

COMMITTENTE:



PROGETTAZIONE:



**DIREZIONE TECNICA  
SO GALLERIE**

**PROGETTO DEFINITIVO**

**LINEA PALERMO – MESSINA. RADDOPPIO FIUMETORTO – CEFALU'  
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**Fermata Cefalù – Rampa di accesso alla galleria di sfollamento**

Relazione sulle subsidenze e verifica degli effetti indotti sulle opere in  
superficie

SCALA:

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## 1 PREMESSA

La variante prevede l’allungamento della rampa della galleria di sfollamento scavata in tradizionale tra le due gallerie di linea per una lunghezza di circa 550 metri. Nella presente relazione si analizzano gli effetti sulle opere in superficie prodotti dalla variante in oggetto.

L’opera sotto-attraversa un’area urbanizzata nei primi 300m, sostanzialmente alla stessa quota delle gallerie di linea, tra le quali si sviluppa, con coperture all’incirca di 30m. Successivamente, quando riprende a salire più repentinamente, interessa aree non abitate (ad eccezione di un solo edificio) fino all’imbocco.

La galleria attraversa prevalentemente la formazione del flysch numidico nella litofacies pelitico arenacea (FNaq) e solo negli ultimi 50 metri, prima dell’imbocco, interessa, con la calotta, il deposito quaternario dei terrazzi marini. Per la maggior parte del tracciato lo spessore del flysch sulla calotta è dell’ordine del diametro di scavo (8-10m) che si assottiglia, fino a scomparire negli ultimi 60m nella zona di imbocco.

Nel dettaglio la fermata Cefalù prevede in successione: lo scavo della galleria di linea del binario pari mediante TBM scudata, la realizzazione della galleria centrale di sfollamento con scavo in tradizionale e, infine, lo scavo della seconda galleria di banchina mediante TBM scudata ad un interasse di circa 47 m. In tale tratta le gallerie di linea e di sfollamento interessano il Flysch Numidico nella facies pelitico-arenacea.

Gli edifici sottoposti a verifica sono quelli ricadenti nel bacino di subsidenza ed interessati dall’allungamento della rampa di sfollamento.

Si evidenzia che la galleria in variante della rampa di sfollamento sotto-passa numerosi fabbricati già interessati dai cedimenti prodotti dalle due gallerie di linea appena prima dalla fermata Cefalù dal lato Palermo. Nelle varie fasi progettuali precedenti, fino al livello esecutivo, tutta la zona della fermata è stata già oggetto di verifica di eventuali effetti prodotti sugli edifici soprastanti le opere in sottoraneo. Le valutazioni che seguono sono volte a verificare che la variante della rampa non modifica le previsioni già effettuate partendo dagli stessi modelli ed ipotesi già effettuate nelle progettazioni precedenti.

La metodologia di lavoro si è sviluppata seguendo i seguenti passi:

1. Studio della subsidenza: analisi dei cedimenti provocati sulle opere in superficie dagli scavi in sottoraneo (curve di subsidenza) attraverso procedimento semiempirico (Attewell et al. 1986) (cap. 3);
2. Studio degli effetti sugli edifici: valutazione del rischio di danno provocato sulle opere in superficie dai cedimenti del terreno utilizzando un procedimento semiempirico (Burland, 1995; Mair, Taylor, Burland, 1996) (cap. 4).

## 2 DOCUMENTI DI RIFERIMENTO

### 2.1 Bibliografia

Rif. [1] M. PANET – A. GUENOT “Analysis of Convergence behind the face of a tunnel” – Laboratoire Central des Ponts et Chaussées, Paris, France, 1982.

Rif. [2] R. MAIR – R. N. TAYLOR “Bored Tunnelling in the Urban Environment” – Proceedings of the 14th Int. Conf. On Soil Mech. and Found. Eng., Vol. 4, Hamburg, Germany, 1997.

Rif. [3] R. RIBACCHI “Opere in sotterraneo” – XVIII Convegno Nazionale di Geotecnica, Rimini, Italia, 1993.

Rif. [4] V. S. ROMERO – W. H. HANSMIRE “New Methods for Building Protection from Settlement due to Underground Transit Construction”, 2001.

Rif. [5] BOSCARDIN M.D., CORDING E.G. (1989): “Building response to excavation induced settlement”. Jnl Geo Engrg., ASCE.

Rif. [6] MAIR R.J., TAYLOR R.N., BURLAND J.B. (1996): “Prediction of Ground Movements and Assessment of Risk of Building Damage due to Bored Tunnelling”, Geotechnical Aspects of Underground Construction in Soft Ground, London.

### 2.2 Elaborati di progetto di riferimento

Rif. [7] S.O. Gallerie, documento RS7B00D07RSGN0100000A “Schede edifici interferenti”

Rif. [8] S.O. Gallerie, documento RS7B00D07WBG0100000A “Sezione tipo galleria di sfollamento”

Rif. [9] S.O. Gallerie, documento RS7B00D07P7GN0100000A “Planimetria opere interferenti e classi di danno”

## 3 ALLEGATI

Il documento è corredato dai seguenti allegati:

All. [1] SCHEDE DI ANALISI DEGLI EDIFICI - ANALISI NELLA CONDIZIONE ATTESA;

All. [2] SCHEDE DI ANALISI DEGLI EDIFICI - ANALISI NELLA CONDIZIONE DI CALCOLO;

## 4 STUDIO DELLA SUBSIDENZA

Il primo passo consiste nell’individuare lungo il tracciato le diverse configurazioni che si presentano in funzione della presenza di più gallerie e delle relative fasi esecutive.

Il secondo passo, nella determinazione della distribuzione dei cedimenti in assenza di edifici (conca di subsidenza green field) per ciascuna configurazione individuata.

Si riporta di seguito la sequenza di realizzativa adottata nella configurazione di calcolo:

1. scavo della galleria di banchina binario pari;
2. scavo della galleria di sfollamento
3. scavo della galleria di banchina binario dispari

### 4.1 Cedimenti del terreno in condizioni green field

In questo paragrafo è illustrato il procedimento utilizzato per la valutazione delle subsidenze conseguenti allo scavo della galleria.

Le correlazioni che sono state dedotte consentono di valutare la distribuzione spaziale, l’ampiezza e l’evoluzione delle subsidenze sulla base di parametri di semplice determinazione. Definiti i parametri geometrici della galleria e le caratteristiche del terreno attraversato, è possibile individuare i profili di subsidenza trasversale. L’involuppo della zona interessata dalle deformazioni è infatti funzione della distanza dall’asse verticale della galleria e dipende dalle dimensioni della galleria stessa, dalla sua quota, dal volume perso e dai parametri di resistenza-deformabilità del terreno attraversato.

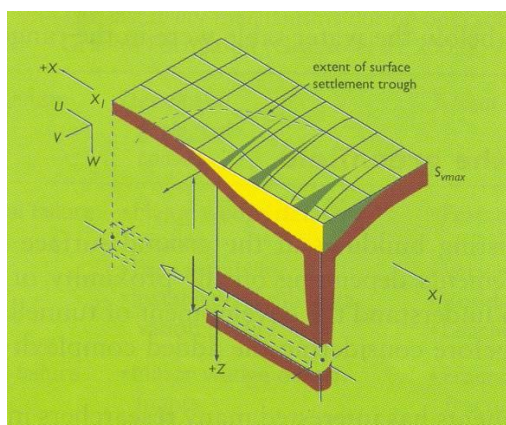
La curva dei cedimenti indotti a breve termine in *senso trasversale* all’asse della galleria in condizioni “green field” (superficie libera), è schematizzabile con buona approssimazione con una curva di probabilità normale ricavabile dalla seguente equazione (Attewell et al. 1986):

$$S_v = \frac{0.313 \cdot V_p \cdot \varphi^2}{(k \cdot z_0)} \cdot e^{\left(\frac{-y^2}{2 \cdot i^2}\right)}$$

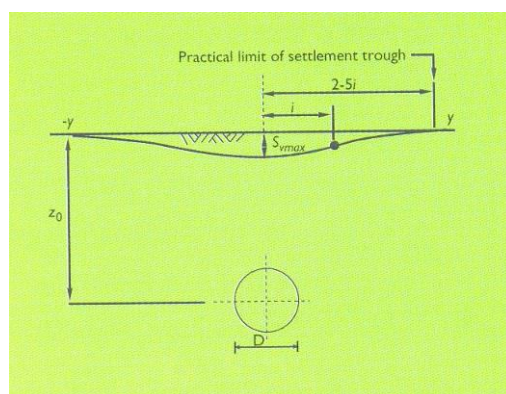
dove:

- $S_v$  = cedimento verticale nel punto posto alla distanza  $y$  dall’asse della galleria;
- $V_p$  = volume perso in superficie, provocato dallo scavo, per unità di lunghezza. Viene espresso come percentuale nominale del volume teorico di scavo. Rappresenta l’area sottesa tra la curva dei cedimenti del piano campagna e la sua superficie indeformata
- $\varphi$  = diametro della galleria;
- $k$  = coefficiente adimensionale dipendente dalla natura dei terreni interessati;

- $z_0$  = profondità dell'asse longitudinale della galleria dal p.c.;
- $y$  = coordinata del punto (di cui si vuole definire il cedimento) misurata rispetto all'asse della galleria;
- $i = k \cdot z_0$  = distanza fra il punto di flesso della curva e l'asse della galleria.



In letteratura i limiti del bacino di subsidenza (oltre i quali gli spostamenti verticali possono essere ritenuti trascurabili) sono posti a  $y = \pm 2.5 i$ . Oltre tali limiti gli spostamenti hanno un valore  $S_v \leq 0.044 S_{v,max}$ , del tutto ininfluyente per gli edifici, e si assumono nulli.



Per l'analisi della subsidenza indotta da più gallerie si opera con la sovrapposizione degli effetti, tenendo conto, come si vedrà in seguito, del disturbo indotto nel terreno dallo scavo delle gallerie precedentemente realizzate.

#### 4.1.1 Valutazione del volume perso

L’analisi di rischio degli edifici è stata condotta per due diverse condizioni di verifica.

La prima condizione viene definita “condizione attesa” ed è considerata rappresentativa del normale avanzamento degli scavi con TBM e con metodologia tradizionale nelle condizioni geologiche e geotecniche attese lungo il tracciato della galleria. Per tale condizione, il volume perso imposto per la determinazione del bacino di subsidenza per i diversi fornici è stato valutato come descritto nella seguente Tabella 1, in funzione delle diverse metodologie di scavo impiegate. In particolare, si è assunto un volume perso pari a 0.5% per lo scavo meccanizzato delle gallerie di linea con TBM scudata e un volume perso pari all’1% per lo scavo della galleria centrale di sfollamento realizzata con metodo tradizionale ed un volume perso pari a 0.5% per le rampe di accesso al piano mezzanino realizzate con metodo tradizionale in presenza di interventi di consolidamento del cavo realizzati in avanzamento.

La seconda, denominata “condizione di calcolo”, è rappresentativa di uno scenario di rischio che contempla eventuali anomalie nel funzionamento della macchina o di comportamento del terreno e consente di ottenere una valutazione conservativa della condizione di rischio degli edifici presenti nell’area interessata dallo scavo delle gallerie. Per tale condizione, il volume perso imposto per la determinazione del bacino di subsidenza per i diversi fornici è stato cautelativamente valutato come descritto nella seguente Tabella 2, in funzione delle diverse metodologie di scavo impiegate. In particolare, si è assunto un volume perso pari a 1% per lo scavo meccanizzato delle gallerie di linea con TBM scudata e un volume perso pari a 2% per lo scavo della galleria centrale di sfollamento realizzata con metodo tradizionale.

Il disturbo indotto nel terreno dallo scavo delle gallerie precedentemente realizzate viene considerato nelle condizioni di interesse ridotto tra le gallerie, laddove tale effetto non risulta trascurabile, incrementando cautelativamente, in ragione del 40%, il valore del volume perso durante lo scavo delle gallerie realizzate successivamente. Pertanto, in corrispondenza della variante della fermata Cefalù, è stato assunto pari a 0.7% e a 1.4%, rispettivamente per la “condizione attesa” e per la “condizione di calcolo”, il volume perso nel calcolo delle subsidenze indotte dallo scavo della galleria di linea binario dispari, nella tratta in affiancamento alla galleria centrale di sfollamento già realizzata.

**Tabella 1: “Condizione attesa” - Volume perso per le diverse sezioni e metodologie di scavo**

Tipologia di sezione	Metodo di scavo	Volume perso
Gallerie di linea binario pari	Scavo meccanizzato	0.5%
Galleria centrale di sfollamento	Scavo in tradizionale	1.0%
Gallerie di linea binario dispari	Scavo meccanizzato	0.7%

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**Tabella 2: “Condizione di calcolo” - Volume perso per le diverse sezioni e metodologie di scavo**

Tipologia di sezione	Metodo di scavo	Volume perso
Gallerie di linea binario pari	Scavo meccanizzato	1.0%
Galleria centrale di sfollamento	Scavo in tradizionale	2.0%
Gallerie di linea binario dispari	Scavo meccanizzato	1.4%

#### 4.1.2 Caratterizzazione dei materiali interessati dallo scavo – Scelta della costante $k$

Caratterizzazione dei materiali interessati dallo scavo – Scelta della costante  $k$

Come precedentemente descritto, il valore da attribuire alla costante  $k$  dipende dalle caratteristiche dei terreni interessati dalle operazioni di scavo.

Un attento esame delle stratigrafie e delle caratteristiche dei materiali attesi ha consentito di definire i ranges di variabilità della costante  $k$  rappresentativi degli effetti dello scavo in corrispondenza dell'area oggetto dell'analisi, facendo riferimento agli studi parametrici riportati in letteratura.

Considerazioni circa la notevole estensione del potenziale bacino di subsidenza, determinata essenzialmente dall'entità delle coperture presenti, e le caratteristiche geometriche degli edifici che insistono sopra al tracciato della futura Galleria Cefalù, generalmente di dimensioni modeste e comunque sempre molto limitate rispetto all'estensione del bacino stesso, hanno condotto ad assumere, quali maggiormente conservativi ai fini delle analisi di seguito riportate, valori della costante  $k$  corrispondenti all'estremo inferiore dei ranges indicati in letteratura per le diverse tipologie di materiali interessati dallo scavo. Tali valori infatti, minimizzando l'estensione del bacino di subsidenza e massimizzando il valore del cedimento massimo atteso, conducono alla massimizzazione dello spostamento differenziale tra gli estremi degli edifici, cui la distorsione è direttamente legata.

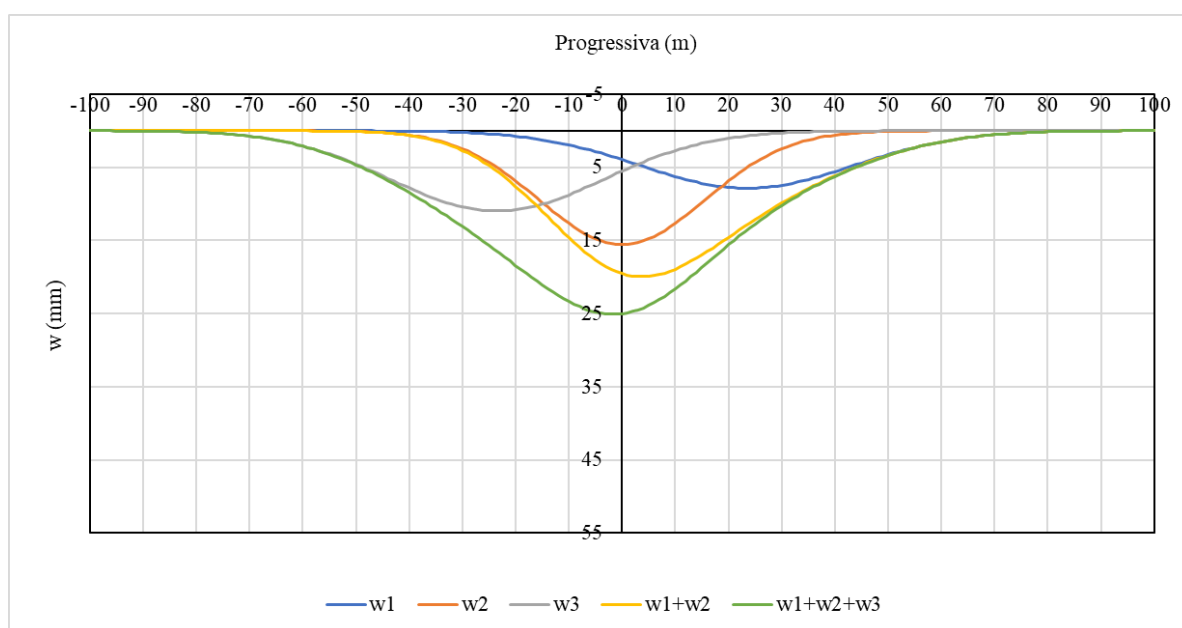
Nell'area della fermata Cefalù, l'esame della caratterizzazione geomeccanica di tali materiali, per il dettaglio della quale si rimanda allo specifico elaboro di progetto, ha condotto ad adottare nei calcoli un valore del parametro  $k$  pari a 0.4. Tale valore corrispondente infatti all'estremo inferiore del range individuato in letteratura come caratteristico di terreni argillosi consistenti, essendo rappresentativo anche del comportamento dei materiali granulari che potrebbero essere localmente presenti in forma lenti all'interno della formazione coesiva.

Essendo indipendente dalle modalità di scavo delle gallerie, tale parametro è stato assunto invariato per le verifiche condotte per la “condizione attesa” e per la “condizione di calcolo” precedentemente descritte.

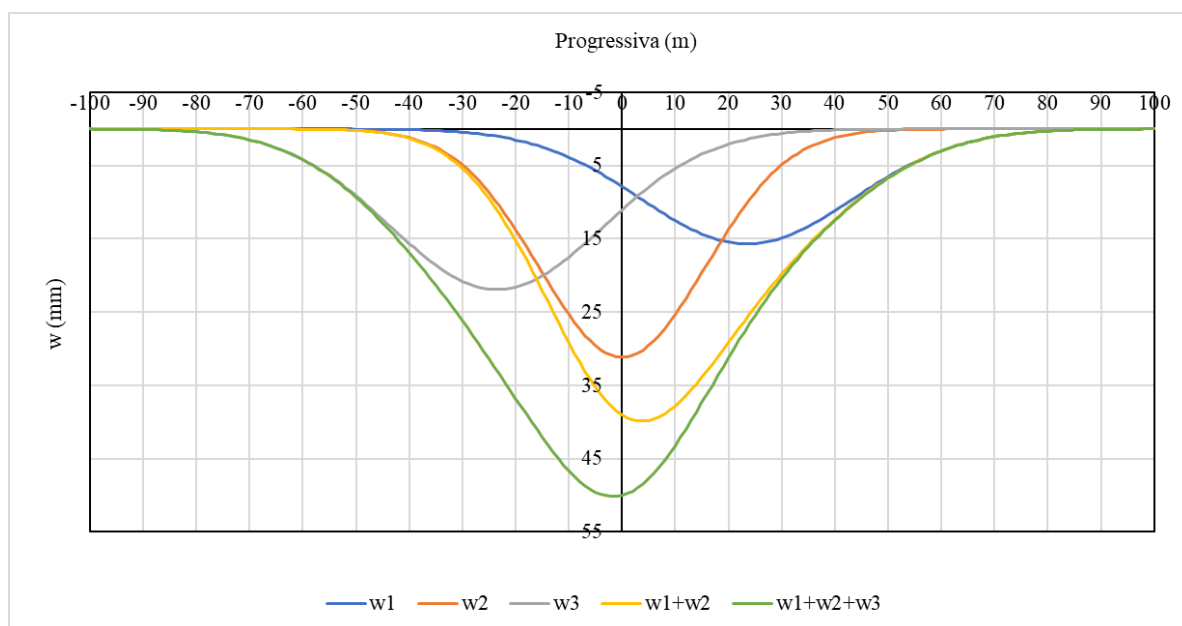


### 4.1.3 Valutazione delle curve di subsidenza

Nella Figura 1e nella Figura 2si riportano gli andamenti del profilo di cedimento del piano campagna conseguente allo scavo delle due gallerie di linea e della galleria centrale di sfollamento.



**Figura 1: Profilo di cedimento – “Condizione attesa”**



**Figura 2: Profilo di cedimento – “Condizione di calcolo”**

## 5 ANALISI DEL RISCHIO DI DANNO DEGLI EDIFICI

Costruite le curve di subsidenza, si passa quindi al calcolo degli effetti sugli edifici.

Allo scopo si sono considerati gli edifici sensibili in corrispondenza della variante della fermata di Cefalù (per la descrizione completa si rimanda all’elab. “Schede edifici interferenti” [Rif. [7]).

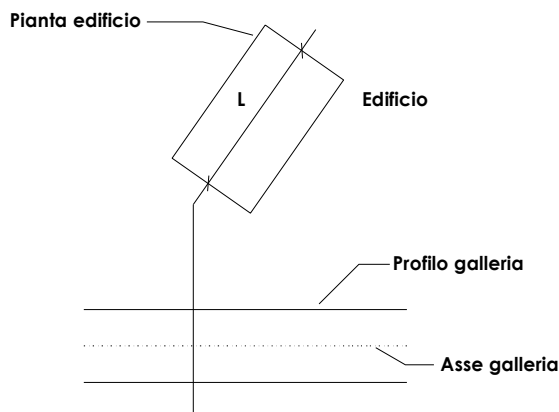
### 5.1 Metodo di analisi dei cedimenti indotti e del danneggiamento

Le analisi degli edifici sono state condotte considerando gli effetti combinati dovuti ai cedimenti verticali ed orizzontali. Per tutti gli edifici è stata svolta l’analisi nel piano trasversale alle gallerie, poiché, come noto, le distorsioni prodotte in senso longitudinale sono inferiori a quelle trasversali. Per tutti gli edifici le analisi sono state svolte con lo schema della trave equivalente nel seguito descritto

#### 5.1.1 Schematizzazione dei fabbricati interferenti

I fabbricati interferiti vengono schematizzati come semplici travi elastiche e prive di peso aventi altezza  $H$  e lunghezza  $L$  pari a quelle della sezione dell’edificio analizzato (Burland, 1997).

La dimensione  $L$  (lunghezza) viene considerata secondo lo schema riportato di seguito (si veda la figura seguente):



#### 5.1.2 Deformazioni indotte sui fabbricati interferiti

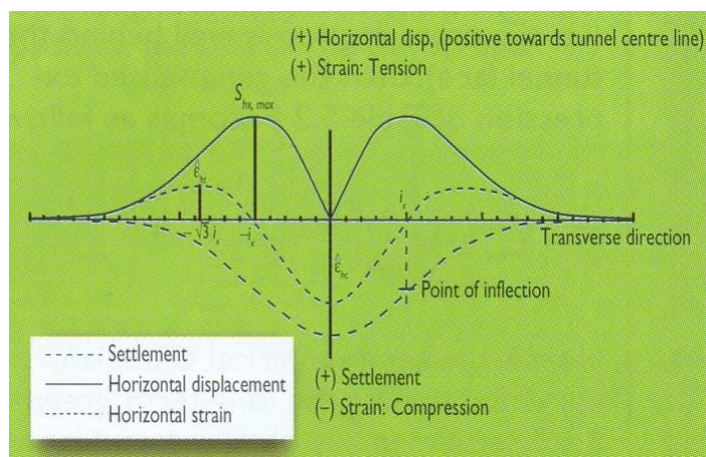
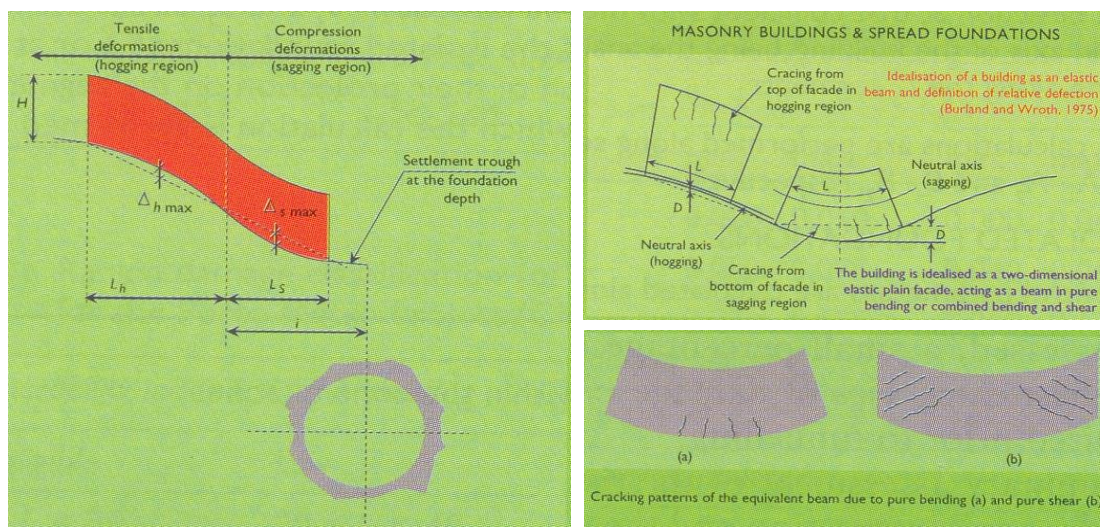
Prendendo in considerazione i movimenti del terreno sul piano trasversale alla galleria, la curva dei cedimenti si suddivide in tre zone:

- due zone con concavità verso il basso – zone “hogging”, dove le strutture che poggiano sul p.c. sono sottoposte a trazione, per la presenza di deformazioni superficiali di estensione e per il contributo della curvatura del p.c. Questa zona è compresa nell’intervallo:

$$y > +i \text{ e } y < -i$$

- una zona con concavità verso l’alto – zona “sagging”, dove le strutture che poggiano sul p.c. sono sottoposte a compressione, per la presenza di deformazioni superficiali di compressione oltre che per il contributo della curvatura del p.c. Questa zona è compresa nell’intervallo:

$$y > -i \text{ e } y < +i$$



Per la definizione delle deformazioni indotte si considera di imprimere alla trave equivalente all’edificio la stessa deformata “green field”, e derivano le seguenti assunzioni:

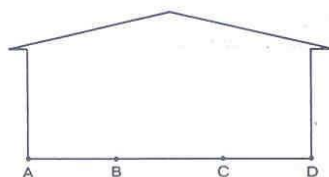
- gli spostamenti orizzontali e verticali di punti esterni ai limiti del bacino sono nulli,
- la nuova configurazione della trave (equivalente all’edificio) implica la mobilitazione di sollecitazioni flessionali e di taglio e corrispondenti deformazioni. Le deformazioni indotte si calcolano mediante le seguenti equazioni:

$$\varepsilon_f = \frac{\Delta/L_i}{\left[ \frac{L_i}{12t} + \frac{3IE}{2tL_iHG} \right]}$$

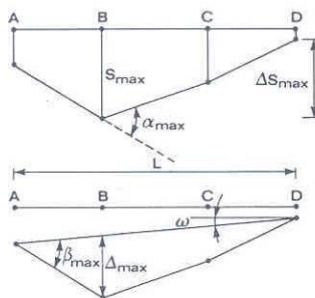
$$\varepsilon_t = \frac{\Delta/L_i}{\left[ 1 + \frac{HL_i^2G}{18IE} \right]}$$

dove:

- $\varepsilon_f$  = deformazione flessionale;
- $\varepsilon_t$  = deformazione di taglio;
- $\Delta/L_i$  = rapporto di inflessione;
- $L_i$  = porzione ( $\leq L$  = lunghezza edificio) di edificio ricadente nella zona analizzata;
- $I$  = modulo di inerzia ( $H^3/12$  in zona sagging ;  $H^3/3$  in zona hogging);
- $E/G$  = rapporto tra il modulo di elasticità longitudinale e tangenziale (12.5 per fabbricati in c.a. e 2.6 per fabbricati in muratura);
- $t$  = distanza dell'asse neutro dal bordo teso della trave ( $H/2$  in zona sagging ;  $H$  in zona di hogging).



S= CEDIMENTO  $\omega$ =ROTAZIONE RIGIDA  
 $\Delta S$ = CEDIMENTO DIFFERENZIALE  
 $\beta$ =ROTAZIONE RELATIVA  
 $\alpha$ = DEFORMAZIONE ANGOLARE  
 $\Delta$ = INFLESSIONE  
 $\Delta/L$ = RAPPORTO DI INFLESSIONE (CURVATURA) .....



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Oltre a queste deformazioni, si deve tenere conto degli effetti delle deformazioni orizzontali  $\varepsilon_y$  del terreno. Il valore di  $\varepsilon_y$  è ricavabile dalla seguente equazione:

$$\varepsilon_y = \frac{\Delta S_h}{L_i}$$

dove:

- $S_h = (y/z_0) \times S_v$  = spostamento orizzontale nel punto posto alla distanza  $y$  dall'asse della galleria
- $S_v$  = cedimento verticale nel punto posto alla distanza  $y$  dall'asse della galleria
- $\Delta S_h$  = si veda l'illustrazione

I campi di deformazione vengono composti, per ogni campo deformativo (hogging a dx – sagging – hogging a sx), secondo le seguenti equazioni:

$$\varepsilon_{totale} = \varepsilon_y + \varepsilon_f \quad (\text{condizione di flessione})$$

$$\varepsilon_{totale} = 0.35 \cdot \varepsilon_y + \left[ (0.65 \cdot \varepsilon_y)^2 + \varepsilon_r^2 \right]^{0.5} \quad (\text{condizione di taglio, } n = 0.3)$$

In zona di “hogging” le deformazioni indotte dai cedimenti verticali (deformazioni in estensione) si sommano alle deformazioni indotte dagli spostamenti orizzontali (deformazioni in estensione), mentre in zona di “sagging” alle deformazioni indotte dai cedimenti verticali (deformazioni in estensione) si sottraggono le deformazioni indotte dagli spostamenti orizzontali (deformazioni in compressione).

## 5.2 Definizione delle categorie di danno

Il sistema di valutazione del danno indotto sulle strutture è basato sulla sulla classificazione di Boscardin e Cording (1989) che hanno individuato sei classi di danno (da 0 a 5), a cui fanno corrispondere dei valori limite di deformazione a trazione, riportati e descritti nelle seguenti tabelle.

**Categoria di danno e corrispondenti deformazioni limite**

(M.D. Boscardin & E.G. Cording, 1989)

<b>Categoria di danno</b>	<b>Intensità del danno*</b>	<b>Deformazione limite di allungamento <math>\epsilon_{lim}</math> (%)</b>
0	Trascurabile	0.00 ÷ 0.05
1	Molto lieve	0.05 ÷ 0.075
2	Lieve	0.075 ÷ 0.15
3	Moderata	0.15 ÷ 0.30
4 a 5	Da severa a molto severa	> 0.30

<b>Categoria di danno e gli effetti associati</b>	
<b>Categoria di danno</b>	<b>Descrizione</b>
0	Fessure capillari con apertura $\leq 0.1$ mm
1	Fessure sottili cui si rimedia facilmente con lavori di tinteggiatura. Il danno in genere è limitato agli intonaci delle pareti interne. Fessure alle pareti esterne rilevabili con attento esame. Tipica apertura delle lesioni $\leq 1$ mm
2	Fessure facilmente stuccabili, tinteggiatura necessaria. Le fessure ricorrenti possono essere mascherate con opportuni rivestimenti. Fessure visibili anche all'esterno: può essere necessaria qualche ripresa della stillatura per garantire l'impermeabilità. Possibili difficoltà nell'apertura di porte e finestre. Tipica apertura delle lesioni $\leq 5$ mm
3	Le fessure richiedono cucì e scuci della muratura. Anche all'esterno sono necessari interventi sulla muratura. Possibile blocco di porte e finestre. Rottura di tubazioni. Spesso l'impermeabilità non è garantita. Tipica apertura delle lesioni $5 \div 15$ mm oppure numero elevato di lesioni con apertura $\leq 3$ mm
4	Necessarie importanti riparazioni, compresa demolizione e ricostruzione di parti di muri, specie al di sopra di porte e di finestre. I telai di porte e di finestre si distorcono: percepibile pendenza dei pavimenti. Muri inclinati o spanciati; qualche perdita d'appoggio di travi. Tubazioni distrutte. Tipica apertura delle lesioni $15 \div 25$ mm, dipendente anche dal numero delle lesioni
5	Richiesti importanti lavori con parziale o totale demolizione e ricostruzione. Le travi perdono l'appoggio, i muri si inclinano fortemente e richiedono puntellatura. Pericolo di instabilità. Tipica apertura delle lesioni $\leq 25$ mm, dipendente anche dal numero delle lesioni

### 5.3 Risultati dello studio sul danneggiamento degli edifici interferenti

Per ogni edificio analizzato sia nella condizione di attesa sia nella condizione di calcolo sono state individuate le relative categorie di danneggiamento, con riferimento ai rispettivi casi di studio considerati. L'ultima colonna della tabella seguente riporta la categoria di danno massima dell'edificio considerando tutti i casi di studio.

Edificio	Categoria di danno		Edificio	Categoria di danno	
	Condizione "attesa"	Condizione "di calcolo"		Condizione "attesa"	Condizione "di calcolo"
1	0	2	102A	0	0
2	0	1	102B	0	0
3	0	1	103	0	0
4	0	0	104	0	0
5	0	1	105	0	0
6	0	1	106-S1	0	0
7	0	0	106-S2	0	0
8	0	1	107-S1	0	0
9	0	0	107-S2	0	0
10	0	1	108	0	0
11	0	1	109	0	2
11bis	0	1	110	0	0
101	0	0			

In Allegato si riportano le schede delle analisi che riassumono i dati di input dei fabbricati, le curve di subsidenza ed i risultati delle analisi di danneggiamento per ogni edificio analizzato. Nello specifico, nell’Allegato 1 sono raccolte le schede delle analisi svolte nella condizione attesa e nell’Allegato 2 sono riportate le schede di danno riferite alle analisi svolte nella condizione di calcolo.

#### 5.4 Commento ai risultati dello studio sul danneggiamento degli edifici interferenti

Sono stati analizzati 25 edifici che ricadono all’interno dell’area di influenza della variante della fermata Cefalù.

Lo stato di conservazione di tali edifici, oggetto delle schede di censimento fabbricati allegate al presente progetto, è descritto da ottimo a discreto.

Le analisi condotte secondo le ipotesi conservative proprie della “condizione di calcolo”, verificando tutte le condizioni di potenziale subsidenza indotta durante tutte le successive fasi di scavo delle gallerie di fermata e di linea previste in progetto, hanno evidenziato per tutti gli edifici esaminati un livello di danno ascrivibile alle classi 0, 1 e 2. Poiché le analisi condotte hanno evidenziato la possibile occorrenza di soli danni da “trascurabili” a “lievi”, non sono richiesti interventi di salvaguardia a tutela di tali edifici.

Le medesime analisi, condotte per la “condizione attesa”, hanno evidenziato invece per tutti gli edifici esaminati un livello di danno ascrivibile alle classi 0, 1.

Si sottolinea che l’approccio progettuale proposto risulta conservativo, e che quindi i risultati ottenuti si possono ascrivere alla peggiore configurazione di danno possibile, essendo la metodologia di analisi contraddistinta da ipotesi molto cautelative, sia sulla caratterizzazione geomeccanica, sul comportamento dei materiali allo scavo e sulla conduzione dello scavo stesso, nella scelta della costante





**LINEA PALERMO – MESSINA. RADDOPPIO FIUMETORTO – CEFALU’**  
**CASTELBUONO. TRATTA OGLIASTRILLO - CASTELBUONO FERMATA CEFALÙ – RAMPA DI ACCESSO ALLA GALLERIA DI SFOLLAMENTO**

RELAZIONE SULLE SUBSIDENZE E VERIFICA DEGLI EFFETTI INDOTTI SULLE OPERE IN SUPERFICIE

COMMESSA	LOTTO	CODIFICA	DOCUMENTO	REV.	FOGLIO
<b>RS7B</b>	00	D 07 RH	GN 01 00 001	A	17 di 18

k e nelle assunzioni sui volumi persi, sia sulle caratteristiche strutturali degli edifici (rigidezza degli edifici trascurata, nessuna distinzione fra fondazioni su plinti, travi rovesce o su platea).

Tutti gli edifici esaminati, in quanto ricadenti nell’area di influenza della galleria, saranno in ogni caso oggetto di un apposito sistema di monitoraggio in corso d’opera già previsto in progetto esecutivo.



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RELAZIONE SULLE SUBSIDENZE E VERIFICA DEGLI EFFETTI INDOTTI SULLE OPERE IN SUPERFICIE

COMMESSA	LOTTO	CODIFICA	DOCUMENTO	REV.	FOGLIO
RS7B	00	D 07 RH	GN 01 00 001	A	18 di 18

## 6 CONCLUSIONI

Nella presente relazione, facente parte dei documenti relativi alla variante della fermata Cefalù, nell'ambito del raddoppio della tratta Fiumetorto-Cefalù-Castelbuono della Linea Palermo-Messina, sono stati analizzati gli effetti sulle preesistenze prodotti dallo scavo delle gallerie.

L'inserimento in un contesto fortemente urbanizzato e la complessità geometrica della fermata hanno indotto a studiare con particolare attenzione l'interazione dell'opera con le preesistenze in tale tratta.

In particolare, si è proceduto a valutare i risentimenti che lo scavo delle gallerie produce in superficie e gli effetti che i cedimenti indotti determinano sulle strutture preesistenti, allo scopo di stabilire se tali effetti possono prefigurare un rischio di danno non accettabile e, in tal caso, valutare la necessità di mettere in opera eventuali misure preventive di salvaguardia, quali a titolo esemplificativo, interventi di consolidamento de terreno o della struttura.

Le analisi svolte, si sono basate sull'applicazione di modellazioni empiriche di comprovata affidabilità, volte dapprima alla valutazione delle subsidenze indotte in superficie dagli scavi in sotterraneo e successivamente alla valutazione del danno potenzialmente indotto sulle opere in superficie, alla luce delle informazioni sullo stato di conservazione di queste ultime.

Secondo le valutazioni condotte, adottando l'ipotesi conservativa denominata "condizione di calcolo" volta a massimizzare il volume perso conseguente allo scavo, tutti gli edifici ricadenti all'interno del bacino di subsidenza generato dallo scavo delle gallerie in corrispondenza della variante in oggetto, ricadono nelle classi di danno 0, 1 e 2. Pertanto, si confermano i modesti effetti indotti sulle preesistenze anche a seguito dell'allungamento della galleria di sfollamento, come previsto da progetto esecutivo.

Non son pertanto richiesti interventi di salvaguardia a tutela di tali edifici.

Tutti gli edifici esaminati, in quanto ricadenti nell'area di influenza della galleria, saranno in ogni caso oggetto di apposito sistema di monitoraggio in corso d'opera, che verrà predisposto in corrispondenza della fermata Cefalù e dell'imbocco lato Palermo, così come descritto nei relativi elaborati di progetto esecutivo.



