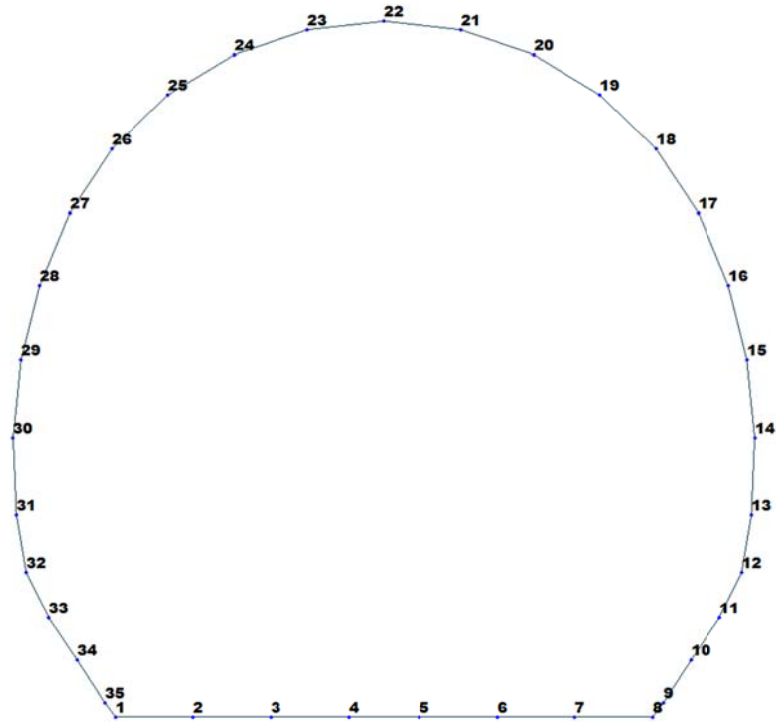


Figure 5 Node numbering

Table 3 Bounderies parameters

Node	Type	SDx (kN/m)	SDz (kN/m)	Stiffness (kN/m)	Direction	Multi-Linear Type	cx (m)	cy (kN)	dx (m)	dy (kN)	ex (m)	ey (kN)
1	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
1	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
2	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
2	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
3	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
3	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
4	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
4	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
5	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
5	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
6	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
6	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
7	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
7	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
8	Comp.-only	0	0	1528000	Dz(-)	Unsymmetric	0	0	0	0	0	0
8	Linear	764000	0	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
9	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
10	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
11	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
12	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
13	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
14	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
15	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
16	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
17	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800

Node	Type	SDx (kN/m)	SDz (kN/m)	Stiffness (kN/m)	Direction	Multi-Linear Type	cx (m)	cy (kN)	dx (m)	dy (kN)	ex (m)	ey (kN)
18	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
19	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
20	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
21	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
22	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
23	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
24	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
25	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
26	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
27	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
28	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
29	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
30	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
31	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
32	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
33	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
34	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800
35	Multi-Linear	0	0	0	Dz(-)	Unsymmetric	0.01	150	0.10	107400	0.20	214800

A.6.2. Load for T2 and T3 cross section (FdE-C01/06 / CT1 T2-T3)

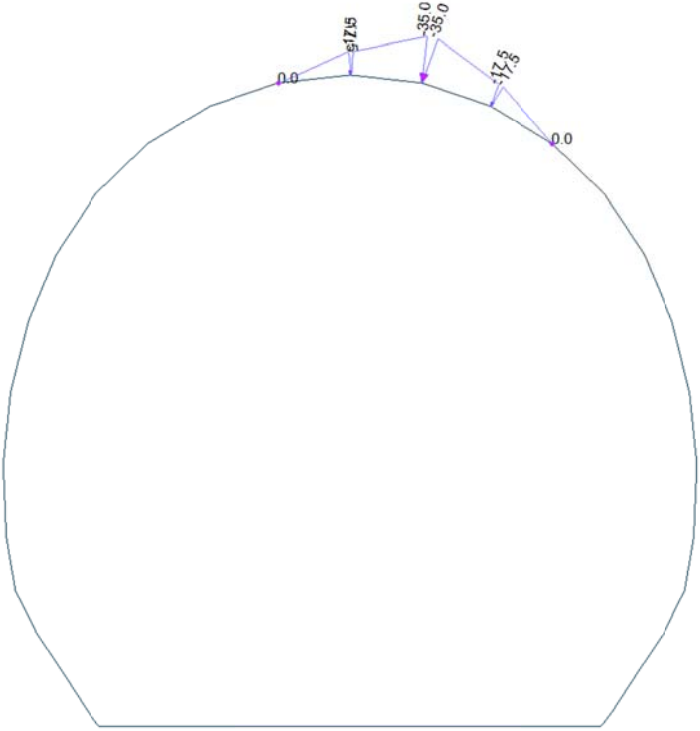


Figure 6 Load G5 – Block analysis

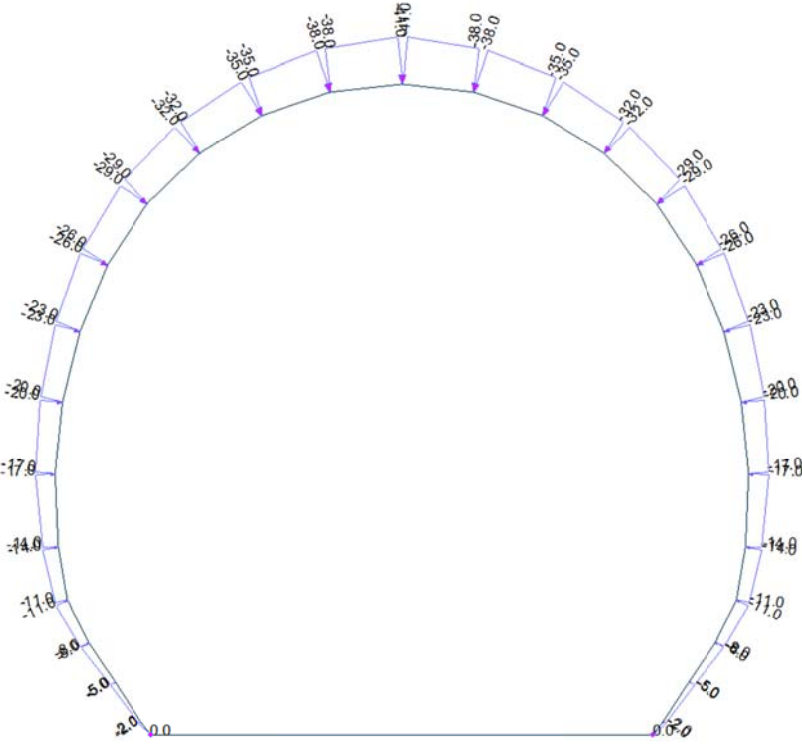


Figure 7 Load G5 – FEM analysis

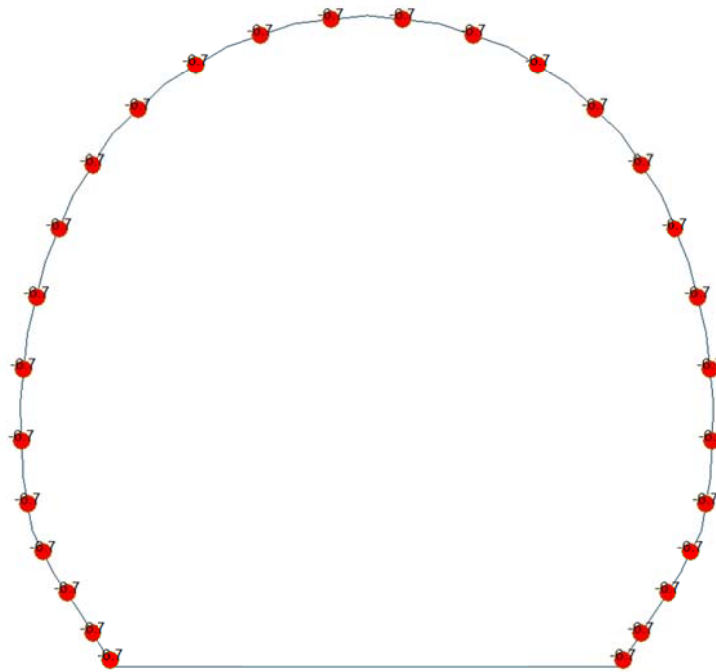


Figure 8 Load G6 SLU

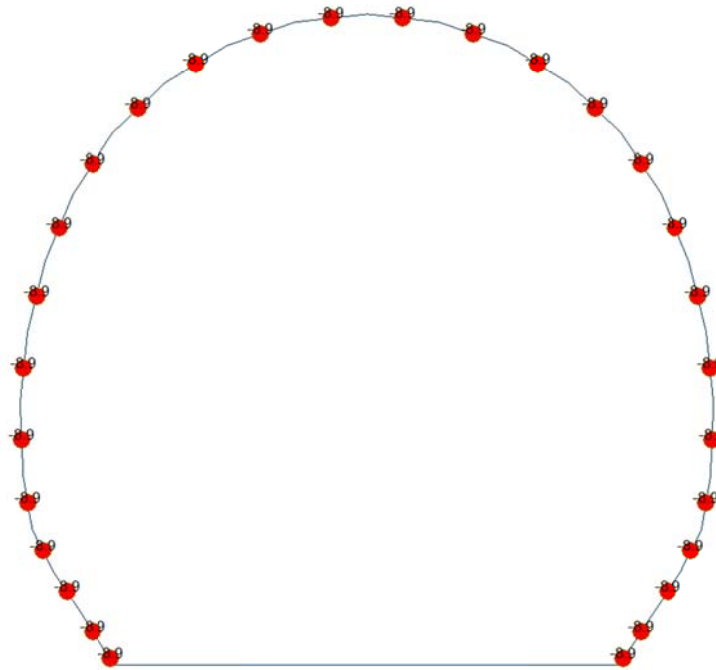


Figure 9 Load G6 SLE

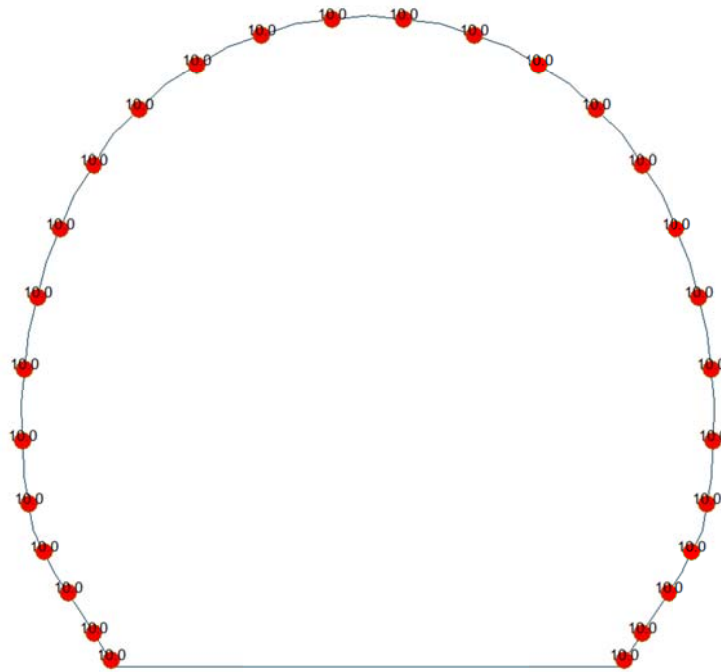


Figure 10 Load Q1 E (Costant temperature)

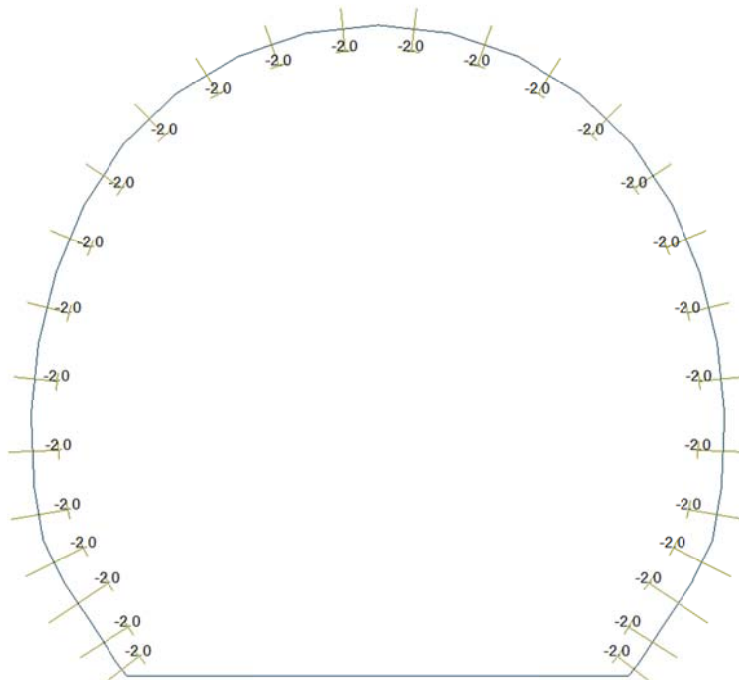


Figure 11 Load Q1 E (Temperature)

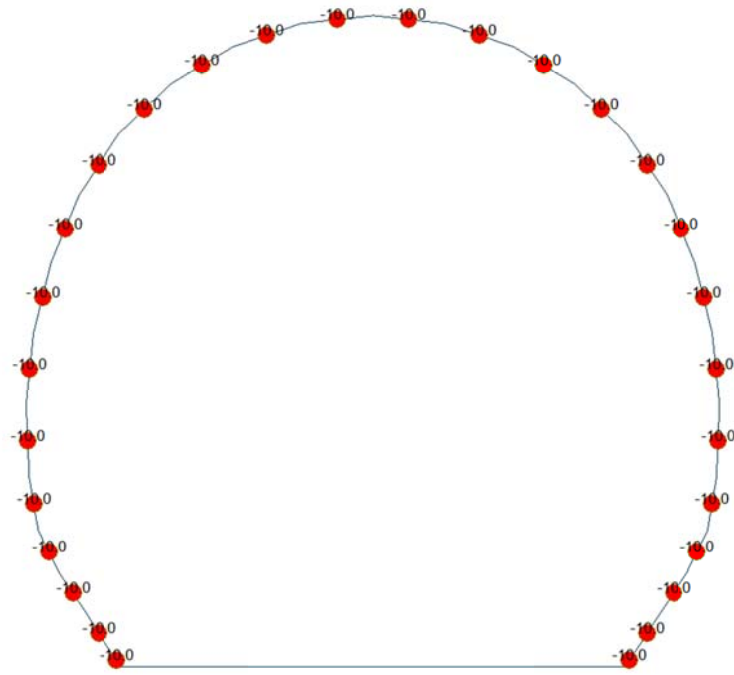


Figure 12 Load Q1 I (Costant temperature)

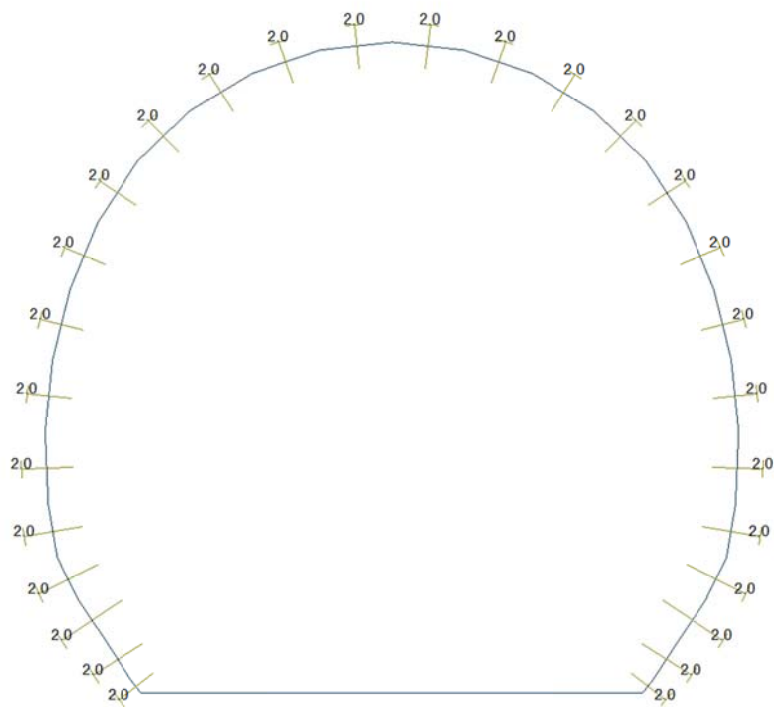


Figure 13 Load Q1 I (Temperature gradient)

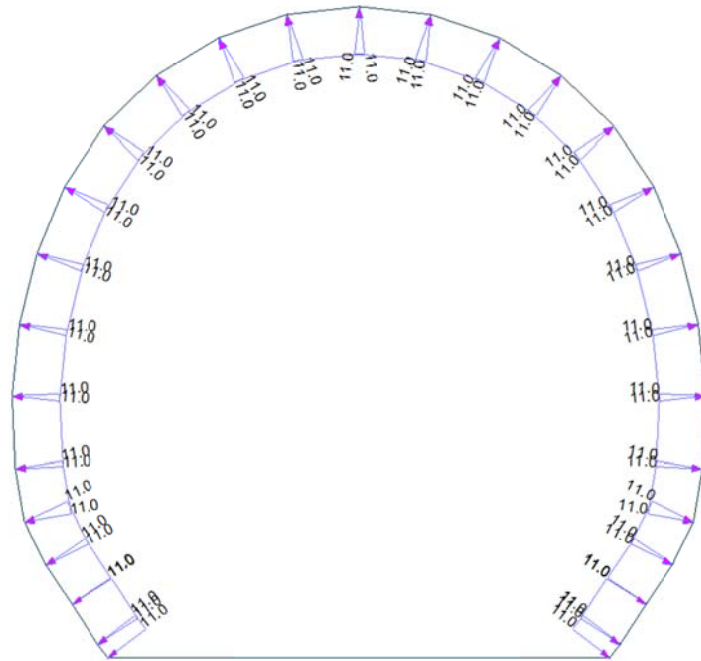


Figure 14 Load A1 Pression

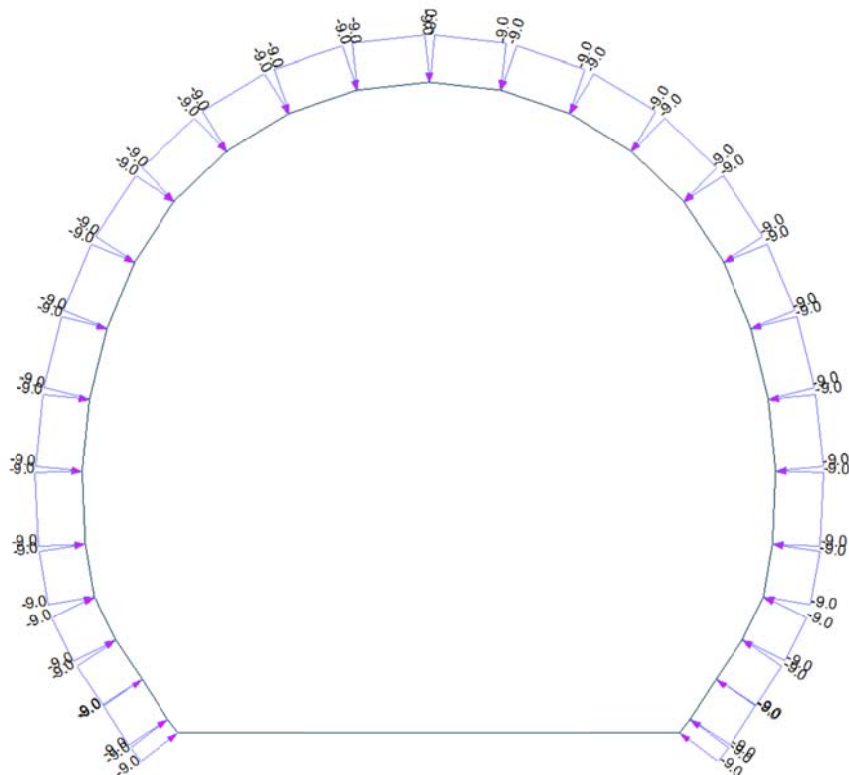


Figure 15 Load A1 Aspiration

A.6.3. Load combinations

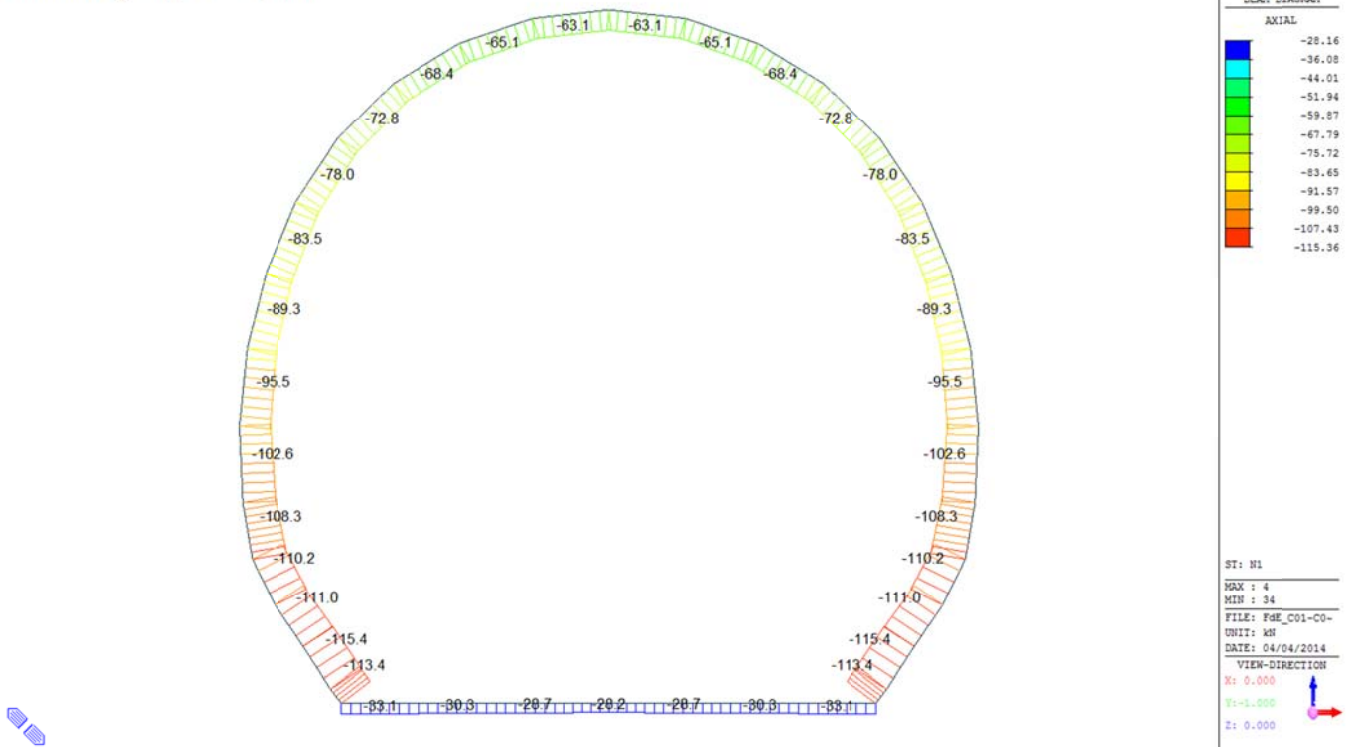
LIST OF LOAD COMBINATIONS

NUM	NAME	ACTIVE	TYPE	LOADCASE(FACTOR) +	LOADCASE(FACTOR) +	LOADCASE(FACTOR)
1	1	Inactive G1(1.350) +	Add		Q1 - E(1.500)	
2	2	Inactive G1(1.350) +	Add	G6 - SLU(1.000) +		Q1 - I(1.500)
3	5	Inactive G1(1.350) + + Q1 - E(1.500)	Add	G2(1.350) +		G5(1.350)
4	6	Inactive G1(1.350) + + G6 - SLU(1.000) +	Add	G2(1.350) + Q1 - I(1.500)		G5(1.350)
5	11	Inactive G1(1.000) + + A1 - P(1.000)	Add	G2(1.000) +		Q1 - E(0.600)
6	12	Inactive G1(1.000) + + Q1 - I(0.600) +	Add	G2(1.000) + A1 - A(1.000)		G6 - SLU(1.000)
7	21	Strength/Stress G1(1.000) +	Add	G5(1.000) +		Q1 - E(0.600)
8	22	Strength/Stress G1(1.000) +	Add	G5(1.000) +		G6 - SLU(1.000)
9	SLE - 1	Inactive G1(1.000) +	Add		Q1 - E(1.000)	
10	SLE - 2	Inactive G1(1.000) +	Add	G6 - SLE(1.000) +		Q1 - I(1.000)
11	SLE - 5	Inactive G1(1.000) + + Q1 - E(1.000)	Add	G2(1.000) +		G5(1.000)
12	SLE - 6	Inactive G1(1.000) + + G6 - SLE(1.000) +	Add	G2(1.000) + Q1 - I(1.000)		G5(1.000)

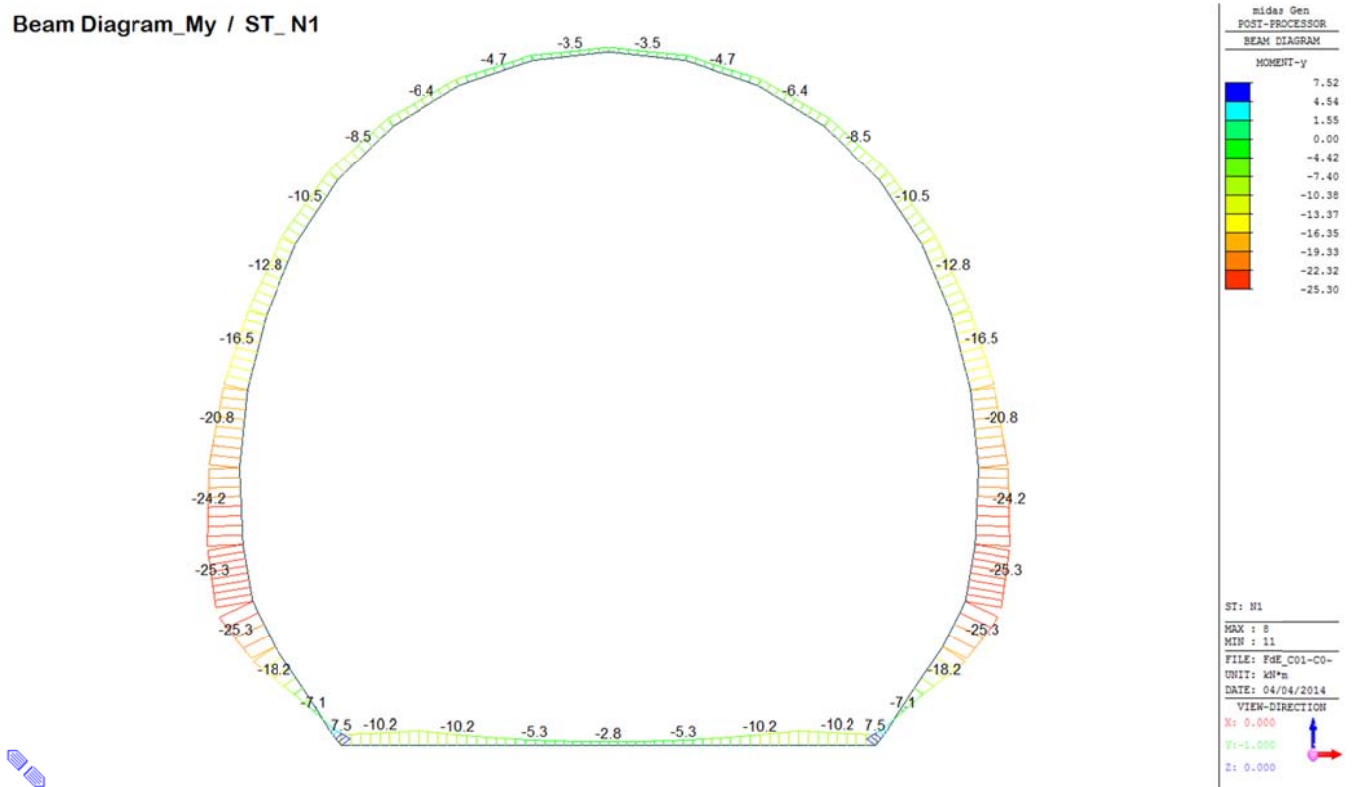
A.6.4. Output and check result for T2 and T3 cross section (FdE-C01/06 and CT1 T2-T3)

A.5.4.1. Load combination SLU 1

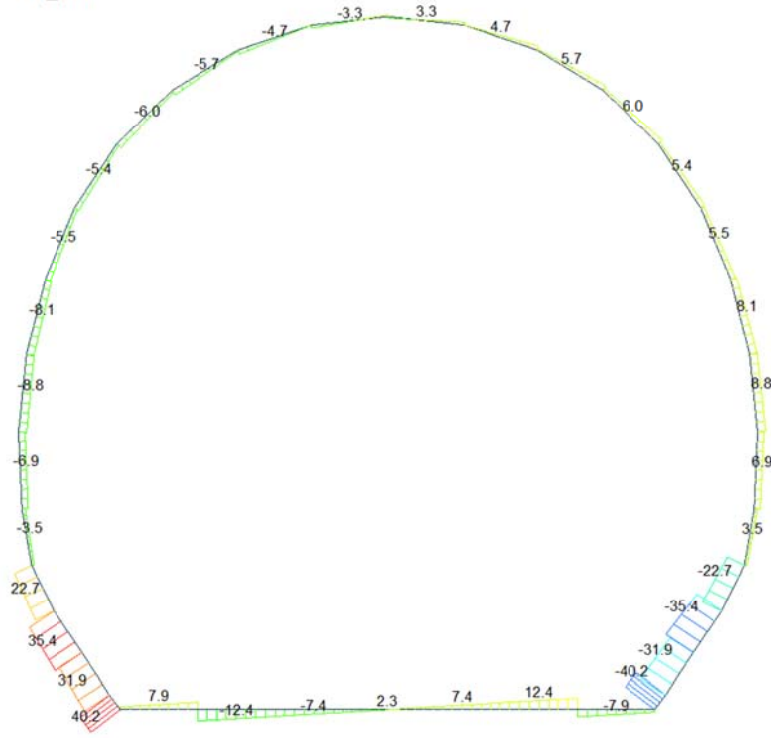
Beam Diagram_Fx / ST_N1



Beam Diagram_My / ST_N1



Beam Diagram_Fz / ST_N1



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

40.24
32.92
25.61
18.29
10.97
3.66
0.00
-10.97
-18.29
-25.60
-32.92
-40.24

ST: N1

MAX : 35

MIN : 8

FILE: PdE_C01-CO-

UNIT: kN

DATE: 04/04/2014

VIEW-DIRECTION

X: 0.000

Y: -1.000

Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

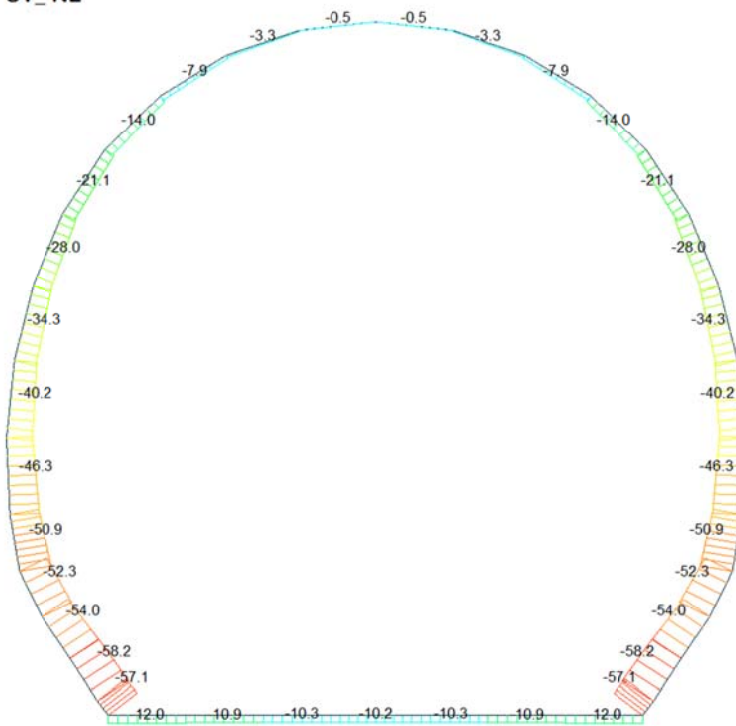
R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.03	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,EC2}$ [N/mm ²]	Verifica a taglio
N1	1	I[1]	-7.5	-33.1	2.9	0.30	-0.61	0.39	-15.36	1.03	OK	0.014	0.306	1.17	OK
N1	1	J[2]	-10.2	-33.1	7.9	0.30	-0.79	0.57	-15.36	1.03	OK	0.040	0.396	1.21	OK
N1	2	I[2]	-10.2	-30.3	12.5	0.30	-0.78	0.58	-15.36	1.03	OK	0.062	0.391	1.21	OK
N1	2	J[3]	-5.3	-30.3	7.4	0.30	-0.45	0.25	-15.36	1.03	OK	0.037	0.226	1.14	OK
N1	3	I[3]	-5.3	-28.7	7.4	0.30	-0.45	0.25	-15.36	1.03	OK	0.037	0.223	1.14	OK
N1	3	J[4]	-2.8	-28.7	2.3	0.30	-0.28	0.09	-15.36	1.03	OK	0.012	0.142	1.10	OK
N1	4	I[4]	-2.8	-28.2	2.3	0.30	-0.28	0.09	-15.36	1.03	OK	0.012	0.141	1.10	OK
N1	4	J[5]	-2.8	-28.2	2.3	0.30	-0.28	0.09	-15.36	1.03	OK	0.012	0.141	1.10	OK
N1	5	I[5]	-2.8	-28.7	2.3	0.30	-0.28	0.09	-15.36	1.03	OK	0.012	0.142	1.10	OK
N1	5	J[6]	-5.3	-28.7	7.4	0.30	-0.45	0.25	-15.36	1.03	OK	0.037	0.223	1.14	OK
N1	6	I[6]	-5.3	-30.3	7.4	0.30	-0.45	0.25	-15.36	1.03	OK	0.037	0.226	1.14	OK
N1	6	J[7]	-10.2	-30.3	12.5	0.30	-0.78	0.58	-15.36	1.03	OK	0.062	0.391	1.21	OK
N1	7	I[7]	-10.2	-33.1	7.9	0.30	-0.79	0.57	-15.36	1.03	OK	0.040	0.396	1.21	OK
N1	7	J[8]	-7.5	-33.1	2.9	0.30	-0.61	0.39	-15.36	1.03	OK	0.014	0.306	1.17	OK
N1	8	I[8]	2.9	-112.4	39.5	0.30	-0.18	-0.57	-15.36	1.03	OK	0.198	0.375	1.20	OK
N1	8	J[9]	7.5	-113.4	40.2	0.30	0.12	-0.88	-15.36	1.03	OK	0.201	0.440	1.23	OK
N1	9	I[9]	-7.2	-111.7	29.5	0.40	-0.55	-0.01	-15.36	1.03	OK	0.111	0.279	1.16	OK
N1	9	J[10]	2.9	-115.4	31.9	0.40	-0.18	-0.40	-15.36	1.03	OK	0.119	0.288	1.17	OK
N1	10	I[11]	-18.2	-106.4	32.3	0.50	-0.65	0.22	-15.36	1.03	OK	0.097	0.325	1.18	OK
N1	10	J[10]	-7.2	-111.0	35.4	0.50	-0.39	-0.05	-15.36	1.03	OK	0.106	0.222	1.14	OK
N1	11	I[12]	-25.3	-105.7	20.5	0.45	-0.98	0.51	-15.36	1.03	OK	0.068	0.492	1.25	OK
N1	11	J[11]	-18.2	-110.2	22.8	0.45	-0.78	0.29	-15.36	1.03	OK	0.076	0.392	1.21	OK
N1	12	I[13]	-24.2	-103.3	3.5	0.40	-1.16	0.65	-15.36	1.03	OK	0.013	0.582	1.29	OK
N1	12	J[12]	-25.3	-108.3	2.7	0.40	-1.22	0.68	-15.36	1.03	OK	0.010	0.610	1.30	OK
N1	13	I[14]	-20.8	-96.7	6.9	0.35	-1.29	0.74	-15.36	1.03	OK	0.029	0.647	1.31	OK
N1	13	J[13]	-24.2	-102.6	6.6	0.35	-1.48	0.89	-15.36	1.03	OK	0.028	0.738	1.35	OK
N1	14	I[15]	-16.5	-90.5	8.3	0.30	-1.40	0.80	-15.36	1.03	OK	0.041	0.702	1.34	OK
N1	14	J[14]	-20.8	-95.5	8.8	0.30	-1.70	1.03	-15.36	1.03	OK	0.044	0.852	1.39	OK
N1	15	I[16]	-12.8	-84.4	6.8	0.30	-1.13	0.57	-15.36	1.03	OK	0.034	0.567	1.28	OK
N1	15	J[15]	-16.5	-89.3	8.1	0.30	-1.40	0.80	-15.36	1.03	OK	0.040	0.700	1.33	OK
N1	16	I[17]	-10.5	-78.9	3.6	0.30	-0.96	0.44	-15.36	1.03	OK	0.018	0.482	1.25	OK
N1	16	J[16]	-12.8	-83.5	5.5	0.30	-1.13	0.57	-15.36	1.03	OK	0.028	0.566	1.28	OK
N1	17	I[18]	-8.5	-73.8	2.6	0.30	-0.81	0.32	-15.36	1.03	OK	0.013	0.407	1.22	OK
N1	17	J[17]	-10.5	-78.0	5.4	0.30	-0.96	0.44	-15.36	1.03	OK	0.027	0.481	1.25	OK
N1	18	I[19]	-6.4	-69.3	2.4	0.30	-0.66	0.20	-15.36	1.03	OK	0.012	0.329	1.18	OK
N1	18	J[18]	-8.5	-72.8	6.0	0.30	-0.81	0.33	-15.36	1.03	OK	0.030	0.405	1.22	OK
N1	19	I[20]	-4.7	-65.8	1.4	0.30	-0.53	0.09	-15.36	1.03	OK	0.007	0.265	1.15	OK
N1	19	J[19]	-6.4	-68.4	5.7	0.30	-0.66	0.20	-15.36	1.03	OK	0.028	0.328	1.18	OK
N1	20	I[21]	-3.5	-63.5	0.1	0.30	-0.45	0.02	-15.36	1.03	OK	0.001	0.223	1.14	OK
N1	20	J[20]	-4.7	-65.1	4.7	0.30	-0.53	0.09	-15.36	1.03	OK	0.023	0.264	1.15	OK
N1	21	I[22]	-3.1	-62.6	1.7	0.30	-0.42	0.00	-15.36	1.03	OK	0.009	0.209	1.13	OK
N1	21	J[21]	-3.5	-63.1	3.3	0.30	-0.45	0.02	-15.36	1.03	OK	0.016	0.223	1.14	OK
N1	22	I[22]	-3.5	-63.1	3.3	0.30	-0.45	0.02	-15.36	1.03	OK	0.016	0.223	1.14	OK
N1	22	J[22]	-3.1	-62.6	1.7	0.30	-0.42	0.00	-15.36	1.03	OK	0.009	0.209	1.13	OK
N1	23	I[24]	-4.7	-65.1	4.7	0.30	-0.53	0.09	-15.36	1.03	OK	0.023	0.264	1.15	OK
N1	23	J[23]	-3.5	-63.5	0.1	0.30	-0.45	0.02	-15.36	1.03	OK	0.001	0.223	1.14	OK
N1	24	I[25]	-6.4	-68.4	5.7	0.30	-0.66	0.20	-15.36	1.03	OK	0.028	0.328	1.18	OK
N1	24	J[24]	-4.7	-65.8	1.4	0.30	-0.53	0.09	-15.36	1.03	OK	0.007	0.265	1.15	OK
N1	25	I[26]	-8.5	-72.8	6.0	0.30	-0.81	0.33	-15.36	1.03	OK	0.030	0.405	1.22	OK
N1	25	J[25]	-6.4	-69.3	2.4	0.30	-0.66	0.20	-15.36	1.03	OK	0.012	0.329	1.18	OK
N1	26	I[27]	-10.5	-78.0	5.4	0.30	-0.96	0.44	-15.36	1.03	OK	0.027	0.481	1.25	OK
N1	26	J[26]	-8.5	-73.8	2.6	0.30	-0.81	0.32	-15.36	1.03	OK	0.013	0.407	1.22	OK
N1	27	I[28]	-12.8	-83.5	5.5	0.30	-1.13	0.57	-15.36	1.03	OK	0.028	0.566	1.28	OK
N1	27	J[27]	-10.5	-78.9	3.6	0.30	-0.96	0.44	-15.36	1.03	OK	0.018	0.482	1.25	OK
N1	28	I[29]	-16.5	-89.3	8.1	0.30	-1.40	0.80	-15.36	1.03	OK	0.040	0.700	1.33	OK
N1	28	J[28]	-12.8	-84.4	6.8	0.30	-1.13	0.57	-15.36	1.03	OK	0.034	0.567	1.28	OK
N1	29	I[30]	-20.8	-95.5	8.8	0.30	-1.70	1.03	-15.36	1.03	OK	0.044	0.852	1.39	OK
N1	29	J[29]	-16.5	-90.5	8.3	0.30	-1.40	0.80	-15.36	1.03	OK	0.041	0.702	1.34	OK
N1	30	I[31]	-24.2	-102.6	6.6	0.35	-1.48	0.89	-15.36	1.03	OK	0.028	0.738	1.35	OK
N1	30	J[30]	-20.8	-96.7	6.9	0.35	-1.29	0.74	-15.36	1.03	OK	0.029	0.647	1.31	OK
N1	31	I[32]	-25.3	-108.3	2.7	0.40	-1.22	0.68	-15.36	1.03	OK	0.010	0.610	1.30	OK
N1	31	J[31]	-24.2	-103.3	3.5	0.40	-1.16	0.65	-15.36	1.03	OK	0.013	0.582	1.29	OK
N1	32	I[33]	-18.2	-110.2	22.8	0.45	-0.78	0.29	-15.36	1.03	OK	0.076	0.392	1.21	OK
N1	32	J[32]	-25.3	-105.7	20.5	0.45	-0.98	0.51	-15.36	1.03	OK	0.068	0.492	1.25	OK
N1	33	I[34]	-7.2	-111.0	35.4	0.50	-0.39	-0.05	-15.36	1.03	OK	0.106	0.222	1.14	OK
N1	33	J[33]	-18.2	-106.4	32.3	0.50	-0.65	0.22	-15.36	1.03	OK	0.097	0.324	1.18	OK
N1	34	I[35]	2.9	-115.4	31.9	0.40	-0.18	-0.40	-15.36	1.03	OK	0.119	0.288	1.17	OK
N1	34	J[34]	-7.2	-111.7	29.5	0.40	-0.55	-0.01	-15.36	1.03	OK	0.111	0.279	1.16	OK
N1	35	I[1]	7.5	-113.4	40.2	0.30	0.12	-0.88	-15.36	1.03	OK	0.201	0.440	1.23	OK
N1	35	J[35]	2.9	-112.4	39.5	0.30	-0.18	-0.57	-15.36	1.03	OK	0.198	0.375	1.20	OK

A.5.4.2. Load combination SLU 2

Beam Diagram_Fx / ST_N2



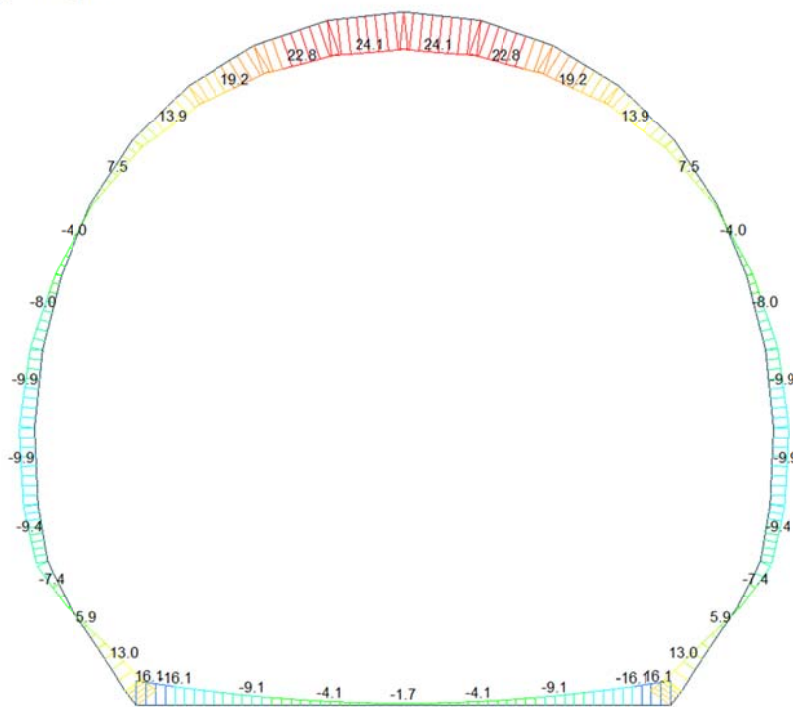
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

0.01
0.00
-10.97
-15.86
-21.16
-26.45
-31.74
-37.03
-42.32
-47.61
-52.90
-58.20

ST: N2
MAX : 21
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N2



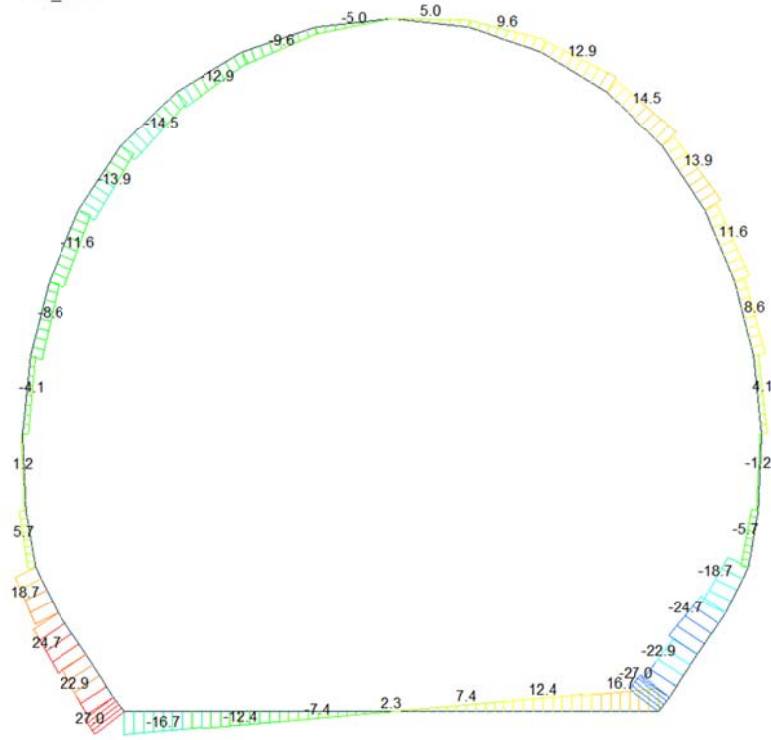
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

24.07
20.42
16.76
13.11
9.45
5.80
2.14
0.00
-5.17
-8.82
-12.48
-16.13

ST: N2
MAX : 21
MIN : 7
FILE: FdE_C01-C0-
UNIT: kNm
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N2



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

27.00
22.09
17.18
12.27
7.36
2.45
0.00
-7.36
-12.27
-17.18
-22.09
-27.00

ST: N2
MAX: 35
MIN: 8
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN·m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N2	1	I[1]	-16.1	-12.0	16.7	0.30	-1.12	1.04	-15.36	1.03	FESSURATA	0.083	0.558	1.28	OK
N2	1	J[2]	-9.1	-12.0	11.6	0.30	-0.64	0.56	-15.36	1.03	OK	0.058	0.322	1.18	OK
N2	2	I[2]	-9.1	-10.9	12.5	0.30	-0.64	0.57	-15.36	1.03	OK	0.062	0.321	1.18	OK
N2	2	J[3]	-4.1	-10.9	7.4	0.30	-0.31	0.24	-15.36	1.03	OK	0.037	0.155	1.10	OK
N2	3	I[3]	-4.1	-10.3	7.4	0.30	-0.31	0.24	-15.36	1.03	OK	0.037	0.154	1.10	OK
N2	3	J[4]	-1.7	-10.3	2.3	0.30	-0.15	0.08	-15.36	1.03	OK	0.012	0.073	1.07	OK
N2	4	I[4]	-1.7	-10.2	2.3	0.30	-0.15	0.08	-15.36	1.03	OK	0.012	0.073	1.07	OK
N2	4	J[5]	-1.7	-10.2	2.3	0.30	-0.15	0.08	-15.36	1.03	OK	0.012	0.073	1.07	OK
N2	5	I[5]	-1.7	-10.3	2.3	0.30	-0.15	0.08	-15.36	1.03	OK	0.012	0.073	1.07	OK
N2	5	J[6]	-4.1	-10.3	7.4	0.30	-0.31	0.24	-15.36	1.03	OK	0.037	0.154	1.10	OK
N2	6	I[6]	-4.1	-10.9	7.4	0.30	-0.31	0.24	-15.36	1.03	OK	0.037	0.155	1.10	OK
N2	6	J[7]	-9.1	-10.9	12.5	0.30	-0.64	0.57	-15.36	1.03	OK	0.062	0.321	1.18	OK
N2	7	I[7]	-9.1	-12.0	11.6	0.30	-0.64	0.56	-15.36	1.03	OK	0.058	0.322	1.18	OK
N2	7	J[8]	-16.1	-12.0	16.7	0.30	-1.12	1.04	-15.36	1.03	FESSURATA	0.083	0.558	1.28	OK
N2	8	I[8]	13.0	-56.2	26.3	0.30	0.68	-1.06	-15.36	1.03	OK	0.131	0.528	1.27	OK
N2	8	J[9]	16.1	-57.1	27.0	0.30	0.88	-1.27	-15.36	1.03	OK	0.135	0.633	1.31	OK
N2	9	I[9]	5.9	-54.5	20.5	0.40	0.09	-0.36	-15.36	1.03	OK	0.077	0.179	1.12	OK
N2	9	J[10]	13.0	-58.2	22.9	0.40	0.34	-0.63	-15.36	1.03	OK	0.086	0.317	1.18	OK
N2	10	I[11]	-1.6	-49.5	21.6	0.50	-0.14	-0.06	-15.36	1.03	OK	0.065	0.099	1.08	OK
N2	10	J[10]	5.9	-54.0	24.7	0.50	0.03	-0.25	-15.36	1.03	OK	0.074	0.125	1.09	OK
N2	11	I[12]	-7.4	-47.8	16.5	0.45	-0.33	0.11	-15.36	1.03	OK	0.055	0.163	1.11	OK
N2	11	J[11]	-1.6	-52.3	18.7	0.45	-0.16	-0.07	-15.36	1.03	OK	0.062	0.116	1.09	OK
N2	12	I[13]	-9.4	-46.0	4.8	0.40	-0.47	0.24	-15.36	1.03	OK	0.018	0.234	1.14	OK
N2	12	J[12]	-7.4	-50.9	5.7	0.40	-0.41	0.15	-15.36	1.03	OK	0.021	0.203	1.13	OK
N2	13	I[14]	-9.9	-40.5	1.0	0.35	-0.60	0.37	-15.36	1.03	OK	0.004	0.301	1.17	OK
N2	13	J[13]	-9.4	-46.4	1.2	0.35	-0.59	0.33	-15.36	1.03	OK	0.005	0.296	1.17	OK
N2	14	I[15]	-8.0	-35.2	3.6	0.30	-0.65	0.42	-15.36	1.03	OK	0.018	0.326	1.18	OK
N2	14	J[14]	-9.9	-40.2	4.1	0.30	-0.80	0.53	-15.36	1.03	OK	0.021	0.398	1.21	OK
N2	15	I[16]	-4.0	-29.4	7.4	0.30	-0.37	0.17	-15.36	1.03	OK	0.037	0.183	1.12	OK
N2	15	J[15]	-8.0	-34.3	8.6	0.30	-0.65	0.42	-15.36	1.03	OK	0.043	0.325	1.18	OK
N2	16	I[17]	1.3	-23.4	9.6	0.30	0.01	-0.16	-15.36	1.03	OK	0.048	0.082	1.07	OK
N2	16	J[16]	-4.0	-28.0	11.6	0.30	-0.36	0.17	-15.36	1.03	OK	0.058	0.181	1.12	OK
N2	17	I[18]	7.5	-16.9	11.1	0.30	0.45	-0.56	-15.36	1.03	OK	0.056	0.279	1.16	OK
N2	17	J[17]	1.3	-21.1	13.9	0.30	0.02	-0.16	-15.36	1.03	OK	0.069	0.078	1.07	OK
N2	18	I[19]	13.9	-10.5	10.9	0.30	0.89	-0.96	-15.36	1.03	OK	0.055	0.480	1.25	OK
N2	18	J[18]	7.5	-14.1	14.5	0.30	0.45	-0.55	-15.36	1.03	OK	0.073	0.274	1.16	OK
N2	19	I[20]	19.2	-5.3	8.6	0.30	1.27	-1.30	-15.36	1.03	FESSURATA	0.043	0.650	1.32	OK
N2	19	J[19]	13.9	-7.9	12.9	0.30	0.90	-0.95	-15.36	1.03	OK	0.065	0.475	1.24	OK
N2	20	I[21]	22.8	-1.6	4.8	0.30	1.52	-1.53	-15.36	1.03	FESSURATA	0.024	0.763	1.36	OK
N2	20	J[20]	19.2	-3.3	9.6	0.30	1.27	-1.29	-15.36	1.03	FESSURATA	0.048	0.647	1.31	OK
N2	21	I[22]	24.1	0.0	0.0	0.30	1.60	-1.60	-15.36	1.03	FESSURATA	0.000	0.802	1.37	OK
N2	21	J[21]	22.8	-0.6	5.0	0.30	1.52	-1.52	-15.36	1.03	FESSURATA	0.025	0.762	1.36	OK
N2	22	I[22]	22.8	-0.6	5.0	0.30	1.52	-1.52	-15.36	1.03	FESSURATA	0.025	0.762	1.36	OK
N2	22	J[22]	24.1	0.0	0.0	0.30	1.60	-1.60	-15.36	1.03	FESSURATA	0.000	0.802	1.37	OK
N2	23	I[24]	19.2	-3.3	9.6	0.30	1.27	-1.29	-15.36	1.03	FESSURATA	0.048	0.647	1.31	OK
N2	23	J[23]	22.8	-1.6	4.8	0.30	1.52	-1.53	-15.36	1.03	FESSURATA	0.024	0.763	1.36	OK
N2	24	I[25]	13.9	-7.9	12.9	0.30	0.90	-0.95	-15.36	1.03	OK	0.065	0.475	1.24	OK
N2	24	J[24]	19.2	-5.3	8.6	0.30	1.27	-1.30	-15.36	1.03	FESSURATA	0.043	0.650	1.32	OK
N2	25	I[26]	7.5	-14.1	14.5	0.30	0.45	-0.55	-15.36	1.03	OK	0.073	0.274	1.16	OK
N2	25	J[25]	13.9	-10.5	10.9	0.30	0.89	-0.96	-15.36	1.03	OK	0.055	0.480	1.25	OK
N2	26	I[27]	1.3	-21.1	13.9	0.30	0.02	-0.16	-15.36	1.03	OK	0.069	0.078	1.07	OK
N2	26	J[26]	7.5	-16.9	11.1	0.30	0.45	-0.56	-15.36	1.03	OK	0.056	0.279	1.16	OK
N2	27	I[28]	-4.0	-28.0	11.6	0.30	-0.36	0.17	-15.36	1.03	OK	0.058	0.181	1.12	OK
N2	27	J[27]	1.3	-23.4	9.6	0.30	0.01	-0.16	-15.36	1.03	OK	0.048	0.082	1.07	OK
N2	28	I[29]	-8.0	-34.3	8.6	0.30	-0.65	0.42	-15.36	1.03	OK	0.043	0.325	1.18	OK
N2	28	J[28]	-4.0	-29.4	7.4	0.30	-0.37	0.17	-15.36	1.03	OK	0.037	0.183	1.12	OK
N2	29	I[30]	-9.9	-40.2	4.1	0.30	-0.80	0.53	-15.36	1.03	OK	0.021	0.398	1.21	OK
N2	29	J[29]	-8.0	-35.2	3.6	0.30	-0.65	0.42	-15.36	1.03	OK	0.018	0.326	1.18	OK
N2	30	I[31]	-9.4	-46.4	1.2	0.35	-0.59	0.33	-15.36	1.03	OK	0.005	0.296	1.17	OK
N2	30	J[30]	-9.9	-40.5	1.0	0.35	-0.60	0.37	-15.36	1.03	OK	0.004	0.301	1.17	OK
N2	31	I[32]	-7.4	-50.9	5.7	0.40	-0.41	0.15	-15.36	1.03	OK	0.021	0.203	1.13	OK
N2	31	J[31]	-9.4	-46.0	4.8	0.40	-0.47	0.24	-15.36	1.03	OK	0.018	0.234	1.14	OK
N2	32	I[33]	-1.6	-52.3	18.7	0.45	-0.16	-0.07	-15.36	1.03	OK	0.062	0.116	1.09	OK
N2	32	J[32]	-7.4	-47.8	16.5	0.45	-0.33	0.11	-15.36	1.03	OK	0.055	0.163	1.11	OK
N2	33	I[34]	5.9	-54.0	24.7	0.50	0.03	-0.25	-15.36	1.03	OK	0.074	0.125	1.09	OK
N2	33	J[33]	-1.6	-49.5	21.6	0.50	-0.14	-0.06	-15.36	1.03	OK	0.065	0.099	1.08	OK
N2	34	I[35]	13.0	-58.2	22.9	0.40	0.34	-0.63	-15.36	1.03	OK	0.086	0.317	1.18	OK
N2	34	J[34]	5.9	-54.5	20.5	0.40	0.09	-0.36	-15.36	1.03	OK	0.077	0.179	1.12	OK
N2	35	I[1]	16.1	-57.1	27.0	0.30	0.88	-1.27	-15.36	1.03	OK	0.135	0.633	1.31	OK
N2	35	J[35]	13.0	-56.2	26.3	0.30	0.68	-1.06	-15.36	1.03	OK	0.131	0.528	1.27	OK

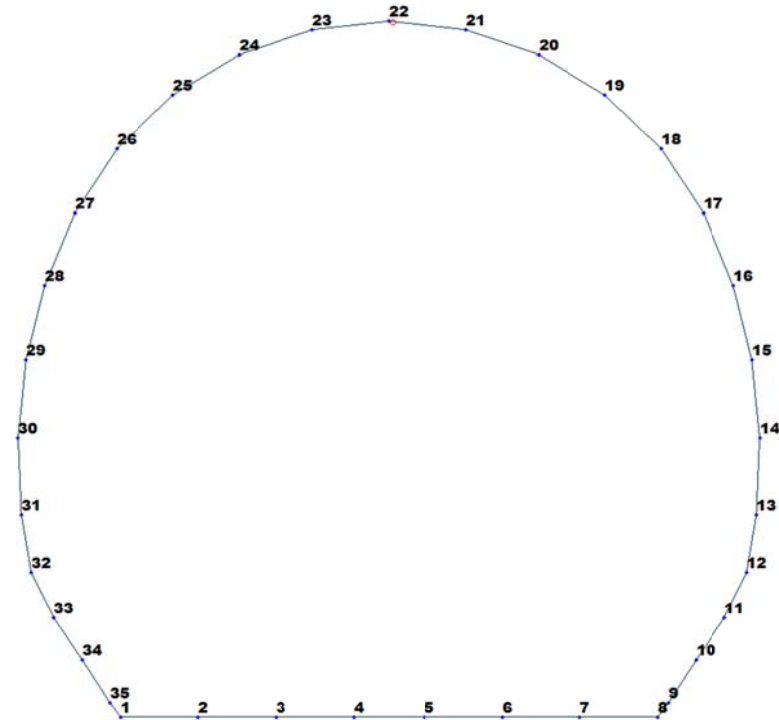


Figure 16 Beam end release

Table 4 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
21	Value	0	0	0	0	0	0	0	0	0	0	2656	0

ITERAZIONE SECONDO IL METODO DI PÖTTLER

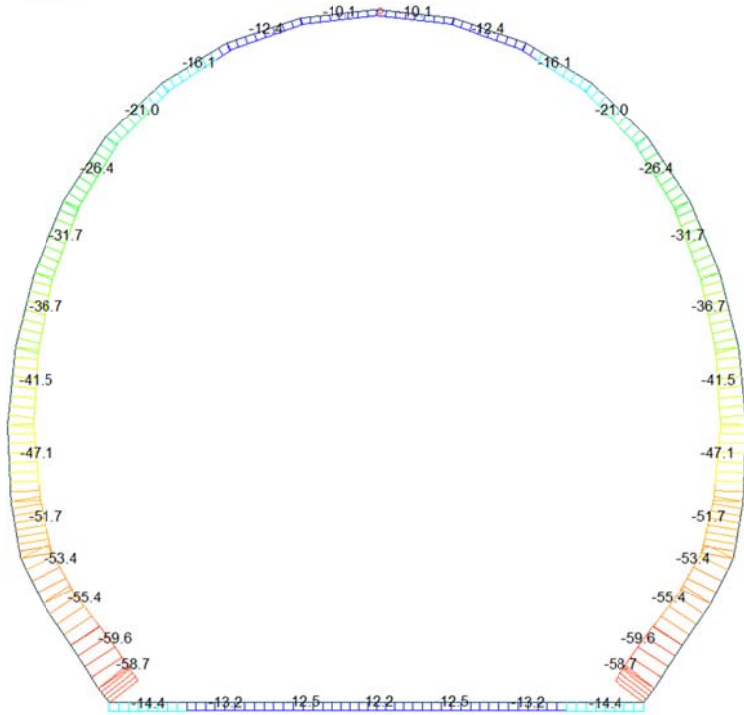
CALCOLO CERNIERE PLASTICHE

ITERAZIONE IN NODO 21 J

MIDAS		PÖTTLER	
$Cf_{iniziale, arbitraria}$	0.000377 [rad/kN*m]	E_p	26'400'000 [kN/m ²]
$1/Cf_{iniziale, arbitraria}$	2'656 [kN*m/rad]	d	0.30 [m]
M_{nodo}	1.450 [kN*m]	e	0.1433 [m]
N_{nodo}	10.120 [kN]	a	0.02 [m]
V_{nodo}	3.960 [kN]	$\Psi_{pöttler}$	0.0005212 [rad]
$Cf_{MIDAS} = Cf_{pöttler}$	S	$Cf_{pöttler}$	0.0003594 [rad/kN*m]
$\Psi_{pöttler} < 4 \text{ mrad}$	S	$1/Cf_{pöttler}$	2'782 [kN*m/rad]

0.521152

Beam Diagram_Fx / ST_N2



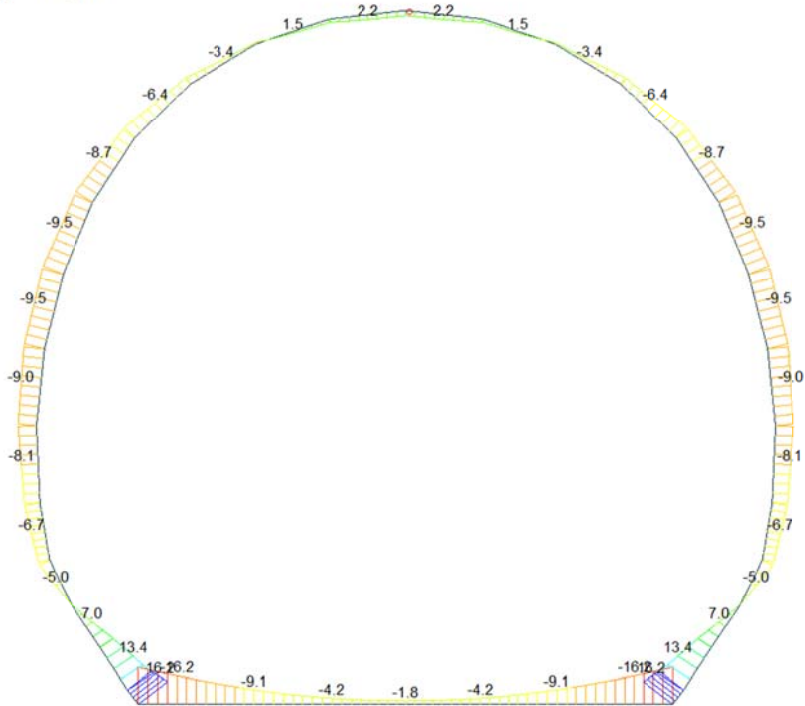
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-9.56
Cyan	-14.11
Green	-18.65
Light Green	-23.20
Yellow-Green	-27.74
Yellow	-32.29
Orange-Yellow	-36.83
Orange	-41.38
Red-Orange	-45.93
Red	-50.47
Dark Red	-55.02
Black	-59.56

ST: N2
MAX : 21
MIN : 34
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/07/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N2



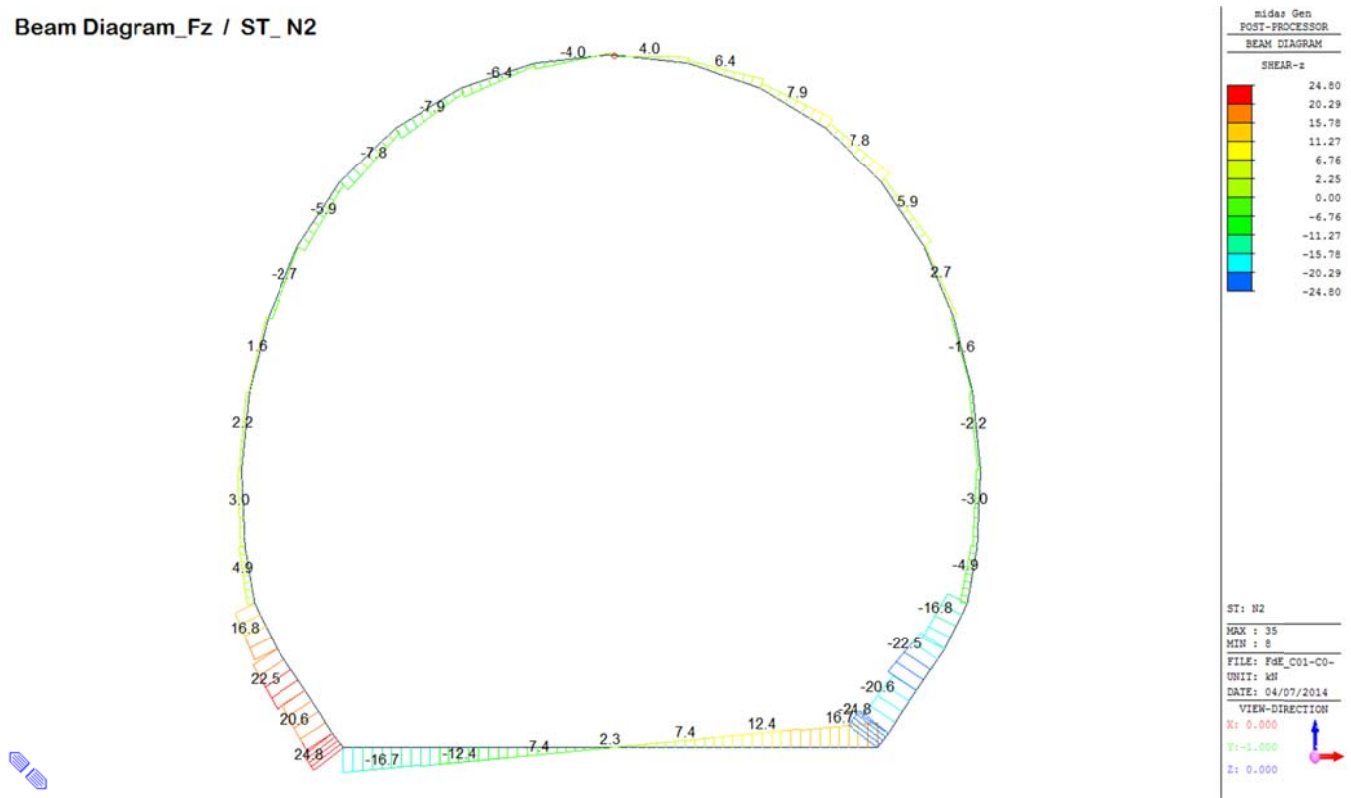
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	16.23
Cyan	13.28
Green	10.33
Light Green	7.38
Yellow-Green	4.43
Yellow	0.00
Orange-Yellow	-1.48
Orange	-4.43
Red-Orange	-7.38
Red	-10.33
Dark Red	-13.28
Black	-16.23

ST: N2
MAX : 8
MIN : 7
FILE: PdE_C01-CO-
UNIT: kN*m
DATE: 04/07/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N2



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_s [N/mm ²]	37.00	F_d [N/mm ²]	30.71	$f_{ctk,0.95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ϕ	0.80
$f_{ctd,90\%}$ [N/mm ²]	15.36	$f_{ctd,90\%}$ [N/mm ²]	1.03	E_p [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 21 J

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,90\%}$
N2	21 j	Calotta	1.5	10.1	4.0	26'400'000	0.143	0.30	OK	1.00	15.36	OK

Combinazione di carico	Nodo n°	a [m]	Φ_{Pnter} [rad]	$1/Cf_{ed,AS}$ [kN·m/rad]	$1/Cf_{e,nter}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{Pnter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{ctd,(EC2)}$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{ctvd}$
N2	21 j	0.020	0.5211519	2'686	2'782	OK	0.146	OK	1.03	0.29	7.14	1.45	OK

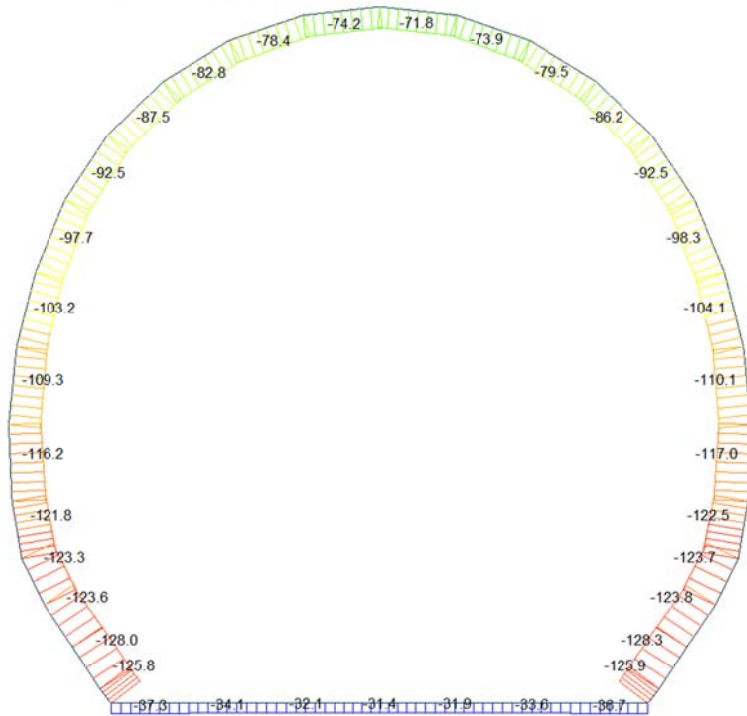
Iterazione ok

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup}	σ _{inf}	f _{ctd,95%}	f _{ctd,95%}		τ _{cp}	τ _{cp}	f _{ctd,EC2}	Verifica a taglio
							[N/mm ²]	[N/mm ²]	[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	[N/mm ²]	τ _{cp,max} ≤ F _{ctd}
N2	1	I[1]	-16.2	-14.4	16.7	0.30	-1.13	1.03	-15.36	1.03	OK	0.093	0.565	1.28	OK
N2	1	J[2]	-9.2	-14.4	11.6	0.30	-0.66	0.56	-15.36	1.03	OK	0.058	0.329	1.18	OK
N2	2	I[2]	-9.2	-13.2	12.5	0.30	-0.65	0.57	-15.36	1.03	OK	0.062	0.327	1.18	OK
N2	2	J[3]	-4.2	-13.2	7.4	0.30	-0.32	0.24	-15.36	1.03	OK	0.037	0.162	1.11	OK
N2	3	I[3]	-4.2	-12.5	7.4	0.30	-0.32	0.24	-15.36	1.03	OK	0.037	0.160	1.11	OK
N2	3	J[4]	-1.8	-12.5	2.3	0.30	-0.16	0.08	-15.36	1.03	OK	0.012	0.079	1.07	OK
N2	4	I[4]	-1.8	-12.2	2.3	0.30	-0.16	0.08	-15.36	1.03	OK	0.012	0.079	1.07	OK
N2	4	J[5]	-1.8	-12.2	2.3	0.30	-0.16	0.08	-15.36	1.03	OK	0.012	0.079	1.07	OK
N2	5	I[5]	-1.8	-12.5	2.3	0.30	-0.16	0.08	-15.36	1.03	OK	0.012	0.079	1.07	OK
N2	5	J[6]	-4.2	-12.5	7.4	0.30	-0.32	0.24	-15.36	1.03	OK	0.037	0.160	1.11	OK
N2	6	I[6]	-4.2	-13.2	7.4	0.30	-0.32	0.24	-15.36	1.03	OK	0.037	0.162	1.11	OK
N2	6	J[7]	-9.2	-13.2	12.5	0.30	-0.65	0.57	-15.36	1.03	OK	0.062	0.327	1.18	OK
N2	7	I[7]	-9.2	-14.4	11.6	0.30	-0.66	0.56	-15.36	1.03	OK	0.058	0.329	1.18	OK
N2	7	J[8]	-16.2	-14.4	16.7	0.30	-1.13	1.03	-15.36	1.03	OK	0.093	0.565	1.28	OK
N2	8	I[9]	13.4	-57.7	24.1	0.30	0.70	-1.09	-15.36	1.03	OK	0.120	0.543	1.27	OK
N2	8	J[8]	16.2	-58.7	24.8	0.30	0.89	-1.28	-15.36	1.03	OK	0.124	0.639	1.31	OK
N2	9	I[10]	7.0	-55.9	18.2	0.40	0.12	-0.40	-15.36	1.03	OK	0.068	0.201	1.13	OK
N2	9	J[9]	13.4	-59.6	20.6	0.40	0.35	-0.65	-15.36	1.03	OK	0.077	0.326	1.18	OK
N2	10	I[11]	0.2	-50.9	19.5	0.50	-0.10	-0.11	-15.36	1.03	OK	0.058	0.102	1.08	OK
N2	10	J[10]	7.0	-55.4	22.5	0.50	0.06	-0.28	-15.36	1.03	OK	0.068	0.140	1.10	OK
N2	11	I[12]	-5.0	-48.9	14.6	0.45	-0.26	0.04	-15.36	1.03	OK	0.049	0.128	1.09	OK
N2	11	J[11]	0.2	-53.4	16.8	0.45	-0.11	-0.12	-15.36	1.03	OK	0.056	0.119	1.09	OK
N2	12	I[13]	-6.7	-46.7	4.1	0.40	-0.37	0.13	-15.36	1.03	OK	0.015	0.183	1.12	OK
N2	12	J[12]	-5.0	-51.7	4.9	0.40	-0.32	0.06	-15.36	1.03	OK	0.018	0.158	1.11	OK
N2	13	I[14]	-8.1	-41.2	2.7	0.35	-0.51	0.28	-15.36	1.03	OK	0.012	0.257	1.15	OK
N2	13	J[13]	-6.7	-47.1	3.0	0.35	-0.46	0.19	-15.36	1.03	OK	0.013	0.230	1.14	OK
N2	14	I[15]	-9.0	-36.5	2.2	0.30	-0.72	0.48	-15.36	1.03	OK	0.011	0.362	1.20	OK
N2	14	J[14]	-8.1	-41.5	1.7	0.30	-0.68	0.40	-15.36	1.03	OK	0.008	0.338	1.19	OK
N2	15	I[16]	-9.5	-31.8	1.6	0.30	-0.74	0.53	-15.36	1.03	OK	0.008	0.370	1.20	OK
N2	15	J[15]	-9.0	-36.7	0.4	0.30	-0.72	0.48	-15.36	1.03	OK	0.002	0.362	1.20	OK
N2	16	I[17]	-8.7	-27.0	0.7	0.30	-0.67	0.49	-15.36	1.03	OK	0.004	0.334	1.19	OK
N2	16	J[16]	-9.5	-31.7	2.7	0.30	-0.74	0.53	-15.36	1.03	OK	0.013	0.370	1.20	OK
N2	17	I[18]	-6.4	-22.2	3.1	0.30	-0.50	0.36	-15.36	1.03	OK	0.015	0.252	1.15	OK
N2	17	J[17]	-8.7	-26.4	5.9	0.30	-0.67	0.49	-15.36	1.03	OK	0.029	0.333	1.18	OK
N2	18	I[19]	-3.4	-17.5	4.2	0.30	-0.29	0.17	-15.36	1.03	OK	0.021	0.144	1.10	OK
N2	18	J[18]	-6.4	-21.0	7.8	0.30	-0.50	0.36	-15.36	1.03	OK	0.039	0.250	1.15	OK
N2	19	I[20]	-0.6	-13.5	3.6	0.30	-0.08	-0.01	-15.36	1.03	OK	0.018	0.045	1.05	OK
N2	19	J[19]	-3.4	-16.1	7.9	0.30	-0.28	0.18	-15.36	1.03	OK	0.040	0.142	1.10	OK
N2	20	I[21]	1.5	-10.7	1.7	0.30	0.06	-0.13	-15.36	1.03	OK	0.008	0.066	1.06	OK
N2	20	J[20]	-0.6	-12.4	6.4	0.30	-0.08	0.00	-15.36	1.03	OK	0.032	0.041	1.05	OK
N2	21	I[22]	2.2	-9.6	1.1	0.30	0.11	-0.18	-15.36	1.03	OK	0.005	0.089	1.07	OK
N2	21	J[21]	1.5	-10.1	4.0	0.30	0.06	-0.13	-15.36	1.03	OK	0.020	0.065	1.06	OK
N2	22	I[23]	1.5	-10.1	4.0	0.30	0.06	-0.13	-15.36	1.03	OK	0.020	0.065	1.06	OK
N2	22	J[22]	2.2	-9.6	1.1	0.30	0.11	-0.18	-15.36	1.03	OK	0.005	0.089	1.07	OK
N2	23	I[24]	-0.6	-12.4	6.4	0.30	-0.08	0.00	-15.36	1.03	OK	0.032	0.041	1.05	OK
N2	23	J[23]	1.5	-10.7	1.7	0.30	0.06	-0.13	-15.36	1.03	OK	0.008	0.066	1.06	OK
N2	24	I[25]	-3.4	-16.1	7.9	0.30	-0.28	0.18	-15.36	1.03	OK	0.040	0.142	1.10	OK
N2	24	J[24]	-0.6	-13.5	3.6	0.30	-0.08	-0.01	-15.36	1.03	OK	0.018	0.045	1.05	OK
N2	25	I[26]	-6.4	-21.0	7.8	0.30	-0.50	0.36	-15.36	1.03	OK	0.039	0.250	1.15	OK
N2	25	J[25]	-3.4	-17.5	4.2	0.30	-0.29	0.17	-15.36	1.03	OK	0.021	0.144	1.10	OK
N2	26	I[27]	-8.7	-26.4	5.9	0.30	-0.67	0.49	-15.36	1.03	OK	0.029	0.333	1.18	OK
N2	26	J[26]	-6.4	-22.2	3.1	0.30	-0.50	0.36	-15.36	1.03	OK	0.015	0.252	1.15	OK
N2	27	I[28]	-9.5	-31.7	2.7	0.30	-0.74	0.53	-15.36	1.03	OK	0.013	0.370	1.20	OK
N2	27	J[27]	-8.7	-27.0	0.7	0.30	-0.67	0.49	-15.36	1.03	OK	0.004	0.334	1.19	OK
N2	28	I[29]	-9.0	-36.7	0.4	0.30	-0.72	0.48	-15.36	1.03	OK	0.002	0.362	1.20	OK
N2	28	J[28]	-9.5	-31.8	1.6	0.30	-0.74	0.53	-15.36	1.03	OK	0.008	0.370	1.20	OK
N2	29	I[30]	-8.1	-41.5	1.7	0.30	-0.68	0.40	-15.36	1.03	OK	0.008	0.338	1.19	OK
N2	29	J[29]	-9.0	-36.5	2.2	0.30	-0.72	0.48	-15.36	1.03	OK	0.011	0.362	1.20	OK
N2	30	I[31]	-6.7	-47.1	3.0	0.35	-0.46	0.19	-15.36	1.03	OK	0.013	0.230	1.14	OK
N2	30	J[30]	-8.1	-41.2	2.7	0.35	-0.51	0.28	-15.36	1.03	OK	0.012	0.257	1.15	OK
N2	31	I[32]	-5.0	-51.7	4.9	0.40	-0.32	0.06	-15.36	1.03	OK	0.018	0.158	1.11	OK
N2	31	J[31]	-6.7	-46.7	4.1	0.40	-0.37	0.13	-15.36	1.03	OK	0.015	0.183	1.12	OK
N2	32	I[33]	0.2	-53.4	16.8	0.45	-0.11	-0.12	-15.36	1.03	OK	0.056	0.119	1.09	OK
N2	32	J[32]	-5.0	-48.9	14.6	0.45	-0.26	0.04	-15.36	1.03	OK	0.049	0.128	1.09	OK
N2	33	I[33]	7.0	-55.4	22.5	0.50	0.06	-0.28	-15.36	1.03	OK	0.068	0.140	1.10	OK
N2	33	J[33]	0.2	-50.9	19.5	0.50	-0.10	-0.11	-15.36	1.03	OK	0.058	0.102	1.08	OK
N2	34	I[35]	13.4	-59.6	20.6	0.40	0.35	-0.65	-15.36	1.03	OK	0.077	0.326	1.18	OK
N2	34	J[34]	7.0	-55.9	18.2	0.40	0.12	-0.40	-15.36	1.03	OK	0.068	0.201	1.13	OK
N2	35	I[1]	16.2	-58.7	24.8	0.30	0.89	-1.28	-15.36	1.03	OK	0.124	0.639	1.31	OK
N2	35	J[35]	13.4	-57.7	24.1	0.30	0.70	-1.09	-15.36	1.03	OK	0.120	0.543	1.27	OK