LINEA PALERMO – MESSINA. RADDOPPIO FIUMETORTO – CEFALU'  
CASTELBUONO. TRATTA OGLIASTRILLO - CASTELBUONO  
FERMATA CEFALÙ – VARIANTE RAMPA DI ACCESSO ALLA  
GALLERIA DI SFOLLAMENTO

RELAZIONE SULLE SUBSIDENZE E VERIFICA  
DEGLI EFFETTI INDOTTI SULLE OPERE IN  
SUPERFICIE

COMMESSA	LOTTO	CODIFICA	DOCUMENTO	REV.	ALLEGATI
RS7B	00	D 07 RH	GN 01 00 001	A	1

## ALLEGATO 1

<b>TITOLO</b>	SCHEDE DI ANALISI DEGLI EDIFICI - ANALISI NELLA CONDIZIONE ATTESA
<b>TIPO DI DOCUMENTO:</b>	Documento – Formato A4
<b>CODIFICA:</b>	-
<b>PAGINE:</b>	-
<b>DATA:</b>	Ott 2022
<b>SORGENTE:</b>	Italferr - UO Gallerie
<b>NOTE:</b>	Allegato 1 di 2 alla Relazione sulle subsidenze e verifica degli effetti indotti sulle opere civili

## ALLEGATO 1 – ANALISI NELLA CONDIZIONE ATTESA

Per le analisi svolte in condizioni attese si è valutata la distribuzione dei cedimenti superficiali e la stima del danno indotto dagli scavi sugli edifici interferenti con i seguenti valori di  $V_p$  (in condizioni indisturbate) e di  $k$  (-):

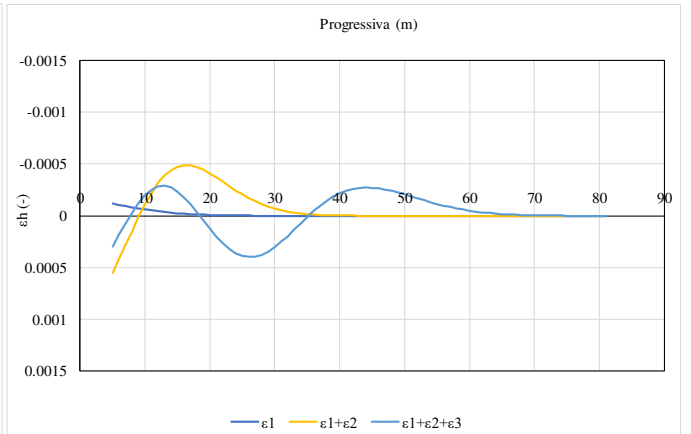
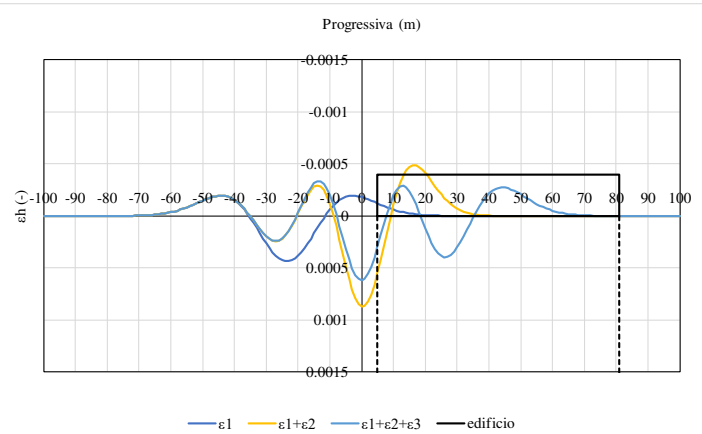
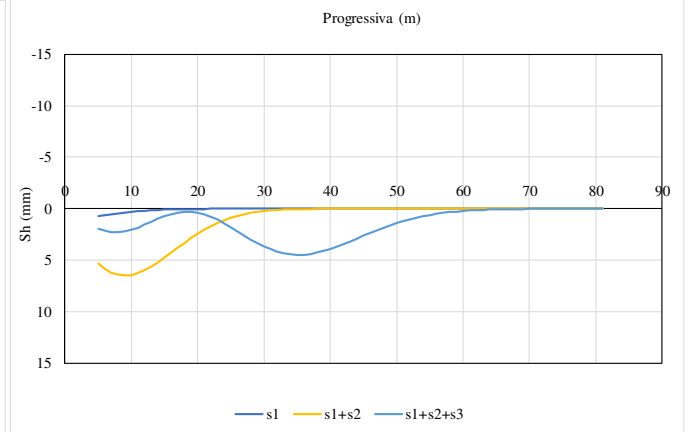
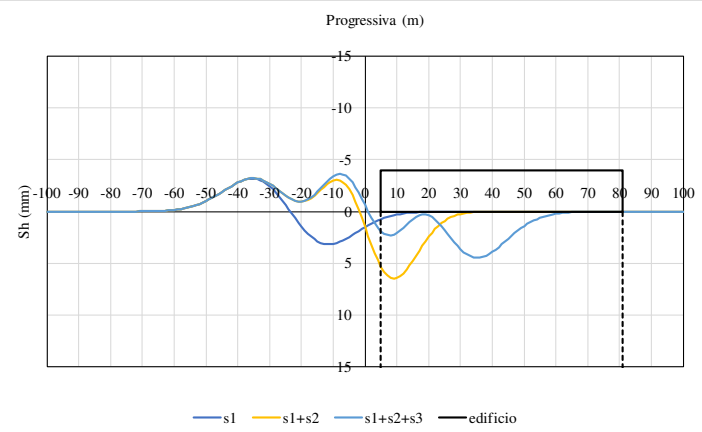
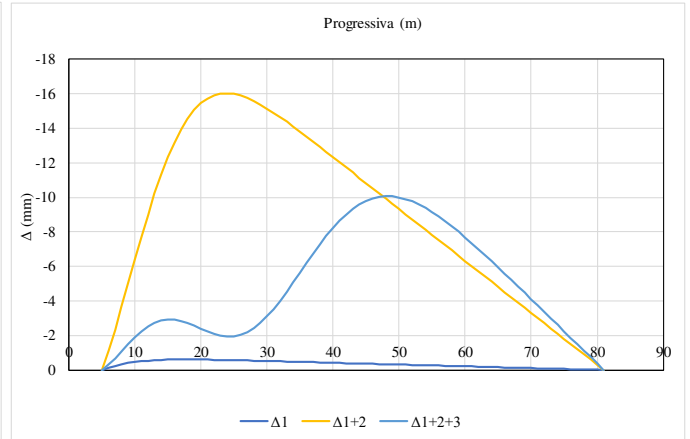
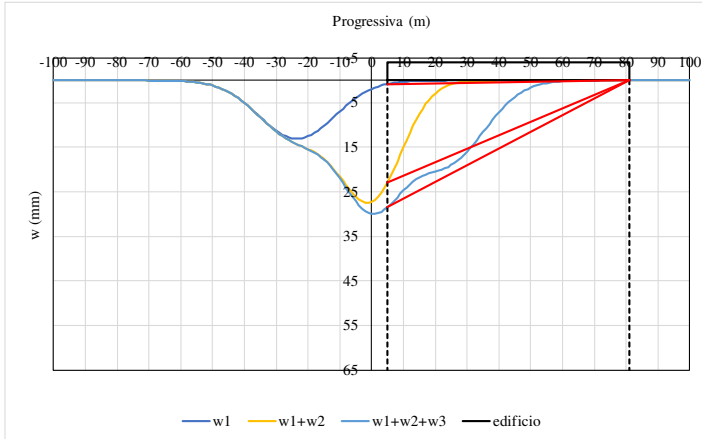
Parametri di $K$ e $V_p$	Condizione attesa (previsione degli effetti)
	Coefficiente $K$
	0.40
$V_{pScavo}$ meccanizzato Galleria di linea binario pari	0.5%
$V_{pScavo}$ tradizionale (per galleria centrale)	1.0%
$V_{pScavo}$ meccanizzato Galleria di linea binario dispari	0.7%

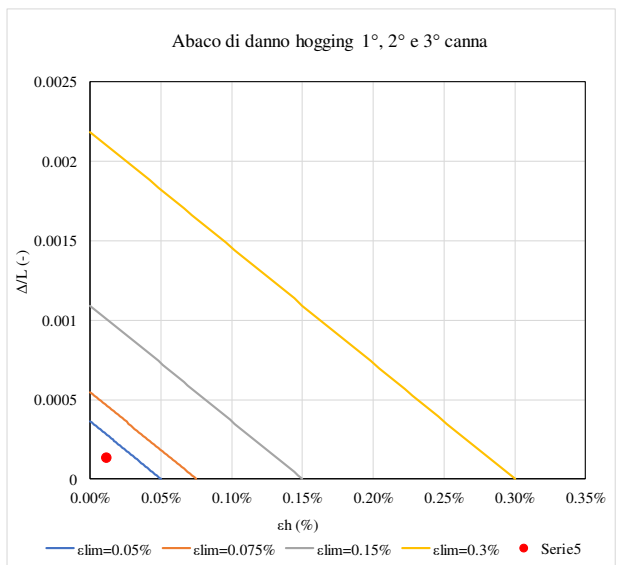
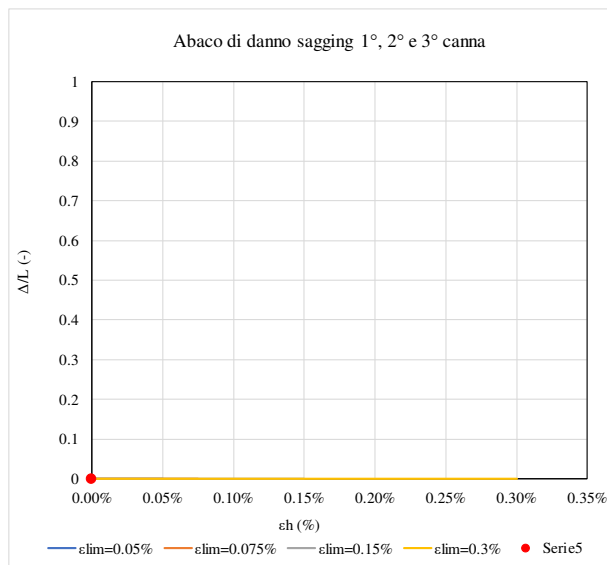
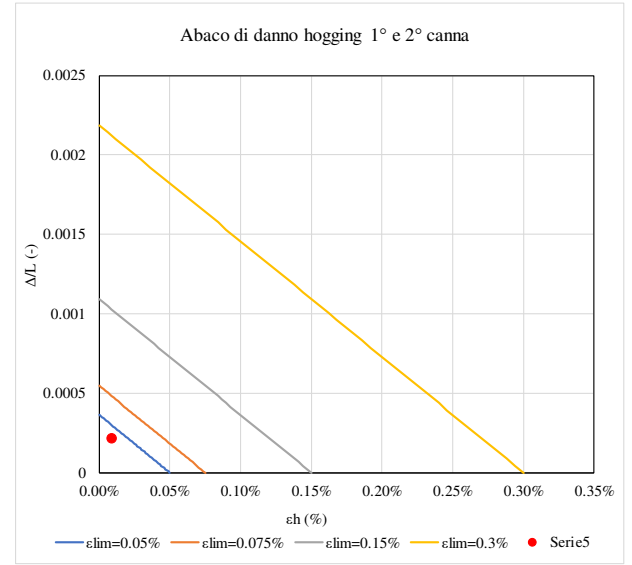
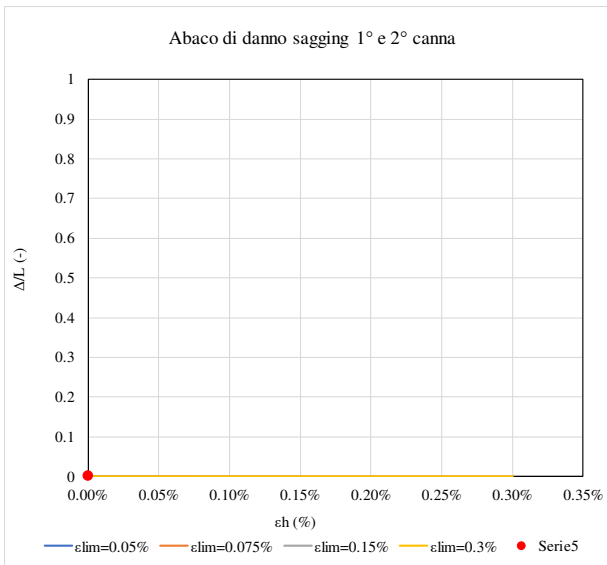
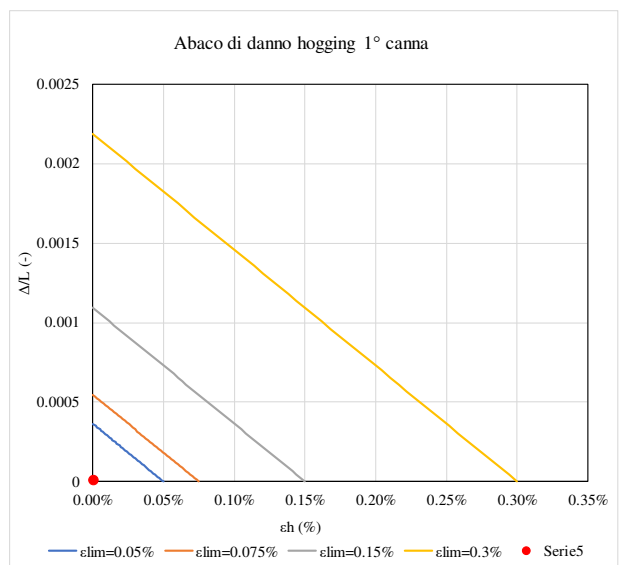
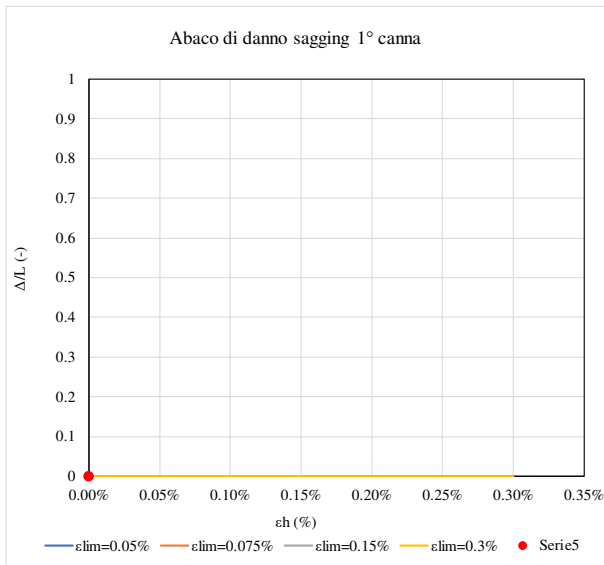
Nelle sezioni di calcolo dove si verifica l'influenza degli scavi precedenti sullo scavo delle gallerie scavate in seguito, sono stati presi in considerazione i nuovi valori di volume perso aumentati del 40%.

edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
1	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.001%	0.021%	0.013%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.001%	-0.009%	-0.012%

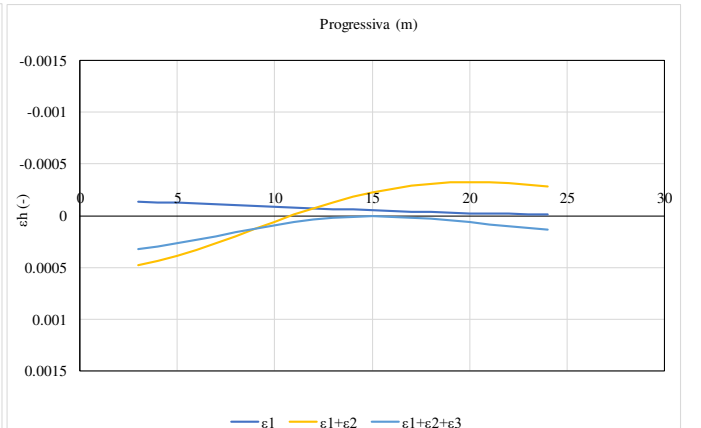
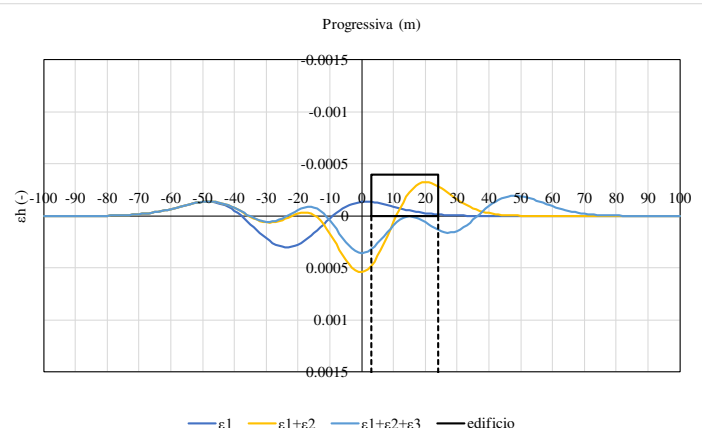
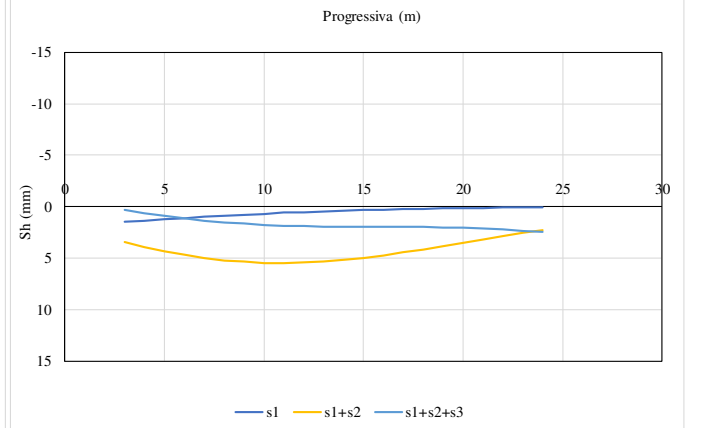
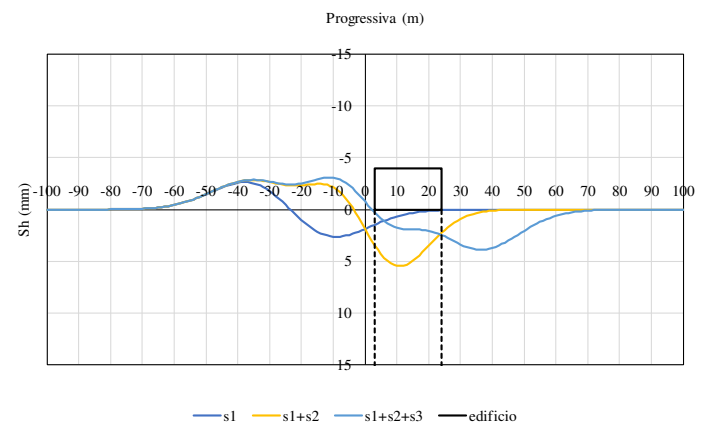
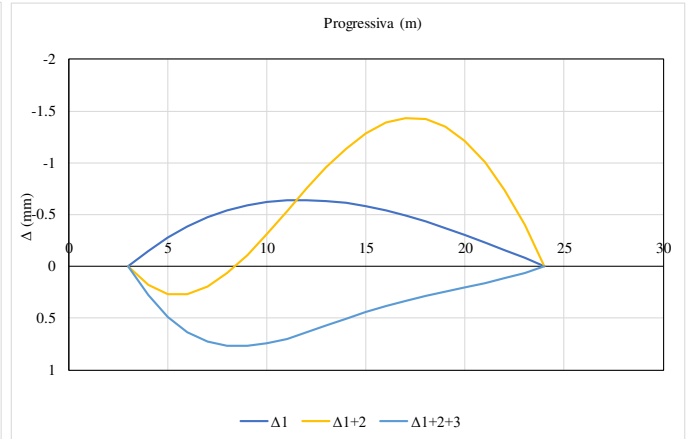
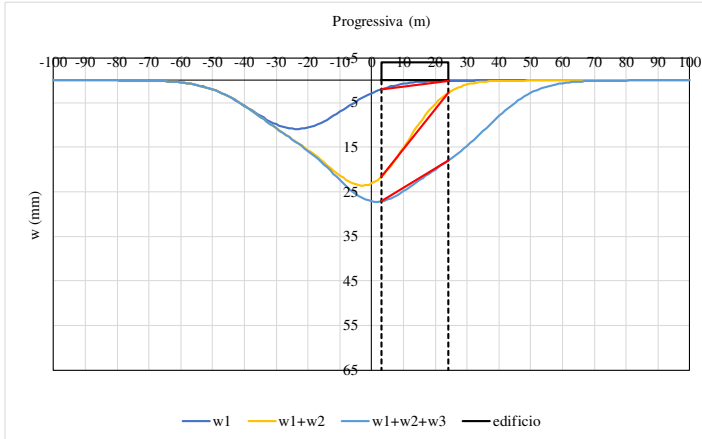




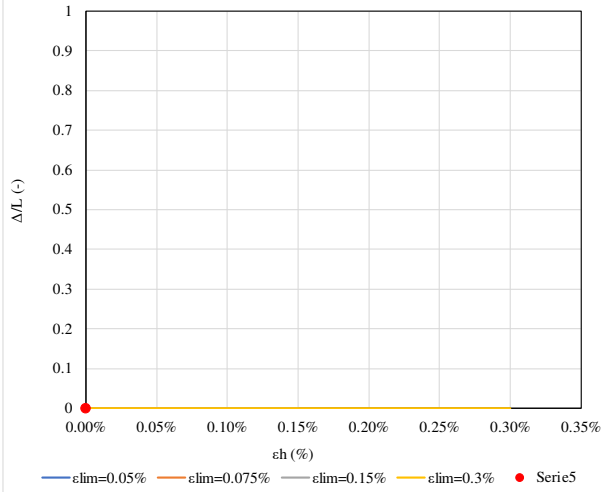
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
2	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.005%	0.004%
0.003%	0.010%	#DIV/0!

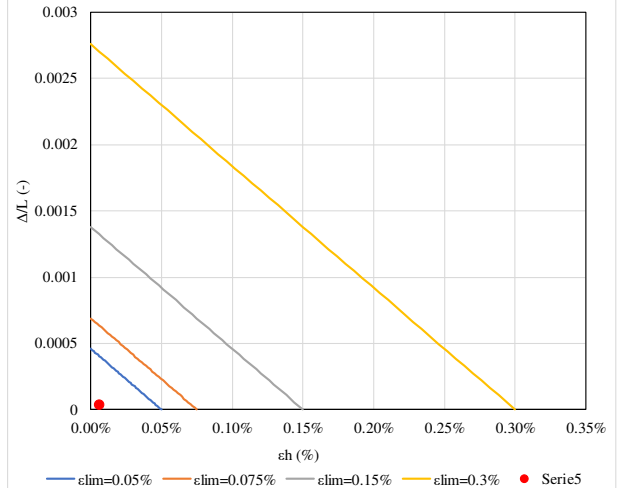
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.007%	-0.024%	#DIV/0!



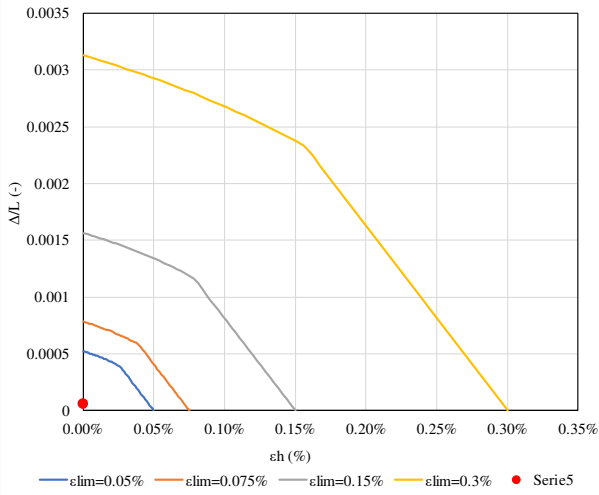
Abaco di danno sagging 1° canna



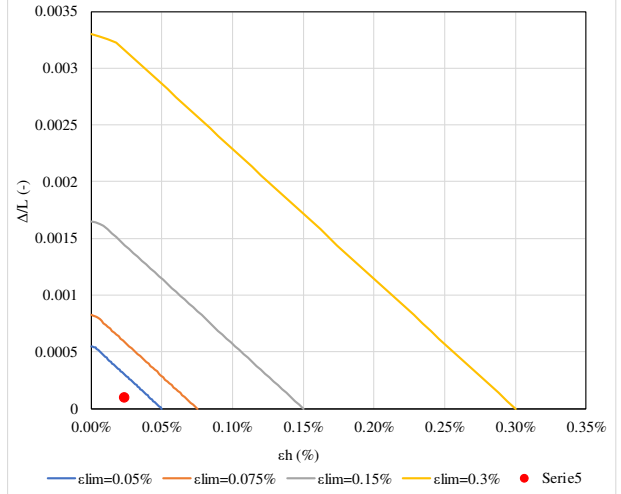
Abaco di danno hogging 1° canna



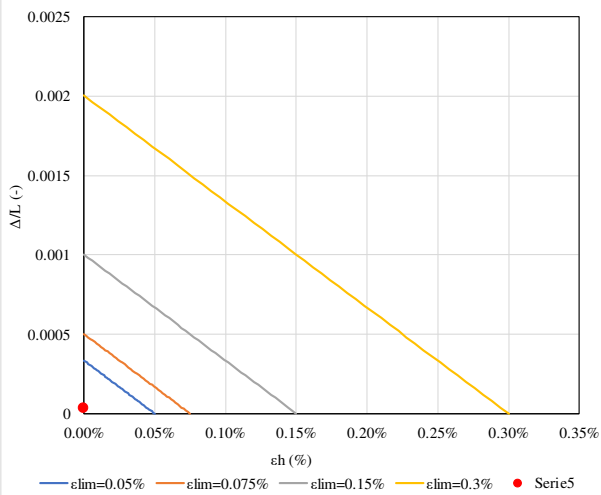
Abaco di danno sagging 1° e 2° canna



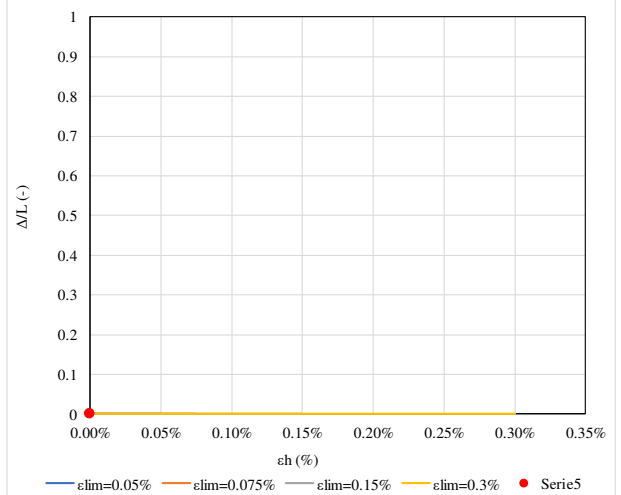
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



Abaco di danno hogging 1°, 2° e 3° canna

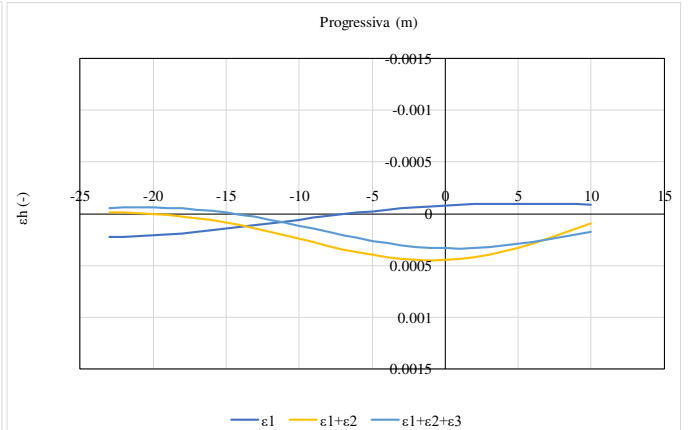
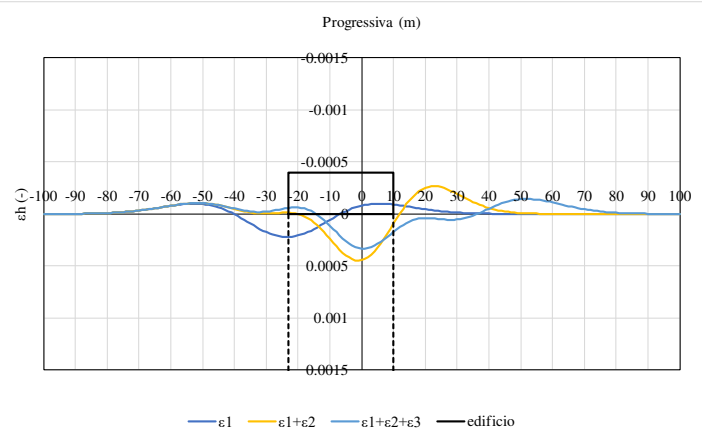
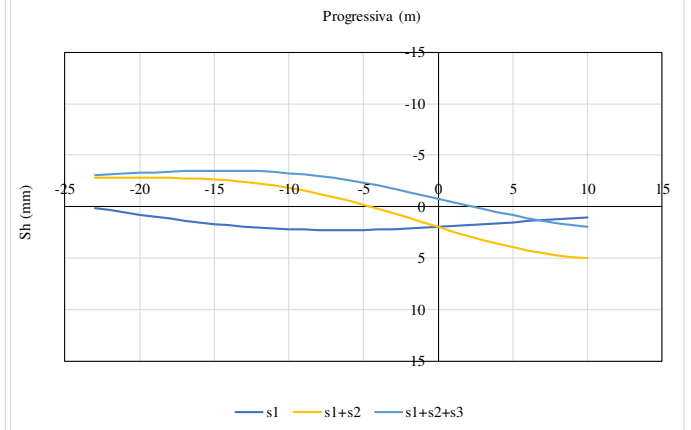
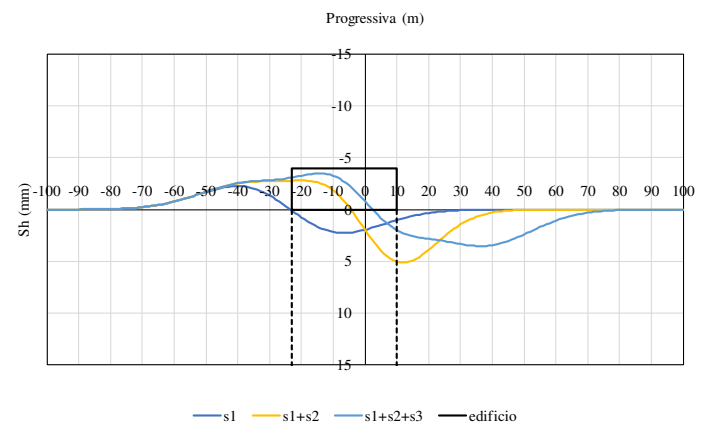
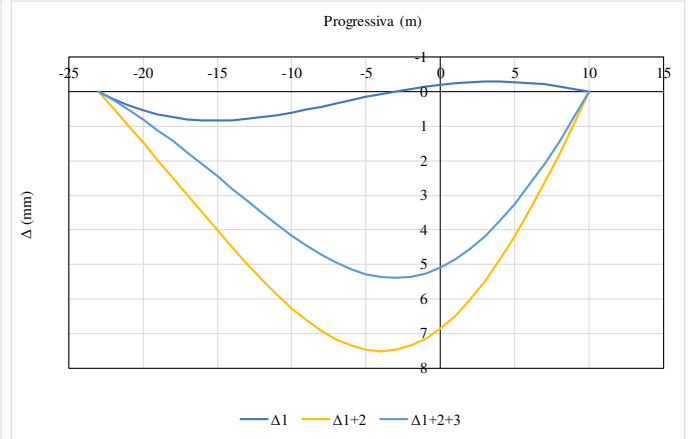
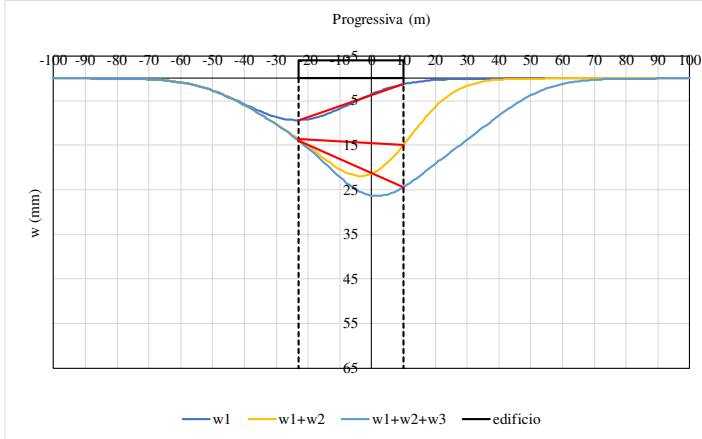


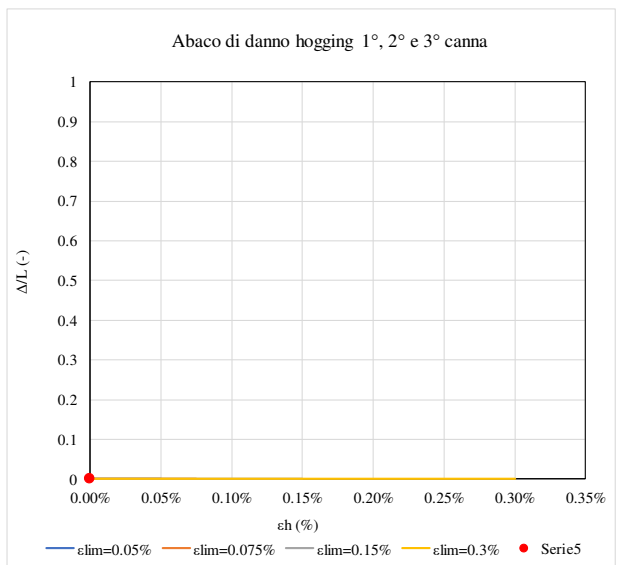
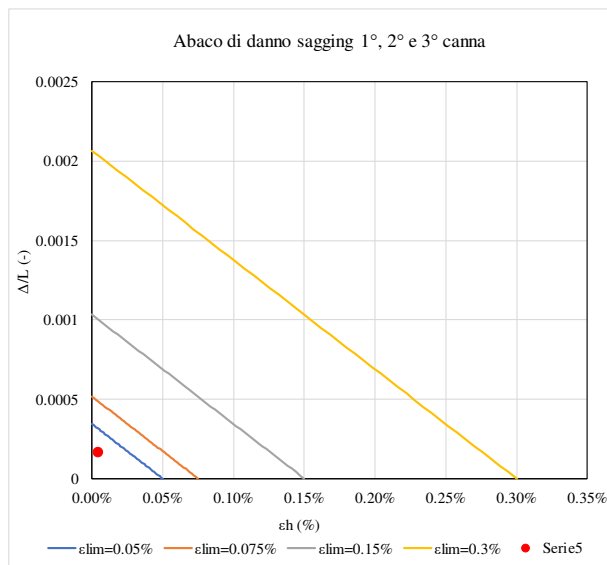
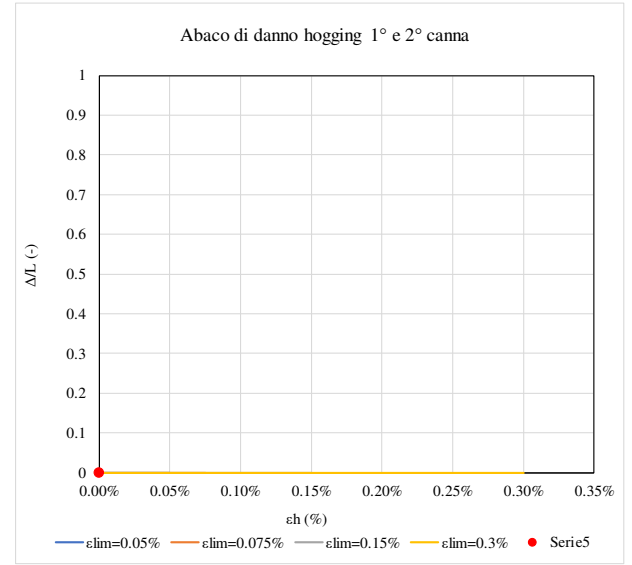
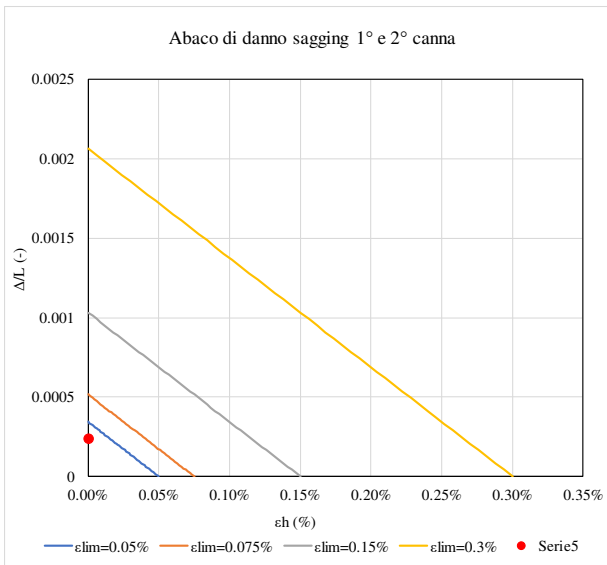
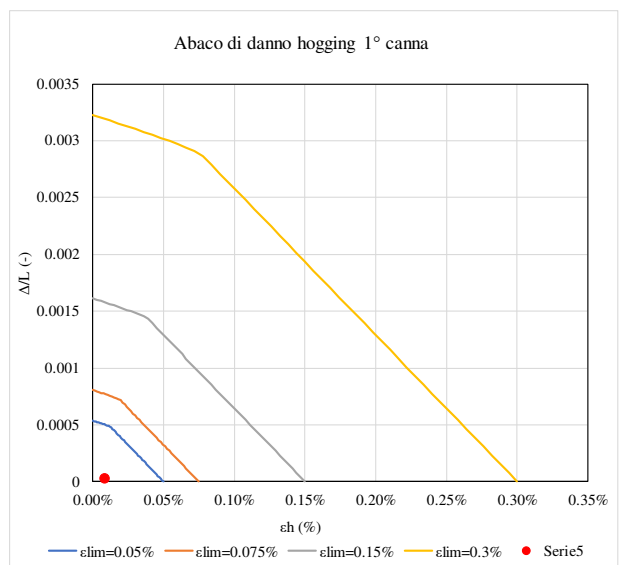
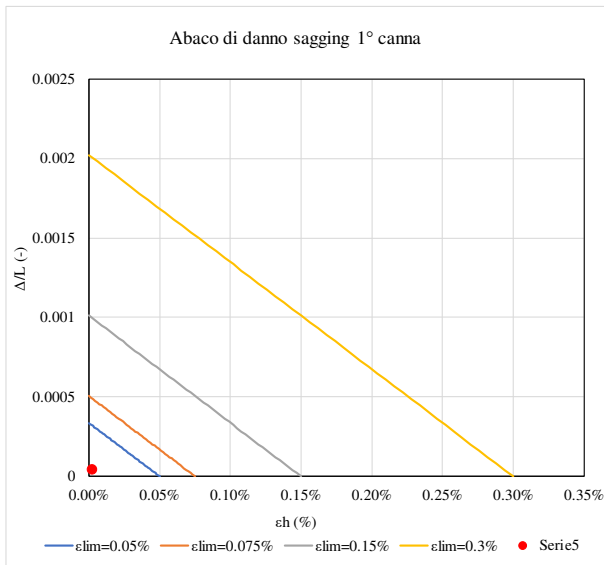


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
3	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.004%	0.023%	0.017%
0.002%	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.003%	-0.001%	-0.005%
-0.009%	#DIV/0!	#DIV/0!

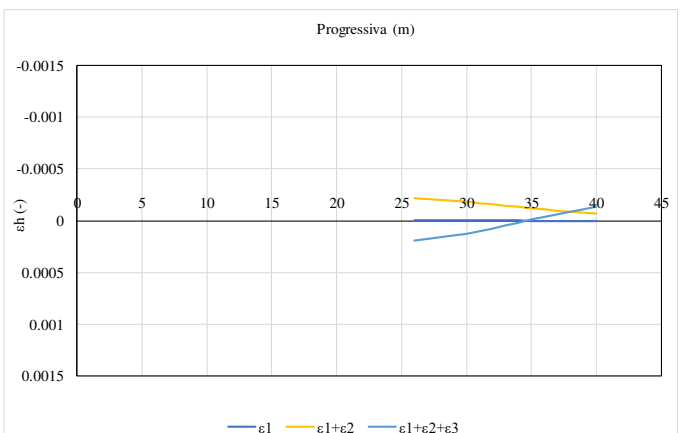
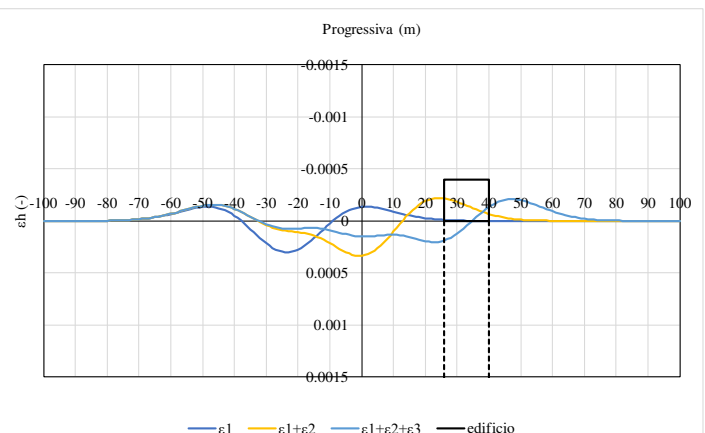
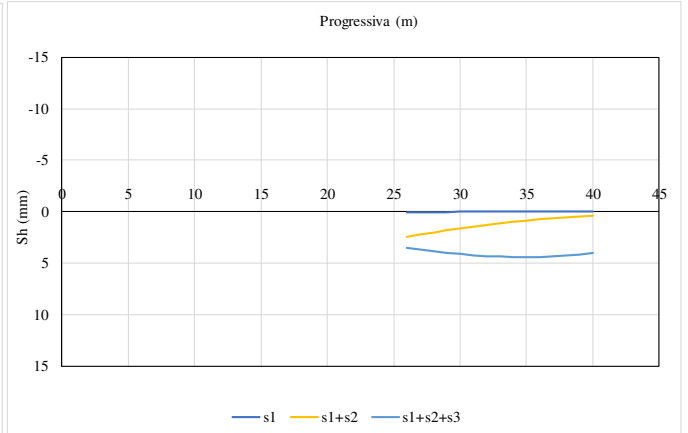
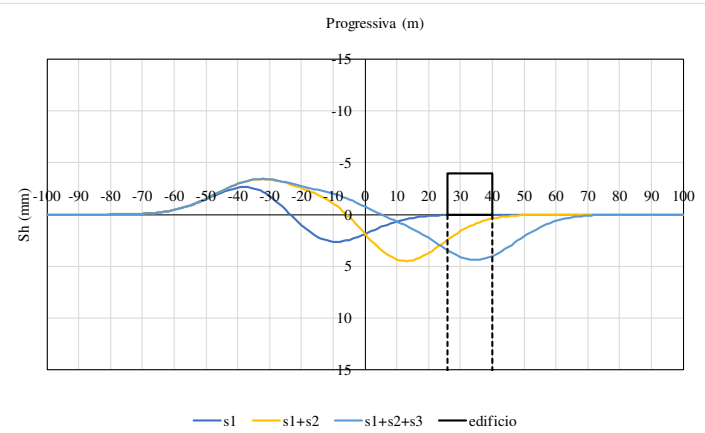
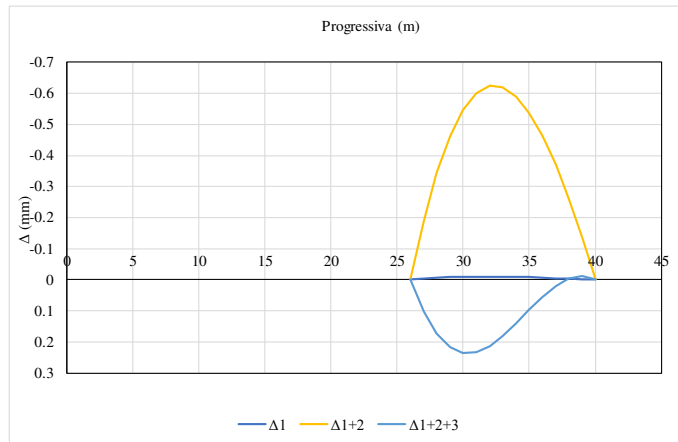
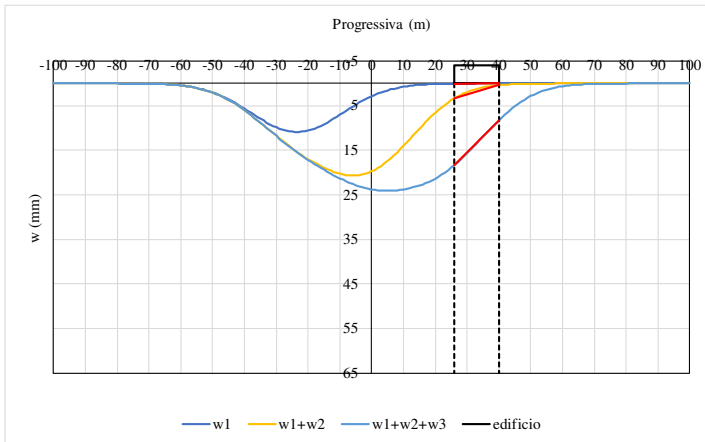


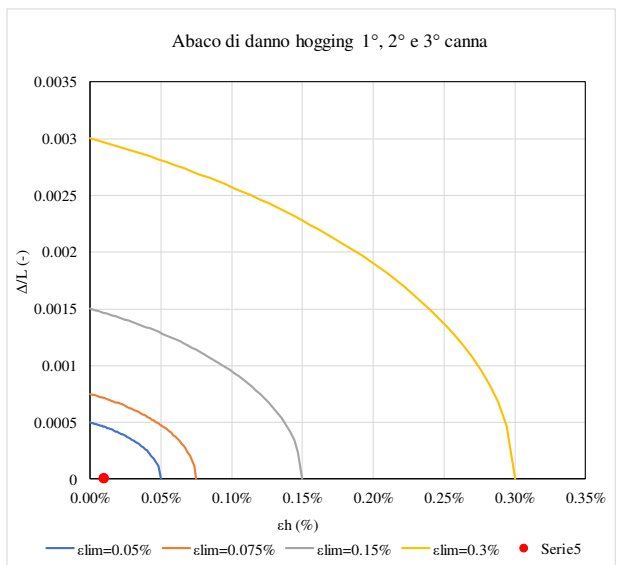
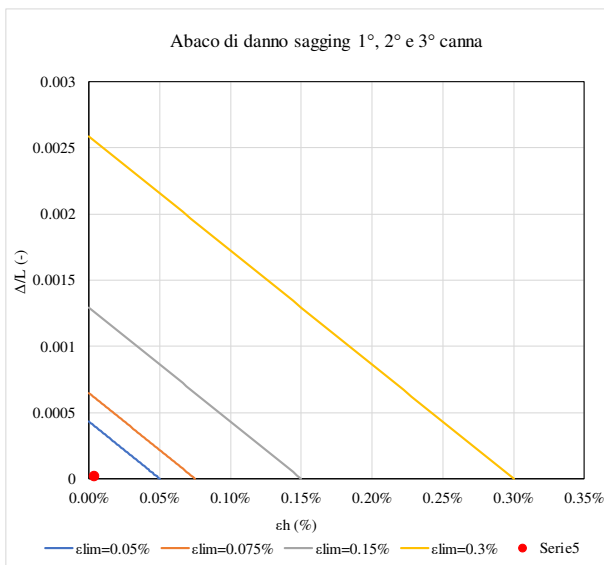
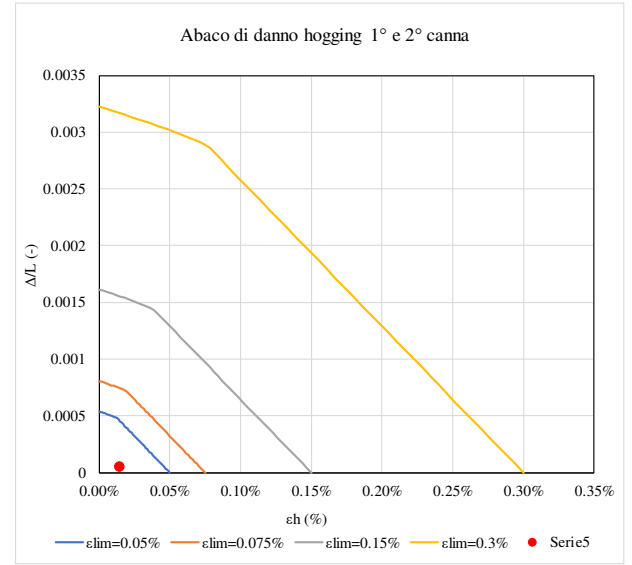
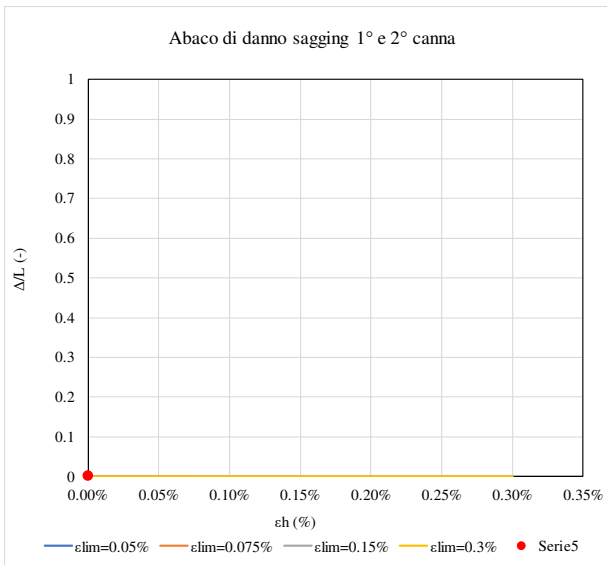
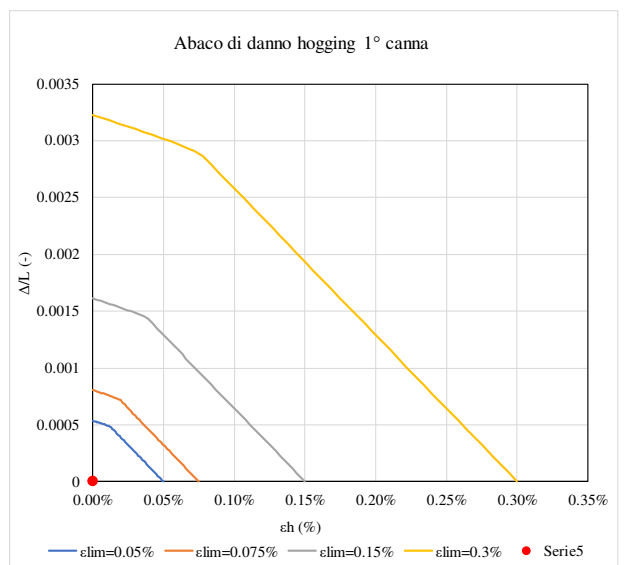
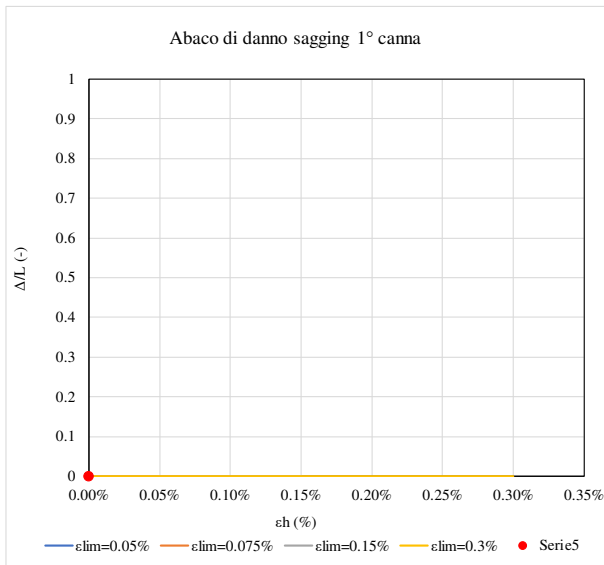


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
4	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.002%
0.000%	0.005%	0.001%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	-0.004%
0.000%	-0.015%	-0.010%

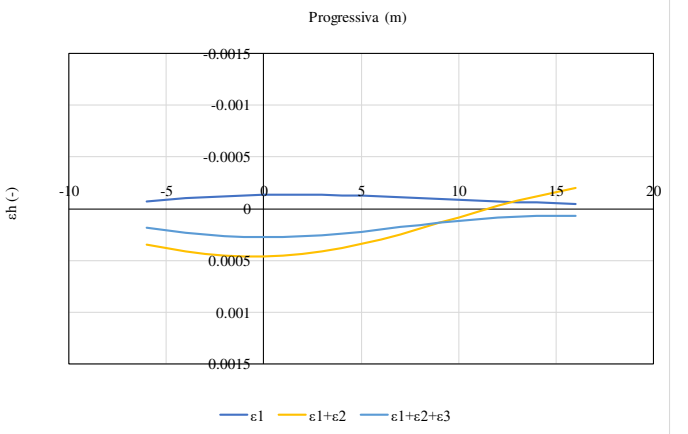
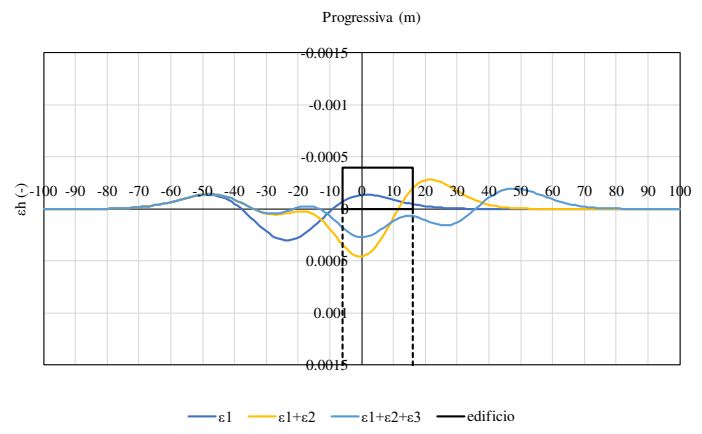
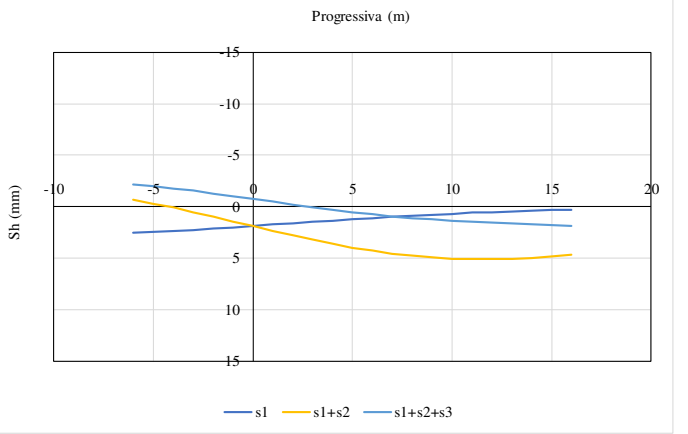
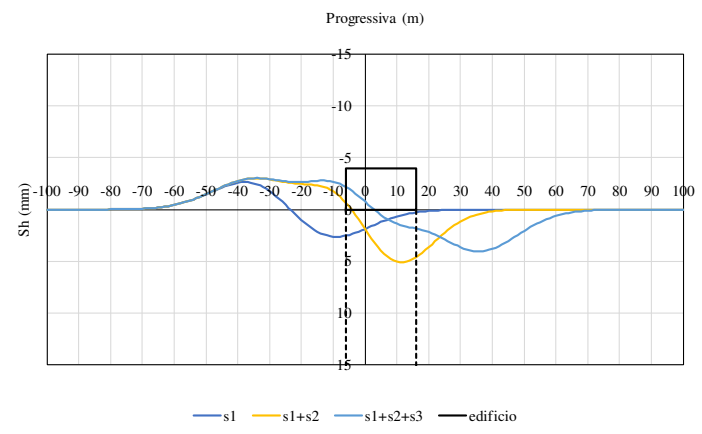
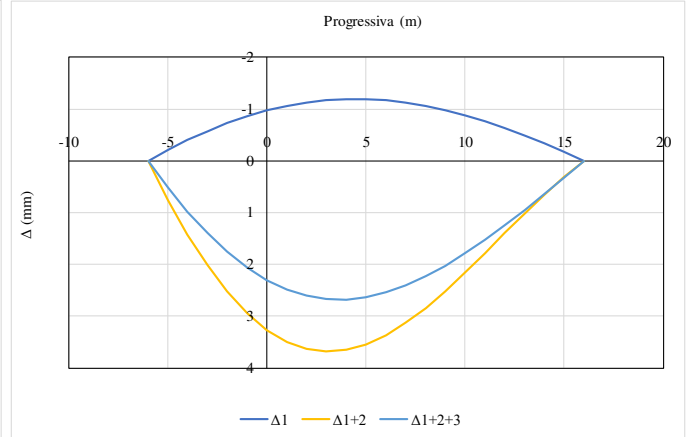
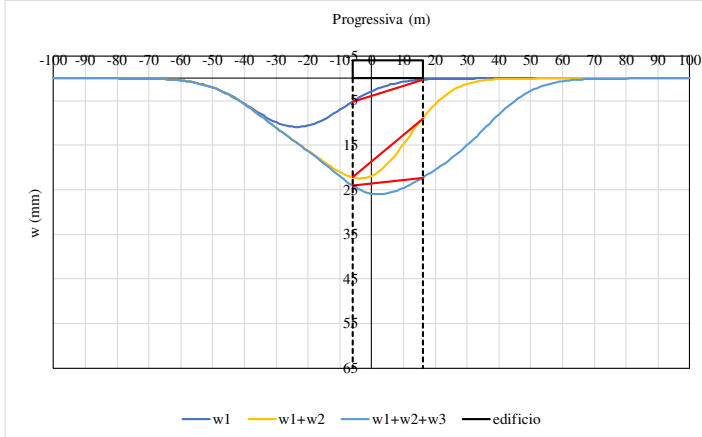




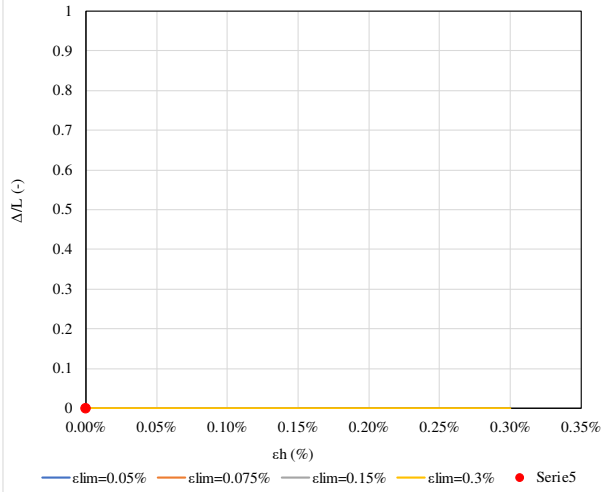
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
5	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.018%	0.013%
0.006%	#DIV/0!	#DIV/0!

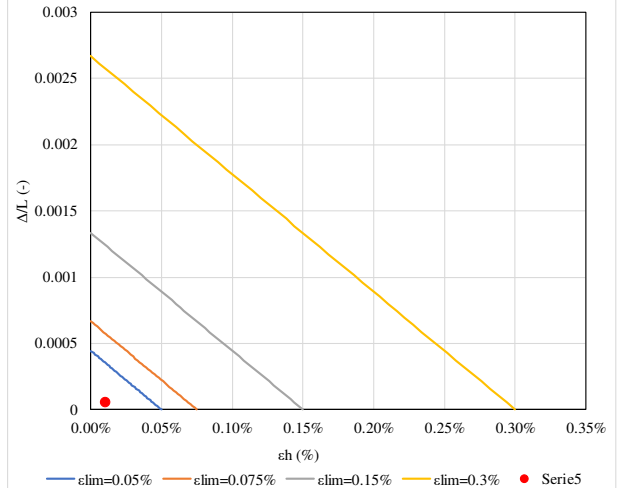
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.010%	#DIV/0!
-0.010%	#DIV/0!	#DIV/0!



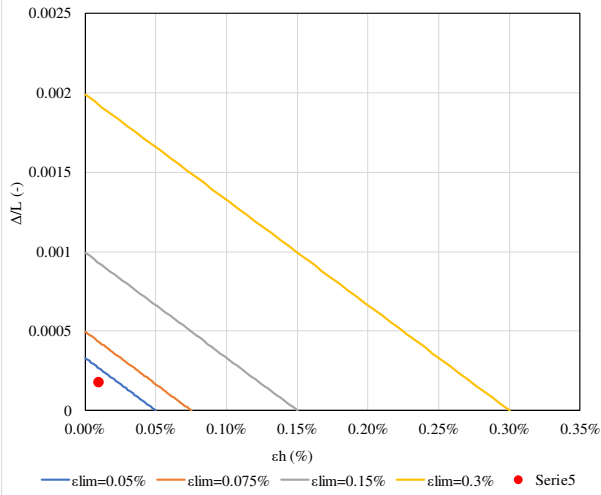
Abaco di danno sagging 1° canna



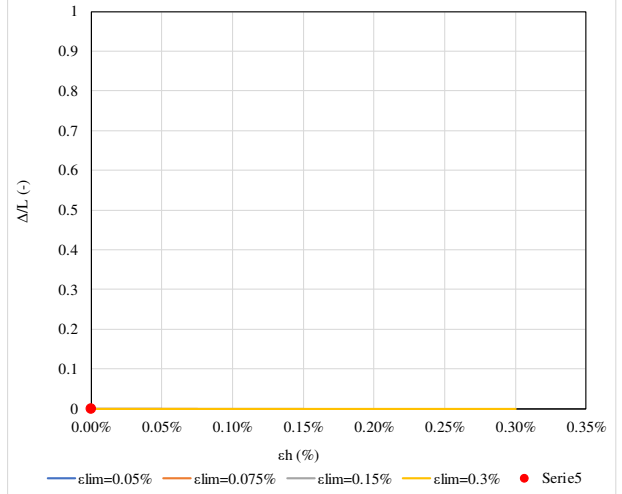
Abaco di danno hogging 1° canna



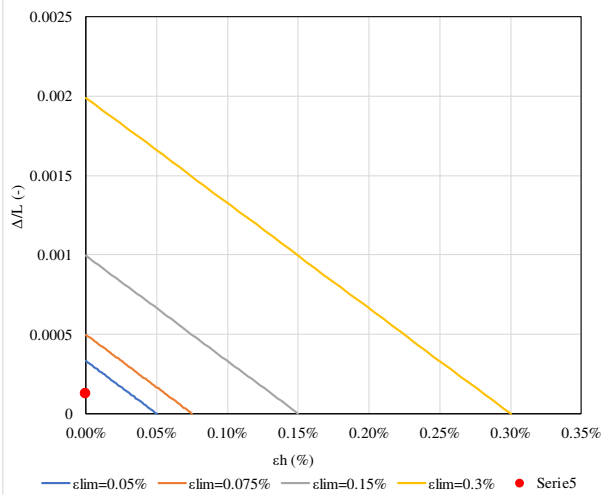
Abaco di danno sagging 1° e 2° canna



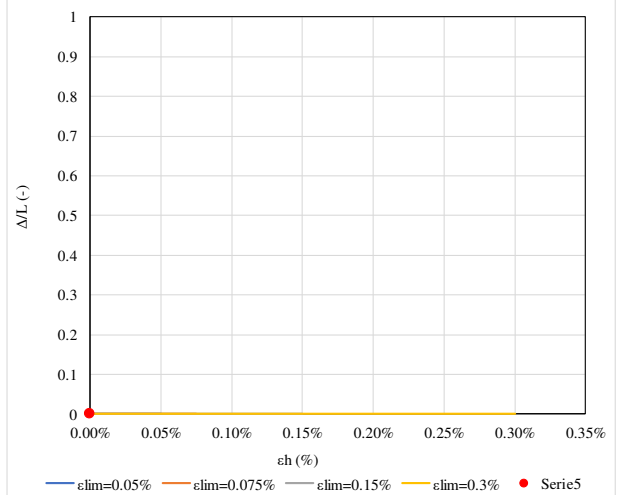
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



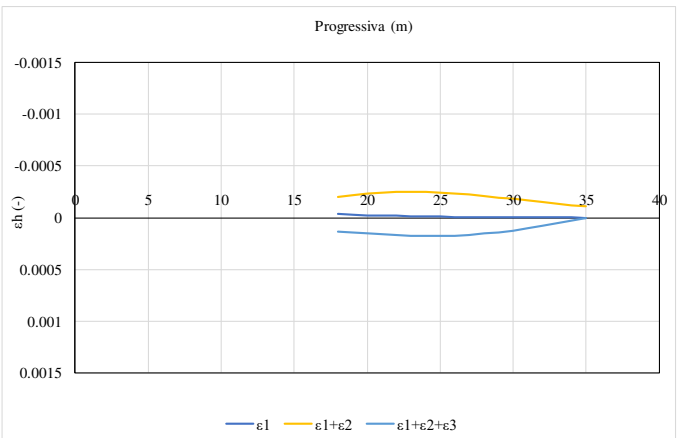
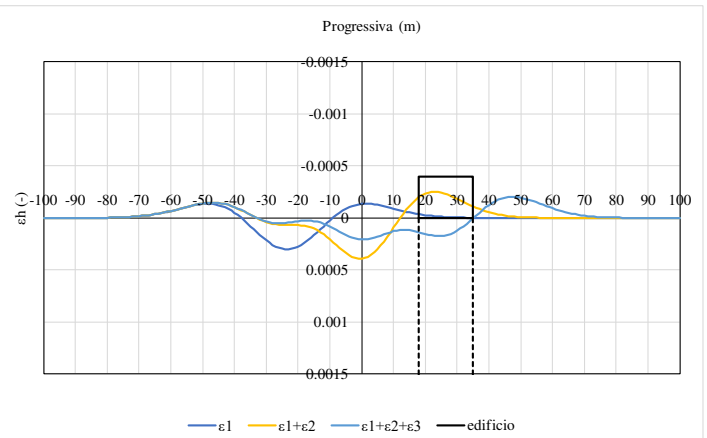
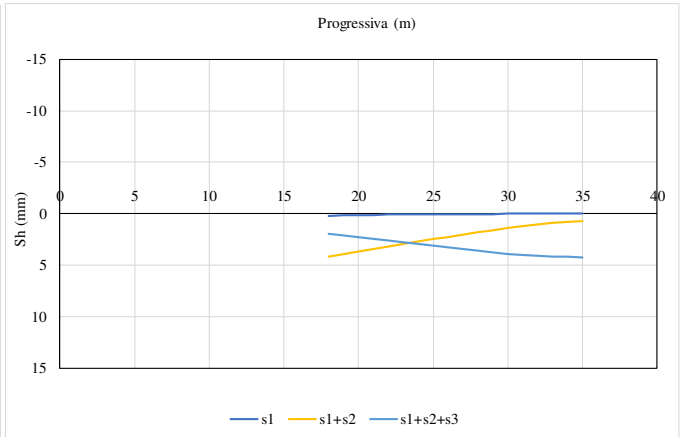
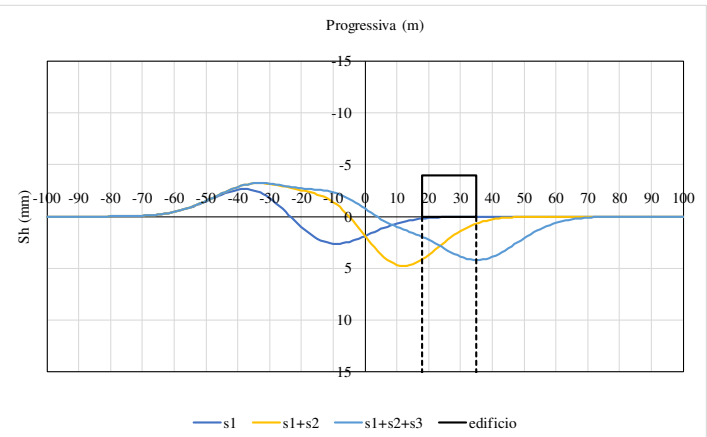
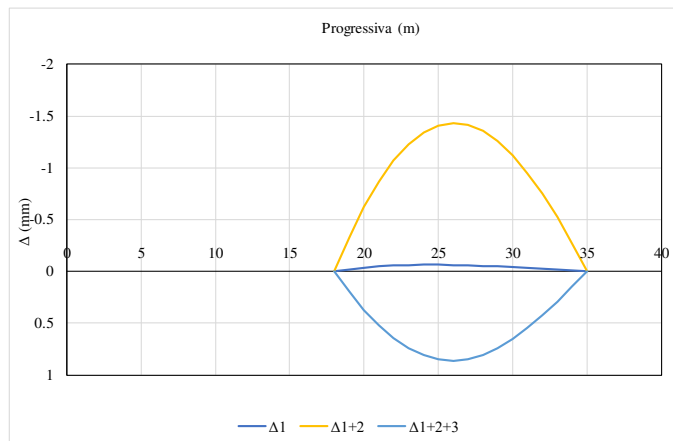
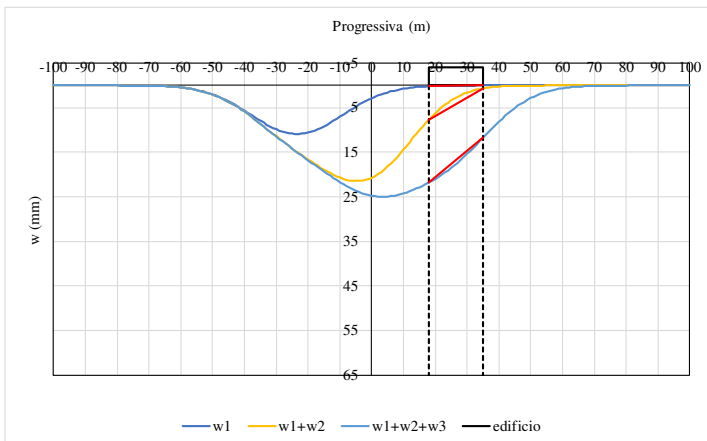
Abaco di danno hogging 1°, 2° e 3° canna



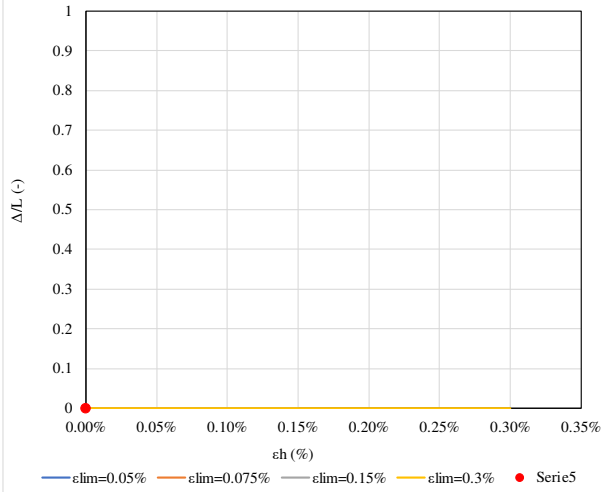
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
6	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.005%
0.000%	0.009%	#DIV/0!

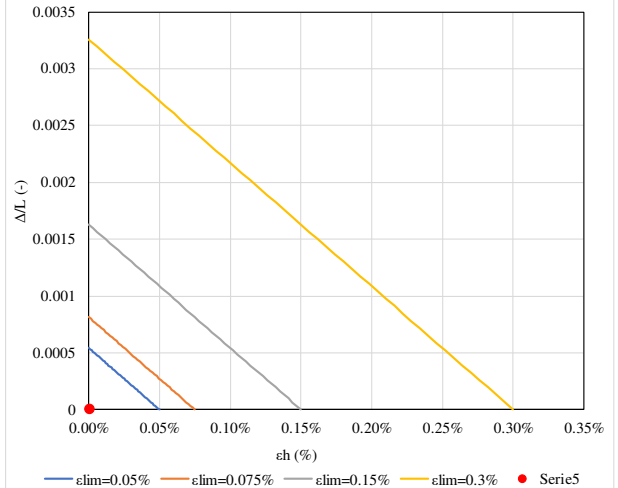
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.001%	-0.021%	#DIV/0!