A.5.4.3. Load combination SLU 5 Block analysis

Beam Diagram_Fx - Block analysis / ST_N5



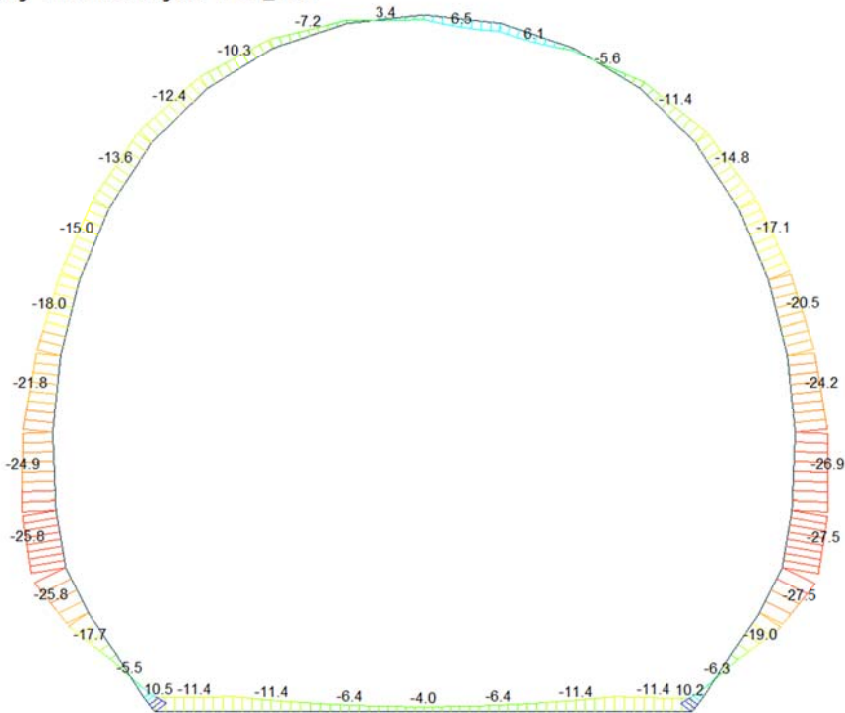
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-31.43
Cyan	-40.24
Green	-49.04
Light Green	-57.84
Yellow-Green	-66.64
Yellow	-75.44
Orange	-84.25
Light Orange	-93.05
Red-Orange	-101.85
Red	-110.65
Dark Red	-119.45
Black	-128.26

ST: N5
MAX : 4
MIN : 9
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_N5



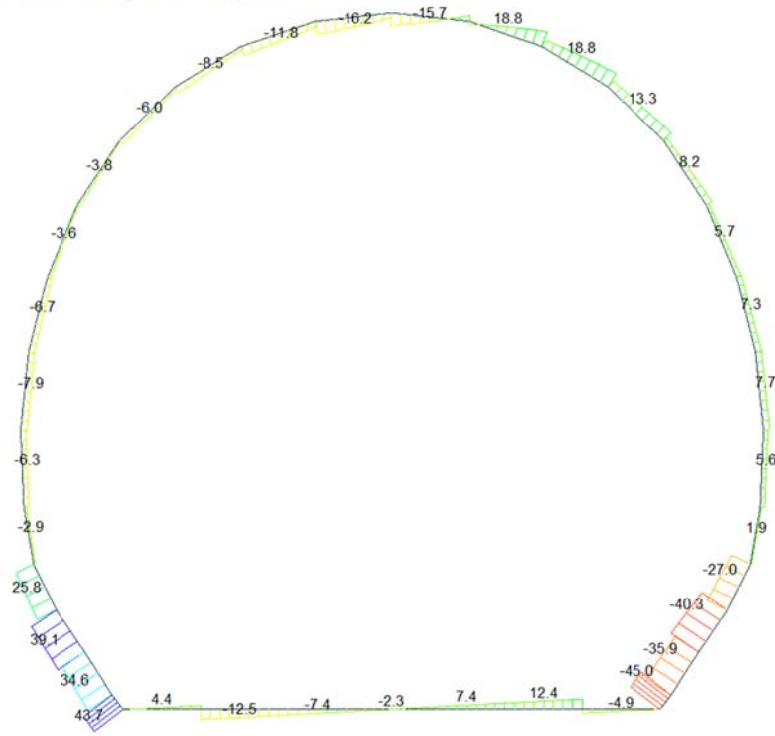
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	10.48
Cyan	7.02
Green	3.57
Light Green	0.00
Yellow-Green	-3.33
Yellow	-6.79
Orange	-10.24
Light Orange	-13.69
Red-Orange	-17.14
Red	-20.60
Dark Red	-24.05
Black	-27.50

ST: N5
MAX : 35
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_Fz - Block analysis / ST_N5



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

43.73
35.66
27.59
19.53
11.46
0.00
-4.68
-12.74
-20.81
-28.88
-36.95
-45.01

ST: N5
MAX: 35
MIN: 8
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N5	1	I[1]	-10.5	-37.3	0.7	0.30	-0.82	0.57	-15.36	1.03	OK	0.003	0.412	1.22	OK
N5	1	J[2]	-11.4	-37.3	4.4	0.30	-0.88	0.64	-15.36	1.03	OK	0.022	0.442	1.23	OK
N5	2	I[2]	-11.4	-34.1	12.5	0.30	-0.87	0.65	-15.36	1.03	OK	0.062	0.437	1.23	OK
N5	2	J[3]	-6.4	-34.1	7.4	0.30	-0.54	0.32	-15.36	1.03	OK	0.037	0.271	1.16	OK
N5	3	I[3]	-6.4	-32.1	7.4	0.30	-0.54	0.32	-15.36	1.03	OK	0.037	0.268	1.16	OK
N5	3	J[4]	-4.0	-32.1	2.3	0.30	-0.37	0.16	-15.36	1.03	OK	0.012	0.187	1.12	OK
N5	4	I[4]	-4.0	-31.4	2.3	0.30	-0.37	0.16	-15.36	1.03	OK	0.012	0.186	1.12	OK
N5	4	J[5]	-4.0	-31.4	2.3	0.30	-0.37	0.16	-15.36	1.03	OK	0.012	0.186	1.12	OK
N5	5	I[5]	-4.0	-31.9	2.3	0.30	-0.37	0.16	-15.36	1.03	OK	0.012	0.186	1.12	OK
N5	5	J[6]	-6.4	-31.9	7.4	0.30	-0.53	0.32	-15.36	1.03	OK	0.037	0.267	1.16	OK
N5	6	I[6]	-6.4	-33.6	7.4	0.30	-0.54	0.32	-15.36	1.03	OK	0.037	0.270	1.16	OK
N5	6	J[7]	-11.4	-33.6	12.4	0.30	-0.87	0.65	-15.36	1.03	OK	0.062	0.435	1.23	OK
N5	7	I[7]	-11.4	-36.7	4.9	0.30	-0.88	0.64	-15.36	1.03	OK	0.024	0.440	1.23	OK
N5	7	J[8]	-10.2	-36.7	0.2	0.30	-0.80	0.56	-15.36	1.03	OK	0.001	0.401	1.21	OK
N5	8	I[9]	5.0	-125.0	44.3	0.30	-0.08	-0.75	-15.36	1.03	OK	0.222	0.417	1.22	OK
N5	8	J[8]	10.2	-125.9	45.0	0.30	0.26	-1.10	-15.36	1.03	OK	0.225	0.550	1.28	OK
N5	9	I[10]	-6.3	-124.6	33.5	0.40	-0.55	-0.07	-15.36	1.03	OK	0.126	0.311	1.18	OK
N5	9	J[9]	5.0	-128.3	35.9	0.40	-0.13	-0.51	-15.36	1.03	OK	0.135	0.321	1.18	OK
N5	10	I[11]	-19.0	-119.2	37.3	0.50	-0.69	0.22	-15.36	1.03	OK	0.112	0.347	1.19	OK
N5	10	J[10]	-6.3	-123.8	40.3	0.50	-0.40	-0.10	-15.36	1.03	OK	0.121	0.248	1.15	OK
N5	11	I[12]	-27.5	-119.2	24.8	0.45	-1.08	0.55	-15.36	1.03	OK	0.083	0.540	1.27	OK
N5	11	J[11]	-19.0	-123.7	27.0	0.45	-0.84	0.29	-15.36	1.03	OK	0.090	0.419	1.22	OK
N5	12	I[13]	-26.9	-117.6	1.9	0.40	-1.30	0.72	-15.36	1.03	OK	0.007	0.652	1.32	OK
N5	12	J[12]	-27.5	-122.5	1.1	0.40	-1.34	0.72	-15.36	1.03	OK	0.004	0.669	1.32	OK
N5	13	I[14]	-24.2	-111.1	5.6	0.35	-1.50	0.87	-15.36	1.03	OK	0.024	0.752	1.35	OK
N5	13	J[13]	-26.9	-117.0	5.3	0.35	-1.65	0.99	-15.36	1.03	OK	0.023	0.827	1.38	OK
N5	14	I[15]	-20.5	-105.1	7.2	0.30	-1.72	1.02	-15.36	1.03	OK	0.036	0.859	1.39	OK
N5	14	J[14]	-24.2	-110.2	7.7	0.30	-1.98	1.25	-15.36	1.03	FESSURATA	0.039	0.991	1.44	OK
N5	15	I[16]	-17.2	-99.2	6.1	0.30	-1.47	0.81	-15.36	1.03	OK	0.031	0.737	1.35	OK
N5	15	J[15]	-20.5	-104.1	7.4	0.30	-1.71	1.02	-15.36	1.03	OK	0.037	0.857	1.39	OK
N5	16	I[17]	-14.8	-93.6	3.8	0.30	-1.30	0.67	-15.36	1.03	OK	0.019	0.648	1.31	OK
N5	16	J[16]	-17.2	-98.3	5.7	0.30	-1.47	0.82	-15.36	1.03	OK	0.029	0.736	1.35	OK
N5	17	I[18]	-11.4	-88.2	5.4	0.30	-1.05	0.46	-15.36	1.03	OK	0.027	0.525	1.27	OK
N5	17	J[17]	-14.8	-92.5	8.2	0.30	-1.29	0.68	-15.36	1.03	OK	0.041	0.646	1.31	OK
N5	18	I[19]	-5.6	-82.7	9.7	0.30	-0.65	0.10	-15.36	1.03	OK	0.049	0.324	1.18	OK
N5	18	J[18]	-11.4	-86.2	13.3	0.30	-1.04	0.47	-15.36	1.03	OK	0.067	0.522	1.26	OK
N5	19	I[20]	1.8	-76.9	8.6	0.30	-0.14	-0.37	-15.36	1.03	OK	0.043	0.256	1.15	OK
N5	19	J[19]	-5.6	-79.5	18.9	0.30	-0.64	0.11	-15.36	1.03	OK	0.094	0.319	1.18	OK
N5	20	I[21]	6.0	-72.2	3.6	0.30	0.16	-0.64	-15.36	1.03	OK	0.018	0.322	1.18	OK
N5	20	J[20]	1.8	-73.9	18.9	0.30	-0.13	-0.35	-15.36	1.03	OK	0.094	0.246	1.15	OK
N5	21	I[22]	3.4	-71.3	15.7	0.30	-0.01	-0.46	-15.36	1.03	OK	0.078	0.238	1.14	OK
N5	21	J[21]	6.0	-71.8	7.0	0.30	0.16	-0.64	-15.36	1.03	OK	0.035	0.321	1.18	OK
N5	22	I[22]	-2.5	-74.2	16.2	0.30	-0.41	-0.08	-15.36	1.03	OK	0.081	0.247	1.15	OK
N5	22	J[22]	3.4	-73.6	5.3	0.30	-0.02	-0.47	-15.36	1.03	OK	0.027	0.245	1.15	OK
N5	23	I[24]	-7.2	-78.4	11.8	0.30	-0.74	0.22	-15.36	1.03	OK	0.059	0.369	1.20	OK
N5	23	J[23]	-2.5	-76.7	7.0	0.30	-0.42	-0.09	-15.36	1.03	OK	0.035	0.256	1.15	OK
N5	24	I[25]	-10.3	-82.8	8.5	0.30	-0.96	0.41	-15.36	1.03	OK	0.042	0.482	1.25	OK
N5	24	J[24]	-7.2	-80.1	4.2	0.30	-0.74	0.21	-15.36	1.03	OK	0.021	0.372	1.20	OK
N5	25	I[26]	-12.4	-87.5	6.1	0.30	-1.12	0.54	-15.36	1.03	OK	0.030	0.560	1.28	OK
N5	25	J[25]	-10.3	-84.0	2.4	0.30	-0.97	0.41	-15.36	1.03	OK	0.012	0.484	1.25	OK
N5	26	I[27]	-13.6	-92.5	3.8	0.30	-1.22	0.60	-15.36	1.03	OK	0.019	0.609	1.30	OK
N5	26	J[26]	-12.4	-88.2	1.0	0.30	-1.12	0.53	-15.36	1.03	OK	0.005	0.561	1.28	OK
N5	27	I[28]	-15.0	-97.7	3.6	0.30	-1.32	0.67	-15.36	1.03	OK	0.018	0.661	1.32	OK
N5	27	J[27]	-13.6	-93.0	1.7	0.30	-1.22	0.60	-15.36	1.03	OK	0.008	0.610	1.30	OK
N5	28	I[29]	-18.0	-103.2	6.7	0.30	-1.54	0.86	-15.36	1.03	OK	0.034	0.772	1.36	OK
N5	28	J[28]	-15.0	-98.3	5.5	0.30	-1.33	0.67	-15.36	1.03	OK	0.027	0.663	1.32	OK
N5	29	I[30]	-21.8	-109.3	7.9	0.30	-1.82	1.09	-15.36	1.03	FESSURATA	0.040	0.910	1.41	OK
N5	29	J[29]	-18.0	-104.3	7.4	0.30	-1.55	0.85	-15.36	1.03	OK	0.037	0.774	1.36	OK
N5	30	I[31]	-24.9	-116.2	6.0	0.35	-1.55	0.89	-15.36	1.03	OK	0.026	0.776	1.36	OK
N5	30	J[30]	-21.8	-110.3	6.3	0.35	-1.38	0.75	-15.36	1.03	OK	0.027	0.692	1.33	OK
N5	31	I[32]	-26.8	-121.8	2.1	0.40	-1.27	0.66	-15.36	1.03	OK	0.008	0.637	1.31	OK
N5	31	J[31]	-24.9	-116.9	2.9	0.40	-1.23	0.64	-15.36	1.03	OK	0.011	0.613	1.30	OK
N5	32	I[33]	-17.7	-123.3	25.8	0.45	-0.80	0.25	-15.36	1.03	OK	0.086	0.400	1.21	OK
N5	32	J[32]	-26.8	-118.8	23.6	0.45	-1.03	0.50	-15.36	1.03	OK	0.079	0.515	1.26	OK
N5	33	I[34]	-5.5	-123.6	39.1	0.50	-0.38	-0.12	-15.36	1.03	OK	0.117	0.247	1.15	OK
N5	33	J[33]	-17.7	-119.0	36.0	0.50	-0.66	0.19	-15.36	1.03	OK	0.108	0.332	1.18	OK
N5	34	I[35]	5.4	-128.0	34.6	0.40	-0.12	-0.52	-15.36	1.03	OK	0.130	0.320	1.18	OK
N5	34	J[34]	-5.5	-124.3	32.2	0.40	-0.52	-0.10	-15.36	1.03	OK	0.121	0.311	1.17	OK
N5	35	I[1]	10.5	-125.8	43.7	0.30	0.28	-1.12	-15.36	1.03	OK	0.219	0.559	1.28	OK
N5	35	J[35]	5.4	-124.9	43.0	0.30	-0.05	-0.78	-15.36	1.03	OK	0.215	0.416	1.22	OK

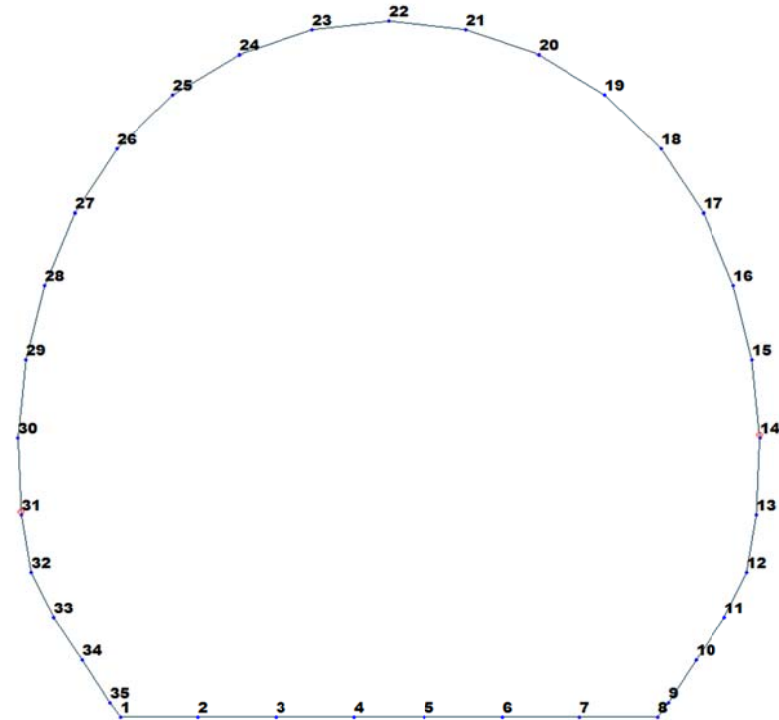


Figure 17 Beam end release

Table 5 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
14	Value	0	0	0	0	0	0	0	0	0	0	44850	0
30	Value	0	0	0	0	59100	0	0	0	0	0	0	0

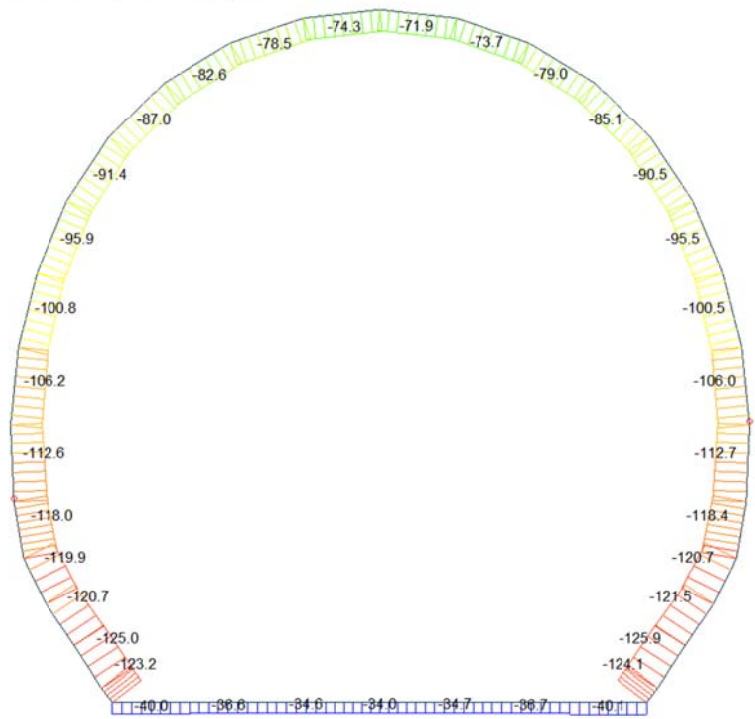
ITERAZIONE SECONDO IL METODO DI PÖTTLER
CALCOLO CERNIERE PLASTICHE
ITERAZIONE IN NODO 14 J

<p style="text-align: center;">MIDAS</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>$C_{f_{MIDAS}}$, arbitraria</td> <td>0.000022</td> <td>[rad/kN²m]</td> </tr> <tr> <td>$1/C_{f_{MIDAS}}$, arbitraria</td> <td>44'850</td> <td>[kN²m/rad]</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>M_{nodo}</td> <td>13.350</td> <td>[kN²m]</td> </tr> <tr> <td>N_{nodo}</td> <td>106.050</td> <td>[kN]</td> </tr> <tr> <td>V_{nodo}</td> <td>4.350</td> <td>[kN]</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>$C_{f_{MIDAS}} = C_{f_{PÖTTLER}}$</td> <td>SI</td> </tr> <tr> <td>$\Psi_{PÖTTLER} < 4 \text{ mrad}$</td> <td>SI</td> </tr> </table>	$C_{f_{MIDAS}}$, arbitraria	0.000022	[rad/kN ² m]	$1/C_{f_{MIDAS}}$, arbitraria	44'850	[kN ² m/rad]	M_{nodo}	13.350	[kN ² m]	N_{nodo}	106.050	[kN]	V_{nodo}	4.350	[kN]	$C_{f_{MIDAS}} = C_{f_{PÖTTLER}}$	SI	$\Psi_{PÖTTLER} < 4 \text{ mrad}$	SI		<p style="text-align: center;">PÖTTLER</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>E_p</td> <td>26'400'000</td> <td>[kN/m²]</td> </tr> <tr> <td>d</td> <td>0.30</td> <td>[m]</td> </tr> <tr> <td>e</td> <td>0.1260</td> <td>[m]</td> </tr> <tr> <td>a</td> <td>0.07</td> <td>[m]</td> </tr> <tr> <td>$\Psi_{PÖTTLER}$</td> <td>0.0003013</td> <td>[rad]</td> </tr> <tr> <td>$C_{f_{PÖTTLER}}$</td> <td>0.0000226</td> <td>[rad/kN²m]</td> </tr> <tr> <td>$1/C_{f_{PÖTTLER}}$</td> <td>44'334</td> <td>[kN²m/rad]</td> </tr> </table> <div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin-left: auto;">0.301347</div>	E_p	26'400'000	[kN/m ²]	d	0.30	[m]	e	0.1260	[m]	a	0.07	[m]	$\Psi_{PÖTTLER}$	0.0003013	[rad]	$C_{f_{PÖTTLER}}$	0.0000226	[rad/kN ² m]	$1/C_{f_{PÖTTLER}}$	44'334	[kN ² m/rad]
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ITERAZIONE IN NODO 30 I

<p style="text-align: center;">MIDAS</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>$C_{f_{MIDAS}}$, arbitraria</td> <td>0.000017</td> <td>[rad/kN²m]</td> </tr> <tr> <td>$1/C_{f_{MIDAS}}$, arbitraria</td> <td>59'100</td> <td>[kN²m/rad]</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>M_{nodo}</td> <td>13.050</td> <td>[kN²m]</td> </tr> <tr> <td>N_{nodo}</td> <td>106.220</td> <td>[kN]</td> </tr> <tr> <td>V_{nodo}</td> <td>3.270</td> <td>[kN]</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>$C_{f_{MIDAS}} = C_{f_{PÖTTLER}}$</td> <td>SI</td> </tr> <tr> <td>$\Psi_{PÖTTLER} < 4 \text{ mrad}$</td> <td>SI</td> </tr> </table>	$C_{f_{MIDAS}}$, arbitraria	0.000017	[rad/kN ² m]	$1/C_{f_{MIDAS}}$, arbitraria	59'100	[kN ² m/rad]	M_{nodo}	13.050	[kN ² m]	N_{nodo}	106.220	[kN]	V_{nodo}	3.270	[kN]	$C_{f_{MIDAS}} = C_{f_{PÖTTLER}}$	SI	$\Psi_{PÖTTLER} < 4 \text{ mrad}$	SI		<p style="text-align: center;">PÖTTLER</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>E_p</td> <td>26'400'000</td> <td>[kN/m²]</td> </tr> <tr> <td>d</td> <td>0.30</td> <td>[m]</td> </tr> <tr> <td>e</td> <td>0.1230</td> <td>[m]</td> </tr> <tr> <td>a</td> <td>0.08</td> <td>[m]</td> </tr> <tr> <td>$\Psi_{PÖTTLER}$</td> <td>0.0002194</td> <td>[rad]</td> </tr> <tr> <td>$C_{f_{PÖTTLER}}$</td> <td>0.0000168</td> <td>[rad/kN²m]</td> </tr> <tr> <td>$1/C_{f_{PÖTTLER}}$</td> <td>59'537</td> <td>[kN²m/rad]</td> </tr> </table> <div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin-left: auto;">0.219361</div>	E_p	26'400'000	[kN/m ²]	d	0.30	[m]	e	0.1230	[m]	a	0.08	[m]	$\Psi_{PÖTTLER}$	0.0002194	[rad]	$C_{f_{PÖTTLER}}$	0.0000168	[rad/kN ² m]	$1/C_{f_{PÖTTLER}}$	59'537	[kN ² m/rad]
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$C_{f_{MIDAS}} = C_{f_{PÖTTLER}}$	SI																																									
$\Psi_{PÖTTLER} < 4 \text{ mrad}$	SI																																									
E_p	26'400'000	[kN/m ²]																																								
d	0.30	[m]																																								
e	0.1230	[m]																																								
a	0.08	[m]																																								
$\Psi_{PÖTTLER}$	0.0002194	[rad]																																								
$C_{f_{PÖTTLER}}$	0.0000168	[rad/kN ² m]																																								
$1/C_{f_{PÖTTLER}}$	59'537	[kN ² m/rad]																																								

Beam Diagram_Fx - Block analysis / ST_N5

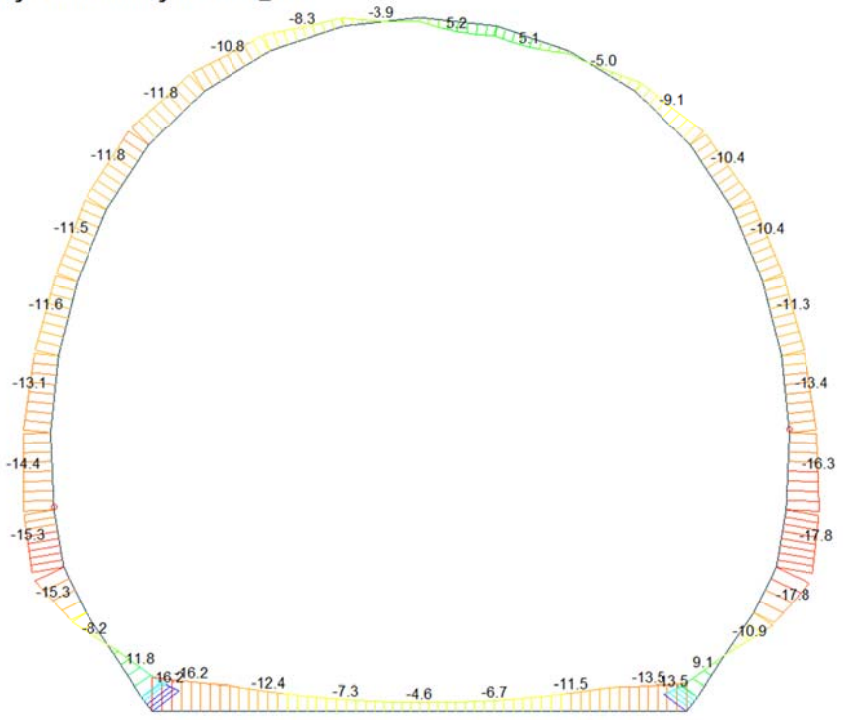


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: N5
MAX : 4
MIN : 9
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_N5

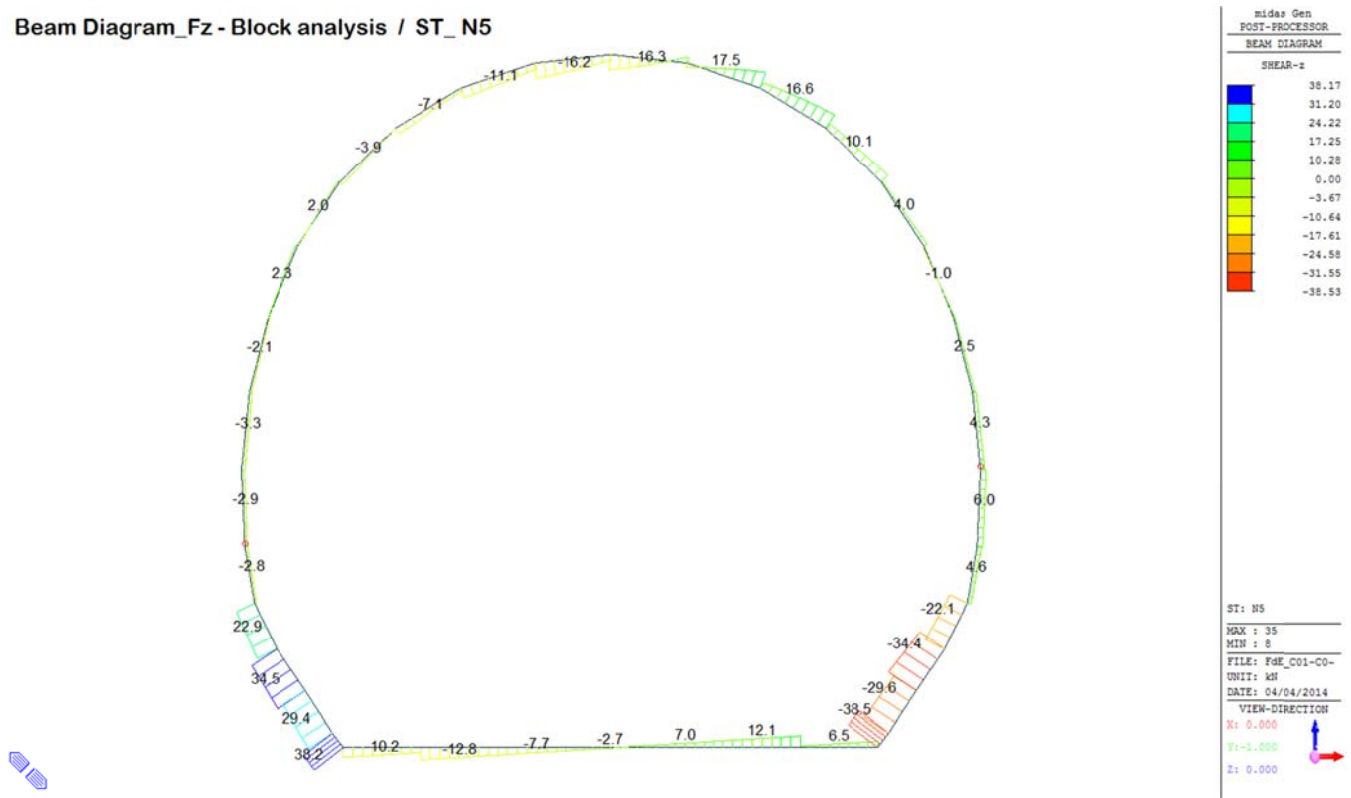


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

ST: N5
MAX : 35
MIN : 12
FILE: PdE_C01-CO-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - Block analysis / ST_N5



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

38.17
31.20
24.22
17.25
10.28
0.00
-3.67
-10.64
-17.61
-24.58
-31.55
-38.53

ST: N5
MAX : 35
MIN : 8
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 0.000
Z: 0.000

VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ct} [N/mm ²]	30.71	$f_{ctk,0.95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95\%}$ [N/mm ²]	15.36	$f_{ctk,95\%}$ [N/mm ²]	1.030	E_p [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 14 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,95\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,95\%}$
N5	14 j	Calotta	13.4	106.1	4.4	26'400'000	0.126	0.30	OK	2.94	15.36	OK

Combinazione di carico	Nodo n°	a [m]	$\Phi_{Prestor}$ [rad]	$1/C_f$ MIDAS [kN·m/rad]	$1/C_f$ Prestor [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{Prestor}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,95\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	f_{cvd} (EC2) [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N5	14 j	0.072	0.3013466	44'850	44'334	OK	0.069	OK	1.03	0.09	7.14	2.02	OK

VERIFICA SEZIONE NODO 30 i

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,95\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,95\%}$
N5	30 i	Volta Dx	13.1	106.2	3.3	26'400'000	0.123	0.30	OK	2.62	15.36	OK

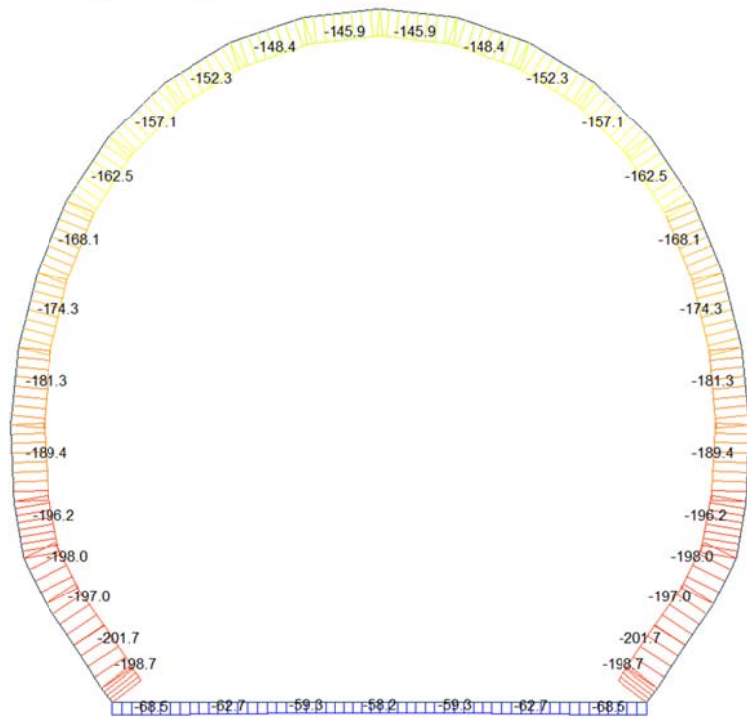
Combinazione di carico	Nodo n°	a [m]	$\Phi_{Prestor}$ [rad]	$1/C_f$ MIDAS [kN·m/rad]	$1/C_f$ Prestor [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{Prestor}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,95\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	f_{cvd} (EC2) [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N5	30 i	0.081	0.2193612	59'100	59'537	OK	0.048	OK	1.03	0.06	7.14	1.94	OK

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup}	σ _{inf}	f _{ctd,95%}	f _{ctd,95%}		τ _{cp}	τ _{cp}	f _{ctd,EC2}	Verifica a taglio
							[N/mm ²]	[N/mm ²]	[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	[N/mm ²]	T _{cp,max} ≤ F _{ctd}
N5	1	I[1]	-16.2	-40.0	10.2	0.30	-1.22	0.95	-15.36	1.03	OK	0.051	0.608	1.30	OK
N5	1	J[2]	-12.4	-40.0	5.2	0.30	-0.96	0.69	-15.36	1.03	OK	0.026	0.480	1.25	OK
N5	2	I[2]	-12.4	-36.6	12.8	0.30	-0.95	0.70	-15.36	1.03	OK	0.064	0.474	1.24	OK
N5	2	J[3]	-7.3	-36.6	7.7	0.30	-0.61	0.36	-15.36	1.03	OK	0.039	0.303	1.17	OK
N5	3	I[3]	-7.3	-34.6	7.7	0.30	-0.60	0.37	-15.36	1.03	OK	0.039	0.299	1.17	OK
N5	3	J[4]	-4.7	-34.6	2.7	0.30	-0.43	0.19	-15.36	1.03	OK	0.013	0.213	1.13	OK
N5	4	I[4]	-4.7	-34.0	2.7	0.30	-0.42	0.20	-15.36	1.03	OK	0.013	0.212	1.13	OK
N5	4	J[5]	-4.5	-34.0	2.0	0.30	-0.41	0.19	-15.36	1.03	OK	0.010	0.206	1.13	OK
N5	5	I[5]	-4.5	-34.7	2.0	0.30	-0.41	0.18	-15.36	1.03	OK	0.010	0.207	1.13	OK
N5	5	J[6]	-6.7	-34.7	7.0	0.30	-0.56	0.33	-15.36	1.03	OK	0.035	0.282	1.16	OK
N5	6	I[6]	-6.7	-36.7	7.0	0.30	-0.57	0.33	-15.36	1.03	OK	0.035	0.286	1.16	OK
N5	6	J[7]	-11.5	-36.7	12.1	0.30	-0.89	0.65	-15.36	1.03	OK	0.060	0.445	1.23	OK
N5	7	I[7]	-11.5	-40.1	1.5	0.30	-0.90	0.63	-15.36	1.03	OK	0.007	0.451	1.23	OK
N5	7	J[8]	-13.5	-40.1	6.5	0.30	-1.04	0.77	-15.36	1.03	OK	0.033	0.518	1.26	OK
N5	8	I[9]	9.1	-123.1	37.8	0.30	0.19	-1.02	-15.36	1.03	OK	0.189	0.508	1.26	OK
N5	8	J[8]	13.5	-124.1	38.5	0.30	0.49	-1.31	-15.36	1.03	OK	0.193	0.657	1.32	OK
N5	9	I[10]	-0.2	-122.2	27.2	0.40	-0.31	-0.30	-15.36	1.03	OK	0.102	0.305	1.17	OK
N5	9	J[9]	9.1	-125.9	29.6	0.40	0.03	-0.66	-15.36	1.03	OK	0.111	0.328	1.18	OK
N5	10	I[11]	-10.9	-117.0	31.3	0.50	-0.50	0.03	-15.36	1.03	OK	0.094	0.248	1.15	OK
N5	10	J[10]	-0.2	-121.5	34.4	0.50	-0.25	-0.24	-15.36	1.03	OK	0.103	0.243	1.14	OK
N5	11	I[12]	-17.9	-116.2	19.9	0.45	-0.79	0.27	-15.36	1.03	OK	0.066	0.394	1.21	OK
N5	11	J[11]	-10.9	-120.7	22.1	0.45	-0.59	0.06	-15.36	1.03	OK	0.074	0.296	1.17	OK
N5	12	I[13]	-16.3	-113.5	4.6	0.40	-0.89	0.33	-15.36	1.03	OK	0.017	0.447	1.23	OK
N5	12	J[12]	-17.9	-118.4	3.8	0.40	-0.97	0.37	-15.36	1.03	OK	0.014	0.483	1.25	OK
N5	13	I[14]	-13.4	-106.8	6.0	0.35	-0.96	0.35	-15.36	1.03	OK	0.026	0.480	1.25	OK
N5	13	J[13]	-16.3	-112.7	5.7	0.35	-1.12	0.48	-15.36	1.03	OK	0.024	0.560	1.28	OK
N5	14	I[15]	-11.3	-101.0	3.8	0.30	-1.09	0.42	-15.36	1.03	OK	0.019	0.546	1.27	OK
N5	14	J[14]	-13.4	-106.1	4.4	0.30	-1.24	0.54	-15.36	1.03	OK	0.022	0.622	1.30	OK
N5	15	I[16]	-10.4	-95.6	1.3	0.30	-1.01	0.37	-15.36	1.03	OK	0.007	0.505	1.26	OK
N5	15	J[15]	-11.3	-100.5	2.6	0.30	-1.09	0.42	-15.36	1.03	OK	0.013	0.545	1.27	OK
N5	16	I[17]	-10.4	-90.8	1.0	0.30	-0.99	0.39	-15.36	1.03	OK	0.005	0.497	1.25	OK
N5	16	J[16]	-10.4	-95.5	0.9	0.30	-1.01	0.37	-15.36	1.03	OK	0.005	0.504	1.26	OK
N5	17	I[18]	-9.1	-86.3	1.2	0.30	-0.89	0.32	-15.36	1.03	OK	0.006	0.446	1.23	OK
N5	17	J[17]	-10.4	-90.5	4.0	0.30	-0.99	0.39	-15.36	1.03	OK	0.020	0.497	1.25	OK
N5	18	I[19]	-5.0	-81.5	6.4	0.30	-0.60	0.06	-15.36	1.03	OK	0.032	0.301	1.17	OK
N5	18	J[18]	-9.1	-85.1	10.1	0.30	-0.89	0.32	-15.36	1.03	OK	0.050	0.444	1.23	OK
N5	19	I[20]	1.3	-76.4	6.4	0.30	-0.17	-0.34	-15.36	1.03	OK	0.032	0.255	1.15	OK
N5	19	J[19]	-5.0	-79.0	16.6	0.30	-0.59	0.07	-15.36	1.03	OK	0.083	0.297	1.17	OK
N5	20	I[21]	4.9	-72.1	5.0	0.30	0.08	-0.57	-15.36	1.03	OK	0.025	0.283	1.16	OK
N5	20	J[20]	1.3	-73.7	17.5	0.30	-0.16	-0.33	-15.36	1.03	OK	0.087	0.246	1.15	OK
N5	21	I[22]	1.9	-71.4	16.3	0.30	-0.11	-0.37	-15.36	1.03	OK	0.081	0.238	1.14	OK
N5	21	J[21]	4.9	-72.0	6.4	0.30	0.08	-0.56	-15.36	1.03	OK	0.032	0.282	1.16	OK
N5	22	I[23]	-3.9	-74.3	16.2	0.30	-0.51	0.01	-15.36	1.03	OK	0.081	0.255	1.15	OK
N5	22	J[22]	1.9	-73.8	5.3	0.30	-0.12	-0.37	-15.36	1.03	OK	0.026	0.246	1.15	OK
N5	23	I[24]	-8.3	-78.5	11.1	0.30	-0.81	0.29	-15.36	1.03	OK	0.056	0.407	1.22	OK
N5	23	J[23]	-3.9	-76.8	6.4	0.30	-0.52	0.01	-15.36	1.03	OK	0.032	0.259	1.15	OK
N5	24	I[25]	-10.8	-82.6	7.1	0.30	-0.99	0.44	-15.36	1.03	OK	0.036	0.497	1.25	OK
N5	24	J[24]	-8.3	-80.0	2.8	0.30	-0.82	0.29	-15.36	1.03	OK	0.014	0.410	1.22	OK
N5	25	I[26]	-11.8	-87.0	3.9	0.30	-1.08	0.50	-15.36	1.03	OK	0.019	0.539	1.27	OK
N5	25	J[25]	-10.8	-83.4	0.2	0.30	-1.00	0.44	-15.36	1.03	OK	0.001	0.498	1.25	OK
N5	26	I[27]	-11.5	-91.4	0.7	0.30	-1.07	0.46	-15.36	1.03	OK	0.004	0.535	1.27	OK
N5	26	J[26]	-11.8	-87.2	2.0	0.30	-1.08	0.50	-15.36	1.03	OK	0.010	0.539	1.27	OK
N5	27	I[28]	-10.8	-95.9	0.3	0.30	-1.04	0.40	-15.36	1.03	OK	0.002	0.521	1.26	OK
N5	27	J[27]	-11.5	-91.2	2.3	0.30	-1.07	0.46	-15.36	1.03	OK	0.011	0.535	1.27	OK
N5	28	I[29]	-11.6	-100.8	2.1	0.30	-1.11	0.43	-15.36	1.03	OK	0.010	0.553	1.28	OK
N5	28	J[28]	-10.8	-95.9	0.8	0.30	-1.04	0.40	-15.36	1.03	OK	0.004	0.521	1.26	OK
N5	29	I[30]	-13.1	-106.2	3.3	0.30	-1.22	0.52	-15.36	1.03	OK	0.016	0.612	1.30	OK
N5	29	J[29]	-11.6	-101.2	2.8	0.30	-1.11	0.43	-15.36	1.03	OK	0.014	0.554	1.28	OK
N5	30	I[31]	-14.5	-112.6	2.7	0.35	-1.03	0.39	-15.36	1.03	OK	0.011	0.515	1.26	OK
N5	30	J[30]	-13.1	-106.7	2.9	0.35	-0.94	0.33	-15.36	1.03	OK	0.012	0.472	1.24	OK
N5	31	I[32]	-15.3	-118.0	1.9	0.40	-0.87	0.28	-15.36	1.03	OK	0.007	0.435	1.23	OK
N5	31	J[31]	-14.5	-113.1	2.8	0.40	-0.82	0.26	-15.36	1.03	OK	0.010	0.412	1.22	OK
N5	32	I[33]	-8.2	-119.9	22.9	0.45	-0.51	-0.02	-15.36	1.03	OK	0.076	0.266	1.16	OK
N5	32	J[32]	-15.3	-115.4	20.7	0.45	-0.71	0.20	-15.36	1.03	OK	0.069	0.355	1.19	OK
N5	33	I[34]	2.6	-120.7	34.5	0.50	-0.18	-0.30	-15.36	1.03	OK	0.104	0.241	1.14	OK
N5	33	J[33]	-8.2	-116.1	31.4	0.50	-0.43	-0.04	-15.36	1.03	OK	0.094	0.232	1.14	OK
N5	34	I[35]	11.8	-125.0	29.4	0.40	0.13	-0.76	-15.36	1.03	OK	0.110	0.378	1.20	OK
N5	34	J[34]	2.6	-121.3	27.1	0.40	-0.21	-0.40	-15.36	1.03	OK	0.101	0.303	1.17	OK
N5	35	I[1]	16.2	-123.2	38.2	0.30	0.67	-1.49	-15.36	1.03	OK	0.191	0.746	1.35	OK
N5	35	J[35]	11.8	-122.3	37.5	0.30	0.38	-1.20	-15.36	1.03	OK	0.187	0.599	1.29	OK

A.5.4.4. Load combination SLU 5 FEM analysis

Beam Diagram_Fx - FEM analysis / ST_N5

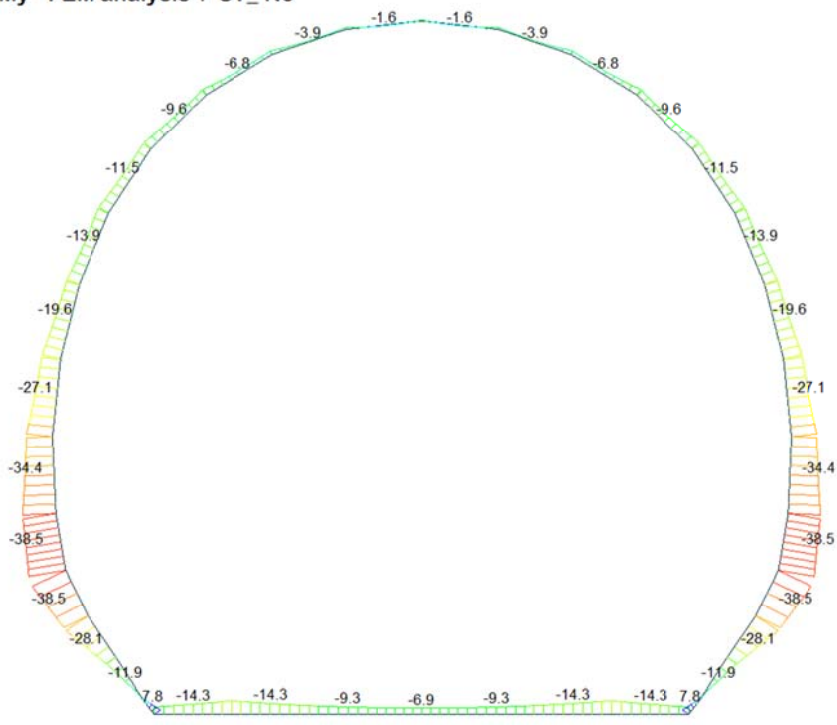


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: N5
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_N5

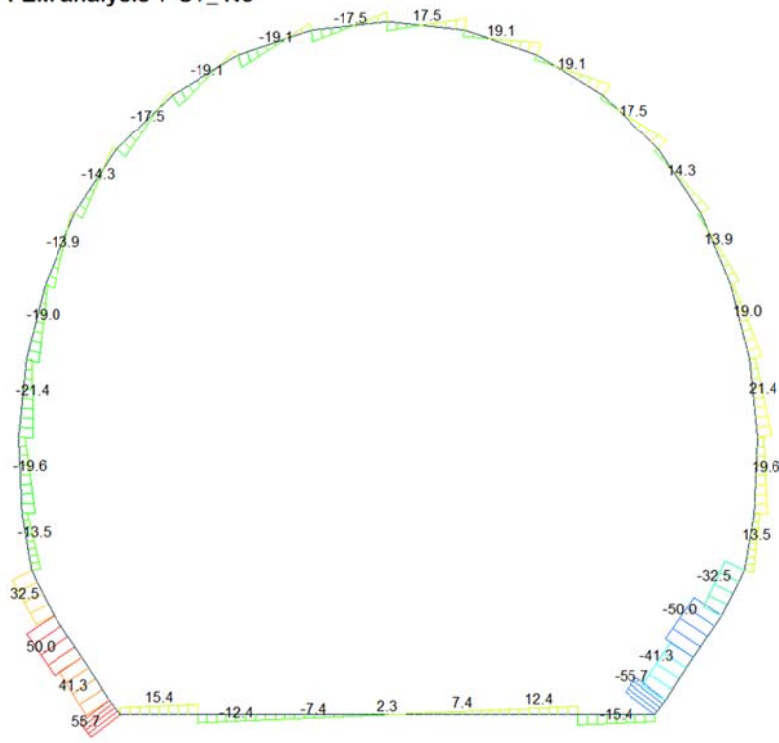


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

ST: N5
MAX : 8
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - FEM analysis / ST_N5



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

55.69
45.57
35.44
25.31
15.19
5.06
0.00
-15.19
-25.31
-35.44
-45.57
-55.69

ST: NS

MAX : 35
MIN : 8

FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION

X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ctd,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N5	1	I[1]	-7.9	-68.5	10.4	0.30	-0.75	0.29	-15.36	1.03	OK	0.052	0.376	1.20	OK
N5	1	J[2]	-14.3	-68.5	15.4	0.30	-1.18	0.69	-15.36	1.03	OK	0.077	0.591	1.29	OK
N5	2	I[2]	-14.3	-62.7	12.5	0.30	-1.16	0.69	-15.36	1.03	OK	0.062	0.581	1.29	OK
N5	2	J[3]	-9.3	-62.7	7.4	0.30	-0.83	0.41	-15.36	1.03	OK	0.037	0.416	1.22	OK
N5	3	I[3]	-9.3	-59.3	7.4	0.30	-0.82	0.43	-15.36	1.03	OK	0.037	0.410	1.22	OK
N5	3	J[4]	-6.9	-59.3	2.3	0.30	-0.66	0.26	-15.36	1.03	OK	0.012	0.329	1.18	OK
N5	4	I[4]	-6.9	-58.2	2.3	0.30	-0.65	0.27	-15.36	1.03	OK	0.012	0.327	1.18	OK
N5	4	J[5]	-6.9	-58.2	2.3	0.30	-0.65	0.27	-15.36	1.03	OK	0.012	0.327	1.18	OK
N5	5	I[5]	-6.9	-59.3	2.3	0.30	-0.66	0.26	-15.36	1.03	OK	0.012	0.329	1.18	OK
N5	5	J[6]	-9.3	-59.3	7.4	0.30	-0.82	0.43	-15.36	1.03	OK	0.037	0.410	1.22	OK
N5	6	I[6]	-9.3	-62.7	7.4	0.30	-0.83	0.41	-15.36	1.03	OK	0.037	0.416	1.22	OK
N5	6	J[7]	-14.3	-62.7	12.5	0.30	-1.16	0.74	-15.36	1.03	OK	0.062	0.581	1.29	OK
N5	7	I[7]	-14.3	-68.5	15.4	0.30	-1.18	0.72	-15.36	1.03	OK	0.077	0.591	1.29	OK
N5	7	J[8]	-7.9	-68.5	10.4	0.30	-0.75	0.29	-15.36	1.03	OK	0.052	0.376	1.20	OK
N5	8	I[8]	1.4	-197.8	55.1	0.30	-0.57	-0.75	-15.36	1.03	OK	0.276	0.659	1.32	OK
N5	8	J[9]	7.9	-198.7	55.7	0.30	-0.14	-1.19	-15.36	1.03	OK	0.278	0.662	1.32	OK
N5	9	I[9]	-11.9	-198.0	40.5	0.40	-0.94	-0.05	-15.36	1.03	OK	0.152	0.495	1.25	OK
N5	9	J[10]	1.4	-201.7	41.3	0.40	-0.45	-0.56	-15.36	1.03	OK	0.155	0.504	1.26	OK
N5	10	I[11]	-28.2	-192.5	49.8	0.50	-1.06	0.29	-15.36	1.03	OK	0.149	0.530	1.27	OK
N5	10	J[10]	-11.9	-197.0	50.0	0.50	-0.68	-0.11	-15.36	1.03	OK	0.150	0.394	1.21	OK
N5	11	I[12]	-38.5	-193.6	32.6	0.45	-1.57	0.71	-15.36	1.03	OK	0.109	0.785	1.37	OK
N5	11	J[11]	-28.2	-198.1	30.5	0.45	-1.27	0.33	-15.36	1.03	OK	0.102	0.637	1.31	OK
N5	12	I[13]	-34.5	-191.3	8.0	0.40	-1.77	0.78	-15.36	1.03	OK	0.030	0.885	1.40	OK
N5	12	J[12]	-38.5	-196.2	13.5	0.40	-1.93	0.95	-15.36	1.03	OK	0.050	0.967	1.43	OK
N5	13	I[14]	-27.1	-183.5	9.4	0.35	-1.85	0.80	-15.36	1.03	OK	0.040	0.926	1.42	OK
N5	13	J[13]	-34.5	-189.4	19.6	0.35	-2.23	1.15	-15.36	1.03	FESSURATA	0.084	1.114	1.49	OK
N5	14	I[15]	-19.6	-176.3	8.4	0.30	-1.89	0.72	-15.36	1.03	OK	0.042	0.947	1.43	OK
N5	14	J[14]	-27.1	-181.3	21.4	0.30	-2.41	1.20	-15.36	1.03	FESSURATA	0.107	1.206	1.52	OK
N5	15	I[16]	-13.9	-169.4	3.3	0.30	-1.49	0.36	-15.36	1.03	OK	0.016	0.747	1.35	OK
N5	15	J[15]	-19.6	-174.3	19.0	0.30	-1.89	0.73	-15.36	1.03	OK	0.095	0.943	1.43	OK
N5	16	I[17]	-11.5	-163.5	4.6	0.30	-1.31	0.22	-15.36	1.03	OK	0.023	0.657	1.32	OK
N5	16	J[16]	-13.9	-168.1	13.9	0.30	-1.49	0.37	-15.36	1.03	OK	0.069	0.745	1.35	OK
N5	17	I[18]	-9.6	-158.3	7.0	0.30	-1.17	0.11	-15.36	1.03	OK	0.035	0.584	1.29	OK
N5	17	J[17]	-11.5	-162.5	14.3	0.30	-1.31	0.23	-15.36	1.03	OK	0.072	0.655	1.32	OK
N5	18	I[19]	-6.8	-153.6	6.7	0.30	-0.97	-0.06	-15.36	1.03	OK	0.033	0.512	1.26	OK
N5	18	J[18]	-9.6	-157.1	17.5	0.30	-1.16	0.12	-15.36	1.03	OK	0.088	0.582	1.29	OK
N5	19	I[20]	-3.9	-149.6	7.8	0.30	-0.76	-0.24	-15.36	1.03	OK	0.039	0.499	1.25	OK
N5	19	J[19]	-6.8	-152.3	19.1	0.30	-0.96	-0.05	-15.36	1.03	OK	0.095	0.508	1.26	OK
N5	20	I[21]	-1.6	-146.7	10.3	0.30	-0.60	-0.38	-15.36	1.03	OK	0.051	0.489	1.25	OK
N5	20	J[20]	-3.9	-148.4	19.1	0.30	-0.76	-0.23	-15.36	1.03	OK	0.096	0.495	1.25	OK
N5	21	I[22]	-0.7	-145.4	14.1	0.30	-0.53	-0.44	-15.36	1.03	OK	0.071	0.485	1.25	OK
N5	21	J[21]	-1.6	-145.9	17.5	0.30	-0.60	-0.38	-15.36	1.03	OK	0.088	0.486	1.25	OK
N5	22	I[22]	-0.7	-145.4	14.1	0.30	-0.53	-0.44	-15.36	1.03	OK	0.071	0.485	1.25	OK
N5	23	I[24]	-3.9	-148.4	19.1	0.30	-0.76	-0.23	-15.36	1.03	OK	0.096	0.495	1.25	OK
N5	23	J[23]	-1.6	-146.7	10.3	0.30	-0.60	-0.38	-15.36	1.03	OK	0.051	0.489	1.25	OK
N5	24	I[25]	-6.8	-152.3	19.1	0.30	-0.96	-0.05	-15.36	1.03	OK	0.095	0.508	1.26	OK
N5	24	J[24]	-3.9	-149.6	7.8	0.30	-0.76	-0.24	-15.36	1.03	OK	0.039	0.499	1.25	OK
N5	25	I[26]	-9.6	-157.1	17.5	0.30	-1.16	0.12	-15.36	1.03	OK	0.088	0.582	1.29	OK
N5	25	J[25]	-6.8	-153.6	6.7	0.30	-0.97	-0.06	-15.36	1.03	OK	0.033	0.512	1.26	OK
N5	26	I[27]	-11.5	-162.5	14.3	0.30	-1.31	0.23	-15.36	1.03	OK	0.072	0.655	1.32	OK
N5	26	J[26]	-9.6	-158.3	7.0	0.30	-1.17	0.11	-15.36	1.03	OK	0.035	0.584	1.29	OK
N5	27	I[28]	-13.9	-168.1	13.9	0.30	-1.49	0.37	-15.36	1.03	OK	0.069	0.745	1.35	OK
N5	27	J[27]	-11.5	-163.5	4.6	0.30	-1.31	0.22	-15.36	1.03	OK	0.023	0.657	1.32	OK
N5	28	I[29]	-19.6	-174.3	19.0	0.30	-1.89	0.73	-15.36	1.03	OK	0.095	0.943	1.43	OK
N5	28	J[28]	-13.9	-169.4	3.3	0.30	-1.49	0.36	-15.36	1.03	OK	0.016	0.747	1.35	OK
N5	29	I[30]	-27.1	-181.3	21.4	0.30	-2.41	1.20	-15.36	1.03	FESSURATA	0.107	1.206	1.52	OK
N5	29	J[29]	-19.6	-176.3	8.4	0.30	-1.89	0.72	-15.36	1.03	OK	0.042	0.947	1.43	OK
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N5	30	J[30]	-27.1	-183.5	9.4	0.35	-1.85	0.80	-15.36	1.03	OK	0.040	0.926	1.42	OK
N5	31	I[32]	-38.5	-196.2	13.5	0.40	-1.93	0.95	-15.36	1.03	OK	0.050	0.967	1.43	OK
N5	31	J[31]	-34.4	-191.3	8.0	0.40	-1.77	0.81	-15.36	1.03	OK	0.030	0.885	1.40	OK
N5	32	I[33]	-28.2	-198.1	30.5	0.45	-1.27	0.39	-15.36	1.03	OK	0.102	0.637	1.31	OK
N5	32	J[32]	-38.5	-193.6	32.6	0.45	-1.57	0.71	-15.36	1.03	OK	0.109	0.785	1.37	OK
N5	33	I[34]	-11.9	-197.0	50.0	0.50	-0.68	-0.11	-15.36	1.03	OK	0.150	0.394	1.21	OK
N5	33	J[33]	-28.2	-192.5	49.8	0.50	-1.06	0.29	-15.36	1.03	OK	0.149	0.530	1.27	OK
N5	34	I[35]	1.4	-201.7	41.3	0.40	-0.45	-0.56	-15.36	1.03	OK	0.155	0.504	1.26	OK
N5	34	J[34]	-11.9	-198.0	40.5	0.40	-0.94	-0.05	-15.36	1.03	OK	0.152	0.495	1.25	OK
N5	35	I[1]	7.9	-198.7	55.7	0.30	-0.14	-1.19	-15.36	1.03	OK	0.278	0.662	1.32	OK
N5	35	J[35]	1.4	-197.8	55.1	0.30	-0.57	-0.75	-15.36	1.03	OK	0.276	0.659	1.32	OK

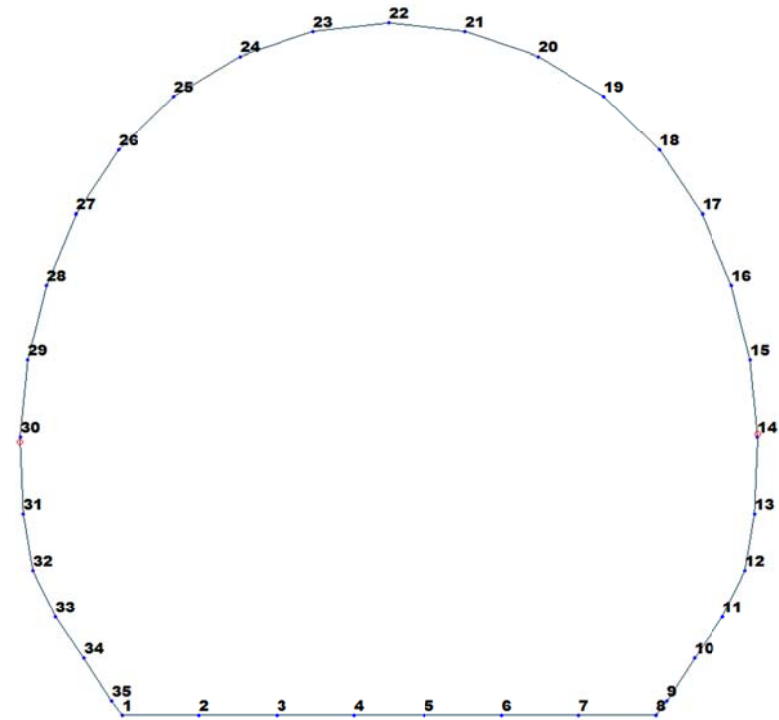


Figure 18 Beam end release

Table 6 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
14	Value	0	0	0	0	0	0	0	0	0	0	256000	0
30	Value	0	0	0	0	0	0	0	0	0	0	269500	0

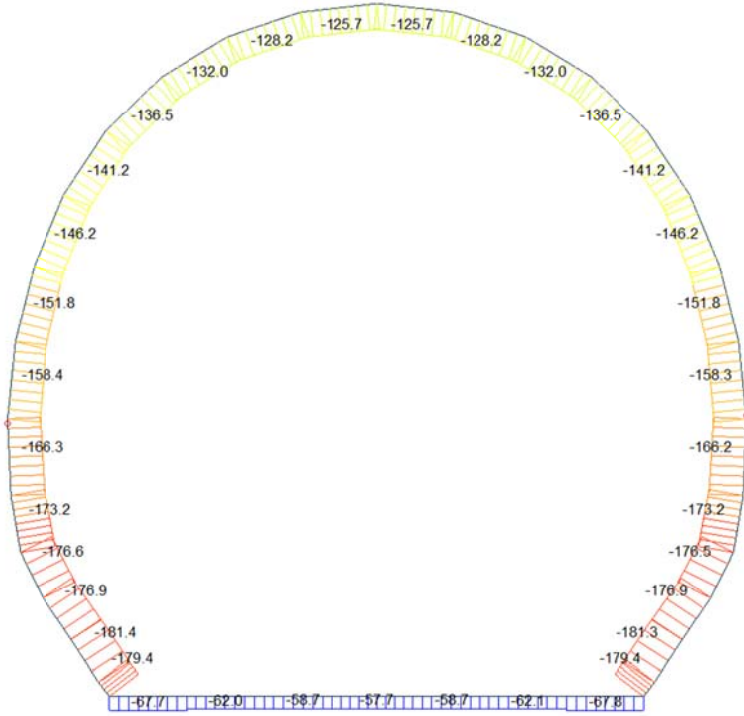
ITERAZIONE SECONDO IL METODO DI PÖTTLER
CALCOLO CERNIERE PLASTICHE
ITERAZIONE IN NODO 14 J

<p>MIDAS</p> <table border="1" style="width: 100%;"> <tr> <td>$Cf_{fissale, arbitraria}$</td> <td>0.000004</td> <td>[rad/kN*m]</td> </tr> <tr> <td>$1/Cf_{fissale, arbitraria}$</td> <td>256'000</td> <td>[kN*m/rad]</td> </tr> </table> <table border="1" style="width: 100%;"> <tr> <td>M_{nodo}</td> <td>16.700</td> <td>[kN*m]</td> </tr> <tr> <td>N_{nodo}</td> <td>158.340</td> <td>[kN]</td> </tr> <tr> <td>V_{nodo}</td> <td>18.610</td> <td>[kN]</td> </tr> </table> <table border="1" style="width: 100%;"> <tr> <td>$Cf_{MIDAS} = Cf_{PÖTTLER}$</td> <td>SI</td> </tr> <tr> <td>$\Psi_{PÖTTLER} < 4 \text{ mrad}$</td> <td>SI</td> </tr> </table>	$Cf_{fissale, arbitraria}$	0.000004	[rad/kN*m]	$1/Cf_{fissale, arbitraria}$	256'000	[kN*m/rad]	M_{nodo}	16.700	[kN*m]	N_{nodo}	158.340	[kN]	V_{nodo}	18.610	[kN]	$Cf_{MIDAS} = Cf_{PÖTTLER}$	SI	$\Psi_{PÖTTLER} < 4 \text{ mrad}$	SI		<p>PÖTTLER</p> <table border="1" style="width: 100%;"> <tr> <td>E_p</td> <td>26'400'000</td> <td>[kN/m²]</td> </tr> <tr> <td>d</td> <td>0.30</td> <td>[m]</td> </tr> <tr> <td>e</td> <td>0.1055</td> <td>[m]</td> </tr> <tr> <td>a</td> <td>0.13</td> <td>[m]</td> </tr> <tr> <td>$\Psi_{PÖTTLER}$</td> <td>0.0000651</td> <td>[rad]</td> </tr> <tr> <td>$Cf_{PÖTTLER}$</td> <td>0.0000039</td> <td>[rad/kN*m]</td> </tr> <tr> <td>$1/Cf_{PÖTTLER}$</td> <td>256'674</td> <td>[kN*m/rad]</td> </tr> </table> <p style="text-align: right; margin-right: 20px;">0.065063</p>	E_p	26'400'000	[kN/m ²]	d	0.30	[m]	e	0.1055	[m]	a	0.13	[m]	$\Psi_{PÖTTLER}$	0.0000651	[rad]	$Cf_{PÖTTLER}$	0.0000039	[rad/kN*m]	$1/Cf_{PÖTTLER}$	256'674	[kN*m/rad]
$Cf_{fissale, arbitraria}$	0.000004	[rad/kN*m]																																								
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ITERAZIONE IN NODO 30 J

<p>MIDAS</p> <table border="1" style="width: 100%;"> <tr> <td>$Cf_{fissale, arbitraria}$</td> <td>0.000004</td> <td>[rad/kN*m]</td> </tr> <tr> <td>$1/Cf_{fissale, arbitraria}$</td> <td>269'500</td> <td>[kN*m/rad]</td> </tr> </table> <table border="1" style="width: 100%;"> <tr> <td>M_{nodo}</td> <td>16.810</td> <td>[kN*m]</td> </tr> <tr> <td>N_{nodo}</td> <td>160.380</td> <td>[kN]</td> </tr> <tr> <td>V_{nodo}</td> <td>9.080</td> <td>[kN]</td> </tr> </table> <table border="1" style="width: 100%;"> <tr> <td>$Cf_{MIDAS} = Cf_{PÖTTLER}$</td> <td>SI</td> </tr> <tr> <td>$\Psi_{PÖTTLER} < 4 \text{ mrad}$</td> <td>SI</td> </tr> </table>	$Cf_{fissale, arbitraria}$	0.000004	[rad/kN*m]	$1/Cf_{fissale, arbitraria}$	269'500	[kN*m/rad]	M_{nodo}	16.810	[kN*m]	N_{nodo}	160.380	[kN]	V_{nodo}	9.080	[kN]	$Cf_{MIDAS} = Cf_{PÖTTLER}$	SI	$\Psi_{PÖTTLER} < 4 \text{ mrad}$	SI		<p>PÖTTLER</p> <table border="1" style="width: 100%;"> <tr> <td>E_p</td> <td>26'400'000</td> <td>[kN/m²]</td> </tr> <tr> <td>d</td> <td>0.30</td> <td>[m]</td> </tr> <tr> <td>e</td> <td>0.1048</td> <td>[m]</td> </tr> <tr> <td>a</td> <td>0.14</td> <td>[m]</td> </tr> <tr> <td>$\Psi_{PÖTTLER}$</td> <td>0.0000622</td> <td>[rad]</td> </tr> <tr> <td>$Cf_{PÖTTLER}$</td> <td>0.0000037</td> <td>[rad/kN*m]</td> </tr> <tr> <td>$1/Cf_{PÖTTLER}$</td> <td>270'308</td> <td>[kN*m/rad]</td> </tr> </table> <p style="text-align: right; margin-right: 20px;">0.062188</p>	E_p	26'400'000	[kN/m ²]	d	0.30	[m]	e	0.1048	[m]	a	0.14	[m]	$\Psi_{PÖTTLER}$	0.0000622	[rad]	$Cf_{PÖTTLER}$	0.0000037	[rad/kN*m]	$1/Cf_{PÖTTLER}$	270'308	[kN*m/rad]
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Beam Diagram_Fx - FEM analysis / ST_N5

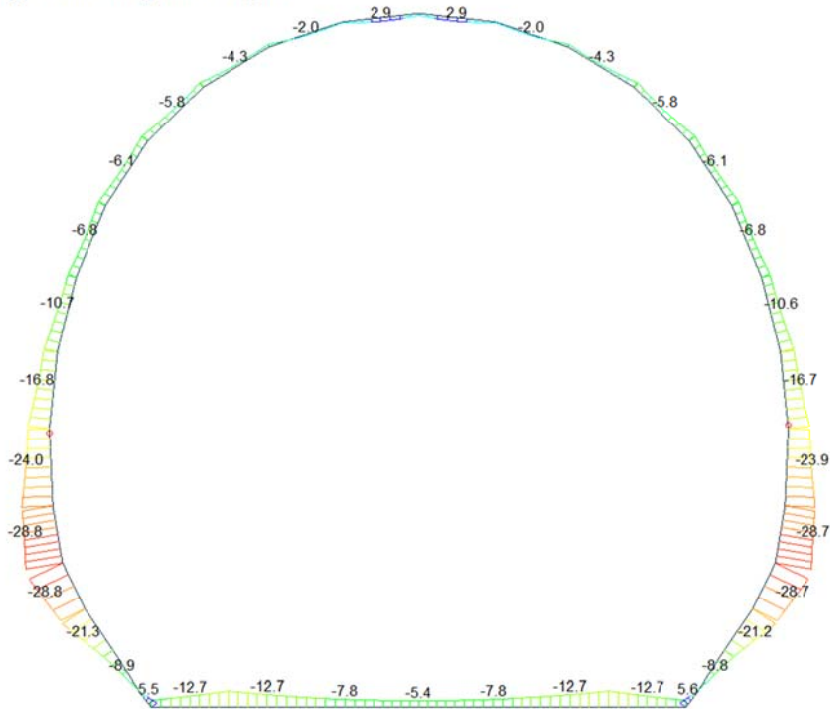


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: N5
MAX : 4
MIN : 34
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/07/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_N5

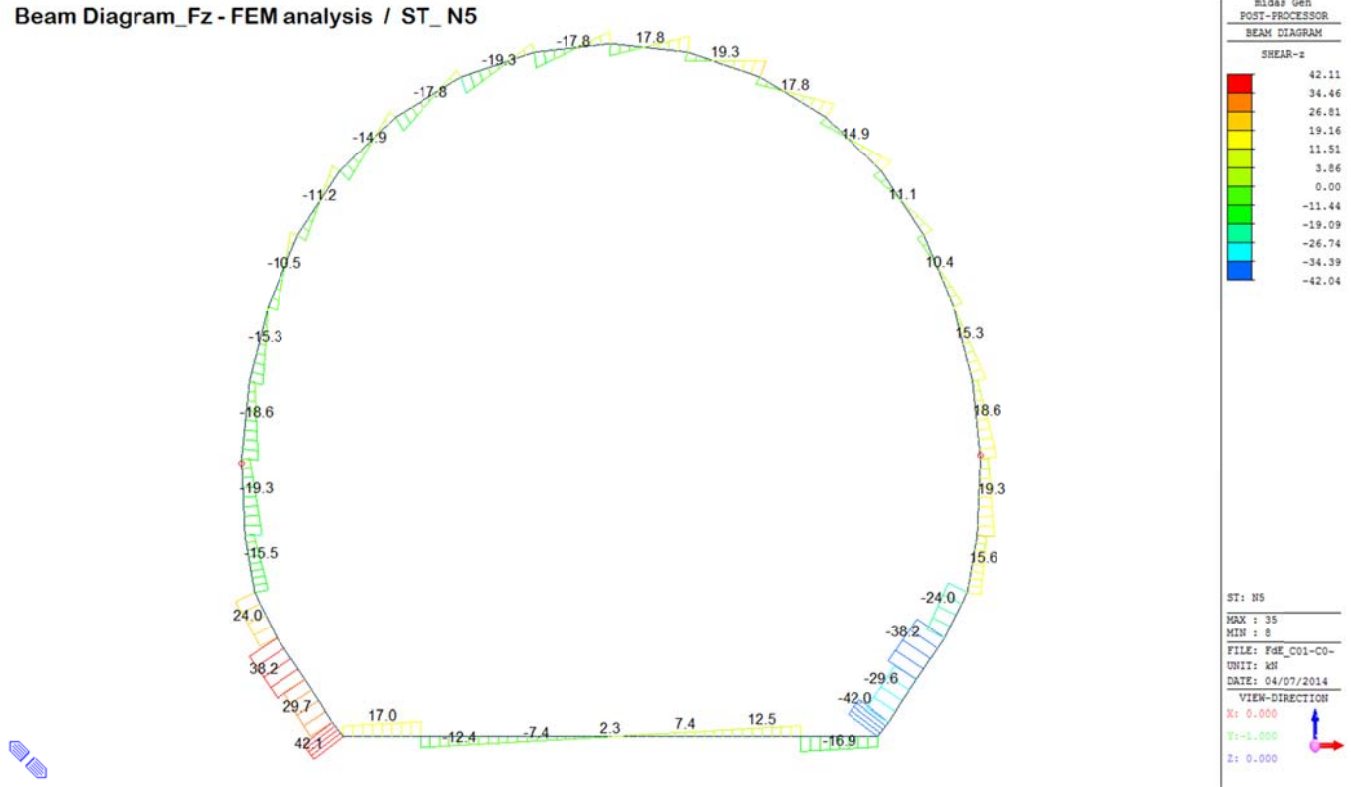


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

ST: N5
MAX : 8
MIN : 31
FILE: PdE_C01-CO-
UNIT: kNm
DATE: 04/07/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - FEM analysis / ST_N5



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_s [N/mm ²]	37.00	F_d [N/mm ²]	30.71	$f_{ctk,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctk,95}$ [N/mm ²]	1.030	E_p [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 14 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,95}$
N5	14 j	Calotta	16.7	158.3	18.6	26'400'000	0.105	0.30	OK	2.37	15.36	OK

Combinazione di carico	Nodo n°	a [m]	$\psi_{posteri}$ [rad]	$1/C_f$ MIDAS [kN°m/rad]	$1/C_f$ Posteri [kN°m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{posteri}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,95}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	f_{cvd} (EC2) [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N5	14 j	0.134	0.0650632	256'000	256'674	OK	0.011	OK	1.03	0.21	7.14	1.87	OK

VERIFICA SEZIONE NODO 30 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,95}$
N5	30 i	Volta Dx	16.8	160.4	9.1	26'400'000	0.105	0.30	OK	2.37	15.36	OK

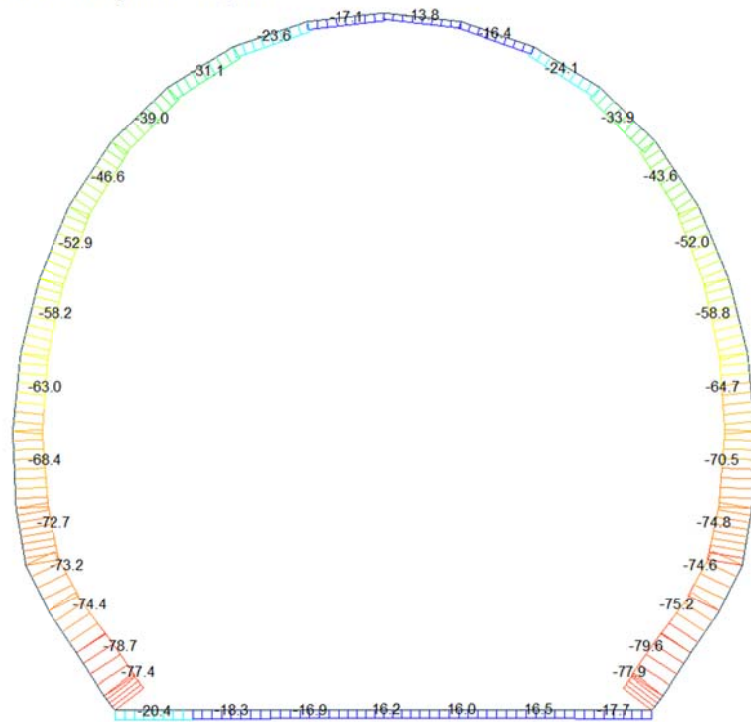
Combinazione di carico	Nodo n°	a [m]	$\psi_{posteri}$ [rad]	$1/C_f$ MIDAS [kN°m/rad]	$1/C_f$ Posteri [kN°m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{posteri}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,95}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	f_{cvd} (EC2) [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N5	30 i	0.136	0.0621882	269'500	270'308	OK	0.010	OK	1.03	0.10	7.14	1.87	OK