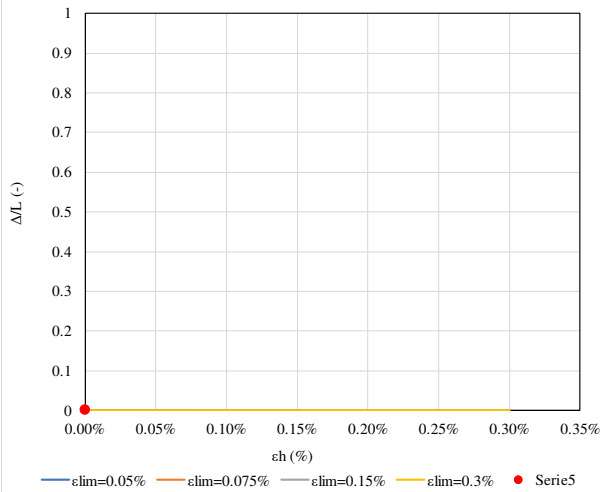
Abaco di danno sagging 1° canna



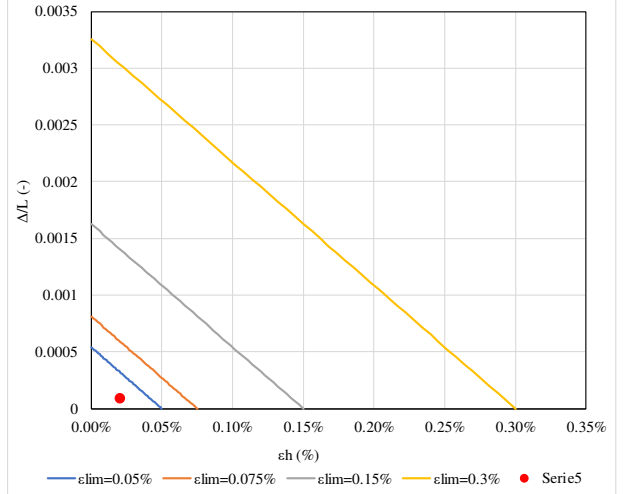
Abaco di danno hogging 1° canna



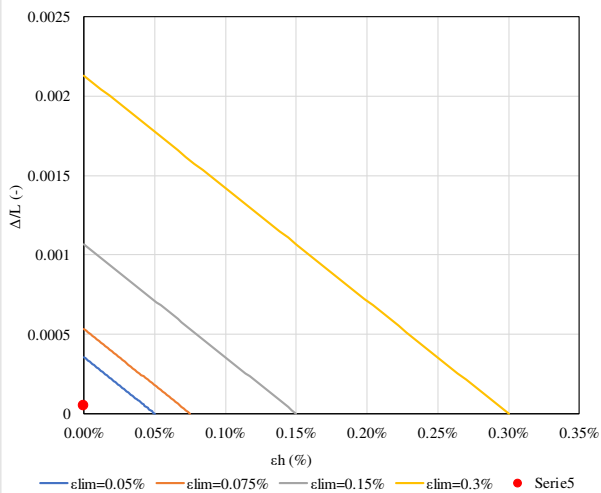
Abaco di danno sagging 1° e 2° canna



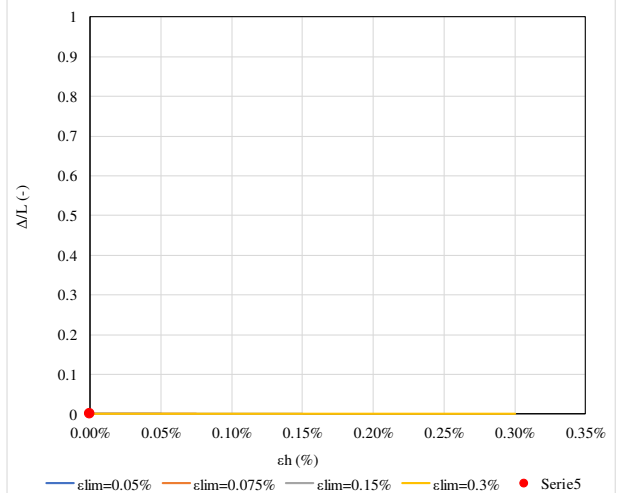
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



Abaco di danno hogging 1°, 2° e 3° canna

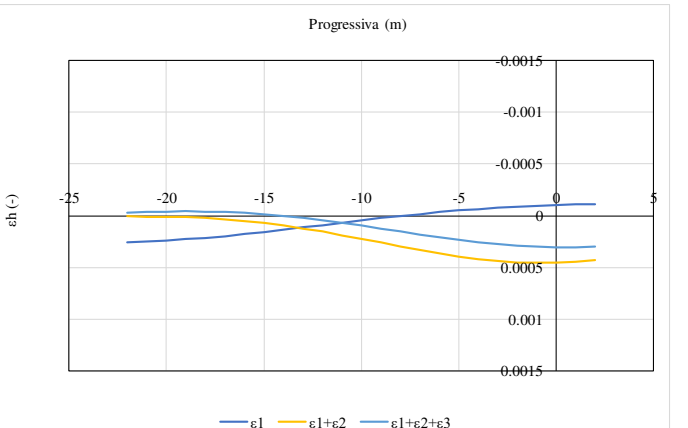
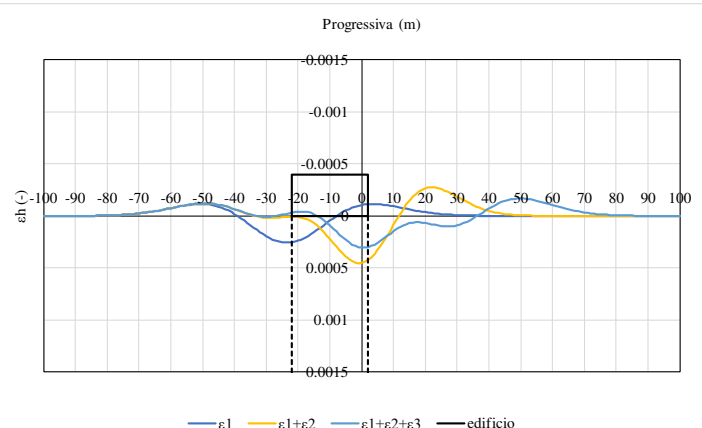
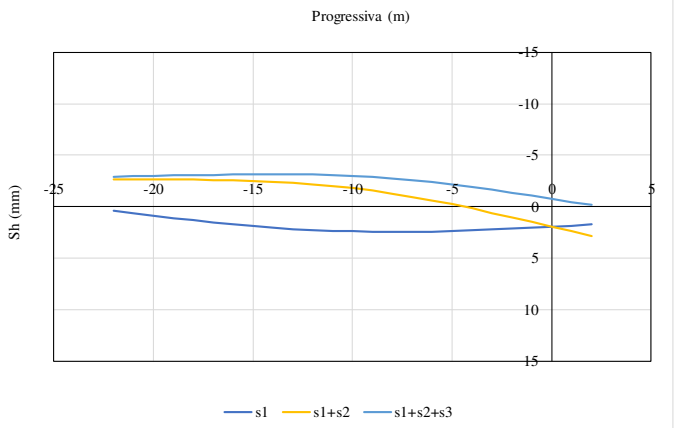
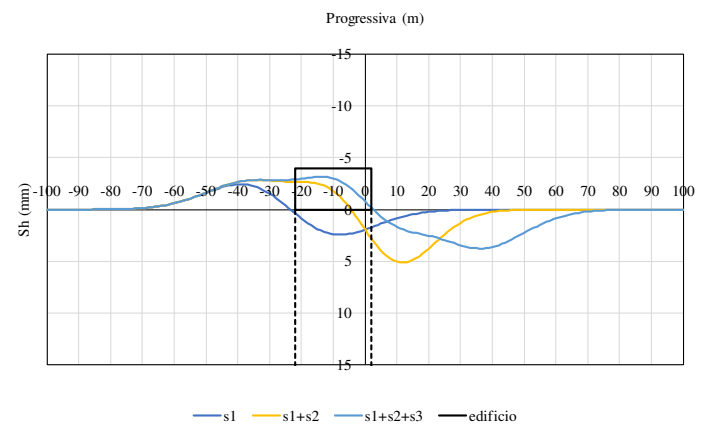
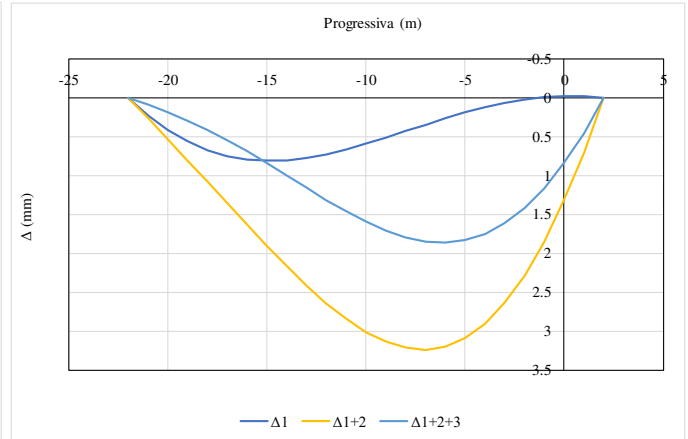
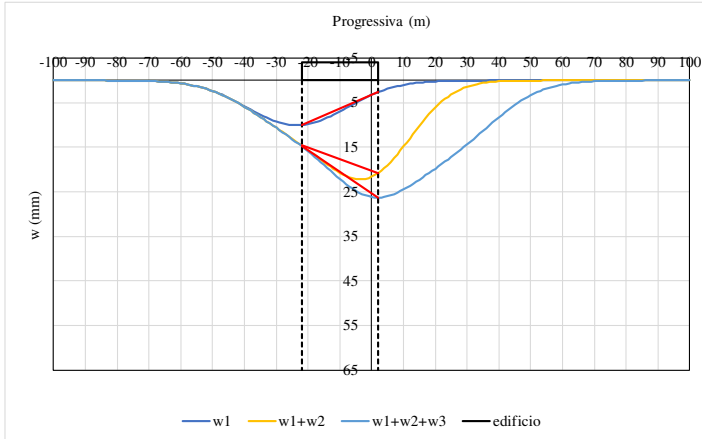


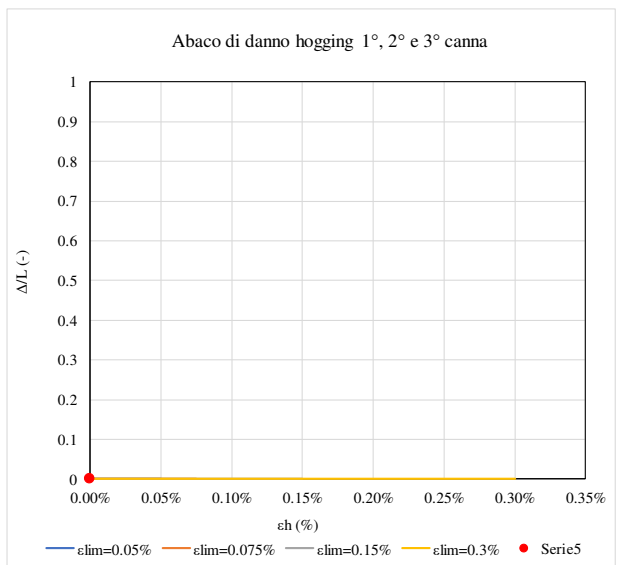
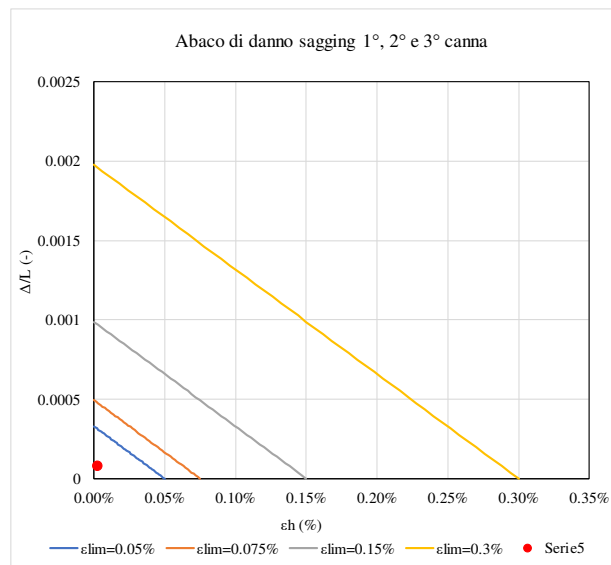
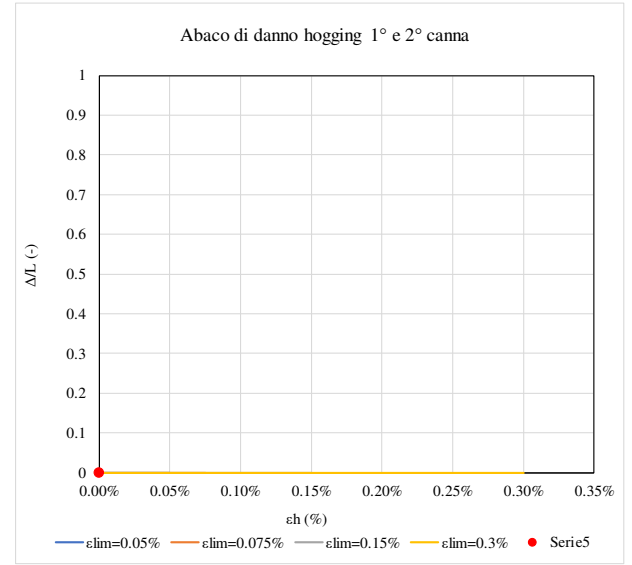
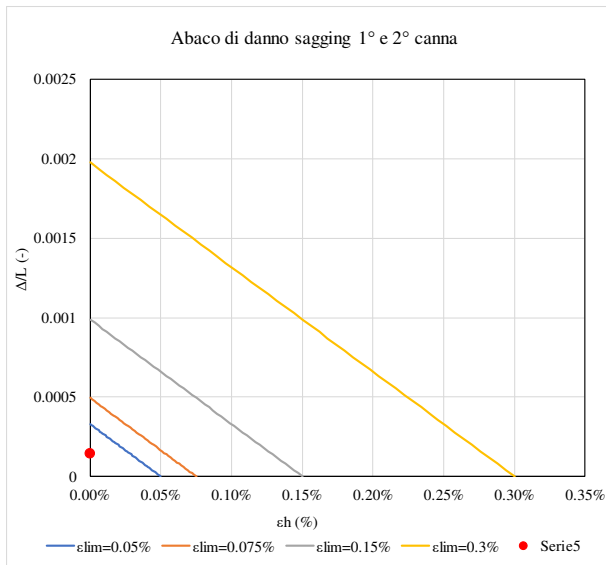
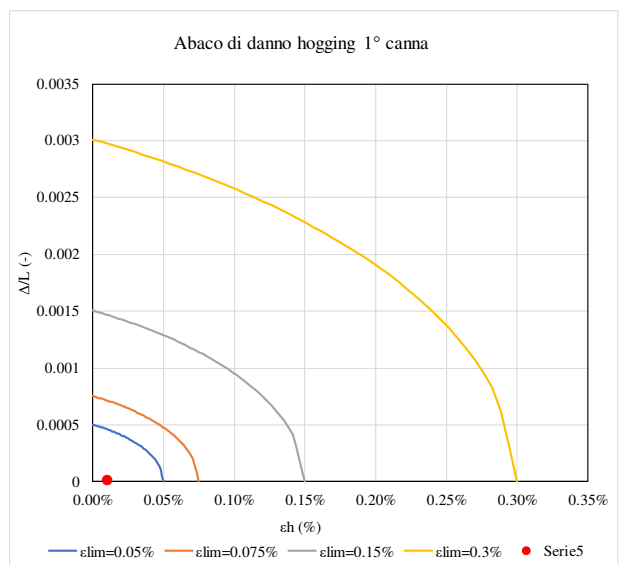
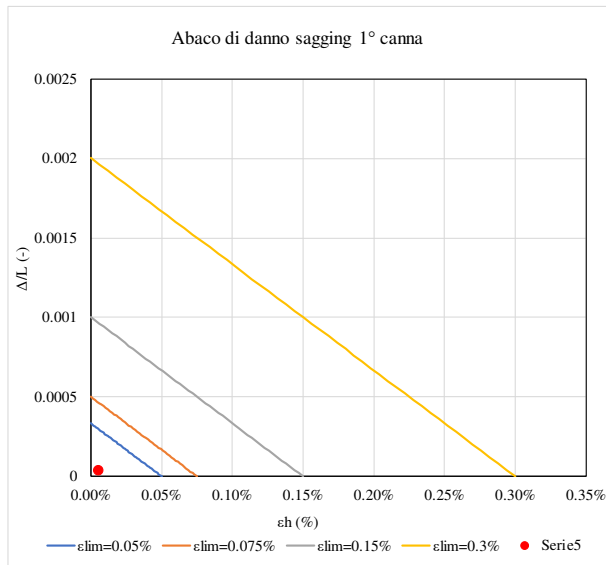


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
7	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.004%	0.014%	0.008%
0.001%	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.006%	#DIV/0!	-0.003%
-0.010%	#DIV/0!	#DIV/0!

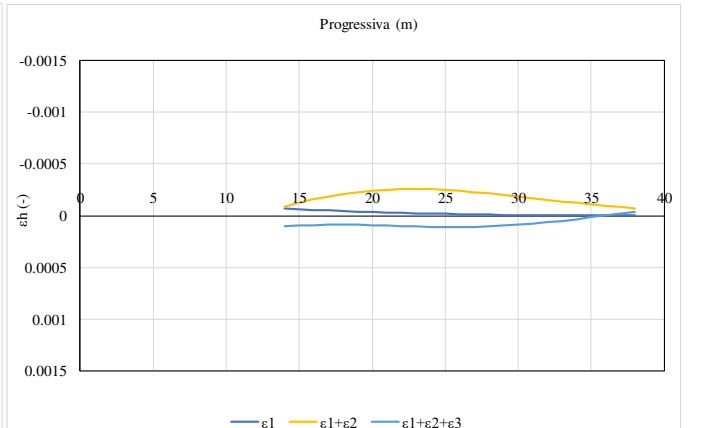
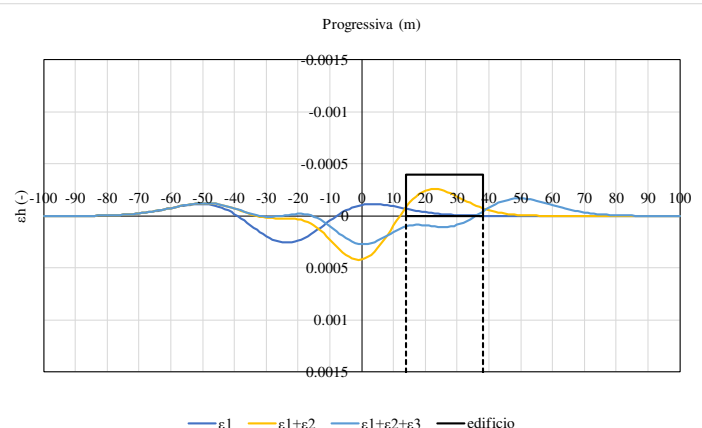
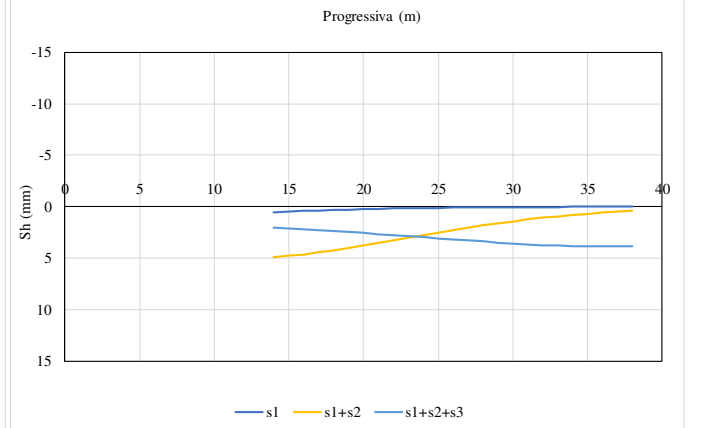
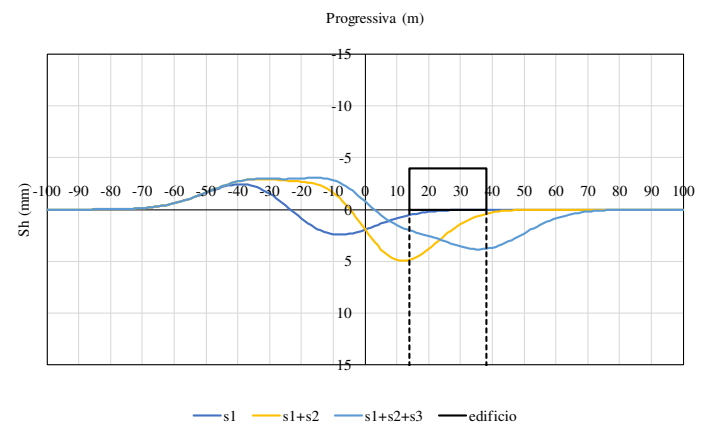
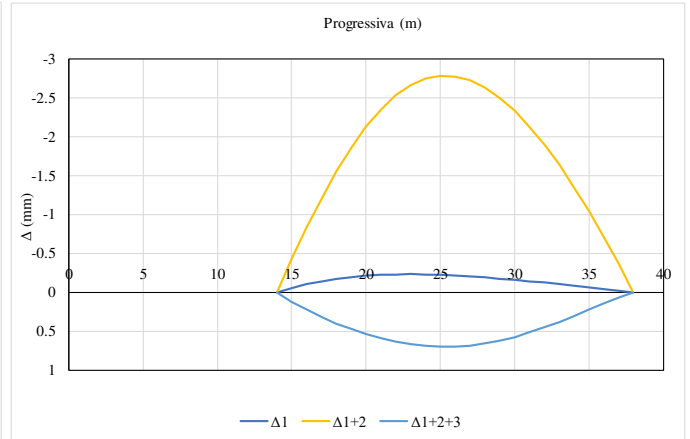
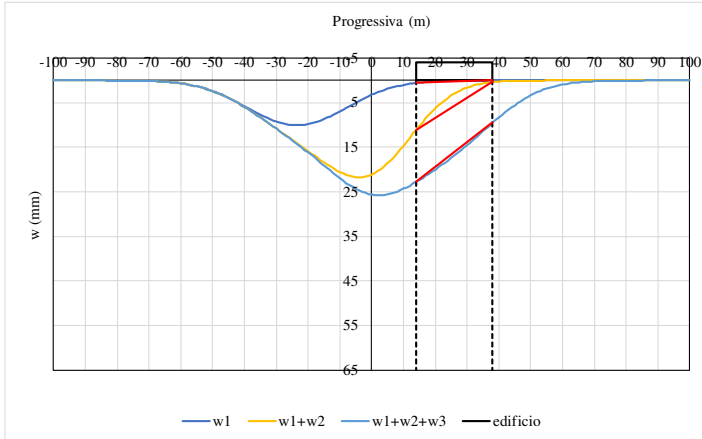




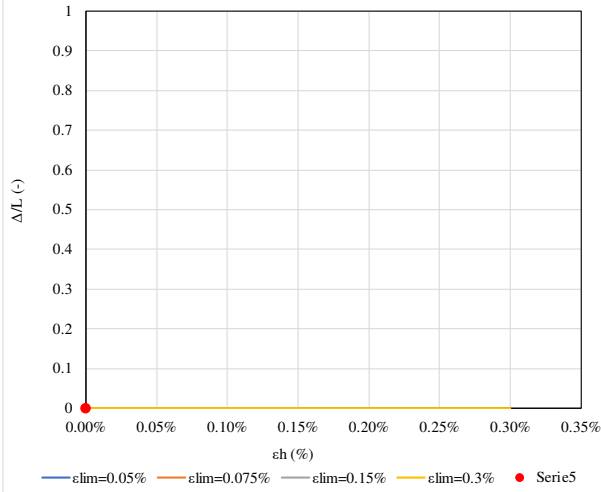
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
8	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.003%
0.001%	0.012%	#DIV/0!

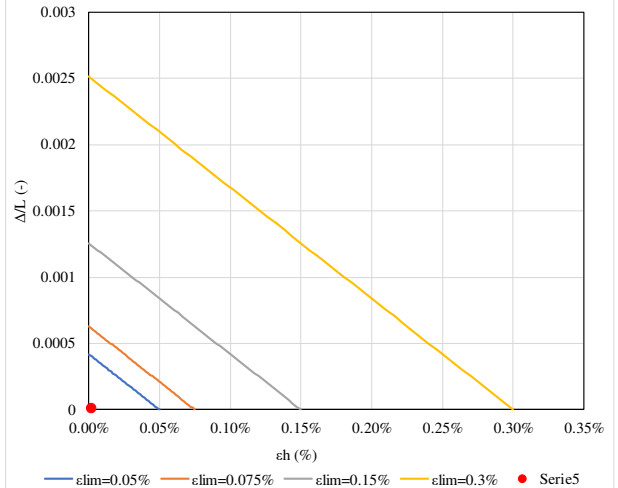
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	-0.001%
-0.002%	-0.019%	#DIV/0!



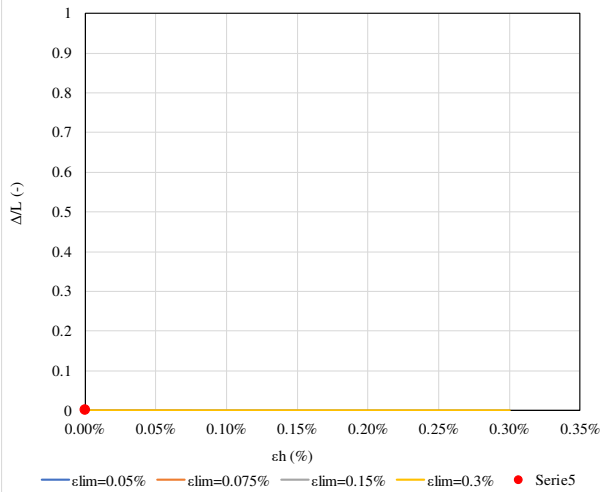
Abaco di danno sagging 1° canna



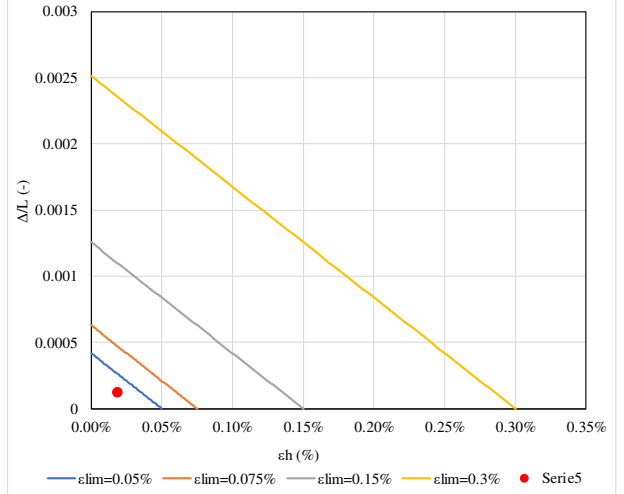
Abaco di danno hogging 1° canna



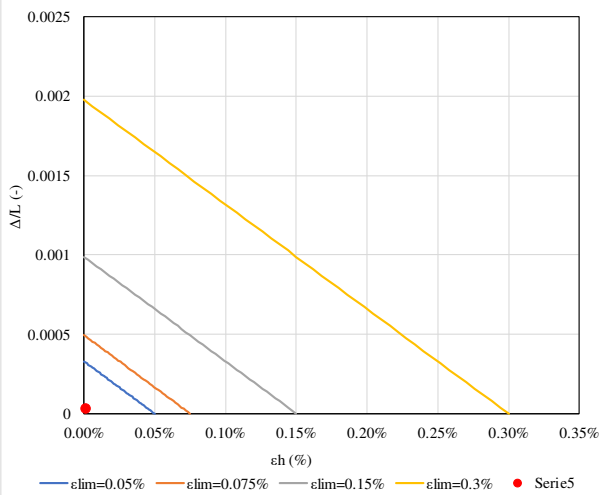
Abaco di danno sagging 1° e 2° canna



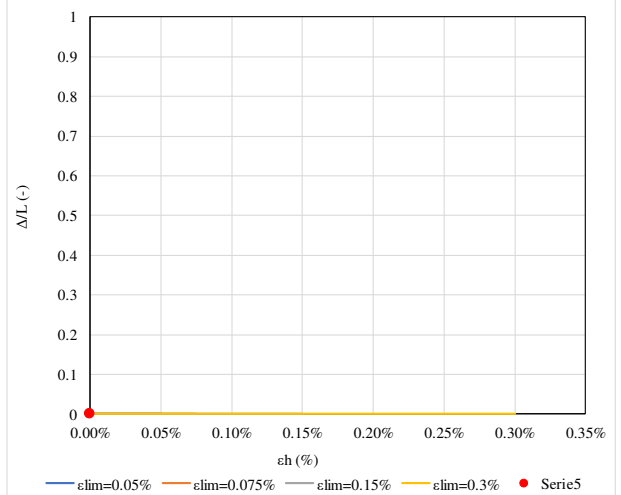
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



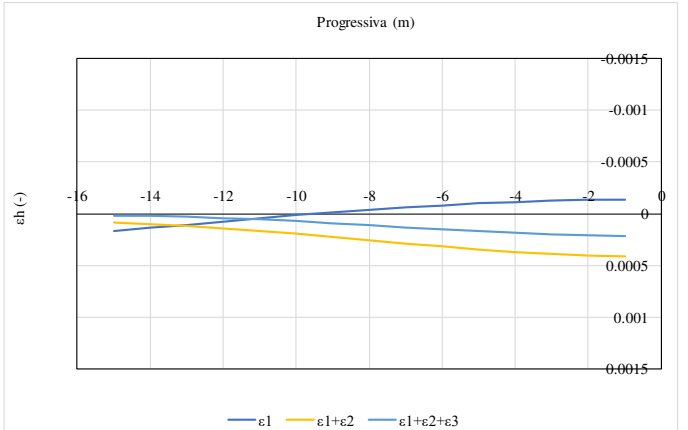
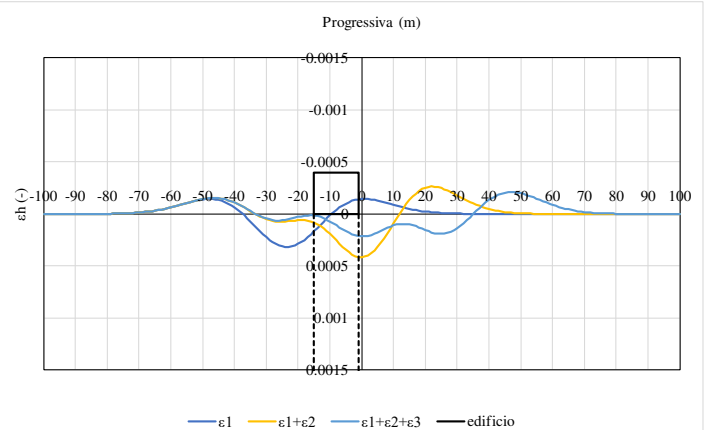
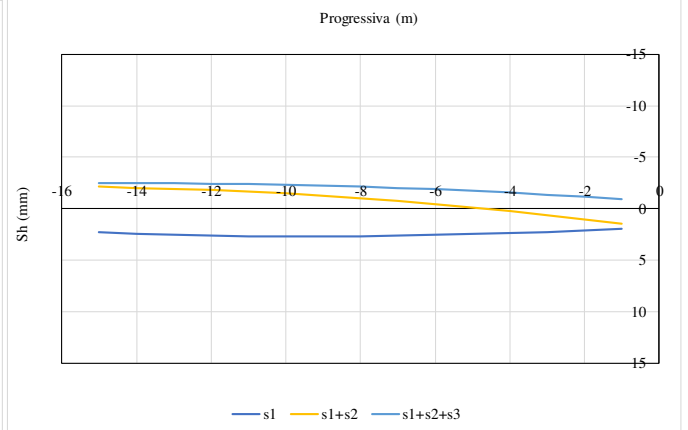
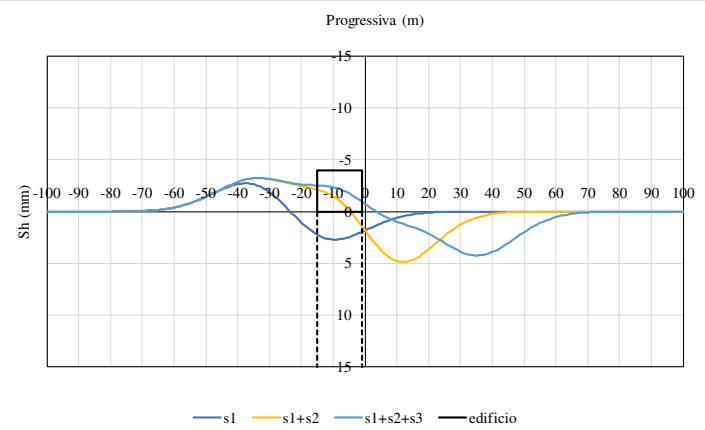
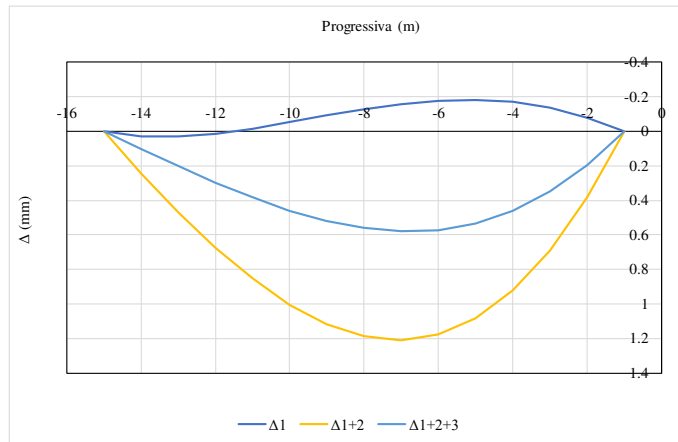
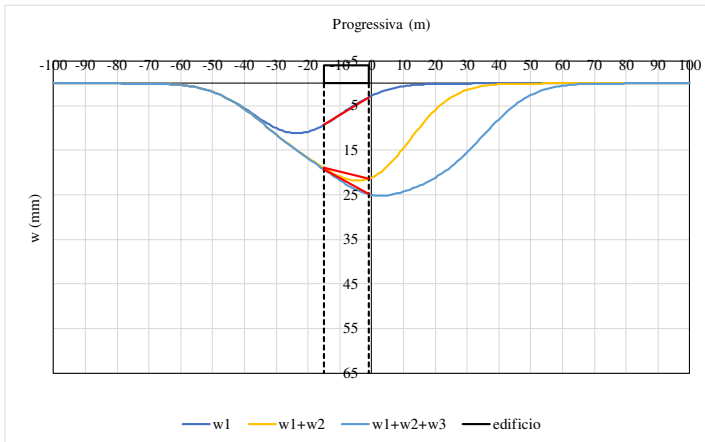
Abaco di danno hogging 1°, 2° e 3° canna

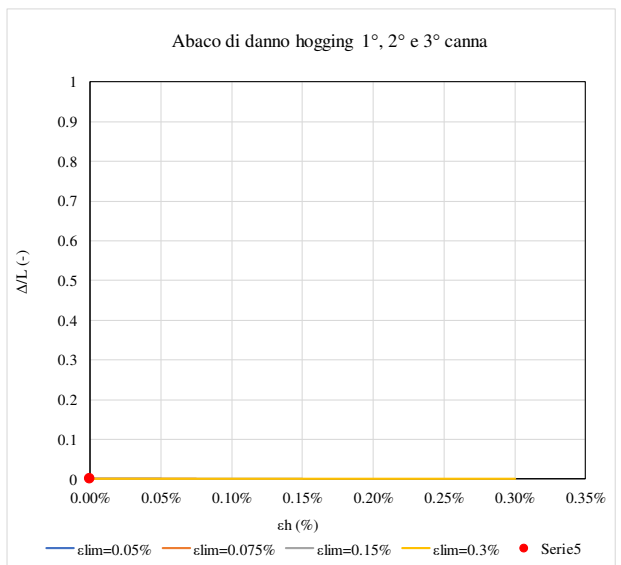
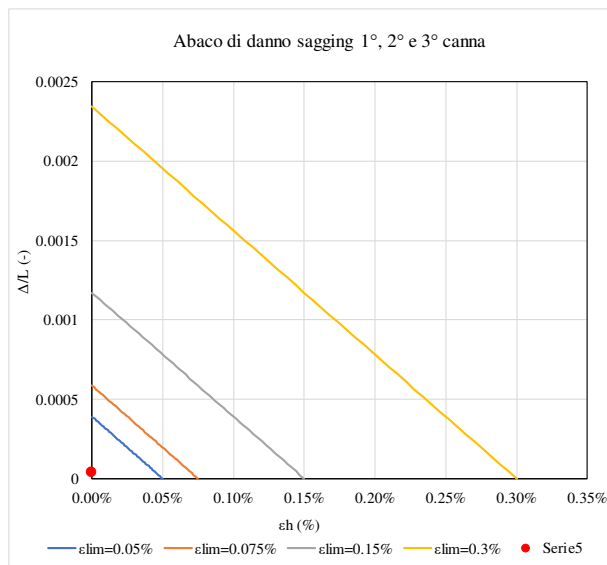
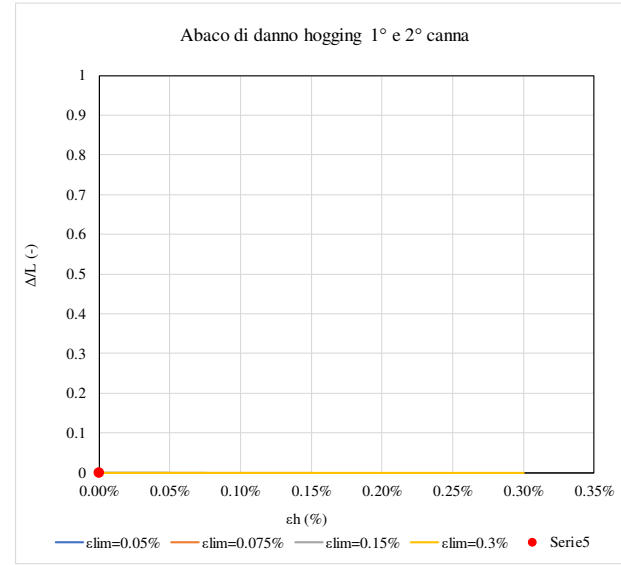
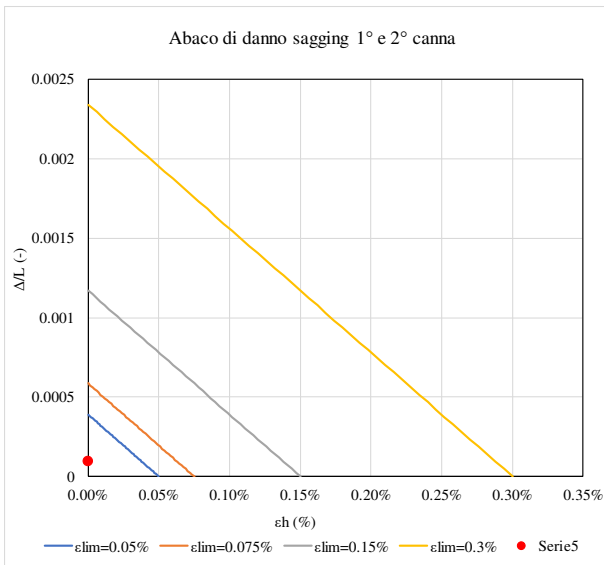
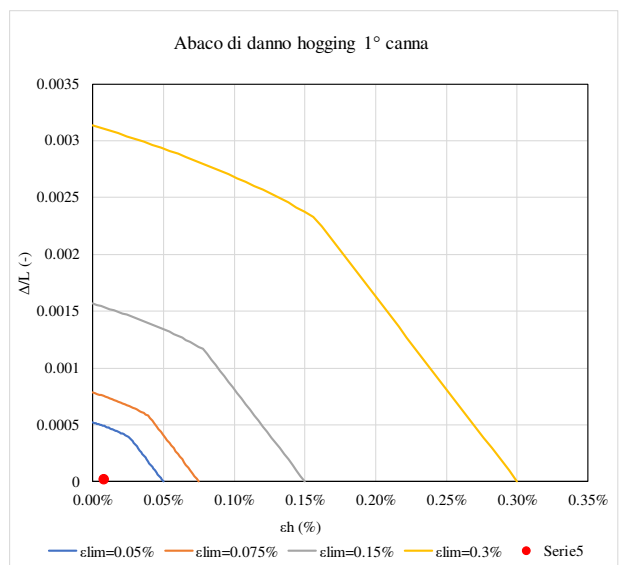
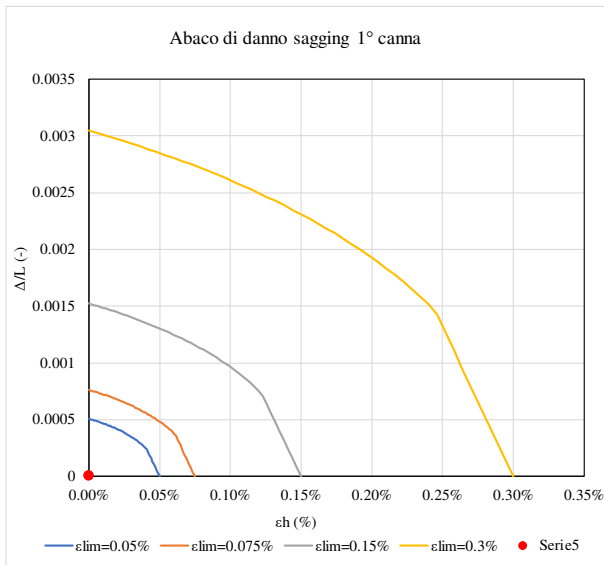


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
9	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.001%	0.009%	0.004%
0.002%	#DIV/0!	#DIV/0!

$\varepsilon_{1,max}$	$\varepsilon_{1+2,max}$	$\varepsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.008%	#DIV/0!	#DIV/0!