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup} [N/mm ²]	σ _{inf} [N/mm ²]	f _{ct,d,95%} [N/mm ²]	f _{ct,d,95%} [N/mm ²]		τ _{cp} [N/mm ²]	τ _{cp} [N/mm ²]	f _{ct,d,EC2} [N/mm ²]	Verifica a taglio τ _{cp,max} ≤ F _{ct,d}
N5	1	I[1]	-5.5	-67.7	11.9	0.30	-0.59	0.14	-15.36	1.03	OK	0.060	0.297	1.17	OK
N5	1	J[2]	-12.7	-67.7	17.0	0.30	-1.08	0.62	-15.36	1.03	OK	0.085	0.538	1.27	OK
N5	2	I[2]	-12.7	-62.0	12.5	0.30	-1.06	0.64	-15.36	1.03	OK	0.062	0.528	1.27	OK
N5	2	J[3]	-7.8	-62.0	7.4	0.30	-0.73	0.31	-15.36	1.03	OK	0.037	0.363	1.20	OK
N5	3	I[3]	-7.8	-58.7	7.4	0.30	-0.71	0.32	-15.36	1.03	OK	0.037	0.357	1.20	OK
N5	3	J[4]	-5.4	-58.7	2.3	0.30	-0.55	0.16	-15.36	1.03	OK	0.012	0.277	1.16	OK
N5	4	I[4]	-5.4	-57.7	2.3	0.30	-0.55	0.16	-15.36	1.03	OK	0.012	0.275	1.16	OK
N5	4	J[5]	-5.4	-57.7	2.3	0.30	-0.55	0.16	-15.36	1.03	OK	0.012	0.275	1.16	OK
N5	5	I[5]	-5.4	-58.8	2.3	0.30	-0.55	0.16	-15.36	1.03	OK	0.012	0.277	1.16	OK
N5	5	J[6]	-7.8	-58.8	7.4	0.30	-0.72	0.32	-15.36	1.03	OK	0.037	0.358	1.20	OK
N5	6	I[6]	-7.8	-62.1	7.4	0.30	-0.73	0.31	-15.36	1.03	OK	0.037	0.363	1.20	OK
N5	6	J[7]	-12.8	-62.1	12.5	0.30	-1.06	0.64	-15.36	1.03	OK	0.062	0.528	1.27	OK
N5	7	I[7]	-12.8	-67.8	16.9	0.30	-1.08	0.62	-15.36	1.03	OK	0.085	0.538	1.27	OK
N5	7	J[8]	-5.6	-67.8	11.9	0.30	-0.60	0.14	-15.36	1.03	OK	0.059	0.297	1.17	OK
N5	8	I[9]	0.7	-178.5	41.5	0.30	-0.55	0.64	-15.36	1.03	OK	0.207	0.585	1.29	OK
N5	8	J[8]	5.6	-179.4	42.0	0.30	-0.23	-0.97	-15.36	1.03	OK	0.210	0.598	1.29	OK
N5	9	I[10]	-8.8	-177.7	28.8	0.40	-0.77	-0.11	-15.36	1.03	OK	0.108	0.444	1.23	OK
N5	9	J[9]	0.7	-181.4	29.6	0.40	-0.43	-0.48	-15.36	1.03	OK	0.111	0.453	1.24	OK
N5	10	I[11]	-21.2	-172.4	37.9	0.50	-0.85	0.16	-15.36	1.03	OK	0.114	0.427	1.22	OK
N5	10	J[10]	-8.8	-176.9	38.2	0.50	-0.57	-0.14	-15.36	1.03	OK	0.115	0.354	1.19	OK
N5	11	I[12]	-28.7	-172.0	24.0	0.45	-1.23	0.47	-15.36	1.03	OK	0.080	0.616	1.30	OK
N5	11	J[11]	-21.2	-176.5	22.0	0.45	-1.02	0.24	-15.36	1.03	OK	0.073	0.510	1.26	OK
N5	12	I[13]	-23.9	-168.2	10.1	0.40	-1.32	0.47	-15.36	1.03	OK	0.038	0.658	1.32	OK
N5	12	J[12]	-28.7	-173.2	15.6	0.40	-1.51	0.64	-15.36	1.03	OK	0.058	0.755	1.36	OK
N5	13	I[14]	-16.7	-160.3	9.1	0.35	-1.28	0.36	-15.36	1.03	OK	0.039	0.638	1.31	OK
N5	13	J[13]	-23.9	-166.2	19.3	0.35	-1.64	0.69	-15.36	1.03	OK	0.083	0.822	1.38	OK
N5	14	I[15]	-10.6	-153.3	5.6	0.30	-1.22	0.19	-15.36	1.03	OK	0.028	0.608	1.30	OK
N5	14	J[14]	-16.7	-158.3	18.6	0.30	-1.64	0.59	-15.36	1.03	OK	0.093	0.821	1.38	OK
N5	15	I[16]	-6.8	-146.9	0.5	0.30	-0.94	-0.04	-15.36	1.03	OK	0.002	0.490	1.25	OK
N5	15	J[15]	-10.6	-151.8	15.3	0.30	-1.21	0.20	-15.36	1.03	OK	0.076	0.605	1.30	OK
N5	16	I[17]	-6.1	-141.5	8.0	0.30	-0.88	-0.06	-15.36	1.03	OK	0.040	0.472	1.24	OK
N5	16	J[16]	-6.8	-146.2	10.4	0.30	-0.94	-0.04	-15.36	1.03	OK	0.052	0.487	1.25	OK
N5	17	I[18]	-5.8	-137.0	10.2	0.30	-0.84	-0.07	-15.36	1.03	OK	0.051	0.457	1.24	OK
N5	17	J[17]	-6.1	-141.2	11.1	0.30	-0.88	-0.06	-15.36	1.03	OK	0.056	0.471	1.24	OK
N5	18	I[19]	-4.3	-132.9	9.3	0.30	-0.73	-0.16	-15.36	1.03	OK	0.046	0.443	1.23	OK
N5	18	J[18]	-5.8	-136.5	14.9	0.30	-0.84	-0.07	-15.36	1.03	OK	0.074	0.455	1.24	OK
N5	19	I[20]	-2.0	-129.4	9.1	0.30	-0.57	-0.30	-15.36	1.03	OK	0.045	0.431	1.23	OK
N5	19	J[19]	-4.3	-132.0	17.8	0.30	-0.73	-0.15	-15.36	1.03	OK	0.089	0.440	1.23	OK
N5	20	I[21]	0.4	-126.6	10.1	0.30	-0.40	-0.45	-15.36	1.03	OK	0.050	0.422	1.22	OK
N5	20	J[20]	-2.0	-128.2	19.3	0.30	-0.56	-0.29	-15.36	1.03	OK	0.097	0.427	1.22	OK
N5	21	I[22]	1.4	-125.2	13.9	0.30	-0.32	-0.51	-15.36	1.03	OK	0.069	0.417	1.22	OK
N5	21	J[21]	0.4	-125.8	17.8	0.30	-0.40	-0.44	-15.36	1.03	OK	0.089	0.419	1.22	OK
N5	22	I[23]	0.4	-125.8	17.8	0.30	-0.40	-0.44	-15.36	1.03	OK	0.089	0.419	1.22	OK
N5	22	J[22]	1.4	-125.2	13.8	0.30	-0.32	-0.51	-15.36	1.03	OK	0.069	0.417	1.22	OK
N5	23	I[24]	-2.1	-128.2	19.3	0.30	-0.56	-0.29	-15.36	1.03	OK	0.097	0.427	1.22	OK
N5	23	J[23]	0.4	-126.6	10.0	0.30	-0.40	-0.45	-15.36	1.03	OK	0.050	0.422	1.22	OK
N5	24	I[25]	-4.3	-132.0	17.8	0.30	-0.73	-0.15	-15.36	1.03	OK	0.089	0.440	1.23	OK
N5	24	J[24]	-2.1	-129.4	9.1	0.30	-0.57	-0.29	-15.36	1.03	OK	0.045	0.431	1.23	OK
N5	25	I[26]	-5.8	-136.5	14.9	0.30	-0.84	-0.07	-15.36	1.03	OK	0.075	0.455	1.24	OK
N5	25	J[25]	-4.3	-133.0	9.3	0.30	-0.73	-0.16	-15.36	1.03	OK	0.046	0.443	1.23	OK
N5	26	I[27]	-6.1	-141.2	11.2	0.30	-0.88	-0.06	-15.36	1.03	OK	0.056	0.471	1.24	OK
N5	26	J[26]	-5.8	-137.0	10.1	0.30	-0.84	-0.07	-15.36	1.03	OK	0.051	0.457	1.24	OK
N5	27	I[28]	-6.8	-146.2	10.5	0.30	-0.94	-0.03	-15.36	1.03	OK	0.062	0.487	1.25	OK
N5	27	J[27]	-6.1	-141.5	8.0	0.30	-0.88	-0.06	-15.36	1.03	OK	0.040	0.472	1.24	OK
N5	28	I[29]	-10.7	-151.8	15.3	0.30	-1.22	0.20	-15.36	1.03	OK	0.077	0.608	1.30	OK
N5	28	J[28]	-6.8	-146.9	0.4	0.30	-0.95	-0.03	-15.36	1.03	OK	0.002	0.490	1.25	OK
N5	29	I[30]	-16.8	-158.4	18.6	0.30	-1.65	0.59	-15.36	1.03	OK	0.093	0.824	1.38	OK
N5	29	J[29]	-10.7	-153.3	5.7	0.30	-1.22	0.20	-15.36	1.03	OK	0.028	0.611	1.30	OK
N5	30	I[31]	-24.0	-166.3	19.3	0.35	-1.65	0.70	-15.36	1.03	OK	0.083	0.825	1.38	OK
N5	30	J[30]	-16.8	-160.4	9.1	0.35	-1.28	0.37	-15.36	1.03	OK	0.039	0.641	1.31	OK
N5	31	I[32]	-28.8	-173.2	15.6	0.40	-1.51	0.65	-15.36	1.03	OK	0.058	0.757	1.36	OK
N5	31	J[31]	-24.0	-168.2	10.1	0.40	-1.32	0.48	-15.36	1.03	OK	0.038	0.660	1.32	OK
N5	32	I[33]	-21.3	-176.6	22.0	0.45	-1.02	0.24	-15.36	1.03	OK	0.073	0.511	1.26	OK
N5	32	J[32]	-28.8	-172.1	24.1	0.45	-1.24	0.47	-15.36	1.03	OK	0.080	0.618	1.30	OK
N5	33	I[34]	-8.9	-176.9	38.2	0.50	-0.57	-0.14	-15.36	1.03	OK	0.115	0.354	1.19	OK
N5	33	J[33]	-21.3	-172.4	38.0	0.50	-0.86	0.17	-15.36	1.03	OK	0.114	0.428	1.22	OK
N5	34	I[35]	0.7	-181.4	29.7	0.40	-0.43	-0.48	-15.36	1.03	OK	0.111	0.453	1.24	OK
N5	34	J[34]	-8.9	-177.7	28.8	0.40	-0.78	-0.11	-15.36	1.03	OK	0.108	0.444	1.23	OK
N5	35	I[1]	5.5	-179.4	42.1	0.30	-0.23	-0.97	-15.36	1.03	OK	0.211	0.598	1.29	OK
N5	35	J[35]	0.7	-178.5	41.6	0.30	-0.55	-0.64	-15.36	1.03	OK	0.208	0.595	1.29	OK

A.5.4.5. Load combination SLU 6 Block analysis

Beam Diagram_Fx - Block analysis / ST_N6



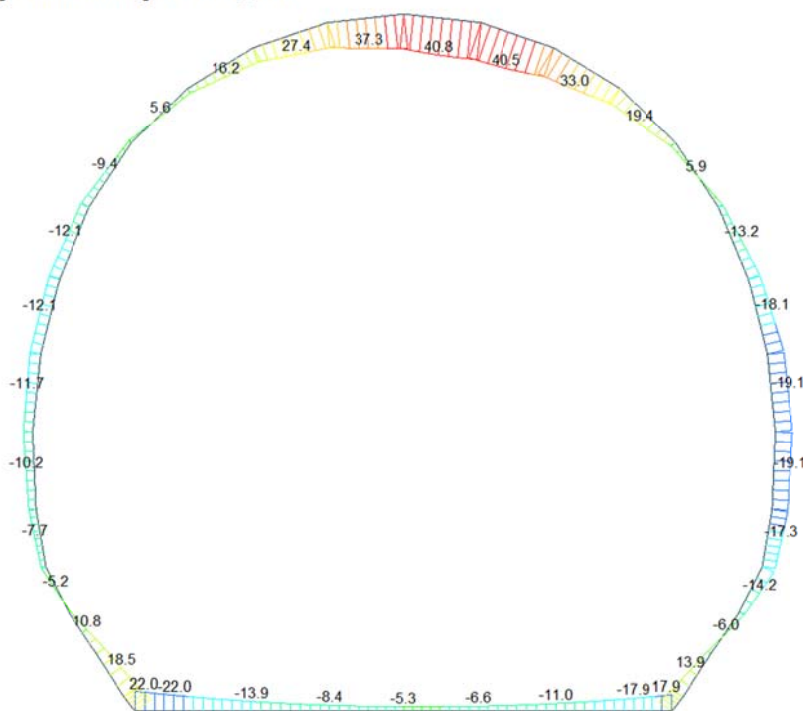
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-13.21
Cyan	-19.24
Green	-25.27
Light Green	-31.30
Yellow-Green	-37.34
Yellow	-43.37
Orange-Yellow	-49.40
Orange	-55.43
Red-Orange	-61.47
Red	-67.50
Dark Red	-73.53
Dark Red	-79.56

ST: N6
MAX : 21
MIN : 9
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_N6



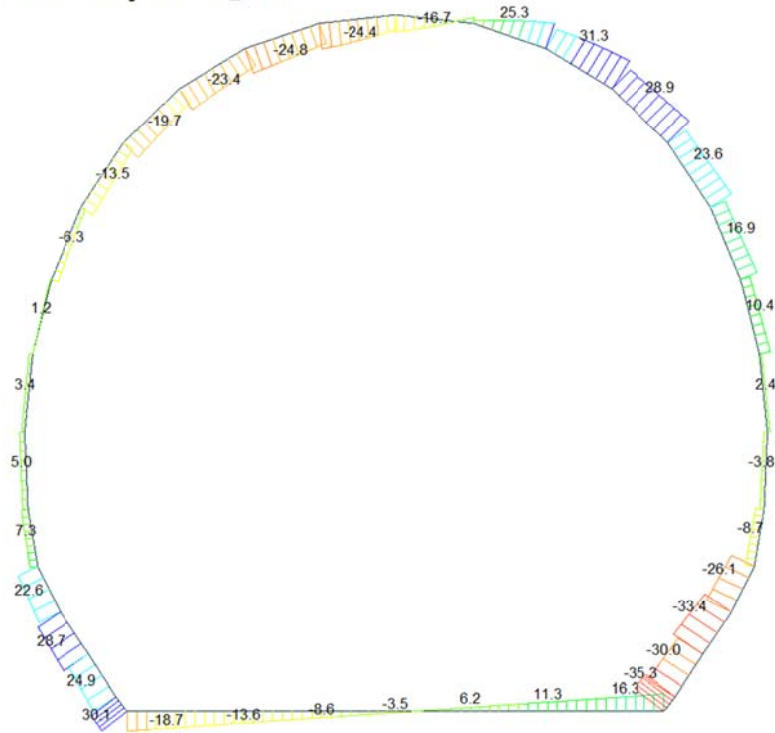
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Red	40.79
Dark Red	35.08
Red-Orange	29.38
Orange	23.67
Yellow-Orange	17.96
Yellow	12.26
Light Green	6.55
Green	0.00
Cyan	-4.86
Blue-Cyan	-10.57
Blue	-16.28
Dark Blue	-21.98

ST: N6
MAX : 21
MIN : 1
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - Block analysis / ST_N6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

31.32
25.26
19.20
13.14
7.08
0.00
-5.05
-11.11
-17.17
-23.23
-29.29
-35.35

ST: N6

MAX : 19
MIN : 8

FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION

X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N6	1	I[1]	-22.0	-20.4	18.7	0.30	-1.53	1.40	-15.36	1.03	FESSURATA	0.093	0.767	1.36	OK
N6	1	J[2]	-13.9	-20.4	13.6	0.30	-1.00	0.86	-15.36	1.03	OK	0.068	0.498	1.25	OK
N6	2	I[2]	-13.9	-18.3	13.6	0.30	-0.99	0.87	-15.36	1.03	OK	0.068	0.494	1.25	OK
N6	2	J[3]	-8.4	-18.3	8.6	0.30	-0.62	0.50	-15.36	1.03	OK	0.043	0.309	1.17	OK
N6	3	I[3]	-8.4	-16.9	8.6	0.30	-0.61	0.50	-15.36	1.03	OK	0.043	0.307	1.17	OK
N6	3	J[4]	-5.4	-16.9	3.5	0.30	-0.41	0.30	-15.36	1.03	OK	0.018	0.207	1.13	OK
N6	4	I[4]	-5.4	-16.2	3.5	0.30	-0.41	0.30	-15.36	1.03	OK	0.018	0.205	1.13	OK
N6	4	J[5]	-4.8	-16.2	1.2	0.30	-0.37	0.27	-15.36	1.03	OK	0.006	0.187	1.12	OK
N6	5	I[5]	-4.8	-16.0	1.2	0.30	-0.37	0.27	-15.36	1.03	OK	0.006	0.187	1.12	OK
N6	5	J[6]	-6.7	-16.0	6.2	0.30	-0.50	0.39	-15.36	1.03	OK	0.031	0.248	1.15	OK
N6	6	I[6]	-6.7	-16.5	6.2	0.30	-0.50	0.39	-15.36	1.03	OK	0.031	0.249	1.15	OK
N6	6	J[7]	-11.0	-16.5	11.3	0.30	-0.79	0.68	-15.36	1.03	OK	0.056	0.395	1.21	OK
N6	7	I[7]	-11.0	-17.7	11.3	0.30	-0.79	0.68	-15.36	1.03	OK	0.056	0.397	1.21	OK
N6	7	J[8]	-17.9	-17.7	16.3	0.30	-1.25	1.14	-15.36	1.03	FESSURATA	0.082	0.627	1.31	OK
N6	8	I[9]	13.9	-76.9	34.6	0.30	0.67	-1.18	-15.36	1.03	OK	0.173	0.590	1.29	OK
N6	8	J[9]	17.9	-77.9	35.4	0.30	0.94	-1.45	-15.36	1.03	OK	0.177	0.727	1.34	OK
N6	9	I[10]	4.4	-75.9	27.6	0.40	-0.02	-0.36	-15.36	1.03	OK	0.104	0.190	1.12	OK
N6	9	J[9]	13.9	-79.6	30.0	0.40	0.32	-0.72	-15.36	1.03	OK	0.113	0.359	1.20	OK
N6	10	I[11]	-6.0	-70.7	30.3	0.50	-0.28	0.00	-15.36	1.03	OK	0.091	0.142	1.10	OK
N6	10	J[10]	4.4	-75.2	33.4	0.50	-0.04	-0.26	-15.36	1.03	OK	0.100	0.150	1.10	OK
N6	11	I[12]	-14.2	-70.1	23.9	0.45	-0.58	0.27	-15.36	1.03	OK	0.080	0.288	1.16	OK
N6	11	J[11]	-6.0	-74.6	26.1	0.45	-0.34	0.01	-15.36	1.03	OK	0.087	0.171	1.11	OK
N6	12	I[13]	-17.3	-69.8	7.9	0.40	-0.82	0.47	-15.36	1.03	OK	0.029	0.411	1.22	OK
N6	12	J[12]	-14.2	-74.8	8.7	0.40	-0.72	0.34	-15.36	1.03	OK	0.033	0.360	1.20	OK
N6	13	I[14]	-19.1	-64.6	3.5	0.35	-1.12	0.76	-15.36	1.03	OK	0.016	0.561	1.28	OK
N6	13	J[13]	-17.3	-70.5	3.8	0.35	-1.06	0.60	-15.36	1.03	OK	0.016	0.531	1.27	OK
N6	14	I[15]	-18.1	-69.7	1.9	0.30	-1.40	0.96	-15.36	1.03	OK	0.009	0.701	1.34	OK
N6	14	J[14]	-19.1	-64.7	2.4	0.30	-1.49	1.06	-15.36	1.03	FESSURATA	0.012	0.745	1.35	OK
N6	15	I[16]	-13.2	-63.9	9.2	0.30	-1.06	0.70	-15.36	1.03	OK	0.046	0.529	1.27	OK
N6	15	J[15]	-18.1	-68.8	10.4	0.30	-1.40	1.01	-15.36	1.03	OK	0.052	0.700	1.33	OK
N6	16	I[17]	-5.2	-47.3	14.9	0.30	-0.51	0.19	-15.36	1.03	OK	0.075	0.253	1.15	OK
N6	16	J[16]	-13.2	-62.0	16.9	0.30	-1.05	0.70	-15.36	1.03	OK	0.084	0.526	1.27	OK
N6	17	I[18]	5.9	-39.4	20.9	0.30	0.26	-0.52	-15.36	1.03	OK	0.104	0.261	1.15	OK
N6	17	J[17]	-5.2	-43.6	23.6	0.30	-0.49	0.20	-15.36	1.03	OK	0.118	0.247	1.15	OK
N6	18	I[19]	19.4	-30.4	25.3	0.30	1.19	-1.39	-15.36	1.03	FESSURATA	0.127	0.697	1.33	OK
N6	18	J[18]	5.9	-33.9	28.9	0.30	0.28	-0.50	-15.36	1.03	OK	0.145	0.252	1.15	OK
N6	19	I[20]	33.0	-21.5	21.1	0.30	2.13	-2.27	-15.36	1.03	FESSURATA	0.106	1.135	1.49	OK
N6	19	J[19]	19.4	-24.1	31.3	0.30	1.21	-1.37	-15.36	1.03	FESSURATA	0.157	0.687	1.33	OK
N6	20	I[21]	40.5	-14.7	2.8	0.30	2.65	-2.75	-15.36	1.03	FESSURATA	0.014	1.374	1.57	OK
N6	20	J[20]	33.0	-16.4	25.3	0.30	2.14	-2.25	-15.36	1.03	FESSURATA	0.084	1.126	1.49	OK
N6	21	I[22]	37.3	-13.2	16.7	0.30	2.44	-2.53	-15.36	1.03	FESSURATA	0.084	1.265	1.54	OK
N6	21	J[21]	40.5	-13.8	6.0	0.30	2.65	-2.74	-15.36	1.03	FESSURATA	0.030	1.372	1.57	OK
N6	22	I[22]	27.4	-17.1	24.4	0.30	1.77	-1.88	-15.36	1.03	FESSURATA	0.122	0.941	1.42	OK
N6	22	J[22]	37.3	-16.6	13.5	0.30	2.43	-2.54	-15.36	1.03	FESSURATA	0.067	1.271	1.54	OK
N6	23	I[24]	16.2	-23.6	24.8	0.30	1.00	-1.16	-15.36	1.03	OK	0.124	0.579	1.29	OK
N6	23	J[23]	27.4	-22.0	20.1	0.30	1.75	-1.90	-15.36	1.03	FESSURATA	0.100	0.949	1.43	OK
N6	24	I[25]	5.6	-31.1	23.4	0.30	0.27	-0.48	-15.36	1.03	OK	0.117	0.238	1.14	OK
N6	24	J[24]	16.2	-28.5	19.1	0.30	0.98	-1.17	-15.36	1.03	OK	0.095	0.587	1.29	OK
N6	25	I[26]	-3.3	-39.0	19.7	0.30	-0.35	0.09	-15.36	1.03	OK	0.098	0.176	1.11	OK
N6	25	J[25]	5.6	-35.5	16.1	0.30	0.25	-0.49	-15.36	1.03	OK	0.080	0.245	1.15	OK
N6	26	I[27]	-9.4	-46.6	13.5	0.30	-0.78	0.47	-15.36	1.03	OK	0.067	0.390	1.21	OK
N6	26	J[26]	-3.3	-42.3	10.7	0.30	-0.35	0.08	-15.36	1.03	OK	0.054	0.182	1.12	OK
N6	27	I[28]	-12.1	-52.9	6.3	0.30	-0.99	0.63	-15.36	1.03	OK	0.032	0.490	1.25	OK
N6	27	J[27]	-9.4	-48.3	4.4	0.30	-0.79	0.46	-15.36	1.03	OK	0.022	0.393	1.21	OK
N6	28	I[29]	-11.8	-58.2	0.0	0.30	-0.98	0.59	-15.36	1.03	OK	0.000	0.489	1.25	OK
N6	28	J[28]	-12.1	-53.3	1.2	0.30	-0.98	0.63	-15.36	1.03	OK	0.006	0.491	1.25	OK
N6	29	I[30]	-10.2	-63.0	2.9	0.30	-0.89	0.47	-15.36	1.03	OK	0.015	0.444	1.23	OK
N6	29	J[29]	-11.8	-58.0	3.4	0.30	-0.98	0.59	-15.36	1.03	OK	0.017	0.488	1.25	OK
N6	30	I[31]	-7.7	-68.4	5.0	0.35	-0.57	0.18	-15.36	1.03	OK	0.021	0.287	1.16	OK
N6	30	J[30]	-10.2	-62.5	4.7	0.35	-0.68	0.32	-15.36	1.03	OK	0.020	0.338	1.19	OK
N6	31	I[32]	-5.2	-72.7	7.3	0.40	-0.38	0.01	-15.36	1.03	OK	0.027	0.188	1.12	OK
N6	31	J[31]	-7.7	-67.7	6.5	0.40	-0.46	0.12	-15.36	1.03	OK	0.024	0.230	1.14	OK
N6	32	I[33]	1.9	-73.2	22.6	0.45	-0.11	-0.22	-15.36	1.03	OK	0.075	0.163	1.11	OK
N6	32	J[32]	-5.2	-68.7	20.4	0.45	-0.31	0.00	-15.36	1.03	OK	0.068	0.153	1.10	OK
N6	33	I[34]	10.8	-74.4	28.7	0.50	0.11	-0.41	-15.36	1.03	OK	0.086	0.204	1.13	OK
N6	33	J[33]	1.9	-69.8	25.7	0.50	-0.09	-0.19	-15.36	1.03	OK	0.077	0.140	1.10	OK
N6	34	I[35]	18.5	-78.7	24.9	0.40	0.50	-0.89	-15.36	1.03	OK	0.093	0.446	1.23	OK
N6	34	J[34]	10.8	-75.0	22.5	0.40	0.22	-0.89	-15.36	1.03	OK	0.084	0.296	1.17	OK
N6	35	I[1]	22.0	-77.4	30.1	0.30	1.21	-1.72	-15.36	1.03	FESSURATA	0.150	0.862	1.40	OK
N6	35	J[35]	18.5	-76.5	29.4	0.30	0.98	-1.49	-15.36	1.03	OK	0.147	0.745	1.35	OK

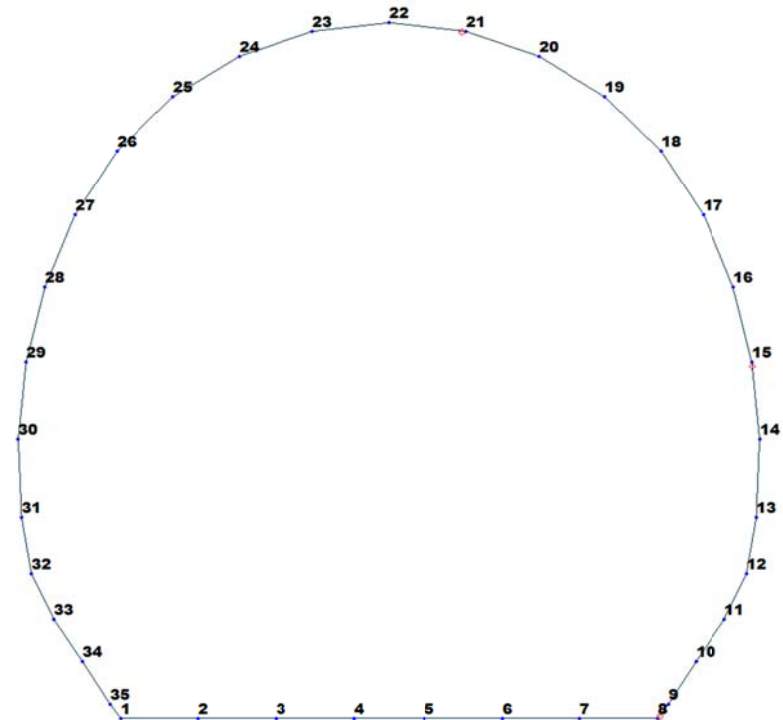


Figure 19 Beam end release

Table 7 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
8	Value	0	0	0	0	0	0	0	0	0	0	29950	0
14	Value	0	0	0	0	57860	0	0	0	0	0	0	0
21	Value	0	0	0	0	3950	0	0	0	0	0	0	0

ITERAZIONE SECONDO IL METODO DI PÖTTLER

CALCOLO CERNIERE PLASTICHE

ITERAZIONE IN NODO 21 J

MIDAS			PÖTTLER		
$Cf_{iniziale, arbitraria}$	0.000253	[rad/kN ² m]	E_p	26'400'000	[kN/m ²]
$1/Cf_{iniziale, arbitraria}$	3'950	[kN ² /rad]	d	0.30	[m]
M_{nodo}	5.110	[kN ² m]	e	0.1419	[m]
N_{nodo}	36.010	[kN]	a	0.02	[m]
V_{nodo}	5.470	[kN]	$\Phi_{pöttler}$	0.0012517	[rad]
$Cf_{MIDAS} = Cf_{pöttler}$	SI		$Cf_{pöttler}$	0.0002449	[rad/kN ² m]
$\Phi_{pöttler} < 4 \text{ mrad}$	SI		$1/Cf_{pöttler}$	4'083	[kN ² /rad]

1.251651

ITERAZIONE IN NODO 8 J

MIDAS			PÖTTLER		
$Cf_{iniziale, arbitraria}$	0.000033	[rad/kN ² m]	E_p	26'400'000	[kN/m ²]
$1/Cf_{iniziale, arbitraria}$	29'950	[kN ² /rad]	d	0.30	[m]
M_{nodo}	4.890	[kN ² m]	e	0.1299	[m]
N_{nodo}	37.650	[kN]	a	0.06	[m]
V_{nodo}	1.710	[kN]	$\Phi_{pöttler}$	0.0001679	[rad]
$Cf_{MIDAS} = Cf_{pöttler}$	SI		$Cf_{pöttler}$	0.0000343	[rad/kN ² m]
$\Phi_{pöttler} < 4 \text{ mrad}$	SI		$1/Cf_{pöttler}$	29'126	[kN ² /rad]

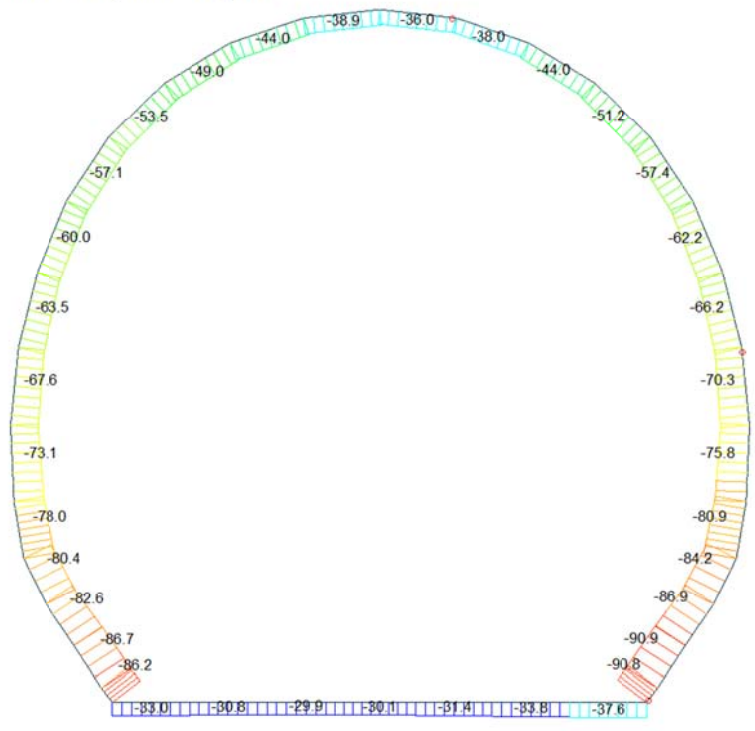
0.167890

ITERAZIONE IN NODO 14 I

MIDAS			PÖTTLER		
$Cf_{iniziale, arbitraria}$	0.000017	[rad/kN ² m]	E_p	26'400'000	[kN/m ²]
$1/Cf_{iniziale, arbitraria}$	57'860	[kN ² /rad]	d	0.30	[m]
M_{nodo}	8.610	[kN ² m]	e	0.1231	[m]
N_{nodo}	69.930	[kN]	a	0.08	[m]
V_{nodo}	0.930	[kN]	$\Phi_{pöttler}$	0.0001470	[rad]
$Cf_{MIDAS} = Cf_{pöttler}$	SI		$Cf_{pöttler}$	0.0000171	[rad/kN ² m]
$\Phi_{pöttler} < 4 \text{ mrad}$	SI		$1/Cf_{pöttler}$	58'587	[kN ² /rad]

0.146961

Beam Diagram_Fx - Block analysis / ST_N6



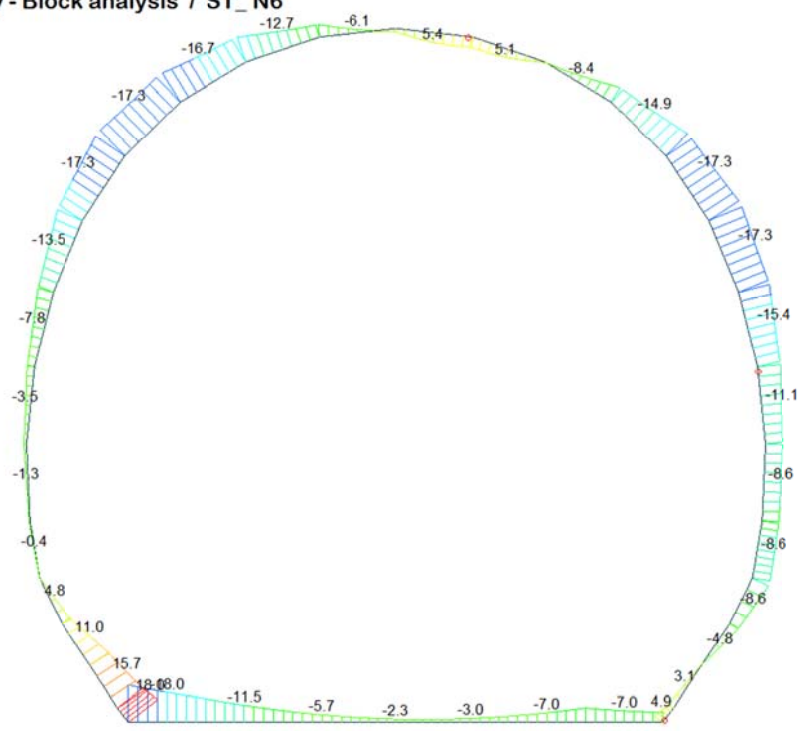
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-29.87
Cyan	-35.42
Green	-40.97
Light Green	-46.52
Yellow-Green	-52.07
Yellow	-57.61
Orange-Yellow	-63.16
Orange	-68.71
Red-Orange	-74.26
Red	-79.80
Dark Red	-85.35
Dark Red	-90.90

ST: N6
MAX : 3
MIN : 9
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_N6



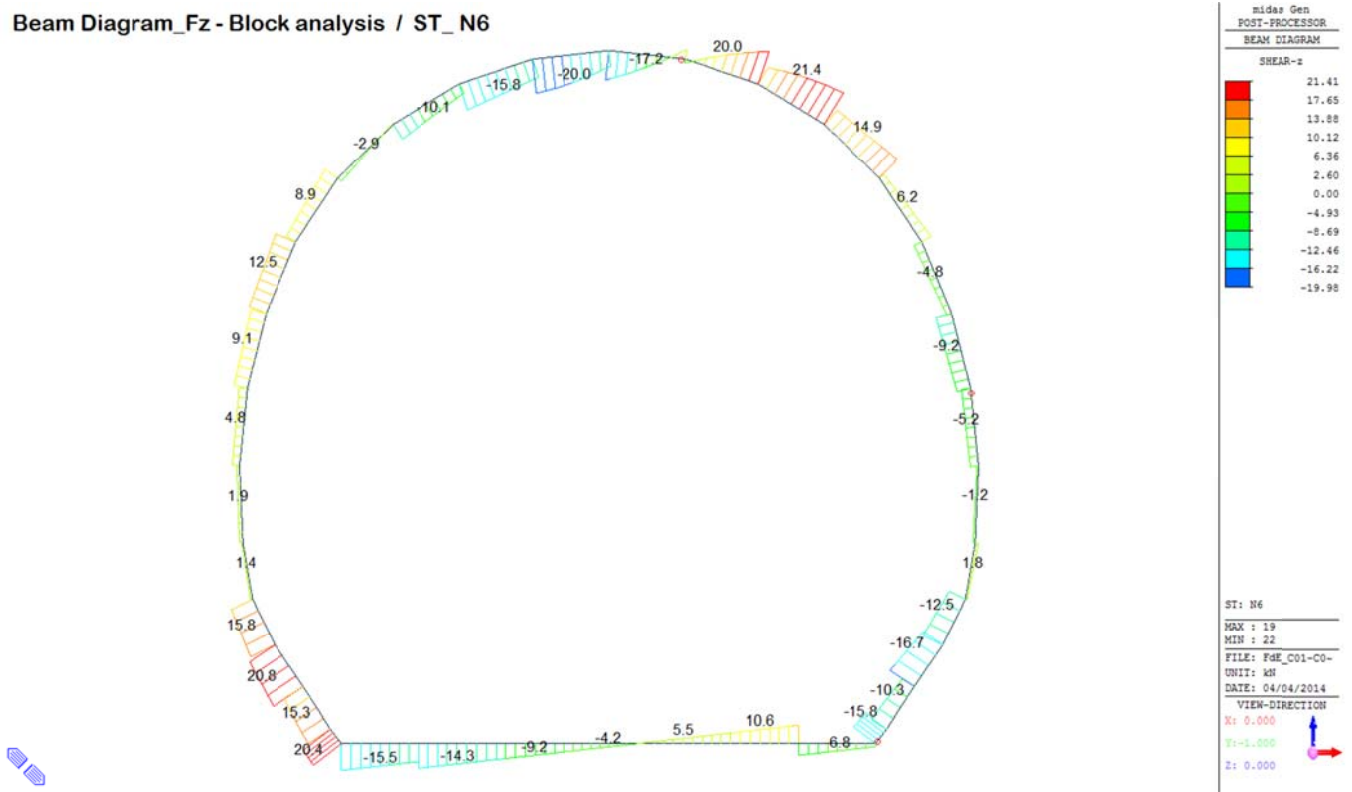
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Dark Red	18.02
Red	14.75
Orange-Red	11.47
Orange	8.19
Yellow-Orange	4.92
Yellow	1.64
Light Green	0.00
Green	-4.92
Light Green	-8.19
Cyan	-11.47
Blue-Cyan	-14.75
Blue	-18.02

ST: N6
MAX : 35
MIN : 1
FILE: PdE_C01-CO-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - Block analysis / ST_N6



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ct} [N/mm ²]	30.71	$f_{ctk,0.95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95\%}$ [N/mm ²]	15.36	$f_{ctk,95\%}$ [N/mm ²]	1.030	E_p [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 21 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,90\%}$
N6	21 j	Calotta	5.1	36.0	5.5	26'400'000	0.142	0.30	OK	2.97	15.36	OK

Combinazione di carico	Nodo n°	a [m]	$\Phi_{Prestor}$ [rad]	$1/C_{f,MIDAS}$ [kN·m/rad]	$1/C_{f,Prestor}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{Prestor}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd}(EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N6	21 j	0.024	1.2516514	3'950	4'083	Iterazione ok	0.345	OK	1.03	0.34	7.14	2.03	OK

VERIFICA SEZIONE NODO 8 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,90\%}$
N6	8 j	Volta Dx	4.9	37.7	1.7	26'400'000	0.130	0.30	OK	1.25	15.36	OK

Combinazione di carico	Nodo n°	a [m]	$\Phi_{Prestor}$ [rad]	$1/C_{f,MIDAS}$ [kN·m/rad]	$1/C_{f,Prestor}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{Prestor}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd}(EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N6	8 j	0.060	0.1678902	29'950	29'126	Iterazione ok	0.040	OK	1.03	0.04	7.14	1.53	OK

VERIFICA SEZIONE NODO 14 l

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd,90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd,90\%}$
N6	14 l	Volta Sx	8.6	69.9	0.9	26'400'000	0.123	0.30	OK	1.73	15.36	OK

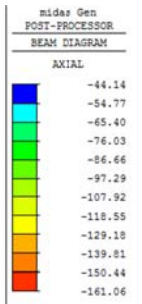
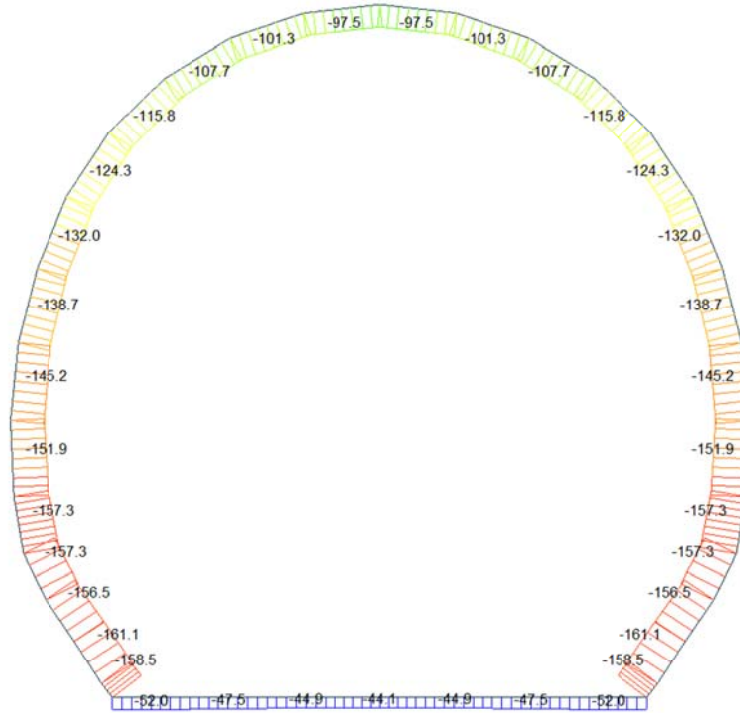
Combinazione di carico	Nodo n°	a [m]	$\Phi_{Prestor}$ [rad]	$1/C_{f,MIDAS}$ [kN·m/rad]	$1/C_{f,Prestor}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	$w_{Prestor}$ [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd,90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd}(EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N6	14 l	0.081	0.1489605	57'960	58'587	Iterazione ok	0.032	OK	1.03	0.02	7.14	1.69	OK

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup} [N/mm ²]	σ _{inf} [N/mm ²]	f _{ct,d,95%} [N/mm ²]	f _{ct,d,95%} [N/mm ²]		τ _{cp} [N/mm ²]	τ _{cp} [N/mm ²]	f _{ct,d,EC2} [N/mm ²]	Verifica a taglio τ _{cp,max} ≤ F _{ct,d}
N6	1	I[1]	-18.0	-33.0	15.5	0.30	-1.31	1.03	-15.36	1.03	OK	0.077	0.656	1.32	OK
N6	1	J[2]	-11.6	-33.0	10.4	0.30	-0.88	0.66	-15.36	1.03	OK	0.052	0.440	1.23	OK
N6	2	I[2]	-11.6	-30.8	14.3	0.30	-0.87	0.67	-15.36	1.03	OK	0.072	0.436	1.23	OK
N6	2	J[3]	-5.7	-30.8	9.2	0.30	-0.48	0.28	-15.36	1.03	OK	0.046	0.240	1.14	OK
N6	3	I[3]	-5.7	-29.9	9.2	0.30	-0.48	0.28	-15.36	1.03	OK	0.046	0.239	1.14	OK
N6	3	J[4]	-2.3	-29.9	4.2	0.30	-0.25	0.06	-15.36	1.03	OK	0.021	0.127	1.09	OK
N6	4	I[4]	-2.3	-30.1	4.2	0.30	-0.25	0.05	-15.36	1.03	OK	0.021	0.127	1.09	OK
N6	4	J[5]	-1.5	-30.1	0.5	0.30	-0.20	0.00	-15.36	1.03	OK	0.002	0.100	1.08	OK
N6	5	I[5]	-1.5	-31.4	0.5	0.30	-0.20	-0.01	-15.36	1.03	OK	0.002	0.105	1.08	OK
N6	5	J[6]	-3.0	-31.4	5.5	0.30	-0.30	0.09	-15.36	1.03	OK	0.028	0.151	1.10	OK
N6	6	I[6]	-3.0	-33.9	5.5	0.30	-0.31	0.09	-15.36	1.03	OK	0.028	0.155	1.10	OK
N6	6	J[7]	-7.0	-33.9	10.6	0.30	-0.58	0.35	-15.36	1.03	OK	0.053	0.290	1.17	OK
N6	7	I[7]	-7.0	-37.7	6.8	0.30	-0.59	0.34	-15.36	1.03	OK	0.034	0.296	1.17	OK
N6	7	J[8]	-4.9	-37.7	1.7	0.30	-0.45	0.20	-15.36	1.03	OK	0.069	0.226	1.14	OK
N6	8	I[9]	3.1	-89.9	15.1	0.30	-0.09	-0.51	-15.36	1.03	OK	0.075	0.300	1.17	OK
N6	8	J[8]	4.9	-90.8	15.8	0.30	0.02	-0.63	-15.36	1.03	OK	0.079	0.314	1.18	OK
N6	9	I[10]	0.1	-87.2	7.9	0.40	-0.21	-0.22	-15.36	1.03	OK	0.030	0.218	1.13	OK
N6	9	J[9]	3.1	-90.9	10.3	0.40	-0.11	-0.34	-15.36	1.03	OK	0.039	0.227	1.14	OK
N6	10	I[11]	-4.9	-82.4	13.6	0.50	-0.28	-0.05	-15.36	1.03	OK	0.041	0.165	1.11	OK
N6	10	J[10]	0.1	-86.9	16.7	0.50	-0.17	-0.18	-15.36	1.03	OK	0.050	0.174	1.11	OK
N6	11	I[12]	-8.6	-79.7	10.3	0.45	-0.43	0.08	-15.36	1.03	OK	0.034	0.216	1.13	OK
N6	11	J[11]	-4.9	-84.2	12.5	0.45	-0.33	-0.04	-15.36	1.03	OK	0.042	0.187	1.12	OK
N6	12	I[13]	-8.1	-76.0	1.8	0.40	-0.49	0.11	-15.36	1.03	OK	0.007	0.246	1.15	OK
N6	12	J[12]	-8.6	-80.9	1.0	0.40	-0.52	0.12	-15.36	1.03	OK	0.004	0.262	1.15	OK
N6	13	I[14]	-8.6	-69.9	0.9	0.35	-0.62	0.22	-15.36	1.03	OK	0.004	0.311	1.17	OK
N6	13	J[13]	-8.1	-75.8	1.2	0.35	-0.61	0.18	-15.36	1.03	OK	0.005	0.306	1.17	OK
N6	14	I[15]	-11.1	-65.3	5.2	0.30	-0.96	0.52	-15.36	1.03	OK	0.026	0.478	1.25	OK
N6	14	J[14]	-8.6	-70.3	4.7	0.30	-0.81	0.34	-15.36	1.03	OK	0.023	0.404	1.22	OK
N6	15	I[16]	-15.4	-61.3	9.2	0.30	-1.23	0.82	-15.36	1.03	OK	0.046	0.615	1.30	OK
N6	15	J[15]	-11.1	-66.2	8.0	0.30	-0.96	0.52	-15.36	1.03	OK	0.040	0.480	1.25	OK
N6	16	I[17]	-17.3	-57.5	4.8	0.30	-1.35	0.96	-15.36	1.03	OK	0.024	0.673	1.32	OK
N6	16	J[16]	-15.4	-62.2	2.9	0.30	-1.23	0.82	-15.36	1.03	OK	0.015	0.616	1.30	OK
N6	17	I[18]	-14.9	-53.2	3.4	0.30	-1.17	0.82	-15.36	1.03	OK	0.017	0.586	1.29	OK
N6	17	J[17]	-17.3	-57.4	6.2	0.30	-1.35	0.96	-15.36	1.03	OK	0.031	0.673	1.32	OK
N6	18	I[19]	-8.4	-47.7	11.3	0.30	-0.72	0.40	-15.36	1.03	OK	0.057	0.358	1.20	OK
N6	18	J[18]	-14.9	-51.2	14.9	0.30	-1.16	0.82	-15.36	1.03	OK	0.075	0.582	1.29	OK
N6	19	I[20]	0.3	-41.4	11.2	0.30	-0.12	-0.16	-15.36	1.03	OK	0.056	0.138	1.10	OK
N6	19	J[19]	-8.4	-44.1	21.4	0.30	-0.70	0.41	-15.36	1.03	OK	0.107	0.352	1.19	OK
N6	20	I[21]	5.1	-36.3	2.5	0.30	0.22	-0.46	-15.36	1.03	OK	0.013	0.231	1.14	OK
N6	20	J[20]	0.3	-38.0	20.0	0.30	-0.11	-0.14	-15.36	1.03	OK	0.100	0.127	1.09	OK
N6	21	I[22]	1.7	-35.5	17.2	0.30	-0.01	-0.23	-15.36	1.03	OK	0.086	0.118	1.09	OK
N6	21	J[21]	5.1	-36.0	5.5	0.30	0.22	-0.46	-15.36	1.03	OK	0.027	0.230	1.14	OK
N6	22	I[23]	-6.1	-38.9	20.0	0.30	-0.53	0.27	-15.36	1.03	OK	0.100	0.267	1.16	OK
N6	22	J[22]	1.7	-38.4	9.1	0.30	-0.02	-0.24	-15.36	1.03	OK	0.045	0.128	1.09	OK
N6	23	I[24]	-12.8	-44.0	15.8	0.30	-1.00	0.70	-15.36	1.03	OK	0.079	0.498	1.25	OK
N6	23	J[23]	-6.1	-42.3	11.0	0.30	-0.54	0.26	-15.36	1.03	OK	0.055	0.272	1.16	OK
N6	24	I[25]	-16.7	-49.0	10.2	0.30	-1.28	0.95	-15.36	1.03	OK	0.051	0.640	1.31	OK
N6	24	J[24]	-12.8	-46.4	5.8	0.30	-1.00	0.70	-15.36	1.03	OK	0.029	0.502	1.26	OK
N6	25	I[26]	-17.3	-53.5	2.9	0.30	-1.33	0.97	-15.36	1.03	OK	0.014	0.665	1.32	OK
N6	25	J[25]	-16.7	-50.0	0.8	0.30	-1.28	0.95	-15.36	1.03	OK	0.004	0.641	1.31	OK
N6	26	I[27]	-13.5	-57.1	6.1	0.30	-1.09	0.71	-15.36	1.03	OK	0.031	0.546	1.27	OK
N6	26	J[26]	-17.3	-52.9	8.9	0.30	-1.33	0.97	-15.36	1.03	OK	0.044	0.663	1.32	OK
N6	27	I[28]	-7.8	-60.0	10.6	0.30	-0.72	0.32	-15.36	1.03	OK	0.053	0.359	1.20	OK
N6	27	J[27]	-13.5	-55.3	12.5	0.30	-1.09	0.72	-15.36	1.03	OK	0.063	0.543	1.27	OK
N6	28	I[29]	-3.5	-53.5	7.8	0.30	-0.45	0.02	-15.36	1.03	OK	0.039	0.223	1.14	OK
N6	28	J[28]	-7.8	-58.6	9.1	0.30	-0.71	0.32	-15.36	1.03	OK	0.045	0.356	1.19	OK
N6	29	I[30]	-1.3	-67.6	4.2	0.30	-0.31	-0.14	-15.36	1.03	OK	0.021	0.225	1.14	OK
N6	29	J[29]	-3.5	-62.6	4.8	0.30	-0.44	0.03	-15.36	1.03	OK	0.024	0.222	1.14	OK
N6	30	I[31]	-0.4	-73.1	1.9	0.35	-0.23	-0.19	-15.36	1.03	OK	0.008	0.209	1.13	OK
N6	30	J[30]	-1.3	-67.2	1.6	0.35	-0.26	-0.13	-15.36	1.03	OK	0.007	0.192	1.12	OK
N6	31	I[32]	-0.1	-78.0	1.4	0.40	-0.20	-0.19	-15.36	1.03	OK	0.005	0.195	1.12	OK
N6	31	J[31]	-0.4	-73.0	0.5	0.40	-0.20	-0.17	-15.36	1.03	OK	0.002	0.183	1.12	OK
N6	32	I[33]	4.8	-80.4	15.8	0.45	-0.04	-0.32	-15.36	1.03	OK	0.053	0.179	1.12	OK
N6	32	J[32]	-0.1	-75.9	13.6	0.45	-0.17	-0.17	-15.36	1.03	OK	0.045	0.169	1.11	OK
N6	33	I[34]	11.1	-82.6	20.8	0.50	0.10	-0.43	-15.36	1.03	OK	0.062	0.215	1.13	OK
N6	33	J[33]	4.8	-78.1	17.7	0.50	-0.04	-0.27	-15.36	1.03	OK	0.053	0.156	1.11	OK
N6	34	I[35]	15.7	-86.7	15.3	0.40	0.37	-0.81	-15.36	1.03	OK	0.057	0.403	1.21	OK
N6	34	J[34]	11.1	-83.0	12.9	0.40	0.21	-0.62	-15.36	1.03	OK	0.048	0.311	1.17	OK
N6	35	I[1]	18.0	-86.2	20.4	0.30	0.91	-1.49	-15.36	1.03	OK	0.102	0.744	1.35	OK
N6	35	J[35]	15.7	-85.3	19.7	0.30	0.76	-1.33	-15.36	1.03	OK	0.099	0.665	1.32	OK

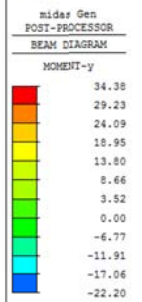
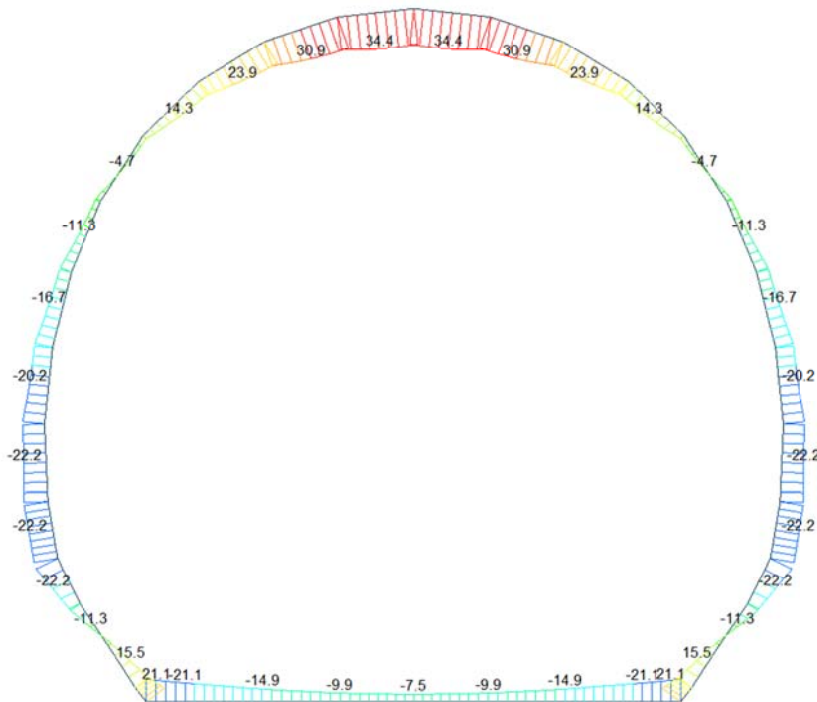
A.5.4.6. Load combination SLU 6 FEM analysis

Beam Diagram_Fx - FEM analysis / ST_N6



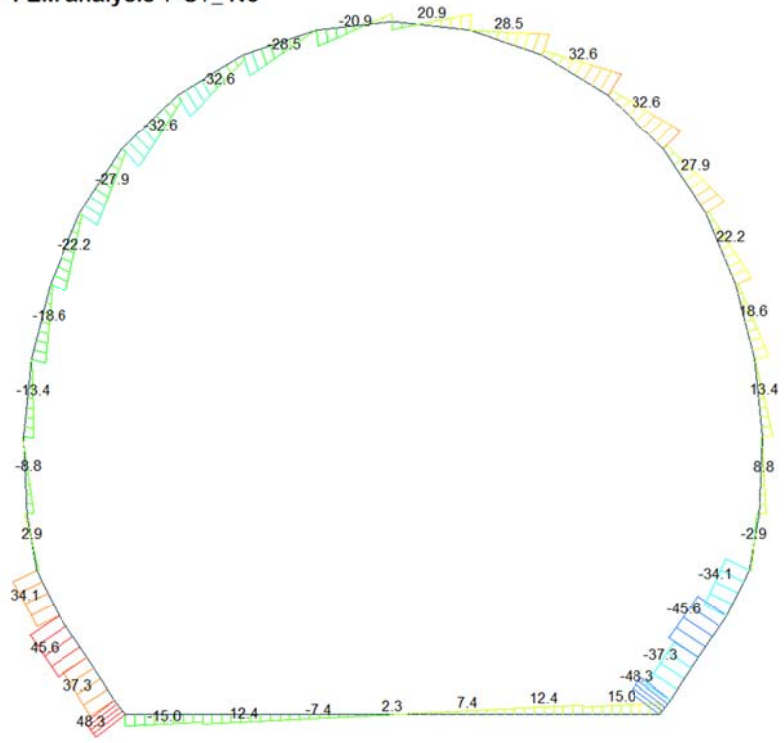
ST: N6
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_N6



ST: N6
MAX : 21
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_Fz - FEM analysis / ST_N6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

48.29
39.51
30.73
21.95
13.17
4.39
0.00
-13.17
-21.95
-30.73
-39.51
-48.29

ST: N6

MAX : 35
MIN : 8

FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION

X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	15.36	$f_{ctd,95}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ct,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{cp} [N/mm ²]	$f_{ctd,EC2}$ [N/mm ²]	Verifica a taglio
N6	1	I[1]	-21.1	-52.0	15.0	0.30	-1.58	1.23	-15.36	1.03	FESSURATA	0.075	0.790	1.37	OK
N6	1	J[2]	-14.9	-52.0	9.9	0.30	-1.17	0.82	-15.36	1.03	OK	0.050	0.583	1.29	OK
N6	2	I[2]	-14.9	-47.5	12.5	0.30	-1.15	0.83	-15.36	1.03	OK	0.062	0.575	1.29	OK
N6	2	J[3]	-9.9	-47.5	7.4	0.30	-0.82	0.50	-15.36	1.03	OK	0.037	0.410	1.22	OK
N6	3	I[3]	-9.9	-44.9	7.4	0.30	-0.81	0.51	-15.36	1.03	OK	0.037	0.406	1.22	OK
N6	3	J[4]	-7.5	-44.9	2.3	0.30	-0.65	0.35	-15.36	1.03	OK	0.012	0.325	1.18	OK
N6	4	I[4]	-7.5	-44.1	2.3	0.30	-0.65	0.35	-15.36	1.03	OK	0.012	0.323	1.18	OK
N6	4	J[5]	-7.5	-44.1	2.3	0.30	-0.65	0.35	-15.36	1.03	OK	0.012	0.323	1.18	OK
N6	5	I[5]	-7.5	-44.9	2.3	0.30	-0.65	0.35	-15.36	1.03	OK	0.012	0.325	1.18	OK
N6	5	J[6]	-9.9	-44.9	7.4	0.30	-0.81	0.51	-15.36	1.03	OK	0.037	0.406	1.22	OK
N6	6	I[6]	-9.9	-47.5	7.4	0.30	-0.82	0.50	-15.36	1.03	OK	0.037	0.410	1.22	OK
N6	6	J[7]	-14.9	-47.5	12.5	0.30	-1.15	0.83	-15.36	1.03	OK	0.062	0.575	1.29	OK
N6	7	I[7]	-14.9	-52.0	9.9	0.30	-1.17	0.82	-15.36	1.03	OK	0.050	0.583	1.29	OK
N6	7	J[8]	-21.1	-52.0	15.0	0.30	-1.58	1.23	-15.36	1.03	FESSURATA	0.075	0.790	1.37	OK
N6	8	I[9]	15.5	-157.6	47.7	0.30	0.61	-1.56	-15.36	1.03	OK	0.239	0.780	1.37	OK
N6	8	J[8]	21.1	-158.5	48.3	0.30	0.88	-1.94	-15.36	1.03	OK	0.241	0.968	1.43	OK
N6	9	I[9]	3.5	-157.4	36.5	0.40	-0.26	-0.52	-15.36	1.03	OK	0.137	0.393	1.21	OK
N6	9	J[9]	15.5	-161.1	37.3	0.40	0.18	-0.99	-15.36	1.03	OK	0.140	0.493	1.25	OK
N6	10	I[11]	-11.3	-151.9	45.4	0.50	-0.58	-0.03	-15.36	1.03	OK	0.136	0.304	1.17	OK
N6	10	J[10]	3.5	-156.5	45.6	0.50	-0.23	-0.40	-15.36	1.03	OK	0.137	0.313	1.18	OK
N6	11	I[12]	-22.2	-152.8	34.1	0.45	-1.00	0.32	-15.36	1.03	OK	0.114	0.498	1.25	OK
N6	11	J[11]	-11.3	-157.3	32.1	0.45	-0.68	-0.01	-15.36	1.03	OK	0.107	0.350	1.19	OK
N6	12	I[13]	-22.2	-152.4	2.9	0.40	-1.21	0.46	-15.36	1.03	OK	0.011	0.607	1.30	OK
N6	12	J[12]	-22.2	-157.3	2.5	0.40	-1.22	0.43	-15.36	1.03	OK	0.008	0.612	1.30	OK
N6	13	I[14]	-20.3	-146.0	1.4	0.35	-1.41	0.57	-15.36	1.03	OK	0.006	0.705	1.34	OK
N6	13	J[13]	-22.2	-151.9	8.8	0.35	-1.54	0.61	-15.36	1.03	OK	0.038	0.768	1.36	OK
N6	14	I[15]	-16.7	-140.1	0.4	0.30	-1.58	0.61	-15.36	1.03	OK	0.002	0.791	1.37	OK
N6	14	J[14]	-20.3	-145.2	13.4	0.30	-1.83	0.87	-15.36	1.03	OK	0.067	0.917	1.42	OK
N6	15	I[16]	-11.3	-133.8	2.9	0.30	-1.20	0.31	-15.36	1.03	OK	0.015	0.599	1.29	OK
N6	15	J[15]	-16.7	-138.8	18.6	0.30	-1.58	0.65	-15.36	1.03	OK	0.093	0.789	1.37	OK
N6	16	I[17]	-4.7	-127.4	3.7	0.30	-0.74	-0.11	-15.36	1.03	OK	0.019	0.425	1.22	OK
N6	16	J[16]	-11.3	-132.0	22.2	0.30	-1.19	0.31	-15.36	1.03	OK	0.111	0.596	1.29	OK
N6	17	I[18]	4.0	-120.1	6.6	0.30	-0.14	-0.66	-15.36	1.03	OK	0.033	0.400	1.21	OK
N6	17	J[17]	-4.7	-124.3	27.9	0.30	-0.73	-0.10	-15.36	1.03	OK	0.139	0.414	1.22	OK
N6	18	I[19]	14.3	-112.3	8.4	0.30	0.58	-1.32	-15.36	1.03	OK	0.042	0.662	1.32	OK
N6	18	J[18]	4.0	-115.8	32.6	0.30	-1.12	-0.65	-15.36	1.03	OK	0.163	0.386	1.21	OK
N6	19	I[20]	23.9	-105.1	5.8	0.30	1.24	-1.95	-15.36	1.03	FESSURATA	0.029	0.973	1.44	OK
N6	19	J[19]	14.3	-107.8	32.7	0.30	0.59	-1.31	-15.36	1.03	OK	0.163	0.655	1.32	OK
N6	20	I[21]	30.9	-99.7	0.8	0.30	1.73	-2.39	-15.36	1.03	FESSURATA	0.004	1.197	1.51	OK
N6	20	J[20]	23.9	-101.3	28.5	0.30	1.26	-1.93	-15.36	1.03	FESSURATA	0.143	0.966	1.43	OK
N6	21	I[22]	33.6	-96.9	10.7	0.30	1.91	-2.56	-15.36	1.03	FESSURATA	0.054	1.280	1.54	OK
N6	21	J[21]	30.9	-97.5	20.9	0.30	1.74	-2.39	-15.36	1.03	FESSURATA	0.105	1.193	1.51	OK
N6	22	I[22]	30.9	-97.5	20.9	0.30	1.74	-2.39	-15.36	1.03	FESSURATA	0.105	1.193	1.51	OK
N6	22	J[22]	33.6	-96.9	10.7	0.30	1.91	-2.56	-15.36	1.03	FESSURATA	0.054	1.280	1.54	OK
N6	23	I[24]	23.9	-101.3	28.5	0.30	1.26	-1.93	-15.36	1.03	FESSURATA	0.143	0.966	1.43	OK
N6	23	J[23]	30.9	-99.7	0.8	0.30	1.73	-2.39	-15.36	1.03	FESSURATA	0.004	1.197	1.51	OK
N6	24	I[25]	14.3	-107.8	32.7	0.30	0.59	-1.31	-15.36	1.03	OK	0.163	0.655	1.32	OK
N6	24	J[24]	23.9	-105.1	5.8	0.30	1.24	-1.95	-15.36	1.03	FESSURATA	0.029	0.973	1.44	OK
N6	25	I[26]	4.0	-115.8	32.6	0.30	-0.12	-0.65	-15.36	1.03	OK	0.163	0.386	1.21	OK
N6	25	J[25]	14.3	-112.3	8.4	0.30	0.58	-1.32	-15.36	1.03	OK	0.042	0.662	1.32	OK
N6	26	I[27]	-4.7	-124.3	27.9	0.30	-0.73	-0.10	-15.36	1.03	OK	0.139	0.414	1.22	OK
N6	26	J[26]	4.0	-120.1	6.6	0.30	-0.14	-0.66	-15.36	1.03	OK	0.033	0.400	1.21	OK
N6	27	I[28]	-11.3	-132.0	22.2	0.30	-1.19	0.31	-15.36	1.03	OK	0.111	0.596	1.29	OK
N6	27	J[27]	-4.7	-127.4	3.7	0.30	-0.74	-0.11	-15.36	1.03	OK	0.019	0.425	1.22	OK
N6	28	I[29]	-16.7	-138.8	18.6	0.30	-1.58	0.65	-15.36	1.03	OK	0.093	0.789	1.37	OK
N6	28	J[28]	-11.3	-133.8	2.9	0.30	-1.20	0.31	-15.36	1.03	OK	0.015	0.599	1.29	OK
N6	29	I[30]	-20.3	-145.2	13.4	0.30	-1.83	0.87	-15.36	1.03	OK	0.067	0.917	1.42	OK
N6	29	J[29]	-16.7	-140.1	0.4	0.30	-1.58	0.65	-15.36	1.03	OK	0.002	0.791	1.37	OK
N6	30	I[31]	-22.2	-151.9	8.8	0.35	-1.52	0.65	-15.36	1.03	OK	0.038	0.761	1.36	OK
N6	30	J[30]	-20.3	-146.0	1.4	0.35	-1.41	0.57	-15.36	1.03	OK	0.006	0.705	1.34	OK
N6	31	I[32]	-22.2	-157.3	2.5	0.40	-1.22	0.44	-15.36	1.03	OK	0.009	0.612	1.30	OK
N6	31	J[31]	-22.2	-152.4	2.9	0.40	-1.21	0.45	-15.36	1.03	OK	0.011	0.607	1.30	OK
N6	32	I[33]	-11.3	-157.3	32.1	0.45	-0.68	-0.01	-15.36	1.03	OK	0.107	0.350	1.19	OK
N6	32	J[32]	-22.2	-152.8	34.1	0.45	-1.00	0.32	-15.36	1.03	OK	0.114	0.498	1.25	OK
N6	33	I[34]	3.5	-156.5	45.6	0.50	-0.23	-0.40	-15.36	1.03	OK	0.137	0.313	1.18	OK
N6	33	J[33]	-11.3	-151.9	45.4	0.50	-0.58	-0.03	-15.36	1.03	OK	0.136	0.304	1.17	OK
N6	34	I[35]	15.5	-161.1	37.3	0.40	0.18	-0.99	-15.36	1.03	OK	0.140	0.493	1.25	OK
N6	34	J[34]	3.5	-157.4	36.5	0.40	-0.26	-0.52	-15.36	1.03	OK	0.137	0.393	1.21	OK
N6	35	I[1]	21.1	-158.5	48.3	0.30	0.88	-1.94	-15.36	1.03	OK	0.241	0.968	1.43	OK
N6	35	J[35]	15.5	-157.6	47.7	0.30	0.61	-1.56	-15.36	1.03	OK	0.239	0.780	1.37	OK

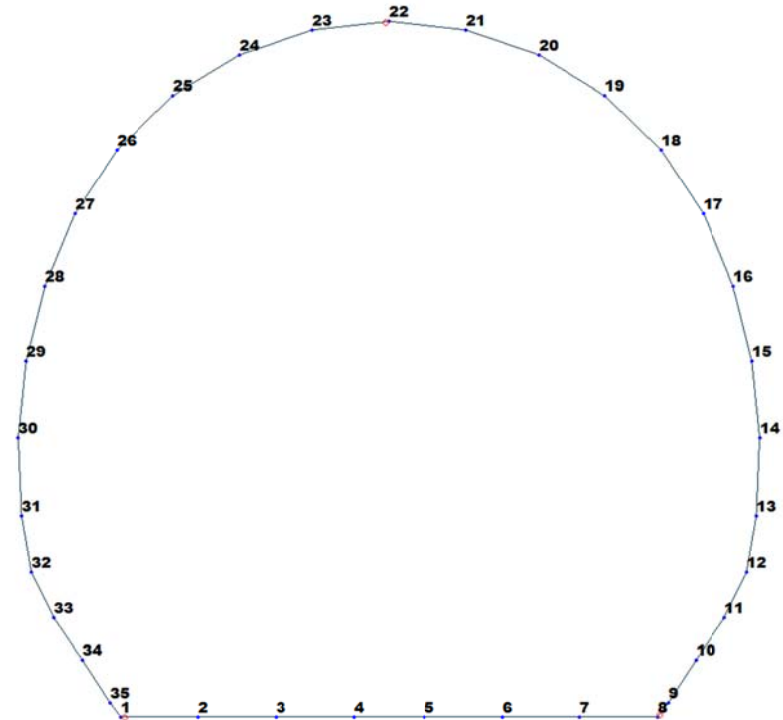


Figure 20 Beam end release

Table 8 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
1	Value	0	0	0	0	68200	0	0	0	0	0	0	0
8	Value	0	0	0	0	0	0	0	0	0	0	68200	0
22	Value	0	0	0	0	0	0	0	0	0	0	24050	0

ITERAZIONE SECONDO IL METODO DI PÖTLER

CALCOLO CERNIERE PLASTICHE

ITERAZIONE IN NODO 22]

MIDAS		PÖTLER	
$Cf_{iniziale, arbitraria}$	0.000942 [rad/kN*m]	E_p	26'400'000 [kN/m ²]
$1/Cf_{iniziale, arbitraria}$	24'060 [kN*m/rad]	d	0.30 [m]
M_{nodo}	14.090 [kN*m]	e	0.1314 [m]
N_{nodo}	107.240 [kN]	a	0.06 [m]
V_{nodo}	11.890 [kN]	$\Psi_{pötlér}$	0.0005783 [rad]
$Cf_{MIDAS} = Cf_{pötlér}$	SI	$Cf_{pötlér}$	0.0000410 [rad/kN*m]
$\Psi_{pötlér} < 4 \text{ mrad}$	SI	$1/Cf_{pötlér}$	24'364 [kN*m/rad]

0.578310

ITERAZIONE IN NODO 1]

MIDAS		PÖTLER	
$Cf_{iniziale, arbitraria}$	0.000015 [rad/kN*m]	E_p	26'400'000 [kN/m ²]
$1/Cf_{iniziale, arbitraria}$	68'200 [kN*m/rad]	d	0.30 [m]
M_{nodo}	7.870 [kN*m]	e	0.1214 [m]
N_{nodo}	64.630 [kN]	a	0.09 [m]
V_{nodo}	6.560 [kN]	$\Psi_{pötlér}$	0.0001145 [rad]
$Cf_{MIDAS} = Cf_{pötlér}$	SI	$Cf_{pötlér}$	0.0000145 [rad/kN*m]
$\Psi_{pötlér} < 4 \text{ mrad}$	SI	$1/Cf_{pötlér}$	68'757 [kN*m/rad]

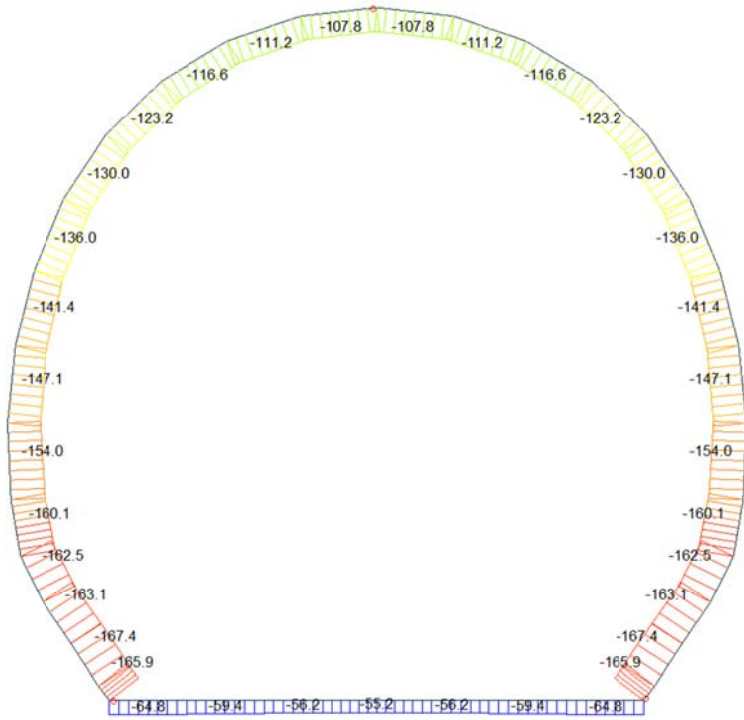
0.114460

ITERAZIONE IN NODO 8]

MIDAS		PÖTLER	
$Cf_{iniziale, arbitraria}$	0.000015 [rad/kN*m]	E_p	26'400'000 [kN/m ²]
$1/Cf_{iniziale, arbitraria}$	68'200 [kN*m/rad]	d	0.30 [m]
M_{nodo}	7.870 [kN*m]	e	0.1214 [m]
N_{nodo}	64.840 [kN]	a	0.09 [m]
V_{nodo}	6.560 [kN]	$\Psi_{pötlér}$	0.0001143 [rad]
$Cf_{MIDAS} = Cf_{pötlér}$	SI	$Cf_{pötlér}$	0.0000145 [rad/kN*m]
$\Psi_{pötlér} < 4 \text{ mrad}$	SI	$1/Cf_{pötlér}$	68'875 [kN*m/rad]

0.114266

Beam Diagram_Fx - FEM analysis / ST_N6



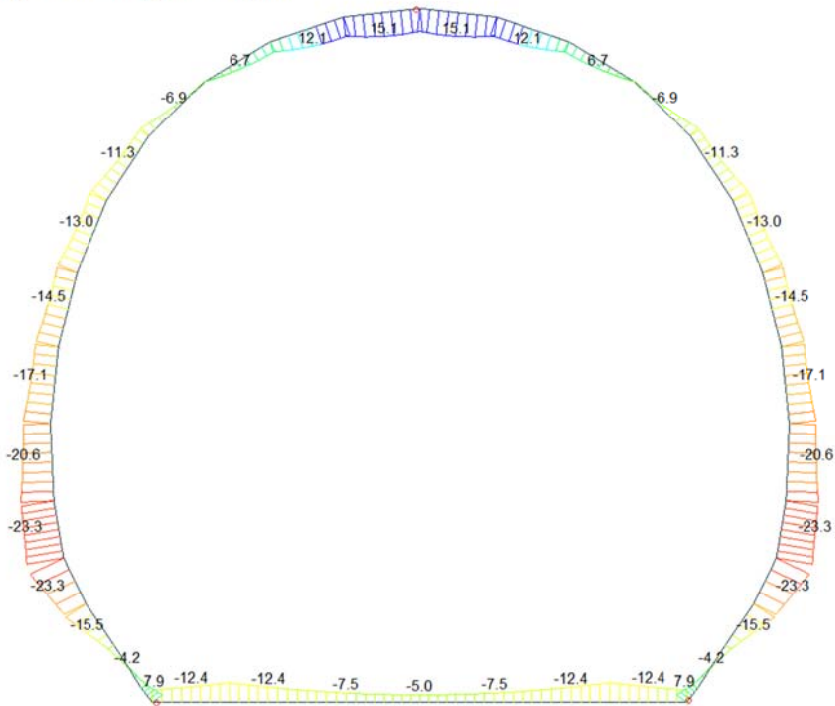
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-55.22
Cyan	-65.42
Green	-75.62
Light Green	-85.82
Yellow-Green	-96.01
Yellow	-106.21
Orange-Yellow	-116.41
Orange	-123.2
Red-Orange	-130.0
Red	-136.0
Dark Red	-147.00
Black	-157.20
Dark Blue	-167.40

ST: N6
MAX : 4
MIN : 34
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_N6



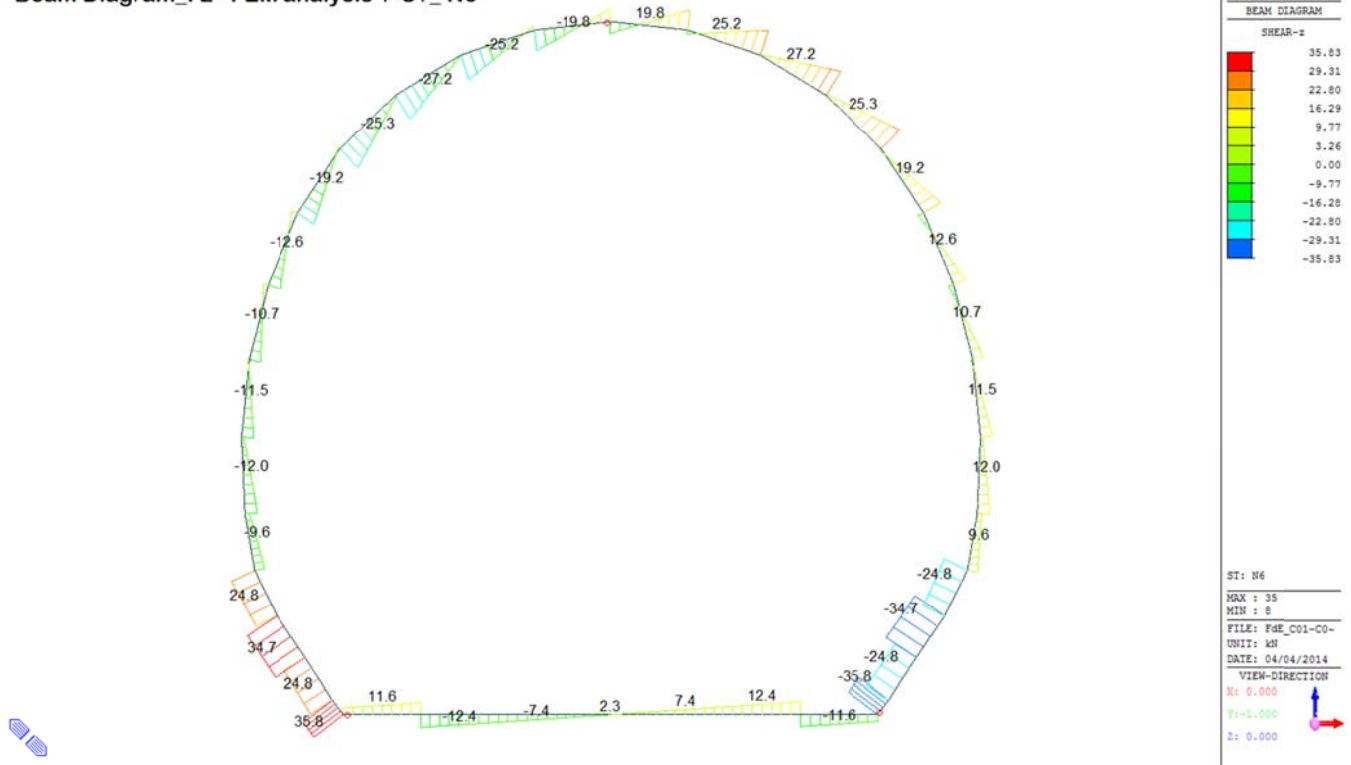
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	15.07
Cyan	11.58
Green	8.10
Light Green	4.61
Yellow-Green	0.00
Yellow	-2.35
Orange-Yellow	-5.84
Orange	-9.32
Red-Orange	-12.81
Red	-16.29
Dark Red	-19.78
Black	-23.26

ST: N6
MAX : 21
MIN : 12
FILE: PdE_C01-CO-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - FEM analysis / ST_N6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

35.83
29.31
22.80
16.29
9.77
3.26
0.00
-9.77
-16.28
-22.80
-29.31
-35.83

ST: N6
MAX: 35
MIN: 8
FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: 0.000
Z: 0.000

VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ct} [N/mm ²]	30.71	$f_{ctm,0.95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.60	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95\%}$ [N/mm ²]	15.36	$f_{ctk,95\%}$ [N/mm ²]	1.030	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 22 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd, 90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd, 90\%}$
N6	22 j	Calotta	14.1	107.2	11.9	26'400'000	0.131	0.30	OK	3.84	15.36	OK

Combinazione di carico	Nodo n°	a [m]	Ψ_{potter} [rad]	$1/Cf_{MIDAS}$ [kN°m/rad]	$1/Cf_{potter}$ [kN°m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{potter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd, 90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd} (EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp, max} \leq F_{cvd}$
N6	22 j	0.056	0.5783103	24'050	24'364	OK	0.141	OK	1.03	0.32	7.14	2.24	OK

Iterazione ok

VERIFICA SEZIONE NODO 1 i

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd, 90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd, 90\%}$
N6	1 i	Volta Dx	7.9	64.8	6.6	26'400'000	0.121	0.30	OK	1.51	15.36	OK

Combinazione di carico	Nodo n°	a [m]	Ψ_{potter} [rad]	$1/Cf_{MIDAS}$ [kN°m/rad]	$1/Cf_{potter}$ [kN°m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{potter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd, 90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd} (EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp, max} \leq F_{cvd}$
N6	1 i	0.086	0.1144604	68'200	68'757	OK	0.025	OK	1.03	0.11	7.14	1.62	OK

Iterazione ok

VERIFICA SEZIONE NODO 8 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_s [N/mm ²]	$f_{ctd, 90\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ctd, 90\%}$
N6	8 j	Volta Sx	7.9	64.8	6.6	26'400'000	0.121	0.30	OK	1.51	15.36	OK

Combinazione di carico	Nodo n°	a [m]	Ψ_{potter} [rad]	$1/Cf_{MIDAS}$ [kN°m/rad]	$1/Cf_{potter}$ [kN°m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{potter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ctd, 90\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd} (EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp, max} \leq F_{cvd}$
N6	8 j	0.086	0.1142657	68'200	68'875	OK	0.024	OK	1.03	0.11	7.14	1.62	OK

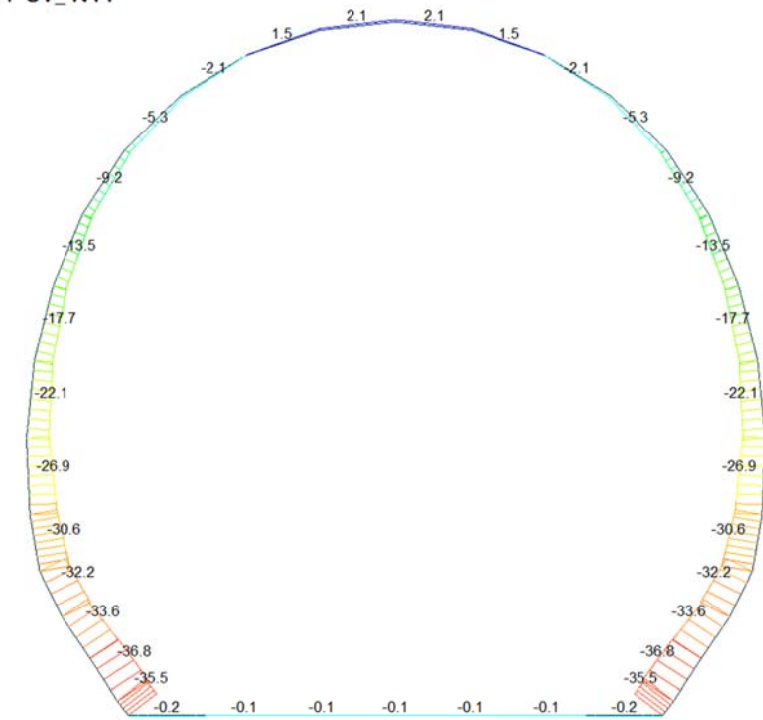
Iterazione ok

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup}	σ _{inf}	f _{cd,90%}	f _{ctd,90%}		τ _{cp}	τ _{cp}	f _{ctd,EC2}	Verifica a taglio
							[N/mm ²]	[N/mm ²]	[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	[N/mm ²]	T _{cp,max} ≤ F _{ctd}
N6	1	I[1]	-7.9	-64.8	6.6	0.30	-0.74	0.31	-15.36	1.03	OK	0.033	0.370	1.20	OK
N6	1	J[2]	-12.4	-64.8	11.6	0.30	-1.04	0.61	-15.36	1.03	OK	0.058	0.522	1.26	OK
N6	2	I[2]	-12.4	-59.4	12.5	0.30	-1.03	0.63	-15.36	1.03	OK	0.062	0.513	1.26	OK
N6	2	J[3]	-7.5	-59.4	7.4	0.30	-0.70	0.30	-15.36	1.03	OK	0.037	0.348	1.19	OK
N6	3	I[3]	-7.5	-56.2	7.4	0.30	-0.68	0.31	-15.36	1.03	OK	0.037	0.342	1.19	OK
N6	3	J[4]	-5.0	-56.2	2.3	0.30	-0.52	0.15	-15.36	1.03	OK	0.012	0.261	1.15	OK
N6	4	I[4]	-5.0	-55.2	2.3	0.30	-0.52	0.15	-15.36	1.03	OK	0.012	0.260	1.15	OK
N6	4	J[5]	-5.0	-55.2	2.3	0.30	-0.52	0.15	-15.36	1.03	OK	0.012	0.260	1.15	OK
N6	5	I[5]	-5.0	-56.2	2.3	0.30	-0.52	0.15	-15.36	1.03	OK	0.012	0.261	1.15	OK
N6	5	J[6]	-7.5	-56.2	7.4	0.30	-0.68	0.31	-15.36	1.03	OK	0.037	0.342	1.19	OK
N6	6	I[6]	-7.5	-59.4	7.4	0.30	-0.70	0.30	-15.36	1.03	OK	0.037	0.348	1.19	OK
N6	6	J[7]	-12.4	-59.4	12.5	0.30	-1.03	0.63	-15.36	1.03	OK	0.062	0.513	1.26	OK
N6	7	I[7]	-12.4	-64.8	11.6	0.30	-1.04	0.61	-15.36	1.03	OK	0.058	0.522	1.26	OK
N6	7	J[8]	-7.9	-64.8	6.6	0.30	-0.74	0.31	-15.36	1.03	OK	0.033	0.370	1.20	OK
N6	8	I[9]	3.7	-165.0	35.3	0.30	-0.30	-0.80	-15.36	1.03	OK	0.176	0.550	1.28	OK
N6	8	J[8]	7.9	-165.9	35.8	0.30	-0.03	-1.08	-15.36	1.03	OK	0.179	0.553	1.28	OK
N6	9	I[10]	-4.2	-163.7	24.0	0.40	-0.57	-0.25	-15.36	1.03	OK	0.090	0.409	1.22	OK
N6	9	J[9]	3.7	-167.4	24.9	0.40	-0.28	-0.56	-15.36	1.03	OK	0.093	0.419	1.22	OK
N6	10	I[11]	-15.5	-158.5	34.5	0.50	-0.69	0.05	-15.36	1.03	OK	0.104	0.344	1.19	OK
N6	10	J[10]	-4.2	-163.1	34.7	0.50	-0.43	-0.22	-15.36	1.03	OK	0.104	0.326	1.18	OK
N6	11	I[12]	-23.3	-158.0	24.8	0.45	-1.04	0.34	-15.36	1.03	OK	0.083	0.520	1.26	OK
N6	11	J[11]	-15.5	-162.5	22.8	0.45	-0.82	0.10	-15.36	1.03	OK	0.076	0.410	1.22	OK
N6	12	I[13]	-20.6	-155.1	4.2	0.40	-1.16	0.39	-15.36	1.03	OK	0.016	0.581	1.29	OK
N6	12	J[12]	-23.3	-160.1	9.6	0.40	-1.27	0.47	-15.36	1.03	OK	0.036	0.636	1.31	OK
N6	13	I[14]	-17.1	-148.1	1.8	0.35	-1.26	0.41	-15.36	1.03	OK	0.008	0.630	1.31	OK
N6	13	J[13]	-20.6	-154.0	12.0	0.35	-1.45	0.57	-15.36	1.03	OK	0.052	0.725	1.34	OK
N6	14	I[15]	-14.5	-142.1	1.5	0.30	-1.44	0.49	-15.36	1.03	OK	0.007	0.720	1.34	OK
N6	14	J[14]	-17.1	-147.1	11.5	0.30	-1.63	0.65	-15.36	1.03	OK	0.057	0.815	1.38	OK
N6	15	I[16]	-13.0	-136.5	5.1	0.30	-1.32	0.41	-15.36	1.03	OK	0.025	0.662	1.32	OK
N6	15	J[15]	-14.5	-141.4	10.7	0.30	-1.44	0.50	-15.36	1.03	OK	0.053	0.719	1.34	OK
N6	16	I[17]	-11.3	-131.3	5.9	0.30	-1.19	0.31	-15.36	1.03	OK	0.029	0.595	1.29	OK
N6	16	J[16]	-13.0	-136.0	12.6	0.30	-1.32	0.42	-15.36	1.03	OK	0.063	0.661	1.32	OK
N6	17	I[18]	-6.9	-125.8	2.1	0.30	-0.88	0.04	-15.36	1.03	OK	0.011	0.441	1.23	OK
N6	17	J[17]	-11.3	-130.0	19.2	0.30	-1.19	0.32	-15.36	1.03	OK	0.096	0.593	1.29	OK
N6	18	I[19]	-0.2	-119.7	1.2	0.30	-0.42	-0.38	-15.36	1.03	OK	0.006	0.399	1.21	OK
N6	18	J[18]	-6.9	-123.3	25.3	0.30	-0.87	0.05	-15.36	1.03	OK	0.127	0.437	1.23	OK
N6	19	I[20]	6.7	-114.0	0.4	0.30	0.07	-0.83	-15.36	1.03	OK	0.002	0.414	1.22	OK
N6	19	J[19]	-0.2	-116.6	27.2	0.30	-0.40	-0.37	-15.36	1.03	OK	0.136	0.389	1.21	OK
N6	20	I[21]	12.0	-109.5	4.2	0.30	0.44	-1.17	-15.36	1.03	OK	0.021	0.584	1.29	OK
N6	20	J[20]	6.7	-111.2	25.2	0.30	0.08	-0.82	-15.36	1.03	OK	0.128	0.409	1.22	OK
N6	21	I[22]	14.1	-107.2	11.9	0.30	0.59	-1.30	-15.36	1.03	OK	0.059	0.648	1.31	OK
N6	21	J[21]	12.0	-107.8	19.8	0.30	0.44	-1.16	-15.36	1.03	OK	0.099	0.581	1.29	OK
N6	22	I[23]	12.0	-107.8	19.8	0.30	0.44	-1.16	-15.36	1.03	OK	0.099	0.581	1.29	OK
N6	22	J[22]	14.1	-107.2	11.9	0.30	0.58	-1.30	-15.36	1.03	OK	0.059	0.648	1.31	OK
N6	23	I[24]	6.7	-111.2	25.2	0.30	0.08	-0.82	-15.36	1.03	OK	0.126	0.409	1.22	OK
N6	23	J[23]	12.0	-109.5	4.2	0.30	0.44	-1.17	-15.36	1.03	OK	0.021	0.584	1.29	OK
N6	24	I[25]	-0.2	-116.6	27.2	0.30	-0.40	-0.37	-15.36	1.03	OK	0.136	0.389	1.21	OK
N6	24	J[24]	6.7	-114.0	0.4	0.30	0.07	-0.83	-15.36	1.03	OK	0.002	0.414	1.22	OK
N6	25	I[26]	-6.9	-123.3	25.3	0.30	-0.87	0.05	-15.36	1.03	OK	0.127	0.437	1.23	OK
N6	25	J[25]	-0.2	-119.7	1.2	0.30	-0.42	-0.38	-15.36	1.03	OK	0.006	0.399	1.21	OK
N6	26	I[27]	-11.3	-130.0	19.2	0.30	-1.19	0.32	-15.36	1.03	OK	0.096	0.593	1.29	OK
N6	26	J[26]	-6.9	-125.8	2.1	0.30	-0.88	0.04	-15.36	1.03	OK	0.011	0.441	1.23	OK
N6	27	I[28]	-13.0	-136.0	12.6	0.30	-1.32	0.42	-15.36	1.03	OK	0.063	0.661	1.32	OK
N6	27	J[27]	-11.3	-131.3	5.9	0.30	-1.19	0.31	-15.36	1.03	OK	0.029	0.595	1.29	OK
N6	28	I[29]	-14.5	-141.4	10.7	0.30	-1.44	0.50	-15.36	1.03	OK	0.053	0.719	1.34	OK
N6	28	J[28]	-13.0	-136.5	5.1	0.30	-1.32	0.41	-15.36	1.03	OK	0.025	0.662	1.32	OK
N6	29	I[30]	-17.1	-147.1	11.5	0.30	-1.63	0.65	-15.36	1.03	OK	0.057	0.815	1.38	OK
N6	29	J[29]	-14.5	-142.1	1.5	0.30	-1.44	0.49	-15.36	1.03	OK	0.007	0.720	1.34	OK
N6	30	I[31]	-20.6	-154.0	12.0	0.35	-1.45	0.57	-15.36	1.03	OK	0.052	0.725	1.34	OK
N6	30	J[30]	-17.1	-148.1	1.8	0.35	-1.26	0.41	-15.36	1.03	OK	0.008	0.630	1.31	OK
N6	31	I[32]	-23.3	-160.1	9.6	0.40	-1.27	0.47	-15.36	1.03	OK	0.036	0.636	1.31	OK
N6	31	J[31]	-20.6	-155.1	4.2	0.40	-1.16	0.39	-15.36	1.03	OK	0.016	0.581	1.29	OK
N6	32	I[33]	-15.5	-162.5	22.8	0.45	-0.85	0.10	-15.36	1.03	OK	0.076	0.425	1.22	OK
N6	32	J[32]	-23.3	-158.0	24.8	0.45	-1.04	0.34	-15.36	1.03	OK	0.083	0.520	1.26	OK
N6	33	I[34]	-4.2	-163.1	34.7	0.50	-0.43	-0.22	-15.36	1.03	OK	0.104	0.326	1.18	OK
N6	33	J[33]	-15.5	-158.5	34.5	0.50	-0.72	0.05	-15.36	1.03	OK	0.104	0.360	1.20	OK
N6	34	I[35]	3.7	-167.4	24.8	0.40	-0.28	-0.56	-15.36	1.03	OK	0.093	0.419	1.22	OK
N6	34	J[34]	-4.2	-163.7	24.0	0.40	-0.57	-0.25	-15.36	1.03	OK	0.090	0.409	1.22	OK
N6	35	I[1]	7.9	-165.9	35.8	0.30	-0.03	-1.08	-15.36	1.03	OK	0.179	0.553	1.28	OK
N6	35	J[35]	3.7	-165.0	35.3	0.30	-0.30	-0.80	-15.36	1.03	OK	0.176	0.550	1.28	OK

A.5.4.7. Load combination SLU 11

Beam Diagram_Fx / ST_N11



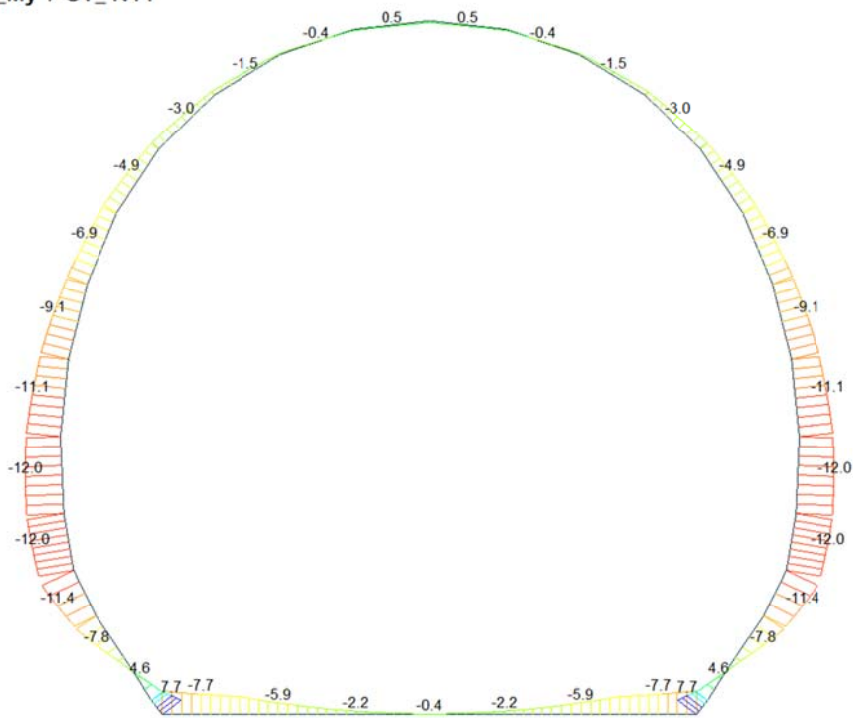
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

2.11
0.00
-4.96
-8.50
-12.03
-15.57
-19.10
-22.64
-26.17
-29.71
-33.24
-36.78

ST: N11
MAX : 21
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N11



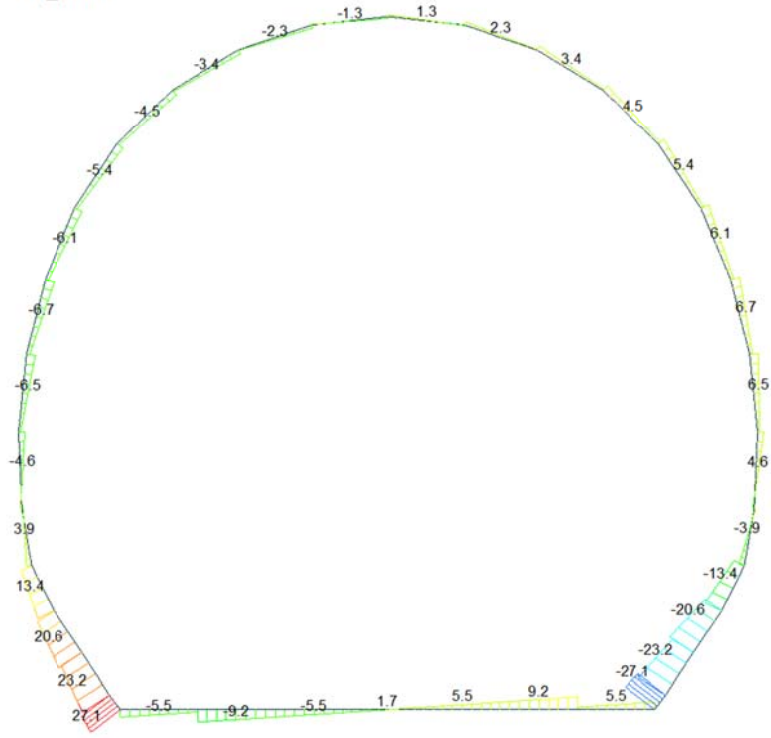
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

7.68
5.89
4.10
2.31
0.00
-1.27
-3.06
-4.85
-6.64
-8.43
-10.22
-12.01

ST: N11
MAX : 8
MIN : 13
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N11



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

27.10
22.17
17.25
12.32
7.39
2.46
0.00
-7.39
-12.32
-17.25
-22.17
-27.10

ST: N11

MAX : 35
MIN : 8

FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

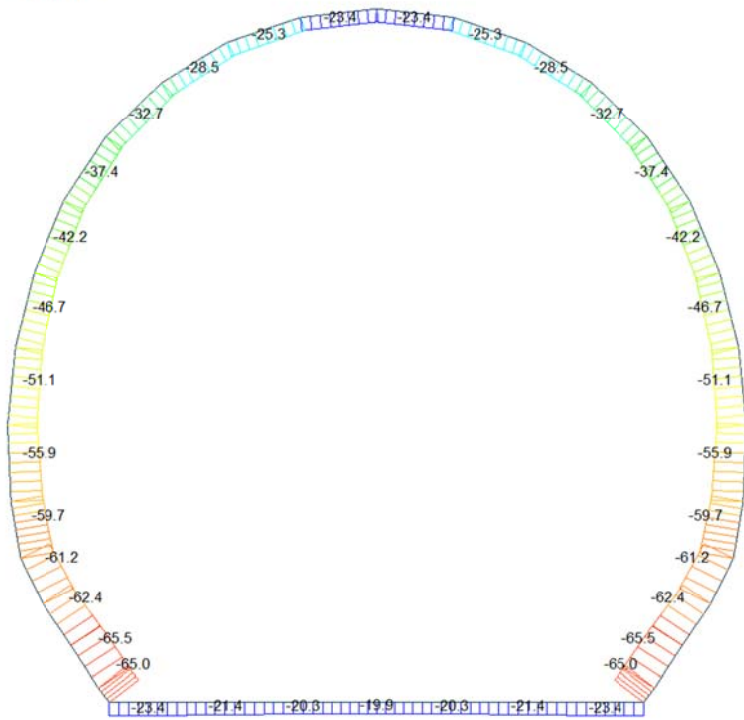
CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{cp} [N/mm ²]	$f_{ctd,EC2}$ [N/mm ²]	Verifica a taglio
N11	1	I[1]	-7.7	-0.2	5.5	0.30	-0.51	0.51	-20.47	1.37	OK	0.028	0.256	1.50	OK
N11	1	J[2]	-5.9	-0.2	1.8	0.30	-0.39	0.39	-20.47	1.37	OK	0.009	0.196	1.47	OK
N11	2	I[2]	-5.9	-0.1	9.2	0.30	-0.39	0.39	-20.47	1.37	OK	0.046	0.196	1.47	OK
N11	2	J[3]	-2.2	-0.1	5.5	0.30	-0.15	0.15	-20.47	1.37	OK	0.027	0.073	1.41	OK
N11	3	I[3]	-2.2	-0.1	5.5	0.30	-0.15	0.15	-20.47	1.37	OK	0.027	0.073	1.41	OK
N11	3	J[4]	-0.4	-0.1	1.7	0.30	-0.03	0.03	-20.47	1.37	OK	0.009	0.013	1.38	OK
N11	4	I[4]	-0.4	-0.1	1.7	0.30	-0.03	0.03	-20.47	1.37	OK	0.009	0.013	1.38	OK
N11	4	J[5]	-0.4	-0.1	1.7	0.30	-0.03	0.03	-20.47	1.37	OK	0.009	0.013	1.38	OK
N11	5	I[5]	-0.4	-0.1	1.7	0.30	-0.03	0.03	-20.47	1.37	OK	0.009	0.013	1.38	OK
N11	5	J[6]	-2.2	-0.1	5.5	0.30	-0.15	0.15	-20.47	1.37	OK	0.027	0.073	1.41	OK
N11	6	I[6]	-2.2	-0.1	5.5	0.30	-0.15	0.15	-20.47	1.37	OK	0.027	0.073	1.41	OK
N11	6	J[7]	-5.9	-0.1	9.2	0.30	-0.39	0.39	-20.47	1.37	OK	0.046	0.196	1.47	OK
N11	7	I[7]	-5.9	-0.2	1.8	0.30	-0.39	0.39	-20.47	1.37	OK	0.009	0.196	1.47	OK
N11	7	J[8]	-7.7	-0.2	5.5	0.30	-0.51	0.51	-20.47	1.37	OK	0.028	0.256	1.50	OK
N11	8	I[8]	4.6	-34.8	25.3	0.30	0.19	-0.43	-20.47	1.37	OK	0.126	0.213	1.48	OK
N11	8	J[9]	7.7	-35.5	27.1	0.30	0.39	-0.63	-20.47	1.37	OK	0.136	0.315	1.52	OK
N11	9	I[9]	-2.1	-34.0	17.9	0.40	-0.16	-0.01	-20.47	1.37	OK	0.067	0.085	1.41	OK
N11	9	J[10]	4.6	-36.8	23.3	0.40	0.08	-0.27	-20.47	1.37	OK	0.087	0.133	1.44	OK
N11	10	I[11]	-7.8	-30.2	14.7	0.50	-0.25	0.13	-20.47	1.37	OK	0.044	0.124	1.43	OK
N11	10	J[10]	-2.1	-33.6	20.6	0.50	-0.12	-0.02	-20.47	1.37	OK	0.062	0.067	1.41	OK
N11	11	I[12]	-11.4	-28.9	8.2	0.45	-0.40	0.27	-20.47	1.37	OK	0.027	0.201	1.47	OK
N11	11	J[11]	-7.8	-32.2	13.4	0.45	-0.30	0.16	-20.47	1.37	OK	0.045	0.152	1.45	OK
N11	12	I[13]	-12.0	-26.9	0.9	0.40	-0.52	0.38	-20.47	1.37	OK	0.003	0.258	1.50	OK
N11	12	J[12]	-11.4	-30.6	3.9	0.40	-0.50	0.35	-20.47	1.37	OK	0.015	0.252	1.49	OK
N11	13	I[14]	-11.1	-22.5	4.6	0.35	-0.61	0.48	-20.47	1.37	OK	0.020	0.304	1.52	OK
N11	13	J[13]	-12.0	-26.9	1.1	0.35	-0.66	0.51	-20.47	1.37	OK	0.005	0.331	1.53	OK
N11	14	I[15]	-9.2	-18.4	6.5	0.30	-0.67	0.55	-20.47	1.37	OK	0.032	0.336	1.53	OK
N11	14	J[14]	-11.1	-22.1	1.3	0.30	-0.81	0.67	-20.47	1.37	OK	0.007	0.406	1.56	OK
N11	15	I[16]	-6.9	-14.1	6.7	0.30	-0.51	0.42	-20.47	1.37	OK	0.034	0.254	1.49	OK
N11	15	J[15]	-9.2	-17.7	2.2	0.30	-0.67	0.55	-20.47	1.37	OK	0.011	0.335	1.53	OK
N11	16	I[17]	-4.9	-10.0	6.1	0.30	-0.36	0.29	-20.47	1.37	OK	0.031	0.179	1.46	OK
N11	16	J[16]	-6.9	-13.5	2.1	0.30	-0.51	0.42	-20.47	1.37	OK	0.010	0.253	1.49	OK
N11	17	I[18]	-3.0	-6.1	5.4	0.30	-0.22	0.18	-20.47	1.37	OK	0.027	0.111	1.43	OK
N11	17	J[17]	-4.9	-9.2	2.0	0.30	-0.36	0.29	-20.47	1.37	OK	0.010	0.178	1.46	OK
N11	18	I[19]	-1.5	-2.7	4.5	0.30	-0.11	0.09	-20.47	1.37	OK	0.022	0.054	1.40	OK
N11	18	J[18]	-3.0	-5.3	1.7	0.30	-0.22	0.18	-20.47	1.37	OK	0.008	0.110	1.43	OK
N11	19	I[20]	-0.4	-0.1	3.4	0.30	-0.02	0.02	-20.47	1.37	OK	0.017	0.012	1.38	OK
N11	19	J[19]	-1.5	-2.1	1.1	0.30	-0.10	0.09	-20.47	1.37	OK	0.005	0.052	1.40	OK
N11	20	I[21]	0.3	1.5	2.3	0.30	0.03	-0.02	-20.47	1.37	OK	0.012	0.008	1.38	OK
N11	20	J[20]	-0.4	0.3	0.4	0.30	-0.02	0.02	-20.47	1.37	OK	0.002	0.012	1.38	OK
N11	21	I[22]	0.5	2.1	1.3	0.30	0.04	-0.03	-20.47	1.37	OK	0.007	0.014	1.38	OK
N11	21	J[21]	0.3	1.7	0.5	0.30	0.03	-0.02	-20.47	1.37	OK	0.002	0.008	1.38	OK
N11	22	I[22]	0.3	1.7	0.5	0.30	0.03	-0.02	-20.47	1.37	OK	0.002	0.008	1.38	OK
N11	22	J[22]	0.5	2.1	1.3	0.30	0.04	-0.03	-20.47	1.37	OK	0.007	0.014	1.38	OK
N11	23	I[24]	-0.4	0.3	0.4	0.30	-0.02	0.02	-20.47	1.37	OK	0.002	0.012	1.38	OK
N11	23	J[23]	0.3	1.5	2.3	0.30	0.03	-0.02	-20.47	1.37	OK	0.012	0.008	1.38	OK
N11	24	I[25]	-1.5	-2.1	1.1	0.30	-0.10	0.09	-20.47	1.37	OK	0.005	0.052	1.40	OK
N11	24	J[24]	-0.4	-0.1	3.4	0.30	-0.02	0.02	-20.47	1.37	OK	0.017	0.012	1.38	OK
N11	25	I[26]	-3.0	-5.3	1.7	0.30	-0.22	0.18	-20.47	1.37	OK	0.008	0.110	1.43	OK
N11	25	J[25]	-1.5	-2.7	4.5	0.30	-0.11	0.09	-20.47	1.37	OK	0.022	0.054	1.40	OK
N11	26	I[27]	-4.9	-9.2	2.0	0.30	-0.36	0.29	-20.47	1.37	OK	0.010	0.178	1.46	OK
N11	26	J[26]	-3.0	-6.1	5.4	0.30	-0.22	0.18	-20.47	1.37	OK	0.027	0.111	1.43	OK
N11	27	I[28]	-6.9	-13.5	2.1	0.30	-0.51	0.42	-20.47	1.37	OK	0.010	0.253	1.49	OK
N11	27	J[27]	-4.9	-10.0	6.1	0.30	-0.36	0.29	-20.47	1.37	OK	0.031	0.179	1.46	OK
N11	28	I[29]	-9.2	-17.7	2.2	0.30	-0.67	0.55	-20.47	1.37	OK	0.011	0.335	1.53	OK
N11	28	J[28]	-6.9	-14.1	6.7	0.30	-0.51	0.42	-20.47	1.37	OK	0.034	0.254	1.49	OK
N11	29	I[30]	-11.1	-22.1	1.3	0.30	-0.81	0.67	-20.47	1.37	OK	0.007	0.406	1.56	OK
N11	29	J[29]	-9.2	-18.4	6.5	0.30	-0.67	0.55	-20.47	1.37	OK	0.032	0.336	1.53	OK
N11	30	I[31]	-12.0	-26.9	1.1	0.35	-0.66	0.51	-20.47	1.37	OK	0.005	0.331	1.53	OK
N11	30	J[30]	-11.1	-22.5	4.6	0.35	-0.61	0.48	-20.47	1.37	OK	0.020	0.304	1.52	OK
N11	31	I[32]	-11.4	-30.6	3.9	0.40	-0.50	0.35	-20.47	1.37	OK	0.015	0.252	1.49	OK
N11	31	J[31]	-12.0	-26.9	0.9	0.40	-0.52	0.38	-20.47	1.37	OK	0.003	0.258	1.50	OK
N11	32	I[33]	-7.8	-32.2	13.4	0.45	-0.30	0.16	-20.47	1.37	OK	0.045	0.152	1.45	OK
N11	32	J[32]	-11.4	-28.9	8.2	0.45	-0.40	0.27	-20.47	1.37	OK	0.027	0.201	1.47	OK
N11	33	I[34]	-2.1	-33.6	20.6	0.50	-0.12	-0.02	-20.47	1.37	OK	0.062	0.067	1.41	OK
N11	33	J[33]	-7.8	-30.2	14.7	0.50	-0.25	0.13	-20.47	1.37	OK	0.044	0.124	1.43	OK
N11	34	I[35]	4.6	-36.8	23.3	0.40	0.08	-0.27	-20.47	1.37	OK	0.087	0.133	1.44	OK
N11	34	J[34]	-2.1	-34.0	17.9	0.40	-0.16	-0.01	-20.47	1.37	OK	0.067	0.085	1.41	OK
N11	35	I[1]	7.7	-35.5	27.1	0.30	0.39	-0.63	-20.47	1.37	OK	0.136	0.315	1.52	OK
N11	35	J[35]	4.6	-34.8	25.3	0.30	0.19	-0.43	-20.47	1.37	OK	0.126	0.213	1.48	OK

Beam Diagram_Fx / ST_N12



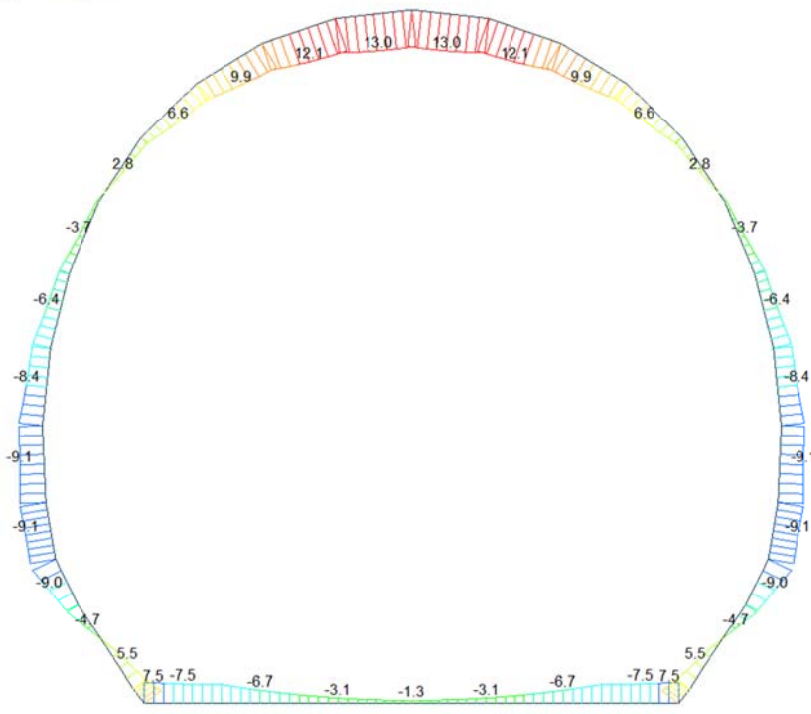
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-19.90
Cyan	-24.04
Green	-28.19
Light Green	-32.33
Yellow-Green	-36.48
Yellow	-40.62
Orange	-44.77
Light Orange	-48.91
Orange-Red	-53.06
Red-Orange	-57.20
Red	-61.35
Dark Red	-65.49

ST: N12
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N12



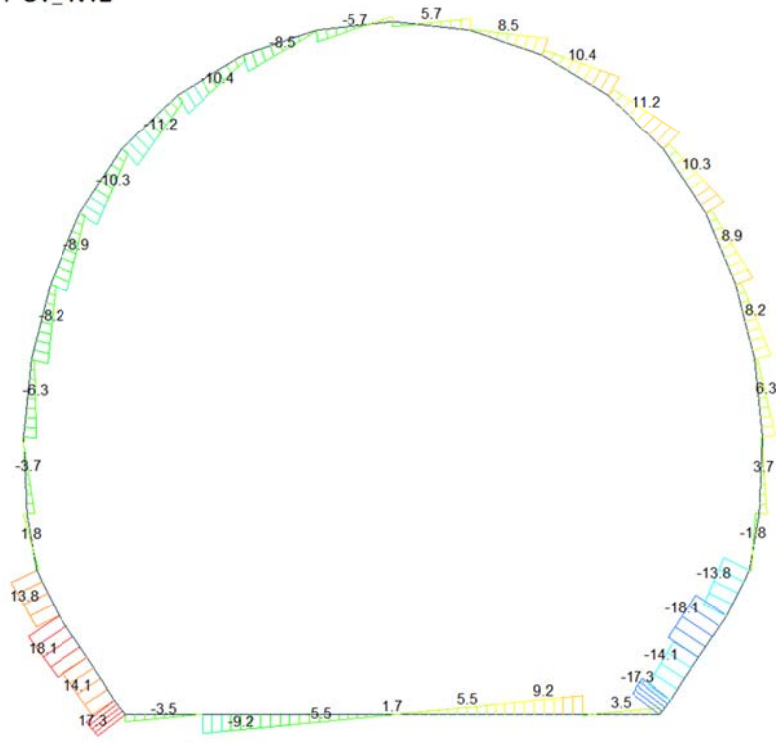
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Red	13.05
Orange-Red	11.03
Orange	9.02
Light Orange	7.00
Yellow	4.98
Yellow-Green	2.96
Green	0.00
Light Green	-1.07
Cyan	-3.09
Green-Cyan	-5.11
Blue-Cyan	-7.12
Blue	-9.14

ST: N12
MAX : 21
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N12



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

18.07
14.78
11.50
8.21
4.93
1.64
0.00
-4.93
-8.21
-11.50
-14.78
-18.07

ST: N12

MAX : 33
MIN : 10

FILE: PdE_C01-CO-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION

X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

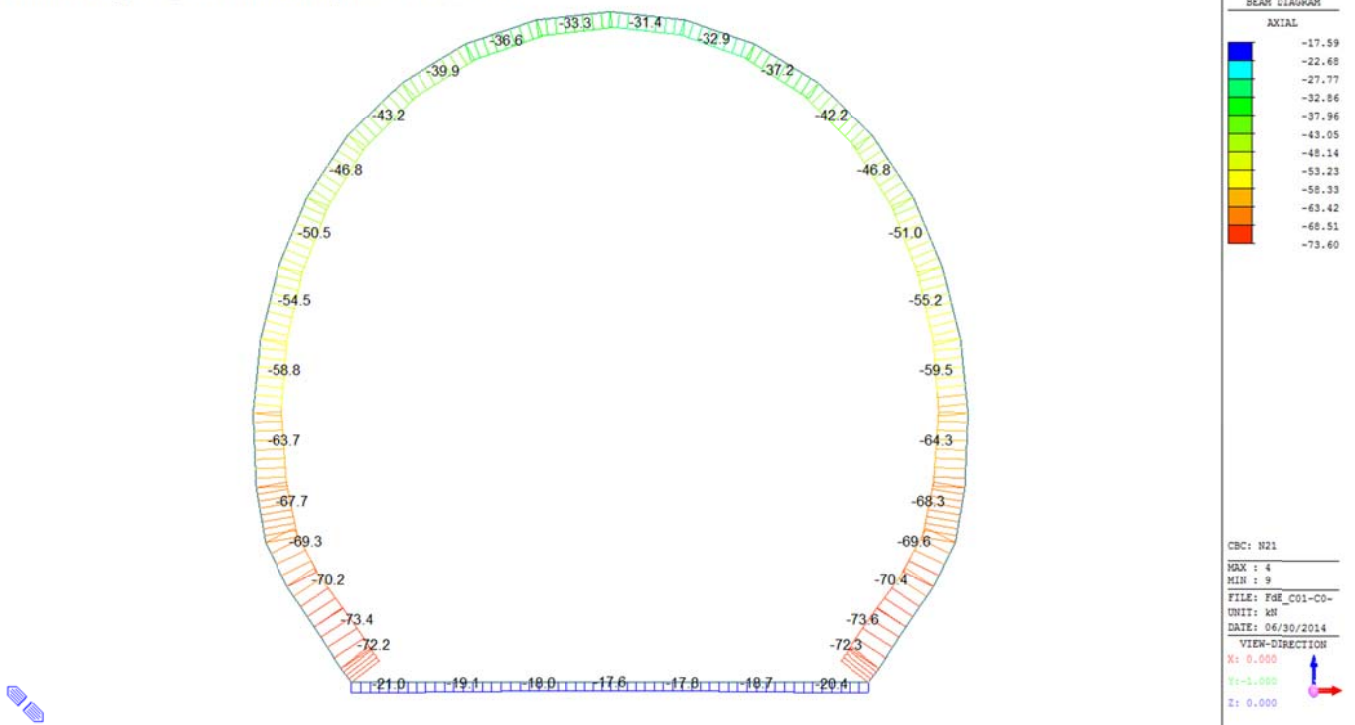
R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

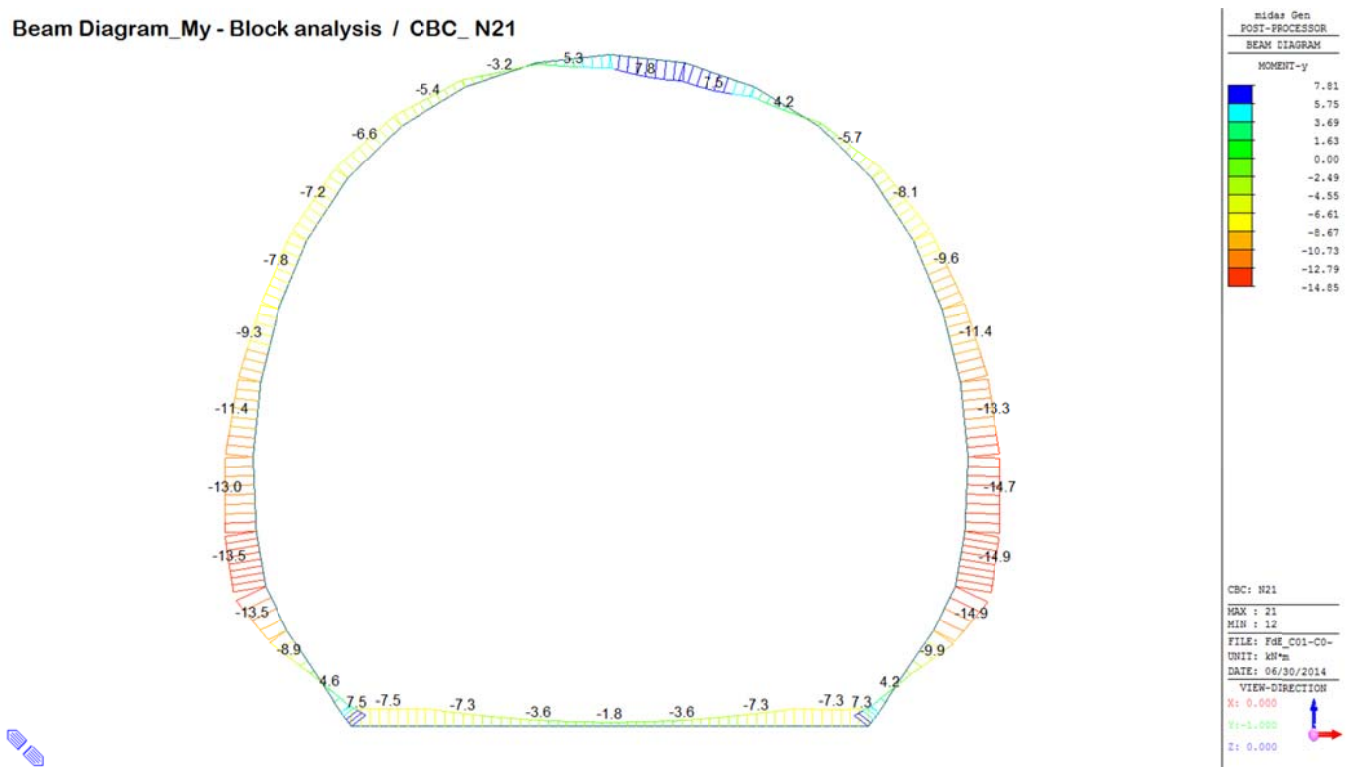
Combinazione di carico	Elemento	Nodo	M_d [kN·m]	N_d [kN]	V_d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{cp} [N/mm ²]	$f_{ctd,EC2}$ [N/mm ²]	Verifica a taglio
													$\tau_{cp,max} \leq F_{ctd}$		
N12	1	I[1]	-7.5	-23.4	3.5	0.30	-0.58	0.42	-20.47	1.37	OK	0.017	0.290	1.51	OK
N12	1	J[2]	-6.7	-23.4	0.3	0.30	-0.53	0.37	-20.47	1.37	OK	0.001	0.263	1.50	OK
N12	2	I[2]	-6.7	-21.4	9.2	0.30	-0.52	0.38	-20.47	1.37	OK	0.046	0.260	1.50	OK
N12	2	J[3]	-3.1	-21.4	5.5	0.30	-0.27	0.13	-20.47	1.37	OK	0.027	0.137	1.44	OK
N12	3	I[3]	-3.1	-20.3	5.5	0.30	-0.27	0.14	-20.47	1.37	OK	0.027	0.135	1.44	OK
N12	3	J[4]	-1.3	-20.3	1.7	0.30	-0.15	0.02	-20.47	1.37	OK	0.009	0.075	1.41	OK
N12	4	I[4]	-1.3	-19.9	1.7	0.30	-0.15	0.02	-20.47	1.37	OK	0.009	0.075	1.41	OK
N12	4	J[5]	-1.3	-19.9	1.7	0.30	-0.15	0.02	-20.47	1.37	OK	0.009	0.075	1.41	OK
N12	5	I[5]	-1.3	-20.3	1.7	0.30	-0.15	0.02	-20.47	1.37	OK	0.009	0.075	1.41	OK
N12	5	J[6]	-3.1	-20.3	5.5	0.30	-0.27	0.14	-20.47	1.37	OK	0.027	0.135	1.44	OK
N12	6	I[6]	-3.1	-21.4	5.5	0.30	-0.27	0.13	-20.47	1.37	OK	0.027	0.137	1.44	OK
N12	6	J[7]	-6.7	-21.4	9.2	0.30	-0.52	0.38	-20.47	1.37	OK	0.046	0.260	1.50	OK
N12	7	I[7]	-6.7	-23.4	0.3	0.30	-0.53	0.37	-20.47	1.37	OK	0.001	0.263	1.50	OK
N12	7	J[8]	-7.5	-23.4	3.5	0.30	-0.58	0.42	-20.47	1.37	OK	0.017	0.290	1.51	OK
N12	8	I[8]	5.5	-64.3	17.3	0.30	0.16	-0.58	-20.47	1.37	OK	0.086	0.292	1.51	OK
N12	8	J[9]	7.5	-65.0	16.8	0.30	0.28	-0.72	-20.47	1.37	OK	0.084	0.359	1.54	OK
N12	9	I[10]	1.1	-62.8	14.1	0.40	-0.11	-0.20	-20.47	1.37	OK	0.053	0.157	1.45	OK
N12	9	J[9]	5.5	-65.5	12.9	0.40	0.04	-0.37	-20.47	1.37	OK	0.048	0.186	1.46	OK
N12	10	I[11]	-4.7	-59.0	18.1	0.50	-0.23	-0.01	-20.47	1.37	OK	0.054	0.118	1.43	OK
N12	10	J[10]	1.1	-62.4	17.4	0.50	-0.10	-0.15	-20.47	1.37	OK	0.052	0.125	1.43	OK
N12	11	I[12]	-9.0	-57.8	13.8	0.45	-0.39	0.14	-20.47	1.37	OK	0.046	0.197	1.47	OK
N12	11	J[11]	-4.7	-61.2	12.4	0.45	-0.27	0.00	-20.47	1.37	OK	0.041	0.137	1.44	OK
N12	12	I[13]	-9.0	-56.0	1.8	0.40	-0.48	0.20	-20.47	1.37	OK	0.007	0.241	1.49	OK
N12	12	J[12]	-9.0	-59.7	0.9	0.40	-0.49	0.19	-20.47	1.37	OK	0.003	0.243	1.49	OK
N12	13	I[14]	-8.4	-51.5	0.6	0.35	-0.56	0.26	-20.47	1.37	OK	0.002	0.278	1.51	OK
N12	13	J[13]	-9.1	-55.9	3.7	0.35	-0.61	0.29	-20.47	1.37	OK	0.016	0.304	1.52	OK
N12	14	I[15]	-6.5	-47.4	1.4	0.30	-0.59	0.27	-20.47	1.37	OK	0.007	0.294	1.51	OK
N12	14	J[14]	-8.4	-51.1	6.3	0.30	-0.73	0.39	-20.47	1.37	OK	0.031	0.363	1.54	OK
N12	15	I[16]	-3.7	-43.0	2.8	0.30	-0.39	0.10	-20.47	1.37	OK	0.014	0.196	1.47	OK
N12	15	J[15]	-6.5	-46.7	8.2	0.30	-0.59	0.27	-20.47	1.37	OK	0.041	0.293	1.51	OK
N12	16	I[17]	-0.7	-38.7	3.0	0.30	-0.18	-0.08	-20.47	1.37	OK	0.015	0.129	1.44	OK
N12	16	J[16]	-3.7	-42.2	9.0	0.30	-0.39	0.11	-20.47	1.37	OK	0.045	0.194	1.47	OK
N12	17	I[18]	2.8	-34.3	3.8	0.30	0.07	-0.30	-20.47	1.37	OK	0.019	0.150	1.45	OK
N12	17	J[17]	-0.7	-37.4	10.3	0.30	-0.17	-0.08	-20.47	1.37	OK	0.052	0.125	1.43	OK
N12	18	I[19]	6.6	-30.1	4.0	0.30	0.34	-0.54	-20.47	1.37	OK	0.020	0.269	1.50	OK
N12	18	J[18]	2.8	-32.7	11.2	0.30	0.08	-0.29	-20.47	1.37	OK	0.056	0.147	1.44	OK
N12	19	I[20]	9.9	-26.5	2.8	0.30	0.57	-0.75	-20.47	1.37	OK	0.014	0.373	1.55	OK
N12	19	J[19]	6.6	-28.5	10.4	0.30	0.34	-0.53	-20.47	1.37	OK	0.052	0.266	1.50	OK
N12	20	I[21]	12.1	-24.1	0.4	0.30	0.73	-0.89	-20.47	1.37	OK	0.002	0.443	1.58	OK
N12	20	J[20]	9.9	-25.3	8.5	0.30	0.57	-0.74	-20.47	1.37	OK	0.042	0.371	1.55	OK
N12	21	I[22]	12.9	-23.0	2.5	0.30	0.78	-0.93	-20.47	1.37	OK	0.013	0.467	1.59	OK
N12	21	J[21]	12.1	-23.4	5.7	0.30	0.73	-0.88	-20.47	1.37	OK	0.028	0.442	1.58	OK
N12	22	I[22]	12.1	-23.4	5.7	0.30	0.73	-0.88	-20.47	1.37	OK	0.028	0.442	1.58	OK
N12	22	J[22]	12.9	-23.0	2.5	0.30	0.78	-0.93	-20.47	1.37	OK	0.013	0.467	1.59	OK
N12	23	I[24]	9.9	-25.3	8.5	0.30	0.57	-0.74	-20.47	1.37	OK	0.042	0.371	1.55	OK
N12	23	J[23]	12.1	-24.1	0.4	0.30	0.73	-0.89	-20.47	1.37	OK	0.002	0.443	1.58	OK
N12	24	I[25]	6.6	-28.5	10.4	0.30	0.34	-0.53	-20.47	1.37	OK	0.052	0.266	1.50	OK
N12	24	J[24]	9.9	-26.5	2.8	0.30	0.57	-0.75	-20.47	1.37	OK	0.014	0.373	1.55	OK
N12	25	I[26]	2.8	-32.7	11.2	0.30	0.08	-0.29	-20.47	1.37	OK	0.056	0.147	1.44	OK
N12	25	J[25]	6.6	-30.1	4.0	0.30	0.34	-0.54	-20.47	1.37	OK	0.020	0.269	1.50	OK
N12	26	I[27]	-0.7	-37.4	10.3	0.30	-0.17	-0.08	-20.47	1.37	OK	0.052	0.125	1.43	OK
N12	26	J[26]	2.8	-34.3	3.8	0.30	0.07	-0.30	-20.47	1.37	OK	0.019	0.150	1.45	OK
N12	27	I[28]	-3.7	-42.2	9.0	0.30	-0.39	0.11	-20.47	1.37	OK	0.045	0.194	1.47	OK
N12	27	J[27]	-0.7	-38.7	3.0	0.30	-0.18	-0.08	-20.47	1.37	OK	0.015	0.129	1.44	OK
N12	28	I[29]	-6.5	-46.7	8.2	0.30	-0.59	0.27	-20.47	1.37	OK	0.041	0.293	1.51	OK
N12	28	J[28]	-3.7	-43.0	2.8	0.30	-0.39	0.10	-20.47	1.37	OK	0.014	0.196	1.47	OK
N12	29	I[30]	-8.4	-51.1	6.3	0.30	-0.73	0.39	-20.47	1.37	OK	0.031	0.363	1.54	OK
N12	29	J[29]	-6.5	-47.4	1.4	0.30	-0.59	0.27	-20.47	1.37	OK	0.007	0.294	1.51	OK
N12	30	I[31]	-9.1	-55.9	3.7	0.35	-0.61	0.29	-20.47	1.37	OK	0.016	0.304	1.52	OK
N12	30	J[30]	-8.4	-51.5	0.6	0.35	-0.56	0.26	-20.47	1.37	OK	0.002	0.278	1.51	OK
N12	31	I[32]	-9.0	-59.7	0.9	0.40	-0.49	0.19	-20.47	1.37	OK	0.003	0.243	1.49	OK
N12	31	J[31]	-9.1	-56.0	1.8	0.40	-0.48	0.20	-20.47	1.37	OK	0.007	0.241	1.49	OK
N12	32	I[33]	-4.7	-61.2	12.4	0.45	-0.27	0.00	-20.47	1.37	OK	0.041	0.137	1.44	OK
N12	32	J[32]	-9.0	-57.8	13.8	0.45	-0.39	0.14	-20.47	1.37	OK	0.046	0.197	1.47	OK
N12	33	I[34]	1.1	-62.4	17.4	0.50	-0.10	-0.15	-20.47	1.37	OK	0.052	0.125	1.43	OK
N12	33	J[33]	-4.7	-59.0	18.1	0.50	-0.23	-0.01	-20.47	1.37	OK	0.054	0.118	1.43	OK
N12	34	I[35]	5.5	-65.5	12.9	0.40	0.04	-0.37	-20.47	1.37	OK	0.048	0.186	1.46	OK
N12	34	J[34]	1.1	-62.8	14.1	0.40	-0.11	-0.20	-20.47	1.37	OK	0.053	0.157	1.45	OK
N12	35	I[1]	7.5	-65.0	16.8	0.30	0.28	-0.72	-20.47	1.37	OK	0.084	0.359	1.54	OK
N12	35	J[35]	5.5	-64.3	17.3	0.30	0.16	-0.58	-20.47	1.37	OK	0.086	0.292	1.51	OK

A.5.4.9. Load combination SLU 21 Block analysis

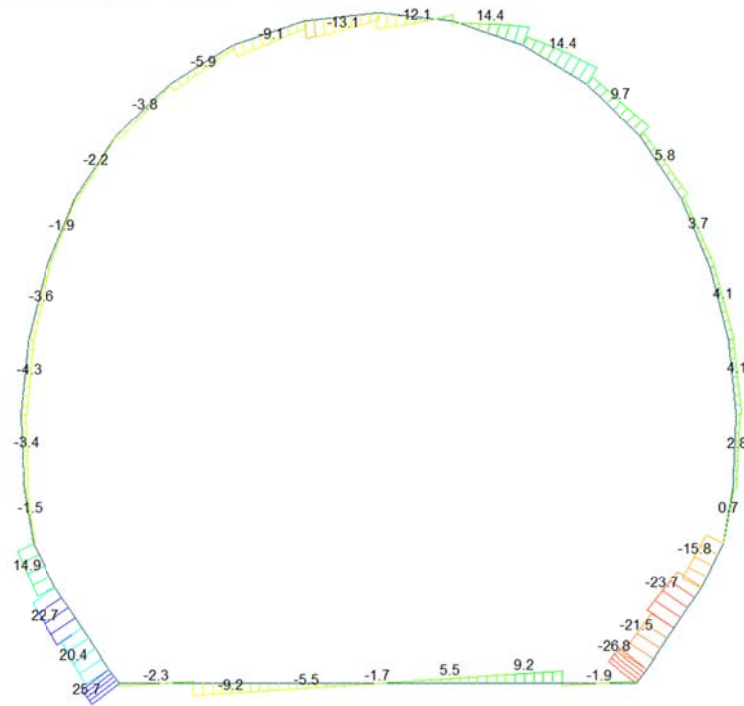
Beam Diagram_Fx - Block analysis / CBC_N21



Beam Diagram_My - Block analysis / CBC_N21



Beam Diagram_Fz - Block analysis / CBC_N21



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

25.75
20.97
16.19
11.42
6.64
0.00
-2.92
-7.69
-12.47
-17.25
-22.02
-26.80

CBC: N21
MAX : 35
MIN : 8
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

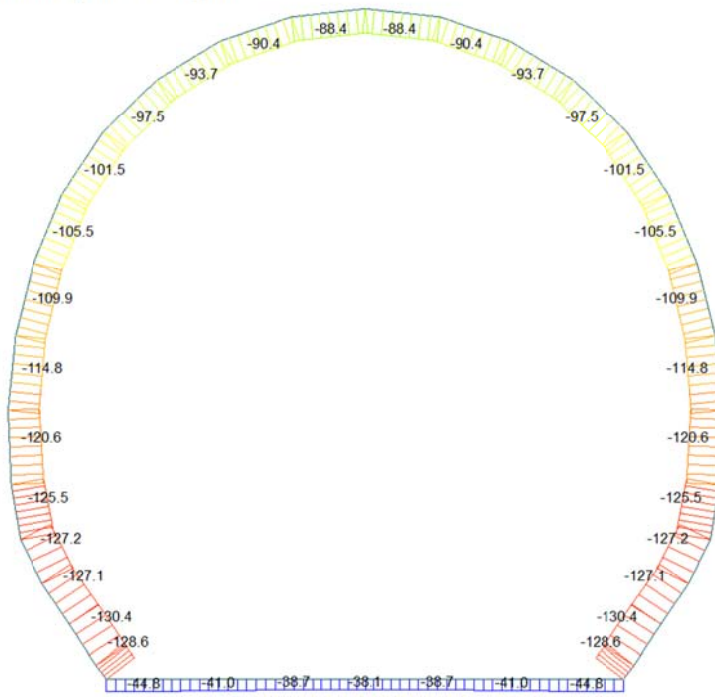
R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN·m]	N_d [kN]	V_d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N21	1	I[1]	-7.5	-21.0	2.3	0.23	-0.94	0.76	-20.47	1.37	OK	0.015	0.472	1.59	OK
N21	1	J[2]	-7.3	-21.0	1.5	0.23	-0.92	0.74	-20.47	1.37	OK	0.010	0.461	1.59	OK
N21	2	I[2]	-7.3	-19.1	9.2	0.23	-0.91	0.75	-20.47	1.37	OK	0.060	0.457	1.58	OK
N21	2	J[3]	-3.6	-19.1	5.5	0.23	-0.50	0.33	-20.47	1.37	OK	0.036	0.248	1.49	OK
N21	3	I[3]	-3.6	-18.0	5.5	0.23	-0.49	0.33	-20.47	1.37	OK	0.036	0.246	1.49	OK
N21	3	J[4]	-1.8	-18.0	1.7	0.23	-0.29	0.13	-20.47	1.37	OK	0.011	0.143	1.44	OK
N21	4	I[4]	-1.8	-17.6	1.7	0.23	-0.29	0.13	-20.47	1.37	OK	0.011	0.143	1.44	OK
N21	4	J[5]	-1.8	-17.6	1.7	0.23	-0.29	0.13	-20.47	1.37	OK	0.011	0.143	1.44	OK
N21	5	I[5]	-1.8	-17.8	1.7	0.23	-0.29	0.13	-20.47	1.37	OK	0.011	0.143	1.44	OK
N21	5	J[6]	-3.6	-17.8	5.5	0.23	-0.49	0.33	-20.47	1.37	OK	0.036	0.245	1.49	OK
N21	6	I[6]	-3.6	-18.8	5.5	0.23	-0.49	0.33	-20.47	1.37	OK	0.036	0.247	1.49	OK
N21	6	J[7]	-7.3	-18.8	9.2	0.23	-0.91	0.75	-20.47	1.37	OK	0.060	0.455	1.58	OK
N21	7	I[7]	-7.3	-20.4	1.9	0.23	-0.92	0.74	-20.47	1.37	OK	0.012	0.458	1.59	OK
N21	7	J[8]	-7.3	-20.4	1.9	0.23	-0.92	0.74	-20.47	1.37	OK	0.012	0.458	1.59	OK
N21	8	I[8]	4.2	-17.7	26.3	0.23	0.16	-0.79	-20.47	1.37	OK	0.171	0.394	1.56	OK
N21	8	J[9]	7.3	-17.4	26.8	0.23	0.51	-1.14	-20.47	1.37	OK	0.175	0.571	1.63	OK
N21	9	I[9]	-2.5	-70.9	19.7	0.33	-0.35	-0.07	-20.47	1.37	OK	0.090	0.215	1.48	OK
N21	9	J[9]	4.2	-73.6	21.5	0.33	0.01	-0.45	-20.47	1.37	OK	0.098	0.227	1.48	OK
N21	10	I[11]	-9.9	-67.0	21.5	0.43	-0.48	0.17	-20.47	1.37	OK	0.075	0.239	1.49	OK
N21	10	J[10]	-2.5	-70.4	23.7	0.43	-0.25	-0.08	-20.47	1.37	OK	0.083	0.164	1.45	OK
N21	11	I[12]	-14.9	-66.3	14.2	0.38	-0.79	0.44	-20.47	1.37	OK	0.056	0.396	1.56	OK
N21	11	J[11]	-9.9	-69.6	15.8	0.38	-0.59	0.23	-20.47	1.37	OK	0.063	0.297	1.51	OK
N21	12	I[13]	-14.7	-64.6	0.7	0.33	-1.01	0.61	-20.47	1.37	OK	0.003	0.503	1.60	OK
N21	12	J[12]	-14.9	-66.3	0.1	0.33	-1.03	0.61	-20.47	1.37	OK	0.001	0.513	1.61	OK
N21	13	I[14]	-13.3	-60.0	2.8	0.28	-1.24	0.81	-20.47	1.37	OK	0.015	0.618	1.65	OK
N21	13	J[13]	-14.7	-64.3	2.6	0.28	-1.35	0.90	-20.47	1.37	OK	0.014	0.677	1.68	OK
N21	14	I[15]	-11.4	-55.7	3.7	0.23	-1.54	1.05	-20.47	1.37	OK	0.024	0.768	1.71	OK
N21	14	J[14]	-13.3	-59.5	4.1	0.23	-1.77	1.25	-20.47	1.37	OK	0.027	0.886	1.76	OK
N21	15	I[16]	-9.6	-51.5	3.2	0.23	-1.31	0.86	-20.47	1.37	OK	0.021	0.655	1.67	OK
N21	15	J[15]	-11.4	-55.2	4.1	0.23	-1.53	1.05	-20.47	1.37	OK	0.027	0.766	1.71	OK
N21	16	I[17]	-8.1	-47.6	2.3	0.23	-1.12	0.71	-20.47	1.37	OK	0.015	0.562	1.63	OK
N21	16	J[16]	-9.6	-51.1	3.7	0.23	-1.31	0.86	-20.47	1.37	OK	0.024	0.654	1.67	OK
N21	17	I[18]	-5.7	-43.7	3.7	0.23	-0.84	0.46	-20.47	1.37	OK	0.024	0.419	1.57	OK
N21	17	J[17]	-8.1	-46.8	5.8	0.23	-1.12	0.71	-20.47	1.37	OK	0.038	0.581	1.63	OK
N21	18	I[19]	-1.5	-39.6	7.1	0.23	-0.34	0.00	-20.47	1.37	OK	0.046	0.172	1.46	OK
N21	18	J[18]	-5.7	-42.2	9.8	0.23	-0.83	0.47	-20.47	1.37	OK	0.064	0.416	1.57	OK
N21	19	I[20]	4.2	-35.3	6.9	0.23	0.32	-0.52	-20.47	1.37	OK	0.045	0.312	1.52	OK
N21	19	J[19]	-1.5	-37.2	14.4	0.23	-0.33	0.01	-20.47	1.37	OK	0.094	0.167	1.45	OK
N21	20	I[21]	7.5	-31.7	2.3	0.23	0.72	-0.99	-20.47	1.37	OK	0.015	0.497	1.60	OK
N21	20	J[20]	4.2	-32.9	14.4	0.23	0.33	-0.61	-20.47	1.37	OK	0.094	0.307	1.52	OK
N21	21	I[22]	5.3	-31.0	12.1	0.23	0.47	-0.74	-20.47	1.37	OK	0.079	0.370	1.55	OK
N21	21	J[21]	7.5	-31.5	4.7	0.23	0.72	-0.99	-20.47	1.37	OK	0.031	0.496	1.60	OK
N21	22	I[22]	0.5	-33.3	13.1	0.23	-0.09	-0.20	-20.47	1.37	OK	0.086	0.145	1.44	OK
N21	22	J[22]	5.3	-32.9	5.0	0.23	0.46	-0.75	-20.47	1.37	OK	0.033	0.374	1.55	OK
N21	23	I[24]	-3.2	-36.6	9.1	0.23	-0.52	0.20	-20.47	1.37	OK	0.059	0.261	1.50	OK
N21	23	J[23]	0.5	-35.4	5.5	0.23	-0.10	-0.20	-20.47	1.37	OK	0.036	0.154	1.45	OK
N21	24	I[25]	-5.4	-39.9	5.9	0.23	-0.78	0.44	-20.47	1.37	OK	0.039	0.391	1.56	OK
N21	24	J[24]	-3.2	-37.9	2.8	0.23	-0.53	0.20	-20.47	1.37	OK	0.018	0.264	1.50	OK
N21	25	I[26]	-6.6	-43.3	3.8	0.23	-0.94	0.56	-20.47	1.37	OK	0.025	0.468	1.59	OK
N21	25	J[25]	-5.4	-40.6	1.1	0.23	-0.79	0.43	-20.47	1.37	OK	0.007	0.393	1.56	OK
N21	26	I[27]	-7.2	-46.8	2.2	0.23	-1.02	0.61	-20.47	1.37	OK	0.014	0.508	1.61	OK
N21	26	J[26]	-6.6	-43.7	0.1	0.23	-0.94	0.56	-20.47	1.37	OK	0.001	0.469	1.59	OK
N21	27	I[28]	-7.8	-50.5	1.9	0.23	-1.10	0.66	-20.47	1.37	OK	0.013	0.551	1.63	OK
N21	27	J[27]	-7.2	-47.1	0.5	0.23	-1.02	0.61	-20.47	1.37	OK	0.003	0.509	1.61	OK
N21	28	I[29]	-9.3	-54.5	3.6	0.23	-1.30	0.82	-20.47	1.37	OK	0.023	0.648	1.67	OK
N21	28	J[28]	-7.8	-50.9	2.7	0.23	-1.10	0.66	-20.47	1.37	OK	0.017	0.552	1.63	OK
N21	29	I[30]	-11.4	-58.8	4.3	0.23	-1.55	1.04	-20.47	1.37	OK	0.028	0.773	1.72	OK
N21	29	J[29]	-9.3	-55.0	3.9	0.23	-1.30	0.82	-20.47	1.37	OK	0.025	0.649	1.67	OK
N21	30	I[31]	-13.0	-63.7	3.2	0.28	-1.23	0.77	-20.47	1.37	OK	0.017	0.613	1.65	OK
N21	30	J[30]	-11.4	-59.3	3.4	0.28	-1.08	0.66	-20.47	1.37	OK	0.018	0.541	1.62	OK
N21	31	I[32]	-13.5	-67.7	0.9	0.33	-0.95	0.54	-20.47	1.37	OK	0.004	0.475	1.59	OK
N21	31	J[31]	-13.0	-64.1	1.5	0.33	-0.91	0.52	-20.47	1.37	OK	0.007	0.456	1.58	OK
N21	32	I[33]	-8.9	-69.3	14.9	0.38	-0.55	0.19	-20.47	1.37	OK	0.059	0.276	1.50	OK
N21	32	J[32]	-13.5	-66.0	13.2	0.38	-0.73	0.39	-20.47	1.37	OK	0.052	0.367	1.55	OK
N21	33	I[34]	-1.9	-70.2	22.7	0.43	-0.22	-0.10	-20.47	1.37	OK	0.079	0.163	1.45	OK
N21	33	J[33]	-8.9	-66.9	20.4	0.43	-0.44	0.13	-20.47	1.37	OK	0.071	0.222	1.48	OK
N21	34	I[35]	4.6	-73.4	20.4	0.33	0.03	-0.47	-20.47	1.37	OK	0.093	0.237	1.49	OK
N21	34	J[34]	-1.9	-70.7	18.7	0.33	-0.32	-0.11	-20.47	1.37	OK	0.085	0.214	1.48	OK
N21	35	I[1]	7.5	-72.3	25.8	0.23	0.54	-1.17	-20.47	1.37	OK	0.168	0.583	1.64	OK
N21	35	J[35]	4.6	-71.6	25.2	0.23	0.20	-0.83	-20.47	1.37	OK	0.164	0.414	1.57	OK

A.5.4.10. Load combination SLU 21 FEM analysis

Beam Diagram_Fx - FEM analysis / CBC_N21



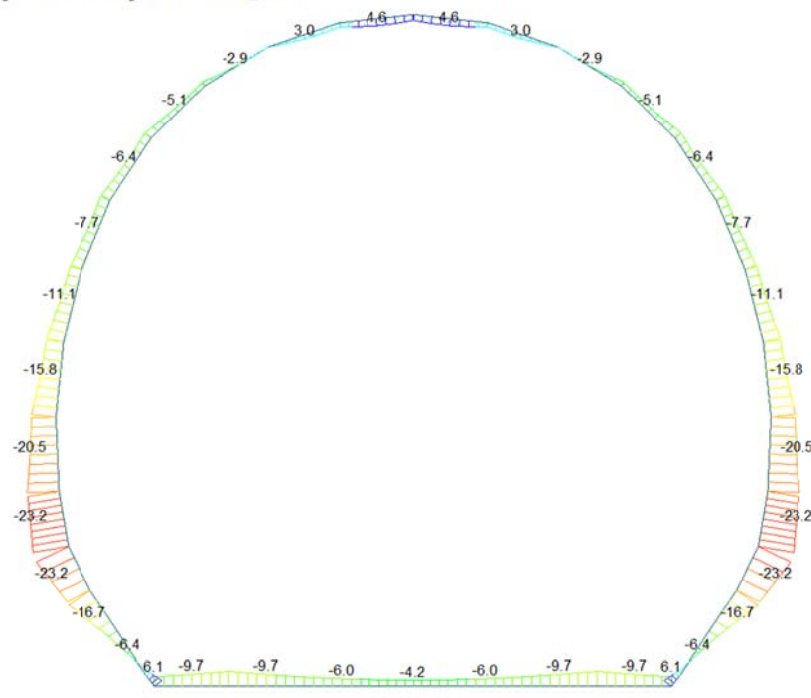
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-38.06
Cyan	-46.45
Green	-54.85
Light Green	-63.25
Yellow-Green	-71.65
Yellow	-80.05
Orange-Yellow	-88.45
Orange	-96.85
Red-Orange	-105.25
Red	-113.65
Dark Red	-122.05
Black	-130.45

CBC: N21
MAX : 4
MIN : 34
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_My - FEM analysis / CBC_N21



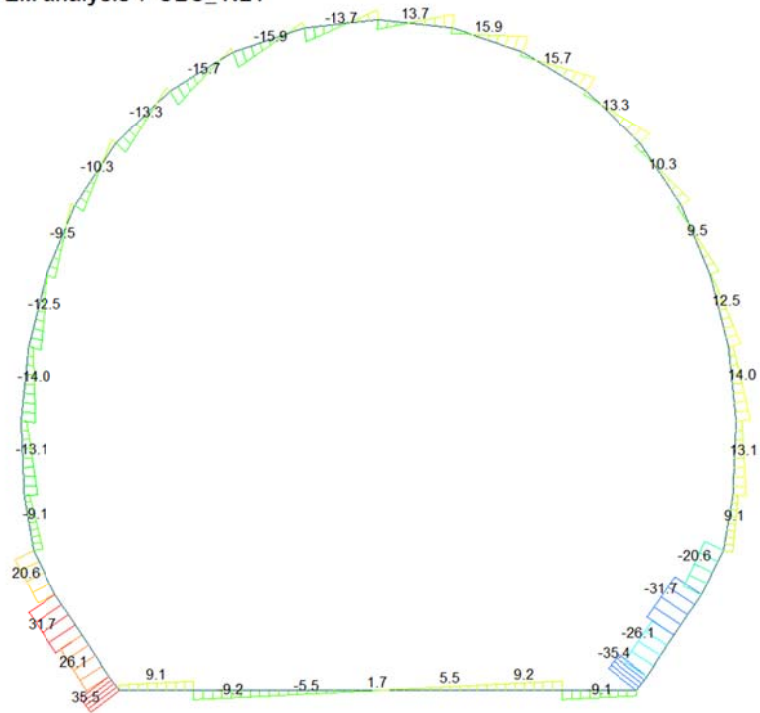
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	6.10
Cyan	3.43
Green	0.00
Light Green	-1.89
Yellow-Green	-4.55
Yellow	-7.22
Orange-Yellow	-9.88
Orange	-12.54
Red-Orange	-15.21
Red	-17.87
Dark Red	-20.53
Black	-23.19

CBC: N21
MAX : 8
MIN : 12
FILE: F8E_C01-C0-
UNIT: kN*m
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: 1.000
Z: 0.000

Beam Diagram_Fz - FEM analysis / CBC_N21



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

35.45
29.00
22.56
16.11
9.67
3.22
0.00
-9.67
-16.11
-22.56
-29.00
-35.45

CBC: N21
MAX : 35
MIN : 8
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

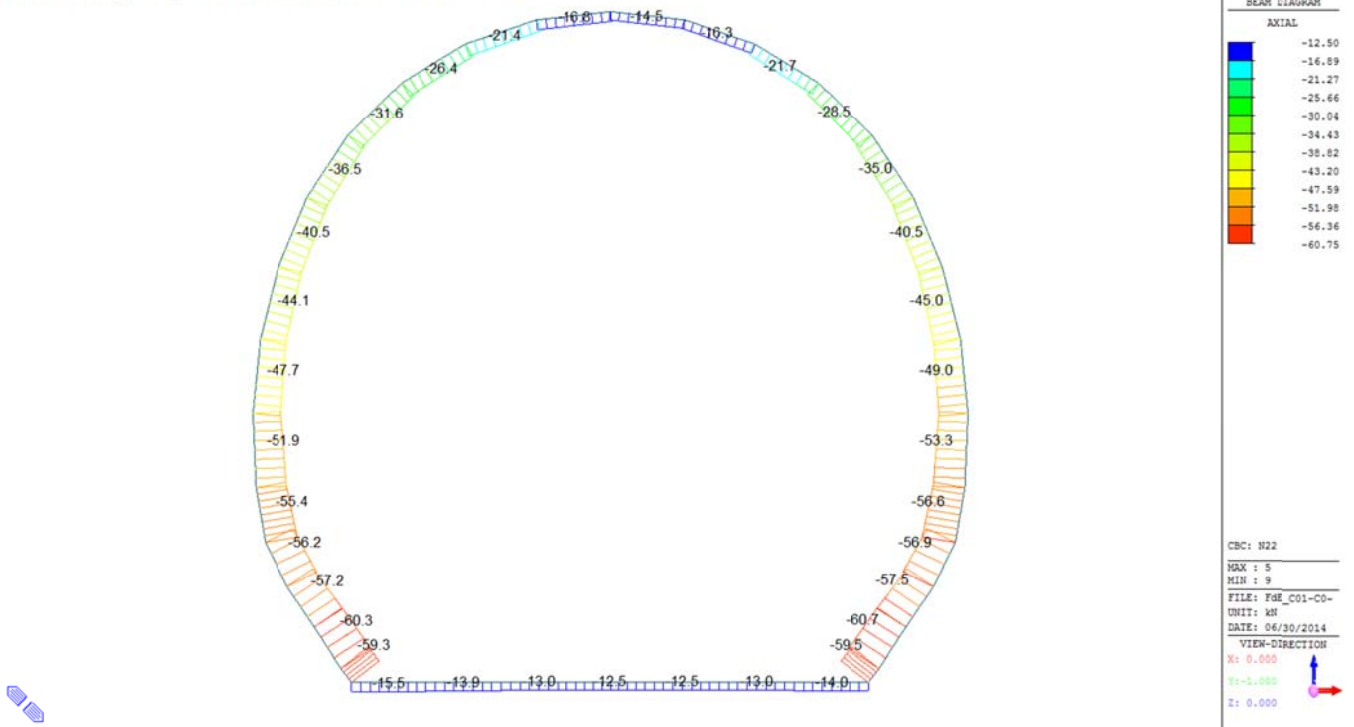
R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{ctm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ctd,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

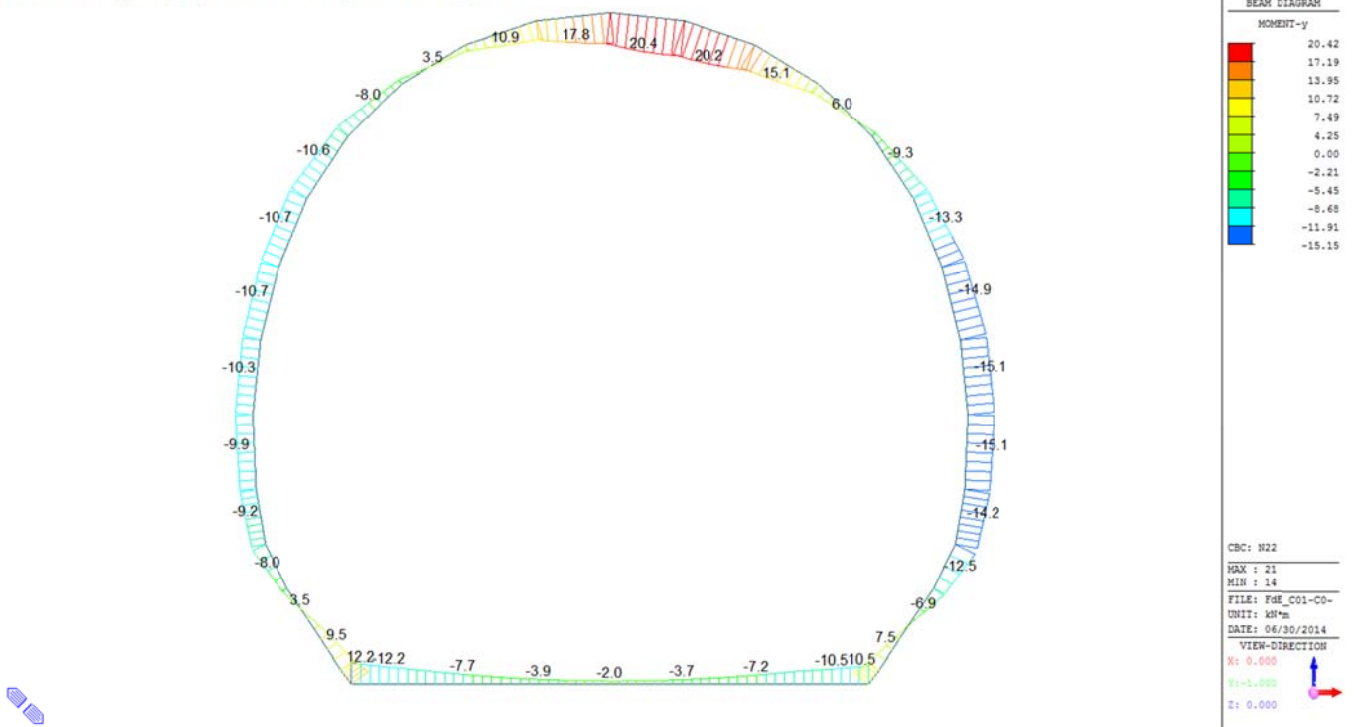
Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N21	1	I[1]	-6.1	-44.8	5.3	0.23	-0.89	0.50	-20.47	1.37	OK	0.035	0.443	1.58	OK
N21	1	J[2]	-9.7	-44.8	9.1	0.23	-1.29	0.90	-20.47	1.37	OK	0.059	0.647	1.67	OK
N21	2	I[2]	-9.7	-41.0	9.2	0.23	-1.28	0.92	-20.47	1.37	OK	0.060	0.639	1.66	OK
N21	2	J[3]	-6.0	-41.0	5.5	0.23	-0.86	0.50	-20.47	1.37	OK	0.036	0.430	1.57	OK
N21	3	I[3]	-6.0	-38.7	5.5	0.23	-0.85	0.51	-20.47	1.37	OK	0.036	0.426	1.57	OK
N21	3	J[4]	-4.2	-38.7	1.7	0.23	-0.65	0.31	-20.47	1.37	OK	0.011	0.324	1.53	OK
N21	4	I[4]	-4.2	-38.1	1.7	0.23	-0.64	0.31	-20.47	1.37	OK	0.011	0.322	1.53	OK
N21	4	J[5]	-4.2	-38.1	1.7	0.23	-0.64	0.31	-20.47	1.37	OK	0.011	0.322	1.53	OK
N21	5	I[5]	-4.2	-38.7	1.7	0.23	-0.65	0.31	-20.47	1.37	OK	0.011	0.324	1.53	OK
N21	5	J[6]	-6.0	-38.7	5.5	0.23	-0.85	0.51	-20.47	1.37	OK	0.036	0.426	1.57	OK
N21	6	I[6]	-6.0	-41.0	5.5	0.23	-0.85	0.50	-20.47	1.37	OK	0.036	0.430	1.57	OK
N21	6	J[7]	-9.7	-41.0	9.2	0.23	-1.28	0.92	-20.47	1.37	OK	0.060	0.639	1.66	OK
N21	7	I[7]	-9.7	-44.8	9.1	0.23	-1.29	0.90	-20.47	1.37	OK	0.059	0.647	1.67	OK
N21	7	J[8]	-6.1	-44.8	5.3	0.23	-0.89	0.50	-20.47	1.37	OK	0.035	0.443	1.58	OK
N21	8	I[9]	2.0	-128.0	35.0	0.23	-0.33	-0.78	-20.47	1.37	OK	0.228	0.556	1.63	OK
N21	8	J[9]	6.1	-128.6	35.5	0.23	0.13	-1.25	-20.47	1.37	OK	0.231	0.626	1.66	OK
N21	9	I[10]	-6.4	-127.7	25.5	0.33	-0.74	-0.03	-20.47	1.37	OK	0.116	0.387	1.55	OK
N21	9	J[9]	2.0	-130.4	26.1	0.33	-0.29	-0.51	-20.47	1.37	OK	0.119	0.395	1.56	OK
N21	10	I[11]	-16.7	-123.7	31.5	0.43	-0.83	0.25	-20.47	1.37	OK	0.110	0.414	1.57	OK
N21	10	J[10]	-6.4	-127.1	31.7	0.43	-0.50	-0.09	-20.47	1.37	OK	0.110	0.296	1.51	OK
N21	11	I[12]	-23.2	-123.9	20.6	0.38	-1.29	0.64	-20.47	1.37	OK	0.081	0.645	1.66	OK
N21	11	J[11]	-16.7	-127.2	19.1	0.38	-1.03	0.36	-20.47	1.37	OK	0.075	0.514	1.61	OK
N21	12	I[13]	-20.5	-121.8	5.1	0.33	-1.50	0.76	-20.47	1.37	OK	0.023	0.750	1.71	OK
N21	12	J[12]	-23.2	-125.5	9.1	0.33	-1.65	0.90	-20.47	1.37	OK	0.041	0.829	1.74	OK
N21	13	I[14]	-15.8	-116.3	5.5	0.28	-1.63	0.80	-20.47	1.37	OK	0.029	0.813	1.73	OK
N21	13	J[13]	-20.5	-120.6	13.1	0.28	-2.00	1.14	-20.47	1.37	OK	0.070	1.000	1.81	OK
N21	14	I[15]	-11.1	-111.1	4.4	0.23	-1.75	0.78	-20.47	1.37	OK	0.029	0.873	1.76	OK
N21	14	J[14]	-15.8	-114.8	14.1	0.23	-2.29	1.30	-20.47	1.37	OK	0.092	1.147	1.86	OK
N21	15	I[16]	-7.7	-106.3	0.9	0.23	-1.34	0.42	-20.47	1.37	OK	0.006	0.670	1.67	OK
N21	15	J[15]	-11.1	-109.9	12.5	0.23	-1.74	0.79	-20.47	1.37	OK	0.082	0.871	1.76	OK
N21	16	I[17]	-6.4	-102.1	4.2	0.23	-1.17	0.28	-20.47	1.37	OK	0.027	0.583	1.64	OK
N21	16	J[16]	-7.7	-105.5	9.5	0.23	-1.34	0.42	-20.47	1.37	OK	0.062	0.668	1.67	OK
N21	17	I[18]	-5.1	-98.3	5.5	0.23	-1.01	0.15	-20.47	1.37	OK	0.036	0.504	1.61	OK
N21	17	J[17]	-6.4	-101.5	10.3	0.23	-1.16	0.28	-20.47	1.37	OK	0.067	0.581	1.64	OK
N21	18	I[19]	-2.9	-94.9	4.7	0.23	-0.74	-0.08	-20.47	1.37	OK	0.030	0.413	1.57	OK
N21	18	J[18]	-5.1	-97.5	13.3	0.23	-1.00	0.16	-20.47	1.37	OK	0.086	0.502	1.60	OK
N21	19	I[20]	0.0	-91.7	4.2	0.23	-0.40	-0.40	-20.47	1.37	OK	0.027	0.399	1.56	OK
N21	19	J[19]	-2.9	-93.7	15.7	0.23	-0.74	-0.08	-20.47	1.37	OK	0.102	0.407	1.56	OK
N21	20	I[21]	2.6	-89.2	5.9	0.23	-0.10	-0.68	-20.47	1.37	OK	0.038	0.388	1.55	OK
N21	20	J[20]	0.0	-90.4	15.9	0.23	-0.39	-0.40	-20.47	1.37	OK	0.104	0.393	1.56	OK
N21	21	I[22]	3.6	-87.9	9.7	0.23	0.03	-0.79	-20.47	1.37	OK	0.063	0.397	1.56	OK
N21	21	J[21]	2.6	-88.4	13.7	0.23	-0.09	-0.68	-20.47	1.37	OK	0.089	0.384	1.55	OK
N21	22	I[22]	2.6	-88.4	13.7	0.23	-0.09	-0.68	-20.47	1.37	OK	0.089	0.384	1.55	OK
N21	22	J[22]	3.6	-87.9	9.7	0.23	0.03	-0.79	-20.47	1.37	OK	0.063	0.397	1.56	OK
N21	23	I[24]	0.0	-90.4	15.9	0.23	-0.39	-0.40	-20.47	1.37	OK	0.104	0.393	1.56	OK
N21	23	J[23]	2.6	-89.2	5.9	0.23	-0.10	-0.68	-20.47	1.37	OK	0.038	0.388	1.55	OK
N21	24	I[25]	-2.9	-93.7	15.7	0.23	-0.74	-0.08	-20.47	1.37	OK	0.102	0.407	1.56	OK
N21	24	J[24]	0.0	-91.7	4.2	0.23	-0.40	-0.40	-20.47	1.37	OK	0.027	0.399	1.56	OK
N21	25	I[26]	-5.1	-97.5	13.3	0.23	-1.00	0.16	-20.47	1.37	OK	0.086	0.502	1.60	OK
N21	25	J[25]	-2.9	-94.9	4.7	0.23	-0.74	-0.08	-20.47	1.37	OK	0.030	0.413	1.57	OK
N21	26	I[27]	-6.4	-101.5	10.3	0.23	-1.16	0.28	-20.47	1.37	OK	0.067	0.581	1.64	OK
N21	26	J[26]	-5.1	-98.3	5.5	0.23	-1.01	0.15	-20.47	1.37	OK	0.036	0.504	1.61	OK
N21	27	I[28]	-7.7	-105.5	9.5	0.23	-1.34	0.42	-20.47	1.37	OK	0.062	0.668	1.67	OK
N21	27	J[27]	-6.4	-102.1	4.2	0.23	-1.17	0.28	-20.47	1.37	OK	0.027	0.583	1.64	OK
N21	28	I[29]	-11.1	-109.9	12.5	0.23	-1.74	0.79	-20.47	1.37	OK	0.082	0.871	1.76	OK
N21	28	J[28]	-7.7	-106.3	0.9	0.23	-1.34	0.42	-20.47	1.37	OK	0.006	0.670	1.67	OK
N21	29	I[30]	-15.8	-114.8	14.1	0.23	-2.29	1.30	-20.47	1.37	OK	0.092	1.147	1.86	OK
N21	29	J[29]	-11.1	-111.1	4.4	0.23	-1.75	0.78	-20.47	1.37	OK	0.029	0.873	1.76	OK
N21	30	I[31]	-20.5	-120.6	13.1	0.28	-2.00	1.14	-20.47	1.37	OK	0.070	1.000	1.81	OK
N21	30	J[30]	-15.8	-116.3	5.5	0.28	-1.63	0.80	-20.47	1.37	OK	0.029	0.813	1.73	OK
N21	31	I[32]	-23.2	-125.5	9.1	0.33	-1.66	0.90	-20.47	1.37	OK	0.041	0.829	1.74	OK
N21	31	J[31]	-20.5	-121.8	5.1	0.33	-1.50	0.76	-20.47	1.37	OK	0.023	0.750	1.71	OK
N21	32	I[33]	-16.7	-127.2	19.1	0.38	-1.03	0.36	-20.47	1.37	OK	0.075	0.514	1.61	OK
N21	32	J[32]	-23.2	-123.9	20.6	0.38	-1.29	0.64	-20.47	1.37	OK	0.081	0.645	1.66	OK
N21	33	I[34]	-6.4	-127.1	31.7	0.43	-0.50	-0.09	-20.47	1.37	OK	0.110	0.296	1.51	OK
N21	33	J[33]	-16.7	-123.7	31.5	0.43	-0.83	0.25	-20.47	1.37	OK	0.110	0.414	1.57	OK
N21	34	I[35]	2.0	-130.5	26.1	0.33	-0.29	-0.51	-20.47	1.37	OK	0.119	0.395	1.56	OK
N21	34	J[34]	-6.4	-127.7	25.5	0.33	-0.74	-0.03	-20.47	1.37	OK	0.116	0.387	1.55	OK
N21	35	I[1]	6.1	-128.6	35.5	0.23	0.13	-1.25	-20.47	1.37	OK	0.231	0.626	1.66	OK
N21	35	J[35]	2.0	-128.0	35.0	0.23	-0.33	-0.78	-20.47	1.37	OK	0.228	0.556	1.63	OK