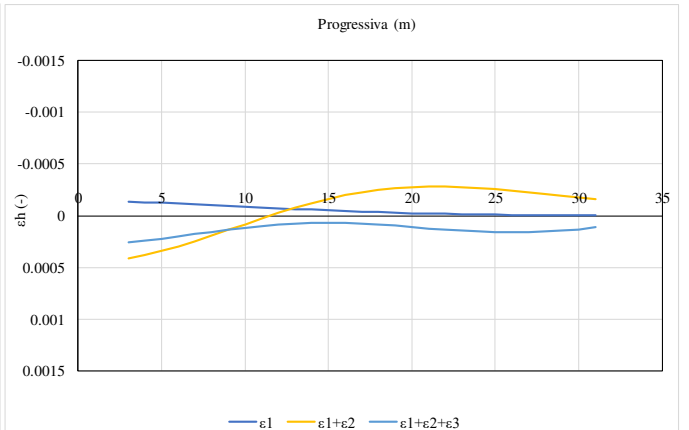
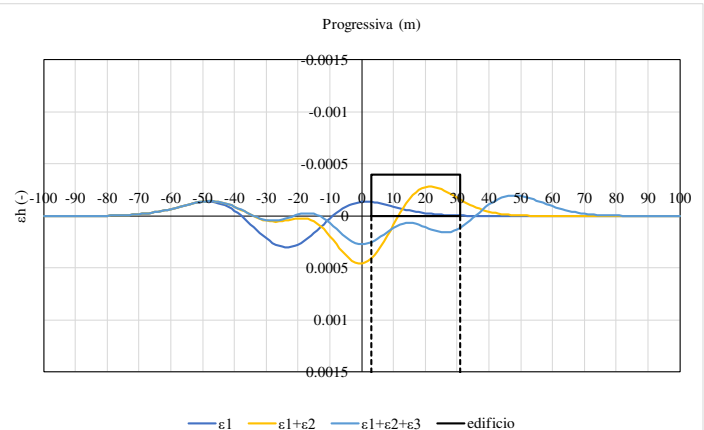
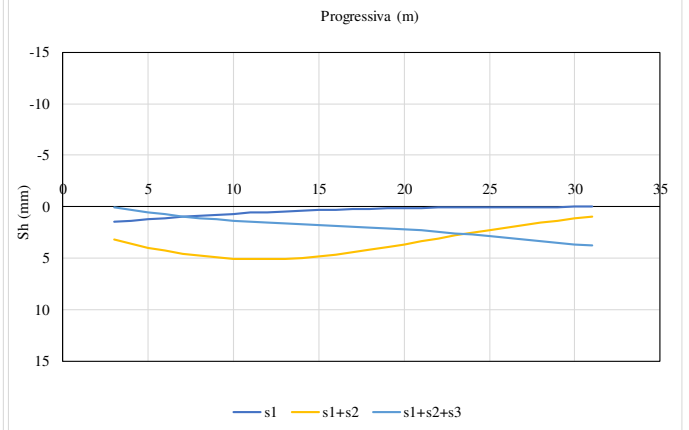
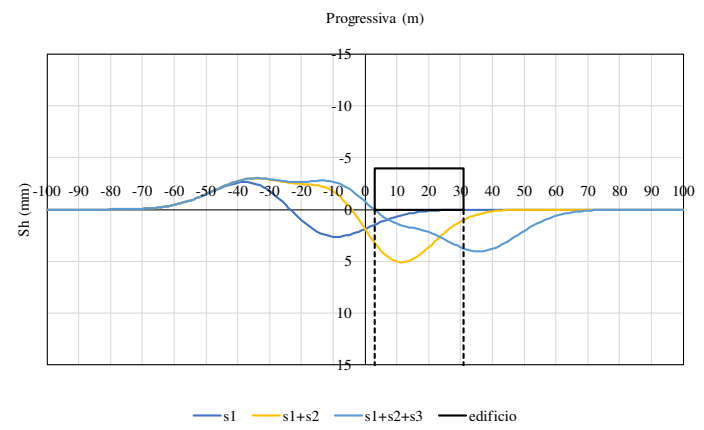
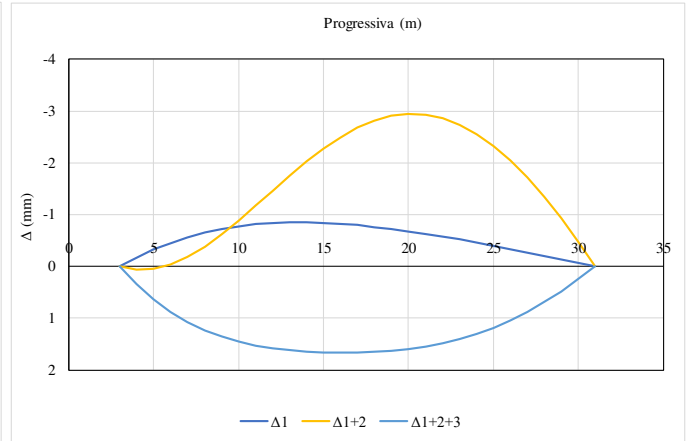
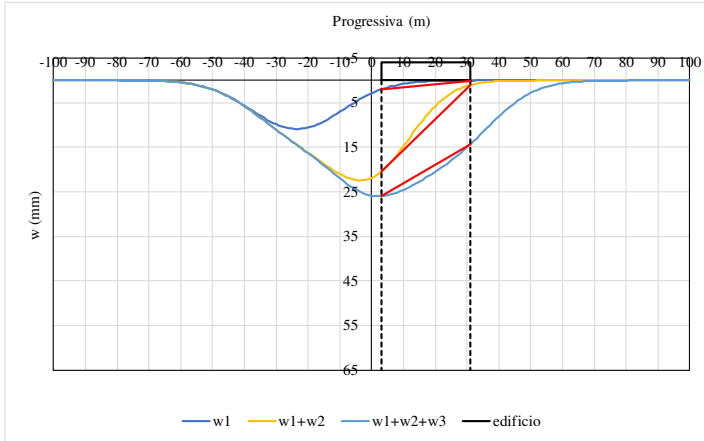


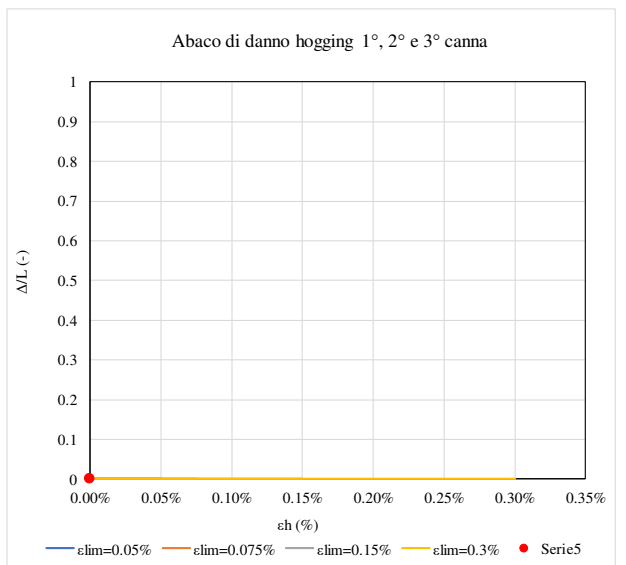
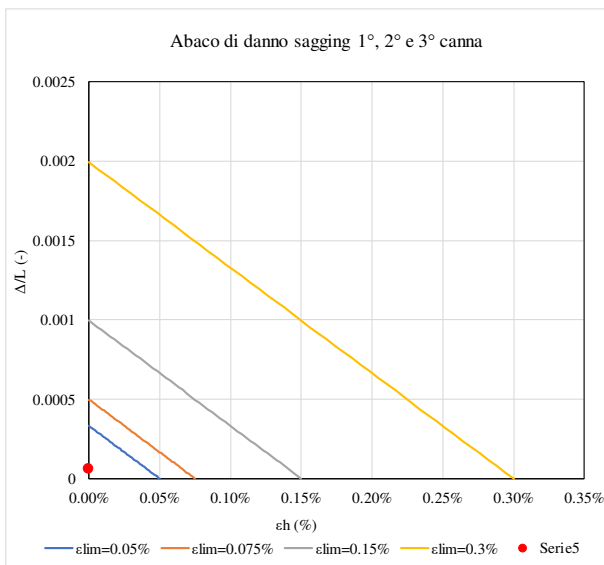
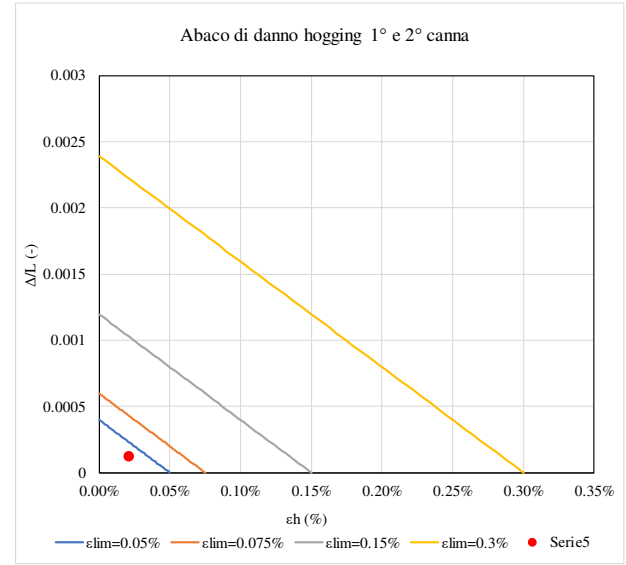
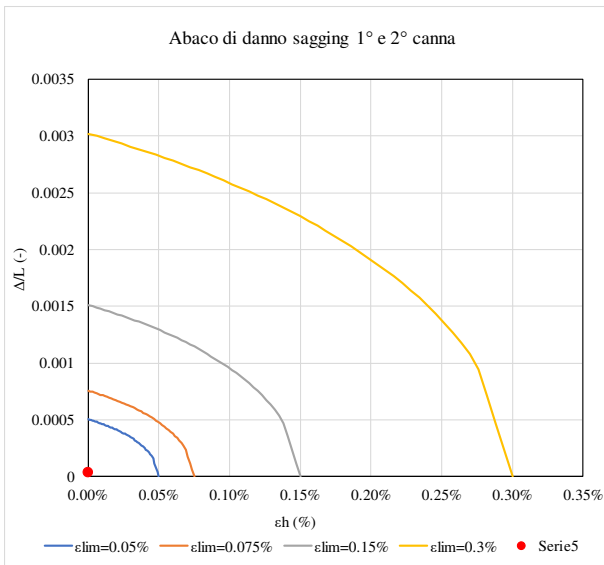
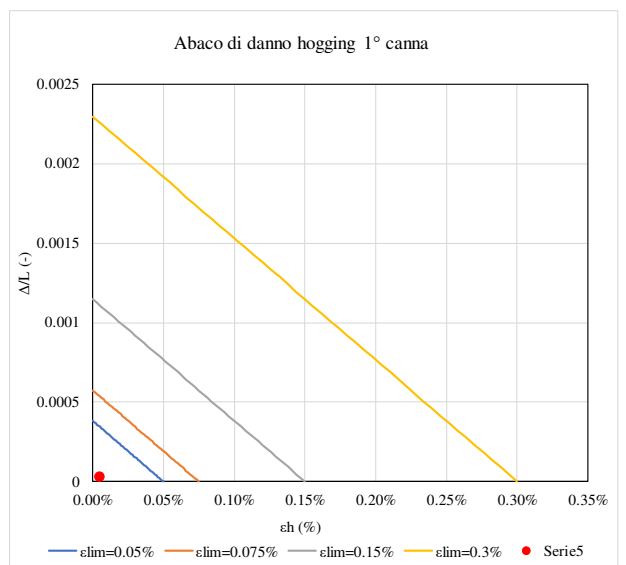
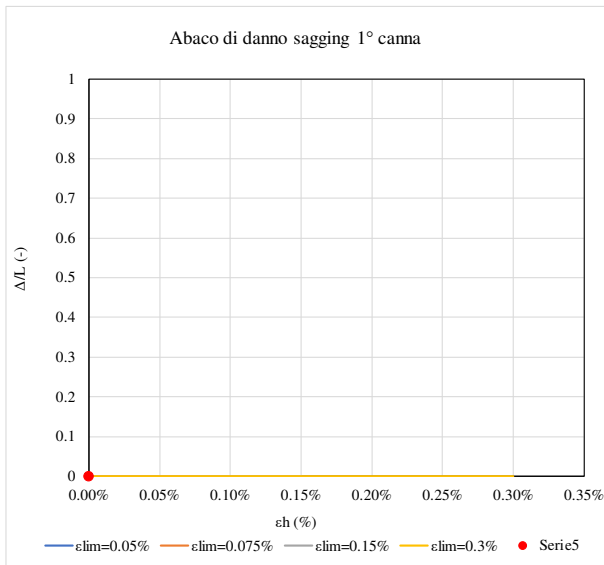


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
10	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.003%	0.006%
0.003%	0.012%	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.005%	-0.021%	#DIV/0!



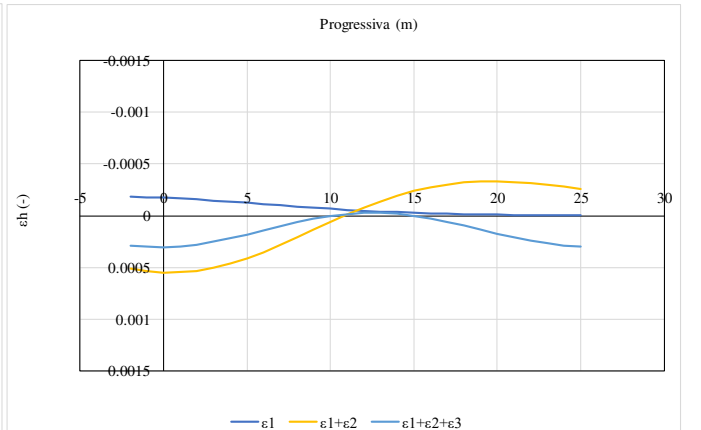
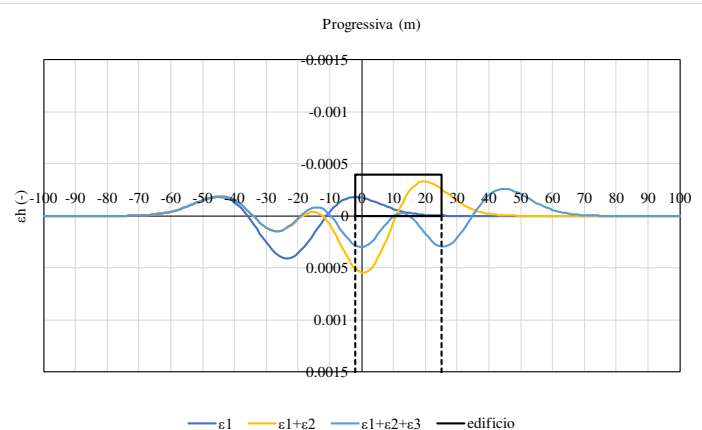
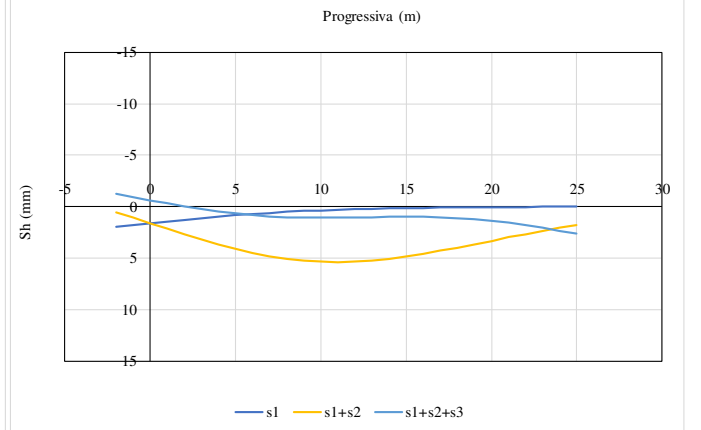
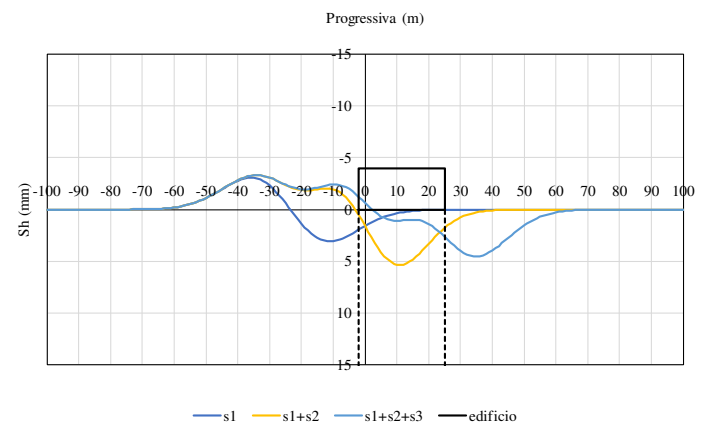
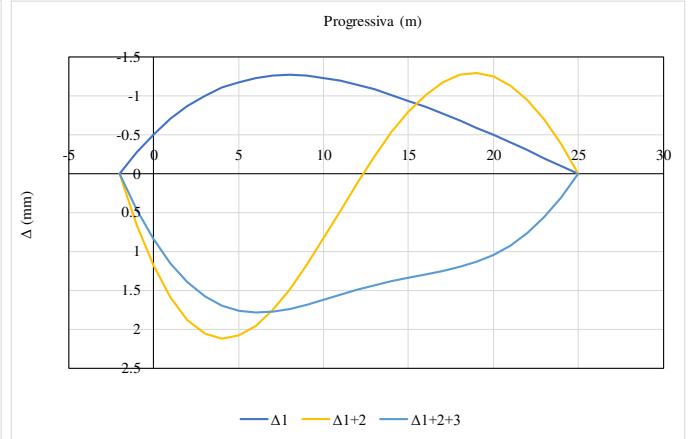
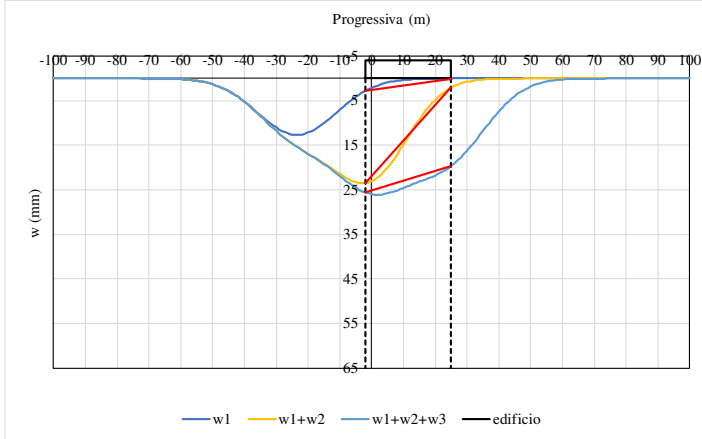




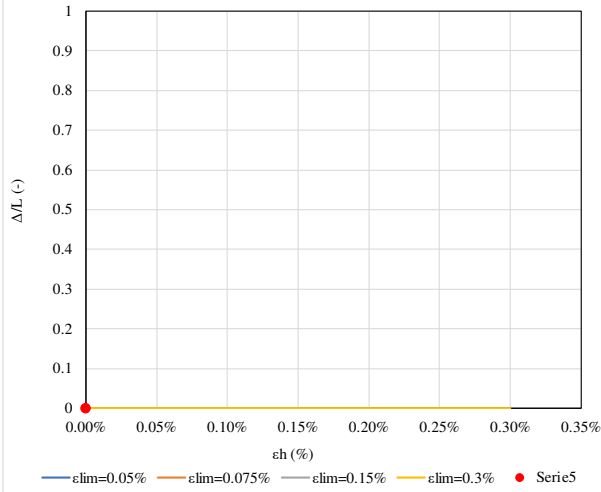
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
11	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.015%	0.007%
0.005%	0.011%	#DIV/0!

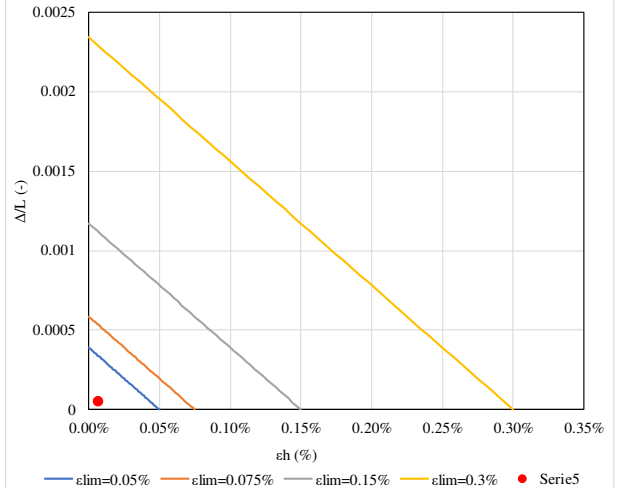
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.004%	-0.002%
-0.007%	-0.028%	#DIV/0!



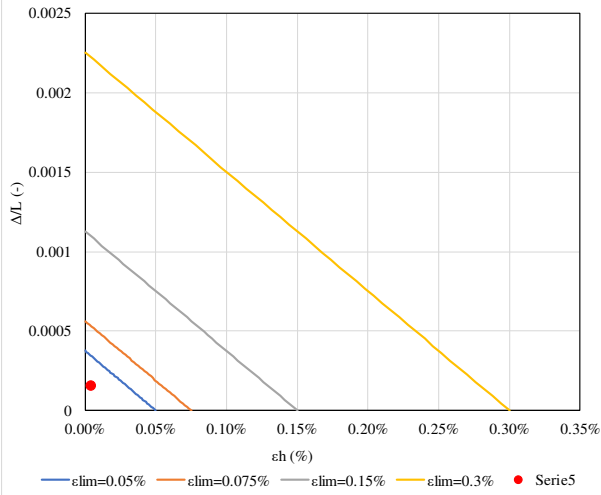
Abaco di danno sagging 1° canna



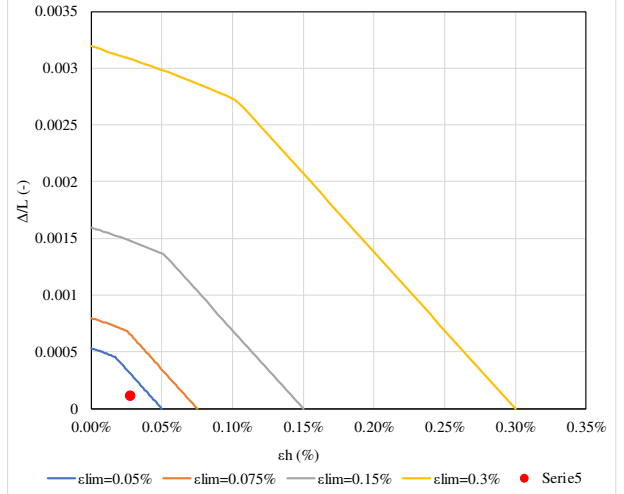
Abaco di danno hogging 1° canna



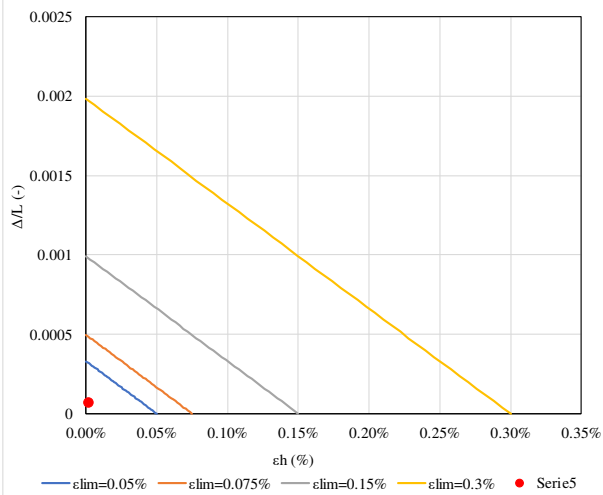
Abaco di danno sagging 1° e 2° canna



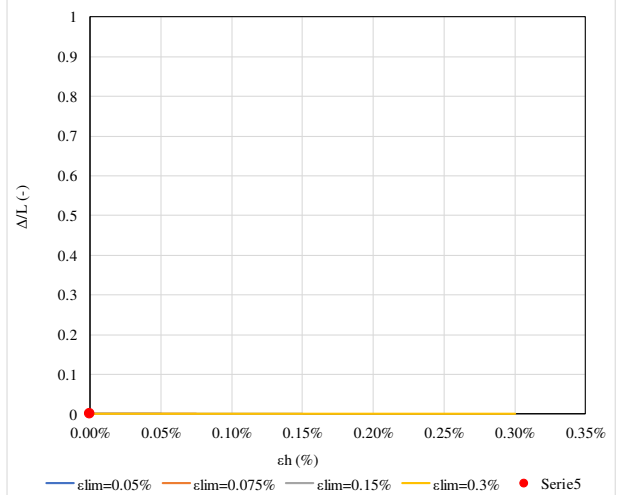
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



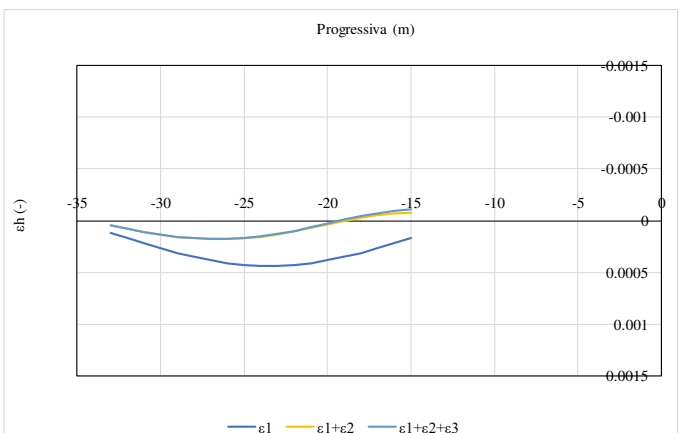
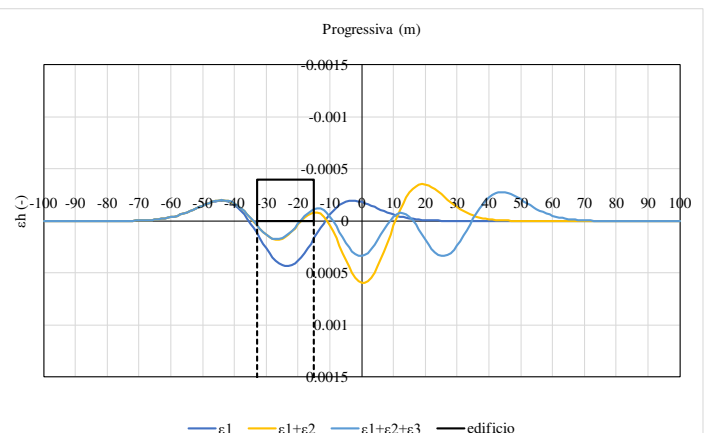
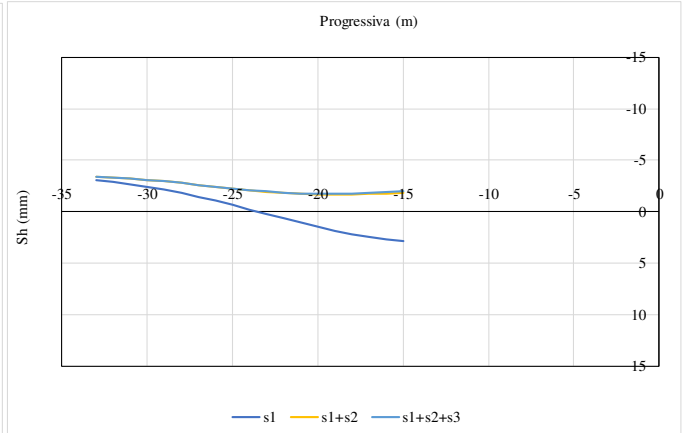
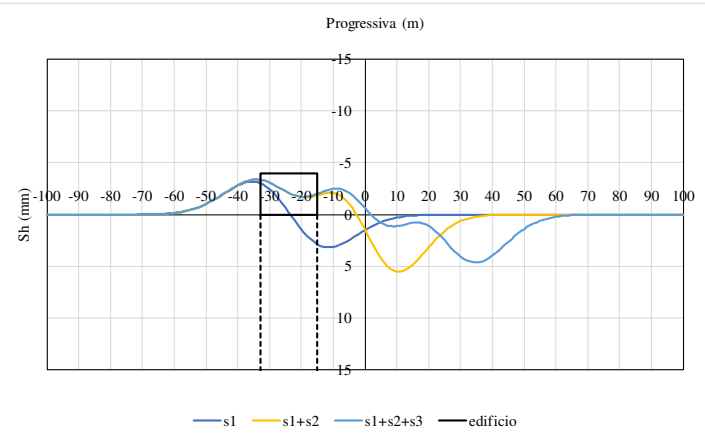
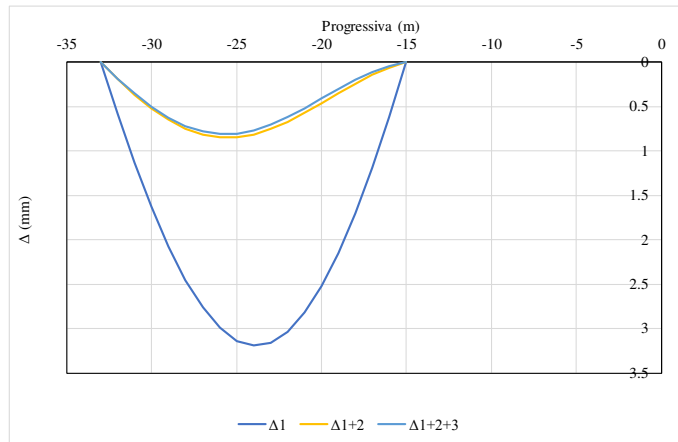
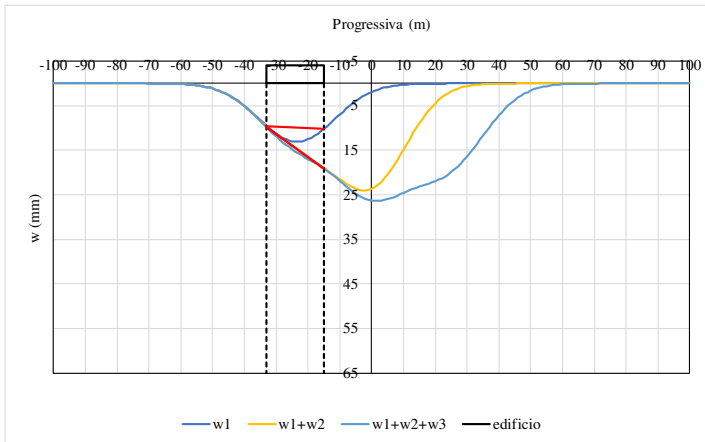
Abaco di danno hogging 1°, 2° e 3° canna

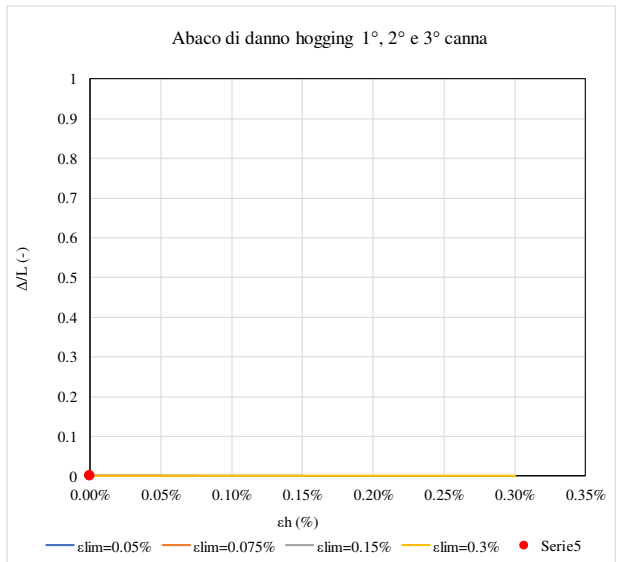
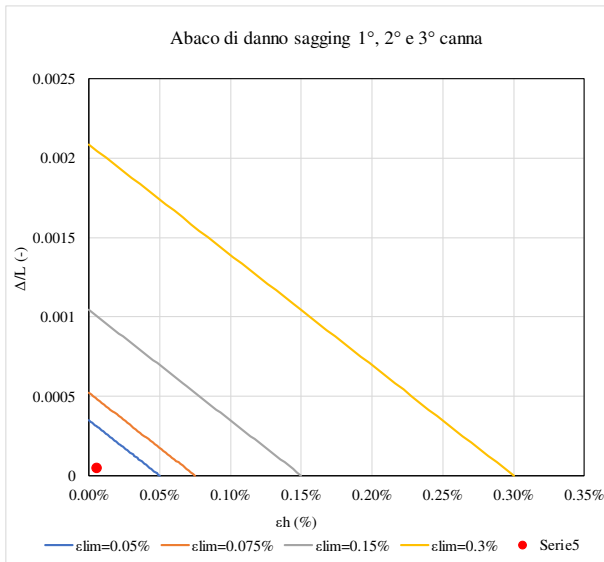
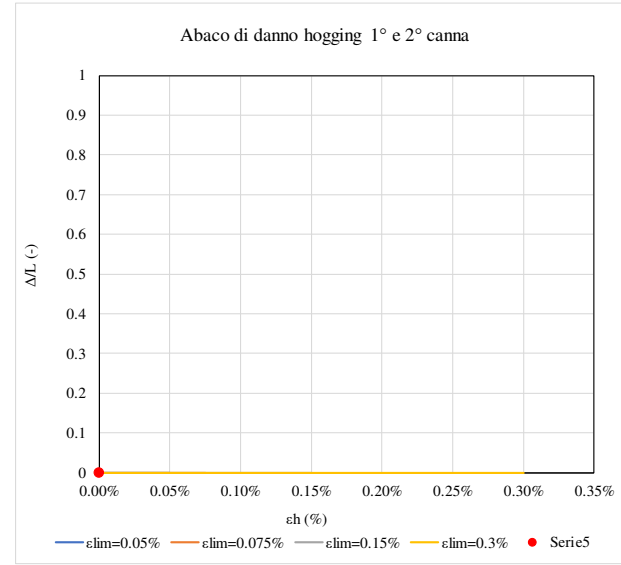
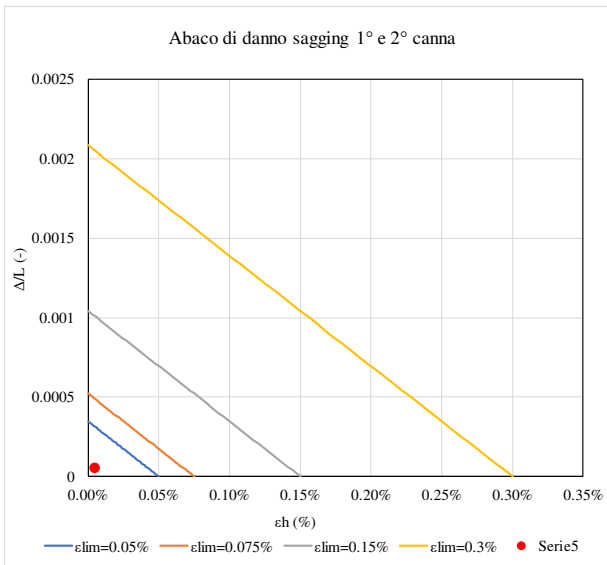
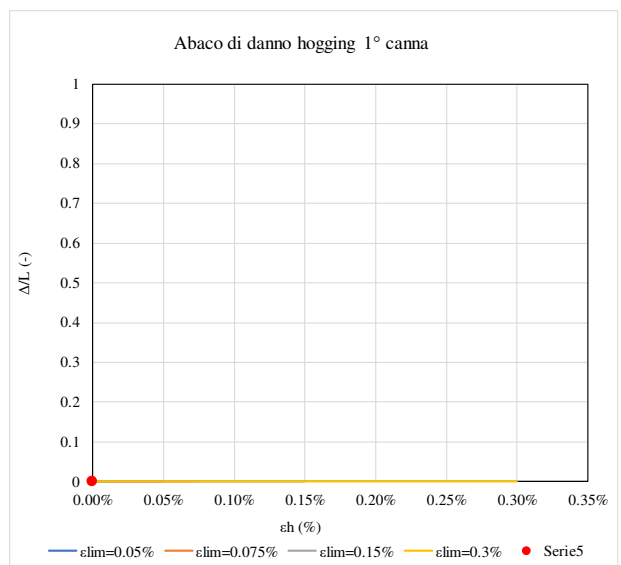
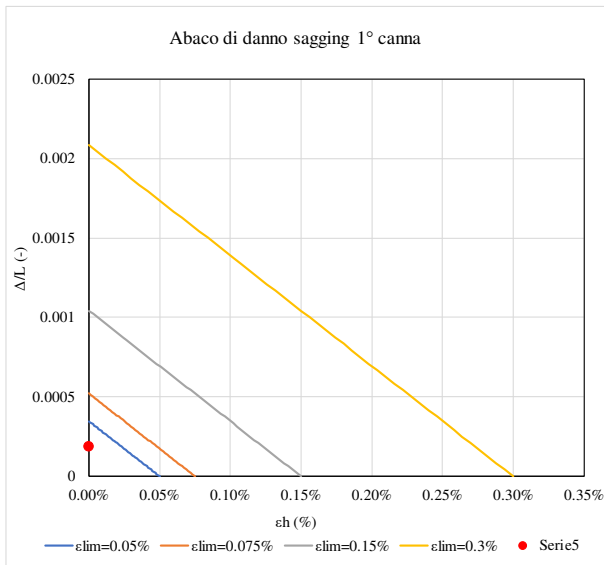


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
11bis	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.019%	0.005%	0.005%
#DIV/0!	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.005%	-0.006%
#DIV/0!	#DIV/0!	#DIV/0!