A.5.4.11. Load combination SLU 22 Block analysis

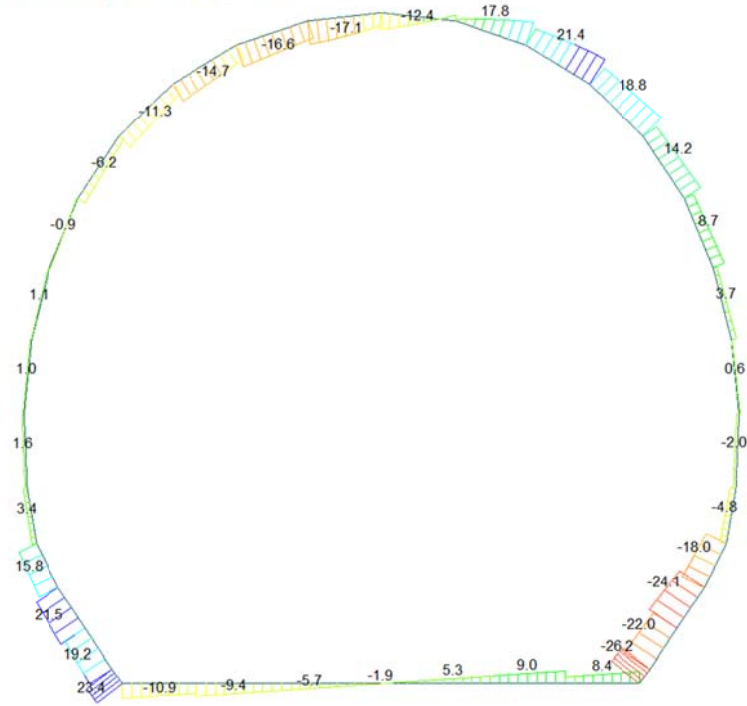
Beam Diagram_Fx - Block analysis / CBC_N22



Beam Diagram_My - Block analysis / CBC_N22



Beam Diagram_Fz - Block analysis / CBC_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

23.43
18.92
14.41
9.89
5.38
0.00
-3.65
-8.16
-12.68
-17.19
-21.70
-26.22

CBC: N22
MAX : 35
MIN : 8
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000



VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ctd,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{top} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	Verifica a taglio
N22	1	I[1]	-12.2	-15.5	10.9	0.23	-1.45	1.32	-20.47	1.37	OK	0.071	0.726	1.70	OK
N22	1	J[2]	-7.7	-15.5	7.2	0.23	-0.94	0.80	-20.47	1.37	OK	0.047	0.470	1.59	OK
N22	2	I[2]	-7.7	-14.0	9.4	0.23	-0.93	0.81	-20.47	1.37	OK	0.061	0.466	1.59	OK
N22	2	J[3]	-3.9	-14.0	5.7	0.23	-0.51	0.39	-20.47	1.37	OK	0.037	0.253	1.49	OK
N22	3	I[3]	-3.9	-13.0	5.7	0.23	-0.50	0.39	-20.47	1.37	OK	0.037	0.251	1.49	OK
N22	3	J[4]	-2.0	-13.0	1.9	0.23	-0.29	0.17	-20.47	1.37	OK	0.012	0.144	1.44	OK
N22	4	I[4]	-2.0	-12.5	1.9	0.23	-0.29	0.18	-20.47	1.37	OK	0.012	0.143	1.44	OK
N22	4	J[5]	-2.0	-12.5	1.5	0.23	-0.28	0.17	-20.47	1.37	OK	0.010	0.138	1.44	OK
N22	5	I[5]	-2.0	-12.5	1.5	0.23	-0.28	0.17	-20.47	1.37	OK	0.010	0.138	1.44	OK
N22	5	J[6]	-3.7	-12.5	5.3	0.23	-0.47	0.36	-20.47	1.37	OK	0.035	0.235	1.49	OK
N22	6	I[6]	-3.7	-13.0	5.3	0.23	-0.47	0.36	-20.47	1.37	OK	0.035	0.236	1.49	OK
N22	6	J[7]	-7.3	-13.0	9.0	0.23	-0.88	0.77	-20.47	1.37	OK	0.059	0.439	1.58	OK
N22	7	I[7]	-7.3	-14.0	4.6	0.23	-0.88	0.76	-20.47	1.37	OK	0.030	0.442	1.58	OK
N22	7	J[8]	-10.5	-14.0	8.4	0.23	-1.25	1.13	-20.47	1.37	OK	0.055	0.626	1.66	OK
N22	8	I[8]	7.5	-58.8	25.7	0.23	0.59	-1.11	-20.47	1.37	OK	0.167	0.553	1.63	OK
N22	8	J[9]	10.5	-59.5	26.2	0.23	0.93	-1.45	-20.47	1.37	OK	0.171	0.725	1.70	OK
N22	9	I[10]	0.6	-58.0	20.2	0.33	-0.14	-0.21	-20.47	1.37	OK	0.092	0.176	1.46	OK
N22	9	J[9]	7.5	-60.8	22.0	0.33	0.23	-0.60	-20.47	1.37	OK	0.100	0.298	1.51	OK
N22	10	I[11]	-6.9	-54.2	21.8	0.43	-0.35	0.10	-20.47	1.37	OK	0.076	0.175	1.46	OK
N22	10	J[10]	0.6	-57.5	24.1	0.43	-0.11	-0.15	-20.47	1.37	OK	0.084	0.134	1.44	OK
N22	11	I[12]	-12.5	-53.6	16.3	0.38	-0.66	0.38	-20.47	1.37	OK	0.065	0.331	1.53	OK
N22	11	J[11]	-6.9	-56.9	18.0	0.38	-0.44	0.14	-20.47	1.37	OK	0.071	0.218	1.48	OK
N22	12	I[13]	-14.2	-52.9	4.2	0.33	-0.94	0.62	-20.47	1.37	OK	0.019	0.471	1.59	OK
N22	12	J[12]	-12.5	-56.6	4.8	0.33	-0.86	0.52	-20.47	1.37	OK	0.022	0.431	1.57	OK
N22	13	I[14]	-15.2	-48.9	1.8	0.28	-1.33	0.98	-20.47	1.37	OK	0.010	0.657	1.67	OK
N22	13	J[13]	-14.2	-53.3	2.0	0.28	-1.28	0.90	-20.47	1.37	OK	0.011	0.639	1.66	OK
N22	14	I[15]	-14.9	-45.3	0.3	0.23	-1.89	1.50	-20.47	1.37	FESSURATA	0.002	0.945	1.78	OK
N22	14	J[14]	-15.2	-49.0	0.7	0.23	-1.93	1.51	-20.47	1.37	FESSURATA	0.004	0.966	1.79	OK
N22	15	I[16]	-13.3	-41.4	2.8	0.23	-1.69	1.33	-20.47	1.37	OK	0.018	0.844	1.74	OK
N22	15	J[15]	-14.9	-45.0	3.7	0.23	-1.89	1.50	-20.47	1.37	FESSURATA	0.024	0.944	1.78	OK
N22	16	I[17]	-9.3	-37.1	7.3	0.23	-1.22	0.89	-20.47	1.37	OK	0.048	0.608	1.65	OK
N22	16	J[16]	-13.3	-40.5	8.7	0.23	-1.68	1.33	-20.47	1.37	OK	0.057	0.842	1.74	OK
N22	17	I[17]	-2.7	-31.9	12.1	0.23	-0.45	0.17	-20.47	1.37	OK	0.079	0.224	1.48	OK
N22	17	J[17]	-9.3	-35.0	14.2	0.23	-1.21	0.90	-20.47	1.37	OK	0.093	0.603	1.65	OK
N22	18	I[19]	6.0	-25.9	16.1	0.23	0.57	-0.79	-20.47	1.37	OK	0.105	0.395	1.56	OK
N22	18	J[18]	-2.7	-28.5	18.8	0.23	-0.43	0.19	-20.47	1.37	OK	0.123	0.217	1.48	OK
N22	19	I[20]	15.1	-19.8	13.8	0.23	1.63	-1.80	-20.47	1.37	FESSURATA	0.090	0.900	1.77	OK
N22	19	J[19]	6.0	-21.7	21.4	0.23	0.58	-0.77	-20.47	1.37	OK	0.139	0.386	1.55	OK
N22	20	I[21]	20.2	-15.1	1.1	0.23	2.22	-2.36	-20.47	1.37	FESSURATA	0.007	1.178	1.87	OK
N22	20	J[20]	15.1	-16.3	17.8	0.23	1.64	-1.78	-20.47	1.37	FESSURATA	0.116	0.892	1.76	OK
N22	21	I[22]	17.8	-14.1	12.4	0.23	1.96	-2.08	-20.47	1.37	FESSURATA	0.081	1.041	1.82	OK
N22	21	J[21]	20.2	-14.5	4.4	0.23	2.23	-2.35	-20.47	1.37	FESSURATA	0.029	1.176	1.87	OK
N22	22	I[22]	10.9	-16.8	17.1	0.23	1.17	-1.31	-20.47	1.37	OK	0.112	0.656	1.67	OK
N22	22	J[23]	17.8	-16.4	9.1	0.23	1.95	-2.09	-20.47	1.37	FESSURATA	0.059	1.046	1.82	OK
N22	23	I[24]	3.5	-21.4	16.6	0.23	0.31	-0.49	-20.47	1.37	OK	0.108	0.246	1.49	OK
N22	23	J[23]	10.9	-20.2	13.1	0.23	1.15	-1.33	-20.47	1.37	OK	0.085	0.663	1.67	OK
N22	24	I[25]	-3.0	-26.4	14.7	0.23	-0.46	0.23	-20.47	1.37	OK	0.096	0.229	1.48	OK
N22	24	J[24]	3.5	-24.5	11.5	0.23	0.29	-0.51	-20.47	1.37	OK	0.075	0.253	1.49	OK
N22	25	I[26]	-8.0	-31.6	11.3	0.23	-1.04	0.77	-20.47	1.37	OK	0.074	0.522	1.61	OK
N22	25	J[25]	-3.0	-29.0	8.6	0.23	-0.47	0.22	-20.47	1.37	OK	0.056	0.235	1.49	OK
N22	26	I[27]	-10.6	-36.5	6.2	0.23	-1.36	1.04	-20.47	1.37	OK	0.040	0.680	1.68	OK
N22	26	J[26]	-8.0	-33.3	4.2	0.23	-1.05	0.76	-20.47	1.37	OK	0.027	0.526	1.61	OK
N22	27	I[28]	-10.7	-40.5	0.9	0.23	-1.39	1.04	-20.47	1.37	OK	0.006	0.694	1.68	OK
N22	27	J[27]	-10.6	-37.0	0.5	0.23	-1.36	1.04	-20.47	1.37	OK	0.003	0.681	1.68	OK
N22	28	I[29]	-10.3	-44.1	0.2	0.23	-1.36	0.98	-20.47	1.37	OK	0.002	0.682	1.68	OK
N22	28	J[28]	-10.7	-40.4	1.2	0.23	-1.39	1.04	-20.47	1.37	OK	0.008	0.694	1.68	OK
N22	29	I[30]	-9.9	-47.7	0.6	0.23	-1.33	0.92	-20.47	1.37	OK	0.004	0.667	1.67	OK
N22	29	J[29]	-10.3	-44.0	1.0	0.23	-1.36	0.98	-20.47	1.37	OK	0.006	0.682	1.68	OK
N22	30	I[31]	-9.2	-51.9	1.6	0.28	-0.89	0.52	-20.47	1.37	OK	0.008	0.445	1.58	OK
N22	30	J[30]	-9.9	-47.6	1.4	0.28	-0.93	0.59	-20.47	1.37	OK	0.007	0.465	1.59	OK
N22	31	I[32]	-8.1	-55.4	3.4	0.33	-0.61	0.28	-20.47	1.37	OK	0.015	0.306	1.52	OK
N22	31	J[31]	-9.2	-51.7	2.8	0.33	-0.66	0.35	-20.47	1.37	OK	0.013	0.332	1.53	OK
N22	32	I[33]	-3.1	-56.2	15.8	0.38	-0.28	-0.02	-20.47	1.37	OK	0.062	0.148	1.44	OK
N22	32	J[32]	-8.1	-52.9	14.2	0.38	-0.47	0.20	-20.47	1.37	OK	0.056	0.237	1.49	OK
N22	33	I[34]	3.5	-57.2	21.5	0.43	-0.02	-0.25	-20.47	1.37	OK	0.075	0.133	1.44	OK
N22	33	J[33]	-3.1	-53.8	19.2	0.43	-0.23	-0.02	-20.47	1.37	OK	0.067	0.125	1.43	OK
N22	34	I[35]	9.5	-60.3	19.2	0.33	0.34	-0.71	-20.47	1.37	OK	0.087	0.354	1.54	OK
N22	34	J[34]	3.5	-57.6	17.5	0.33	0.02	-0.37	-20.47	1.37	OK	0.079	0.184	1.46	OK
N22	35	I[1]	12.2	-59.3	23.4	0.23	1.13	-1.64	-20.47	1.37	OK	0.153	0.821	1.74	OK
N22	35	J[35]	9.5	-58.6	22.9	0.23	0.82	-1.33	-20.47	1.37	OK	0.149	0.667	1.67	OK

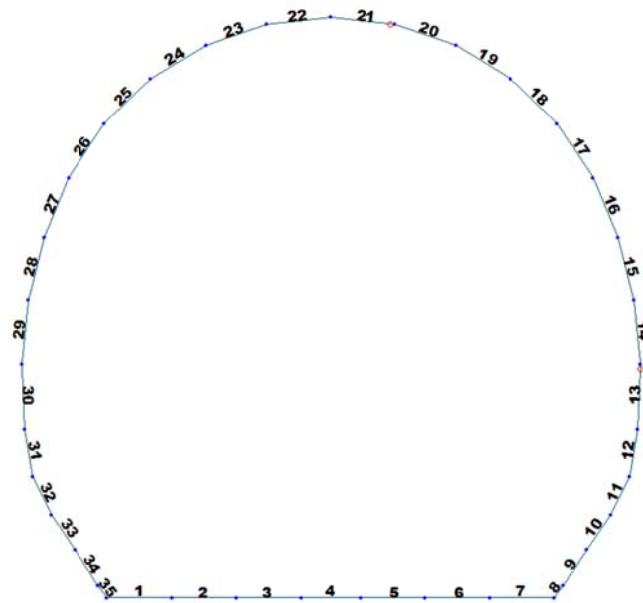


Figure 21 Beam end release

Table 9 Beam end release input value

Element	Type	Fxi	Fyi	Fzi	Mxi	Myi	Mzi	Fxj	Fyj	Fzj	Mxj	Myj	Mzj
13	Value	0	0	0	0	0	0	0	0	0	0	30100	0
21	Value	0	0	0	0	5170	0	0	0	0	0	0	0

ITERAZIONE SECONDO IL METODO DI PÖTTLER

CALCOLO CERNIERE PLASTICHE

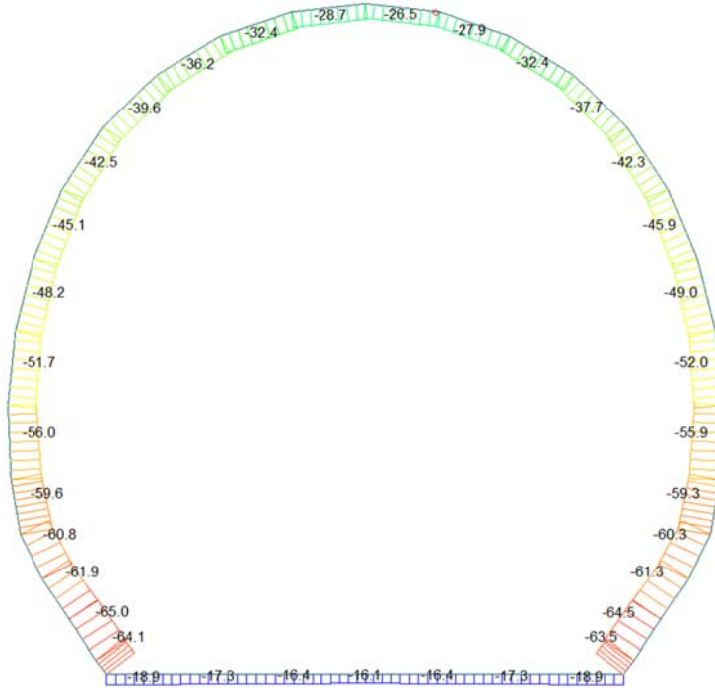
ITERAZIONE IN NODO 21 j

MIDAS				PÖTTLER			
$Cf_{plastiche, arbitraria}$	0.000193	[rad/kN ² m]		E_p	26'400'000	[kN/m ²]	
$1/Cf_{plastiche, arbitraria}$	5'170	[kN ² /m/rad]		d	0.30	[m]	
M_{nodo}	3.730	[kN ² m]		e	0.1408	[m]	
N_{nodo}	26.430	[kN]		a	0.03	[m]	
V_{nodo}	3.960	[kN]		$\Phi_{pöttler}$	0.0007018	[rad]	0.701806
$Cf_{MIDAS} = Cf_{pöttler}$	SI			$Cf_{pöttler}$	0.0001882	[rad/kN ² m]	
$\Phi_{pöttler} < 4 \text{ mrad}$	SI			$1/Cf_{pöttler}$	5'315	[kN ² /m/rad]	

ITERAZIONE IN NODO 13 i

MIDAS				PÖTTLER			
$Cf_{plastiche, arbitraria}$	0.000033	[rad/kN ² m]		E_p	26'400'000	[kN/m ²]	
$1/Cf_{plastiche, arbitraria}$	30'100	[kN ² /m/rad]		d	0.30	[m]	
M_{nodo}	6.650	[kN ² m]		e	0.1291	[m]	
N_{nodo}	51.520	[kN]		a	0.06	[m]	
V_{nodo}	2.730	[kN]		$\Phi_{pöttler}$	0.0002084	[rad]	0.208427
$Cf_{MIDAS} = Cf_{pöttler}$	SI			$Cf_{pöttler}$	0.0000313	[rad/kN ² m]	
$\Phi_{pöttler} < 4 \text{ mrad}$	SI			$1/Cf_{pöttler}$	31'906	[kN ² /m/rad]	

Beam Diagram_Fx - Block analysis / ST_N22



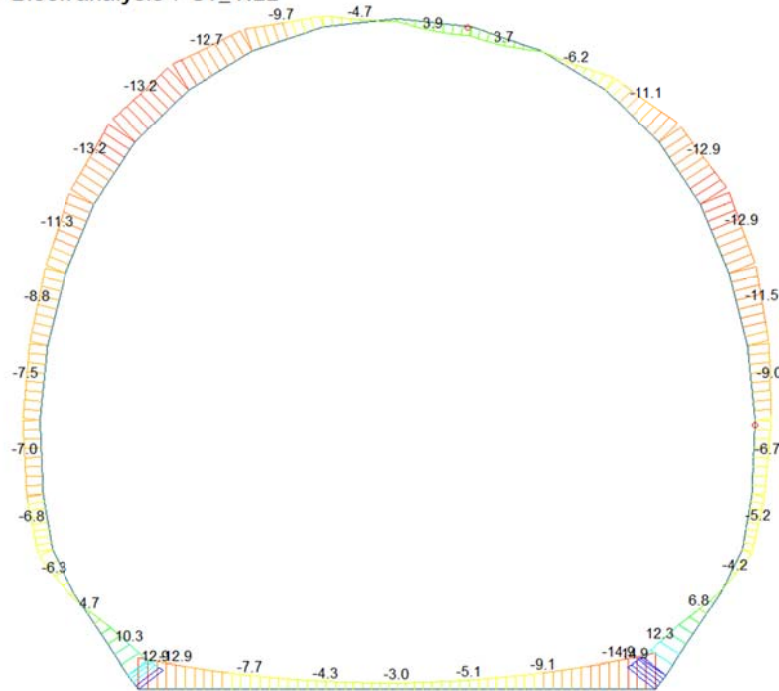
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-16.11
Cyan	-20.56
Green	-25.01
Light Green	-29.45
Yellow-Green	-33.90
Yellow	-38.35
Orange-Yellow	-42.80
Orange	-47.25
Red-Orange	-51.70
Red	-56.15
Dark Red	-60.60
Dark Red	-65.04

ST: N22
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_N22



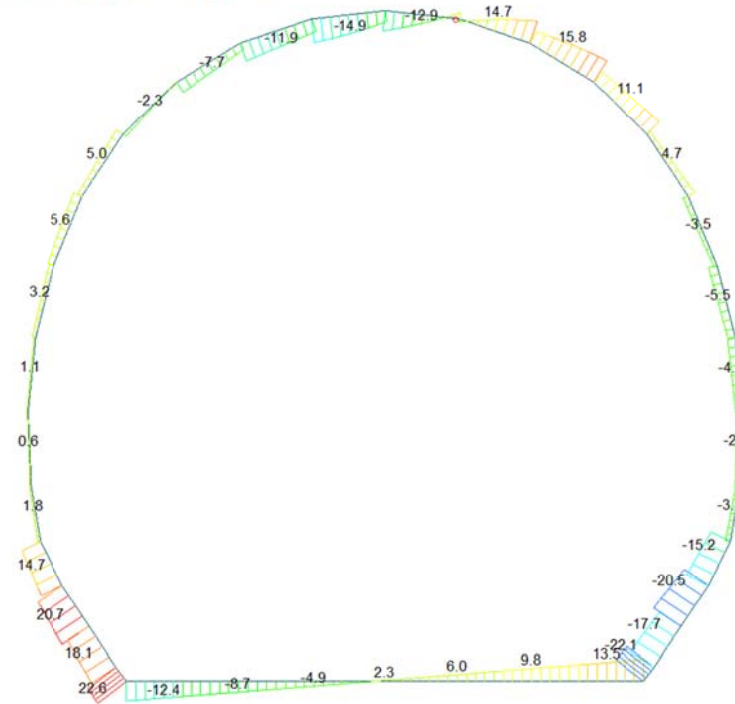
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	14.88
Cyan	12.18
Green	9.47
Light Green	6.76
Yellow-Green	4.06
Yellow	0.00
Orange-Yellow	-1.35
Orange	-4.06
Red-Orange	-6.76
Red	-9.47
Dark Red	-12.18
Dark Red	-14.88

ST: N22
MAX : 8
MIN : 7
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz - Block analysis / ST_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

22.59
18.53
14.47
10.41
6.35
2.29
0.00
-5.83
-9.89
-13.95
-18.01
-22.07

ST: N22
MAX : 35
MIN : 8
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

R_s [N/mm ²]	37.00	F_a [N/mm ²]	30.71	$f_{ck,0.95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ct,80\%}$ [N/mm ²]	20.47	$f_{ct,80\%}$ [N/mm ²]	1.373	E_p [N/mm ²]	26'400		

VERIFICHE SEZIONI FESSURATE

VERIFICA SEZIONE NODO 21 j

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_d [N/mm ²]	$f_{ct,80\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ct,80\%}$
N22	21 j	Calotta	3.7	26.5	4.0	26'400'000	0.141	0.30	OK	1.92	20.47	OK

Combinazione di carico	Nodo n°	a [m]	Ψ_{potter} [rad]	$1/C_{f_{lim,DAS}}$ [kN·m/rad]	$1/C_{f_{potter}}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{potter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ct,80\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd}(EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N22	21 j	0.028	0.7018060	5'170	5'315	OK	0.191	OK	1.37	0.22	9.52	2.13	OK

Iterazione ok

VERIFICA SEZIONE NODO 13 i

Combinazione di carico	Nodo n°	Posizione del nodo	M_d [kN·m/m]	N_d [kN/m]	V_d [kN/m]	$E_p = 0.8 \cdot E_{cm}$ [kN/m ²]	e_d [m]	d [m]	Verifica dell'eccentricità $e_d < d/2$	σ_d [N/mm ²]	$f_{ct,80\%}$ [N/mm ²]	Verifica della compressione $\sigma_d < f_{ct,80\%}$
N22	13 i	Volta Dx	6.7	51.5	2.7	26'400'000	0.129	0.30	OK	1.64	20.47	OK

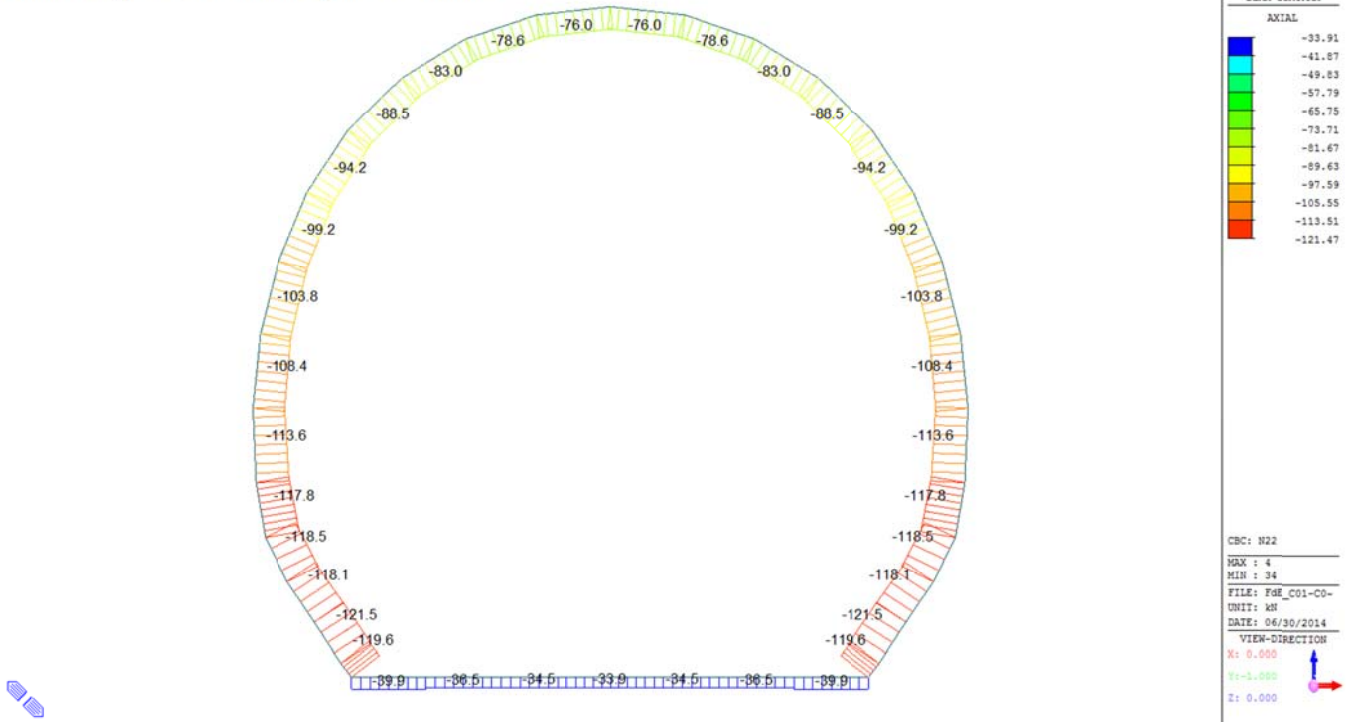
Combinazione di carico	Nodo n°	a [m]	Ψ_{potter} [rad]	$1/C_{f_{lim,DAS}}$ [kN·m/rad]	$1/C_{f_{potter}}$ [kN·m/rad]	Verifica della rotazione massima < 4 [mrad]	w_{potter} [mm]	Ampiezza della fessura $w < 1$ [mm]	$f_{ct,80\%}$ [N/mm ²]	τ_{cp} [N/mm ²]	$\sigma_{c,lim}$ [N/mm ²]	$f_{cvd}(EC2)$ [N/mm ²]	Verifica a taglio $\tau_{cp,max} \leq F_{cvd}$
N22	13 i	0.063	0.2084266	30'100	31'906	OK	0.049	OK	1.37	0.07	9.52	2.03	OK

Iterazione ok

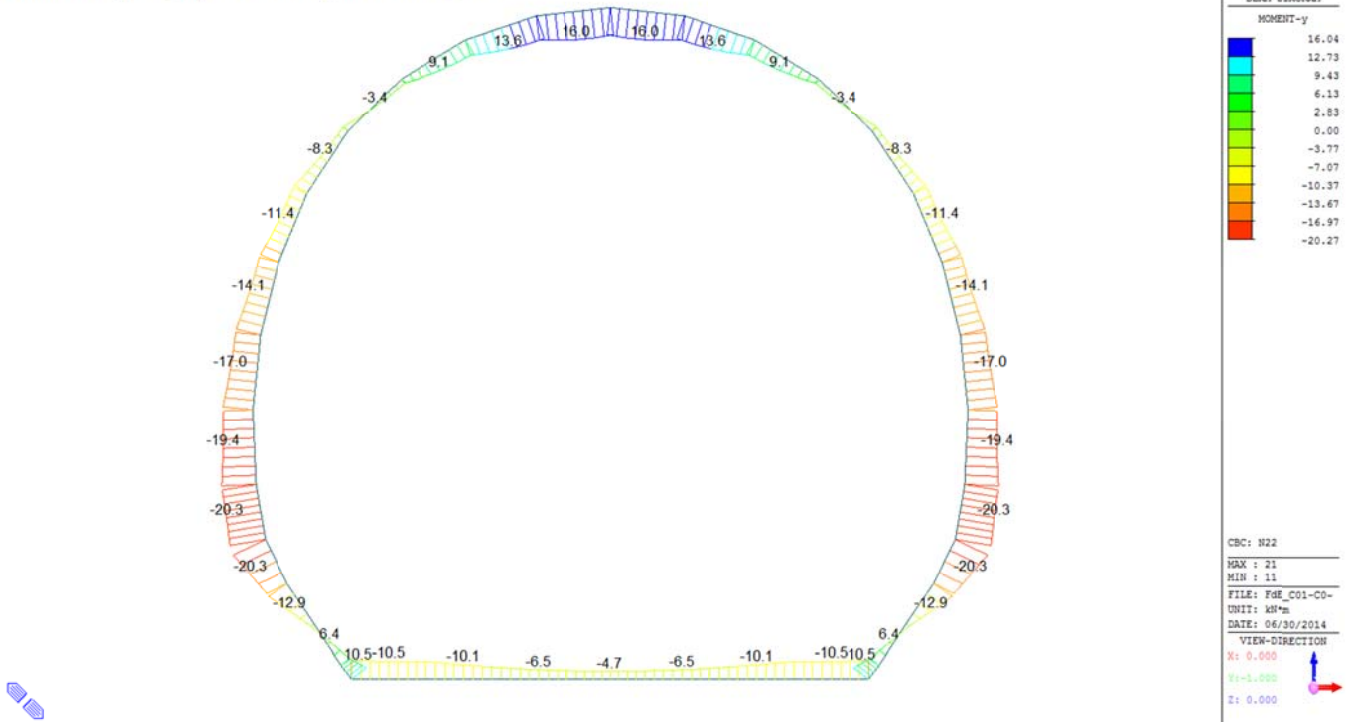
VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN·m]	N _d [kN]	V _d [kN]	d [m]	Solicitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ _{sup} [N/mm ²]	σ _{inf} [N/mm ²]	f _{ct,90%} [N/mm ²]	f _{ctd,90%} [N/mm ²]		τ _{cp} [N/mm ²]	f _{cp} [N/mm ²]	f _{Ev,EC2} [N/mm ²]	Verifica a taglio τ _{cp,max} ≤ F _{v,d}
N22	1	J[1]	-12.9	-18.9	12.4	0.23	-1.55	1.32	-20.47	1.37	OK	0.081	0.774	1.72	OK
N22	1	J[2]	-7.7	-18.9	8.7	0.23	-0.95	0.79	-20.47	1.37	OK	0.056	0.475	1.59	OK
N22	2	J[2]	-7.7	-17.3	8.7	0.23	-0.94	0.79	-20.47	1.37	OK	0.056	0.472	1.59	OK
N22	2	J[3]	-4.3	-17.3	4.9	0.23	-0.56	0.41	-20.47	1.37	OK	0.032	0.280	1.51	OK
N22	3	J[3]	-4.3	-16.4	4.9	0.23	-0.56	0.41	-20.47	1.37	OK	0.032	0.278	1.51	OK
N22	3	J[4]	-2.8	-16.4	1.2	0.23	-0.38	0.24	-20.47	1.37	OK	0.008	0.192	1.47	OK
N22	4	J[4]	-2.8	-16.1	1.2	0.23	-0.38	0.24	-20.47	1.37	OK	0.008	0.191	1.47	OK
N22	4	J[5]	-3.0	-16.1	2.3	0.23	-0.41	0.27	-20.47	1.37	OK	0.015	0.206	1.47	OK
N22	5	J[5]	-3.0	-16.4	2.3	0.23	-0.41	0.27	-20.47	1.37	OK	0.015	0.206	1.47	OK
N22	5	J[6]	-5.1	-16.4	6.0	0.23	-0.65	0.51	-20.47	1.37	OK	0.039	0.324	1.53	OK
N22	6	J[6]	-5.1	-17.3	6.0	0.23	-0.65	0.50	-20.47	1.37	OK	0.039	0.326	1.53	OK
N22	6	J[7]	-9.1	-17.3	9.8	0.23	-1.10	0.95	-20.47	1.37	OK	0.064	0.551	1.63	OK
N22	7	J[7]	-9.1	-18.9	9.8	0.23	-1.11	0.94	-20.47	1.37	OK	0.064	0.554	1.63	OK
N22	7	J[8]	-14.9	-18.9	13.5	0.23	-1.77	1.31	-20.47	1.37	OK	0.088	0.885	1.76	OK
N22	8	J[9]	12.4	-62.9	21.5	0.23	1.13	-1.67	-20.47	1.37	OK	0.140	0.837	1.74	OK
N22	8	J[8]	14.9	-63.6	22.1	0.23	1.21	-1.96	-20.47	1.37	OK	0.144	0.982	1.80	OK
N22	9	J[10]	6.8	-61.7	15.9	0.33	0.19	-0.56	-20.47	1.37	OK	0.072	0.282	1.51	OK
N22	9	J[9]	12.4	-64.5	17.7	0.33	0.49	-0.88	-20.47	1.37	OK	0.080	0.438	1.58	OK
N22	10	J[11]	0.5	-57.9	18.2	0.43	-0.12	-0.15	-20.47	1.37	OK	0.064	0.135	1.44	OK
N22	10	J[10]	6.8	-61.3	20.5	0.43	0.08	-0.36	-20.47	1.37	OK	0.072	0.182	1.46	OK
N22	11	J[12]	-4.2	-56.9	13.5	0.38	-0.32	0.02	-20.47	1.37	OK	0.055	0.162	1.45	OK
N22	11	J[11]	0.5	-60.3	15.2	0.38	-0.14	-0.18	-20.47	1.37	OK	0.060	0.159	1.45	OK
N22	12	J[13]	-5.2	-55.6	2.5	0.33	-0.46	0.12	-20.47	1.37	OK	0.011	0.229	1.48	OK
N22	12	J[12]	-4.2	-59.3	3.1	0.33	-0.41	0.05	-20.47	1.37	OK	0.014	0.206	1.47	OK
N22	13	J[14]	-6.7	-51.5	2.7	0.28	-0.69	0.32	-20.47	1.37	OK	0.015	0.346	1.54	OK
N22	13	J[13]	-5.2	-55.9	2.9	0.28	-0.60	0.20	-20.47	1.37	OK	0.016	0.300	1.52	OK
N22	14	J[15]	-9.0	-48.3	4.9	0.23	-1.23	0.81	-20.47	1.37	OK	0.032	0.615	1.65	OK
N22	14	J[14]	-6.7	-52.0	4.5	0.23	-0.98	0.53	-20.47	1.37	OK	0.029	0.490	1.60	OK
N22	15	J[16]	-11.5	-45.4	5.5	0.23	-1.50	1.11	-20.47	1.37	OK	0.036	0.752	1.71	OK
N22	15	J[15]	-9.0	-49.0	4.6	0.23	-1.23	0.81	-20.47	1.37	OK	0.030	0.617	1.65	OK
N22	16	J[17]	-12.9	-42.5	3.5	0.23	-1.65	1.28	-20.47	1.37	OK	0.023	0.824	1.74	OK
N22	16	J[16]	-11.5	-45.9	2.0	0.23	-1.51	1.11	-20.47	1.37	OK	0.013	0.753	1.71	OK
N22	17	J[18]	-11.1	-39.2	2.6	0.23	-1.43	1.09	-20.47	1.37	OK	0.017	0.714	1.69	OK
N22	17	J[17]	-12.9	-42.3	4.7	0.23	-1.65	1.28	-20.47	1.37	OK	0.030	0.824	1.74	OK
N22	18	J[19]	-6.2	-35.1	8.4	0.23	-0.86	0.55	-20.47	1.37	OK	0.055	0.428	1.57	OK
N22	18	J[18]	-11.1	-37.7	11.1	0.23	-1.42	1.09	-20.47	1.37	OK	0.072	0.710	1.69	OK
N22	19	J[20]	0.2	-30.5	8.3	0.23	-0.11	-0.15	-20.47	1.37	OK	0.054	0.132	1.44	OK
N22	19	J[19]	-6.2	-32.4	15.9	0.23	-0.85	0.56	-20.47	1.37	OK	0.103	0.423	1.57	OK
N22	20	J[21]	3.7	-26.7	1.9	0.23	0.31	-0.54	-20.47	1.37	OK	0.012	0.270	1.50	OK
N22	20	J[20]	0.2	-27.9	14.7	0.23	-0.10	-0.14	-20.47	1.37	OK	0.096	0.121	1.43	OK
N22	21	J[22]	1.2	-26.1	12.9	0.23	0.02	-0.24	-20.47	1.37	OK	0.084	0.122	1.43	OK
N22	21	J[21]	3.7	-26.5	4.0	0.23	0.31	-0.54	-20.47	1.37	OK	0.026	0.269	1.50	OK
N22	22	J[23]	-4.7	-28.7	14.9	0.23	-0.65	0.40	-20.47	1.37	OK	0.097	0.326	1.53	OK
N22	22	J[22]	1.2	-28.3	6.9	0.23	0.01	-0.25	-20.47	1.37	OK	0.045	0.127	1.43	OK
N22	23	J[24]	-9.7	-32.5	11.9	0.23	-1.24	0.96	-20.47	1.37	OK	0.077	0.621	1.65	OK
N22	23	J[23]	-4.7	-31.2	8.3	0.23	-0.66	0.39	-20.47	1.37	OK	0.054	0.332	1.53	OK
N22	24	J[25]	-12.8	-36.2	7.7	0.23	-1.60	1.29	-20.47	1.37	OK	0.050	0.802	1.73	OK
N22	24	J[24]	-9.7	-34.3	4.5	0.23	-1.25	0.95	-20.47	1.37	OK	0.029	0.625	1.66	OK
N22	25	J[26]	-13.2	-39.6	2.3	0.23	-1.67	1.33	-20.47	1.37	OK	0.015	0.837	1.74	OK
N22	25	J[25]	-12.8	-37.0	0.4	0.23	-1.61	1.29	-20.47	1.37	OK	0.002	0.804	1.73	OK
N22	26	J[27]	-11.3	-42.5	2.9	0.23	-1.46	1.09	-20.47	1.37	OK	0.019	0.731	1.70	OK
N22	26	J[26]	-13.2	-39.3	5.0	0.23	-1.67	1.33	-20.47	1.37	OK	0.032	0.836	1.74	OK
N22	27	J[28]	-8.8	-45.1	4.2	0.23	-1.20	0.81	-20.47	1.37	OK	0.027	0.599	1.65	OK
N22	27	J[27]	-11.3	-41.6	5.6	0.23	-1.46	1.10	-20.47	1.37	OK	0.036	0.730	1.70	OK
N22	28	J[29]	-7.5	-48.2	2.3	0.23	-1.06	0.64	-20.47	1.37	OK	0.015	0.529	1.62	OK
N22	28	J[28]	-8.8	-44.6	3.2	0.23	-1.20	0.81	-20.47	1.37	OK	0.021	0.598	1.64	OK
N22	29	J[30]	-7.0	-51.7	0.7	0.23	-1.02	0.57	-20.47	1.37	OK	0.005	0.512	1.61	OK
N22	29	J[29]	-7.5	-48.0	1.1	0.23	-1.06	0.64	-20.47	1.37	OK	0.007	0.528	1.62	OK
N22	30	J[31]	-6.8	-56.0	0.6	0.28	-0.72	0.32	-20.47	1.37	OK	0.003	0.361	1.54	OK
N22	30	J[30]	-7.0	-51.6	0.4	0.28	-0.72	0.35	-20.47	1.37	OK	0.002	0.362	1.54	OK
N22	31	J[32]	-6.3	-59.6	1.8	0.33	-0.52	0.16	-20.47	1.37	OK	0.008	0.262	1.50	OK
N22	31	J[31]	-6.8	-55.9	1.2	0.33	-0.54	0.21	-20.47	1.37	OK	0.005	0.272	1.50	OK
N22	32	J[33]	-1.7	-60.8	14.7	0.38	-0.23	-0.09	-20.47	1.37	OK	0.058	0.160	1.45	OK
N22	32	J[32]	-6.3	-57.5	13.1	0.38	-0.41	0.11	-20.47	1.37	OK	0.052	0.206	1.47	OK
N22	33	J[34]	4.7	-61.9	20.7	0.43	0.01	-0.30	-20.47	1.37	OK	0.072	0.148	1.45	OK
N22	33	J[33]	-1.7	-58.5	18.4	0.43	-0.19	-0.08	-20.47	1.37	OK	0.064	0.136	1.44	OK
N22	34	J[35]	10.3	-65.0	18.1	0.33	0.37	-0.77	-20.47	1.37	OK	0.082	0.383	1.55	OK
N22	34	J[34]	4.7	-62.3	16.3	0.33	0.07	-0.45	-20.47	1.37	OK	0.074	0.224	1.48	OK
N22	35	J[1]	12.9	-64.1	22.6	0.23	1.19	-1.74	-20.47	1.37	OK	0.147	0.872	1.76	OK
N22	35	J[35]	10.3	-63.4	22.1	0.23	0.90	-1.45	-20.47	1.37	OK	0.144	0.724	1.70	OK

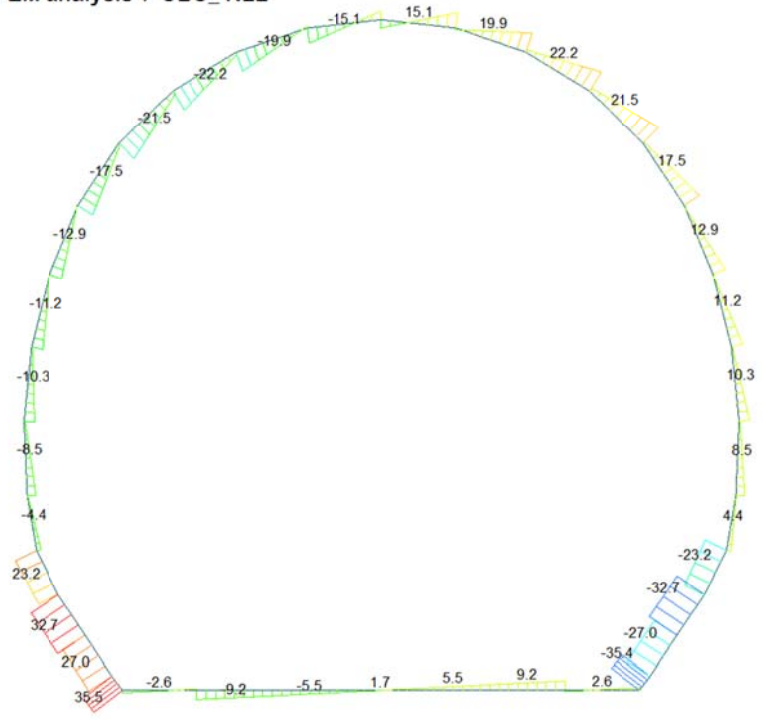
Beam Diagram_Fx - FEM analysis / CBC_N22



Beam Diagram_My - FEM analysis / CBC_N22



Beam Diagram_Fz - FEM analysis / CBC_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

35.45
29.00
22.56
16.11
9.67
3.22
0.00
-9.67
-16.11
-22.56
-29.00
-35.45

CBC: N22
MAX : 35
MIN : 8
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICHE SEZIONALI

CALCESTRUZZO - DATI DI CALCOLO

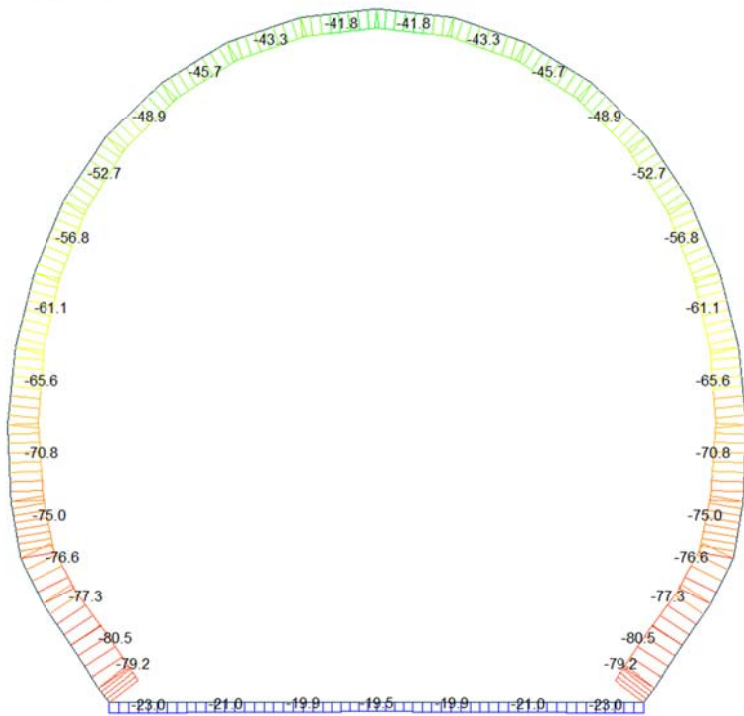
R_{ct} [N/mm ²]	37.00	F_{ctd} [N/mm ²]	30.71	$f_{ctm,95}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.20	α_{cc}	0.80	α_{ct}	0.80	ψ	0.80
$f_{ctd,95}$ [N/mm ²]	20.47	$f_{ctd,95}$ [N/mm ²]	1.373	E_g [N/mm ²]	26'400		

VERIFICHE SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Resistenze di progetto		Risultato verifica	Verifica a taglio secondo EC2			
							σ_{top} [N/mm ²]	σ_{inf} [N/mm ²]	$f_{ctd,95}$ [N/mm ²]	$f_{ctd,95}$ [N/mm ²]		τ_{top} [N/mm ²]	τ_{cp} [N/mm ²]	$f_{ctd,EC2}$ [N/mm ²]	Verifica a taglio
N22	1	I[1]	-10.5	-39.9	2.6	0.23	-1.36	1.02	-20.47	1.37	OK	0.017	0.681	1.68	OK
N22	1	J[2]	-10.1	-39.9	1.2	0.23	-1.32	0.98	-20.47	1.37	OK	0.008	0.662	1.67	OK
N22	2	I[2]	-10.1	-36.5	9.2	0.23	-1.31	0.99	-20.47	1.37	OK	0.060	0.654	1.67	OK
N22	2	J[3]	-6.5	-36.5	5.5	0.23	-0.89	0.58	-20.47	1.37	OK	0.036	0.446	1.58	OK
N22	3	I[3]	-6.5	-34.5	5.5	0.23	-0.88	0.58	-20.47	1.37	OK	0.036	0.442	1.58	OK
N22	3	J[4]	-4.7	-34.5	1.7	0.23	-0.68	0.38	-20.47	1.37	OK	0.011	0.340	1.53	OK
N22	4	I[4]	-4.7	-33.9	1.7	0.23	-0.68	0.38	-20.47	1.37	OK	0.011	0.339	1.53	OK
N22	4	J[5]	-4.7	-33.9	1.7	0.23	-0.68	0.38	-20.47	1.37	OK	0.011	0.339	1.53	OK
N22	5	I[5]	-4.7	-34.5	1.7	0.23	-0.68	0.38	-20.47	1.37	OK	0.011	0.340	1.53	OK
N22	5	J[6]	-6.5	-34.5	5.5	0.23	-0.88	0.58	-20.47	1.37	OK	0.036	0.442	1.58	OK
N22	6	I[6]	-6.5	-36.5	5.5	0.23	-0.89	0.58	-20.47	1.37	OK	0.036	0.446	1.58	OK
N22	6	J[7]	-10.1	-36.5	9.2	0.23	-1.31	0.99	-20.47	1.37	OK	0.060	0.654	1.67	OK
N22	7	I[7]	-10.1	-39.9	1.2	0.23	-1.32	0.98	-20.47	1.37	OK	0.008	0.662	1.67	OK
N22	7	J[8]	-10.5	-39.9	2.6	0.23	-1.36	1.02	-20.47	1.37	OK	0.017	0.681	1.68	OK
N22	8	I[8]	6.4	-118.9	35.0	0.23	0.21	-1.24	-20.47	1.37	OK	0.228	0.621	1.65	OK
N22	8	J[9]	10.5	-118.9	35.5	0.23	0.67	-1.71	-20.47	1.37	OK	0.231	0.854	1.75	OK
N22	9	I[9]	-2.3	-118.7	26.3	0.33	-0.49	-0.23	-20.47	1.37	OK	0.120	0.360	1.54	OK
N22	9	J[10]	6.4	-121.5	27.0	0.33	-0.02	-0.72	-20.47	1.37	OK	0.123	0.368	1.55	OK
N22	10	I[11]	-12.9	-114.7	32.5	0.43	-0.69	0.15	-20.47	1.37	OK	0.113	0.343	1.53	OK
N22	10	J[12]	-2.3	-118.1	32.7	0.43	-0.35	-0.20	-20.47	1.37	OK	0.114	0.275	1.50	OK
N22	11	I[12]	-20.3	-115.2	23.3	0.38	-1.15	0.54	-20.47	1.37	OK	0.092	0.573	1.63	OK
N22	11	J[13]	-12.9	-118.5	21.8	0.38	-0.85	0.22	-20.47	1.37	OK	0.086	0.424	1.57	OK
N22	12	I[13]	-19.4	-114.2	0.3	0.33	-1.41	0.72	-20.47	1.37	OK	0.002	0.706	1.69	OK
N22	12	J[14]	-20.3	-117.8	4.4	0.33	-1.47	0.76	-20.47	1.37	OK	0.020	0.737	1.70	OK
N22	13	I[14]	-17.0	-109.2	0.9	0.28	-1.69	0.91	-20.47	1.37	OK	0.005	0.844	1.74	OK
N22	13	J[15]	-19.4	-113.6	8.5	0.28	-1.89	1.08	-20.47	1.37	OK	0.045	0.944	1.78	OK
N22	14	I[15]	-14.1	-104.6	0.7	0.23	-2.06	1.15	-20.47	1.37	OK	0.005	1.029	1.82	OK
N22	14	J[16]	-17.0	-108.4	10.3	0.23	-2.39	1.37	-20.47	1.37	OK	0.067	1.197	1.88	OK
N22	15	I[16]	-11.4	-100.1	0.4	0.23	-1.72	0.85	-20.47	1.37	OK	0.003	0.862	1.75	OK
N22	15	J[17]	-14.1	-103.8	11.2	0.23	-2.05	1.15	-20.47	1.37	OK	0.073	1.027	1.82	OK
N22	16	I[17]	-8.3	-95.8	0.7	0.23	-1.35	0.52	-20.47	1.37	OK	0.005	0.677	1.68	OK
N22	16	J[18]	-11.4	-99.2	12.9	0.23	-1.72	0.86	-20.47	1.37	OK	0.084	0.861	1.75	OK
N22	17	I[18]	-3.4	-91.1	1.7	0.23	-0.78	-0.01	-20.47	1.37	OK	0.011	0.396	1.56	OK
N22	17	J[19]	-8.3	-94.2	17.5	0.23	-1.35	0.53	-20.47	1.37	OK	0.114	0.674	1.68	OK
N22	18	I[19]	2.9	-85.9	3.6	0.23	-0.05	-0.70	-20.47	1.37	OK	0.023	0.373	1.55	OK
N22	18	J[20]	-3.4	-88.5	21.5	0.23	-0.77	0.00	-20.47	1.37	OK	0.140	0.387	1.55	OK
N22	19	I[20]	9.1	-81.1	2.3	0.23	0.68	-1.38	-20.47	1.37	OK	0.015	0.690	1.68	OK
N22	19	J[21]	2.9	-83.0	22.2	0.23	-0.03	-0.69	-20.47	1.37	OK	0.145	0.361	1.54	OK
N22	20	I[21]	13.6	-77.4	1.8	0.23	1.21	-1.88	-20.47	1.37	OK	0.012	0.941	1.78	OK
N22	20	J[22]	9.1	-78.6	19.9	0.23	0.69	-1.37	-20.47	1.37	OK	0.130	0.685	1.68	OK
N22	21	I[22]	15.4	-75.6	8.4	0.23	1.33	-2.07	-20.47	1.37	OK	0.055	1.036	1.82	OK
N22	21	J[23]	13.6	-76.0	15.1	0.23	1.22	-1.88	-20.47	1.37	OK	0.098	0.938	1.78	OK
N22	22	I[22]	13.6	-76.0	15.1	0.23	1.22	-1.88	-20.47	1.37	OK	0.098	0.938	1.78	OK
N22	22	J[23]	15.4	-75.6	8.4	0.23	1.33	-2.07	-20.47	1.37	OK	0.055	1.036	1.82	OK
N22	23	I[24]	9.1	-78.6	19.9	0.23	0.69	-1.37	-20.47	1.37	OK	0.130	0.685	1.68	OK
N22	23	J[23]	13.6	-77.4	1.8	0.23	1.21	-1.88	-20.47	1.37	OK	0.012	0.941	1.78	OK
N22	24	I[25]	2.9	-83.0	22.2	0.23	-0.03	-0.69	-20.47	1.37	OK	0.145	0.361	1.54	OK
N22	24	J[24]	9.1	-81.1	2.3	0.23	0.68	-1.38	-20.47	1.37	OK	0.015	0.690	1.68	OK
N22	25	I[26]	-3.4	-88.5	21.5	0.23	-0.77	0.00	-20.47	1.37	OK	0.140	0.387	1.55	OK
N22	25	J[25]	2.9	-85.9	3.6	0.23	-0.05	-0.70	-20.47	1.37	OK	0.023	0.373	1.55	OK
N22	26	I[27]	-8.3	-94.2	17.5	0.23	-1.35	0.53	-20.47	1.37	OK	0.114	0.674	1.68	OK
N22	26	J[26]	-3.4	-91.1	1.7	0.23	-0.78	-0.01	-20.47	1.37	OK	0.011	0.396	1.56	OK
N22	27	I[28]	-11.4	-99.2	12.9	0.23	-1.72	0.86	-20.47	1.37	OK	0.084	0.861	1.75	OK
N22	27	J[27]	-8.3	-95.8	0.7	0.23	-1.35	0.52	-20.47	1.37	OK	0.005	0.677	1.68	OK
N22	28	I[29]	-14.1	-103.8	11.2	0.23	-2.05	1.15	-20.47	1.37	OK	0.073	1.027	1.82	OK
N22	28	J[28]	-11.4	-100.1	0.4	0.23	-1.72	0.85	-20.47	1.37	OK	0.003	0.862	1.75	OK
N22	29	I[30]	-17.0	-108.4	10.3	0.23	-2.39	1.37	-20.47	1.37	OK	0.067	1.197	1.88	OK
N22	29	J[29]	-14.1	-104.6	0.7	0.23	-2.06	1.15	-20.47	1.37	OK	0.005	1.029	1.82	OK
N22	30	I[31]	-19.4	-113.6	8.5	0.28	-1.89	1.08	-20.47	1.37	OK	0.045	0.944	1.78	OK
N22	30	J[30]	-17.0	-109.2	0.9	0.28	-1.69	0.91	-20.47	1.37	OK	0.005	0.844	1.74	OK
N22	31	I[32]	-20.3	-117.8	4.4	0.33	-1.47	0.76	-20.47	1.37	OK	0.020	0.737	1.70	OK
N22	31	J[31]	-19.4	-114.2	0.3	0.33	-1.41	0.72	-20.47	1.37	OK	0.002	0.706	1.69	OK
N22	32	I[33]	-12.9	-118.5	21.8	0.38	-0.85	0.22	-20.47	1.37	OK	0.086	0.424	1.57	OK
N22	32	J[32]	-20.3	-115.2	23.3	0.38	-1.15	0.54	-20.47	1.37	OK	0.092	0.573	1.63	OK
N22	33	I[34]	-2.3	-118.1	32.7	0.43	-0.35	-0.20	-20.47	1.37	OK	0.114	0.275	1.50	OK
N22	33	J[33]	-12.9	-114.7	32.5	0.43	-0.69	0.15	-20.47	1.37	OK	0.113	0.343	1.53	OK
N22	34	I[35]	6.4	-121.5	27.0	0.33	-0.02	-0.72	-20.47	1.37	OK	0.123	0.368	1.55	OK
N22	34	J[34]	-2.3	-118.7	26.3	0.33	-0.49	-0.23	-20.47	1.37	OK	0.120	0.360	1.54	OK
N22	35	I[1]	10.5	-118.9	35.5	0.23	0.67	-1.71	-20.47	1.37	OK	0.231	0.854	1.75	OK
N22	35	J[35]	6.4	-118.9	35.0	0.23	0.21	-1.24	-20.47	1.37	OK	0.228	0.621	1.65	OK

A.5.4.13. Load combination SLE 1

Beam Diagram_Fx / ST_NSLE - 1



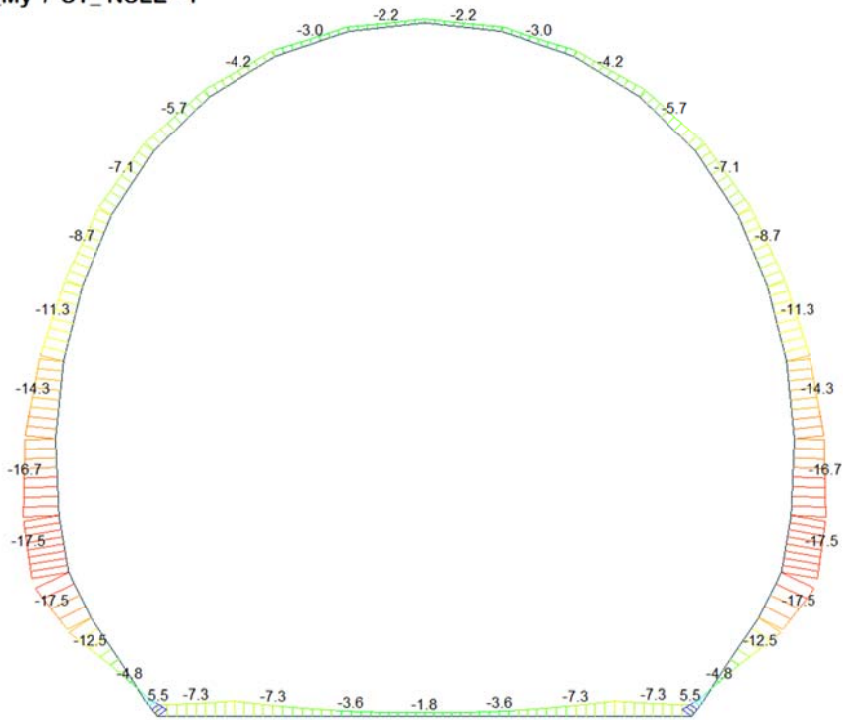
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-19.55
Cyan	-25.09
Green	-30.63
Light Green	-36.17
Yellow-Green	-41.72
Yellow	-47.26
Orange-Yellow	-52.80
Orange	-58.35
Red-Orange	-63.89
Red	-69.43
Dark Red	-74.97
Black	-80.52

ST: NSLE - 1
MAX : 4
MIN : 34
FILE: Pst_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_NSLE - 1



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	5.45
Cyan	3.36
Green	1.28
Light Green	0.00
Yellow-Green	-2.89
Yellow	-4.98
Orange-Yellow	-7.07
Orange	-9.15
Red-Orange	-11.24
Red	-13.33
Dark Red	-15.41
Black	-17.50

ST: NSLE - 1
MAX : 8
MIN : 12
FILE: Pst_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R_{ck} [N/mm ²]	37.00	F_{ck} [N/mm ²]	30.71	$f_{ctk0.05}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.00	α_{cc}	1.00	α_{ct}	1.00	φ	0.80
f_{cd} [N/mm ²]	30.71	f_{ctd} [N/mm ²]	2.059	E_{φ} [N/mm ²]	26'400		

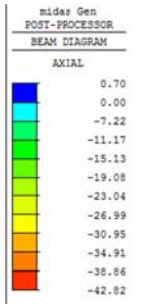
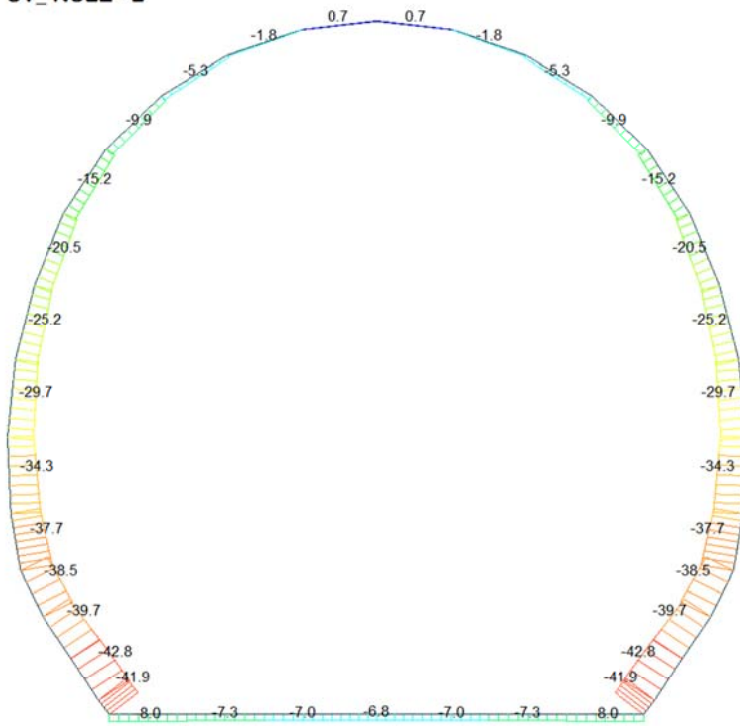
VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ_{sup} [N/mm ²]	σ_{inf} [N/mm ²]	f_{cd} [N/mm ²]	f_{ctd} [N/mm ²]	
NSLE - 1	1	I[1]	-5.5	-23.0	1.8	0.30	-0.44	0.29	-30.71	2.06	OK
NSLE - 1	1	J[2]	-7.3	-23.0	5.6	0.30	-0.56	0.41	-30.71	2.06	OK
NSLE - 1	2	I[2]	-7.3	-21.0	9.2	0.30	-0.56	0.42	-30.71	2.06	OK
NSLE - 1	2	J[3]	-3.6	-21.0	5.5	0.30	-0.31	0.17	-30.71	2.06	OK
NSLE - 1	3	I[3]	-3.6	-19.9	5.5	0.30	-0.31	0.18	-30.71	2.06	OK
NSLE - 1	3	J[4]	-1.8	-19.9	1.7	0.30	-0.19	0.06	-30.71	2.06	OK
NSLE - 1	4	I[4]	-1.8	-19.6	1.7	0.30	-0.19	0.06	-30.71	2.06	OK
NSLE - 1	4	J[5]	-1.8	-19.6	1.7	0.30	-0.19	0.06	-30.71	2.06	OK
NSLE - 1	5	I[5]	-1.8	-19.9	1.7	0.30	-0.19	0.06	-30.71	2.06	OK
NSLE - 1	5	J[6]	-3.6	-19.9	5.5	0.30	-0.31	0.18	-30.71	2.06	OK
NSLE - 1	6	I[6]	-3.6	-21.0	5.5	0.30	-0.31	0.17	-30.71	2.06	OK
NSLE - 1	6	J[7]	-7.3	-21.0	9.2	0.30	-0.56	0.42	-30.71	2.06	OK
NSLE - 1	7	I[7]	-7.3	-23.0	5.6	0.30	-0.56	0.41	-30.71	2.06	OK
NSLE - 1	7	J[8]	-5.5	-23.0	1.8	0.30	-0.44	0.29	-30.71	2.06	OK
NSLE - 1	8	I[9]	2.2	-78.5	27.8	0.30	-0.11	-0.41	-30.71	2.06	OK
NSLE - 1	8	J[8]	5.5	-79.2	28.3	0.30	0.10	-0.63	-30.71	2.06	OK
NSLE - 1	9	I[10]	-4.9	-77.8	20.6	0.40	-0.38	-0.01	-30.71	2.06	OK
NSLE - 1	9	J[9]	2.2	-80.5	22.4	0.40	-0.12	-0.28	-30.71	2.06	OK
NSLE - 1	10	I[11]	-12.6	-73.9	22.5	0.50	-0.45	0.15	-30.71	2.06	OK
NSLE - 1	10	J[10]	-4.9	-77.3	24.8	0.50	-0.27	-0.04	-30.71	2.06	OK
NSLE - 1	11	I[12]	-17.5	-73.3	14.2	0.45	-0.68	0.36	-30.71	2.06	OK
NSLE - 1	11	J[11]	-12.6	-76.6	15.9	0.45	-0.54	0.20	-30.71	2.06	OK
NSLE - 1	12	I[13]	-16.7	-71.3	2.5	0.40	-0.80	0.45	-30.71	2.06	OK
NSLE - 1	12	J[12]	-17.5	-75.0	1.8	0.40	-0.84	0.47	-30.71	2.06	OK
NSLE - 1	13	I[14]	-14.3	-66.4	4.9	0.35	-0.89	0.51	-30.71	2.06	OK
NSLE - 1	13	J[13]	-16.7	-70.8	4.7	0.35	-1.02	0.62	-30.71	2.06	OK
NSLE - 1	14	I[15]	-11.3	-61.9	5.8	0.30	-0.96	0.55	-30.71	2.06	OK
NSLE - 1	14	J[14]	-14.3	-65.7	6.2	0.30	-1.17	0.74	-30.71	2.06	OK
NSLE - 1	15	I[16]	-8.7	-57.5	4.8	0.30	-0.77	0.39	-30.71	2.06	OK
NSLE - 1	15	J[15]	-11.3	-61.1	5.7	0.30	-0.96	0.55	-30.71	2.06	OK
NSLE - 1	16	I[17]	-7.1	-53.4	2.6	0.30	-0.65	0.29	-30.71	2.06	OK
NSLE - 1	16	J[16]	-8.7	-56.8	4.0	0.30	-0.77	0.39	-30.71	2.06	OK
NSLE - 1	17	I[18]	-5.7	-49.6	1.8	0.30	-0.54	0.21	-30.71	2.06	OK
NSLE - 1	17	J[17]	-7.1	-52.7	3.9	0.30	-0.65	0.30	-30.71	2.06	OK
NSLE - 1	18	I[19]	-4.2	-46.3	1.6	0.30	-0.43	0.12	-30.71	2.06	OK
NSLE - 1	18	J[18]	-5.7	-48.9	4.3	0.30	-0.54	0.21	-30.71	2.06	OK
NSLE - 1	19	I[20]	-3.0	-43.8	0.9	0.30	-0.34	0.05	-30.71	2.06	OK
NSLE - 1	19	J[19]	-4.2	-45.7	4.1	0.30	-0.43	0.13	-30.71	2.06	OK
NSLE - 1	20	I[21]	-2.2	-42.1	0.2	0.30	-0.28	0.00	-30.71	2.06	OK
NSLE - 1	20	J[20]	-3.0	-43.3	3.4	0.30	-0.34	0.05	-30.71	2.06	OK
NSLE - 1	21	I[22]	-1.9	-41.4	1.3	0.30	-0.26	-0.01	-30.71	2.06	OK
NSLE - 1	21	J[21]	-2.2	-41.8	2.4	0.30	-0.28	0.00	-30.71	2.06	OK
NSLE - 1	22	I[23]	-2.2	-41.8	2.4	0.30	-0.28	0.00	-30.71	2.06	OK
NSLE - 1	22	J[22]	-1.9	-41.4	1.3	0.30	-0.26	-0.01	-30.71	2.06	OK
NSLE - 1	23	I[24]	-3.0	-43.3	3.4	0.30	-0.37	0.05	-30.71	2.06	OK
NSLE - 1	23	J[23]	-2.2	-42.1	0.2	0.30	-0.28	0.00	-30.71	2.06	OK
NSLE - 1	24	I[25]	-4.2	-45.7	4.1	0.30	-0.53	0.13	-30.71	2.06	OK
NSLE - 1	24	J[24]	-3.0	-43.8	0.9	0.30	-0.37	0.05	-30.71	2.06	OK
NSLE - 1	25	I[26]	-5.7	-48.9	4.3	0.30	-0.57	0.21	-30.71	2.06	OK
NSLE - 1	25	J[25]	-4.2	-46.3	1.6	0.30	-0.53	0.12	-30.71	2.06	OK
NSLE - 1	26	I[27]	-7.1	-52.7	3.9	0.30	-0.65	0.30	-30.71	2.06	OK
NSLE - 1	26	J[26]	-5.7	-49.6	1.8	0.30	-0.57	0.21	-30.71	2.06	OK
NSLE - 1	27	I[28]	-8.7	-56.8	4.0	0.30	-0.77	0.39	-30.71	2.06	OK
NSLE - 1	27	J[27]	-7.1	-53.4	2.6	0.30	-0.65	0.29	-30.71	2.06	OK
NSLE - 1	28	I[29]	-11.3	-61.1	5.7	0.30	-0.96	0.55	-30.71	2.06	OK
NSLE - 1	28	J[28]	-8.7	-57.5	4.8	0.30	-0.77	0.39	-30.71	2.06	OK
NSLE - 1	29	I[30]	-14.3	-65.7	6.2	0.30	-1.17	0.74	-30.71	2.06	OK
NSLE - 1	29	J[29]	-11.3	-61.9	5.8	0.30	-0.96	0.55	-30.71	2.06	OK
NSLE - 1	30	I[31]	-16.7	-70.8	4.7	0.35	-1.02	0.62	-30.71	2.06	OK
NSLE - 1	30	J[30]	-14.3	-66.4	4.8	0.35	-0.89	0.51	-30.71	2.06	OK
NSLE - 1	31	I[32]	-17.5	-75.0	1.8	0.40	-0.84	0.47	-30.71	2.06	OK
NSLE - 1	31	J[31]	-16.7	-71.3	2.5	0.40	-0.80	0.45	-30.71	2.06	OK
NSLE - 1	32	I[33]	-12.6	-76.6	15.9	0.45	-0.54	0.20	-30.71	2.06	OK
NSLE - 1	32	J[32]	-17.5	-73.3	14.2	0.45	-0.68	0.36	-30.71	2.06	OK
NSLE - 1	33	I[34]	-4.9	-77.3	24.8	0.50	-0.27	-0.04	-30.71	2.06	OK
NSLE - 1	33	J[33]	-12.6	-73.9	22.5	0.50	-0.45	0.15	-30.71	2.06	OK
NSLE - 1	34	I[35]	2.2	-80.5	22.4	0.40	-0.12	-0.28	-30.71	2.06	OK
NSLE - 1	34	J[34]	-4.9	-77.8	20.6	0.40	-0.38	-0.01	-30.71	2.06	OK
NSLE - 1	35	I[1]	5.5	-79.2	28.3	0.30	0.10	-0.63	-30.71	2.06	OK
NSLE - 1	35	J[35]	2.2	-78.5	27.8	0.30	-0.11	-0.41	-30.71	2.06	OK

$\sigma_{c, max}$	-1.17
$\sigma_{t, max}$	0.74

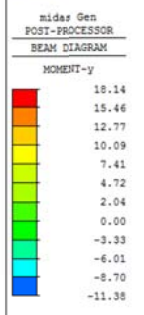
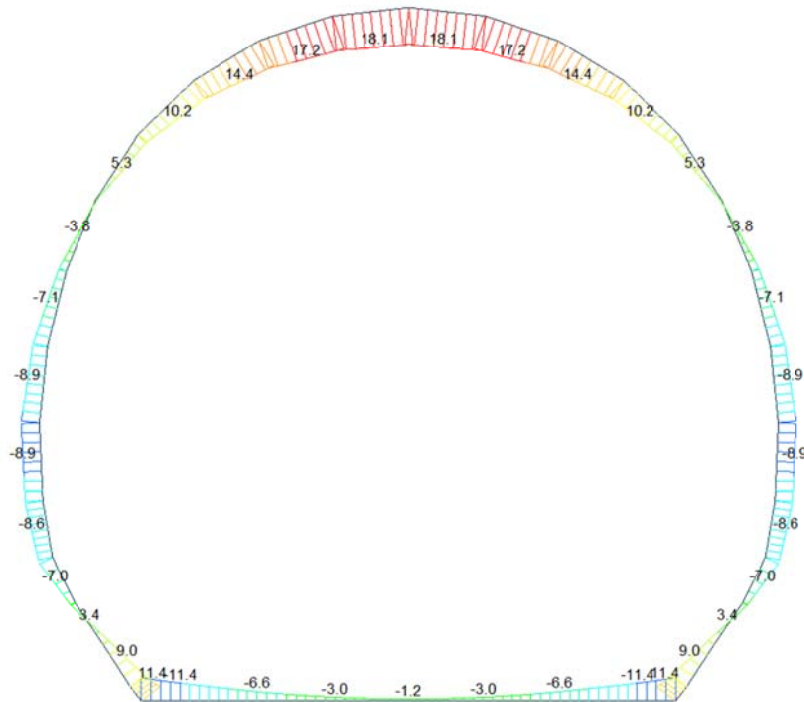
A.5.4.14. Load combination SLE 2

Beam Diagram_Fx / ST_NSLE - 2



ST: NSLE - 2
 MAX : 21
 MIN : 34
 FILE: FdE_C01-C0-
 UNIT: kN
 DATE: 04/04/2014
 VIEW-DIRECTION
 X: 0.000
 Y: 1.000
 Z: 0.000

Beam Diagram_My / ST_NSLE - 2



ST: NSLE - 2
 MAX : 22
 MIN : 7
 FILE: FdE_C01-C0-
 UNIT: kN*m
 DATE: 04/04/2014
 VIEW-DIRECTION
 X: 0.000
 Y: 1.000
 Z: 0.000

VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R _{ck} [N/mm ²]	37.00	F _{ck} [N/mm ²]	30.71	f _{ctk0.05} [N/mm ²]	2.06	E _{cm} [N/mm ²]	33'000
γ _c	1.00	α _{cc}	1.00	α _{ct}	1.00	φ	0.80
f _{cd} [N/mm ²]	30.71	f _{ctd} [N/mm ²]	2.059	E _φ [N/mm ²]	26'400		

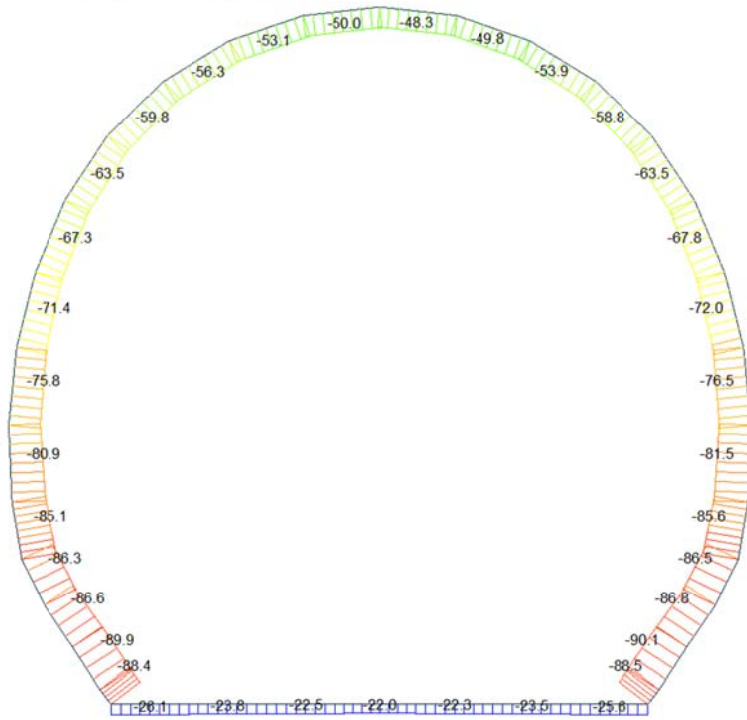
VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ _{sup} [N/mm ²]	σ _{inf} [N/mm ²]	f _{cd} [N/mm ²]	f _{ctd} [N/mm ²]	
NSLE - 2	1	I[1]	-11.4	-8.0	11.4	0.30	-0.79	0.73	-30.71	2.06	OK
NSLE - 2	1	J[2]	-6.6	-8.0	7.6	0.30	-0.47	0.42	-30.71	2.06	OK
NSLE - 2	2	I[2]	-6.6	-7.4	9.2	0.30	-0.47	0.42	-30.71	2.06	OK
NSLE - 2	2	J[3]	-3.0	-7.4	5.5	0.30	-0.22	0.17	-30.71	2.06	OK
NSLE - 2	3	I[3]	-3.0	-7.0	5.5	0.30	-0.22	0.17	-30.71	2.06	OK
NSLE - 2	3	J[4]	-1.2	-7.0	1.7	0.30	-0.10	0.05	-30.71	2.06	OK
NSLE - 2	4	I[4]	-1.2	-6.8	1.7	0.30	-0.10	0.05	-30.71	2.06	OK
NSLE - 2	4	J[5]	-1.2	-6.8	1.7	0.30	-0.10	0.05	-30.71	2.06	OK
NSLE - 2	5	I[5]	-1.2	-7.0	1.7	0.30	-0.10	0.05	-30.71	2.06	OK
NSLE - 2	5	J[6]	-3.0	-7.0	5.5	0.30	-0.22	0.17	-30.71	2.06	OK
NSLE - 2	6	I[6]	-3.0	-7.4	5.5	0.30	-0.22	0.17	-30.71	2.06	OK
NSLE - 2	6	J[7]	-6.6	-7.4	9.2	0.30	-0.47	0.42	-30.71	2.06	OK
NSLE - 2	7	I[7]	-6.6	-8.0	7.6	0.30	-0.47	0.42	-30.71	2.06	OK
NSLE - 2	7	J[8]	-11.4	-8.0	11.4	0.30	-0.79	0.73	-30.71	2.06	OK
NSLE - 2	8	I[9]	9.0	-41.3	20.4	0.30	0.46	-0.74	-30.71	2.06	OK
NSLE - 2	8	J[8]	11.4	-42.0	20.9	0.30	0.62	-0.90	-30.71	2.06	OK
NSLE - 2	9	I[10]	3.4	-40.1	16.1	0.40	0.03	-0.23	-30.71	2.06	OK
NSLE - 2	9	J[9]	9.0	-42.8	17.9	0.40	0.23	-0.44	-30.71	2.06	OK
NSLE - 2	10	I[11]	-2.5	-36.3	16.9	0.50	-0.13	-0.01	-30.71	2.06	OK
NSLE - 2	10	J[10]	3.4	-39.7	19.1	0.50	0.00	-0.16	-30.71	2.06	OK
NSLE - 2	11	I[12]	-7.0	-35.2	12.9	0.45	-0.28	0.13	-30.71	2.06	OK
NSLE - 2	11	J[11]	-2.5	-38.5	14.6	0.45	-0.16	-0.01	-30.71	2.06	OK
NSLE - 2	12	I[13]	-8.6	-34.0	4.0	0.40	-0.41	0.24	-30.71	2.06	OK
NSLE - 2	12	J[12]	-7.0	-37.7	4.6	0.40	-0.36	0.17	-30.71	2.06	OK
NSLE - 2	13	I[14]	-8.9	-30.0	0.6	0.35	-0.52	0.35	-30.71	2.06	OK
NSLE - 2	13	J[13]	-8.6	-34.3	0.8	0.35	-0.52	0.32	-30.71	2.06	OK
NSLE - 2	14	I[15]	-7.1	-26.0	3.4	0.30	-0.56	0.39	-30.71	2.06	OK
NSLE - 2	14	J[14]	-8.9	-29.7	3.7	0.30	-0.69	0.50	-30.71	2.06	OK
NSLE - 2	15	I[16]	-3.8	-21.6	6.2	0.30	-0.33	0.18	-30.71	2.06	OK
NSLE - 2	15	J[15]	-7.1	-25.3	7.1	0.30	-0.56	0.39	-30.71	2.06	OK
NSLE - 2	16	I[17]	0.4	-17.0	7.8	0.30	-0.03	-0.08	-30.71	2.06	OK
NSLE - 2	16	J[16]	-3.8	-20.5	9.2	0.30	-0.32	0.19	-30.71	2.06	OK
NSLE - 2	17	I[18]	5.3	-12.1	8.8	0.30	0.31	-0.39	-30.71	2.06	OK
NSLE - 2	17	J[17]	0.4	-15.3	10.9	0.30	-0.02	-0.08	-30.71	2.06	OK
NSLE - 2	18	I[19]	10.3	-7.3	8.6	0.30	0.66	-0.71	-30.71	2.06	OK
NSLE - 2	18	J[18]	5.3	-9.9	11.2	0.30	0.32	-0.39	-30.71	2.06	OK
NSLE - 2	19	I[20]	14.4	-3.3	6.8	0.30	0.95	-0.97	-30.71	2.06	OK
NSLE - 2	19	J[19]	10.3	-5.3	9.9	0.30	0.67	-0.70	-30.71	2.06	OK
NSLE - 2	20	I[21]	17.2	-0.6	3.8	0.30	1.14	-1.15	-30.71	2.06	OK
NSLE - 2	20	J[20]	14.4	-1.8	7.3	0.30	0.95	-0.97	-30.71	2.06	OK
NSLE - 2	21	I[22]	18.1	0.7	0.1	0.30	1.21	-1.21	-30.71	2.06	OK
NSLE - 2	21	J[21]	17.2	0.3	3.8	0.30	1.15	-1.14	-30.71	2.06	OK
NSLE - 2	22	I[23]	17.2	0.3	3.8	0.30	1.15	-1.14	-30.71	2.06	OK
NSLE - 2	22	J[22]	18.1	0.7	0.1	0.30	1.21	-1.21	-30.71	2.06	OK
NSLE - 2	23	I[24]	14.4	-1.8	7.3	0.30	0.93	-0.97	-30.71	2.06	OK
NSLE - 2	23	J[23]	17.2	-0.6	3.8	0.30	1.14	-1.15	-30.71	2.06	OK
NSLE - 2	24	I[25]	10.3	-5.3	9.9	0.30	0.57	-0.70	-30.71	2.06	OK
NSLE - 2	24	J[24]	14.4	-3.3	6.8	0.30	0.92	-0.97	-30.71	2.06	OK
NSLE - 2	25	I[26]	5.3	-9.9	11.2	0.30	0.30	-0.39	-30.71	2.06	OK
NSLE - 2	25	J[25]	10.3	-7.3	8.6	0.30	0.56	-0.71	-30.71	2.06	OK
NSLE - 2	26	I[27]	0.4	-15.3	10.9	0.30	-0.02	-0.08	-30.71	2.06	OK
NSLE - 2	26	J[26]	5.3	-12.1	8.8	0.30	0.29	-0.39	-30.71	2.06	OK
NSLE - 2	27	I[28]	-3.8	-20.5	9.2	0.30	-0.32	0.19	-30.71	2.06	OK
NSLE - 2	27	J[27]	0.4	-17.0	7.8	0.30	-0.03	-0.08	-30.71	2.06	OK
NSLE - 2	28	I[29]	-7.1	-25.3	7.1	0.30	-0.56	0.39	-30.71	2.06	OK
NSLE - 2	28	J[28]	-3.8	-21.6	6.2	0.30	-0.33	0.18	-30.71	2.06	OK
NSLE - 2	29	I[30]	-8.9	-29.7	3.7	0.30	-0.69	0.50	-30.71	2.06	OK
NSLE - 2	29	J[29]	-7.1	-26.0	3.4	0.30	-0.56	0.39	-30.71	2.06	OK
NSLE - 2	30	I[31]	-8.6	-34.3	0.8	0.35	-0.52	0.32	-30.71	2.06	OK
NSLE - 2	30	J[30]	-8.9	-30.0	0.6	0.35	-0.52	0.35	-30.71	2.06	OK
NSLE - 2	31	I[32]	-7.0	-37.7	4.6	0.40	-0.36	0.17	-30.71	2.06	OK
NSLE - 2	31	J[31]	-8.6	-34.0	4.0	0.40	-0.41	0.24	-30.71	2.06	OK
NSLE - 2	32	I[33]	-2.5	-38.5	14.6	0.45	-0.16	-0.01	-30.71	2.06	OK
NSLE - 2	32	J[32]	-7.0	-35.2	12.9	0.45	-0.28	0.13	-30.71	2.06	OK
NSLE - 2	33	I[34]	3.4	-39.7	19.1	0.50	0.00	-0.16	-30.71	2.06	OK
NSLE - 2	33	J[33]	-2.5	-36.3	16.9	0.50	-0.13	-0.01	-30.71	2.06	OK
NSLE - 2	34	I[35]	9.0	-42.8	17.9	0.40	0.23	-0.44	-30.71	2.06	OK
NSLE - 2	34	J[34]	3.4	-40.1	16.1	0.40	0.03	-0.23	-30.71	2.06	OK
NSLE - 2	35	I[1]	11.4	-42.0	20.9	0.30	0.62	-0.90	-30.71	2.06	OK
NSLE - 2	35	J[35]	9.0	-41.3	20.4	0.30	0.46	-0.74	-30.71	2.06	OK

σ _{c, max}	-1.21
σ _{t, max}	1.21

A.5.4.15. Load combination SLE 5 Block analysis

Beam Diagram_Fx - Block analysis / ST_NSLE - 5

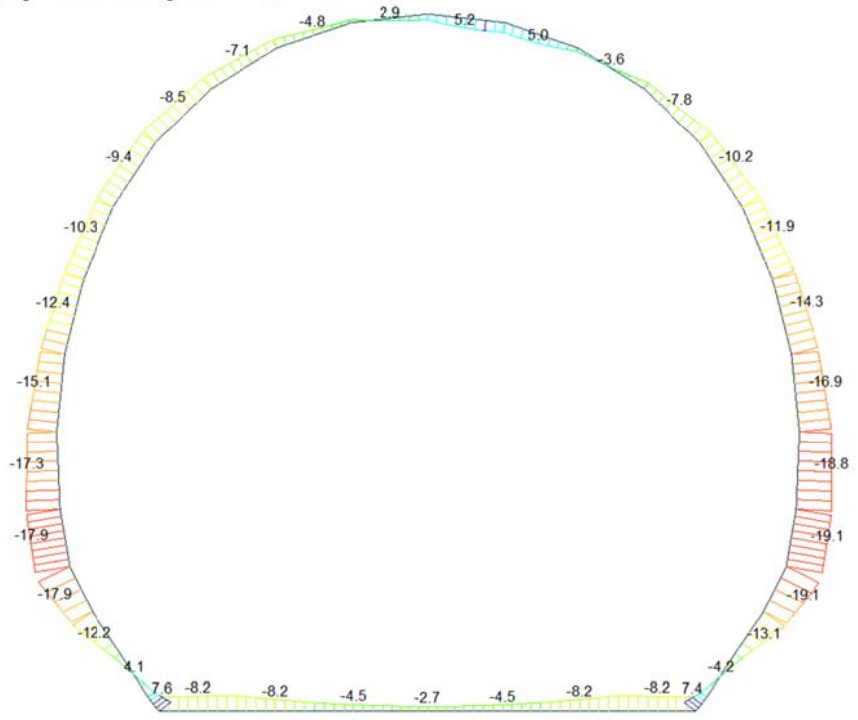


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: NSLE - 5
MAX : 4
MIN : 9
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_NSLE - 5



VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R_{ck} [N/mm ²]	37.00	F_{ck} [N/mm ²]	30.71	$f_{ctk0.05}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.00	α_{cc}	1.00	α_{ct}	1.00	φ	0.80
f_{cd} [N/mm ²]	30.71	f_{ctd} [N/mm ²]	2.059	E_{φ} [N/mm ²]	26'400		

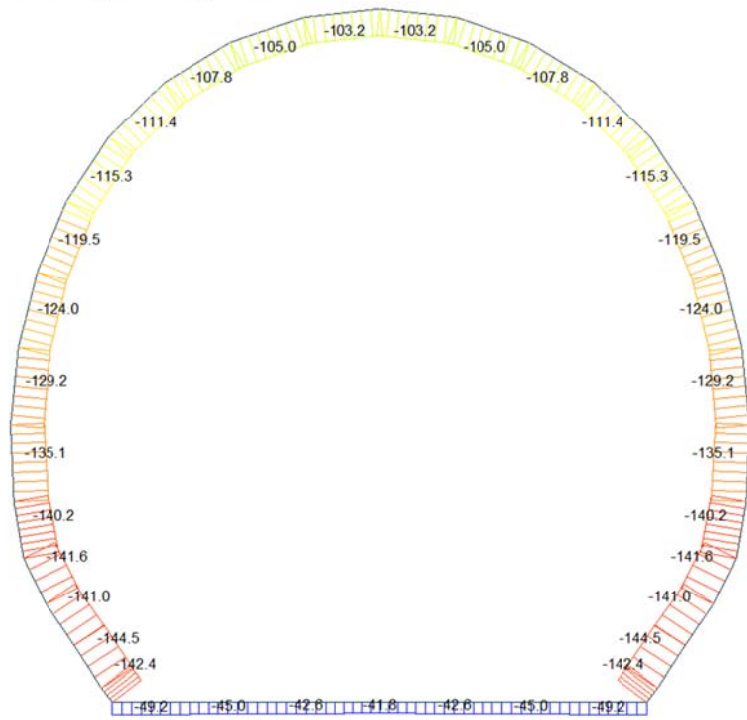
VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ_{sup} [N/mm ²]	σ_{inf} [N/mm ²]	f_{cd} [N/mm ²]	f_{ctd} [N/mm ²]	
NSLE - 5	1	I[1]	-7.6	-26.1	0.8	0.30	-0.60	0.42	-30.71	2.06	OK
NSLE - 5	1	J[2]	-8.2	-26.1	2.9	0.30	-0.63	0.46	-30.71	2.06	OK
NSLE - 5	2	I[2]	-8.2	-23.8	9.2	0.30	-0.62	0.47	-30.71	2.06	OK
NSLE - 5	2	J[3]	-4.5	-23.8	5.5	0.30	-0.38	0.22	-30.71	2.06	OK
NSLE - 5	3	I[3]	-4.5	-22.5	5.5	0.30	-0.37	0.23	-30.71	2.06	OK
NSLE - 5	3	J[4]	-2.7	-22.5	1.7	0.30	-0.25	0.11	-30.71	2.06	OK
NSLE - 5	4	I[4]	-2.7	-22.0	1.7	0.30	-0.25	0.11	-30.71	2.06	OK
NSLE - 5	4	J[5]	-2.7	-22.0	1.7	0.30	-0.25	0.11	-30.71	2.06	OK
NSLE - 5	5	I[5]	-2.7	-22.3	1.7	0.30	-0.25	0.11	-30.71	2.06	OK
NSLE - 5	5	J[6]	-4.5	-22.3	5.5	0.30	-0.37	0.23	-30.71	2.06	OK
NSLE - 5	6	I[6]	-4.5	-23.5	5.5	0.30	-0.38	0.22	-30.71	2.06	OK
NSLE - 5	6	J[7]	-8.2	-23.5	9.2	0.30	-0.62	0.47	-30.71	2.06	OK
NSLE - 5	7	I[7]	-8.2	-25.6	3.3	0.30	-0.63	0.46	-30.71	2.06	OK
NSLE - 5	7	J[8]	-7.4	-25.6	0.4	0.30	-0.58	0.41	-30.71	2.06	OK
NSLE - 5	8	I[9]	3.8	-87.8	31.3	0.30	-0.04	-0.54	-30.71	2.06	OK
NSLE - 5	8	J[8]	7.4	-88.5	31.8	0.30	-0.20	-0.79	-30.71	2.06	OK
NSLE - 5	9	I[10]	-4.3	-87.3	23.6	0.40	-0.38	-0.06	-30.71	2.06	OK
NSLE - 5	9	J[9]	3.8	-90.1	25.4	0.40	-0.08	-0.37	-30.71	2.06	OK
NSLE - 5	10	I[11]	-13.2	-83.4	26.2	0.50	-0.48	0.15	-30.71	2.06	OK
NSLE - 5	10	J[10]	-4.3	-86.8	28.4	0.50	-0.28	-0.07	-30.71	2.06	OK
NSLE - 5	11	I[12]	-19.1	-83.2	17.4	0.45	-0.75	0.38	-30.71	2.06	OK
NSLE - 5	11	J[11]	-13.2	-86.5	19.0	0.45	-0.58	0.20	-30.71	2.06	OK
NSLE - 5	12	I[13]	-18.8	-81.9	1.3	0.40	-0.91	0.50	-30.71	2.06	OK
NSLE - 5	12	J[12]	-19.1	-85.6	0.7	0.40	-0.93	0.50	-30.71	2.06	OK
NSLE - 5	13	I[14]	-16.9	-77.1	3.9	0.35	-1.05	0.61	-30.71	2.06	OK
NSLE - 5	13	J[13]	-18.8	-81.5	3.7	0.35	-1.15	0.69	-30.71	2.06	OK
NSLE - 5	14	I[15]	-14.3	-72.7	5.0	0.30	-1.20	0.71	-30.71	2.06	OK
NSLE - 5	14	J[14]	-16.9	-76.5	5.4	0.30	-1.38	0.87	-30.71	2.06	OK
NSLE - 5	15	I[16]	-11.9	-68.4	4.3	0.30	-1.02	0.57	-30.71	2.06	OK
NSLE - 5	15	J[15]	-14.3	-72.0	5.2	0.30	-1.19	0.71	-30.71	2.06	OK
NSLE - 5	16	I[17]	-10.2	-64.3	2.7	0.30	-0.90	0.47	-30.71	2.06	OK
NSLE - 5	16	J[16]	-11.9	-67.8	4.1	0.30	-1.02	0.57	-30.71	2.06	OK
NSLE - 5	17	I[18]	-7.8	-60.3	3.9	0.30	-0.72	0.32	-30.71	2.06	OK
NSLE - 5	17	J[17]	-10.2	-63.5	6.0	0.30	-0.89	0.47	-30.71	2.06	OK
NSLE - 5	18	I[19]	-3.6	-56.2	7.0	0.30	-0.43	0.05	-30.71	2.06	OK
NSLE - 5	18	J[18]	-7.8	-58.8	9.7	0.30	-0.71	0.32	-30.71	2.06	OK
NSLE - 5	19	I[20]	1.8	-52.0	6.3	0.30	-0.05	-0.29	-30.71	2.06	OK
NSLE - 5	19	J[19]	-3.6	-53.9	13.8	0.30	-0.42	0.06	-30.71	2.06	OK
NSLE - 5	20	I[21]	4.9	-48.6	2.8	0.30	0.17	-0.49	-30.71	2.06	OK
NSLE - 5	20	J[20]	1.8	-49.8	13.9	0.30	-0.05	-0.29	-30.71	2.06	OK
NSLE - 5	21	I[22]	2.9	-47.9	11.6	0.30	0.04	-0.36	-30.71	2.06	OK
NSLE - 5	21	J[21]	4.9	-48.3	5.2	0.30	0.17	-0.49	-30.71	2.06	OK
NSLE - 5	22	I[23]	-1.4	-50.0	12.0	0.30	-0.26	-0.07	-30.71	2.06	OK
NSLE - 5	22	J[22]	2.9	-49.6	3.9	0.30	0.03	-0.36	-30.71	2.06	OK
NSLE - 5	23	I[24]	-4.8	-53.1	8.6	0.30	-0.52	0.14	-30.71	2.06	OK
NSLE - 5	23	J[23]	-1.4	-51.9	5.1	0.30	-0.26	-0.08	-30.71	2.06	OK
NSLE - 5	24	I[25]	-7.1	-56.3	6.1	0.30	-0.75	0.28	-30.71	2.06	OK
NSLE - 5	24	J[24]	-4.8	-54.4	2.9	0.30	-0.53	0.14	-30.71	2.06	OK
NSLE - 5	25	I[26]	-8.6	-59.8	4.3	0.30	-0.79	0.37	-30.71	2.06	OK
NSLE - 5	25	J[25]	-7.1	-57.2	1.6	0.30	-0.76	0.28	-30.71	2.06	OK
NSLE - 5	26	I[27]	-9.4	-63.5	2.7	0.30	-0.84	0.41	-30.71	2.06	OK
NSLE - 5	26	J[26]	-8.6	-60.3	0.7	0.30	-0.80	0.37	-30.71	2.06	OK
NSLE - 5	27	I[28]	-10.3	-67.3	2.6	0.30	-0.91	0.46	-30.71	2.06	OK
NSLE - 5	27	J[27]	-9.4	-63.8	1.1	0.30	-0.84	0.41	-30.71	2.06	OK
NSLE - 5	28	I[29]	-12.4	-71.4	4.7	0.30	-1.07	0.59	-30.71	2.06	OK
NSLE - 5	28	J[28]	-10.3	-67.8	3.8	0.30	-0.91	0.46	-30.71	2.06	OK
NSLE - 5	29	I[30]	-15.1	-75.8	5.6	0.30	-1.26	0.75	-30.71	2.06	OK
NSLE - 5	29	J[29]	-12.4	-72.1	5.2	0.30	-1.07	0.59	-30.71	2.06	OK
NSLE - 5	30	I[31]	-17.3	-80.9	4.2	0.35	-1.08	0.61	-30.71	2.06	OK
NSLE - 5	30	J[30]	-15.1	-76.6	4.4	0.35	-0.96	0.52	-30.71	2.06	OK
NSLE - 5	31	I[32]	-17.9	-85.1	1.4	0.40	-0.88	0.46	-30.71	2.06	OK
NSLE - 5	31	J[31]	-17.3	-81.4	2.0	0.40	-0.85	0.44	-30.71	2.06	OK
NSLE - 5	32	I[33]	-12.2	-86.3	18.1	0.45	-0.55	0.17	-30.71	2.06	OK
NSLE - 5	32	J[32]	-17.9	-82.9	16.5	0.45	-0.71	0.35	-30.71	2.06	OK
NSLE - 5	33	I[34]	-3.6	-86.6	27.5	0.50	-0.26	-0.09	-30.71	2.06	OK
NSLE - 5	33	J[33]	-12.2	-83.3	25.2	0.50	-0.46	0.13	-30.71	2.06	OK
NSLE - 5	34	I[35]	4.1	-89.9	24.4	0.40	-0.07	-0.38	-30.71	2.06	OK
NSLE - 5	34	J[34]	-3.6	-87.2	22.7	0.40	-0.35	-0.08	-30.71	2.06	OK
NSLE - 5	35	I[1]	7.6	-88.4	30.9	0.30	0.21	-0.80	-30.71	2.06	OK
NSLE - 5	35	J[35]	4.1	-87.7	30.3	0.30	-0.02	-0.56	-30.71	2.06	OK

$\sigma_{c, max}$	-1.38
$\sigma_{t, max}$	0.87

A.5.4.16. Load combination SLE 5 FEM analysis

Beam Diagram_Fx - FEM analysis / ST_NSLE - 5

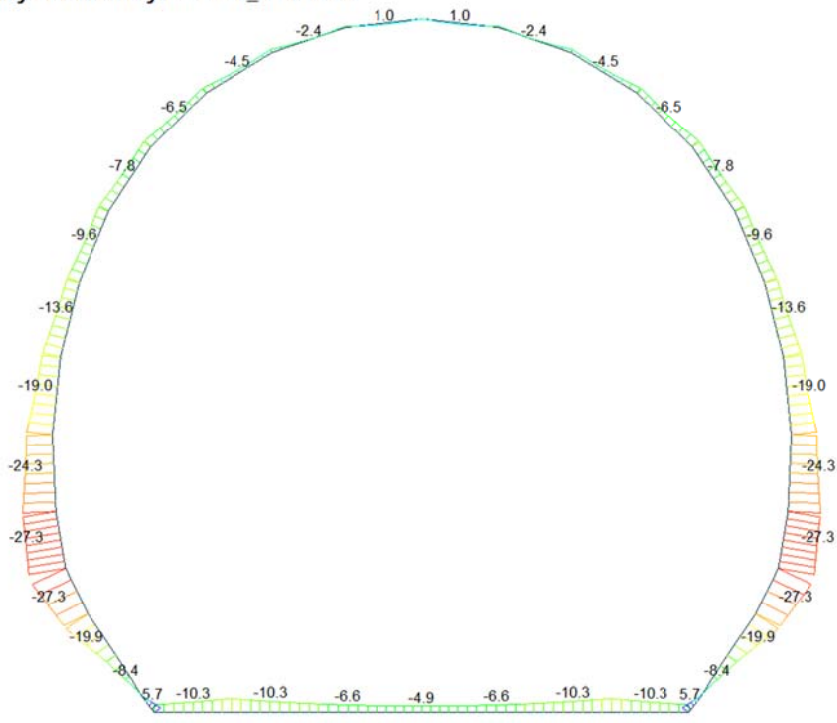


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: NSLE - 5
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_NSLE - 5



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

ST: NSLE - 5
MAX : 8
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R_{ck} [N/mm ²]	37.00	F_{ck} [N/mm ²]	30.71	$f_{ctk0.05}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.00	α_{cc}	1.00	α_{ct}	1.00	φ	0.80
f_{cd} [N/mm ²]	30.71	f_{ctd} [N/mm ²]	2.059	E_{φ} [N/mm ²]	26'400		

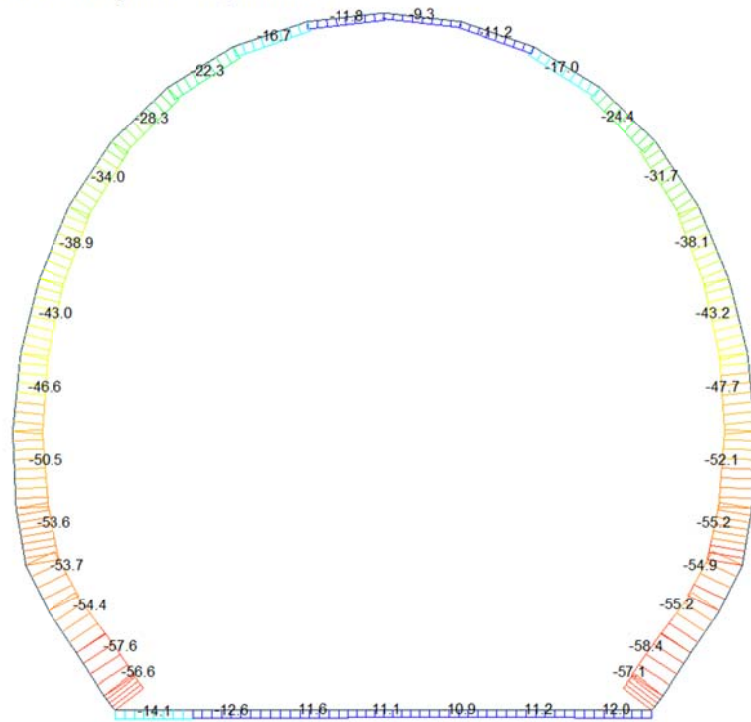
VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ_{sup} [N/mm ²]	σ_{inf} [N/mm ²]	f_{cd} [N/mm ²]	f_{ctd} [N/mm ²]	
NSLE - 5	1	I[1]	-5.7	-49.2	7.4	0.60	-0.18	0.01	-30.71	2.06	OK
NSLE - 5	1	J[2]	-10.3	-49.2	11.1	0.60	-0.25	0.09	-30.71	2.06	OK
NSLE - 5	2	I[2]	-10.3	-45.0	9.2	0.60	-0.25	0.10	-30.71	2.06	OK
NSLE - 5	2	J[3]	-6.7	-45.0	5.5	0.60	-0.19	0.04	-30.71	2.06	OK
NSLE - 5	3	I[3]	-6.7	-42.6	5.5	0.60	-0.18	0.04	-30.71	2.06	OK
NSLE - 5	3	J[4]	-4.9	-42.6	1.7	0.60	-0.15	0.01	-30.71	2.06	OK
NSLE - 5	4	I[4]	-4.9	-41.8	1.7	0.60	-0.15	0.01	-30.71	2.06	OK
NSLE - 5	4	J[5]	-4.9	-41.8	1.7	0.60	-0.15	0.01	-30.71	2.06	OK
NSLE - 5	5	I[5]	-4.9	-42.6	1.7	0.60	-0.15	0.01	-30.71	2.06	OK
NSLE - 5	5	J[6]	-6.7	-42.6	5.5	0.60	-0.18	0.04	-30.71	2.06	OK
NSLE - 5	6	I[6]	-6.7	-45.0	5.5	0.60	-0.19	0.04	-30.71	2.06	OK
NSLE - 5	6	J[7]	-10.3	-45.0	9.2	0.60	-0.25	0.10	-30.71	2.06	OK
NSLE - 5	7	I[7]	-10.3	-49.2	11.1	0.60	-0.25	0.09	-30.71	2.06	OK
NSLE - 5	7	J[8]	-5.7	-49.2	7.4	0.60	-0.18	0.01	-30.71	2.06	OK
NSLE - 5	8	I[9]	1.1	-141.7	39.3	0.60	-0.22	-0.25	-30.71	2.06	OK
NSLE - 5	8	J[8]	5.7	-142.4	39.7	0.60	-0.14	-0.33	-30.71	2.06	OK
NSLE - 5	9	I[10]	-8.4	-141.7	28.8	0.60	-0.38	-0.10	-30.71	2.06	OK
NSLE - 5	9	J[9]	1.1	-144.5	29.4	0.60	-0.22	-0.26	-30.71	2.06	OK
NSLE - 5	10	I[11]	-19.9	-137.7	35.4	0.60	-0.56	0.10	-30.71	2.06	OK
NSLE - 5	10	J[10]	-8.4	-141.0	35.6	0.60	-0.37	-0.10	-30.71	2.06	OK
NSLE - 5	11	I[12]	-27.3	-138.3	23.1	0.60	-0.69	0.22	-30.71	2.06	OK
NSLE - 5	11	J[11]	-19.9	-141.6	21.6	0.60	-0.57	0.10	-30.71	2.06	OK
NSLE - 5	12	I[13]	-24.3	-136.5	5.8	0.60	-0.63	0.18	-30.71	2.06	OK
NSLE - 5	12	J[12]	-27.3	-140.2	9.9	0.60	-0.69	0.22	-30.71	2.06	OK
NSLE - 5	13	I[14]	-19.0	-130.8	6.7	0.55	-0.62	0.14	-30.71	2.06	OK
NSLE - 5	13	J[13]	-24.3	-135.1	14.3	0.55	-0.73	0.24	-30.71	2.06	OK
NSLE - 5	14	I[15]	-13.6	-125.4	5.9	0.55	-0.50	0.04	-30.71	2.06	OK
NSLE - 5	14	J[14]	-19.0	-129.2	15.5	0.55	-0.61	0.14	-30.71	2.06	OK
NSLE - 5	15	I[16]	-9.6	-120.4	2.2	0.57	-0.39	-0.03	-30.71	2.06	OK
NSLE - 5	15	J[15]	-13.6	-124.0	13.8	0.57	-0.47	0.03	-30.71	2.06	OK
NSLE - 5	16	I[17]	-7.8	-116.0	3.5	0.47	-0.46	-0.03	-30.71	2.06	OK
NSLE - 5	16	J[16]	-9.6	-119.5	10.2	0.47	-0.51	0.01	-30.71	2.06	OK
NSLE - 5	17	I[18]	-6.5	-112.2	5.3	0.40	-0.52	-0.04	-30.71	2.06	OK
NSLE - 5	17	J[17]	-7.8	-115.4	10.5	0.40	-0.58	0.01	-30.71	2.06	OK
NSLE - 5	18	I[19]	-4.5	-108.8	5.1	0.35	-0.53	-0.09	-30.71	2.06	OK
NSLE - 5	18	J[18]	-6.5	-111.4	12.8	0.35	-0.63	0.00	-30.71	2.06	OK
NSLE - 5	19	I[20]	-2.4	-105.9	5.9	0.30	-0.51	-0.19	-30.71	2.06	OK
NSLE - 5	19	J[19]	-4.5	-107.8	14.0	0.30	-0.66	-0.06	-30.71	2.06	OK
NSLE - 5	20	I[21]	-0.8	-103.8	7.7	0.30	-0.40	-0.30	-30.71	2.06	OK
NSLE - 5	20	J[20]	-2.4	-105.0	14.1	0.30	-0.51	-0.19	-30.71	2.06	OK
NSLE - 5	21	I[22]	-0.1	-102.8	10.5	0.30	-0.35	-0.34	-30.71	2.06	OK
NSLE - 5	21	J[21]	-0.8	-103.2	13.0	0.30	-0.39	-0.29	-30.71	2.06	OK
NSLE - 5	22	I[23]	-0.8	-103.2	13.0	0.30	-0.39	-0.29	-30.71	2.06	OK
NSLE - 5	22	J[22]	-0.1	-102.8	10.5	0.30	-0.35	-0.34	-30.71	2.06	OK
NSLE - 5	23	I[24]	-2.4	-105.0	14.1	0.30	-0.54	-0.19	-30.71	2.06	OK
NSLE - 5	23	J[23]	-0.8	-103.8	7.7	0.30	-0.40	-0.30	-30.71	2.06	OK
NSLE - 5	24	I[25]	-4.5	-107.8	14.0	0.30	-0.75	-0.06	-30.71	2.06	OK
NSLE - 5	24	J[24]	-2.4	-105.9	5.9	0.30	-0.54	-0.19	-30.71	2.06	OK
NSLE - 5	25	I[26]	-6.5	-111.4	12.8	0.30	-0.83	0.06	-30.71	2.06	OK
NSLE - 5	25	J[25]	-4.5	-108.8	5.1	0.30	-0.76	-0.06	-30.71	2.06	OK
NSLE - 5	26	I[27]	-7.8	-115.4	10.5	0.30	-0.91	0.14	-30.71	2.06	OK
NSLE - 5	26	J[26]	-6.5	-112.2	5.3	0.30	-0.83	0.06	-30.71	2.06	OK
NSLE - 5	27	I[28]	-9.6	-119.5	10.2	0.30	-1.04	0.24	-30.71	2.06	OK
NSLE - 5	27	J[27]	-7.8	-116.0	3.5	0.30	-0.91	0.14	-30.71	2.06	OK
NSLE - 5	28	I[29]	-13.6	-124.0	13.8	0.30	-1.32	0.49	-30.71	2.06	OK
NSLE - 5	28	J[28]	-9.6	-120.4	2.2	0.30	-1.04	0.24	-30.71	2.06	OK
NSLE - 5	29	I[30]	-19.0	-129.2	15.5	0.30	-1.70	0.84	-30.71	2.06	OK
NSLE - 5	29	J[29]	-13.6	-125.4	5.9	0.30	-1.32	0.49	-30.71	2.06	OK
NSLE - 5	30	I[31]	-24.3	-135.1	14.3	0.30	-2.07	1.17	-30.71	2.06	OK
NSLE - 5	30	J[30]	-19.0	-130.8	6.7	0.30	-1.70	0.83	-30.71	2.06	OK
NSLE - 5	31	I[32]	-27.3	-140.2	9.9	0.30	-2.29	1.35	-30.71	2.06	OK
NSLE - 5	31	J[31]	-24.3	-136.5	5.8	0.30	-2.08	1.17	-30.71	2.06	OK
NSLE - 5	32	I[33]	-19.9	-141.6	21.6	0.30	-1.80	0.86	-30.71	2.06	OK
NSLE - 5	32	J[32]	-27.3	-138.3	23.1	0.30	-2.28	1.36	-30.71	2.06	OK
NSLE - 5	33	I[34]	-8.4	-141.0	35.6	0.30	-1.03	0.09	-30.71	2.06	OK
NSLE - 5	33	J[33]	-19.9	-137.7	35.4	0.30	-1.79	0.87	-30.71	2.06	OK
NSLE - 5	34	I[35]	1.1	-144.5	29.4	0.30	-0.41	-0.56	-30.71	2.06	OK
NSLE - 5	34	J[34]	-8.4	-141.7	28.8	0.30	-1.03	0.09	-30.71	2.06	OK
NSLE - 5	35	I[1]	5.7	-142.4	39.7	0.30	-0.09	-0.85	-30.71	2.06	OK
NSLE - 5	35	J[35]	1.1	-141.7	39.3	0.30	-0.40	-0.55	-30.71	2.06	OK

$\sigma_{c, max}$	-2.29
$\sigma_{t, max}$	1.36

A.5.4.17. Load combination SLE 6 Block analysis

Beam Diagram_Fx - Block analysis / ST_NSLE - 6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-8.86
-13.37
-17.88
-22.38
-26.89
-31.40
-35.90
-40.41
-44.92
-49.42
-53.93
-58.44

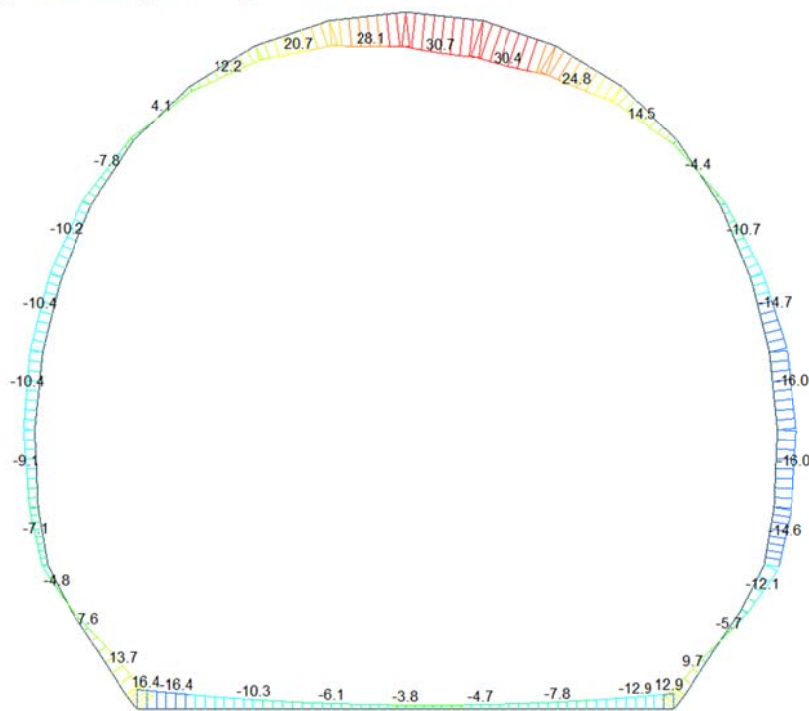
ST: NSLE - 6

MAX : 21
MIN : 9

FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - Block analysis / ST_NSLE - 6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

30.68
26.41
22.13
17.85
13.57
9.30
5.02
0.00
-3.54
-7.82
-12.09
-16.37

ST: NSLE - 6

MAX : 21
MIN : 1

FILE: FdE_C01-C0-
UNIT: kNm
DATE: 04/04/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R_{ck} [N/mm ²]	37.00	F_{ck} [N/mm ²]	30.71	$f_{ctk0.05}$ [N/mm ²]	2.06	E_{cm} [N/mm ²]	33'000
γ_c	1.00	α_{cc}	1.00	α_{ct}	1.00	ϕ	0.80
f_{ctd} [N/mm ²]	30.71	f_{ctd} [N/mm ²]	2.059	E_{ϕ} [N/mm ²]	26'400		

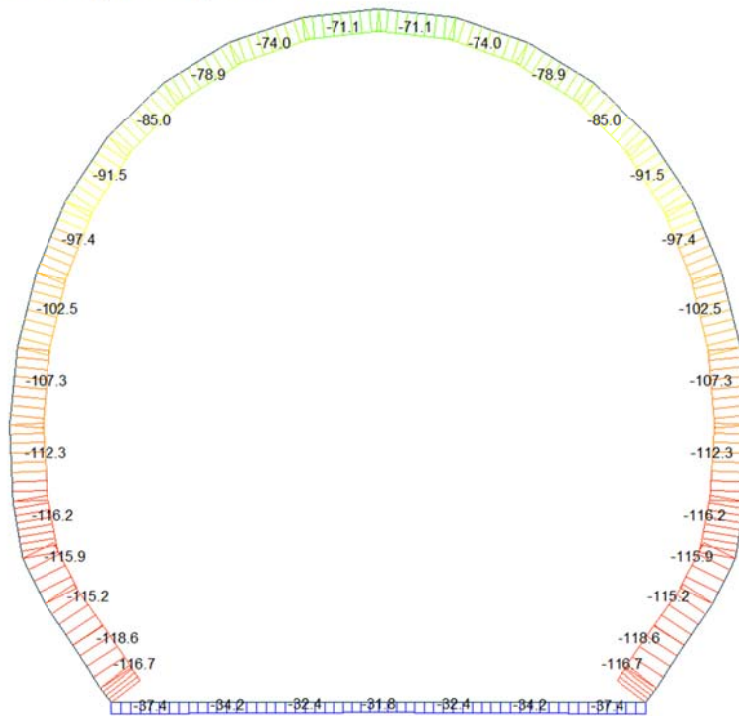
VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M_d [kN-m]	N_d [kN]	V_d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ_{sup} [N/mm ²]	σ_{inf} [N/mm ²]	f_{cd} [N/mm ²]	f_{ctd} [N/mm ²]	
NSLE - 6	1	I[1]	-16.4	-14.1	14.0	0.30	-1.14	1.04	-30.71	2.06	OK
NSLE - 6	1	J[2]	-10.3	-14.1	10.2	0.30	-0.73	0.64	-30.71	2.06	OK
NSLE - 6	2	I[2]	-10.3	-12.6	10.2	0.30	-0.73	0.65	-30.71	2.06	OK
NSLE - 6	2	J[3]	-6.1	-12.6	6.5	0.30	-0.45	0.37	-30.71	2.06	OK
NSLE - 6	3	I[3]	-6.1	-11.6	6.5	0.30	-0.45	0.37	-30.71	2.06	OK
NSLE - 6	3	J[4]	-3.8	-11.6	2.7	0.30	-0.29	0.22	-30.71	2.06	OK
NSLE - 6	4	I[4]	-3.8	-11.1	2.7	0.30	-0.29	0.22	-30.71	2.06	OK
NSLE - 6	4	J[5]	-3.4	-11.1	0.7	0.30	-0.26	0.19	-30.71	2.06	OK
NSLE - 6	5	I[5]	-3.4	-11.0	0.7	0.30	-0.26	0.19	-30.71	2.06	OK
NSLE - 6	5	J[6]	-4.7	-11.0	4.5	0.30	-0.35	0.27	-30.71	2.06	OK
NSLE - 6	6	I[6]	-4.7	-11.3	4.5	0.30	-0.35	0.27	-30.71	2.06	OK
NSLE - 6	6	J[7]	-7.8	-11.3	8.2	0.30	-0.56	0.48	-30.71	2.06	OK
NSLE - 6	7	I[7]	-7.8	-12.0	8.2	0.30	-0.56	0.48	-30.71	2.06	OK
NSLE - 6	7	J[8]	-12.9	-12.0	12.0	0.30	-0.90	0.82	-30.71	2.06	OK
NSLE - 6	8	I[9]	9.7	-56.4	26.8	0.30	0.46	-0.84	-30.71	2.06	OK
NSLE - 6	8	J[8]	12.9	-57.1	27.3	0.30	0.67	-1.05	-30.71	2.06	OK
NSLE - 6	9	I[10]	2.4	-55.7	21.6	0.40	-0.05	-0.23	-30.71	2.06	OK
NSLE - 6	9	J[9]	9.7	-58.4	23.4	0.40	0.22	-0.51	-30.71	2.06	OK
NSLE - 6	10	I[11]	-5.7	-51.8	23.5	0.50	-0.24	0.03	-30.71	2.06	OK
NSLE - 6	10	J[10]	2.4	-55.2	25.8	0.50	-0.05	-0.17	-30.71	2.06	OK
NSLE - 6	11	I[12]	-12.1	-51.5	18.7	0.45	-0.47	0.24	-30.71	2.06	OK
NSLE - 6	11	J[11]	-5.7	-54.9	20.3	0.45	-0.29	0.05	-30.71	2.06	OK
NSLE - 6	12	I[13]	-14.6	-51.6	6.5	0.40	-0.68	0.42	-30.71	2.06	OK
NSLE - 6	12	J[12]	-12.1	-55.2	7.1	0.40	-0.59	0.31	-30.71	2.06	OK
NSLE - 6	13	I[14]	-16.0	-47.7	2.6	0.35	-0.92	0.65	-30.71	2.06	OK
NSLE - 6	13	J[13]	-14.6	-52.1	2.8	0.35	-0.86	0.57	-30.71	2.06	OK
NSLE - 6	14	I[15]	-14.7	-44.0	2.3	0.30	-1.13	0.84	-30.71	2.06	OK
NSLE - 6	14	J[14]	-16.0	-47.7	2.7	0.30	-1.22	0.90	-30.71	2.06	OK
NSLE - 6	15	I[16]	-10.7	-39.6	7.7	0.30	-0.84	0.58	-30.71	2.06	OK
NSLE - 6	15	J[15]	-14.7	-43.2	8.6	0.30	-1.13	0.84	-30.71	2.06	OK
NSLE - 6	16	I[17]	-4.4	-34.6	11.9	0.30	-0.41	0.18	-30.71	2.06	OK
NSLE - 6	16	J[16]	-10.7	-38.1	13.3	0.30	-0.84	0.58	-30.71	2.06	OK
NSLE - 6	17	I[18]	4.2	-28.6	16.2	0.30	0.18	-0.38	-30.71	2.06	OK
NSLE - 6	17	J[17]	-4.4	-31.7	18.2	0.30	-0.40	0.19	-30.71	2.06	OK
NSLE - 6	18	I[19]	14.5	-21.8	19.3	0.30	0.90	-1.04	-30.71	2.06	OK
NSLE - 6	18	J[18]	4.2	-24.4	22.0	0.30	0.20	-0.36	-30.71	2.06	OK
NSLE - 6	19	I[20]	24.8	-15.1	16.1	0.30	1.60	-1.70	-30.71	2.06	OK
NSLE - 6	19	J[19]	14.5	-17.1	23.6	0.30	0.91	-1.02	-30.71	2.06	OK
NSLE - 6	20	I[21]	30.5	-10.0	2.3	0.30	2.00	-2.06	-30.71	2.06	OK
NSLE - 6	20	J[20]	24.8	-11.2	19.0	0.30	1.61	-1.69	-30.71	2.06	OK
NSLE - 6	21	I[22]	28.1	-8.9	12.4	0.30	1.84	-1.90	-30.71	2.06	OK
NSLE - 6	21	J[21]	30.5	-9.3	4.5	0.30	2.00	-2.06	-30.71	2.06	OK
NSLE - 6	22	I[23]	20.7	-11.8	18.2	0.30	1.34	-1.42	-30.71	2.06	OK
NSLE - 6	22	J[22]	28.1	-11.4	10.1	0.30	1.84	-1.91	-30.71	2.06	OK
NSLE - 6	23	I[24]	12.2	-16.7	18.8	0.30	0.76	-0.87	-30.71	2.06	OK
NSLE - 6	23	J[23]	20.7	-15.5	15.2	0.30	1.33	-1.43	-30.71	2.06	OK
NSLE - 6	24	I[25]	4.1	-22.3	17.9	0.30	0.20	-0.35	-30.71	2.06	OK
NSLE - 6	24	J[24]	12.2	-20.4	14.7	0.30	0.74	-0.88	-30.71	2.06	OK
NSLE - 6	25	I[26]	-2.9	-28.3	15.3	0.30	-0.29	0.10	-30.71	2.06	OK
NSLE - 6	25	J[25]	4.1	-25.7	12.6	0.30	0.19	-0.36	-30.71	2.06	OK
NSLE - 6	26	I[27]	-7.8	-34.0	10.8	0.30	-0.63	0.40	-30.71	2.06	OK
NSLE - 6	26	J[26]	-2.9	-30.9	8.7	0.30	-0.30	0.09	-30.71	2.06	OK
NSLE - 6	27	I[28]	-10.2	-38.9	5.6	0.30	-0.81	0.55	-30.71	2.06	OK
NSLE - 6	27	J[27]	-7.8	-35.5	4.1	0.30	-0.64	0.40	-30.71	2.06	OK
NSLE - 6	28	I[29]	-10.4	-43.0	0.8	0.30	-0.83	0.55	-30.71	2.06	OK
NSLE - 6	28	J[28]	-10.2	-39.3	0.1	0.30	-0.81	0.55	-30.71	2.06	OK
NSLE - 6	29	I[30]	-9.2	-46.6	2.2	0.30	-0.77	0.45	-30.71	2.06	OK
NSLE - 6	29	J[29]	-10.4	-42.8	2.6	0.30	-0.83	0.55	-30.71	2.06	OK
NSLE - 6	30	I[31]	-7.1	-50.5	4.3	0.35	-0.49	0.20	-30.71	2.06	OK
NSLE - 6	30	J[30]	-9.2	-46.1	4.1	0.35	-0.58	0.32	-30.71	2.06	OK
NSLE - 6	31	I[32]	-4.8	-53.6	6.3	0.40	-0.31	0.05	-30.71	2.06	OK
NSLE - 6	31	J[31]	-7.1	-49.9	5.7	0.40	-0.39	0.14	-30.71	2.06	OK
NSLE - 6	32	I[33]	0.8	-53.7	17.8	0.45	-0.10	-0.14	-30.71	2.06	OK
NSLE - 6	32	J[32]	-4.8	-50.4	16.1	0.45	-0.25	0.03	-30.71	2.06	OK
NSLE - 6	33	I[34]	7.7	-54.4	22.3	0.50	0.07	-0.29	-30.71	2.06	OK
NSLE - 6	33	J[33]	0.8	-51.1	20.0	0.50	-0.08	-0.12	-30.71	2.06	OK
NSLE - 6	34	I[35]	13.7	-57.6	19.4	0.40	0.37	-0.66	-30.71	2.06	OK
NSLE - 6	34	J[34]	7.7	-54.9	17.6	0.40	0.15	-0.42	-30.71	2.06	OK
NSLE - 6	35	I[1]	16.4	-56.6	23.2	0.30	0.90	-1.28	-30.71	2.06	OK
NSLE - 6	35	J[35]	13.7	-55.9	22.7	0.30	0.73	-1.10	-30.71	2.06	OK

$\sigma_{c, max}$	-2.06
$\sigma_{t, max}$	2.00

A.5.4.18. Load combination SLE 6 FEM analysis

Beam Diagram_Fx - FEM analysis / ST_NSLE - 6

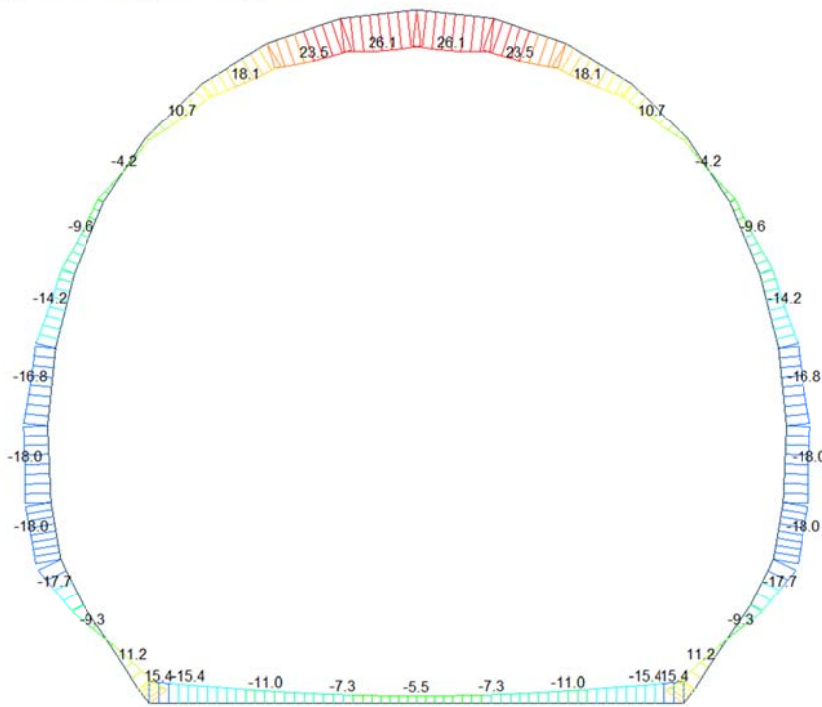


midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

ST: NSLE - 6
MAX : 4
MIN : 34
FILE: FdE_C01-C0-
UNIT: kN
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My - FEM analysis / ST_NSLE - 6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

ST: NSLE - 6
MAX : 21
MIN : 12
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 04/04/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

VERIFICA DELLE TENSIONI AMMISSIBILI

CALCESTRUZZO - DATI DI CALCOLO

R _{ck} [N/mm ²]	37.00	F _{ck} [N/mm ²]	30.71	f _{ctk0.05} [N/mm ²]	2.06	E _{cm} [N/mm ²]	33'000
γ _c	1.00	α _{cc}	1.00	α _{ct}	1.00	φ	0.80
f _{cd} [N/mm ²]	30.71	f _{ctd} [N/mm ²]	2.059	E _φ [N/mm ²]	26'400		

VERIFICA SEZIONI NON FESSURATE

Combinazione di carico	Elemento	Nodo	M _d [kN-m]	N _d [kN]	V _d [kN]	d [m]	Sollecitazioni interne		Tensioni ammissibili di progetto		Risultato verifica
							σ _{sup} [N/mm ²]	σ _{inf} [N/mm ²]	f _{cd} [N/mm ²]	f _{ctd} [N/mm ²]	
NSLE - 6	1	I[1]	-15.4	-37.4	10.8	0.60	-0.32	0.19	-30.71	2.06	OK
NSLE - 6	1	J[2]	-11.0	-37.4	7.0	0.60	-0.25	0.12	-30.71	2.06	OK
NSLE - 6	2	I[2]	-11.0	-34.2	9.2	0.60	-0.24	0.13	-30.71	2.06	OK
NSLE - 6	2	J[3]	-7.3	-34.2	5.5	0.60	-0.18	0.06	-30.71	2.06	OK
NSLE - 6	3	I[3]	-7.3	-32.4	5.5	0.60	-0.18	0.07	-30.71	2.06	OK
NSLE - 6	3	J[4]	-5.5	-32.4	1.7	0.60	-0.15	0.04	-30.71	2.06	OK
NSLE - 6	4	I[4]	-5.5	-31.8	1.7	0.60	-0.14	0.04	-30.71	2.06	OK
NSLE - 6	4	J[5]	-5.5	-31.8	1.7	0.60	-0.14	0.04	-30.71	2.06	OK
NSLE - 6	5	I[5]	-5.5	-32.4	1.7	0.60	-0.15	0.04	-30.71	2.06	OK
NSLE - 6	5	J[6]	-7.3	-32.4	5.5	0.60	-0.18	0.07	-30.71	2.06	OK
NSLE - 6	6	I[6]	-7.3	-34.2	5.5	0.60	-0.18	0.06	-30.71	2.06	OK
NSLE - 6	6	J[7]	-11.0	-34.2	9.2	0.60	-0.24	0.13	-30.71	2.06	OK
NSLE - 6	7	I[7]	-11.0	-37.4	7.0	0.60	-0.25	0.12	-30.71	2.06	OK
NSLE - 6	7	J[8]	-15.4	-37.4	10.8	0.60	-0.32	0.19	-30.71	2.06	OK
NSLE - 6	8	I[9]	11.2	-116.0	36.3	0.60	-0.01	-0.38	-30.71	2.06	OK
NSLE - 6	8	J[8]	15.4	-116.7	36.7	0.60	0.06	-0.45	-30.71	2.06	OK
NSLE - 6	9	I[10]	2.0	-115.9	28.0	0.60	-0.16	-0.23	-30.71	2.06	OK
NSLE - 6	9	J[9]	11.2	-118.6	28.6	0.60	-0.01	-0.38	-30.71	2.06	OK
NSLE - 6	10	I[11]	-9.3	-111.8	34.6	0.60	-0.34	-0.03	-30.71	2.06	OK
NSLE - 6	10	J[10]	2.0	-115.2	34.8	0.60	-0.16	-0.22	-30.71	2.06	OK
NSLE - 6	11	I[12]	-17.7	-112.6	26.3	0.60	-0.48	0.11	-30.71	2.06	OK
NSLE - 6	11	J[11]	-9.3	-115.9	24.8	0.60	-0.35	-0.04	-30.71	2.06	OK
NSLE - 6	12	I[13]	-18.0	-112.6	3.1	0.60	-0.49	0.11	-30.71	2.06	OK
NSLE - 6	12	J[12]	-17.7	-116.2	1.0	0.60	-0.49	0.10	-30.71	2.06	OK
NSLE - 6	13	I[14]	-16.9	-108.0	1.5	0.55	-0.53	0.14	-30.71	2.06	OK
NSLE - 6	13	J[13]	-18.0	-112.3	6.1	0.55	-0.56	0.15	-30.71	2.06	OK
NSLE - 6	14	I[15]	-14.2	-103.6	0.4	0.55	-0.47	0.09	-30.71	2.06	OK
NSLE - 6	14	J[14]	-16.9	-107.3	10.0	0.55	-0.53	0.14	-30.71	2.06	OK
NSLE - 6	15	I[16]	-9.6	-98.9	3.2	0.57	-0.35	0.00	-30.71	2.06	OK
NSLE - 6	15	J[15]	-14.2	-102.5	14.9	0.57	-0.44	0.08	-30.71	2.06	OK
NSLE - 6	16	I[17]	-4.2	-93.9	3.8	0.47	-0.31	-0.08	-30.71	2.06	OK
NSLE - 6	16	J[16]	-9.6	-97.4	17.5	0.47	-0.47	0.05	-30.71	2.06	OK
NSLE - 6	17	I[18]	2.7	-88.4	5.8	0.40	-0.12	-0.32	-30.71	2.06	OK
NSLE - 6	17	J[17]	-4.2	-91.5	21.6	0.40	-0.39	-0.07	-30.71	2.06	OK
NSLE - 6	18	I[19]	10.7	-82.4	7.0	0.35	0.29	-0.76	-30.71	2.06	OK
NSLE - 6	18	J[18]	2.7	-85.0	24.9	0.35	-0.11	-0.37	-30.71	2.06	OK
NSLE - 6	19	I[20]	18.1	-76.9	4.9	0.30	0.95	-1.46	-30.71	2.06	OK
NSLE - 6	19	J[19]	10.7	-78.9	24.8	0.30	0.45	-0.97	-30.71	2.06	OK
NSLE - 6	20	I[21]	23.5	-72.8	0.3	0.30	1.32	-1.81	-30.71	2.06	OK
NSLE - 6	20	J[20]	18.1	-74.0	21.5	0.30	0.96	-1.45	-30.71	2.06	OK
NSLE - 6	21	I[22]	25.5	-70.7	7.8	0.30	1.46	-1.93	-30.71	2.06	OK
NSLE - 6	21	J[21]	23.5	-71.1	15.6	0.30	1.33	-1.80	-30.71	2.06	OK
NSLE - 6	22	I[23]	23.5	-71.1	15.6	0.30	1.33	-1.80	-30.71	2.06	OK
NSLE - 6	22	J[22]	25.5	-70.7	7.8	0.30	1.46	-1.93	-30.71	2.06	OK
NSLE - 6	23	I[24]	18.1	-74.0	21.5	0.30	0.96	-1.45	-30.71	2.06	OK
NSLE - 6	23	J[23]	23.5	-72.8	0.3	0.30	1.32	-1.81	-30.71	2.06	OK
NSLE - 6	24	I[25]	10.7	-78.9	24.8	0.30	0.45	-0.97	-30.71	2.06	OK
NSLE - 6	24	J[24]	18.1	-76.9	4.9	0.30	0.95	-1.46	-30.71	2.06	OK
NSLE - 6	25	I[26]	2.7	-85.0	24.9	0.30	-0.11	-0.46	-30.71	2.06	OK
NSLE - 6	25	J[25]	10.7	-82.4	7.0	0.30	0.44	-0.99	-30.71	2.06	OK
NSLE - 6	26	I[27]	-4.2	-91.5	21.6	0.30	-0.59	-0.02	-30.71	2.06	OK
NSLE - 6	26	J[26]	2.7	-88.4	5.8	0.30	-0.12	-0.47	-30.71	2.06	OK
NSLE - 6	27	I[28]	-9.6	-97.4	17.5	0.30	-0.97	0.32	-30.71	2.06	OK
NSLE - 6	27	J[27]	-4.2	-93.9	3.8	0.30	-0.60	-0.03	-30.71	2.06	OK
NSLE - 6	28	I[29]	-14.2	-102.5	14.9	0.30	-1.29	0.60	-30.71	2.06	OK
NSLE - 6	28	J[28]	-9.6	-98.9	3.2	0.30	-0.97	0.31	-30.71	2.06	OK
NSLE - 6	29	I[30]	-16.9	-107.3	10.0	0.30	-1.48	0.77	-30.71	2.06	OK
NSLE - 6	29	J[29]	-14.2	-103.6	0.4	0.30	-1.29	0.60	-30.71	2.06	OK
NSLE - 6	30	I[31]	-18.0	-112.3	6.1	0.30	-1.58	0.83	-30.71	2.06	OK
NSLE - 6	30	J[30]	-16.9	-108.0	1.5	0.30	-1.48	0.76	-30.71	2.06	OK
NSLE - 6	31	I[32]	-17.7	-116.2	1.0	0.30	-1.57	0.79	-30.71	2.06	OK
NSLE - 6	31	J[31]	-18.0	-112.6	3.1	0.30	-1.58	0.83	-30.71	2.06	OK
NSLE - 6	32	I[33]	-9.3	-115.9	24.8	0.30	-1.01	0.23	-30.71	2.06	OK
NSLE - 6	32	J[32]	-17.7	-112.6	26.3	0.30	-1.55	0.80	-30.71	2.06	OK
NSLE - 6	33	I[34]	2.0	-115.2	34.8	0.30	-0.25	-0.51	-30.71	2.06	OK
NSLE - 6	33	J[33]	-9.3	-111.8	34.6	0.30	-0.99	0.25	-30.71	2.06	OK
NSLE - 6	34	I[35]	11.2	-118.6	28.6	0.30	0.35	-1.14	-30.71	2.06	OK
NSLE - 6	34	J[34]	2.0	-115.9	28.0	0.30	-0.26	-0.52	-30.71	2.06	OK
NSLE - 6	35	I[1]	15.4	-116.7	36.7	0.30	0.64	-1.42	-30.71	2.06	OK
NSLE - 6	35	J[35]	11.2	-116.0	36.3	0.30	0.36	-1.13	-30.71	2.06	OK

σ _{c, max}	-1.93
σ _{t, max}	1.46

ANHANG 7 - FEM- ANALYSE DER INNENSCHALE PROFILTYP T4

Die Anlage 7 führt die graphischen Darstellungen und die wichtigsten Outputs der Analysen der Innenschale des Profiltyps T4 auf, die mit dem Rechenprogramm MIDAS Gen im GZT und GZG durchgeführt wurden.

APPENDICE 7 - ANALISI FEM DEL RIVESTIMENTO DEFINITIVO PROFILO TIPO T4

L'appendice 6 contiene le rappresentazioni grafiche dei principali input e output dell'analisi del rivestimento definitivo per il profilo tipo T4 condotte con il programma MIDAS Gen, oltre alle opportune verifiche sezionali allo SLU e SLE.

A.6.1. General parameters of structure

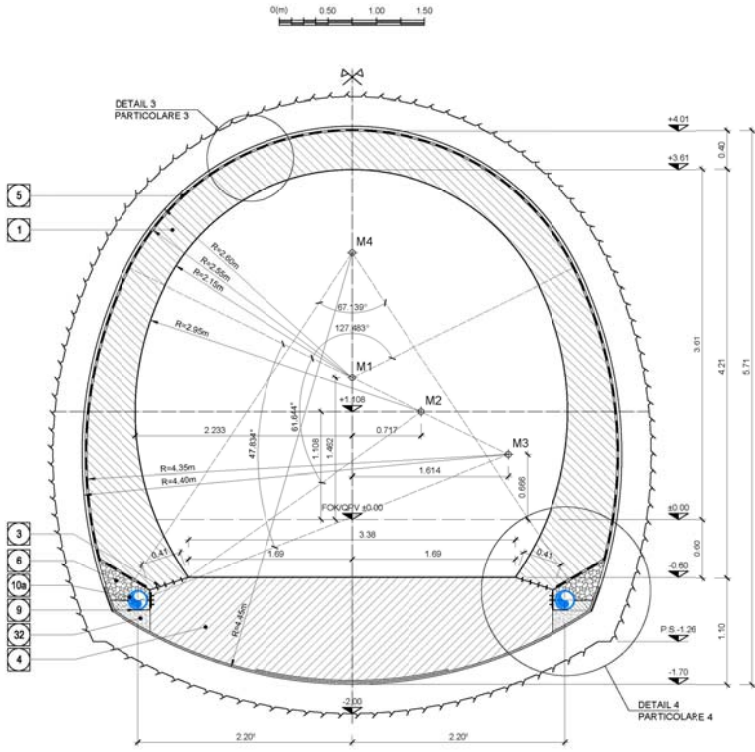


Figure 22 FdE-C01/06 /CT1 T4 cross section

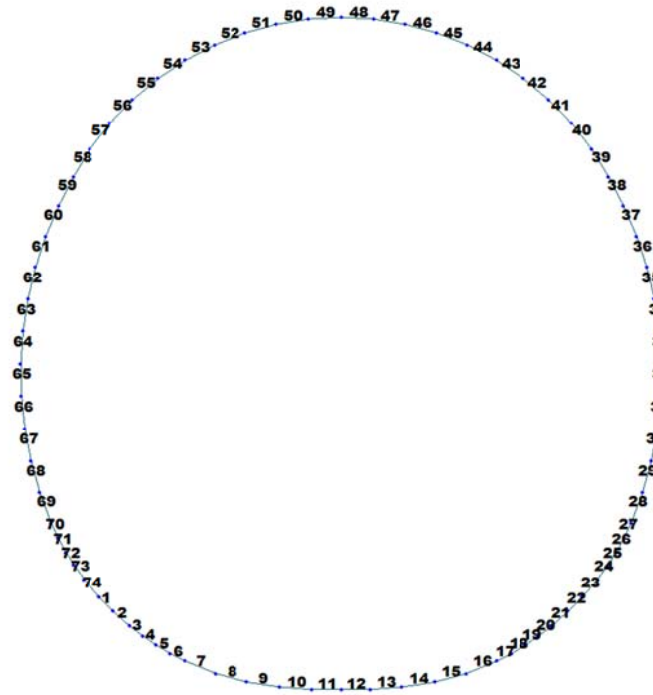


Figure 23 Elements numbering

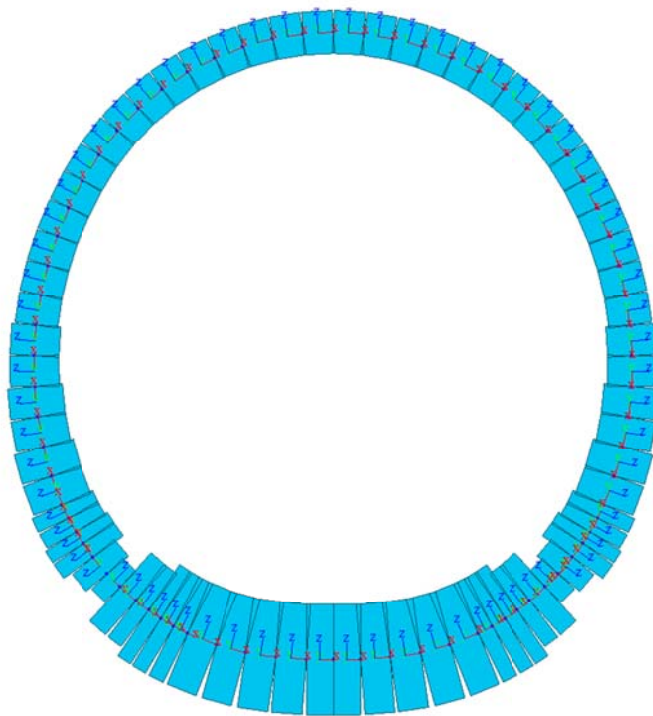


Figure 24 Element local axis

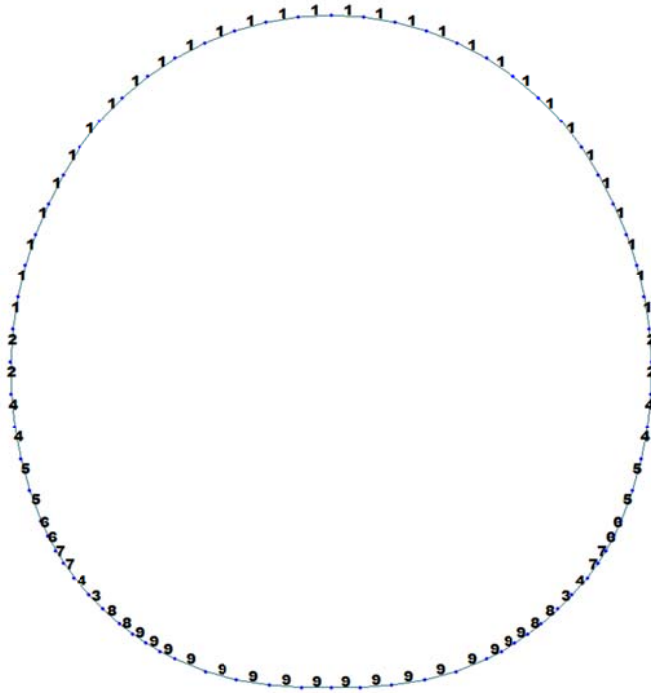


Figure 25 Element section property

Table 10 Section characteristic

ID	Name	Area (m ²)	Asy (m ²)	Asz (m ²)	Ixx (m ⁴)	Iyy (m ⁴)	Izz (m ⁴)	Cyp (m)	Cym (m)	Czp (m)	Czm (m)
1	100 x 35	0.3500	0.2917	0.2917	0.0111	0.0036	0.0292	0.5000	0.5000	0.1750	0.1750
2	100 x 40	0.4000	0.3333	0.3333	0.0160	0.0053	0.0333	0.5000	0.5000	0.2000	0.2000
3	100 x 36	0.3600	0.3000	0.3000	0.0120	0.0039	0.0300	0.5000	0.5000	0.1800	0.1800
4	100 x 45	0.4500	0.3750	0.3750	0.0218	0.0076	0.0375	0.5000	0.5000	0.2250	0.2250
5	100 x 50	0.5500	0.4583	0.4583	0.0364	0.0139	0.0458	0.5000	0.5000	0.2750	0.2750
6	100 x 55	0.5500	0.4583	0.4583	0.0364	0.0139	0.0458	0.5000	0.5000	0.2750	0.2750
7	100 x 60	0.6000	0.5000	0.5000	0.0451	0.0180	0.0500	0.5000	0.5000	0.3000	0.3000
8	100 x 70	0.7500	0.6250	0.6250	0.0759	0.0352	0.0625	0.5000	0.5000	0.3750	0.3750
9	100 x 90	0.9000	0.7500	0.7500	0.1128	0.0607	0.0750	0.5000	0.5000	0.4500	0.4500

Table 11 Material parameters

ID	Name	Type	Code	Elasticity (kN/m ²)	Poisson	Thermal (1/[F])	Density (kN/m ³)	Mass Density (kN/m ³ /g)
1	C30/37	Concrete	NTC2008	3.30e+007	0.2	1e-005	2.50e+001	2.5493e+0
2	B450C	Rebar steel	NTC2008	21.0e+007	0.2	0	7.85e+001	7.850 e+0

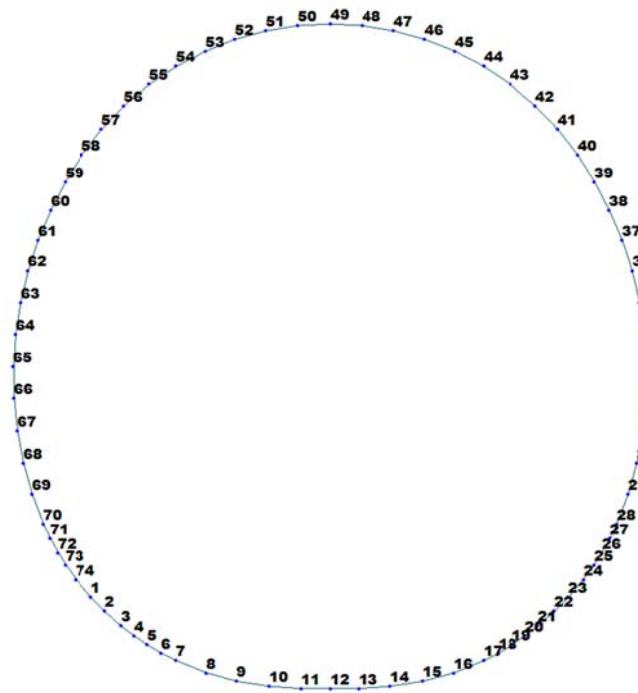


Figure 26 Node numbering

Table 12 Bounderies parameters

Node	Type	SDy (kN/m)	SDz (kN/m)	Stiffness (kN/m)	Direction	Multi-Linear Type	cx (m)	cy (kN)	dx (m)	dy (kN)	ex (m)	ey (kN)
1	Multi-Linear	0.00	0.00	0	Dz(-)	Unsymmetric	0.01	150	0.10	3800	0.20	7600
2	Multi-Linear	0.00	0.00	0	Dz(-)	Unsymmetric	0.01	150	0.10	3800	0.20	7600
3	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
3	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
4	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
4	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
5	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
5	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
6	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
6	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
7	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
7	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
8	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
8	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
9	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
9	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
10	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
10	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
11	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
11	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
12	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
12	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
13	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
13	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
14	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
14	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
15	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
15	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
16	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
16	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0
17	Linear	0.00	0.00	0	Dx(+)	Unsymmetric	0	0	0	0	0	0
17	Comp.-only	0.00	0.00	38000	Dz(-)	Unsymmetric	0	0	0	0	0	0

A.6.2. Load for T4 cross section (FdE-C01/06 / CT1 T4)

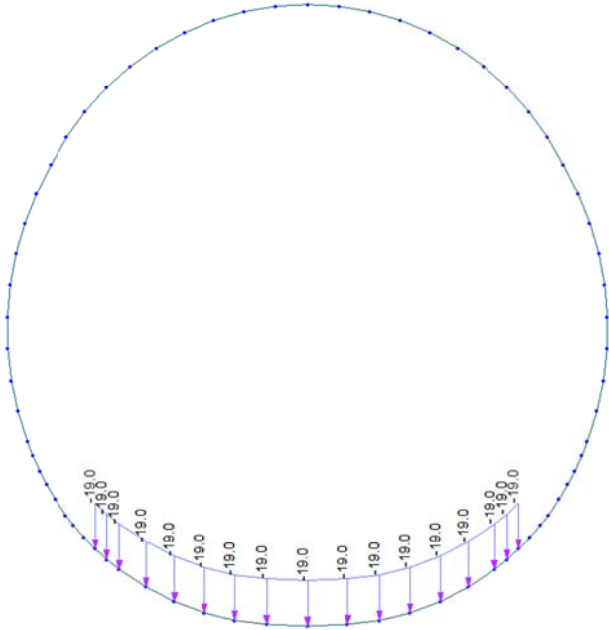


Figure 27 Load G3

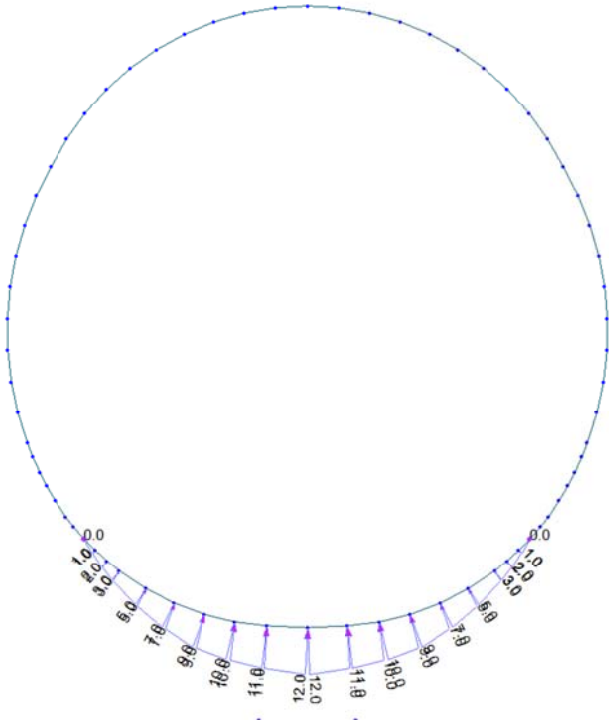


Figure 28 Load G4

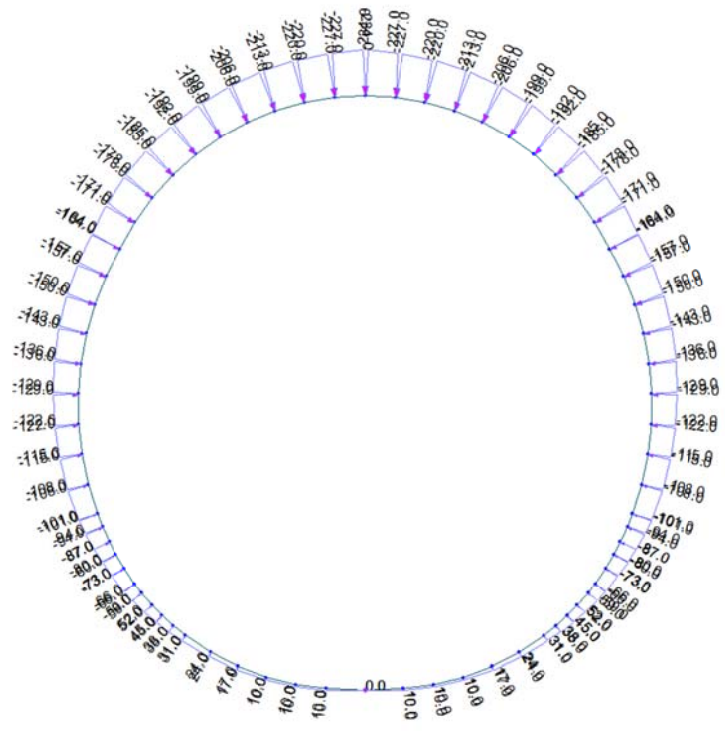


Figure 29 Load G5

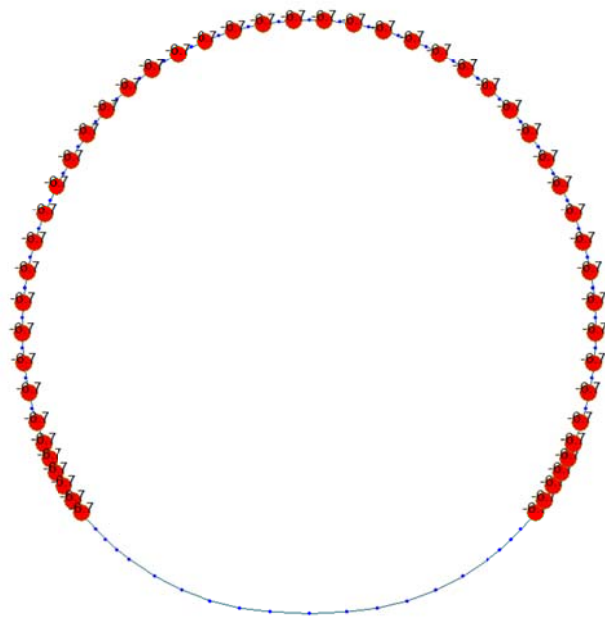


Figure 30 Load G6 SLU

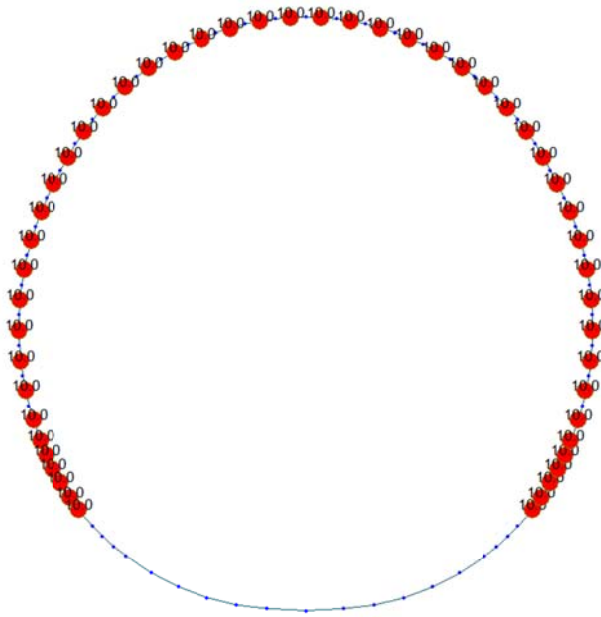


Figure 33 Q1 E (Constant temperature)

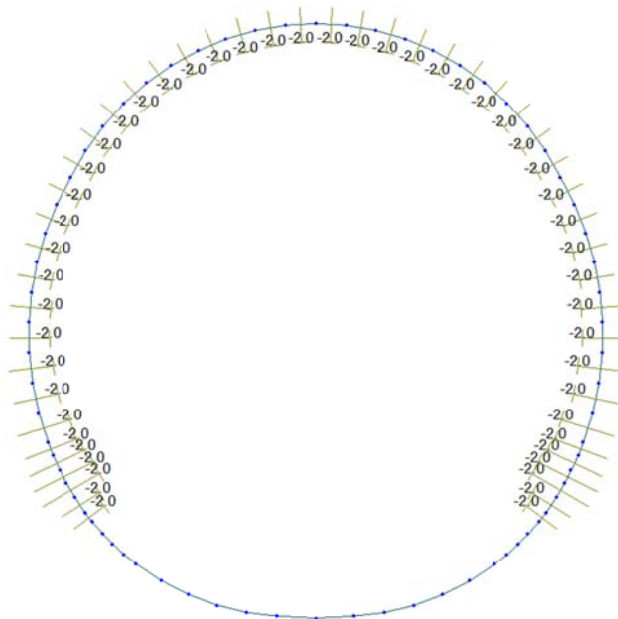


Figure 34 Load Q1 E (Temperature gradient)

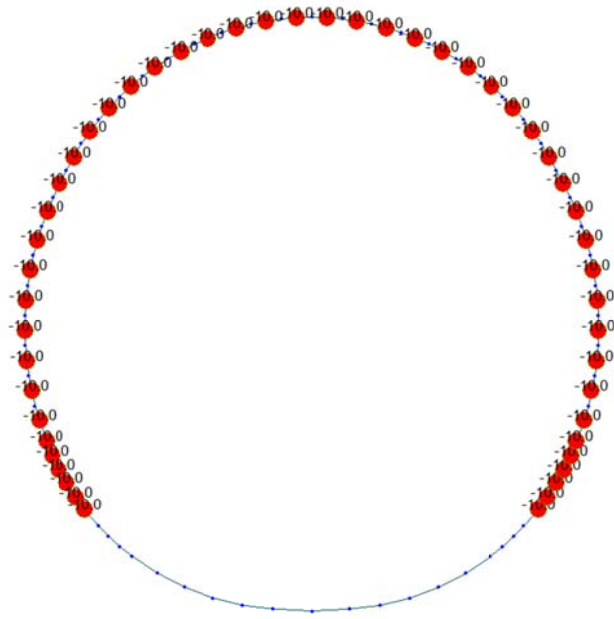


Figure 35 Load Q1 I (Costant temperature)

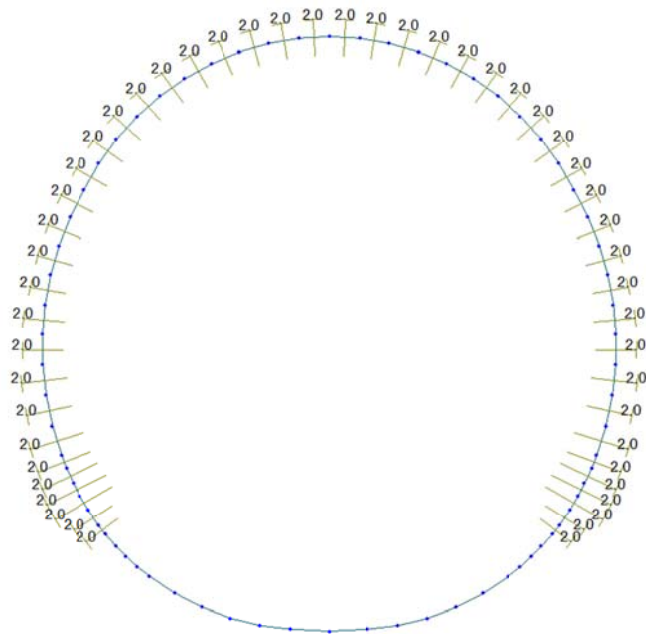


Figure 36 Load Q1 I (Temperature gradient)