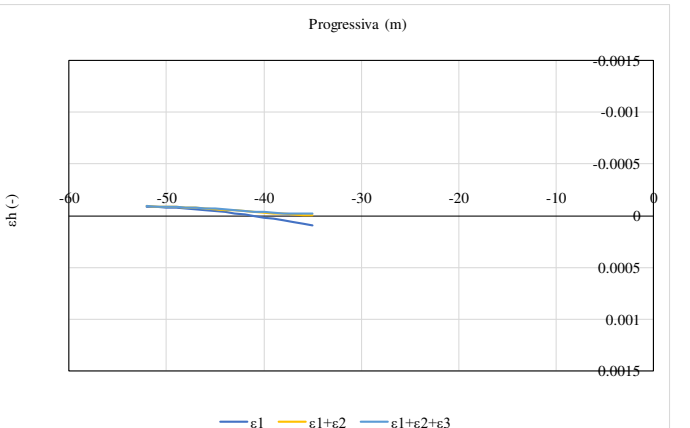
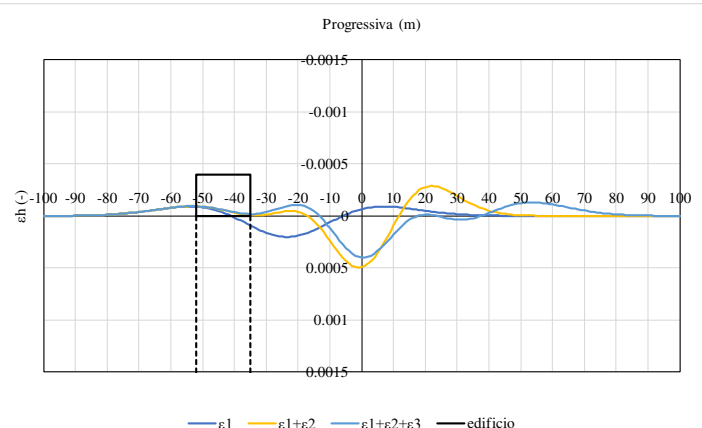
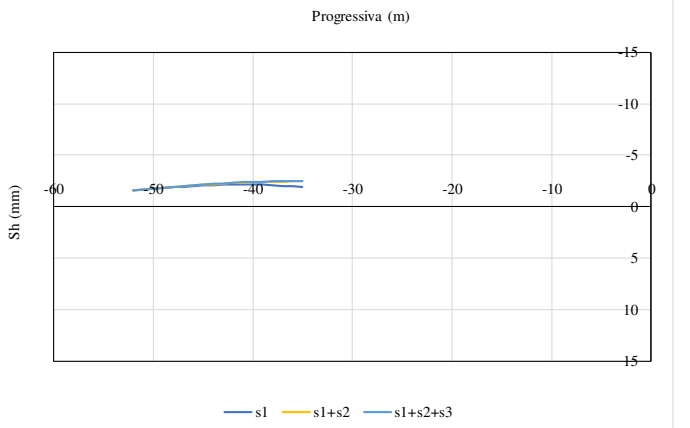
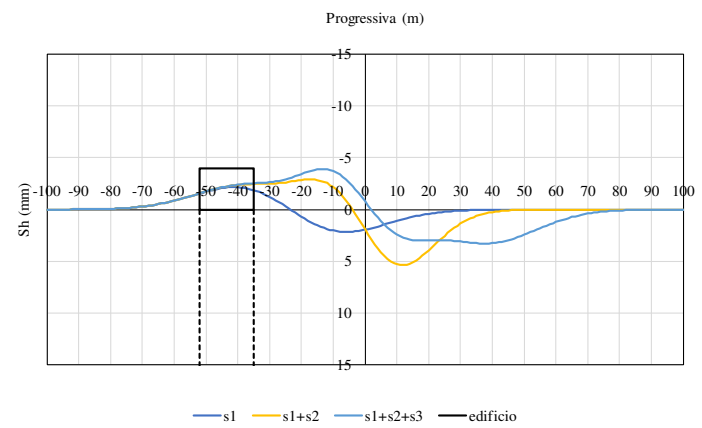
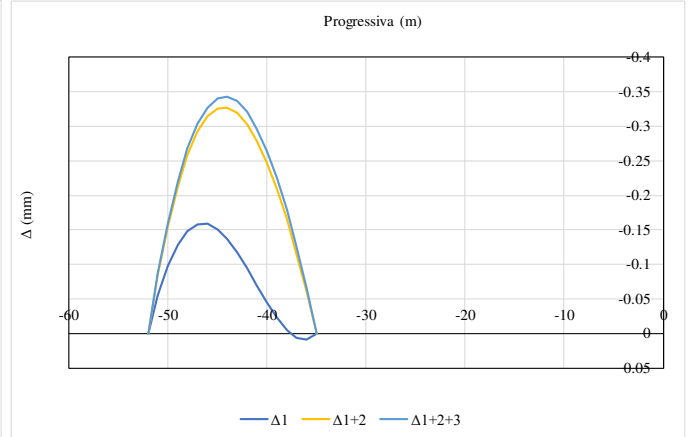
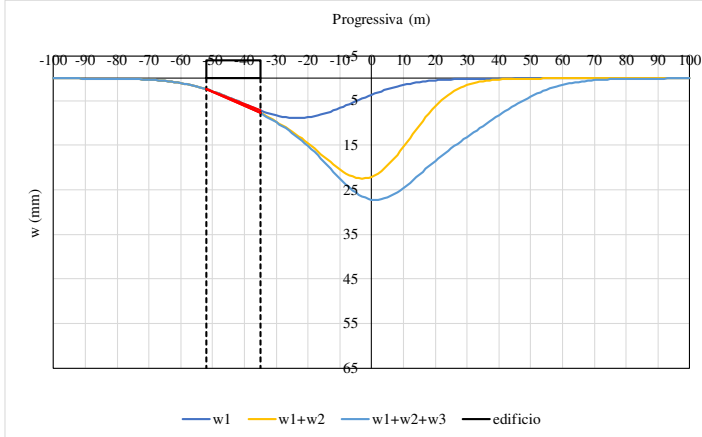


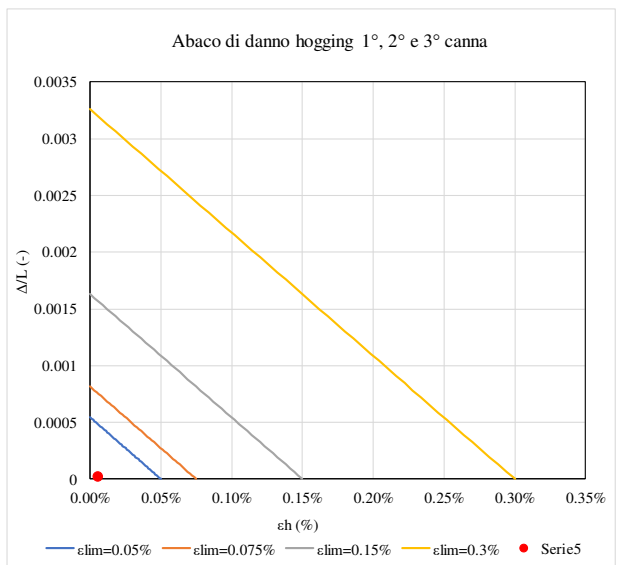
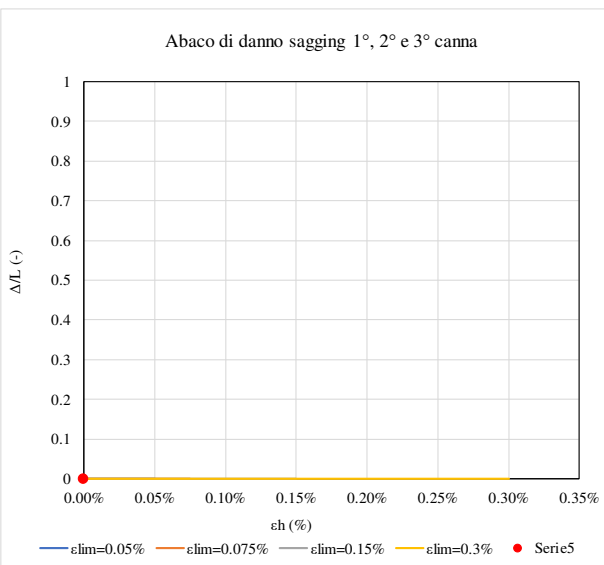
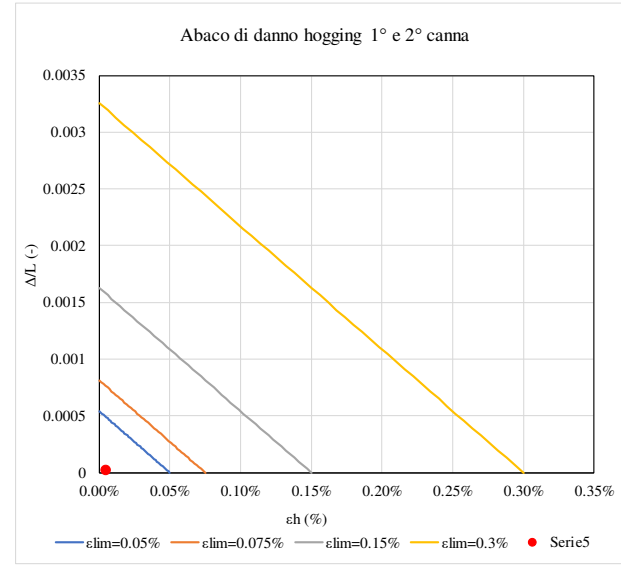
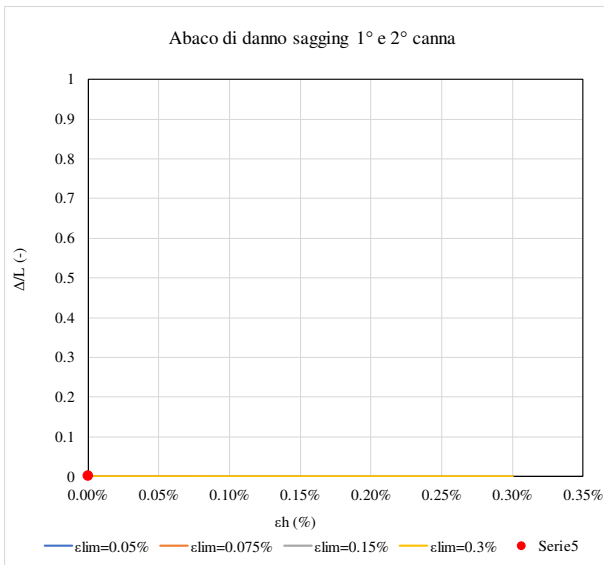
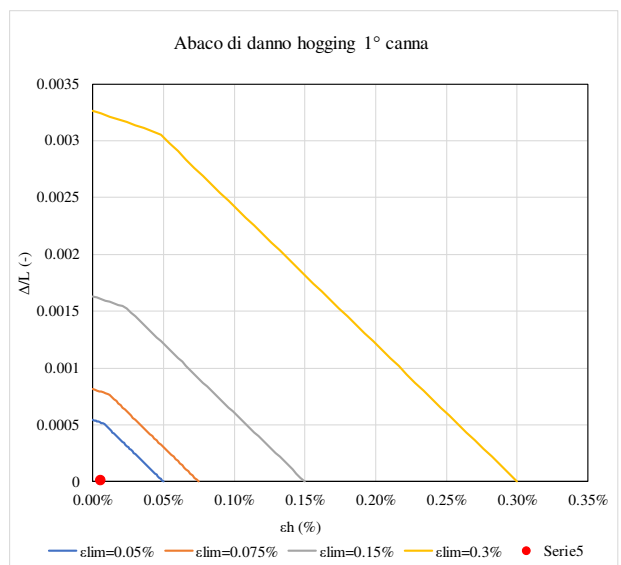
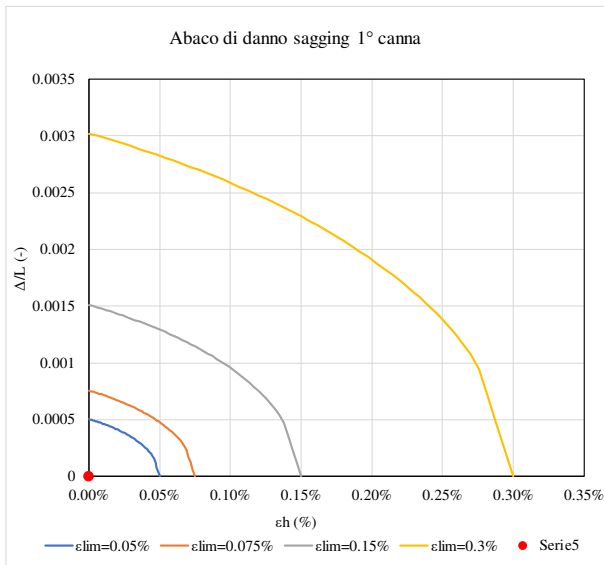


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
101	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.000%	#DIV/0!	#DIV/0!
0.001%	0.002%	0.002%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.006%	-0.005%	-0.006%

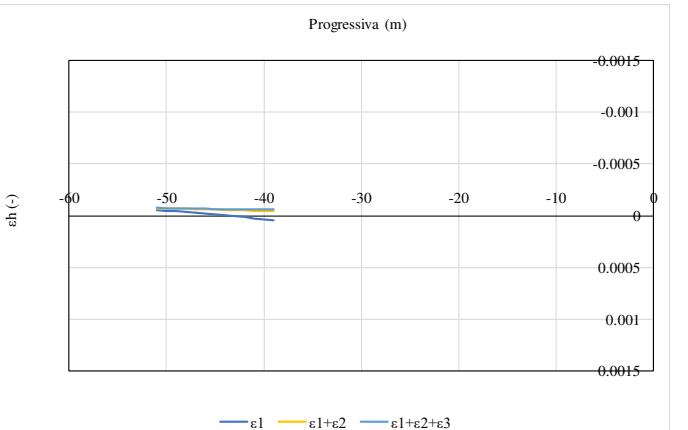
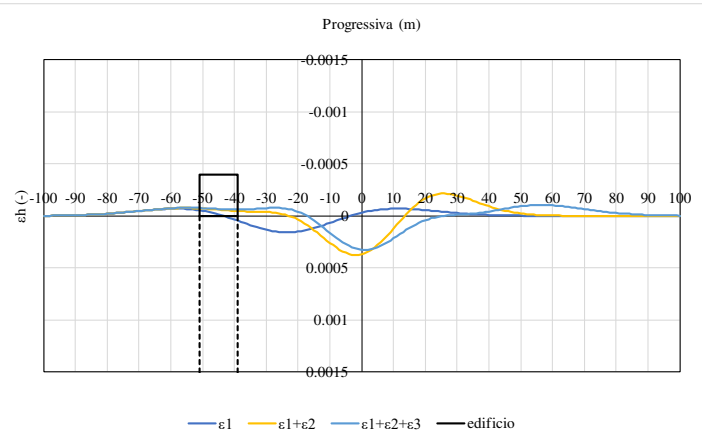
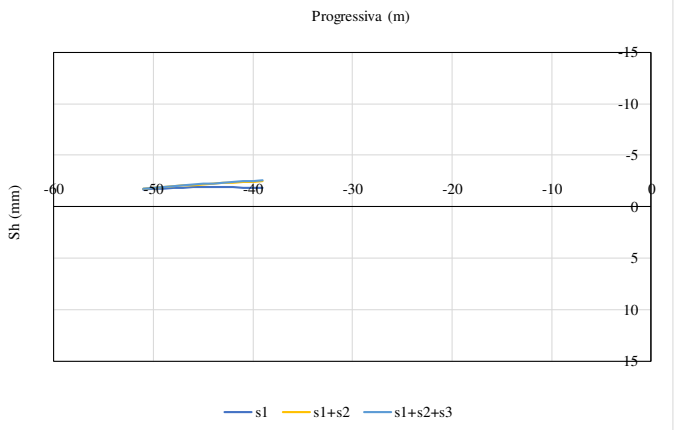
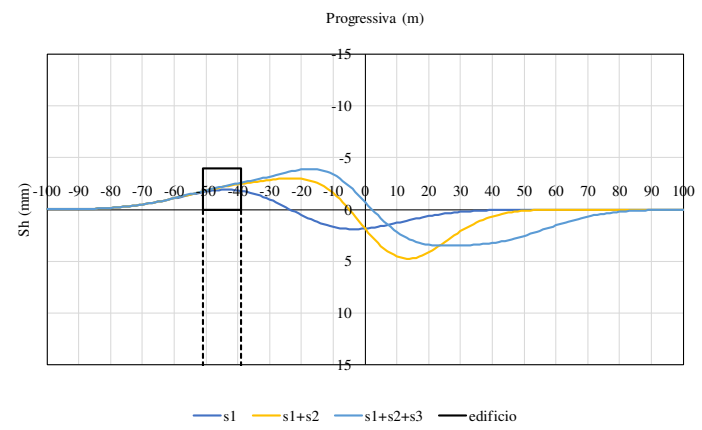
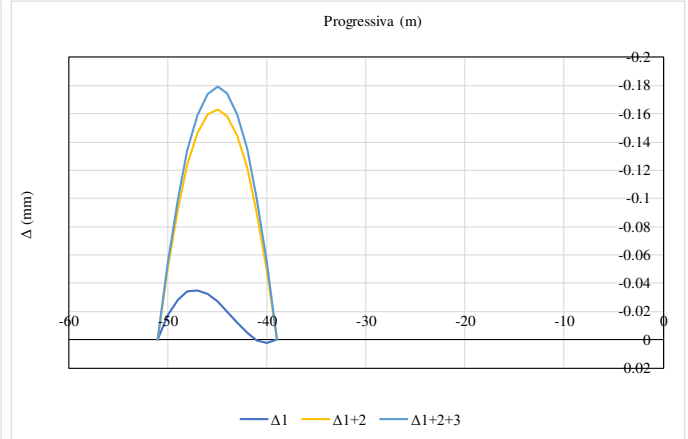
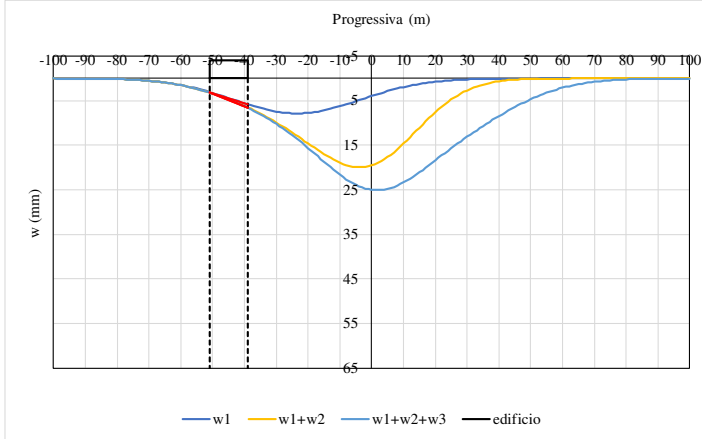


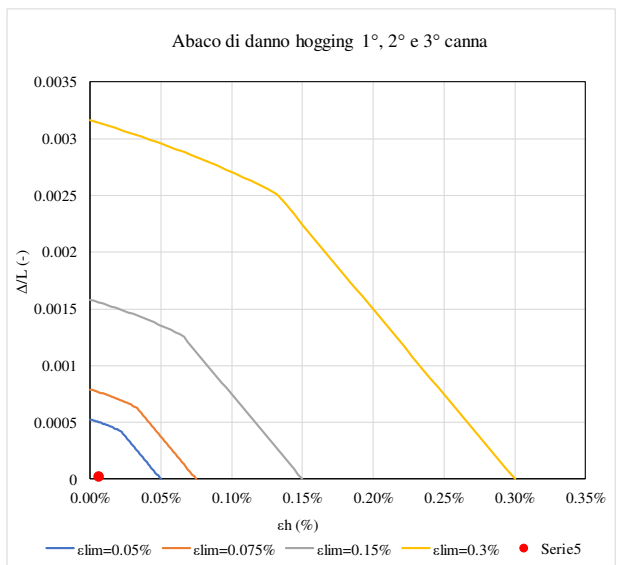
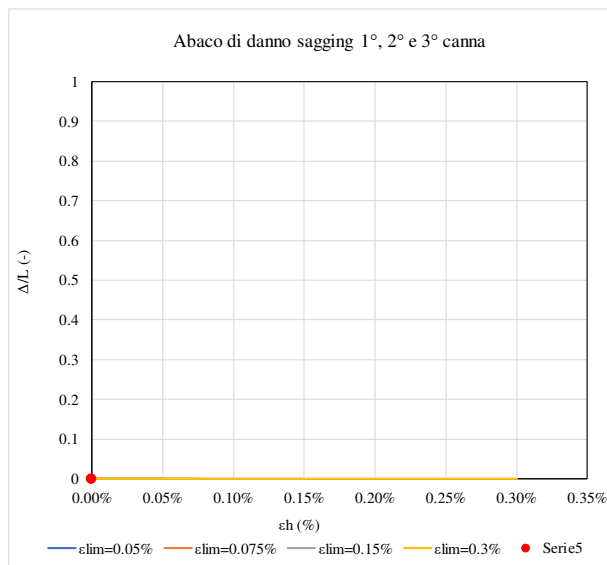
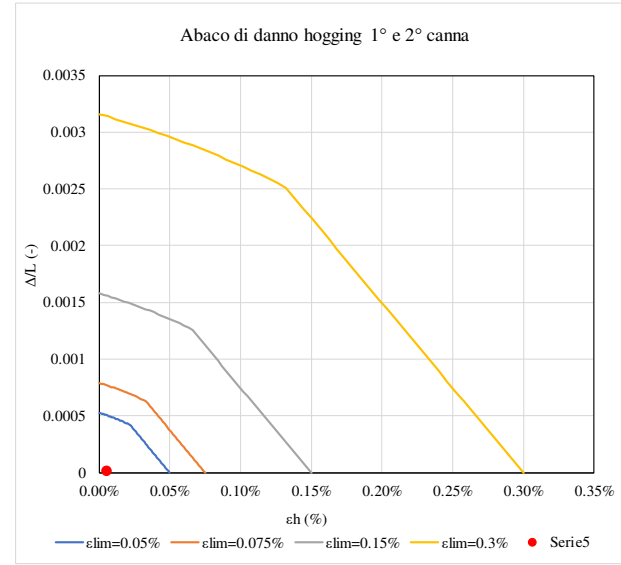
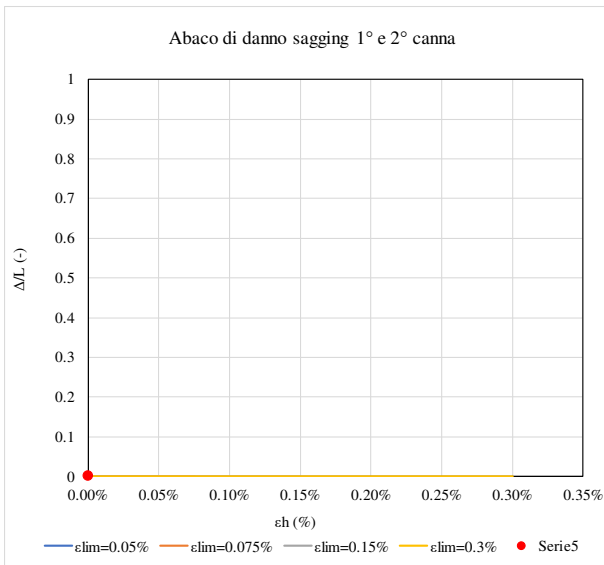
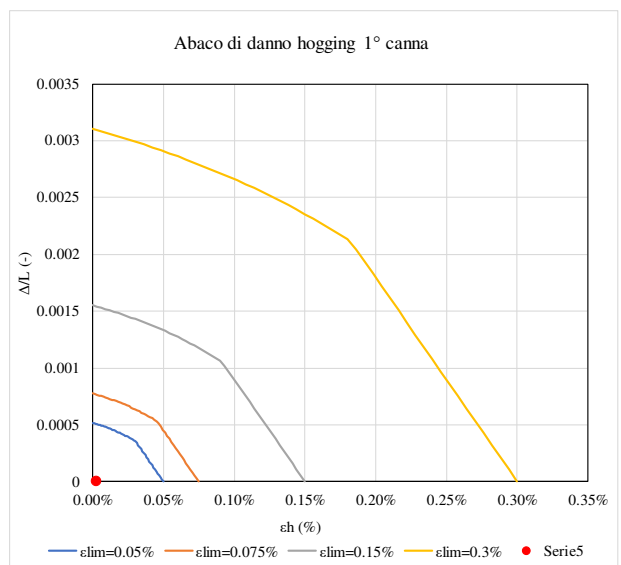
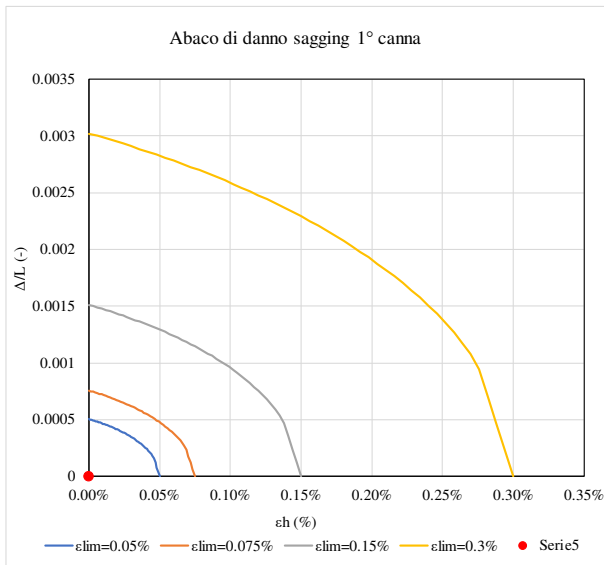


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
102A	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.000%	#DIV/0!	#DIV/0!
0.000%	0.001%	0.002%

$\varepsilon_{1,max}$	$\varepsilon_{1+2,max}$	$\varepsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.003%	-0.006%	-0.007%



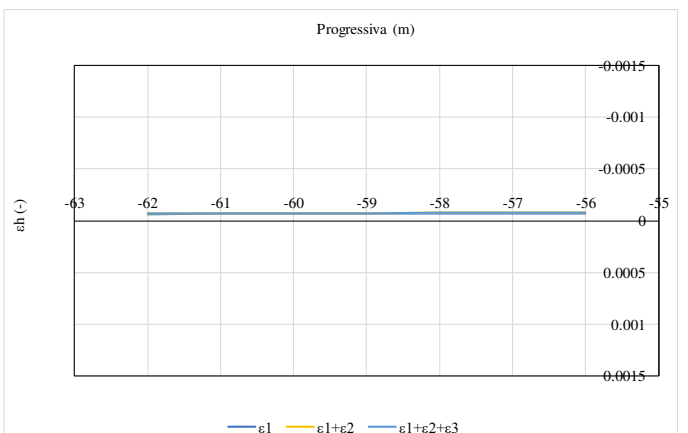
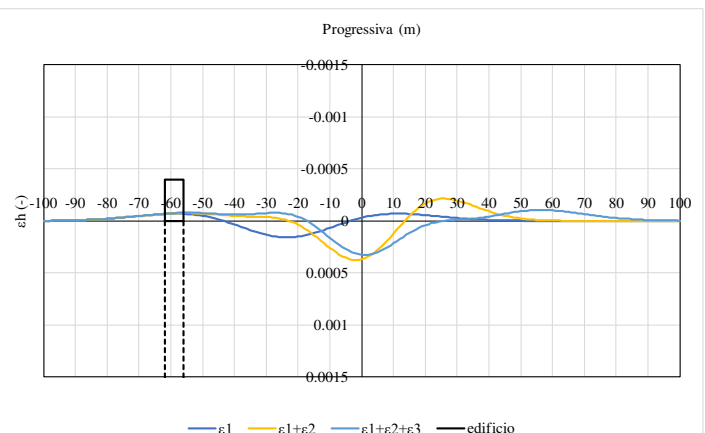
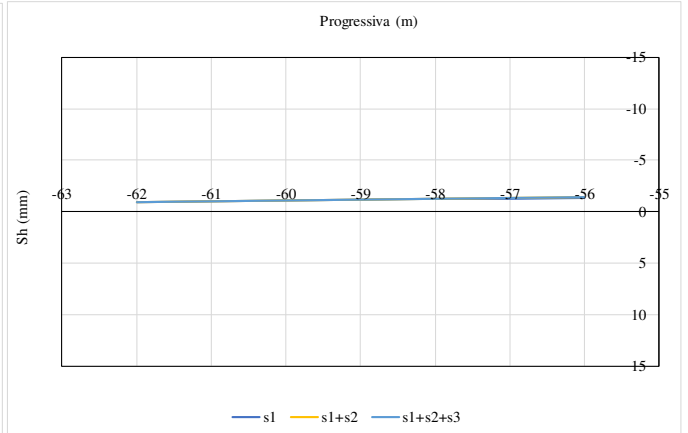
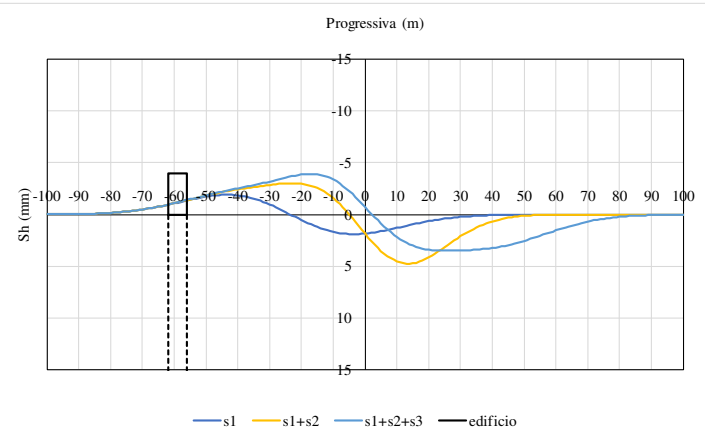
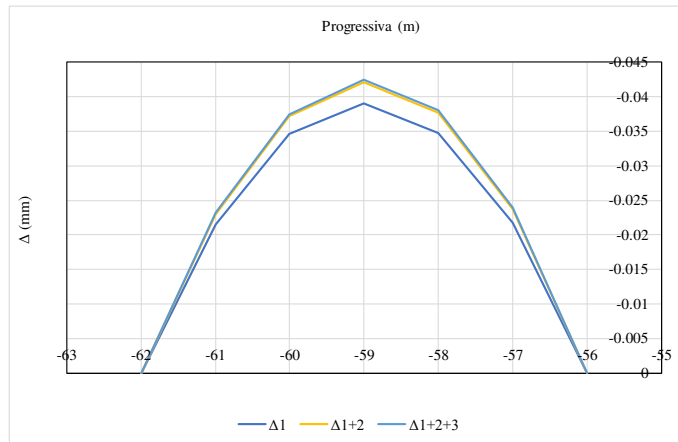
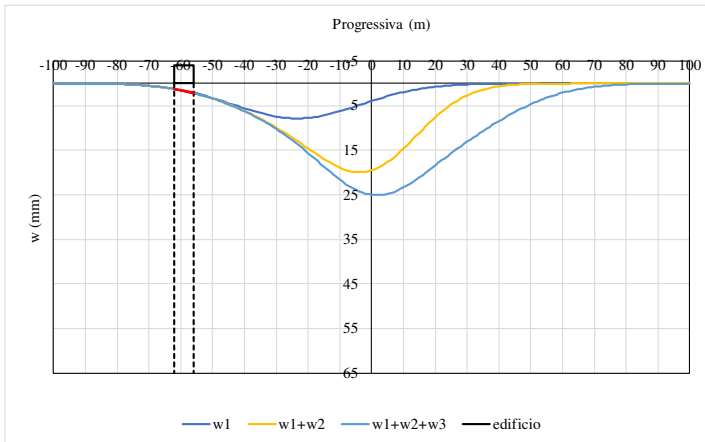


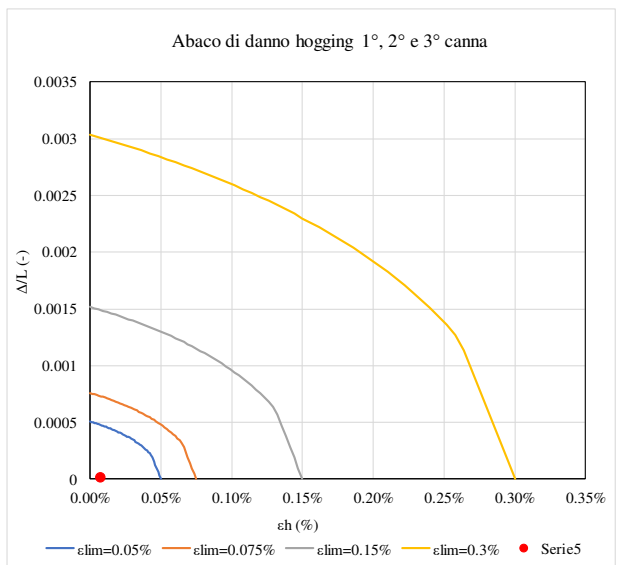
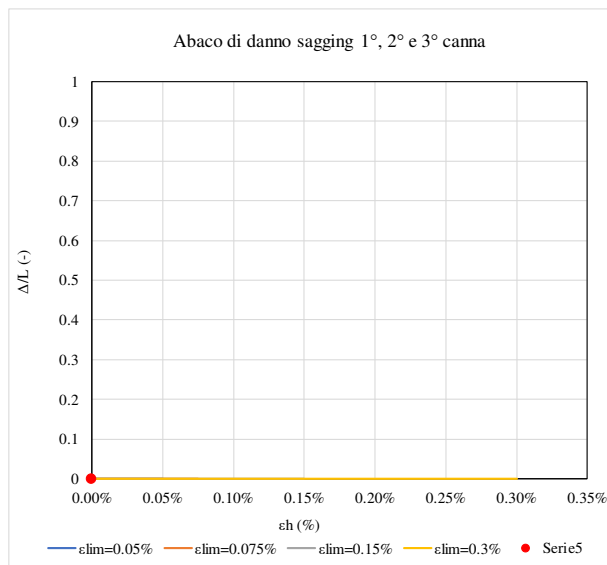
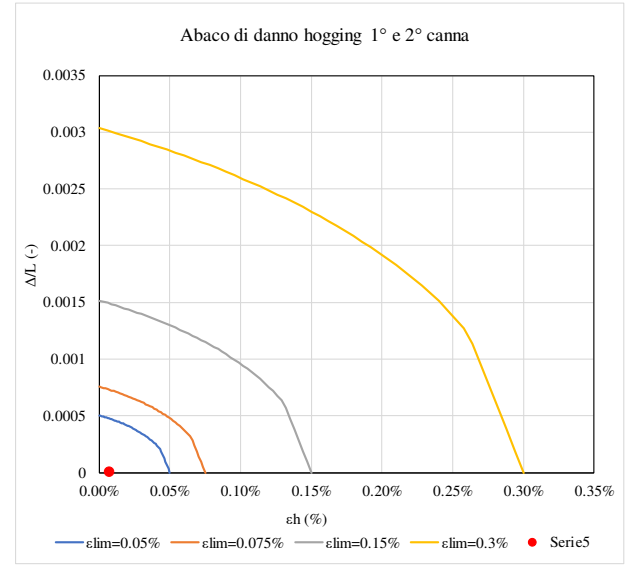
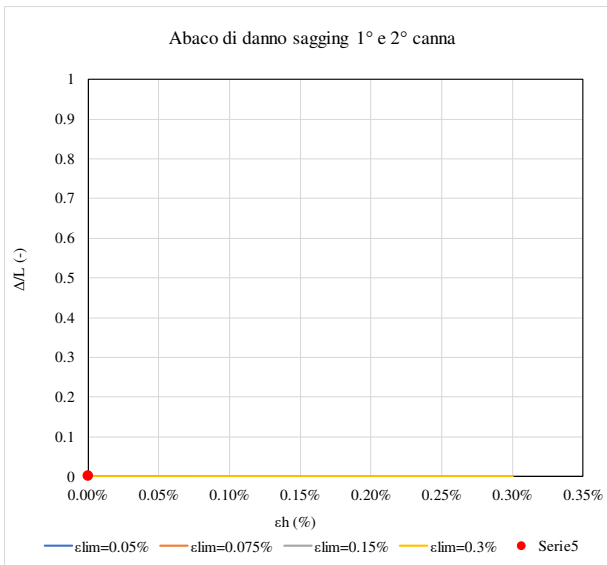
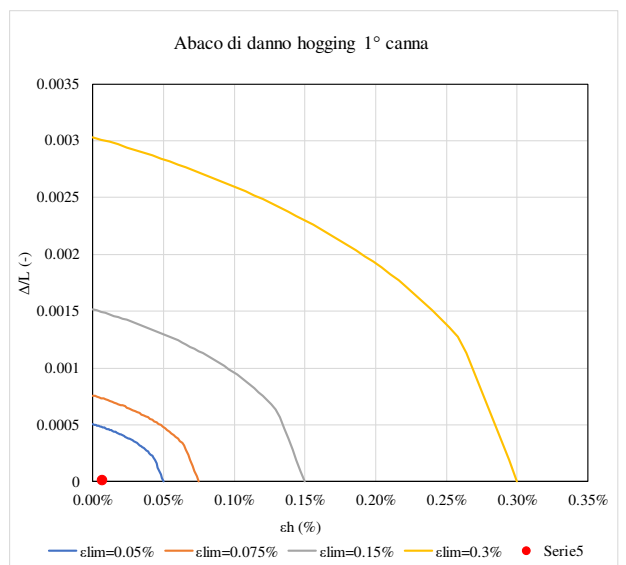
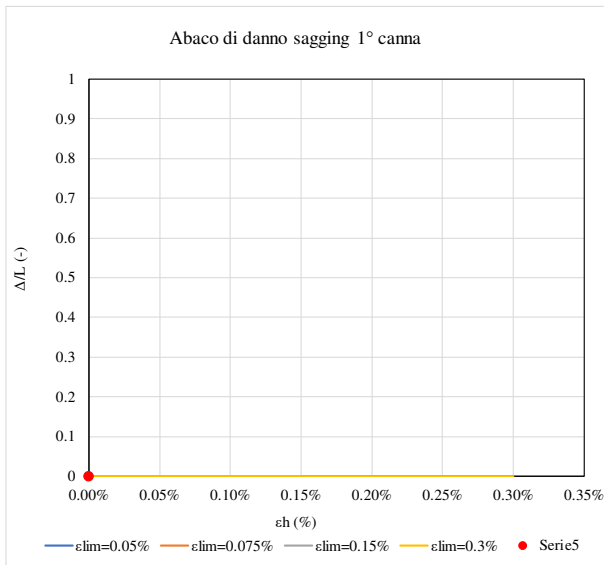


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
102B	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.001%	0.001%	0.001%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.007%	-0.007%	-0.007%