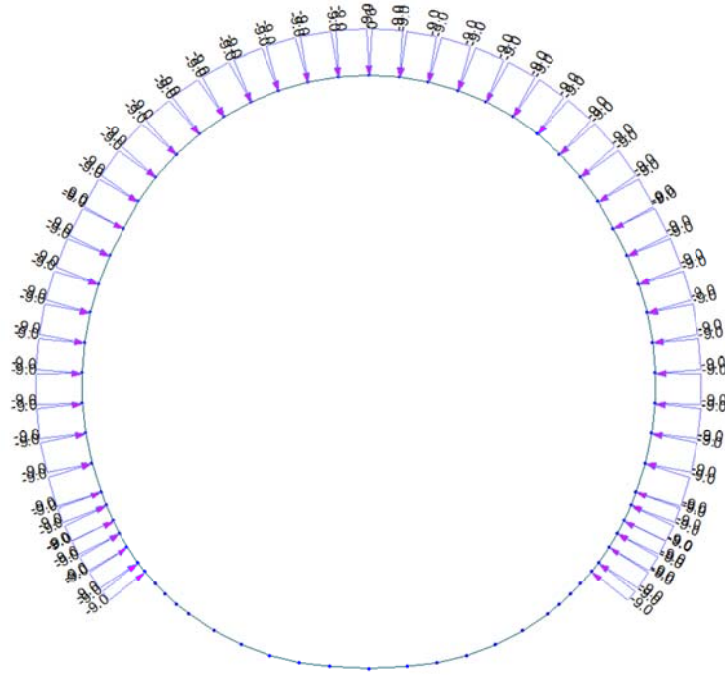


Figure 37 Load A1 aspiration

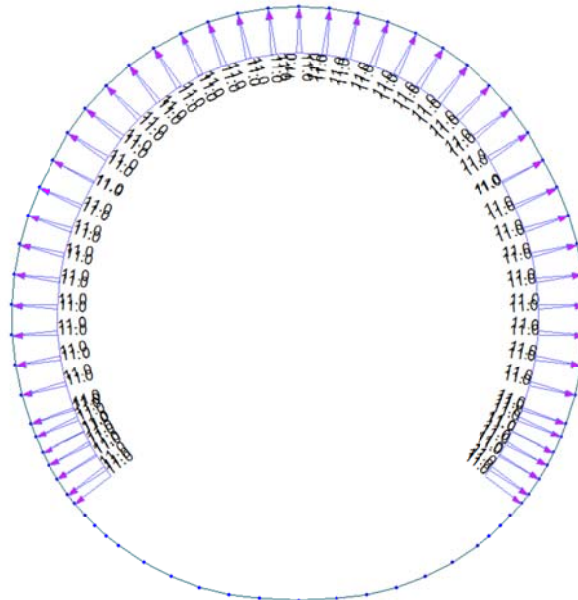


Figure 38 Load A1 pression

A.6.3. Load combinations

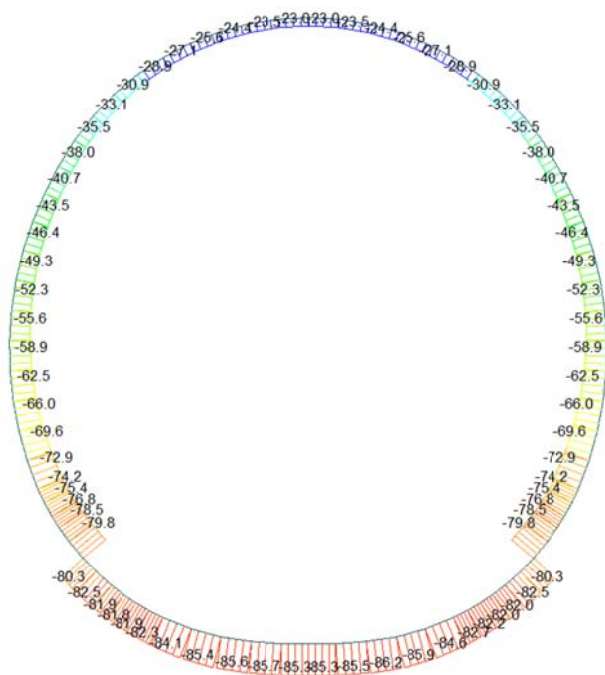
NUM	NAME	ACTIVE	TYPE	LOADCASE(FACTOR) +	LOADCASE(FACTOR) +	LOADCASE(FACTOR)
1	1	Inactive	Add	G1(1.350) +	Q1 - E(1.500)	
2	2	Inactive	Add	G1(1.350) +	G6 - SLU(1.000) +	Q1 - I(1.500)
3	3	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			Q1 - E(1.500)		
4	4	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G6 - SLU(1.000) +	Q1 - I(1.500)	
5	5	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G4(1.350) +	G5(1.350) +	Q1 - E(1.500)
6	6	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G4(1.350) +	G5(1.350) +	Q1 - I(1.500)
	+			G6 - SLU(1.000)		
7	7	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G4(1.350) +	G5(1.350) +	G7(1.350)
	+			Q1 - E(1.500)		
8	8	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G4(1.350) +	G5(1.350) +	G6 - SLU(1.000)
	+			G7(1.350) +	Q1 - I(1.500)	
9	9	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G7(1.350) +	Q1 - E(1.500)	
10	10	Inactive	Add	G1(1.350) +	G2(1.350) +	G3(1.000)
	+			G6 - SLU(1.000) +	G7(1.350) +	Q1 - I(1.500)
11	11	Inactive	Add	G1(1.000) +	G2(1.000) +	G3(1.000)
	+			Q1 - E(0.600) +	A1 - P(1.000)	
12	12	Inactive	Add	G1(1.000) +	G2(1.000) +	G3(1.000)
	+			G6 - SLU(1.000) +	Q1 - I(0.600) +	A1 - A(1.000)
13	21	Inactive	Add	G1(1.000) +	G2(1.000) +	G3(1.000)
	+			G4(1.000) +	G5(1.000) +	Q1 - E(0.600)
14	22	Inactive	Add	G1(1.000) +	G2(1.000) +	G3(1.000)
	+			G4(1.000) +	G5(1.000) +	G6 - SLU(1.000)
15	23	Inactive	Add	G1(1.000) +	G2(1.000) +	G3(1.000)
	+			G4(1.000) +	G5(1.000) +	G7(1.000)
	+			Q1 - E(0.600)		

16	24	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G4(1.000) +		G5(1.000) +	G6 - SLU(1.000)
		G7(1.000)			
17	SLE - 1	Inactive	Add		
		G1(1.000) +		Q1 - E(1.000)	
18	SLE - 2	Inactive	Add		
		G1(1.000) +		G6 - SLE(1.000) +	Q1 - I(1.000)
19	SLE - 3	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		Q1 - E(1.000)			
20	SLE - 4	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G6 - SLE(1.000) +		Q1 - I(1.000)	
21	SLE - 5	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G4(1.000) +		G5(1.000) +	Q1 - E(1.000)
22	SLE - 6	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G4(1.000) +		G5(1.000) +	G6 - SLE(1.000)
		Q1 - I(1.000)			
23	SLE - 7	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G4(1.000) +		G5(1.000) +	G7(1.000)
		Q1 - E(1.000)			
24	SLE - 8	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G4(1.000) +		G5(1.000) +	G6 - SLE(1.000)
		G7(1.000) +		Q1 - I(1.000)	
25	SLE - 9	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G7(1.000) +		Q1 - E(1.000)	
26	SLE - 10	Inactive	Add		
		G1(1.000) +		G2(1.000) +	G3(1.000)
		G6 - SLE(1.000) +		G7(1.000) +	Q1 - I(1.000)

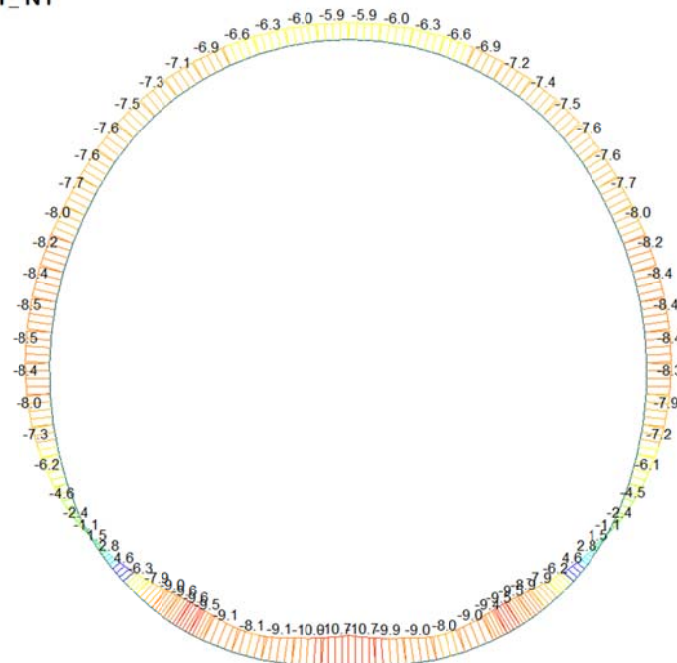
A.6.4. Output and check result for T4 cross section (FdE-C01/06 T4)

A.6.4.1. Load combination SLU 1

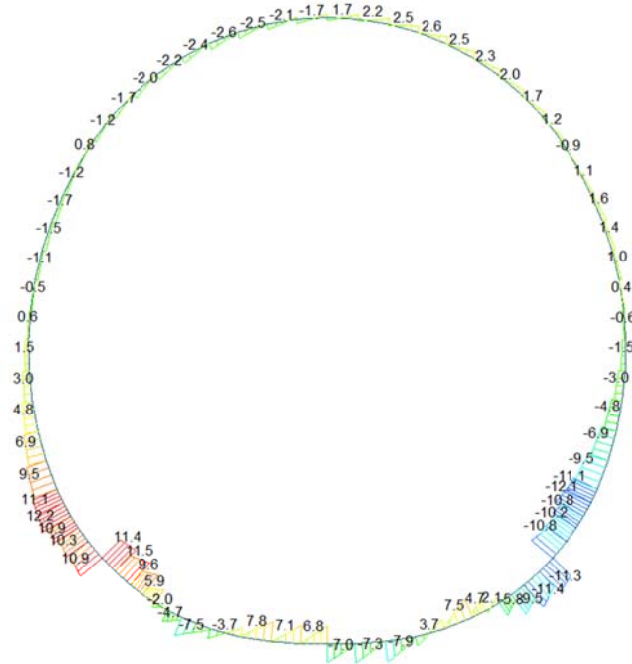
Beam Diagram_Fx / ST_N1



Beam Diagram_My / ST_N1

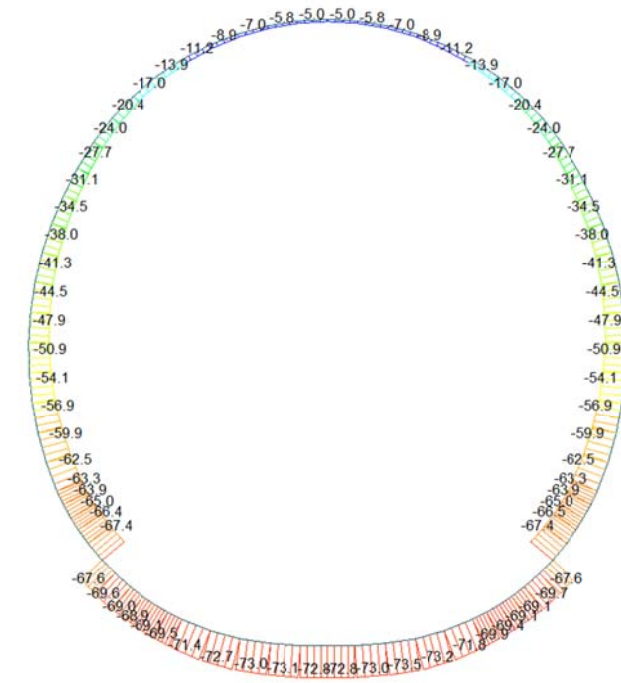


Beam Diagram_Fz / ST_N1

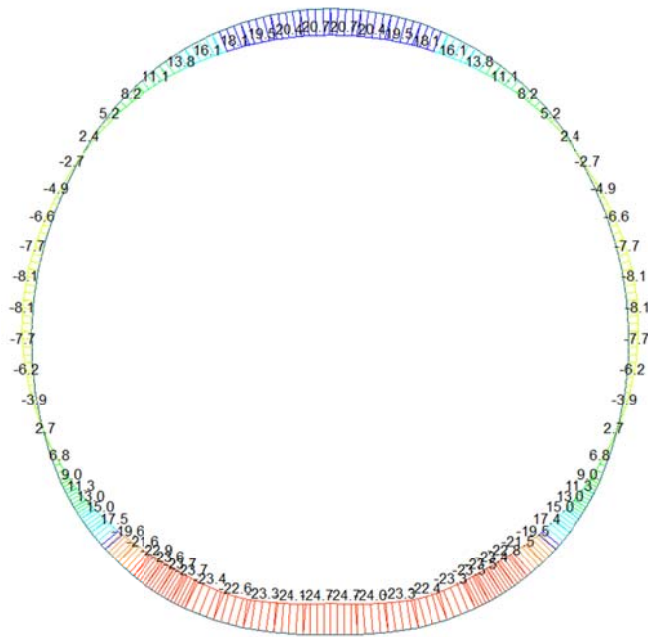


A.6.4.2. Load combination SLU 2

Beam Diagram_Fx / ST_N2



Beam Diagram_My / ST_N2



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

20.74
16.61
12.48
8.35
4.21
0.00
-4.05
-8.18
-12.31
-16.45
-20.58
-24.71

ST: N2

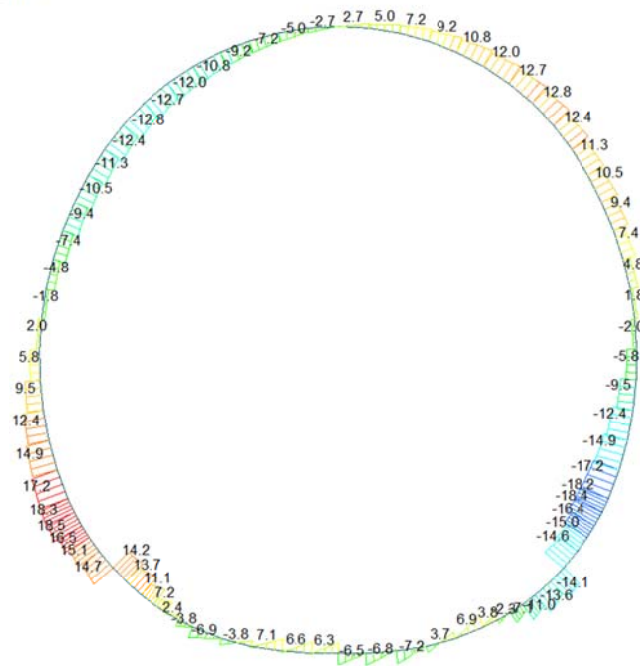
MAX : 48
MIN : 12

FILE: F0E_C01-C0-
UNIT: kN/m

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N2



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

18.49
15.13
11.78
8.42
5.07
1.72
0.00
-4.99
-8.35
-11.70
-15.06
-18.41

ST: N2

MAX : 71
MIN : 26

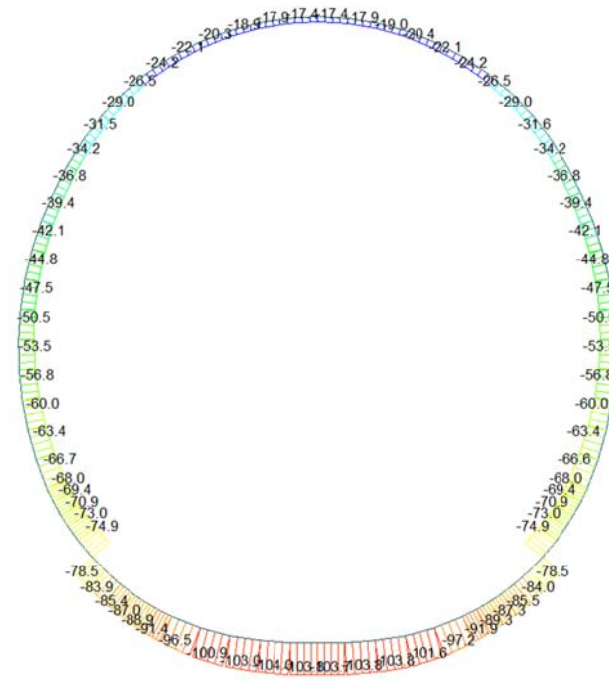
FILE: F0E_C01-C0-
UNIT: kN

DATE: 06/30/2014

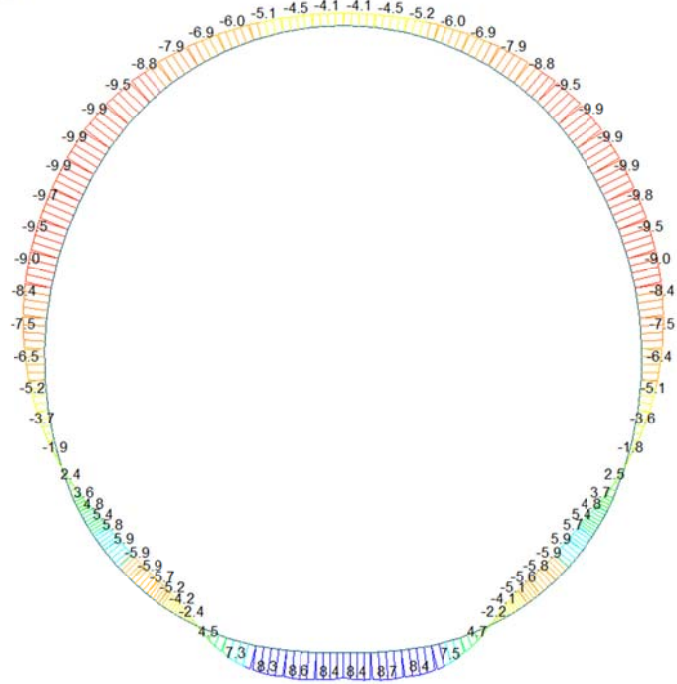
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.3. Load combination SLU 3

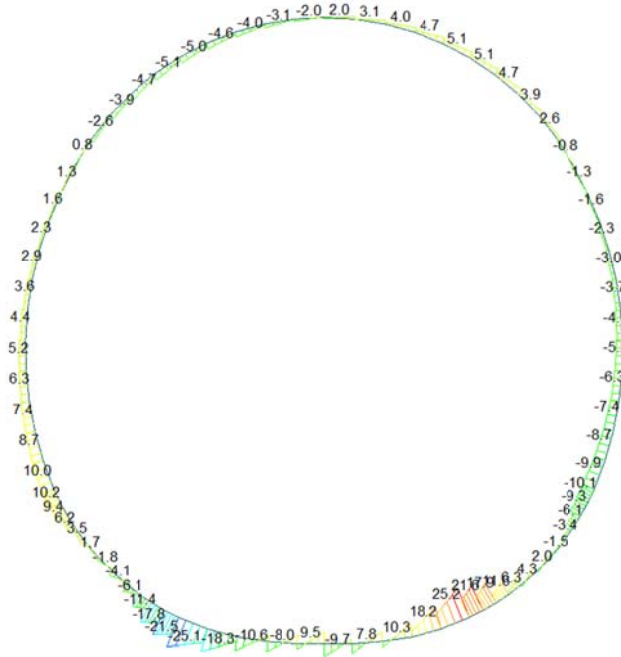
Beam Diagram_Fx / ST_N3



Beam Diagram_My / ST_N3



Beam Diagram_Fz / ST_N3



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-Fz

25.16
20.59
16.02
11.44
6.87
2.30
0.00
-6.85
-11.42
-15.99
-20.56
-25.13

ST: N3

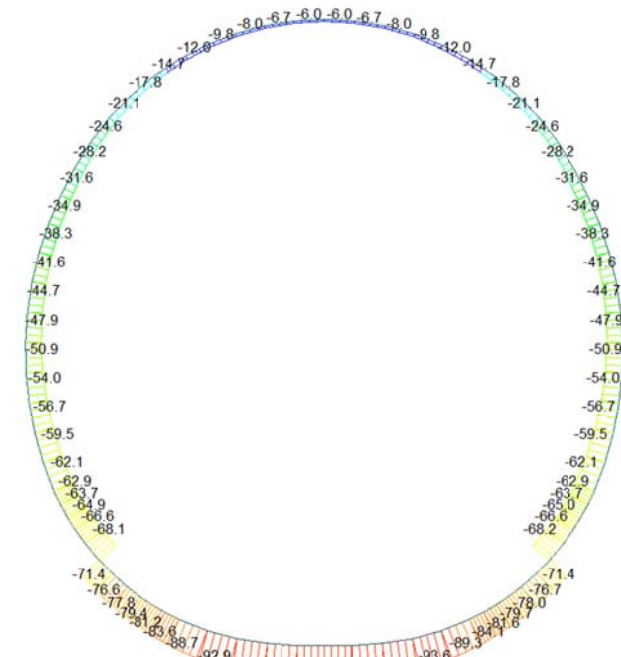
MAX : 16
MIN : 7

FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.4. Load combination SLU 4

Beam Diagram_Fx / ST_N4



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-5.82
-14.02
-22.22
-30.42
-38.61
-46.81
-55.01
-63.21
-71.41
-79.60
-87.80
-96.00

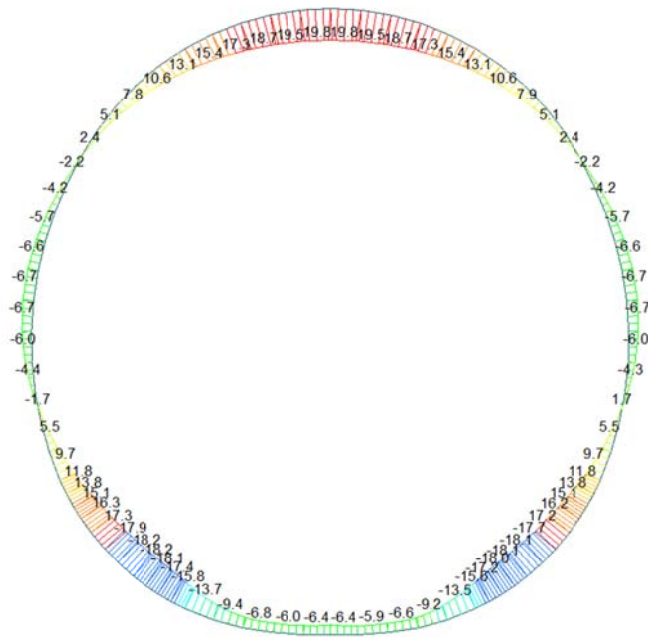
ST: N4

MAX : 48
MIN : 10

FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N4



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

19.80
16.35
12.89
9.43
5.97
2.51
0.00
-4.41
-7.86
-11.32
-14.78
-18.24

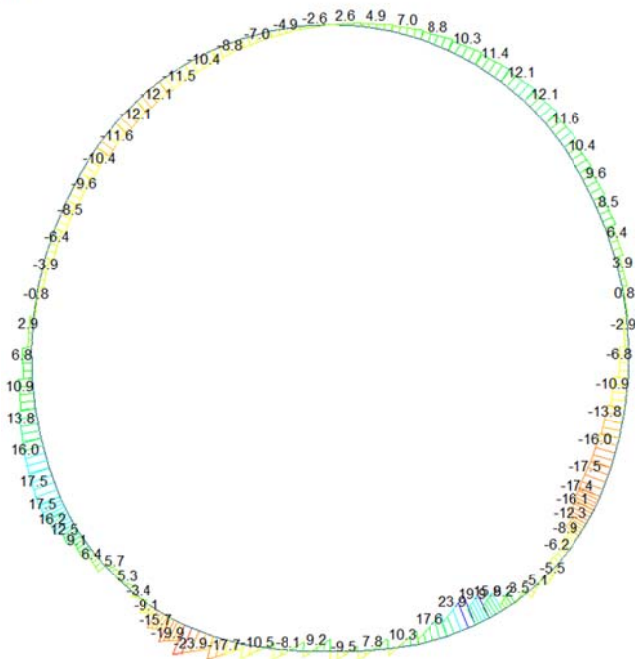
ST: N4

MAX : 49
MIN : 3

FILE: F0E_C01-C0
UNIT: kN*m
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N4



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

23.89
19.55
15.20
10.86
6.51
0.00
-2.18
-6.52
-10.86
-15.21
-19.55
-23.90

ST: N4

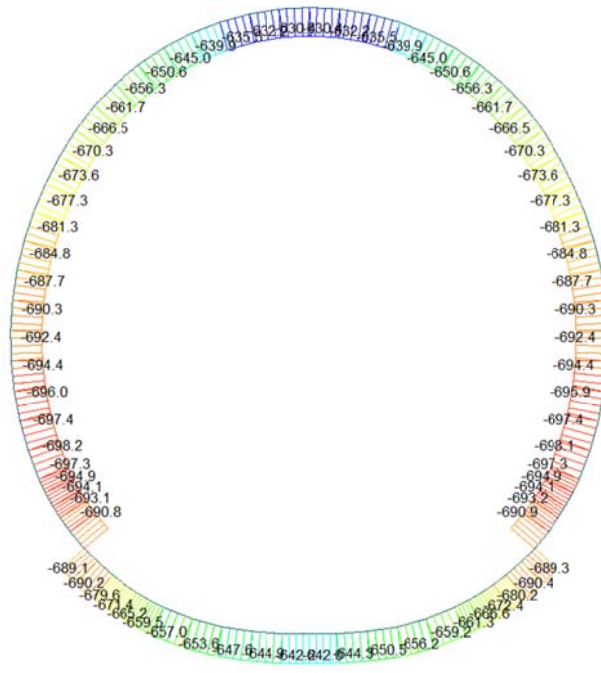
MAX : 16
MIN : 7

FILE: F0E_C01-C0
UNIT: kN
DATE: 06/30/2014

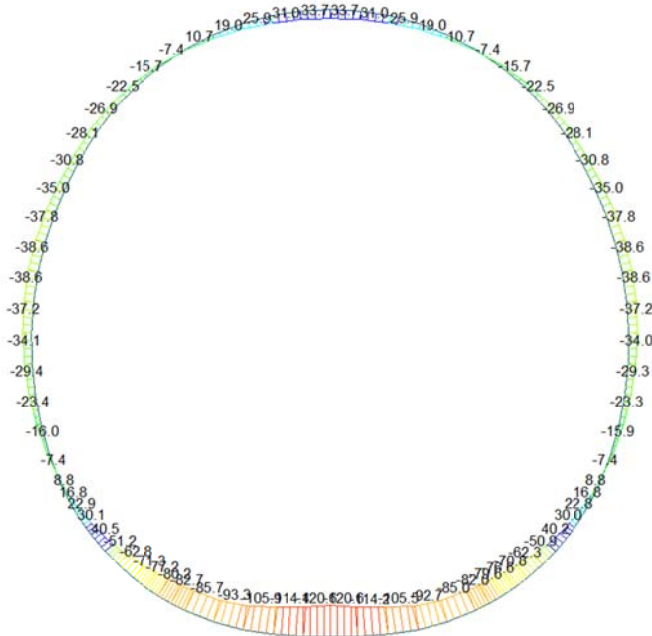
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.5. Load combination SLU 5

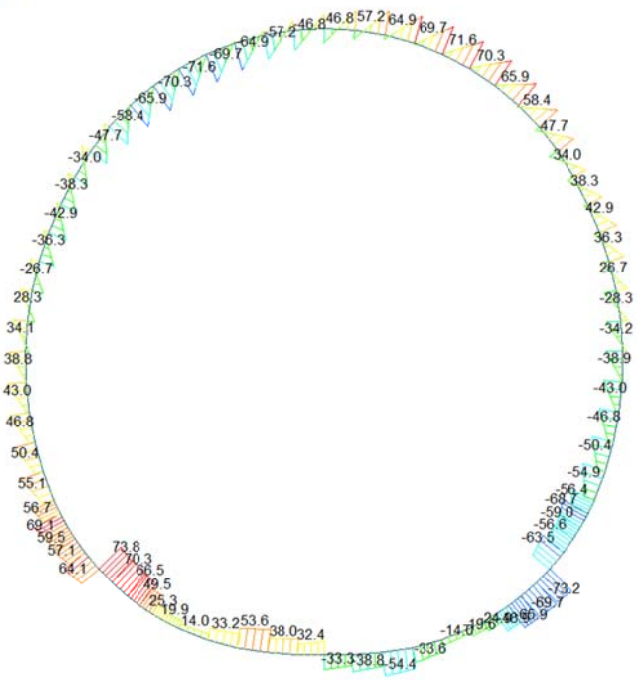
Beam Diagram_Fx / ST_N5



Beam Diagram_My / ST_N5



Beam Diagram_Fz / ST_N5



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

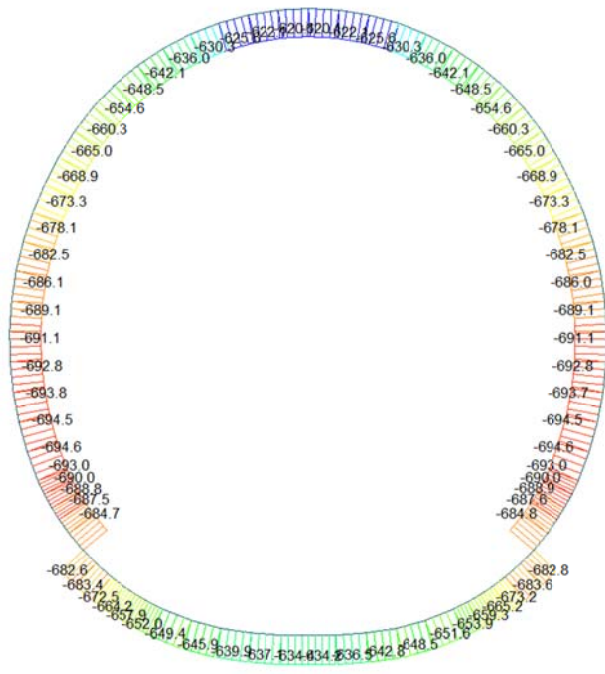
SHEAR-z

73.78
60.42
47.06
33.70
20.34
6.98
0.00
-19.74
-33.10
-46.47
-59.83
-73.19

ST: N5
MAX : 1
MIN : 22
FILE: F0E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.6. Load combination SLU 6

Beam Diagram_Fx / ST_N6



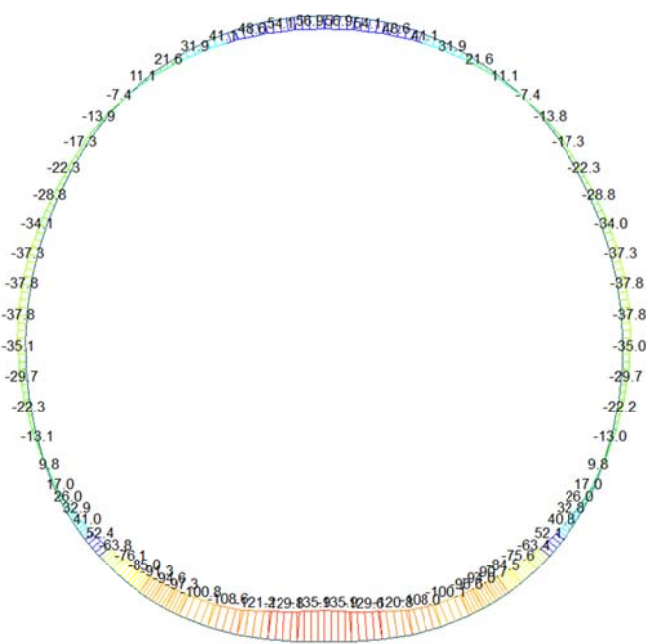
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-619.98
-626.76
-633.54
-640.32
-647.11
-653.89
-660.67
-667.45
-674.24
-681.02
-687.80
-694.58

ST: N6
MAX : 48
MIN : 69
FILE: F0E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N6



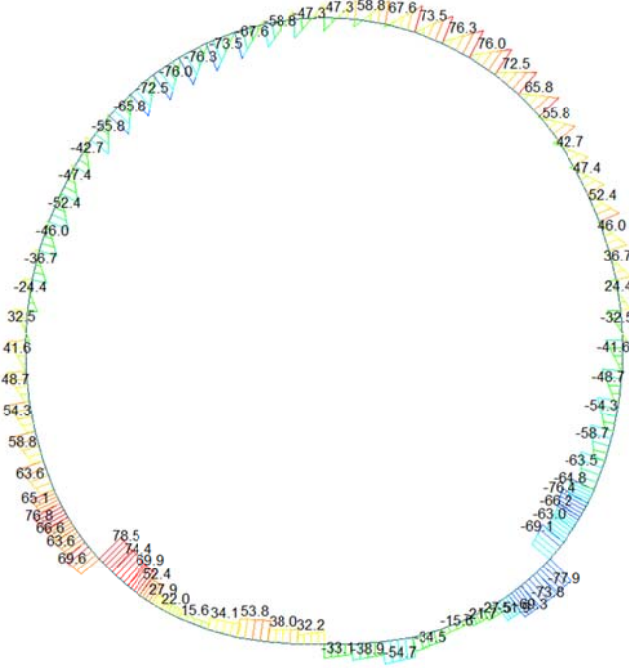
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

56.95
39.42
21.89
0.00
-13.16
-30.69
-48.22
-65.74
-83.27
-100.80
-118.33
-135.85

ST: N6
MAX : 48
MIN : 11
FILE: P01_C01-C0-
UNIT: kN/m
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N6



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

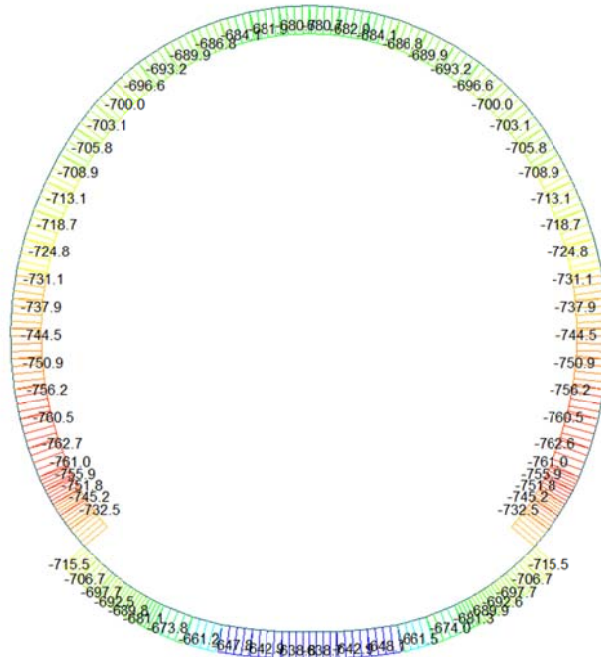
SHEAR-z

78.47
64.26
50.04
35.83
21.61
7.40
0.00
-21.03
-35.25
-49.46
-63.68
-77.89

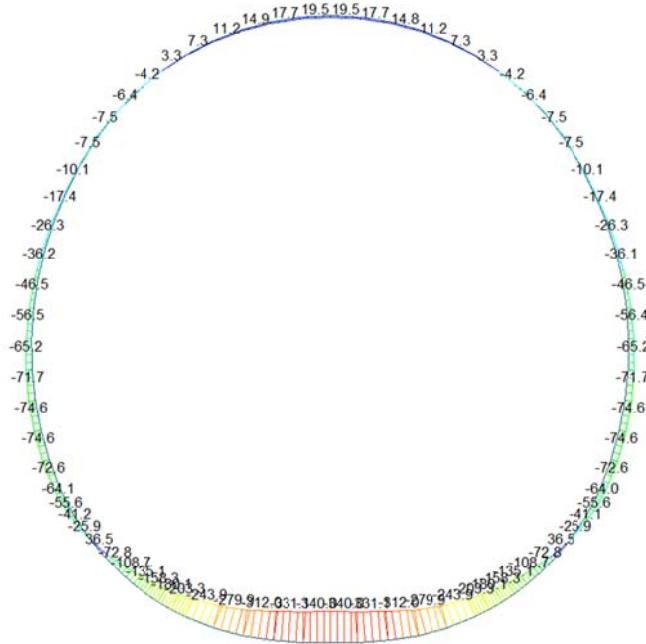
ST: N6
MAX : 1
MIN : 22
FILE: P01_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.7. Load combination SLU 7

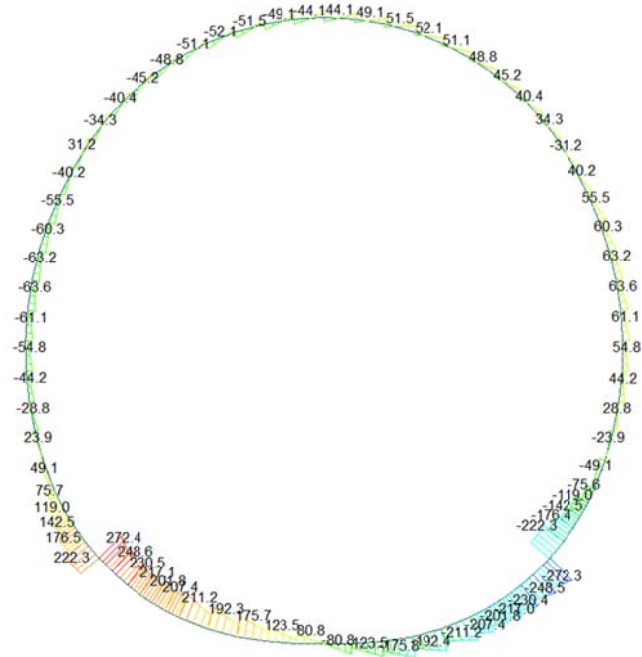
Beam Diagram_Fx / ST_N7



Beam Diagram_My / ST_N7



Beam Diagram_Fz / ST_N7



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

272.39
222.87
173.35
123.83
74.31
24.79
0.00
-74.26
-123.78
-173.30
-222.82
-272.34

ST: N7

MAX : 1
MIN : 22

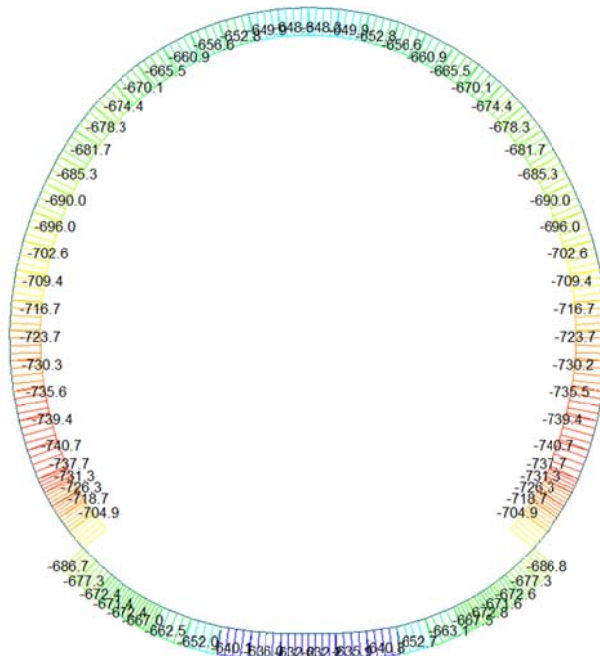
FILE: F8E_C01-C0-
UNIT: kN

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.8. Load combination SLU 8

Beam Diagram_Fx / ST_N8



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-632.17
-642.03
-651.90
-661.76
-671.63
-681.49
-691.36
-701.22
-711.09
-720.95
-730.82
-740.68

ST: N8

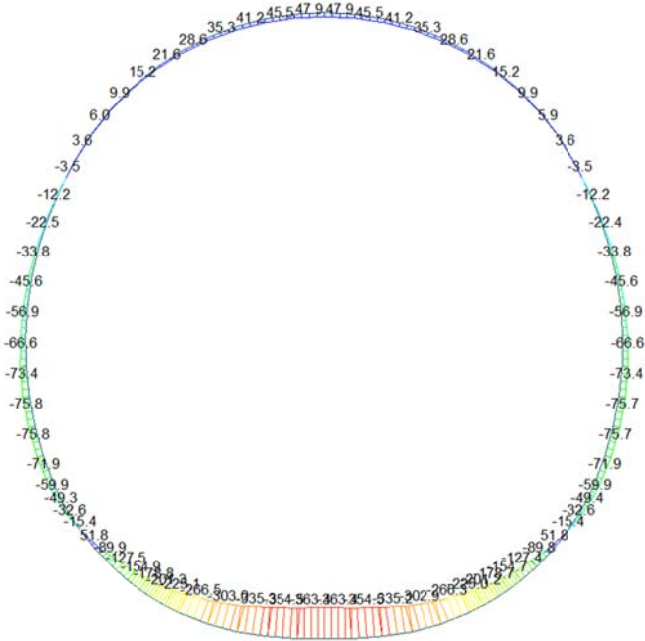
MAX : 12
MIN : 28

FILE: F8E_C01-C0-
UNIT: kN

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N8



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

51.84
0.00
-23.67
-61.42
-99.17
-136.93
-174.68
-212.43
-250.18
-287.94
-325.69
-363.44

ST: N8

MAX : 74
MIN : 11

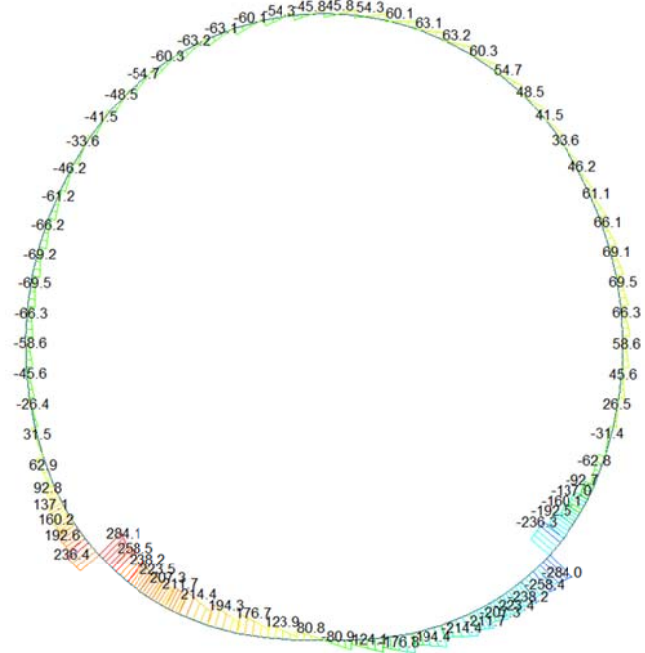
FILE: F0E_C01-C0-
UNIT: kN/m

DATE: 06/30/2014

VIEW-DIRECTION

X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N8



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

284.07
232.43
180.79
129.15
77.51
25.87
0.00
-77.42
-129.06
-180.70
-232.34
-263.98

ST: N8

MAX : 1
MIN : 22

FILE: F0E_C01-C0-
UNIT: kN

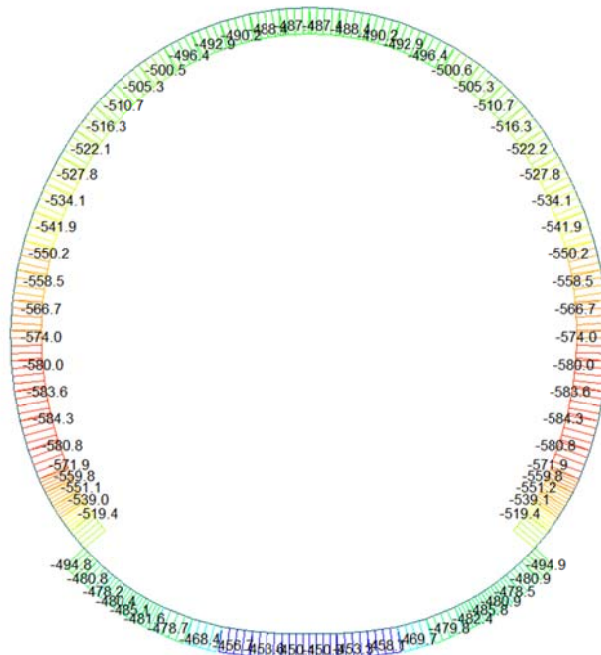
DATE: 06/30/2014

VIEW-DIRECTION

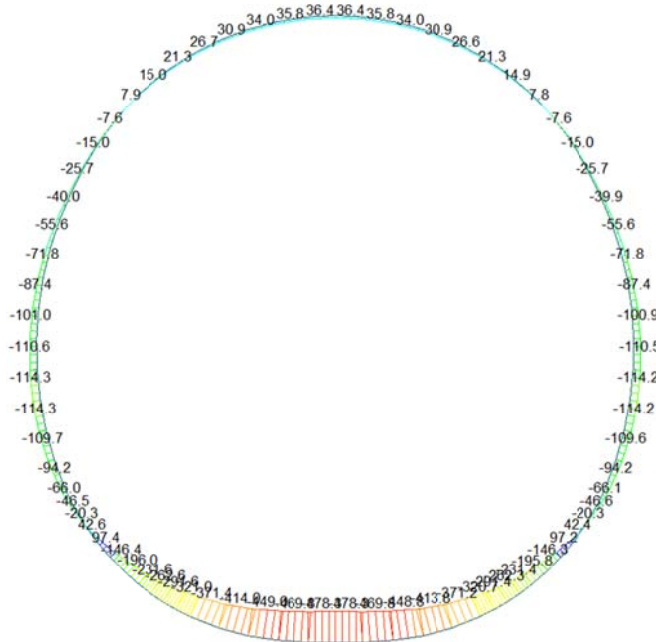
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.9. Load combination SLU 9

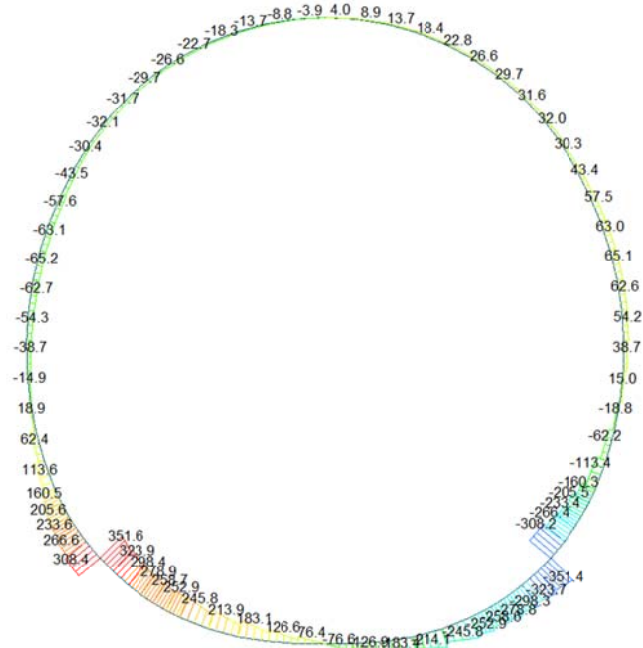
Beam Diagram_Fx / ST_N9



Beam Diagram_My / ST_N9



Beam Diagram_Fz / ST_N9



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

351.56
287.65
223.75
159.84
95.94
32.04
0.00
-95.77
-159.68
-223.58
-287.48
-351.39

ST: N9

MAX : 1
MIN : 22

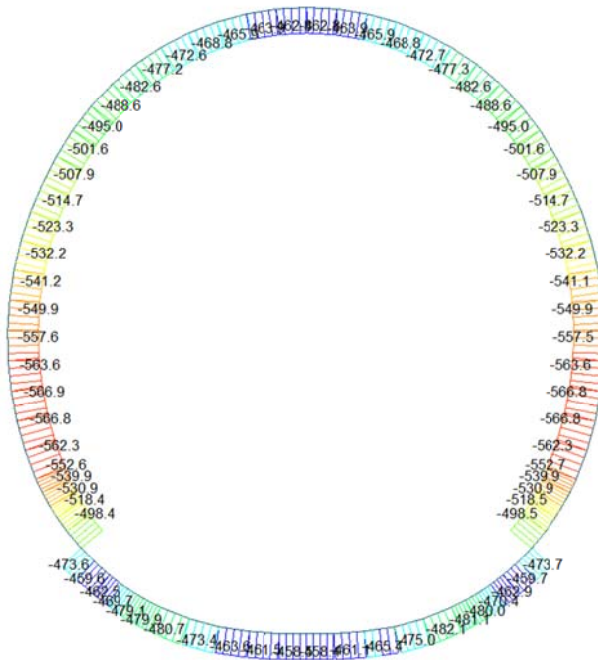
FILE: F8E_C01-C0-
UNIT: kN

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.10. Load combination SLU 10

Beam Diagram_Fx / ST_N10



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-454.21
-464.45
-474.69
-484.93
-495.17
-505.41
-515.65
-525.89
-536.14
-546.38
-556.62
-566.86

ST: N10

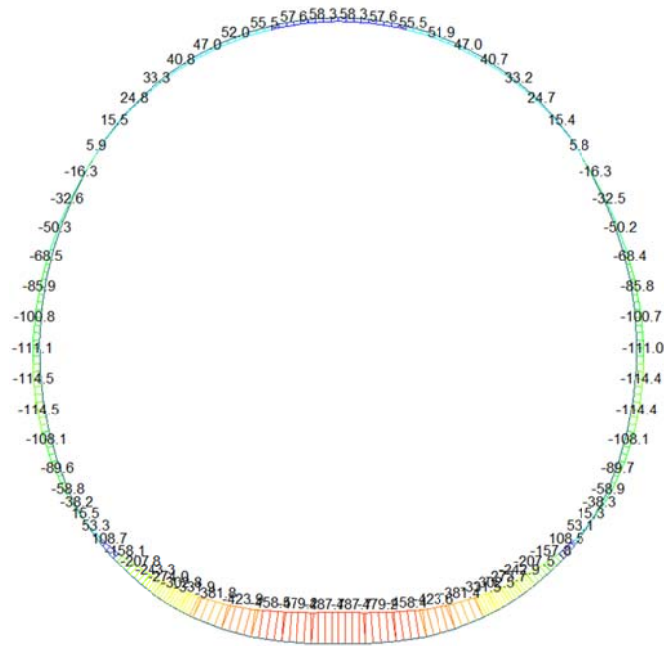
MAX : 2
MIN : 67

FILE: F8E_C01-C0-
UNIT: kN

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N10



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

108.74
54.52
0.00
-53.92
-108.14
-162.36
-216.58
-270.80
-325.02
-379.24
-433.45
-487.67

ST: N10

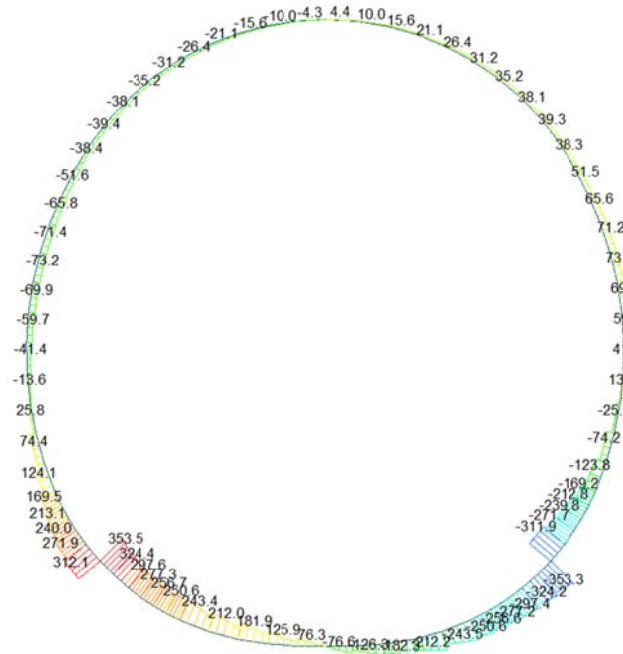
MAX : 74
MIN : 11

FILE: F0E_C01-C0-
UNIT: kN/m

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N10



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

Shear-z

353.48
289.23
224.98
160.73
96.48
32.23
0.00
-96.27
-160.52
-224.77
-289.02
-353.27

ST: N10

MAX : 1
MIN : 22

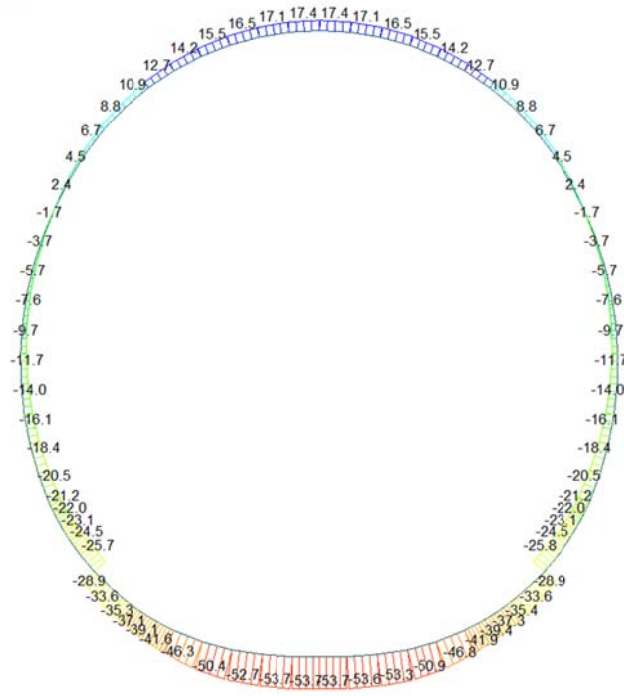
FILE: F0E_C01-C0-
UNIT: kN

DATE: 06/30/2014

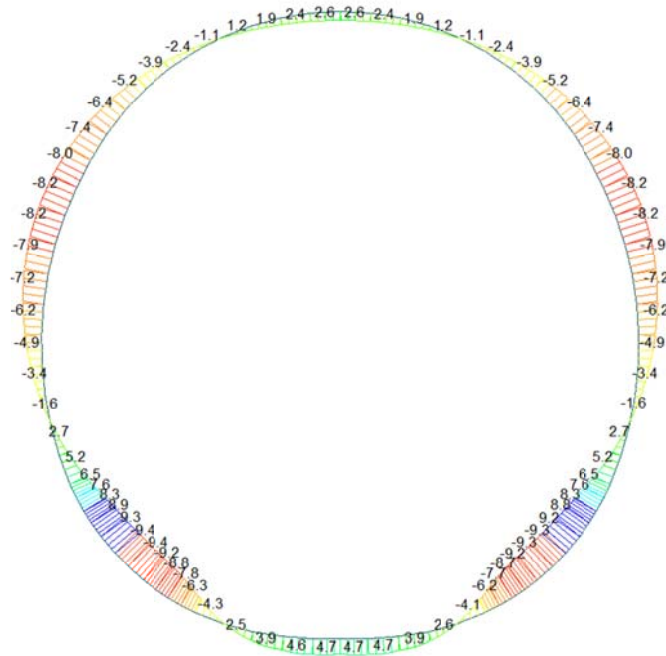
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.11. Load combination SLU 11

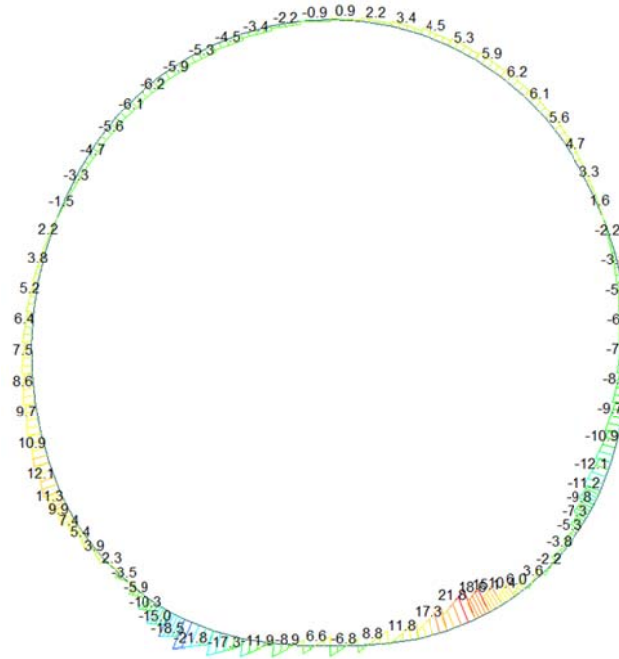
Beam Diagram_Fx / ST_N11



Beam Diagram_My / ST_N11



Beam Diagram_Fz / ST_N11



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

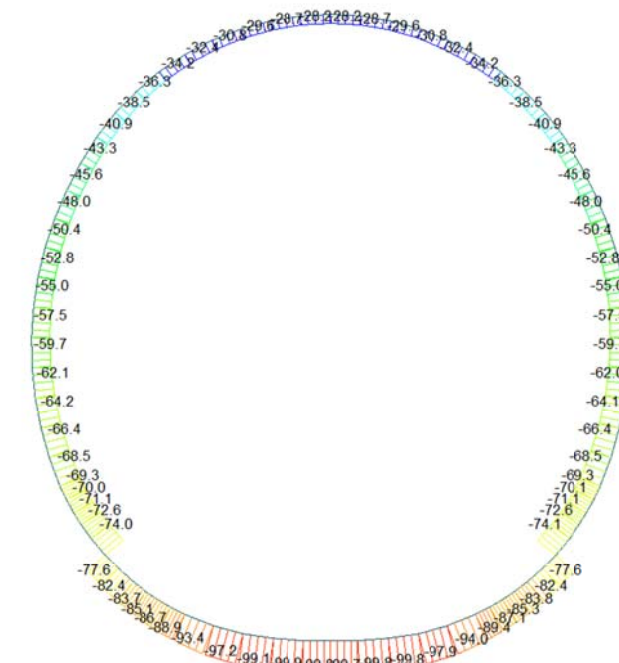
SHEAR-z

21.82
17.85
13.89
9.92
5.95
1.99
0.00
-5.94
-9.91
-13.87
-17.84
-21.80

ST: N11
MAX : 16
MIN : 7
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.12. Load combination SLU 12

Beam Diagram_Fx / ST_N12



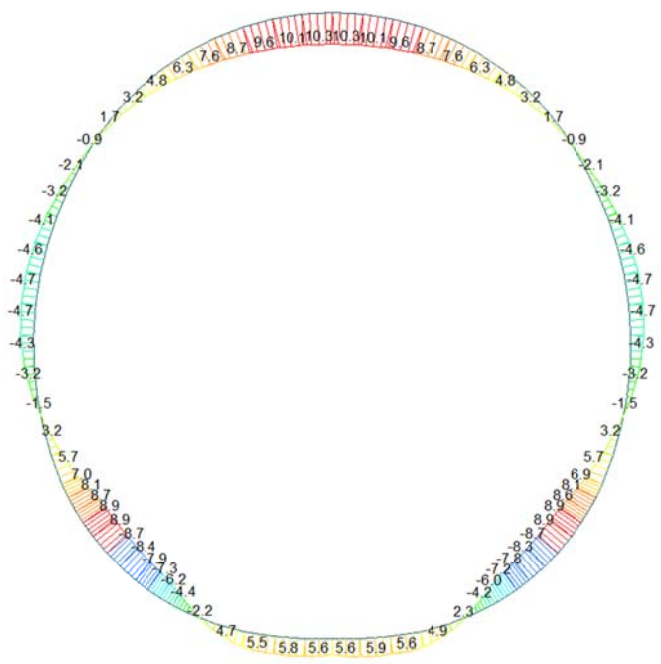
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-28.10
-34.63
-41.16
-47.69
-54.22
-60.75
-67.28
-73.81
-80.34
-86.87
-93.40
-99.93

ST: N12
MAX : 48
MIN : 10
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N12



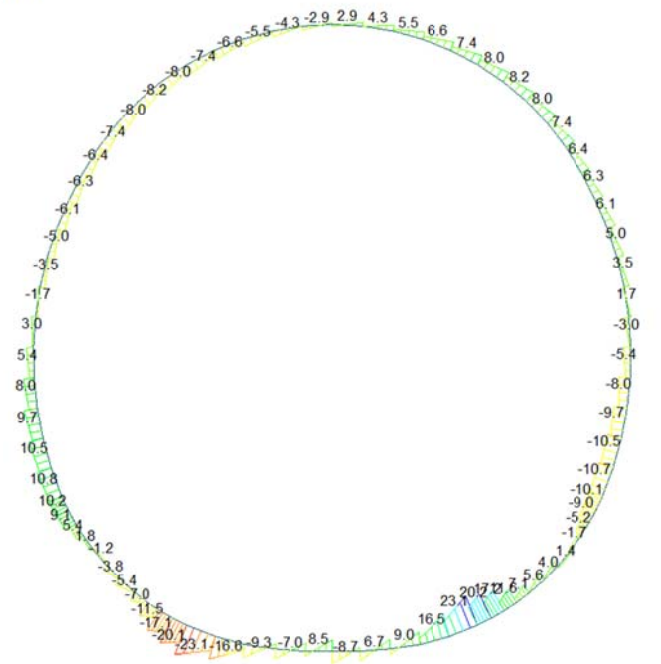
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

10.31
8.58
6.84
5.11
3.38
1.65
0.00
-1.82
-3.55
-5.28
-7.02
-8.75

ST: N12
MAX : 48
MIN : 1
FILE: F0E_C01-C0-
UNIT: kN*m
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N12



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

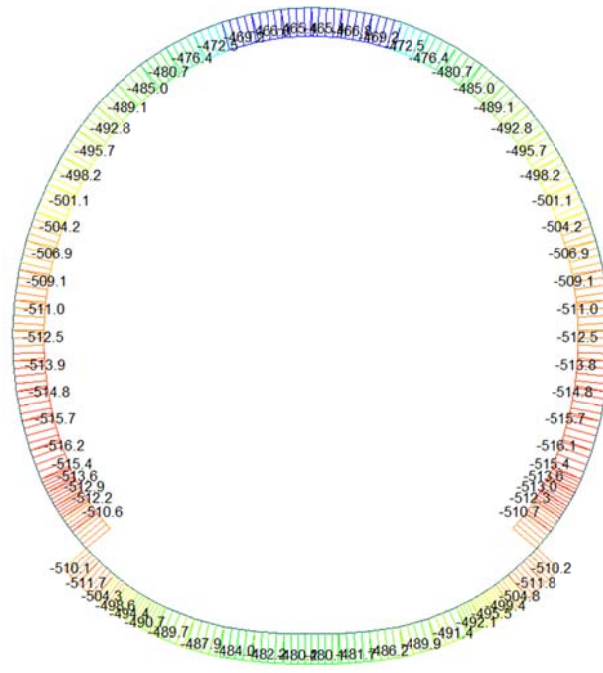
SHEAR-z

23.08
18.88
14.68
10.49
6.29
0.00
-2.10
-6.30
-10.49
-14.69
-18.88
-23.08

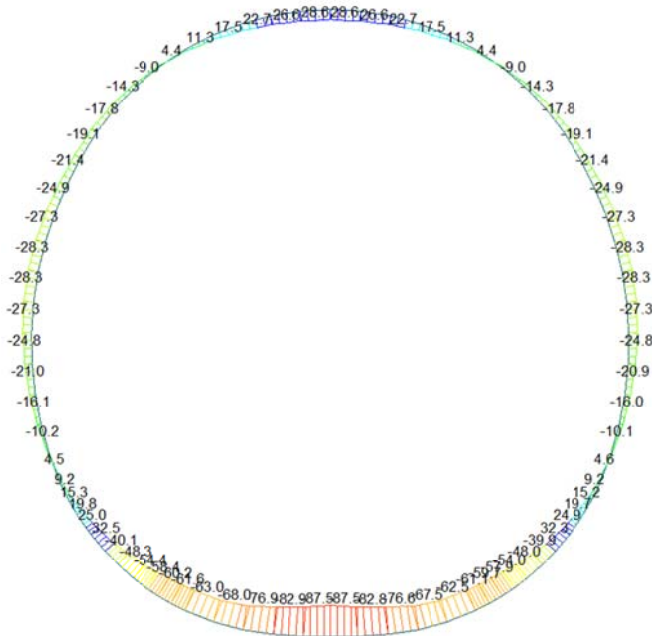
ST: N12
MAX : 16
MIN : 7
FILE: F0E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.13. Load combination SLU 21

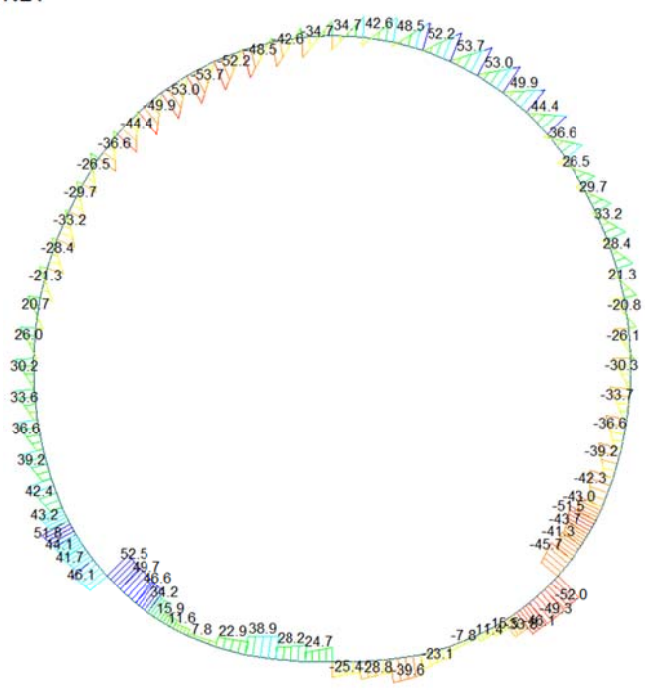
Beam Diagram_Fx / ST_N21



Beam Diagram_My / ST_N21



Beam Diagram_Fz / ST_N21



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-Fz

53.74
43.97
34.20
24.42
14.65
0.00
-4.89
-14.66
-24.43
-34.20
-43.97
-53.74

ST: N21

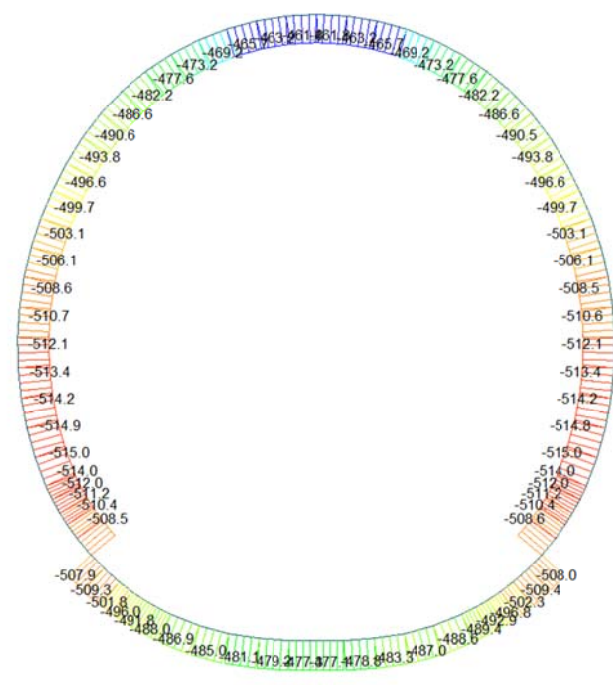
MAX : 44
MIN : 53

FILE: F8E_C01-C0
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.14. Load combination SLU 22

Beam Diagram_Fx / ST_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-461.65
-466.50
-471.35
-476.21
-481.06
-485.91
-490.77
-495.62
-500.47
-505.33
-510.18
-515.04

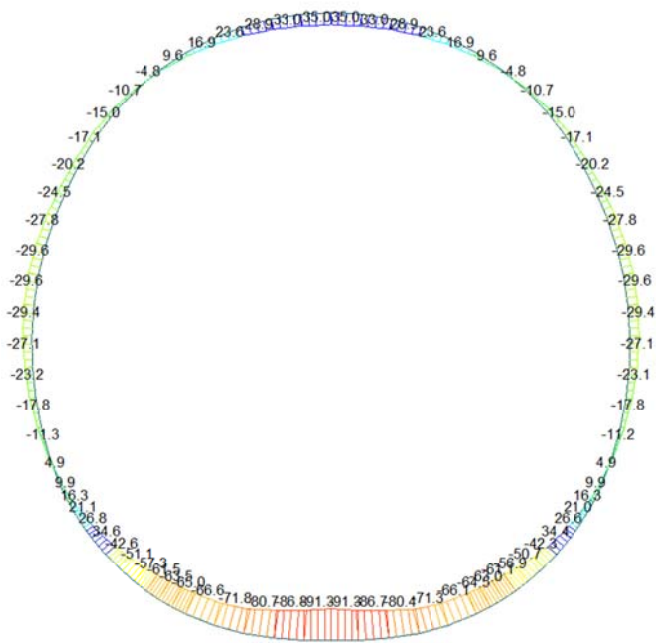
ST: N22

MAX : 48
MIN : 69

FILE: F8E_C01-C0
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

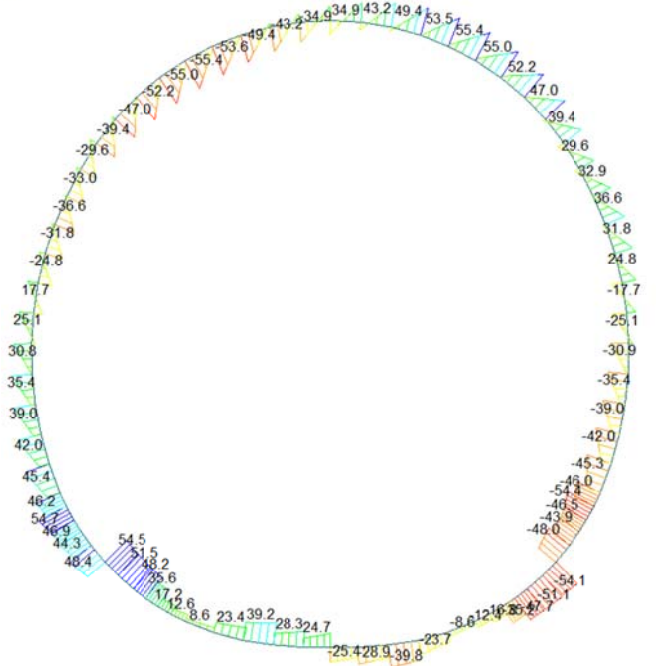
MOMENT-y

35.02
23.53
12.05
0.00
-10.92
-22.40
-33.89
-45.37
-56.86
-68.34
-79.82
-91.31

ST: N22
MAX : 48
MIN : 12
FILE: F01_C01-C0-
UNIT: kN*m
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N22



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

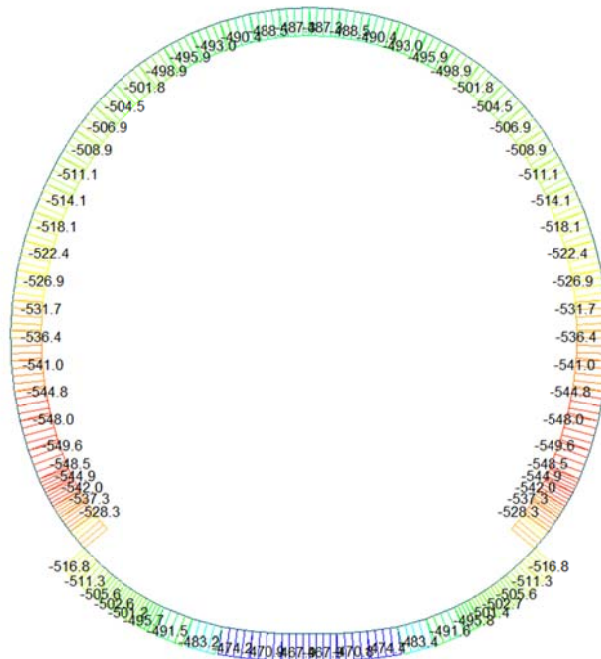
55.42
45.34
35.27
25.19
15.11
0.00
-5.04
-15.12
-25.20
-35.27
-45.35
-55.43

ST: N22
MAX : 44
MIN : 53
FILE: F01_C01-C0-
UNIT: kN
DATE: 06/30/2014

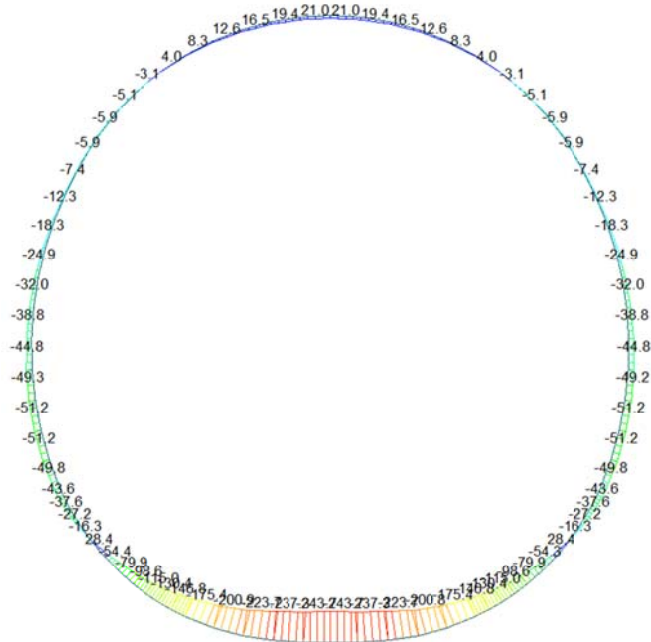
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.15. Load combination SLU 23

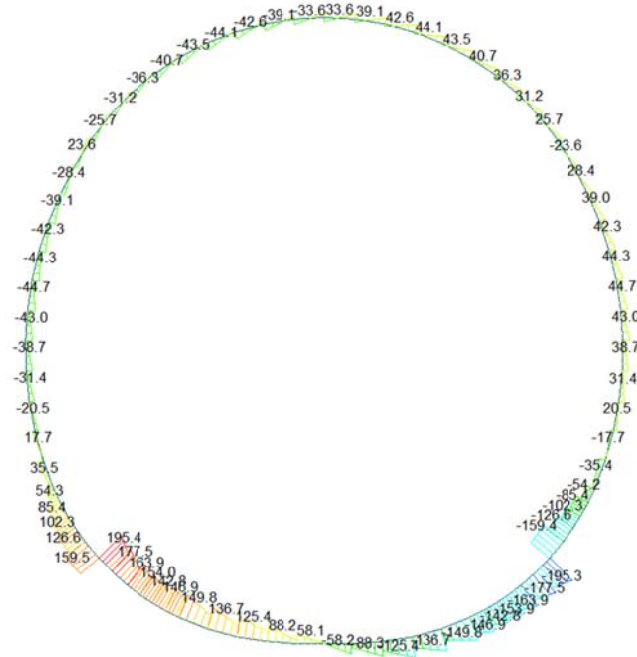
Beam Diagram_Fx / ST_N23



Beam Diagram_My / ST_N23



Beam Diagram_Fz / ST_N23



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

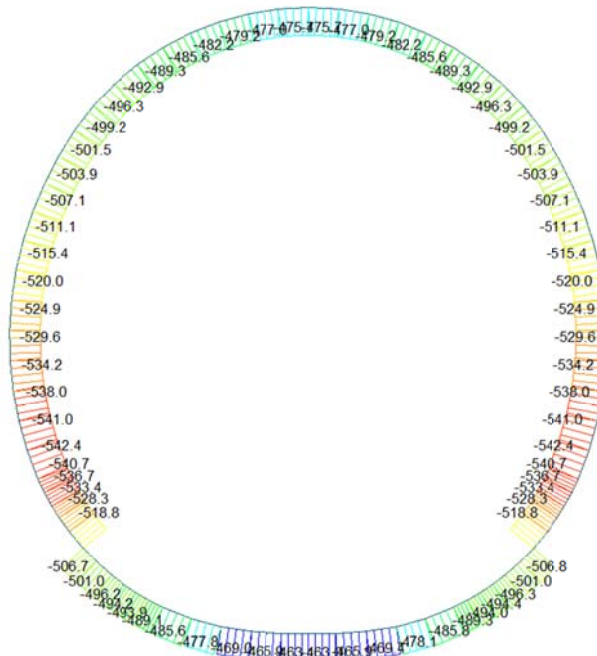
SHEAR-z

195.36
159.85
124.33
88.81
53.29
17.78
0.00
-53.26
-88.77
-124.29
-159.81
-195.33

ST: N23
MAX : 1
MIN : 22
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.16. Load combination SLU 24

Beam Diagram_Fx / ST_N24



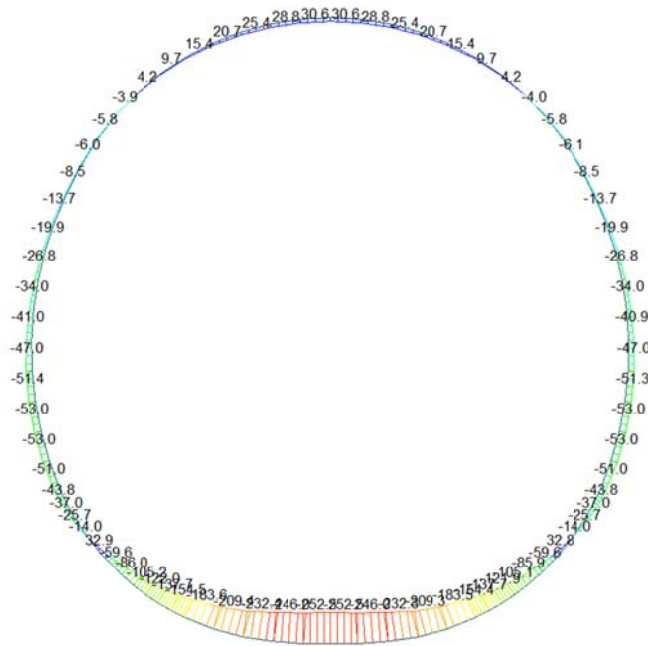
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

-463.04
-470.25
-477.46
-484.67
-491.88
-499.09
-506.30
-513.52
-520.73
-527.94
-535.15
-542.36

ST: N24
MAX : 12
MIN : 69
FILE: F8E_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_N24



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

32.85
0.00
-19.02
-44.96
-70.89
-96.83
-122.77
-148.71
-174.64
-200.58
-226.52
-252.46

ST: N24

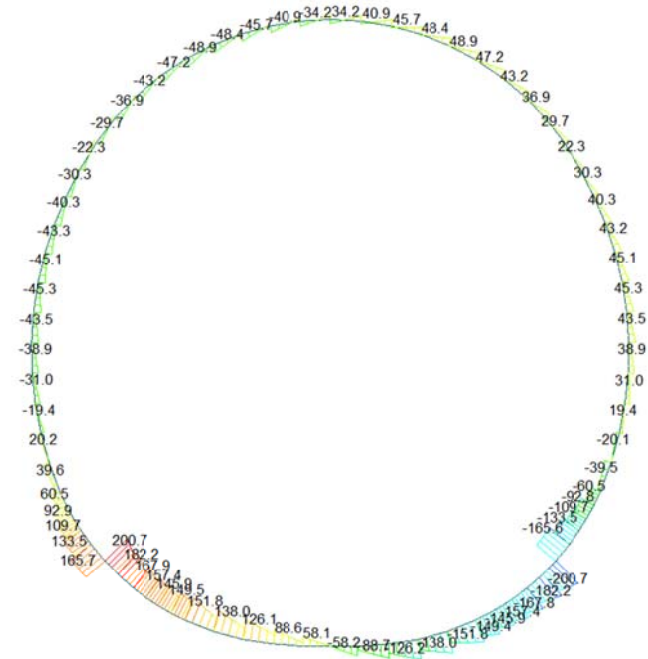
MAX : 74
MIN : 12

FILE: F0E_C01-C0-
UNIT: kN/m

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_Fz / ST_N24



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

SHEAR-z

200.73
164.24
127.75
91.25
54.76
18.27
0.00
-54.71
-91.20
-127.70
-164.19
-200.68

ST: N24

MAX : 1
MIN : 22

FILE: F0E_C01-C0-
UNIT: kN

DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.17. Section checking for load combination without swelling and squeezing