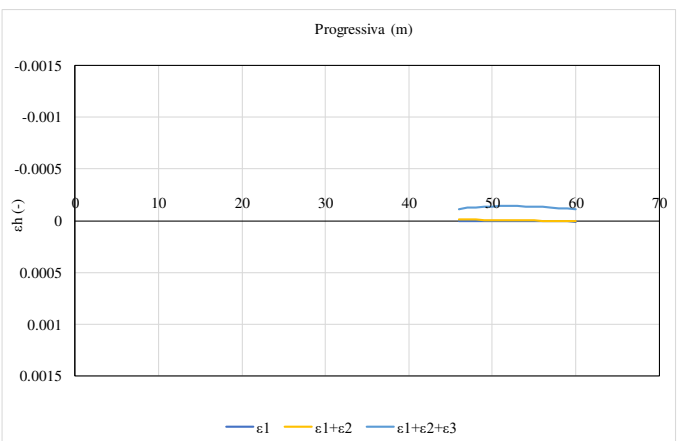
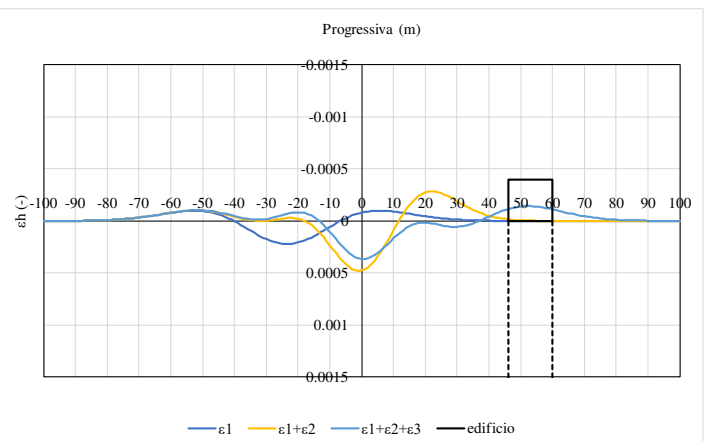
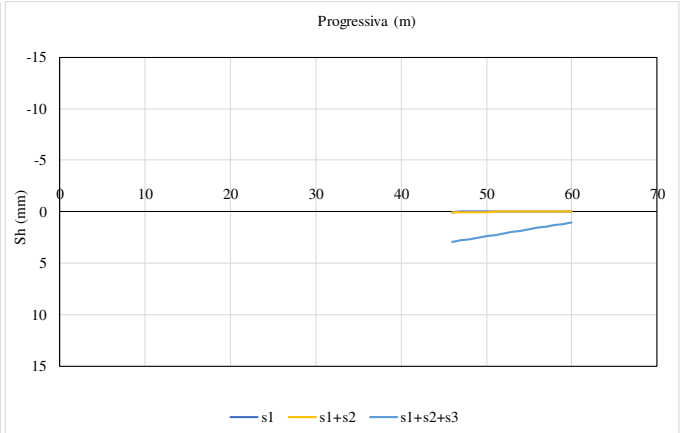
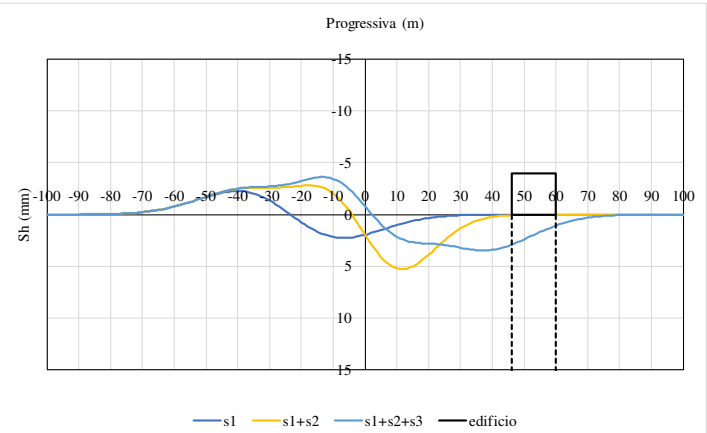
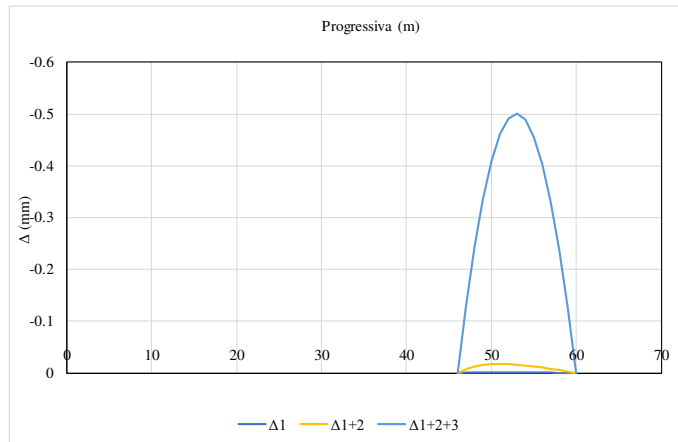
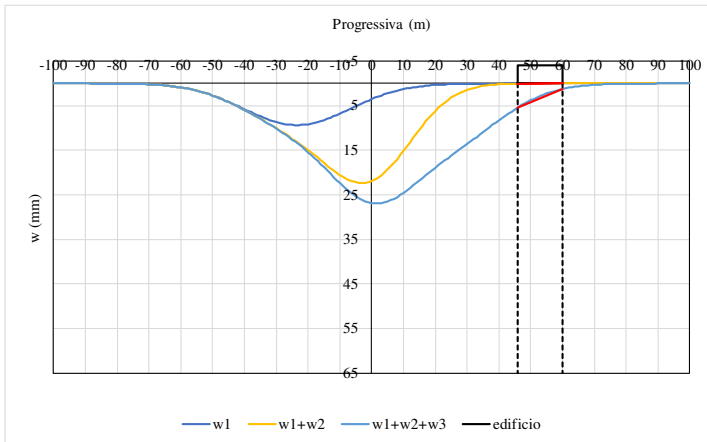


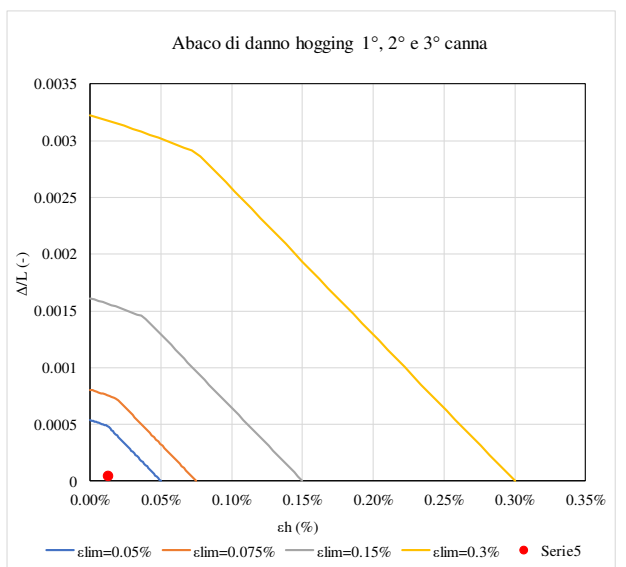
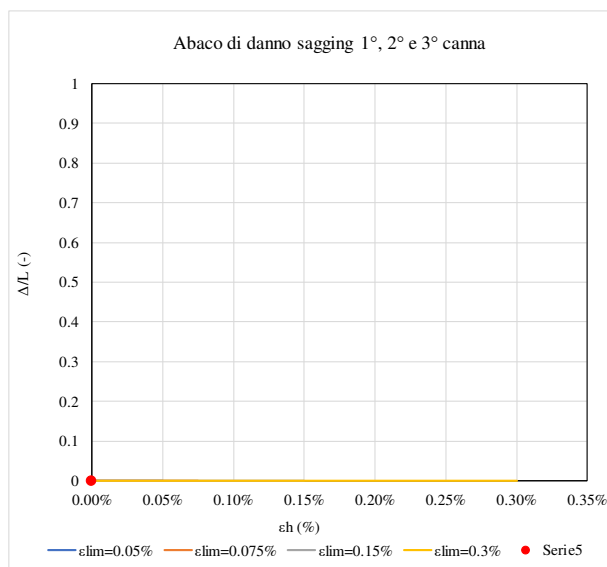
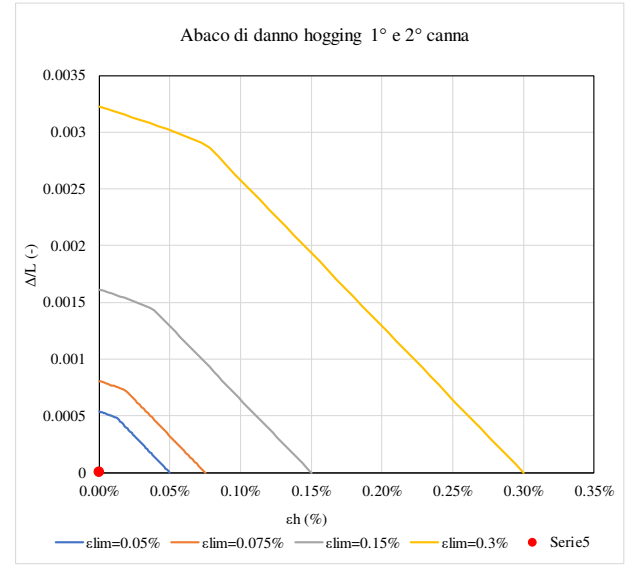
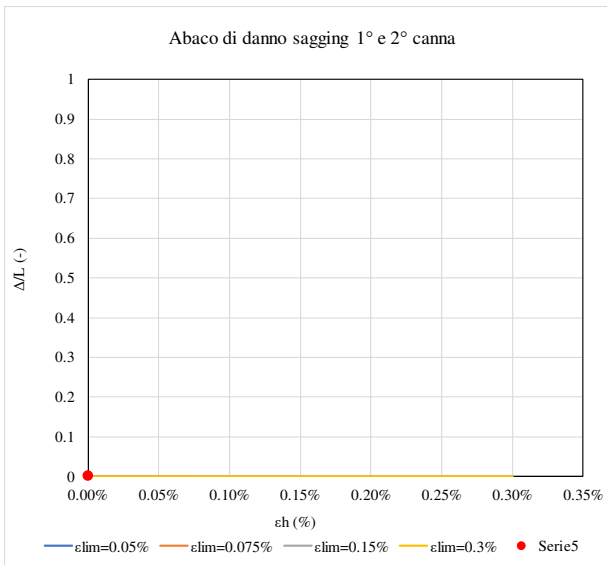
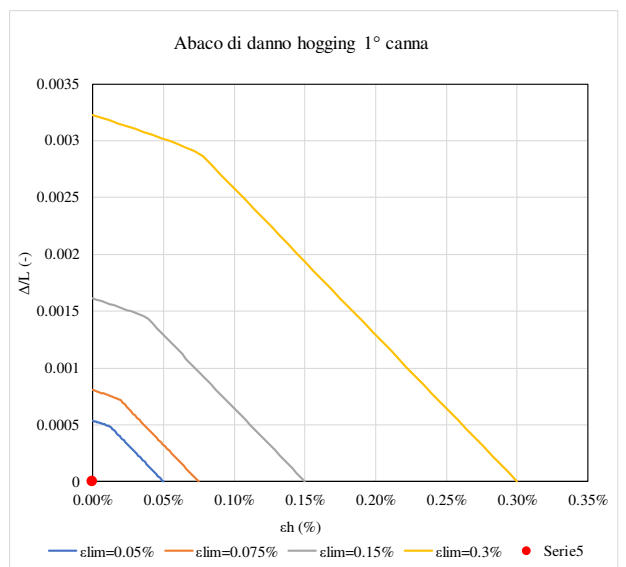
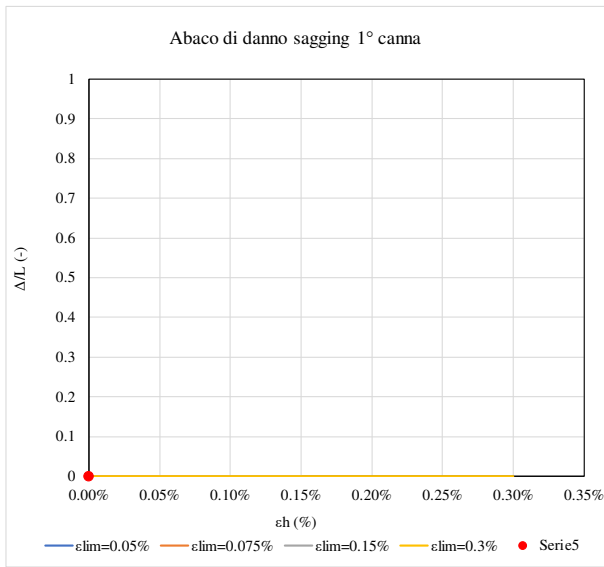


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
103	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.000%	0.004%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.000%	-0.013%

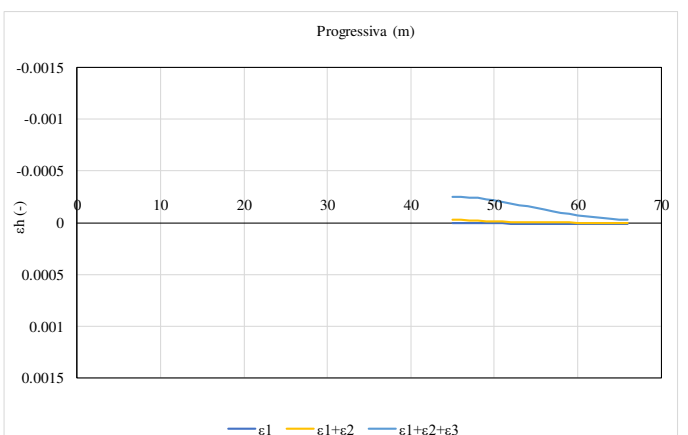
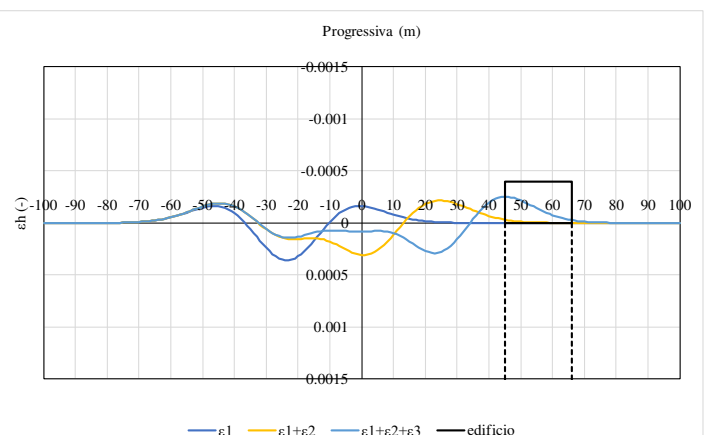
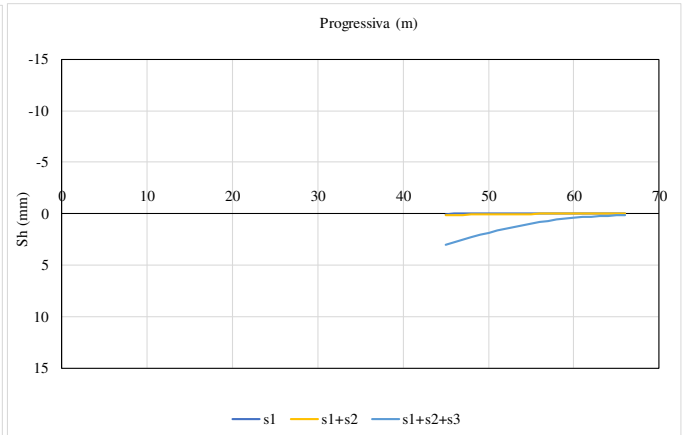
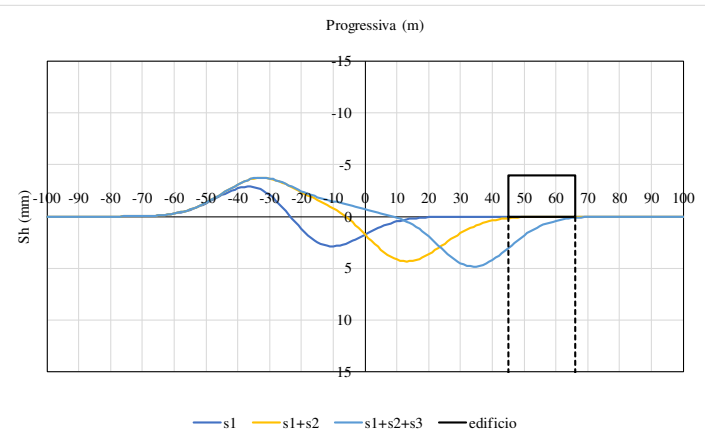
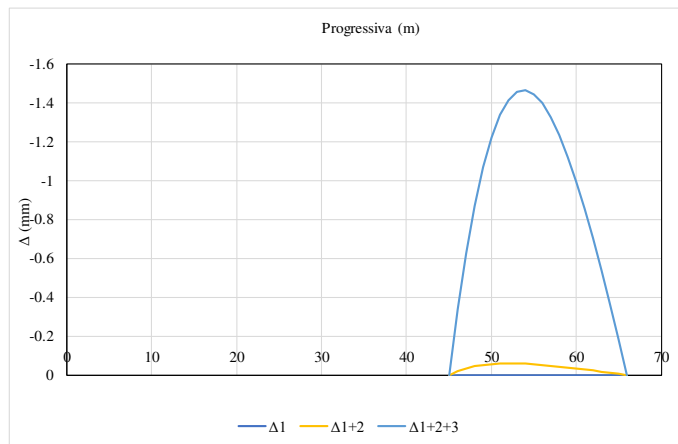
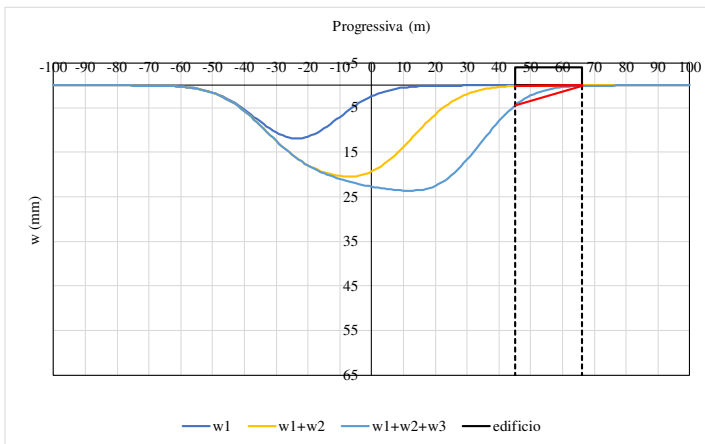


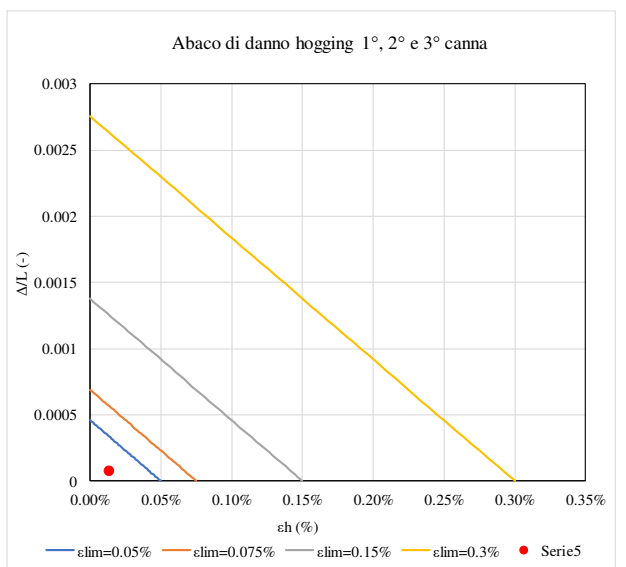
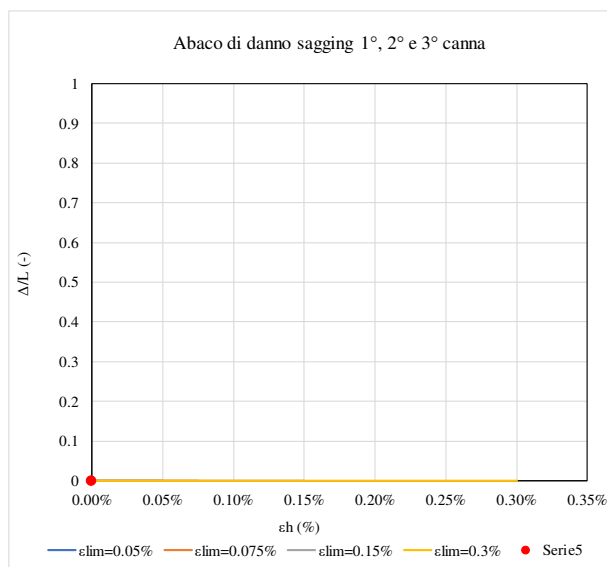
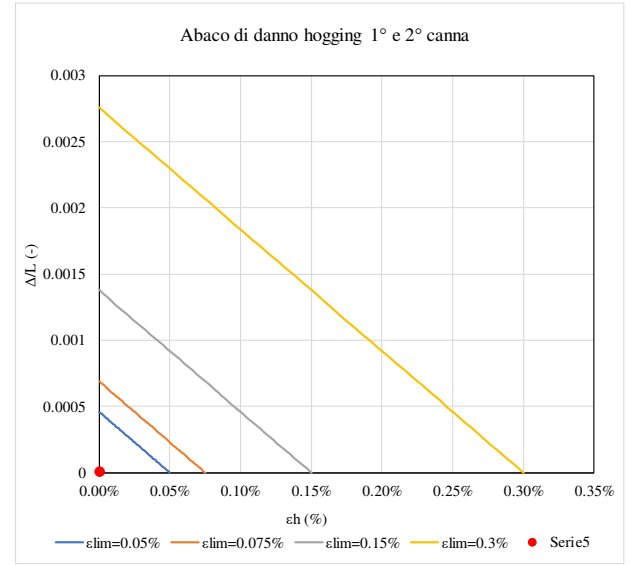
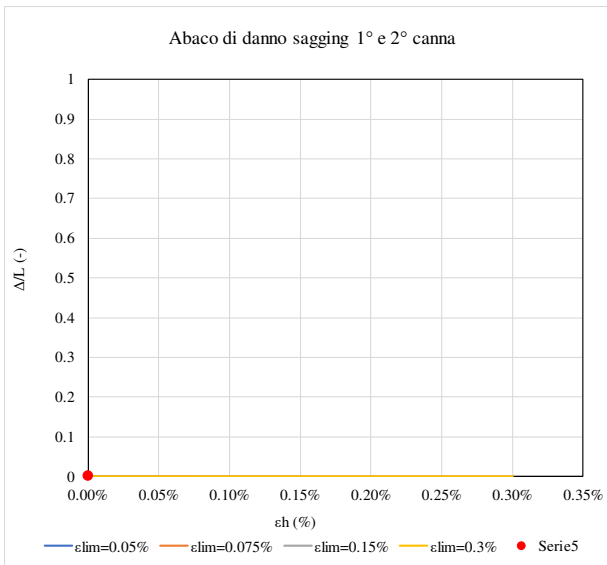
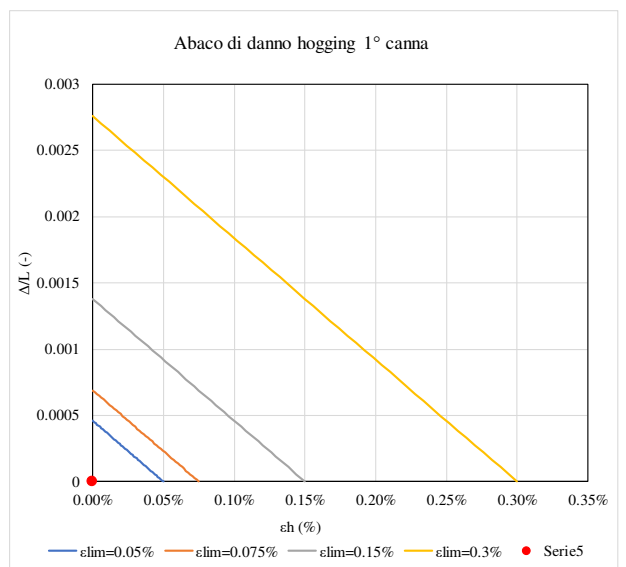
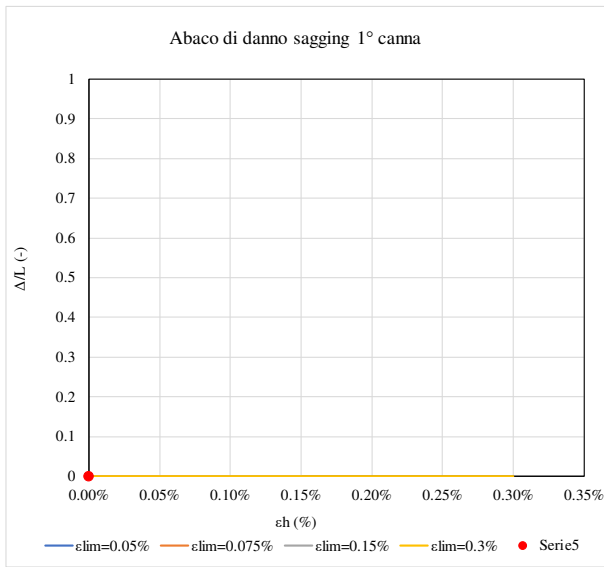


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
104	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.000%	0.007%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	-0.001%	-0.014%

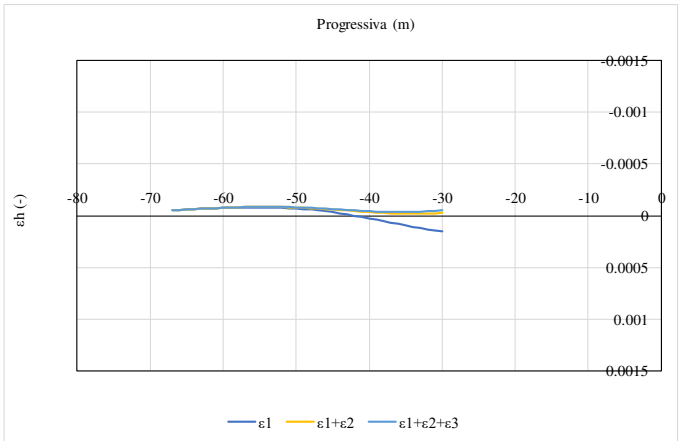
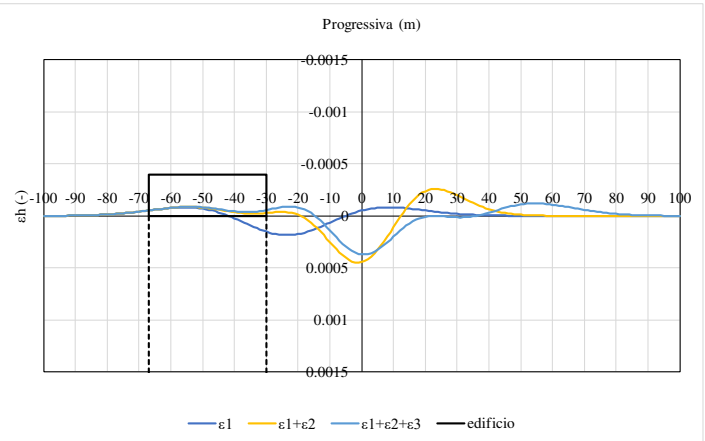
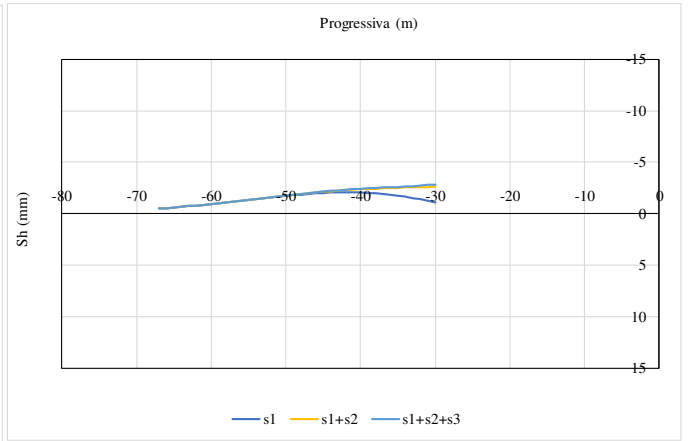
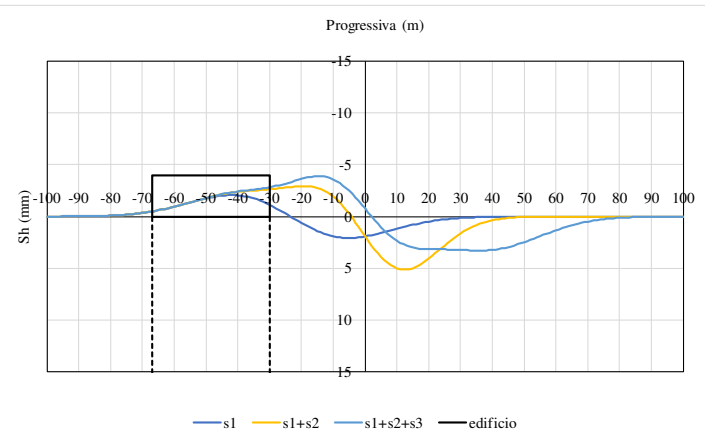
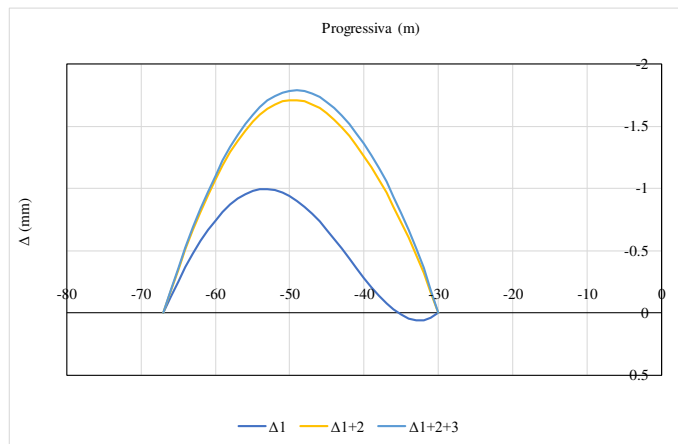
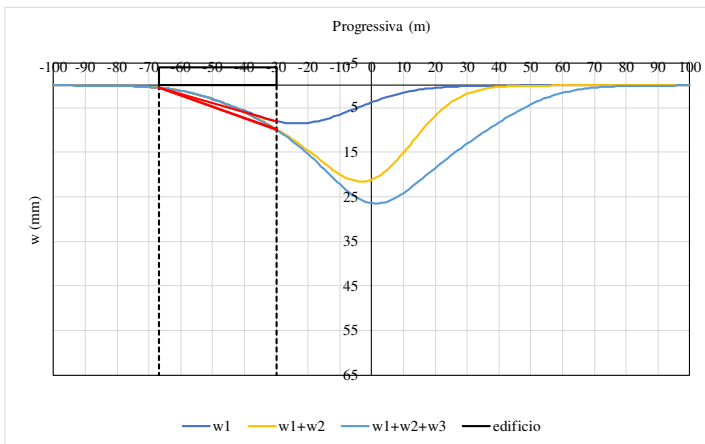


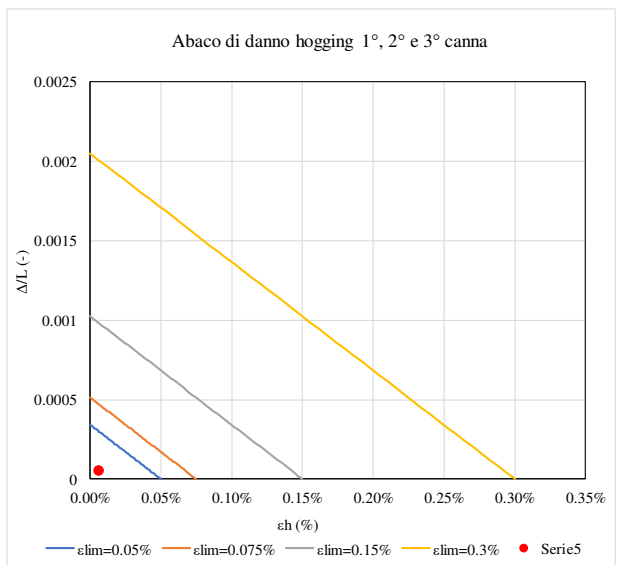
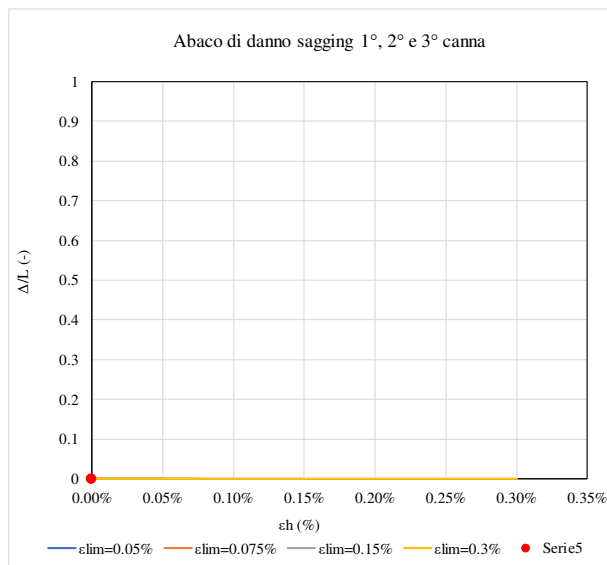
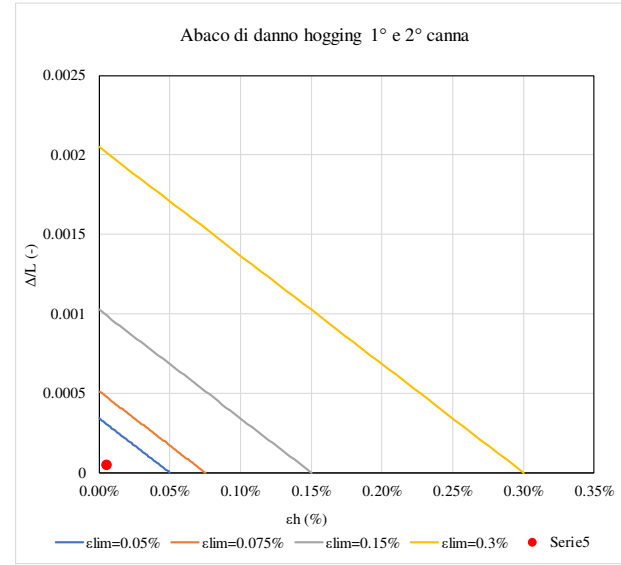
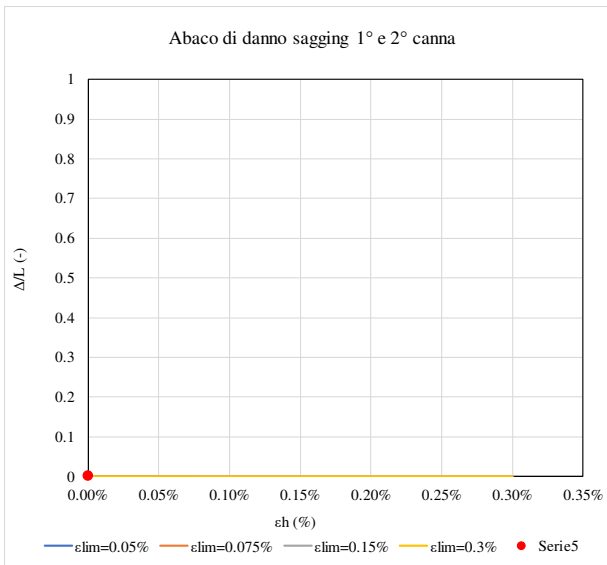
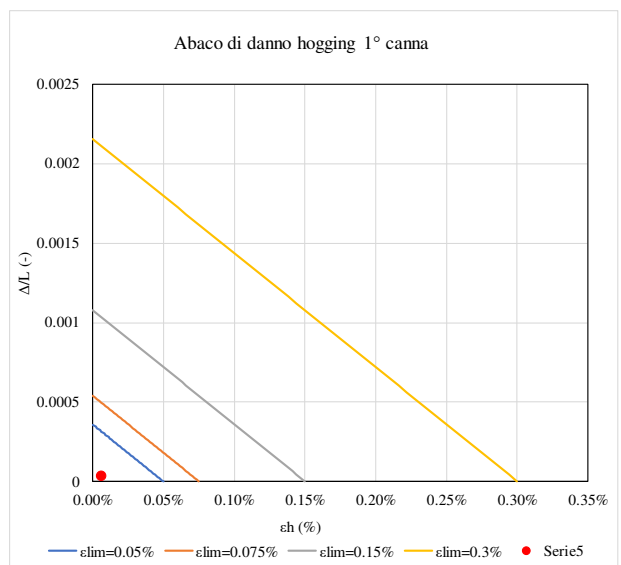
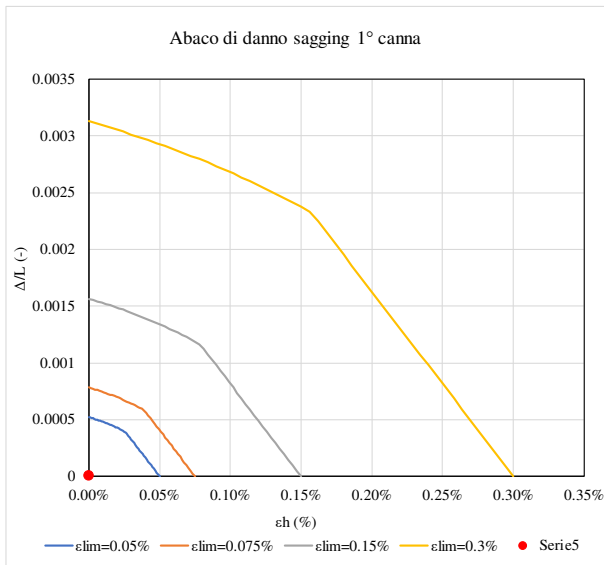


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
105	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.001%	#DIV/0!	#DIV/0!
0.003%	0.005%	0.005%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.006%	-0.006%	-0.006%