SECTION CHECKING															
MEMBER	SECTION PROPERTIES		f _{ck}	f _{yk}	CHECK	LOAD CB	LOAD CB	Rebar	N_Rdmax	N_Ed	M_Edy	M_Edz	V_Rdc	V_Rds	V_Ed
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
1	100 x 36		30.00	450.00	OK	N6	N6	14-2-P14	6'512	680.611	67.560	0.000	231.349	-	80.721
3	1.00	0.36								0.200	0.204	0.000	0.349	-	0.349
2	100 x 70		30.00	450.00	OK	N6	N6	14-2-P16	12'964	681.234	80.167	0.000	349.706	-	76.448
8	1.00	0.75								0.074	0.075	0.000	0.219	-	0.219
3	100 x 70		30.00	450.00	OK	N6	N6	14-2-P16	12'964	670.265	89.352	0.000	348.383	-	71.654
8	1.00	0.75								0.077	0.077	0.000	0.206	-	0.206
4	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	661.789	95.797	0.000	388.649	-	53.930
9	1.00	0.90								0.061	0.062	0.000	0.139	-	0.139
5	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	655.432	99.308	0.000	387.749	-	29.270
9	1.00	0.90								0.063	0.062	0.000	0.075	-	0.075
6	100 x 90		30.00	450.00	OK	N6	N4	14-2-P16	15'354	649.477	102.146	0.000	306.170	-	19.099
9	1.00	0.90								0.062	0.063	0.000	0.062	-	0.062
7	100 x 90		30.00	450.00	OK	N6	N4	14-2-P16	15'354	646.749	105.823	0.000	306.567	-	23.283
9	1.00	0.90								0.063	0.064	0.000	0.076	-	0.076
8	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	643.169	113.795	0.000	386.011	-	34.672
9	1.00	0.90								0.066	0.065	0.000	0.090	-	0.090
9	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	637.125	126.491	0.000	385.155	-	54.084
9	1.00	0.90								0.069	0.069	0.000	0.140	-	0.140
10	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	634.329	135.040	0.000	384.759	-	38.164
9	1.00	0.90								0.072	0.072	0.000	0.099	-	0.099
11	100 x 90		30.00	450.00	OK	N6	N5	14-2-P16	15'354	631.680	141.131	0.000	386.313	-	32.551
9	1.00	0.90								0.075	0.074	0.000	0.084	-	0.084
12	100 x 90		30.00	450.00	OK	N6	N5	14-2-P16	15'354	631.496	141.131	0.000	386.287	-	33.392
9	1.00	0.90								0.075	0.074	0.000	0.086	-	0.086
13	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	633.756	134.841	0.000	384.678	-	39.016
9	1.00	0.90								0.071	0.072	0.000	0.101	-	0.101
14	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	640.023	126.079	0.000	385.566	-	54.953
9	1.00	0.90								0.070	0.069	0.000	0.143	-	0.143
15	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	645.770	113.166	0.000	386.380	-	35.067
9	1.00	0.90								0.065	0.066	0.000	0.091	-	0.091
16	100 x 90		30.00	450.00	OK	N6	N4	14-2-P16	15'354	648.997	105.095	0.000	306.658	-	23.277
9	1.00	0.90								0.063	0.064	0.000	0.076	-	0.076
17	100 x 90		30.00	450.00	OK	N6	N4	14-2-P16	15'354	651.336	101.415	0.000	306.246	-	19.173
9	1.00	0.90								0.063	0.063	0.000	0.063	-	0.063
18	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	656.884	98.611	0.000	387.954	-	28.824
9	1.00	0.90								0.062	0.063	0.000	0.074	-	0.074
19	100 x 90		30.00	450.00	OK	N6	N6	14-2-P16	15'354	662.839	95.155	0.000	388.798	-	53.407
9	1.00	0.90								0.061	0.062	0.000	0.137	-	0.137
20	100 x 70		30.00	450.00	OK	N6	N6	14-2-P16	12'964	670.904	88.773	0.000	348.472	-	71.076
8	1.00	0.75								0.077	0.077	0.000	0.204	-	0.204
21	100 x 70		30.00	450.00	OK	N6	N6	14-2-P16	12'964	681.448	79.663	0.000	349.736	-	75.865
8	1.00	0.75								0.074	0.075	0.000	0.217	-	0.217
22	100 x 36		30.00	450.00	OK	N6	N6	14-2-P14	6'512	680.789	67.155	0.000	231.372	-	80.146
3	1.00	0.36								0.200	0.203	0.000	0.346	-	0.346
23	100 x 45		30.00	450.00	OK	N6	N6	14-2-P14	7'946	683.041	55.470	0.000	261.828	-	71.616
4	1.00	0.45								0.131	0.129	0.000	0.274	-	0.274
24	100 x 60		30.00	450.00	OK	N6	N6	14-2-P14	10'337	685.987	43.766	0.000	308.001	-	65.886
7	1.00	0.60								0.083	0.083	0.000	0.214	-	0.214
25	100 x 60		30.00	450.00	OK	N6	N6	14-2-P14	10'337	687.462	35.306	0.000	308.259	-	69.228
7	1.00	0.60								0.080	0.078	0.000	0.225	-	0.225
26	100 x 55		30.00	450.00	OK	N6	N6	14-2-P14	9'540	688.793	28.166	0.000	293.566	-	79.670
6	1.00	0.55								0.084	0.086	0.000	0.271	-	0.271
27	100 x 55		30.00	450.00	OK	N6	N6	14-2-P14	9'540	692.013	18.746	0.000	294.008	-	68.084
6	1.00	0.55								0.080	0.081	0.000	0.232	-	0.232
28	100 x 50		30.00	450.00	OK	N5	N6	14-2-P14	8'743	696.136	10.589	0.000	278.750	-	66.691
5	1.00	0.50								0.085	0.085	0.000	0.239	-	0.239
29	100 x 50		30.00	450.00	OK	N5	N6	14-2-P14	8'743	694.958	18.344	0.000	278.760	-	61.614
5	1.00	0.50								0.089	0.088	0.000	0.221	-	0.221
30	100 x 45		30.00	450.00	OK	N5	N6	14-2-P14	7'946	693.587	24.885	0.000	262.998	-	56.457
4	1.00	0.45								0.103	0.105	0.000	0.215	-	0.215

SECTION CHECKING															
MEMBER	SECTION PROPERTIES		f _{ck}	f _{yk}	CHECK	LOAD CB	LOAD CB	Rebar	N_Rdmax	N_Ed	M_Edy	M_Edz	V_Rdc	V_Rds	V_Ed
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
31	100 x 45		30.00	450.00	OK	N6	N6	14-2-P14	7'946	688.863	30.597	0.000	262.881	-	49.711
4	1.00	0.45								0.107	0.108	0.000	0.189	-	0.189
32	100 x 40		30.00	450.00	OK	N5	N6	14-2-P14	7'149	689.970	34.423	0.000	246.370	-	40.881
2	1.00	0.40								0.126	0.129	0.000	0.166	-	0.166
33	100 x 40		30.00	450.00	OK	N5	N5	14-2-P14	7'149	687.769	37.370	0.000	246.389	-	33.269
2	1.00	0.40								0.130	0.131	0.000	0.135	-	0.135
34	100 X 35		30.00	450.00	OK	N5	N5	14-2-P12	6'146	685.584	38.969	0.000	228.946	-	29.168
1	1.00	0.35								0.161	0.164	0.000	0.127	-	0.127
35	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	685.815	38.969	0.000	228.427	-	40.516
1	1.00	0.35								0.161	0.164	0.000	0.177	-	0.177
36	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	682.596	38.991	0.000	227.828	-	49.754
1	1.00	0.35								0.162	0.162	0.000	0.218	-	0.218
37	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	678.898	37.134	0.000	227.168	-	55.984
1	1.00	0.35								0.160	0.156	0.000	0.246	-	0.246
38	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	675.434	38.910	0.000	226.571	-	50.874
1	1.00	0.35								0.153	0.152	0.000	0.225	-	0.225
39	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	669.922	31.733	0.000	226.029	-	46.041
1	1.00	0.35								0.147	0.150	0.000	0.204	-	0.204
40	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	669.012	31.733	0.000	225.381	-	58.937
1	1.00	0.35								0.147	0.149	0.000	0.261	-	0.261
41	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	664.562	28.149	0.000	224.618	-	68.629
1	1.00	0.35								0.142	0.142	0.000	0.306	-	0.306
42	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	12.930	18.368	0.000	223.787	-	75.064
1	1.00	0.35								0.182	0.183	0.000	0.335	-	0.335
43	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	9.893	21.456	0.000	222.938	-	78.229
1	1.00	0.35								0.226	0.222	0.000	0.351	-	0.351
44	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	7.268	24.161	0.000	222.118	-	78.157
1	1.00	0.35								0.255	0.255	0.000	0.352	-	0.352
45	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	5.120	26.377	0.000	221.373	-	74.921
1	1.00	0.35								0.285	0.283	0.000	0.338	-	0.338
46	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	3.502	28.021	0.000	220.748	-	68.634
1	1.00	0.35								0.303	0.303	0.000	0.311	-	0.311
47	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	2.454	29.032	0.000	220.286	-	59.446
1	1.00	0.35								0.322	0.316	0.000	0.270	-	0.270
48	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	2.004	29.373	0.000	220.026	-	47.543
1	1.00	0.35								0.323	0.320	0.000	0.216	-	0.216
49	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	2.004	29.373	0.000	220.027	-	47.558
1	1.00	0.35								0.323	0.320	0.000	0.216	-	0.216
50	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	2.455	29.031	0.000	220.286	-	59.461
1	1.00	0.35								0.322	0.316	0.000	0.270	-	0.270
51	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	3.503	28.019	0.000	220.748	-	68.648
1	1.00	0.35								0.303	0.303	0.000	0.311	-	0.311
52	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	5.121	26.374	0.000	221.373	-	74.935
1	1.00	0.35								0.285	0.283	0.000	0.339	-	0.339
53	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	7.270	24.157	0.000	222.118	-	78.171
1	1.00	0.35								0.255	0.255	0.000	0.352	-	0.352
54	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	9.895	21.452	0.000	222.939	-	78.242
1	1.00	0.35								0.226	0.222	0.000	0.351	-	0.351
55	100 X 35		30.00	450.00	OK	N2	N6	14-2-P12	6'146	12.932	18.364	0.000	223.788	-	75.075
1	1.00	0.35								0.182	0.183	0.000	0.335	-	0.335
56	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	664.558	28.141	0.000	224.619	-	68.640
1	1.00	0.35								0.142	0.142	0.000	0.306	-	0.306
57	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	669.009	31.724	0.000	225.382	-	58.946
1	1.00	0.35								0.147	0.149	0.000	0.262	-	0.262
58	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	669.918	31.724	0.000	226.031	-	46.049
1	1.00	0.35								0.147	0.150	0.000	0.204	-	0.204
59	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	675.430	33.900	0.000	226.572	-	50.881
1	1.00	0.35								0.153	0.152	0.000	0.225	-	0.225
60	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	678.894	37.124	0.000	227.170	-	55.990
1	1.00	0.35								0.160	0.156	0.000	0.246	-	0.246

SECTION CHECKING															
MEMBER	SECTION PROPERTIES		fck	fyk	CHECK	LOAD CB	LOAD CB	Rebar	N_Rdmax	N_Ed	M_Edy	M_Edz	V_Rdc	V_Rds	V_Ed
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
61	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	682.592	38.980	0.000	227.830	-	49.759
1	1.00	0.35								0.162	0.162	0.000	0.218	-	0.218
62	100 X 35		30.00	450.00	OK	N5	N6	14-2-P12	6'146	685.814	38.975	0.000	228.429	-	40.519
1	1.00	0.35								0.161	0.164	0.000	0.177	-	0.177
63	100 X 35		30.00	450.00	OK	N5	N5	14-2-P12	6'146	685.590	38.975	0.000	228.947	-	29.055
1	1.00	0.35								0.161	0.164	0.000	0.127	-	0.127
64	100 x 40		30.00	450.00	OK	N5	N5	14-2-P14	7'149	687.786	37.404	0.000	246.391	-	33.133
2	1.00	0.40								0.130	0.131	0.000	0.134	-	0.134
65	100 x 40		30.00	450.00	OK	N5	N6	14-2-P14	7'149	689.998	34.492	0.000	246.372	-	40.853
2	1.00	0.40								0.126	0.129	0.000	0.166	-	0.166
66	100 x 45		30.00	450.00	OK	N6	N6	14-2-P14	7'946	688.882	30.641	0.000	262.884	-	49.686
4	1.00	0.45								0.107	0.108	0.000	0.189	-	0.189
67	100 x 45		30.00	450.00	OK	N5	N6	14-2-P14	7'946	693.631	25.014	0.000	263.001	-	56.466
4	1.00	0.45								0.103	0.103	0.000	0.215	-	0.215
68	100 x 50		30.00	450.00	OK	N5	N6	14-2-P14	8'743	695.003	18.485	0.000	278.763	-	61.687
5	1.00	0.50								0.089	0.088	0.000	0.221	-	0.221
69	100 x 50		30.00	450.00	OK	N5	N6	14-2-P14	8'743	696.174	10.721	0.000	278.751	-	66.855
5	1.00	0.50								0.085	0.083	0.000	0.240	-	0.240
70	100 x 55		30.00	450.00	OK	N6	N6	14-2-P14	9'540	691.997	18.795	0.000	294.006	-	68.391
6	1.00	0.55								0.080	0.081	0.000	0.233	-	0.233
71	100 x 55		30.00	450.00	OK	N6	N6	14-2-P14	9'540	688.751	28.264	0.000	293.560	-	80.058
6	1.00	0.55								0.084	0.084	0.000	0.273	-	0.273
72	100 x 60		30.00	450.00	OK	N6	N6	14-2-P14	10'337	687.399	35.455	0.000	308.250	-	69.688
7	1.00	0.60								0.080	0.079	0.000	0.226	-	0.226
73	100 x 60		30.00	450.00	OK	N6	N6	14-2-P14	10'337	685.896	43.987	0.000	307.989	-	66.397
7	1.00	0.60								0.083	0.084	0.000	0.216	-	0.216
74	100 x 45		30.00	450.00	OK	N6	N6	14-2-P14	7'946	682.910	55.787	0.000	261.811	-	72.161
4	1.00	0.45								0.131	0.130	0.000	0.276	-	0.276

A.6.4.18. Section checking for load combination with swelling and squeezing

SECTION CHECKING															
MEMBER	SECTION PROPERTIES		f _{ck}	f _{yk}	CHECK	LOAD CB	LOAD CB	Rebar	N _{Rdmax}	N _{Ed}	M _{Edy}	M _{Edz}	V _{Rdc}	V _{Rds}	V _{Ed}
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
1	100 x 36		30.00	450.00	OK	N10	N10	14-2-P14	6'512	473.601	158.104	0.000	204.610	375.724	353.475
3	1.00	0.36								0.787	0.778	0.000	1.728	0.941	0.941
2	100 x 70		30.00	450.00	OK	N10	N10	14-2-P16	12'964	459.581	207.766	0.000	319.427	848.409	324.444
8	1.00	0.75								0.196	0.198	0.000	1.018	0.382	0.382
3	100 x 70		30.00	450.00	OK	N10	N10	14-2-P16	12'964	462.469	243.276	0.000	319.291		297.583
8	1.00	0.75								0.270	0.272	0.000	0.932		0.932
4	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	469.720	274.041	0.000	362.428	-	278.924
9	1.00	0.90								0.226	0.224	0.000	0.770	-	0.770
5	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	479.125	302.835	0.000	363.116	-	258.696
9	1.00	0.90								0.268	0.269	0.000	0.712	-	0.712
6	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	479.897	331.901	0.000	362.656	-	252.942
9	1.00	0.90								0.324	0.325	0.000	0.697	-	0.697
7	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	480.654	381.765	0.000	361.941	-	245.756
9	1.00	0.90								0.439	0.436	0.000	0.679	-	0.679
8	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	473.369	423.877	0.000	360.704	-	213.911
9	1.00	0.90								0.551	0.541	0.000	0.593	-	0.593
9	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	463.570	458.527	0.000	359.290	-	183.074
9	1.00	0.90								0.599	0.611	0.000	0.510	-	0.510
10	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	461.527	479.227	0.000	358.983	-	126.622
9	1.00	0.90								0.673	0.669	0.000	0.353	-	0.353
11	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	458.489	487.674	0.000	358.660	-	76.355
9	1.00	0.90								0.668	0.681	0.000	0.213	-	0.213
12	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	458.366	487.674	0.000	358.647	-	76.595
9	1.00	0.90								0.668	0.681	0.000	0.214	-	0.214
13	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	461.124	479.151	0.000	358.940	-	126.873
9	1.00	0.90								0.672	0.669	0.000	0.353	-	0.353
14	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	465.429	458.360	0.000	359.486	-	183.406
9	1.00	0.90								0.601	0.610	0.000	0.510	-	0.510
15	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	475.021	423.593	0.000	360.878	-	214.085
9	1.00	0.90								0.528	0.529	0.000	0.593	-	0.593
16	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	482.074	381.417	0.000	362.090	-	245.794
9	1.00	0.90								0.440	0.436	0.000	0.679	-	0.679
17	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	481.068	331.535	0.000	362.779	-	252.907
9	1.00	0.90								0.325	0.325	0.000	0.697	-	0.697
18	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	480.039	302.472	0.000	363.212	-	258.599
9	1.00	0.90								0.269	0.269	0.000	0.712	-	0.712
19	100 x 90		30.00	450.00	OK	N10	N9	14-2-P16	15'354	470.378	273.691	0.000	362.496	-	278.799
9	1.00	0.90								0.226	0.224	0.000	0.769	-	0.769
20	100 x 70		30.00	450.00	OK	N10	N10	14-2-P16	12'964	462.867	242.943	0.000	319.347	-	297.406
8	1.00	0.75								0.270	0.272	0.000	0.931	-	0.931
21	100 x 70		30.00	450.00	OK	N10	N10	14-2-P16	12'964	459.716	207.457	0.000	319.427	848.409	324.444
8	1.00	0.75								0.196	0.198	0.000	1.018	0.382	0.382
22	100 x 36		30.00	450.00	OK	N10	N10	14-2-P14	6'512	473.723	157.828	0.000	204.626	375.724	353.475
3	1.00	0.36								0.787	0.777	0.000	1.726	0.941	0.941
23	100 x 45		30.00	450.00	OK	N10	N10	14-2-P14	7'946	498.535	108.491	0.000	237.504	338.655	311.901
4	1.00	0.45								0.218	0.221	0.000	1.313	0.921	0.921
24	100 x 60		30.00	450.00	OK	N7	N10	14-2-P14	10'337	742.885	25.899	0.000	285.290	-	271.676
7	1.00	0.60								0.081	0.081	0.000	0.952	-	0.952
25	100 x 60		30.00	450.00	OK	N7	N10	14-2-P14	10'337	749.929	41.142	0.000	286.998	-	239.813
7	1.00	0.60								0.088	0.088	0.000	0.836	-	0.836
26	100 x 55		30.00	450.00	OK	N7	N10	14-2-P14	9'540	753.871	55.600	0.000	273.549	-	212.845
6	1.00	0.55								0.106	0.106	0.000	0.778	-	0.778
27	100 x 55		30.00	450.00	OK	N7	N10	14-2-P14	9'540	758.899	64.034	0.000	275.288	-	169.243
6	1.00	0.55								0.113	0.111	0.000	0.615	-	0.615
28	100 x 50		30.00	450.00	OK	N9	N10	14-2-P14	8'743	576.834	94.213	0.000	261.526	-	123.814
5	1.00	0.50								0.145	0.145	0.000	0.473	-	0.473
29	100 x 50		30.00	450.00	OK	N9	N10	14-2-P14	8'743	580.222	109.627	0.000	262.128	-	74.202
5	1.00	0.50								0.172	0.169	0.000	0.283	-	0.283
30	100 x 45		30.00	450.00	OK	N9	N7	14-2-P14	7'946	579.849	114.230	0.000	271.859	-	28.762
4	1.00	0.45								0.227	0.223	0.000	0.106	-	0.106

SECTION CHECKING															
MEMBER	SECTION PROPERTIES		fck	fyk	CHECK	LOAD CB	LOAD CB	Rebar	N_Rdmax	N_Ed	M_Edy	M_Edz	V_Rdc	V_Rds	V_Ed
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
31	100 x 45		30.00	450.00	OK	N9	N8	14-2-P14	7'946	579.997	114.230	0.000	268.398	-	45.628
4	1.00	0.45								0.227	0.223	0.000	0.170	-	0.170
32	100 x 40		30.00	450.00	OK	N10	N8	14-2-P14	7'149	557.518	111.011	0.000	251.099	-	58.636
2	1.00	0.40								0.279	0.280	0.000	0.234	-	0.234
33	100 x 40		30.00	450.00	OK	N10	N8	14-2-P14	7'149	549.910	100.671	0.000	250.188	-	66.291
2	1.00	0.40								0.246	0.245	0.000	0.265	-	0.265
34	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	558.478	87.357	0.000	210.374	-	69.809
1	1.00	0.35								0.291	0.297	0.000	0.332	-	0.332
35	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	550.177	71.754	0.000	209.225	-	73.088
1	1.00	0.35								0.232	0.229	0.000	0.349	-	0.349
36	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	541.928	55.568	0.000	208.077	-	71.247
1	1.00	0.35								0.181	0.183	0.000	0.342	-	0.342
37	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	534.086	39.932	0.000	206.981	-	65.619
1	1.00	0.35								0.145	0.145	0.000	0.317	-	0.317
38	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	708.901	10.150	0.000	206.103	-	51.500
1	1.00	0.35								0.126	0.126	0.000	0.250	-	0.250
39	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	705.768	6.999	0.000	205.295	-	38.338
1	1.00	0.35								0.122	0.123	0.000	0.187	-	0.187
40	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	703.073	7.488	0.000	204.440	-	39.338
1	1.00	0.35								0.122	0.123	0.000	0.192	-	0.192
41	100 X 35		30.00	450.00	OK	N7	N8	14-2-P12	6'146	699.980	6.442	0.000	227.504	-	48.489
1	1.00	0.35								0.120	0.122	0.000	0.213	-	0.213
42	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	480.692	33.223	0.000	226.954	-	54.733
1	1.00	0.35								0.124	0.126	0.000	0.241	-	0.241
43	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	475.629	40.707	0.000	226.369	-	60.328
1	1.00	0.35								0.140	0.141	0.000	0.267	-	0.267
44	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	471.286	46.974	0.000	225.776	-	63.224
1	1.00	0.35								0.154	0.156	0.000	0.280	-	0.280
45	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	467.744	51.911	0.000	225.216	-	63.128
1	1.00	0.35								0.166	0.168	0.000	0.280	-	0.280
46	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	465.145	55.466	0.000	224.732	-	60.117
1	1.00	0.35								0.177	0.177	0.000	0.268	-	0.268
47	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	463.422	57.608	0.000	224.364	-	54.303
1	1.00	0.35								0.182	0.183	0.000	0.242	-	0.242
48	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	462.683	58.328	0.000	224.152	-	45.834
1	1.00	0.35								0.182	0.185	0.000	0.204	-	0.204
49	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	462.679	58.328	0.000	224.152	-	45.814
1	1.00	0.35								0.182	0.185	0.000	0.204	-	0.204
50	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	463.413	57.623	0.000	224.364	-	54.282
1	1.00	0.35								0.182	0.183	0.000	0.242	-	0.242
51	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	465.129	55.496	0.000	224.731	-	60.097
1	1.00	0.35								0.177	0.178	0.000	0.267	-	0.267
52	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	467.724	51.954	0.000	225.215	-	63.109
1	1.00	0.35								0.166	0.169	0.000	0.280	-	0.280
53	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	471.261	47.028	0.000	225.775	-	63.206
1	1.00	0.35								0.154	0.156	0.000	0.280	-	0.280
54	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	475.601	40.769	0.000	226.368	-	60.311
1	1.00	0.35								0.140	0.141	0.000	0.266	-	0.266
55	100 X 35		30.00	450.00	OK	N10	N8	14-2-P12	6'146	480.663	33.290	0.000	226.952	-	54.726
1	1.00	0.35								0.124	0.126	0.000	0.241	-	0.241
56	100 X 35		30.00	450.00	OK	N8	N8	14-2-P12	6'146	672.225	9.521	0.000	227.503	-	48.493
1	1.00	0.35								0.119	0.121	0.000	0.213	-	0.213
57	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	703.065	7.469	0.000	204.437	-	39.401
1	1.00	0.35								0.122	0.122	0.000	0.193	-	0.193
58	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	705.761	6.984	0.000	205.294	-	38.438
1	1.00	0.35								0.122	0.123	0.000	0.187	-	0.187
59	100 X 35		30.00	450.00	OK	N7	N10	14-2-P12	6'146	708.895	10.140	0.000	206.103	-	51.628
1	1.00	0.35								0.126	0.126	0.000	0.250	-	0.250
60	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	534.083	39.954	0.000	206.982	-	65.758
1	1.00	0.35								0.145	0.145	0.000	0.318	-	0.318

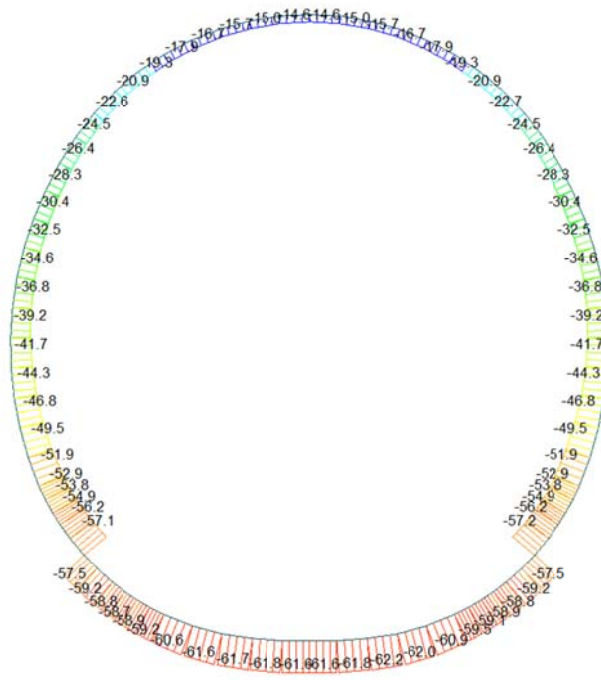
SECTION CHECKING															
MEMBER	SECTION PROPERTIES		fck	fyk	CHECK	LOAD CB	LOAD CB	Rebar	N_Rdmax	N_Ed	M_Edy	M_Edz	V_Rdc	V_Rds	V_Ed
SECTION	Bc (m)	Hc (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
61	100 X 35		30.00	450.00	OK	N9	6	14-2-P12	6'146	541.934	55.616	0.000	208.079	-	71.379
1	1.00	0.35								0.181	0.183	0.000	0.343	-	0.343
62	100 X 35		30.00	450.00	OK	N9	N10	14-2-P12	6'146	550.192	71.827	0.000	209.229	-	73.199
1	1.00	0.35								0.232	0.230	0.000	0.350	-	0.350
63	100 X 35		30.00	450.00	OK	N10	N10	14-2-P12	6'146	541.170	85.901	0.000	210.379	-	69.883
1	1.00	0.35								0.306	0.301	0.000	0.332	-	0.332
64	100 x 40		30.00	450.00	OK	N9	N8	14-2-P14	7'149	566.745	100.988	0.000	250.190	-	66.317
2	1.00	0.40								0.247	0.243	0.000	0.265	-	0.265
65	100 x 40		30.00	450.00	OK	N10	N8	14-2-P14	7'149	557.556	111.133	0.000	251.101	-	58.640
2	1.00	0.40								0.279	0.281	0.000	0.234	-	0.234
66	100 x 45		30.00	450.00	OK	N9	N8	14-2-P14	7'946	580.026	114.326	0.000	268.400	-	45.604
4	1.00	0.45								0.227	0.223	0.000	0.170	-	0.170
67	100 x 45		30.00	450.00	OK	N9	N7	14-2-P14	7'946	579.872	114.326	0.000	271.860	-	28.768
4	1.00	0.45								0.227	0.223	0.000	0.106	-	0.106
68	100 x 50		30.00	450.00	OK	N9	N10	14-2-P14	8'743	580.232	109.695	0.000	262.127	-	74.441
5	1.00	0.50								0.172	0.169	0.000	0.284	-	0.284
69	100 x 50		30.00	450.00	OK	N9	N10	14-2-P14	8'743	576.828	94.235	0.000	261.523	-	124.052
5	1.00	0.50								0.145	0.145	0.000	0.474	-	0.474
70	100 x 55		30.00	450.00	OK	N7	N10	14-2-P14	9'540	758.905	64.061	0.000	275.282	-	169.479
6	1.00	0.55								0.113	0.111	0.000	0.616	-	0.616
71	100 x 55		30.00	450.00	OK	N7	N10	14-2-P14	9'540	753.874	55.623	0.000	273.540	-	213.076
6	1.00	0.55								0.106	0.106	0.000	0.779	-	0.779
72	100 x 60		30.00	450.00	OK	N7	N10	14-2-P14	10'337	749.930	41.160	0.000	286.988	-	240.041
7	1.00	0.60								0.088	0.088	0.000	0.836	-	0.836
73	100 x 60		30.00	450.00	OK	N7	N10	14-2-P14	10'337	742.882	25.911	0.000	285.278	-	271.899
7	1.00	0.60								0.081	0.081	0.000	0.953	-	0.953
74	100 x 45		30.00	450.00	OK	N10	N10	14-2-P14 Stirrup 4-P10/150	7'946	498.431	108.736	0.000	237.490	338.655	311.901
4	1.00	0.45								0.218	0.221	0.000	1.314	0.921	0.921

A.6.4.19. Section checking for fire combination load

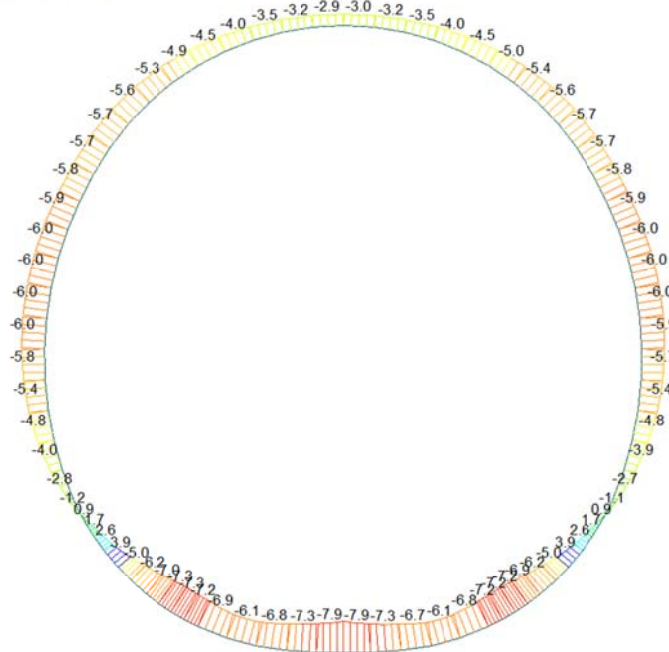
SECTION CHECKING - FIRE COMBINATIONS LOAD															
MEMBER	SECTION PROPERTIES		f _{ck}	f _{yk}	CHECK	LOAD CB	LOAD CB	Rebar	N _{Rdmax}	N _{Ed}	M _{Edy}	M _{Edz}	V _{Rdc}	V _{Rds}	V _{Ed}
SECTION	B _c (m)	H _c (m)	[N/mm ²]	[N/mm ²]		M-N iteration	V			Ratio-N	Ratio-My	Ratio-Mz	Ratio-Vc	Ratio-Vs	Ratio-V
62(M+N) / 53(V)	100 X 35		30.00	360.00	OK	N24	N22	14-2-P12	6'935	520.304	27.881	0.000	209.694	-	53.133
1	1.00	0.30								0.116	0.114	0.000	0.253	-	0.253
65(M+N) / 64(V)	100 x 40		30.00	360.00	OK	N24	N24	14-2-P14	8'200	529.815	42.842	0.000	248.085	-	46.686
2	1.00	0.35								0.112	0.113	0.000	0.188	-	0.188
22(M+N) / 22(V)	100 x 36		30.00	360.00	OK	N24	N24	14-2-P14	7'350	508.202	55.560	0.000	233.158	-	197.158
3	1.00	0.31								0.166	0.167	0.000	0.846	-	0.846
67(M+N) / 74(V)	100 x 45		30.00	360.00	OK	N24	N24	14-2-P14	9'263	538.466	51.672	0.000	261.519	-	162.194
4	1.00	0.40								0.104	0.104	0.000	0.620	-	0.620
68(M+N) / 69(V)	100 x 50		30.00	360.00	OK	N24	N24	14-2-P14	10'325	538.906	51.672	0.000	273.209	-	39.593
5	1.00	0.45								0.087	0.086	0.000	0.145	-	0.145
70(M+N) / 71(V)	100 x 55		30.00	360.00	OK	N24	N24	14-2-P14	11'388	554.332	44.494	0.000	289.507	-	89.446
6	1.00	0.50								0.070	0.071	0.000	0.309	-	0.309
72(M+N) / 73(V)	100 x 60		30.00	360.00	OK	N24	N24	14-2-P14	12'450	548.684	29.995	0.000	300.104	-	130.043
7	1.00	0.55								0.055	0.055	0.000	0.433	-	0.433
20(M+N) / 21(V)	100 x 70		30.00	360.00	OK	N24	N24	14-2-P16	14'808	499.511	100.002	0.000	340.970	-	178.629
8	1.00	0.65								0.071	0.072	0.000	0.524	-	0.524
11(M+N) / 19(V)	100 x 90		30.00	360.00	OK	N24	N24	14-2-P16	19'058	474.398	244.596	0.000	383.415	-	153.689
9	1.00	0.85								0.182	0.182	0.000	0.401	-	0.401

A.6.4.20. Load combination SLE 1

Beam Diagram_Fx / ST_NSLE - 1

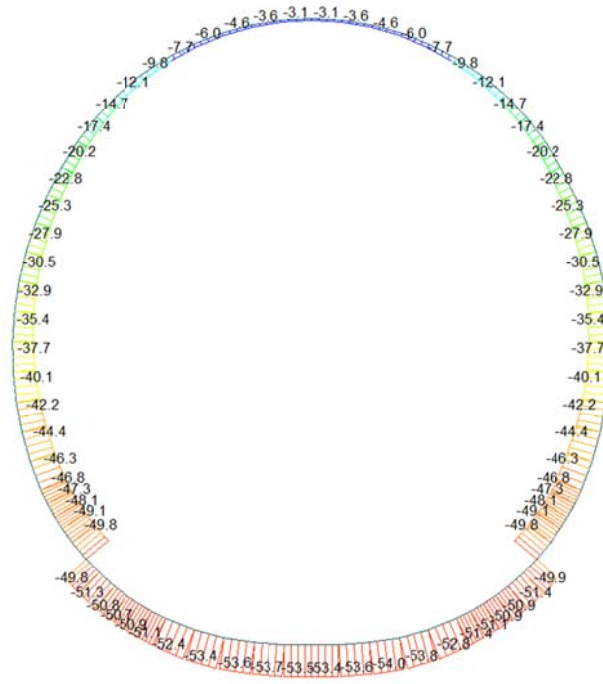


Beam Diagram_My / ST_NSLE - 1

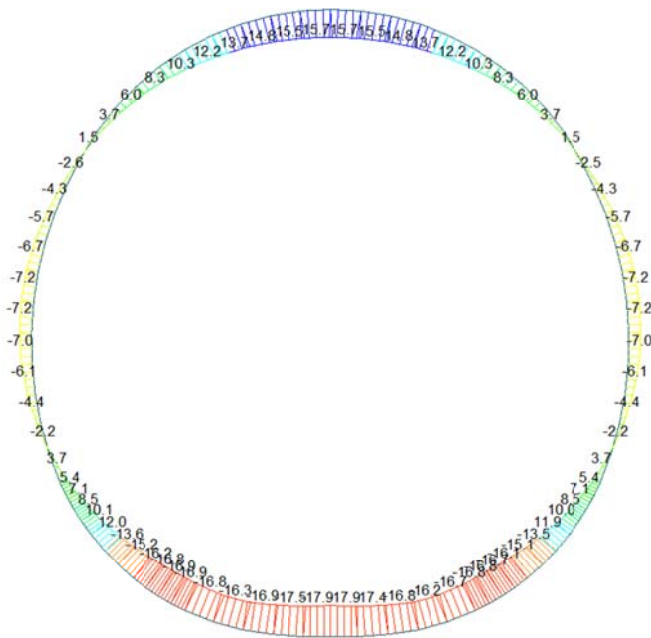


A.6.4.21. Load combination SLE 2

Beam Diagram_Fx / ST_NSLE - 2

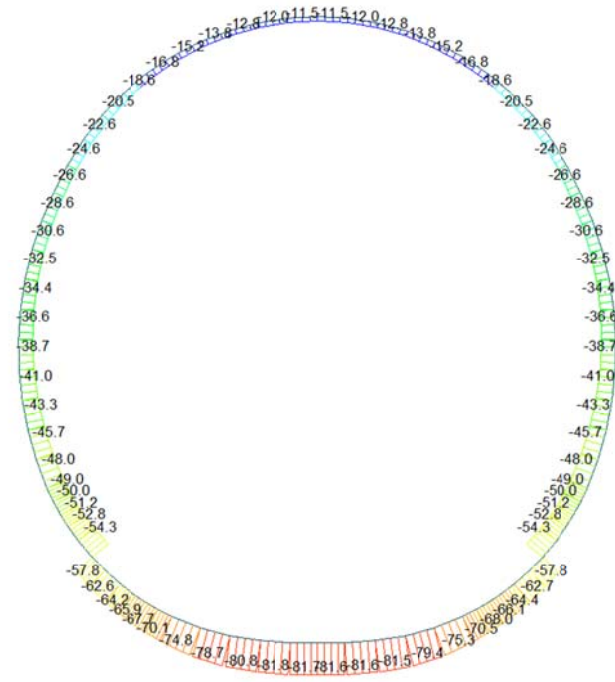


Beam Diagram_My / ST_NSLE - 2



A.6.4.22. Load combination SLE 3

Beam Diagram_Fx / ST_NSLE - 3



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

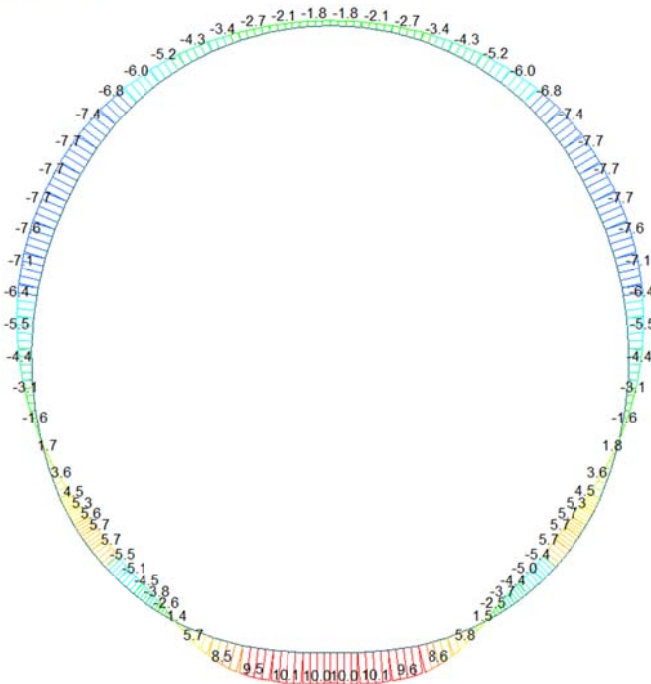
AXIAL

Blue	-11.40
Cyan	-17.80
Green	-24.20
Light Green	-30.59
Yellow-Green	-36.99
Yellow	-43.38
Orange-Yellow	-49.78
Orange	-56.18
Red-Orange	-62.57
Red	-68.97
Dark Red	-75.36
Black	-81.76

ST: NSLE - 3
MAX : 49
MIN : 10
FILE: F0E_C01-C0-
UNIT: kN
DATE: 06/30/2014

VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_NSLE - 3



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

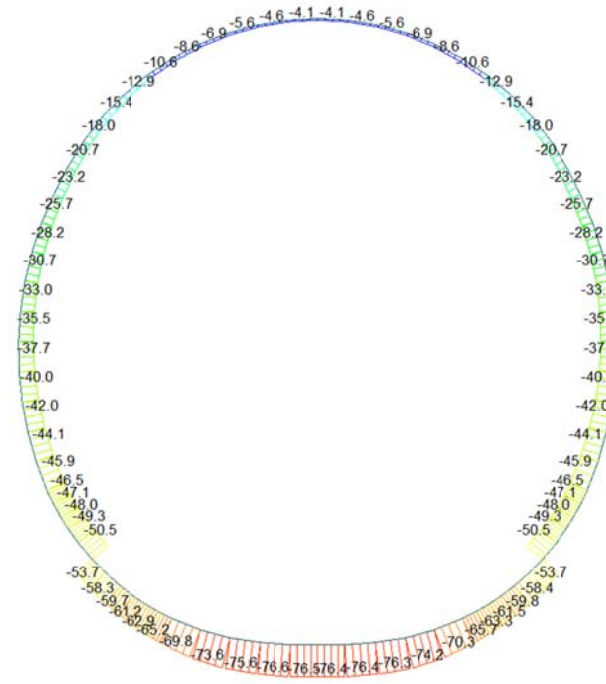
Red	10.14
Orange-Red	8.51
Orange	6.89
Yellow-Orange	5.26
Yellow	3.63
Light Green	2.01
Green	0.00
Light Blue	-1.24
Cyan	-2.87
Blue	-4.50
Dark Blue	-6.12
Black	-7.75

ST: NSLE - 3
MAX : 13
MIN : 37
FILE: F0E_C01-C0-
UNIT: kN*m
DATE: 06/30/2014

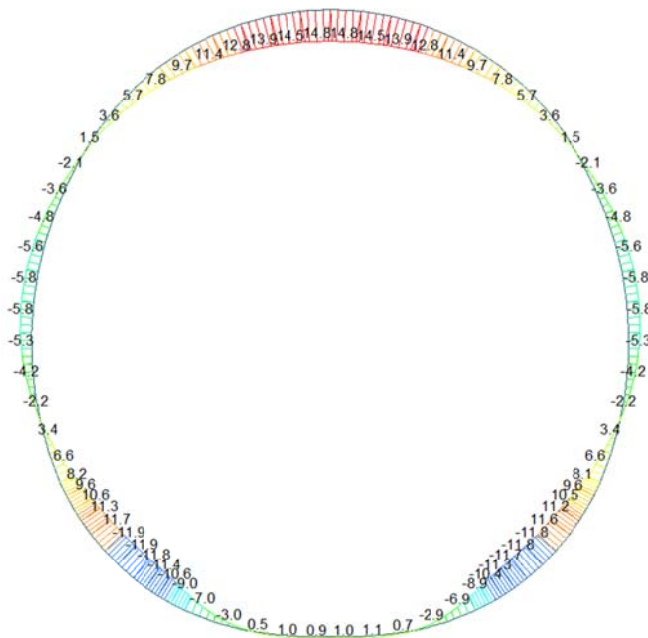
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.23. Load combination SLE 4

Beam Diagram_Fx / ST_NSLE - 4

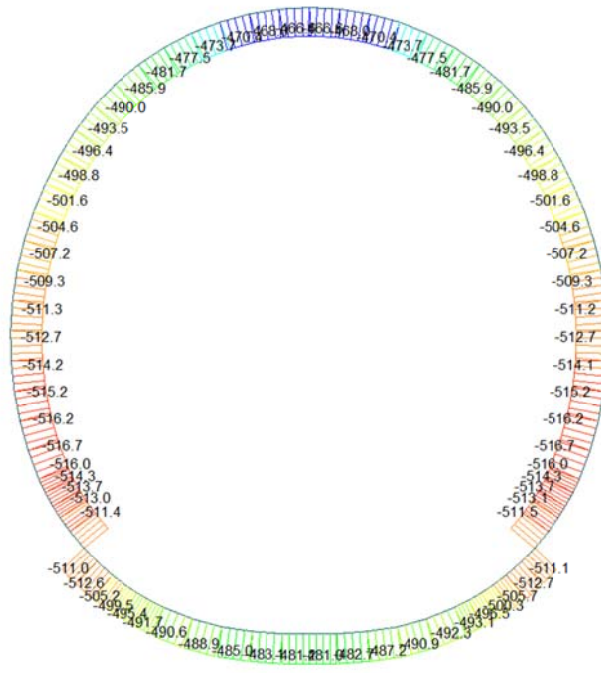


Beam Diagram_My / ST_NSLE - 4

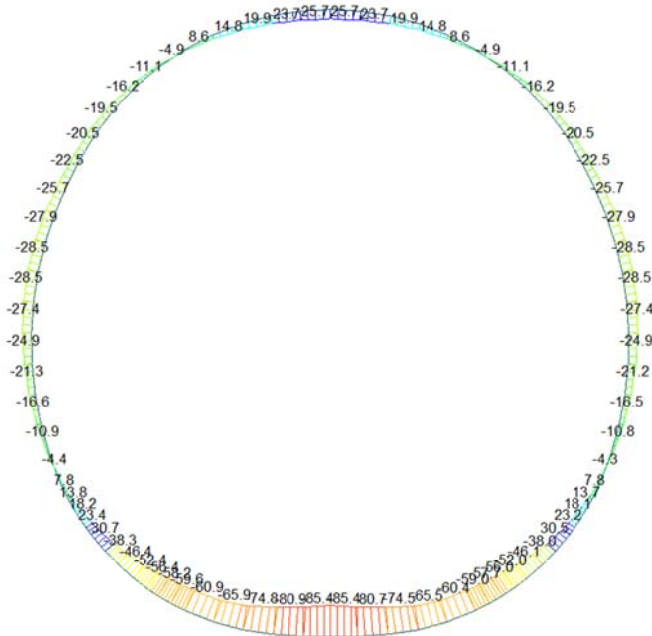


A.6.4.24. Load combination SLE 5

Beam Diagram_Fx / ST_NSLE - 5

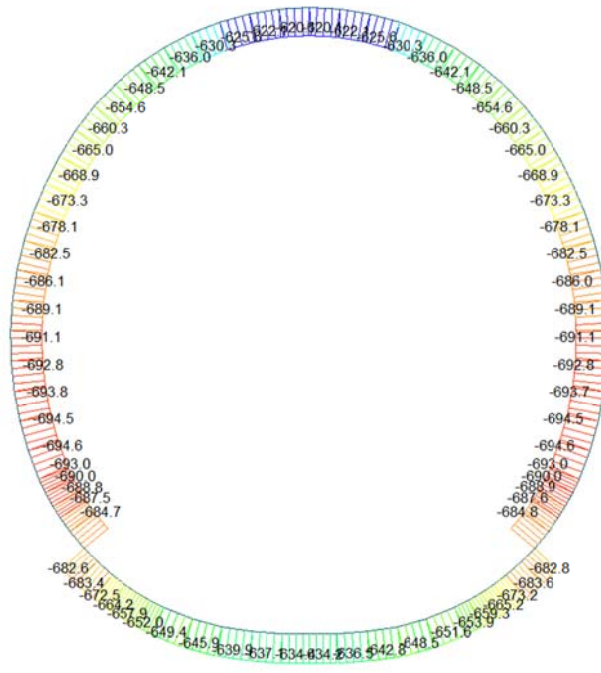


Beam Diagram_My / ST_NSLE - 5

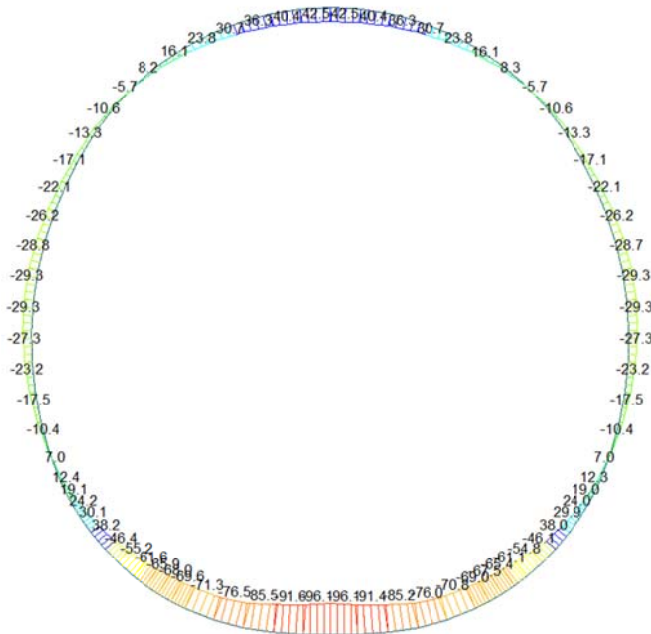


A.6.4.25. Load combination SLE 6

Beam Diagram_Fx / ST_N6

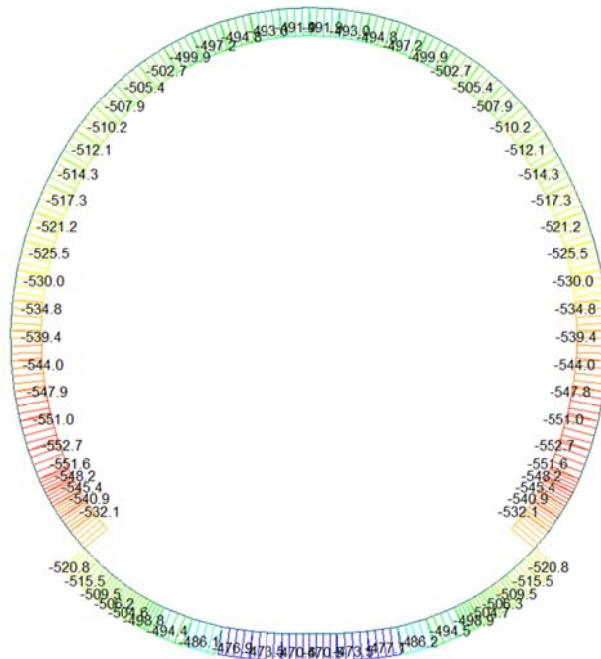


Beam Diagram_My / ST_NSLE - 6

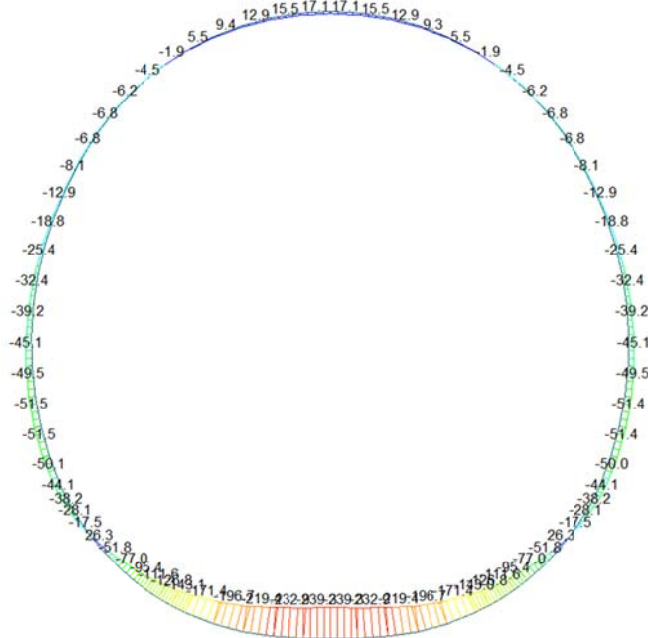


A.6.4.26. Load combination SLE 7

Beam Diagram_Fx / ST_NSLE - 7

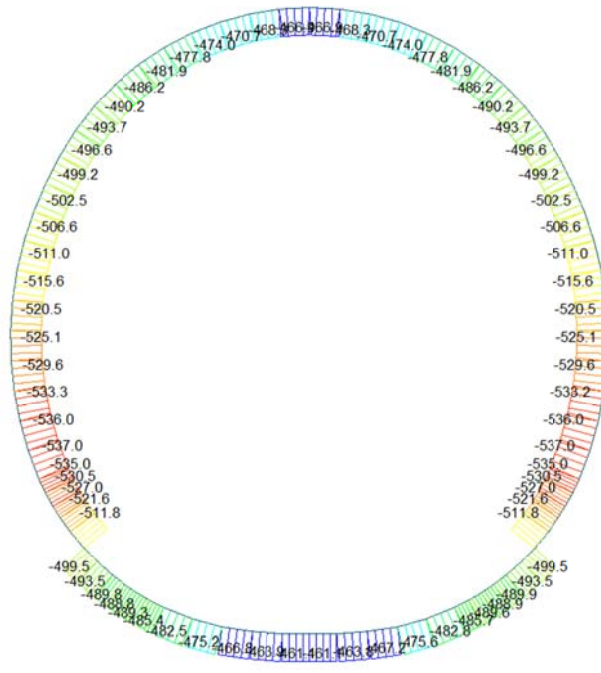


Beam Diagram_My / ST_NSLE - 7

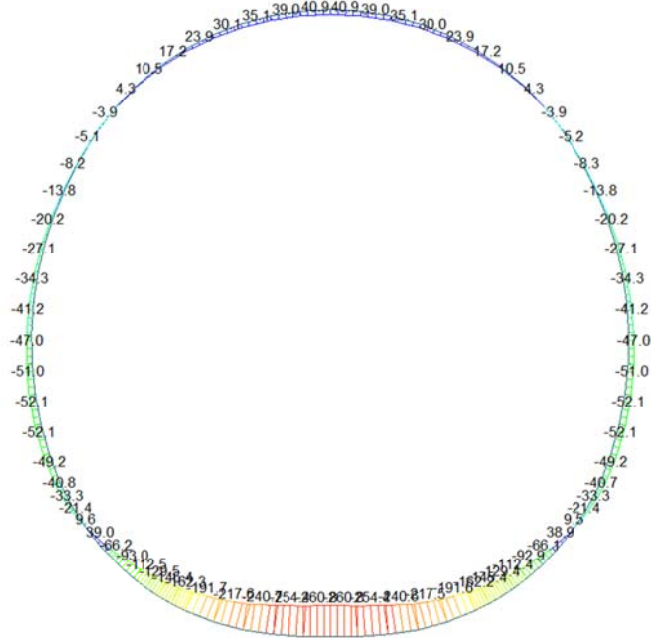


A.6.4.27. Load combination SLE 8

Beam Diagram_Fx / ST_NSLE - 8

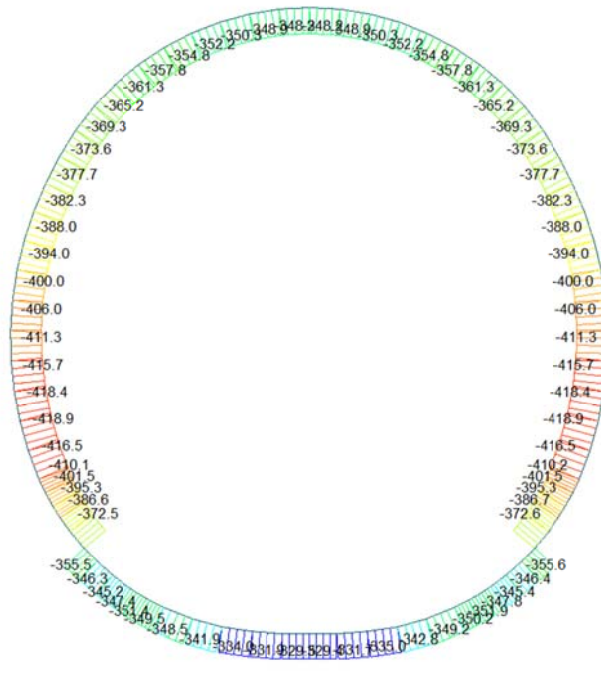


Beam Diagram_My / ST_NSLE - 8

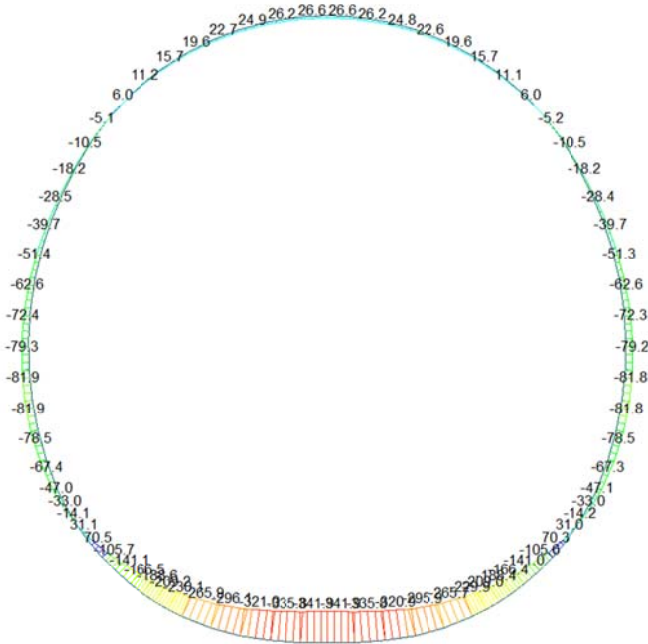


A.6.4.28. Load combination SLE 9

Beam Diagram_Fx / ST_NSLE - 9

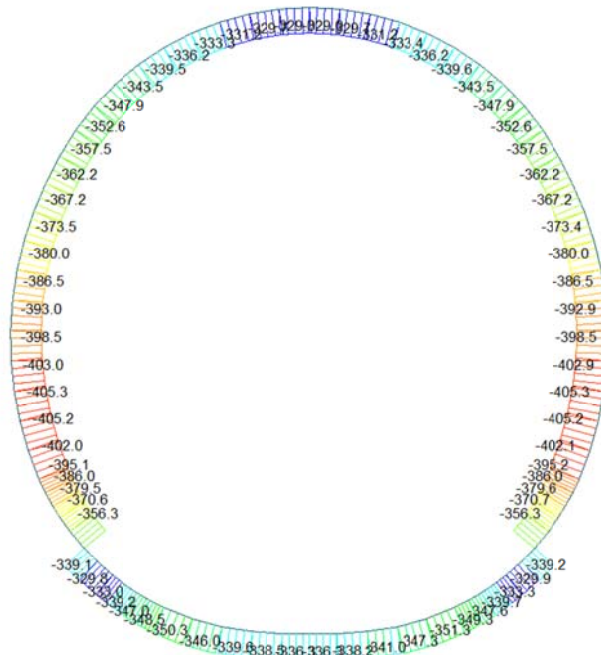


Beam Diagram_My / ST_NSLE - 9



A.6.4.29. Load combination SLE 10

Beam Diagram_Fx / ST_NSLE - 10



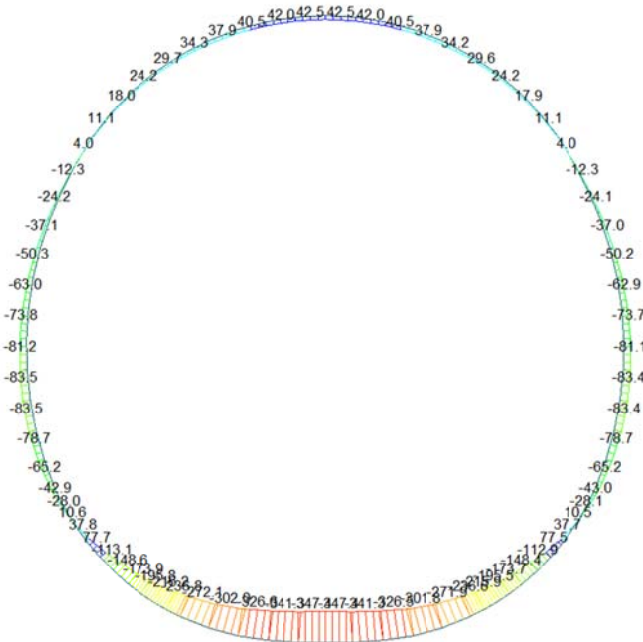
midas Gen
POST-PROCESSOR
BEAM DIAGRAM

AXIAL

Blue	-325.21
Cyan	-332.49
Green	-339.77
Light Green	-347.05
Yellow-Green	-354.33
Yellow	-361.61
Orange-Yellow	-368.89
Orange	-376.17
Red-Orange	-383.46
Red	-390.74
Dark Red	-398.02
Black	-405.30

ST: NSLE - 10
MAX : 2
MIN : 67
FILE: FdE_C01-C0-
UNIT: kN
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

Beam Diagram_My / ST_NSLE - 10



midas Gen
POST-PROCESSOR
BEAM DIAGRAM

MOMENT-y

Blue	77.70
Cyan	39.06
Green	0.00
Light Green	-38.24
Yellow-Green	-76.88
Yellow	-115.53
Orange-Yellow	-154.17
Orange	-192.82
Red-Orange	-231.46
Red	-270.11
Dark Red	-308.76
Black	-347.40

ST: NSLE - 10
MAX : 74
MIN : 11
FILE: FdE_C01-C0-
UNIT: kN*m
DATE: 06/30/2014
VIEW-DIRECTION
X: 0.000
Y: -1.000
Z: 0.000

A.6.4.30. Stress checking for load combination without swelling and squeezing

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	σ_c, MAX	σ_c, Adm	CHECK	σ_s, MAX	σ_s, Adm	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
1	100 x 36		SLE - N6	0.50	2.90	OK	-3.02	-18.00	OK	1.84	360.00	OK
3	1.00	0.36										
2	100 x 70		SLE - N6	0.12	2.90	OK	-1.26	-18.00	OK	0.54	360.00	OK
8	1.00	0.75										
3	100 x 70		SLE - N6	0.13	2.90	OK	-1.32	-18.00	OK	0.62	360.00	OK
8	1.00	0.75										
4	100 x 90		SLE - N6	0.07	2.90	OK	-0.95	-18.00	OK	0.35	360.00	OK
9	1.00	0.90										
5	100 x 90		SLE - N6	0.08	2.90	OK	-0.95	-18.00	OK	0.36	360.00	OK
9	1.00	0.90										
6	100 x 90		SLE - N6	0.08	2.90	OK	-0.96	-18.00	OK	0.37	360.00	OK
9	1.00	0.90										
7	100 x 90		SLE - N6	0.08	2.90	OK	-0.97	-18.00	OK	0.37	360.00	OK
9	1.00	0.90										
8	100 x 90		SLE - N6	0.07	2.90	OK	-1.00	-18.00	OK	0.34	360.00	OK
9	1.00	0.90										
9	100 x 90		SLE - N6	0.08	2.90	OK	-1.06	-18.00	OK	0.37	360.00	OK
9	1.00	0.90										
10	100 x 90		SLE - N6	0.08	2.90	OK	-1.11	-18.00	OK	0.39	360.00	OK
9	1.00	0.90										
11	100 x 90		SLE - N6	0.09	2.90	OK	-1.14	-18.00	OK	0.41	360.00	OK
9	1.00	0.90										
12	100 x 90		SLE - N6	0.09	2.90	OK	-1.14	-18.00	OK	0.41	360.00	OK
9	1.00	0.90										
13	100 x 90		SLE - N6	0.08	2.90	OK	-1.11	-18.00	OK	0.39	360.00	OK
9	1.00	0.90										
14	100 x 90		SLE - N6	0.08	2.90	OK	-1.06	-18.00	OK	0.36	360.00	OK
9	1.00	0.90										
15	100 x 90		SLE - N6	0.07	2.90	OK	-1.00	-18.00	OK	0.33	360.00	OK
9	1.00	0.90										
16	100 x 90		SLE - N6	0.08	2.90	OK	-0.97	-18.00	OK	0.36	360.00	OK
9	1.00	0.90										
17	100 x 90		SLE - N6	0.08	2.90	OK	-0.96	-18.00	OK	0.36	360.00	OK
9	1.00	0.90										
18	100 x 90		SLE - N6	0.08	2.90	OK	-0.95	-18.00	OK	0.36	360.00	OK
9	1.00	0.90										
19	100 x 90		SLE - N6	0.07	2.90	OK	-0.94	-18.00	OK	0.35	360.00	OK
9	1.00	0.90										
20	100 x 70		SLE - N6	0.13	2.90	OK	-1.31	-18.00	OK	0.61	360.00	OK
8	1.00	0.75										
21	100 x 70		SLE - N6	0.12	2.90	OK	-1.25	-18.00	OK	0.53	360.00	OK
8	1.00	0.75										
22	100 x 36		SLE - N6	0.50	2.90	OK	-3.01	-18.00	OK	1.83	360.00	OK
3	1.00	0.36										
23	100 x 45		SLE - N6	0.25	2.90	OK	-1.94	-18.00	OK	0.95	360.00	OK
4	1.00	0.45										
24	100 x 60		SLE - N6	0.10	2.90	OK	-1.19	-18.00	OK	0.39	360.00	OK
7	1.00	0.60										
25	100 x 60		SLE - N6	0.08	2.90	OK	-1.11	-18.00	OK	0.33	360.00	OK
7	1.00	0.60										
26	100 x 55		SLE - N6	0.09	2.90	OK	-1.15	-18.00	OK	0.32	360.00	OK
6	1.00	0.55										
27	100 x 55		SLE - N6	0.06	2.90	OK	-1.04	-18.00	OK	0.17	360.00	OK
6	1.00	0.55										
28	100 x 50		SLE - N5	0.04	2.90	OK	-1.18	-18.00	OK	0.06	360.00	OK
5	1.00	0.50										
29	100 x 50		SLE - N5	0.04	2.90	OK	-1.32	-18.00	OK	0.00	360.00	OK
5	1.00	0.50										
30	100 x 45		SLE - N5	0.11	2.90	OK	-1.66	-18.00	OK	0.24	360.00	OK
4	1.00	0.45										

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	$\sigma_{c, MAX}$	$\sigma_{c, Adm}$	CHECK	$\sigma_{s, MAX}$	$\sigma_{s, Adm}$	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
31	100 x 45		SLE - N6	0.13	2.90	OK	-1.78	-18.00	OK	0.39	360.00	OK
4	1.00	0.45										
32	100 x 40		SLE - N5	0.21	2.90	OK	-2.22	-18.00	OK	0.63	360.00	OK
2	1.00	0.40										
33	100 x 40		SLE - N5	0.22	2.90	OK	-2.31	-18.00	OK	0.67	360.00	OK
2	1.00	0.40										
34	100 X 35		SLE - N5	0.31	2.90	OK	-2.87	-18.00	OK	0.92	360.00	OK
1	1.00	0.35										
35	100 X 35		SLE - N5	0.31	2.90	OK	-2.87	-18.00	OK	0.92	360.00	OK
1	1.00	0.35										
36	100 X 35		SLE - N5	0.30	2.90	OK	-2.86	-18.00	OK	0.95	360.00	OK
1	1.00	0.35										
37	100 X 35		SLE - N5	0.30	2.90	OK	-2.77	-18.00	OK	1.00	360.00	OK
1	1.00	0.35										
38	100 X 35		SLE - N5	0.31	2.90	OK	-2.64	-18.00	OK	1.07	360.00	OK
1	1.00	0.35										
39	100 X 35		SLE - N5	0.33	2.90	OK	-2.56	-18.00	OK	1.16	360.00	OK
1	1.00	0.35										
40	100 X 35		SLE - N5	0.37	2.90	OK	-2.53	-18.00	OK	1.42	360.00	OK
1	1.00	0.35										
41	100 X 35		SLE - N5	0.51	2.90	OK	-2.38	-18.00	OK	2.02	360.00	OK
1	1.00	0.35										
42	100 X 35		SLE - N2	0.64	2.90	OK	-2.15	-18.00	OK	2.60	360.00	OK
1	1.00	0.35										
43	100 X 35		SLE - N2	0.77	2.90	OK	-1.85	-18.00	OK	3.13	360.00	OK
1	1.00	0.35										
44	100 X 35		SLE - N2	0.88	2.90	OK	-1.53	-18.00	OK	3.59	360.00	OK
1	1.00	0.35										
45	100 X 35		SLE - N2	0.97	2.90	OK	-1.81	-18.00	OK	3.96	360.00	OK
1	1.00	0.35										
46	100 X 35		SLE - N2	1.03	2.90	OK	-2.04	-18.00	OK	4.24	360.00	OK
1	1.00	0.35										
47	100 X 35		SLE - N2	1.08	2.90	OK	-2.19	-18.00	OK	4.42	360.00	OK
1	1.00	0.35										
48	100 X 35		SLE - N2	1.09	2.90	OK	-2.25	-18.00	OK	4.48	360.00	OK
1	1.00	0.35										
49	100 X 35		SLE - N2	1.09	2.90	OK	-2.25	-18.00	OK	4.48	360.00	OK
1	1.00	0.35										
50	100 X 35		SLE - N2	1.08	2.90	OK	-2.19	-18.00	OK	4.42	360.00	OK
1	1.00	0.35										
51	100 X 35		SLE - N2	1.03	2.90	OK	-2.04	-18.00	OK	4.24	360.00	OK
1	1.00	0.35										
52	100 X 35		SLE - N2	0.97	2.90	OK	-1.81	-18.00	OK	3.96	360.00	OK
1	1.00	0.35										
53	100 X 35		SLE - N2	0.88	2.90	OK	-1.53	-18.00	OK	3.59	360.00	OK
1	1.00	0.35										
54	100 X 35		SLE - N2	0.77	2.90	OK	-1.85	-18.00	OK	3.13	360.00	OK
1	1.00	0.35										
55	100 X 35		SLE - N2	0.64	2.90	OK	-2.15	-18.00	OK	2.60	360.00	OK
1	1.00	0.35										
56	100 X 35		SLE - N5	0.51	2.90	OK	-2.38	-18.00	OK	2.02	360.00	OK
1	1.00	0.35										
57	100 X 35		SLE - N5	0.36	2.90	OK	-2.53	-18.00	OK	1.42	360.00	OK
1	1.00	0.35										
58	100 X 35		SLE - N5	0.33	2.90	OK	-2.56	-18.00	OK	1.15	360.00	OK
1	1.00	0.35										
59	100 X 35		SLE - N5	0.31	2.90	OK	-2.64	-18.00	OK	1.06	360.00	OK
1	1.00	0.35										
60	100 X 35		SLE - N5	0.30	2.90	OK	-2.78	-18.00	OK	0.99	360.00	OK
1	1.00	0.35										

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	σ_c, MAX	σ_c, Adm	CHECK	σ_s, MAX	σ_s, Adm	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
61	100 X 35		SLE - N5	0.30	2.90	OK	-2.86	-18.00	OK	0.94	360.00	OK
1	1.00	0.35										
62	100 X 35		SLE - N5	0.31	2.90	OK	-2.87	-18.00	OK	0.92	360.00	OK
1	1.00	0.35										
63	100 X 35		SLE - N5	0.31	2.90	OK	-2.87	-18.00	OK	0.92	360.00	OK
1	1.00	0.35										
64	100 x 40		SLE - N5	0.22	2.90	OK	-2.31	-18.00	OK	0.68	360.00	OK
2	1.00	0.40										
65	100 x 40		SLE - N5	0.21	2.90	OK	-2.22	-18.00	OK	0.63	360.00	OK
2	1.00	0.40										
66	100 x 45		SLE - N6	0.14	2.90	OK	-1.79	-18.00	OK	0.39	360.00	OK
4	1.00	0.45										
67	100 x 45		SLE - N5	0.11	2.90	OK	-1.66	-18.00	OK	0.25	360.00	OK
4	1.00	0.45										
68	100 x 50		SLE - N5	0.04	2.90	OK	-1.33	-18.00	OK	0.00	360.00	OK
5	1.00	0.50										
69	100 x 50		SLE - N5	0.04	2.90	OK	-1.18	-18.00	OK	0.06	360.00	OK
5	1.00	0.50										
70	100 x 55		SLE - N6	0.06	2.90	OK	-1.04	-18.00	OK	0.17	360.00	OK
6	1.00	0.55										
71	100 x 55		SLE - N6	0.09	2.90	OK	-1.15	-18.00	OK	0.33	360.00	OK
6	1.00	0.55										
72	100 x 60		SLE - N6	0.09	2.90	OK	-1.11	-18.00	OK	0.33	360.00	OK
7	1.00	0.60										
73	100 x 60		SLE - N6	0.10	2.90	OK	-1.19	-18.00	OK	0.39	360.00	OK
7	1.00	0.60										
74	100 x 45		SLE - N6	0.25	2.90	OK	-1.94	-18.00	OK	0.95	360.00	OK
4	1.00	0.45										

A.6.4.31. Stress checking for load combination with swelling and squeezing

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	$\sigma_{c, MAX}$	$\sigma_{c, Adm}$	CHECK	$\sigma_{s, MAX}$	$\sigma_{s, Adm}$	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
1	100 x 36		SLE - N10	4.30	2.90	FESSURATO	-6.18	-18.00	OK	16.08	360.00	OK
3	1.00	0.36										
2	100 x 70		SLE - N10	1.35	2.90	OK	-2.29	-18.00	OK	6.42	360.00	OK
8	1.00	0.75										
3	100 x 70		SLE - N10	1.65	2.90	OK	-2.61	-18.00	OK	7.97	360.00	OK
8	1.00	0.75										
4	100 x 90		SLE - N10	1.07	2.90	OK	-1.83	-18.00	OK	5.43	360.00	OK
9	1.00	0.90										
5	100 x 90		SLE - N10	1.22	2.90	OK	-1.99	-18.00	OK	6.18	360.00	OK
9	1.00	0.90										
6	100 x 90		SLE - N10	1.37	2.90	OK	-2.14	-18.00	OK	6.98	360.00	OK
9	1.00	0.90										
7	100 x 90		SLE - N10	1.63	2.90	OK	-2.40	-18.00	OK	8.36	360.00	OK
9	1.00	0.90										
8	100 x 90		SLE - N10	1.85	2.90	OK	-2.62	-18.00	OK	9.57	360.00	OK
9	1.00	0.90										
9	100 x 90		SLE - N10	2.04	2.90	OK	-2.80	-18.00	OK	10.59	360.00	OK
9	1.00	0.90										
10	100 x 90		SLE - N10	2.15	2.90	OK	-2.90	-18.00	OK	11.18	360.00	OK
9	1.00	0.90										
11	100 x 90		SLE - N10	2.20	2.90	OK	-2.95	-18.00	OK	11.43	360.00	OK
9	1.00	0.90										
12	100 x 90		SLE - N10	2.20	2.90	OK	-2.95	-18.00	OK	11.43	360.00	OK
9	1.00	0.90										
13	100 x 90		SLE - N10	2.15	2.90	OK	-2.90	-18.00	OK	11.18	360.00	OK
9	1.00	0.90										
14	100 x 90		SLE - N10	2.04	2.90	OK	-2.80	-18.00	OK	10.57	360.00	OK
9	1.00	0.90										
15	100 x 90		SLE - N10	1.85	2.90	OK	-2.62	-18.00	OK	9.55	360.00	OK
9	1.00	0.90										
16	100 x 90		SLE - N10	1.62	2.90	OK	-2.40	-18.00	OK	8.35	360.00	OK
9	1.00	0.90										
17	100 x 90		SLE - N10	1.36	2.90	OK	-2.14	-18.00	OK	6.97	360.00	OK
9	1.00	0.90										
18	100 x 90		SLE - N10	1.21	2.90	OK	-1.99	-18.00	OK	6.17	360.00	OK
9	1.00	0.90										
19	100 x 90		SLE - N10	1.07	2.90	OK	-1.83	-18.00	OK	5.41	360.00	OK
9	1.00	0.90										
20	100 x 70		SLE - N10	1.65	2.90	OK	-2.60	-18.00	OK	7.95	360.00	OK
8	1.00	0.75										
21	100 x 70		SLE - N10	1.35	2.90	OK	-2.29	-18.00	OK	6.40	360.00	OK
8	1.00	0.75										
22	100 x 36		SLE - N10	4.29	2.90	FESSURATO	-6.17	-18.00	OK	16.04	360.00	OK
3	1.00	0.36										
23	100 x 45		SLE - N10	1.51	2.90	OK	-3.09	-18.00	OK	5.63	360.00	OK
4	1.00	0.45										
24	100 x 60		SLE - N7	0.01	2.90	OK	-1.25	-18.00	OK	0.00	360.00	OK
7	1.00	0.60										
25	100 x 60		SLE - N7	0.00	2.90	OK	-1.38	-18.00	OK	0.00	360.00	OK
7	1.00	0.60										
26	100 x 55		SLE - N7	0.00	2.90	OK	-1.75	-18.00	OK	0.00	360.00	OK
6	1.00	0.55										
27	100 x 55		SLE - N7	0.19	2.90	OK	-1.87	-18.00	OK	0.00	360.00	OK
6	1.00	0.55										
28	100 x 50		SLE - N9	0.79	2.90	OK	-2.44	-18.00	OK	2.57	360.00	OK
5	1.00	0.50										
29	100 x 50		SLE - N9	1.08	2.90	OK	-2.72	-18.00	OK	3.98	360.00	OK
5	1.00	0.50										
30	100 x 45		SLE - N9	1.58	2.90	OK	-3.37	-18.00	OK	5.80	360.00	OK
4	1.00	0.45										

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	$\sigma_{c, MAX}$	$\sigma_{c, Adm}$	CHECK	$\sigma_{s, MAX}$	$\sigma_{s, Adm}$	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
31	100 x 45		SLE - N9	1.58	2.90	OK	-3.37	-18.00	OK	5.80	360.00	OK
4	1.00	0.45										
32	100 x 40		SLE - N10	2.05	2.90	OK	-4.04	-18.00	OK	7.19	360.00	OK
2	1.00	0.40										
33	100 x 40		SLE - N10	1.78	2.90	OK	-3.74	-18.00	OK	6.06	360.00	OK
2	1.00	0.40										
34	100 X 35		SLE - N9	1.98	2.90	OK	-4.21	-18.00	OK	5.93	360.00	OK
1	1.00	0.35										
35	100 X 35		SLE - N9	1.39	2.90	OK	-3.64	-18.00	OK	3.50	360.00	OK
1	1.00	0.35										
36	100 X 35		SLE - N9	0.84	2.90	OK	-3.05	-18.00	OK	1.24	360.00	OK
1	1.00	0.35										
37	100 X 35		SLE - N9	0.30	2.90	OK	-2.49	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
38	100 X 35		SLE - N7	0.00	2.90	OK	-1.97	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
39	100 X 35		SLE - N7	0.00	2.90	OK	-1.79	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
40	100 X 35		SLE - N7	0.00	2.90	OK	-1.79	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
41	100 X 35		SLE - N7	0.00	2.90	OK	-1.87	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
42	100 X 35		SLE - N10	0.21	2.90	OK	-2.16	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
43	100 X 35		SLE - N10	0.49	2.90	OK	-2.42	-18.00	OK	0.08	360.00	OK
1	1.00	0.35										
44	100 X 35		SLE - N10	0.72	2.90	OK	-2.63	-18.00	OK	1.06	360.00	OK
1	1.00	0.35										
45	100 X 35		SLE - N10	0.90	2.90	OK	-2.82	-18.00	OK	1.83	360.00	OK
1	1.00	0.35										
46	100 X 35		SLE - N10	1.04	2.90	OK	-3.06	-18.00	OK	2.39	360.00	OK
1	1.00	0.35										
47	100 X 35		SLE - N10	1.12	2.90	OK	-3.22	-18.00	OK	2.72	360.00	OK
1	1.00	0.35										
48	100 X 35		SLE - N10	1.14	2.90	OK	-3.28	-18.00	OK	2.84	360.00	OK
1	1.00	0.35										
49	100 X 35		SLE - N10	1.14	2.90	OK	-3.28	-18.00	OK	2.84	360.00	OK
1	1.00	0.35										
50	100 X 35		SLE - N10	1.12	2.90	OK	-3.22	-18.00	OK	2.73	360.00	OK
1	1.00	0.35										
51	100 X 35		SLE - N10	1.04	2.90	OK	-3.06	-18.00	OK	2.39	360.00	OK
1	1.00	0.35										
52	100 X 35		SLE - N10	0.91	2.90	OK	-2.82	-18.00	OK	1.84	360.00	OK
1	1.00	0.35										
53	100 X 35		SLE - N10	0.72	2.90	OK	-2.64	-18.00	OK	1.07	360.00	OK
1	1.00	0.35										
54	100 X 35		SLE - N10	0.49	2.90	OK	-2.42	-18.00	OK	0.08	360.00	OK
1	1.00	0.35										
55	100 X 35		SLE - N10	0.21	2.90	OK	-2.16	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
56	100 X 35		SLE - N8	0.00	2.90	OK	-1.87	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
57	100 X 35		SLE - N7	0.00	2.90	OK	-1.79	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
58	100 X 35		SLE - N7	0.00	2.90	OK	-1.79	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
59	100 X 35		SLE - N7	0.00	2.90	OK	-1.97	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										
60	100 X 35		SLE - N9	0.30	2.90	OK	-2.49	-18.00	OK	0.00	360.00	OK
1	1.00	0.35										

STRESS CONTROL												
MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$	$\sigma_{ct, Adm}$	CHECK	$\sigma_{c, MAX}$	$\sigma_{c, Adm}$	CHECK	$\sigma_{s, MAX}$	$\sigma_{s, Adm}$	CHECK
SECTION	Bc (m)	Hc (m)		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]		[N/mm ²]	[N/mm ²]	
61	100 X 35		SLE - N9	0.84	2.90	OK	-3.05	-18.00	OK	1.24	360.00	OK
1	1.00	0.35										
62	100 X 35		SLE - N9	1.39	2.90	OK	-3.64	-18.00	OK	3.52	360.00	OK
1	1.00	0.35										
63	100 X 35		SLE - N10	1.98	2.90	OK	-4.21	-18.00	OK	5.95	360.00	OK
1	1.00	0.35										
64	100 x 40		SLE - N9	1.78	2.90	OK	-3.75	-18.00	OK	6.07	360.00	OK
2	1.00	0.40										
65	100 x 40		SLE - N10	2.05	2.90	OK	-4.04	-18.00	OK	7.20	360.00	OK
2	1.00	0.40										
66	100 x 45		SLE - N9	1.58	2.90	OK	-3.37	-18.00	OK	5.81	360.00	OK
4	1.00	0.45										
67	100 x 45		SLE - N9	1.58	2.90	OK	-3.37	-18.00	OK	5.81	360.00	OK
4	1.00	0.45										
68	100 x 50		SLE - N9	1.08	2.90	OK	-2.72	-18.00	OK	3.99	360.00	OK
5	1.00	0.50										
69	100 x 50		SLE - N9	0.79	2.90	OK	-2.44	-18.00	OK	2.57	360.00	OK
5	1.00	0.50										
70	100 x 55		SLE - N7	0.19	2.90	OK	-1.87	-18.00	OK	0.00	360.00	OK
6	1.00	0.55										
71	100 x 55		SLE - N7	0.00	2.90	OK	-1.75	-18.00	OK	0.00	360.00	OK
6	1.00	0.55										
72	100 x 60		SLE - N7	0.00	2.90	OK	-1.38	-18.00	OK	0.00	360.00	OK
7	1.00	0.60										
73	100 x 60		SLE - N7	0.01	2.90	OK	-1.25	-18.00	OK	0.00	360.00	OK
7	1.00	0.60										
74	100 x 45		SLE - N10	1.51	2.90	OK	-3.09	-18.00	OK	5.66	360.00	OK
4	1.00	0.45										

Crack checking for determinants cracked members

MEMBER	SECTION PROPERTIES		LOAD CB	$\sigma_{ct, MAX}$ [N/mm ²]	$\sigma_{ct, Adm}$ [N/mm ²]
SECTION	Bc (m)	Hc (m)			
1	100 x 36		SLE - N10	4.30	2.90
3	1.00	0.36			
22	100 x 36		SLE - N10	4.30	2.90
3	1.00	0.36			