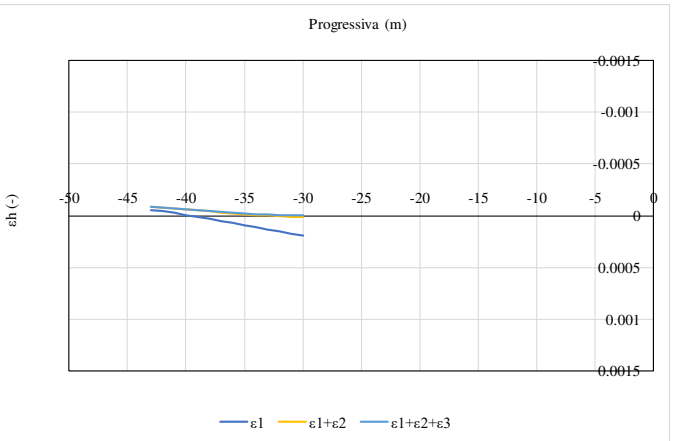
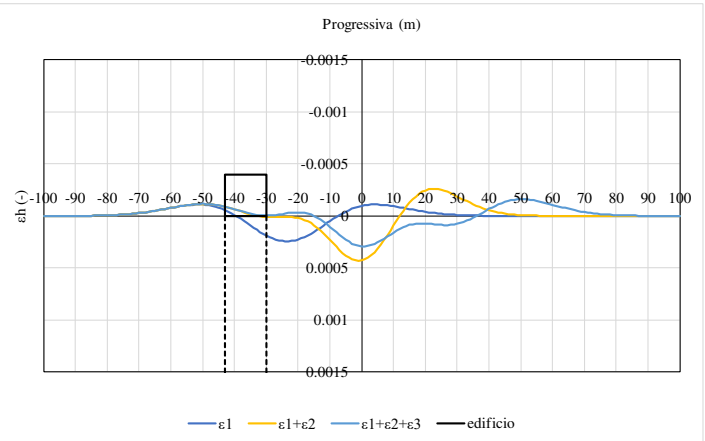
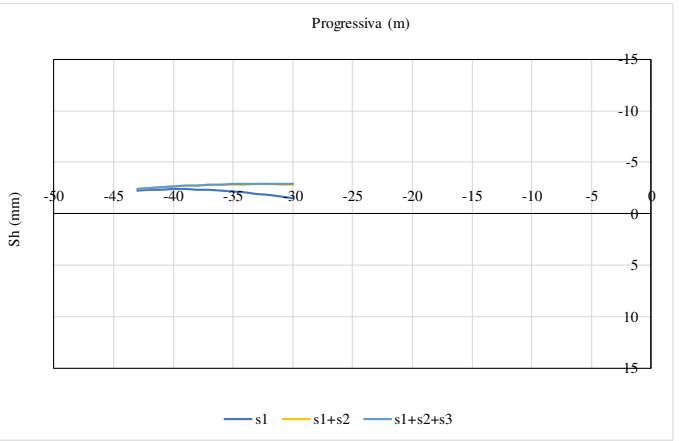
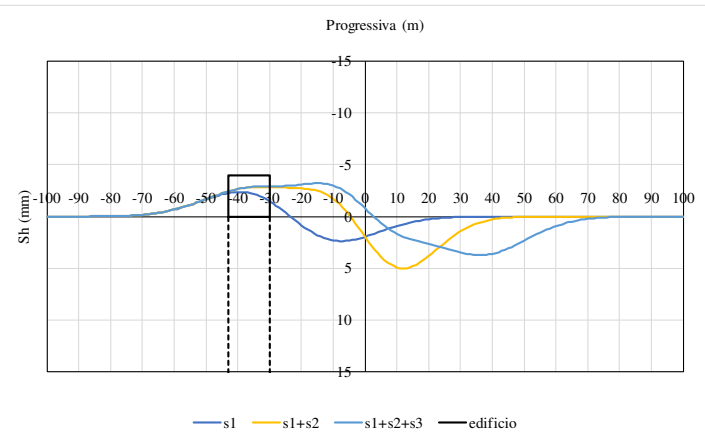
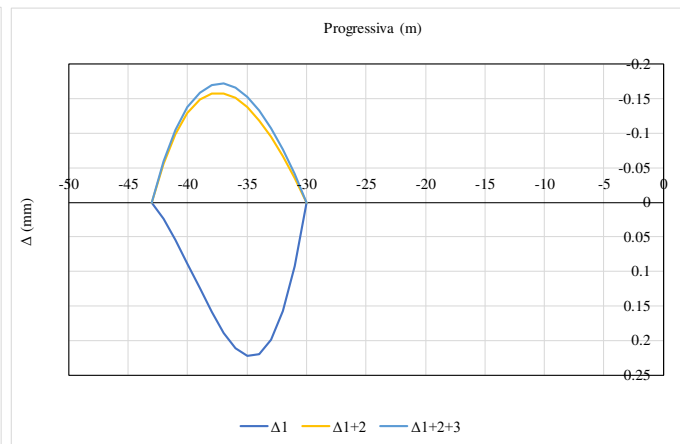
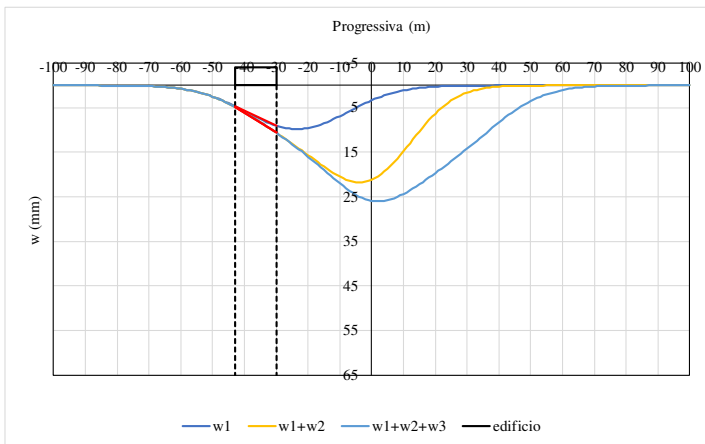


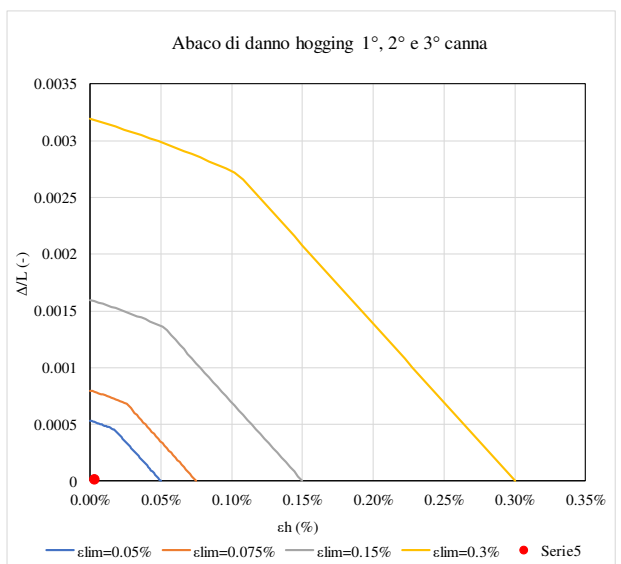
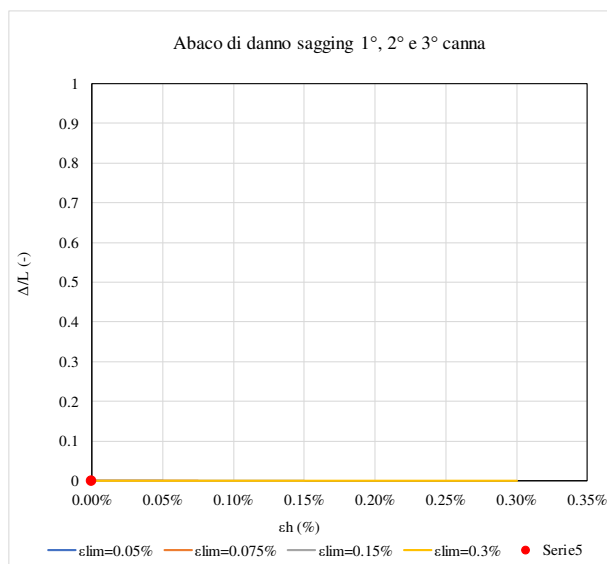
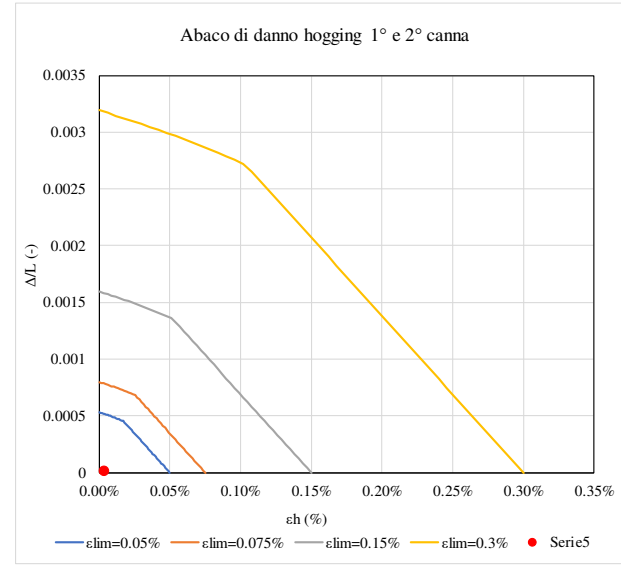
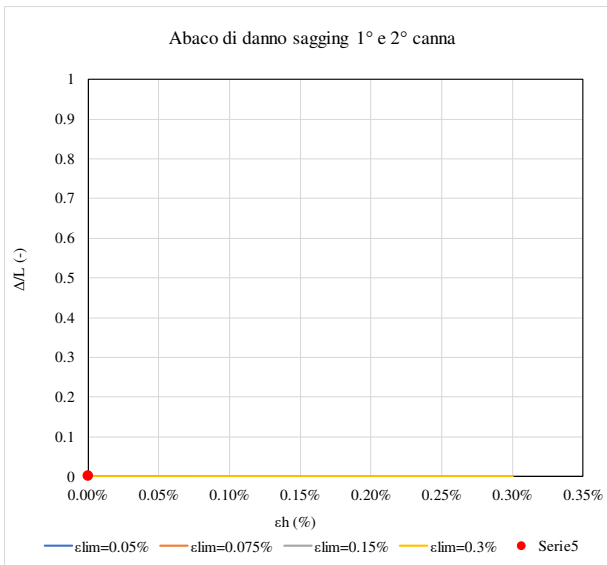
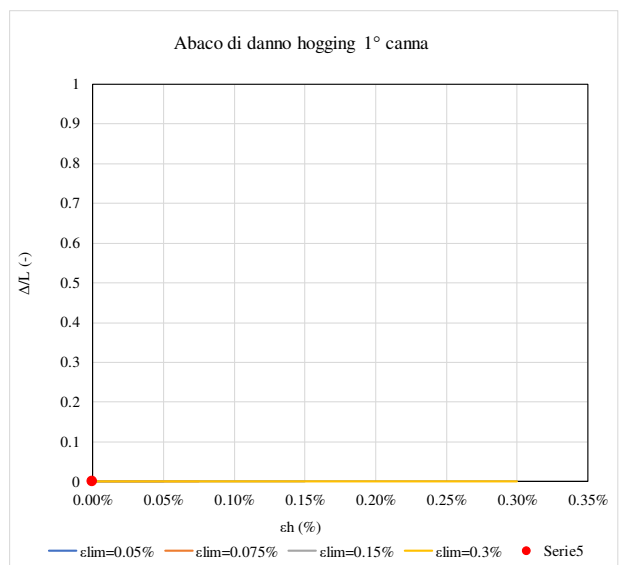
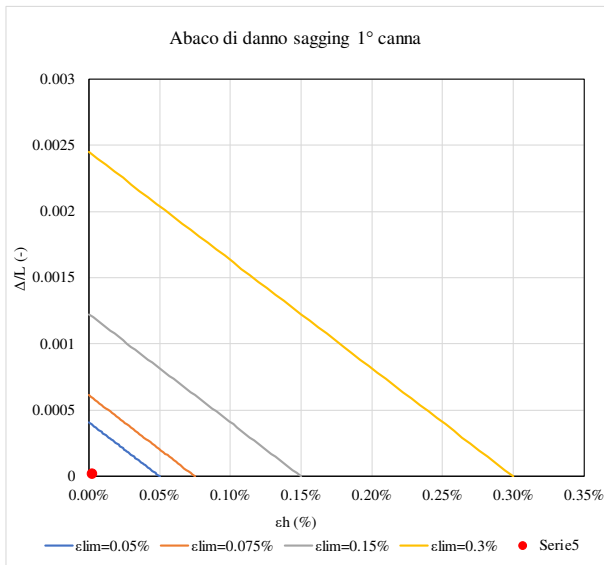


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
106-S1	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.002%	#DIV/0!	#DIV/0!
#DIV/0!	0.001%	0.001%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.003%	#DIV/0!	#DIV/0!
#DIV/0!	-0.004%	-0.004%

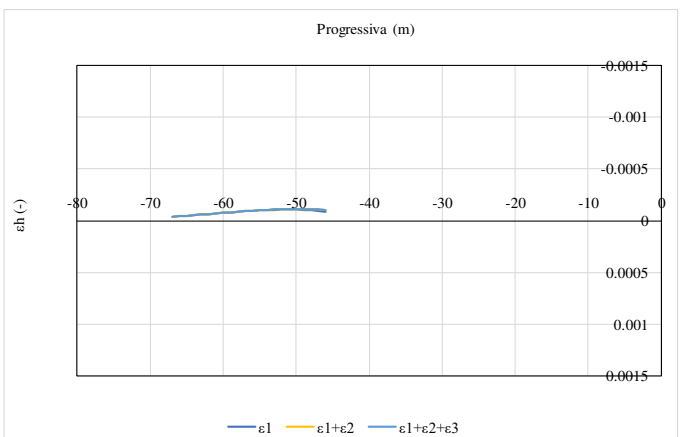
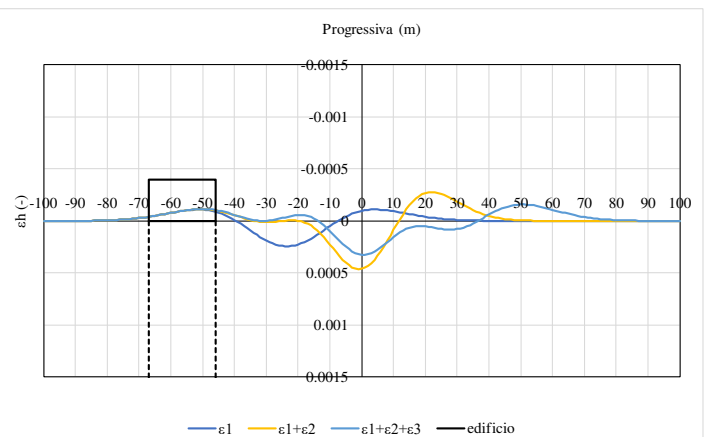
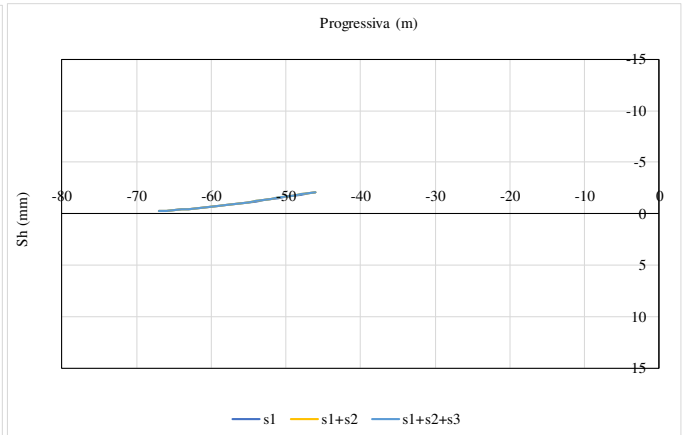
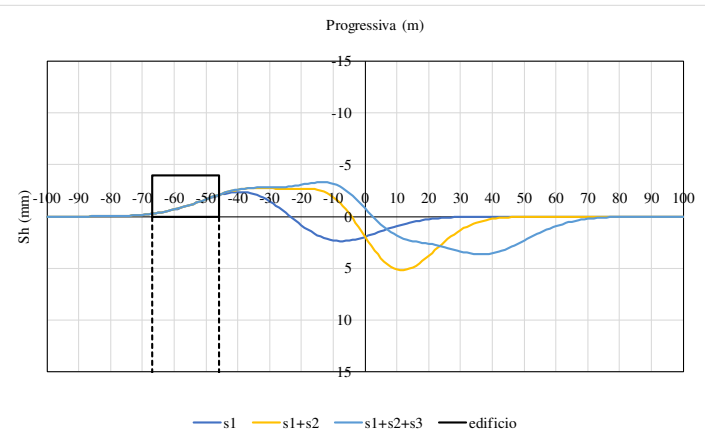
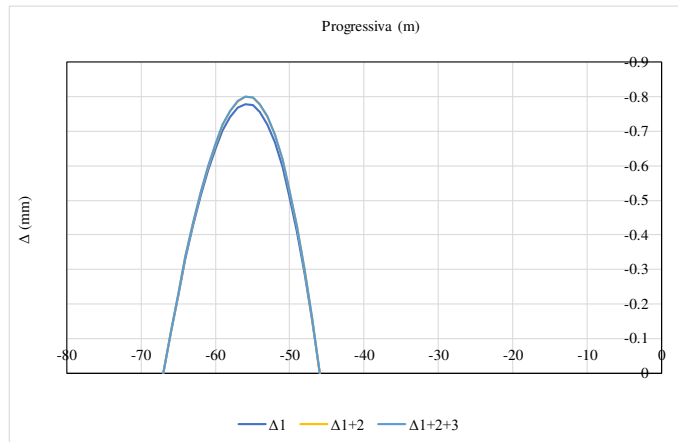
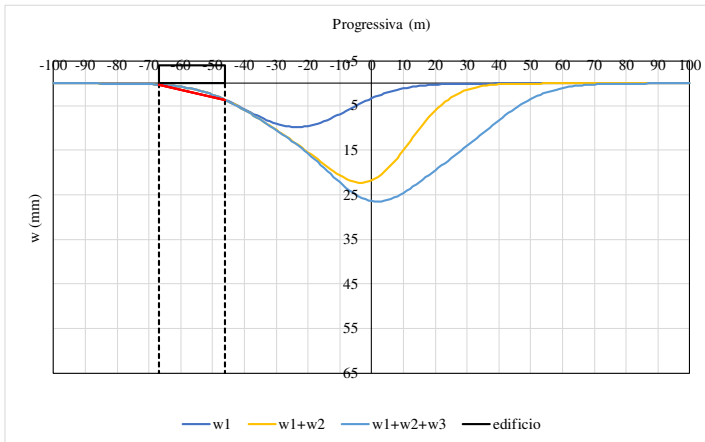


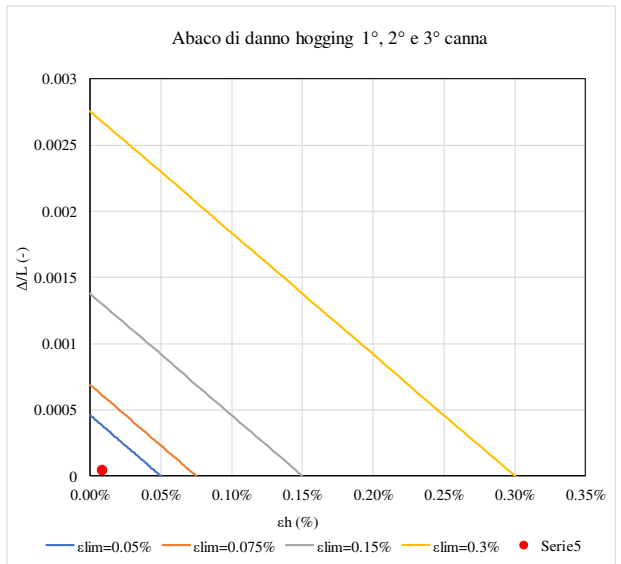
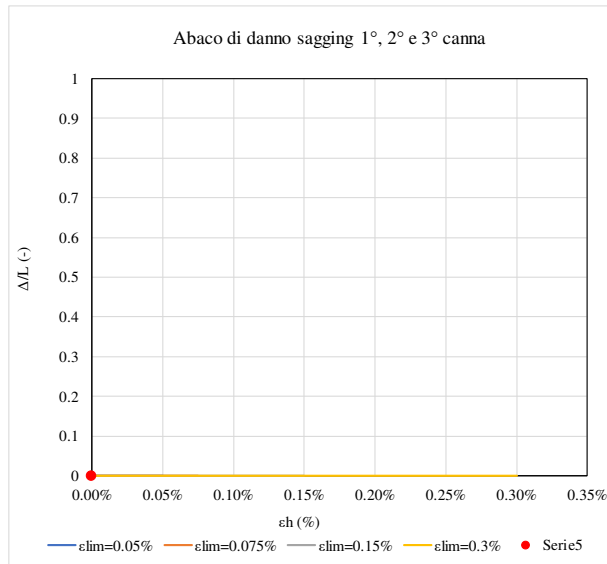
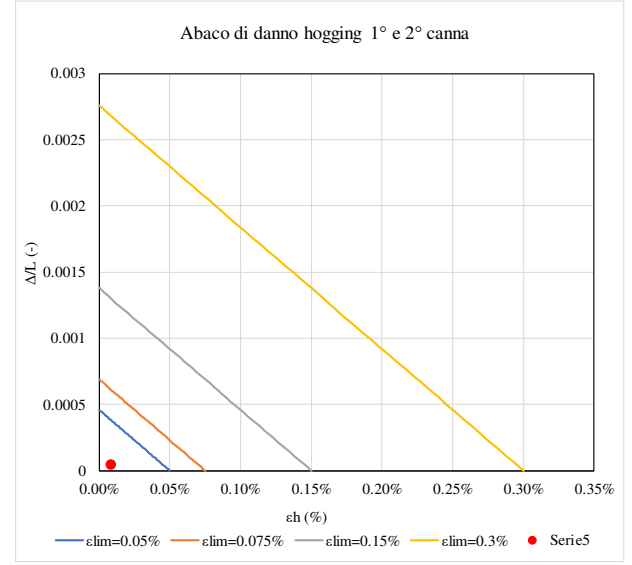
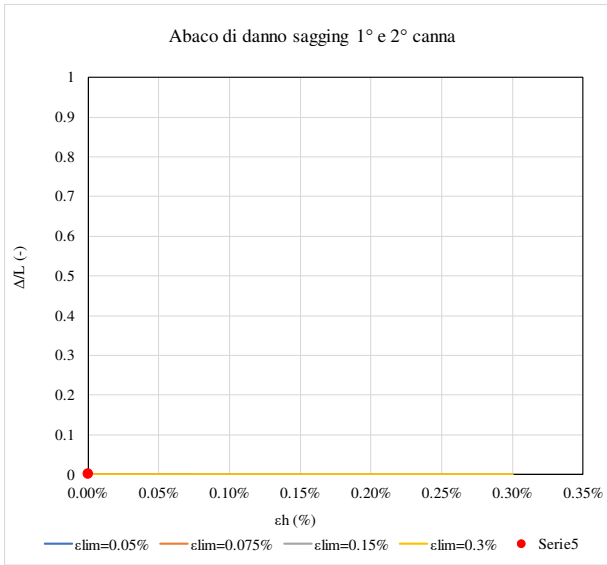
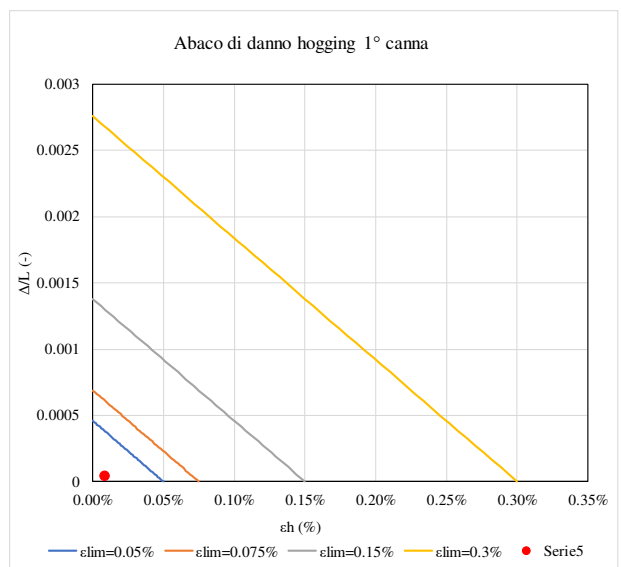
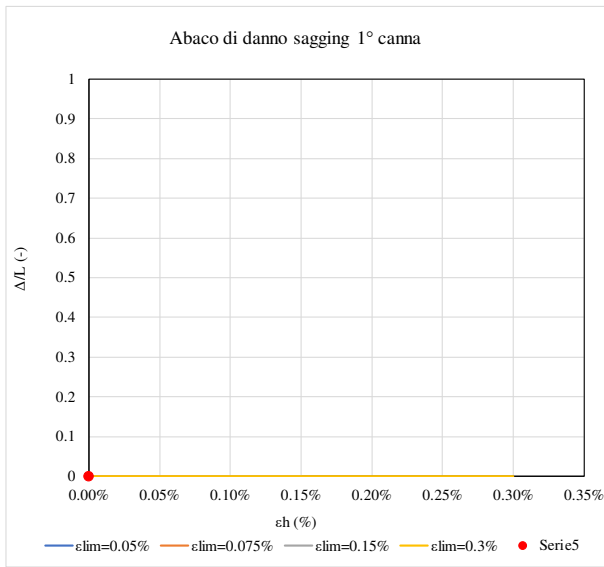


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
106-S2	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.004%	0.004%	0.004%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.009%	-0.009%	-0.009%

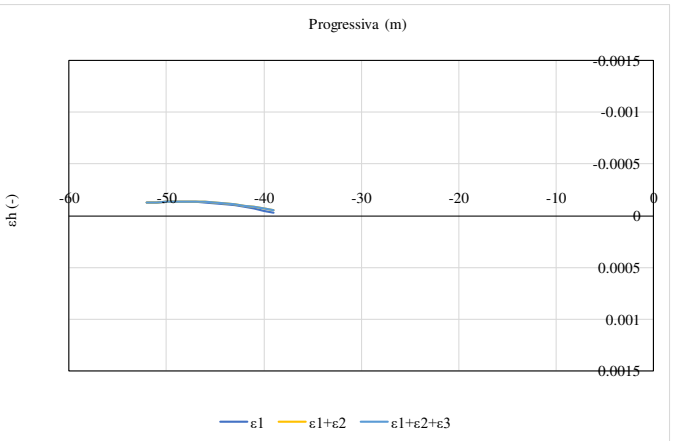
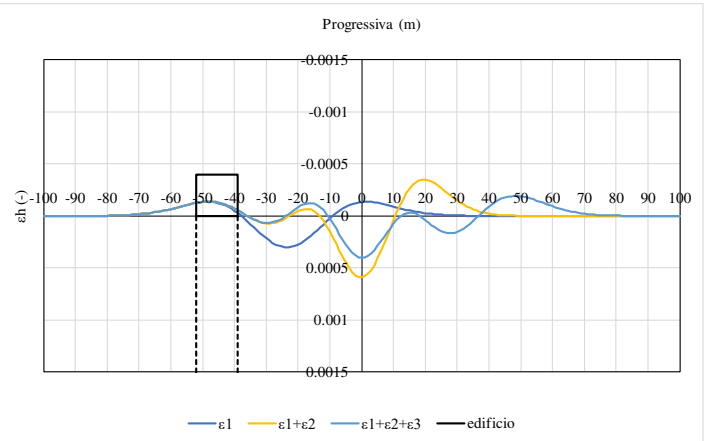
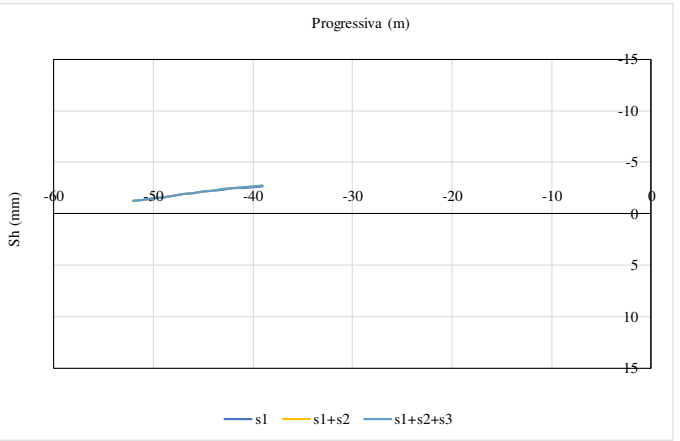
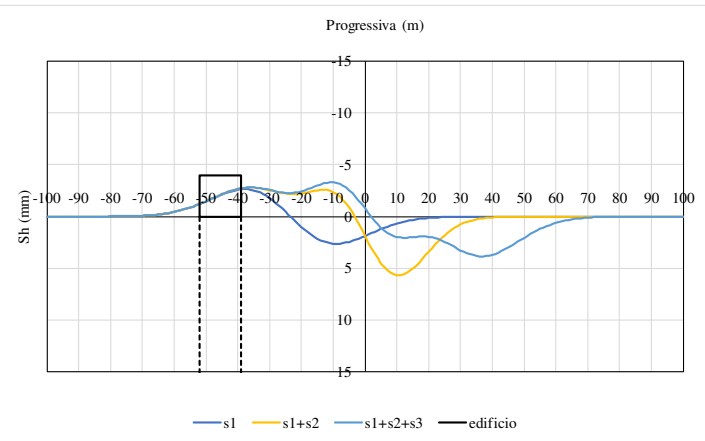
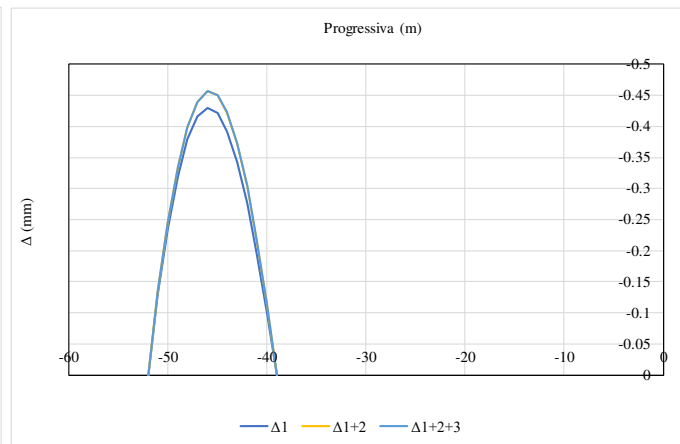
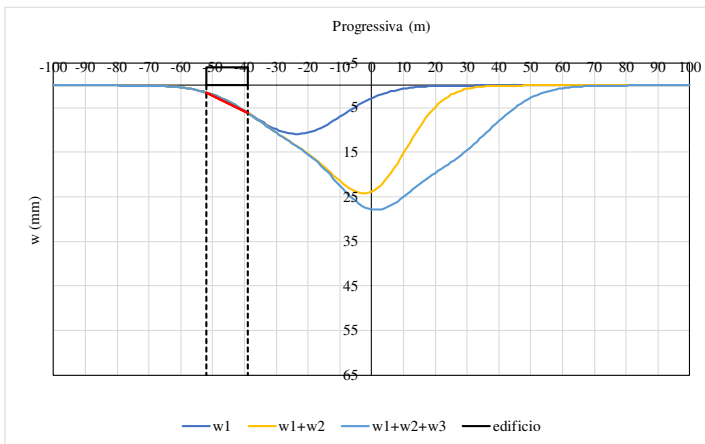


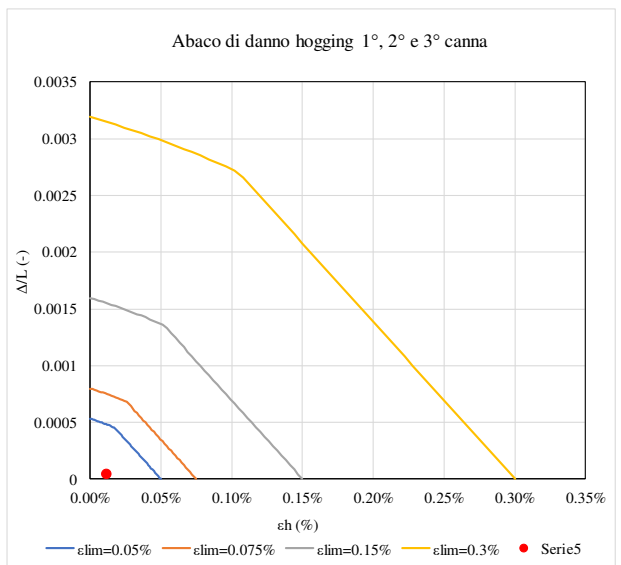
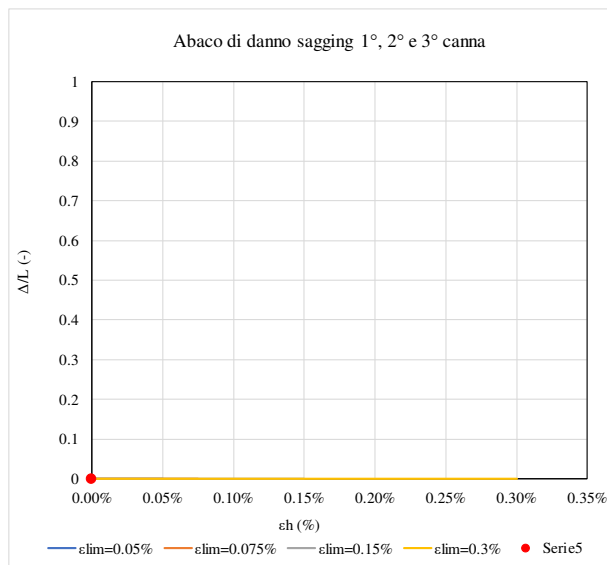
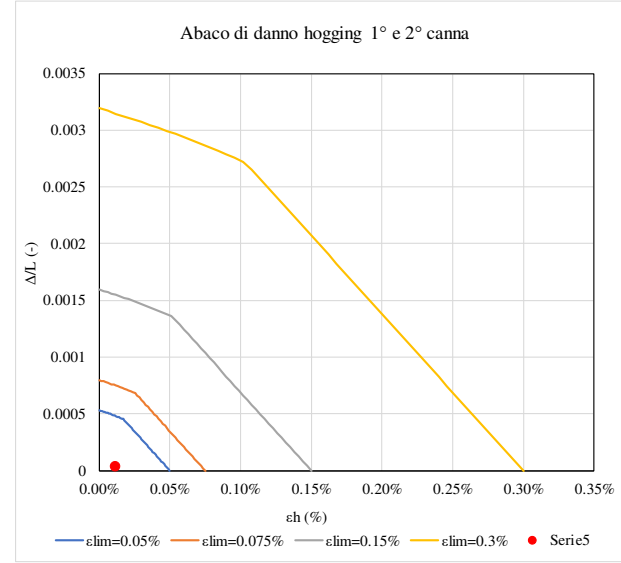
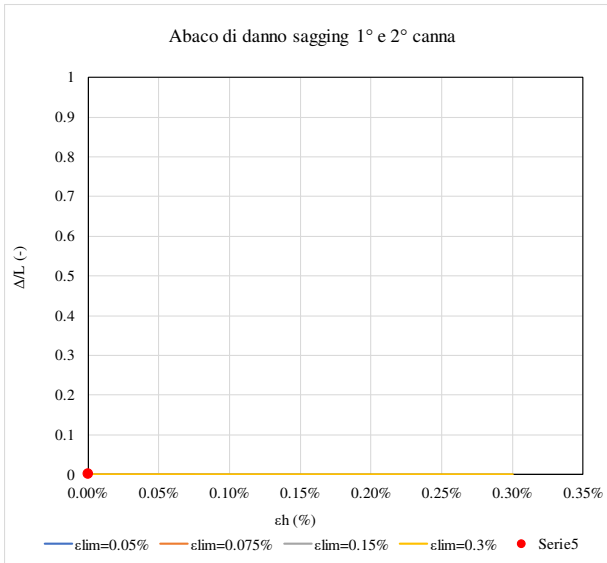
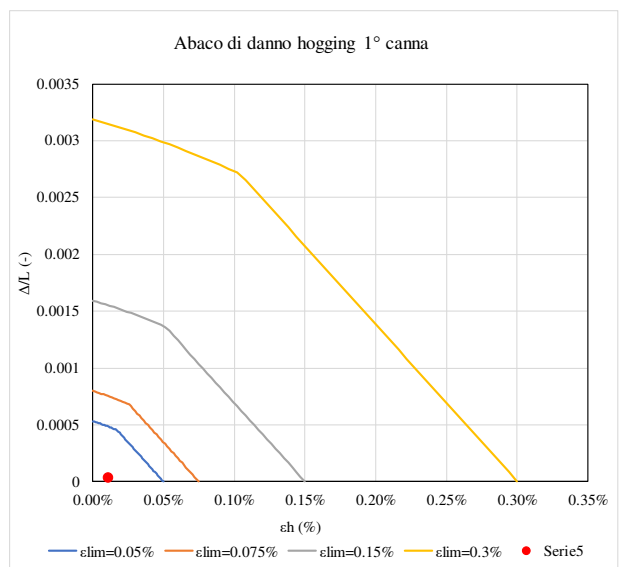
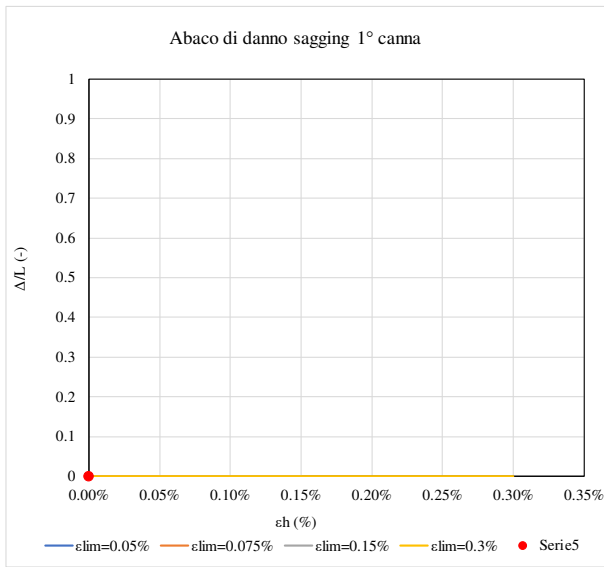


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
107-S1	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.004%	0.004%	0.004%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.011%	-0.012%	-0.012%

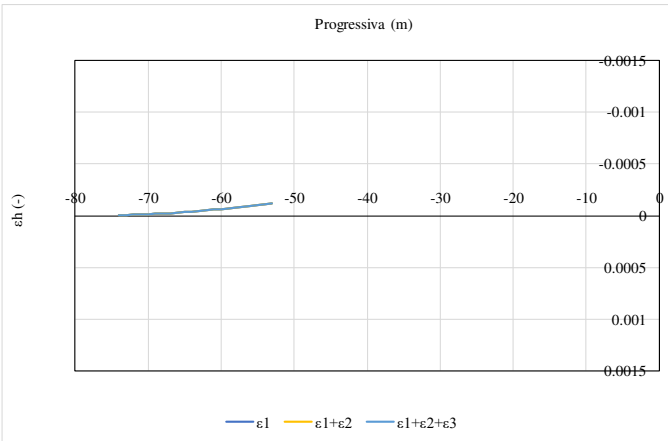
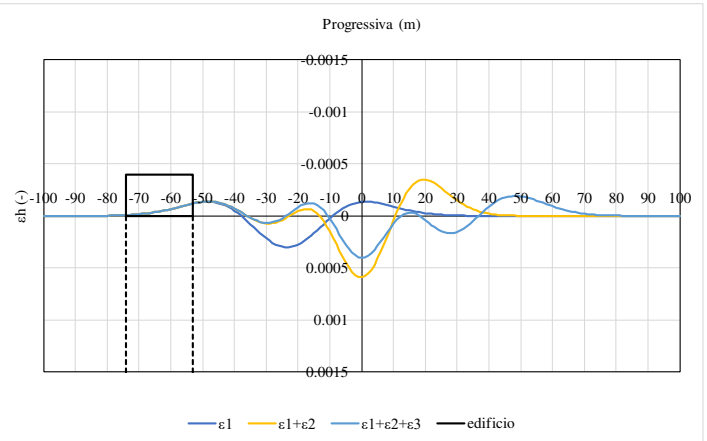
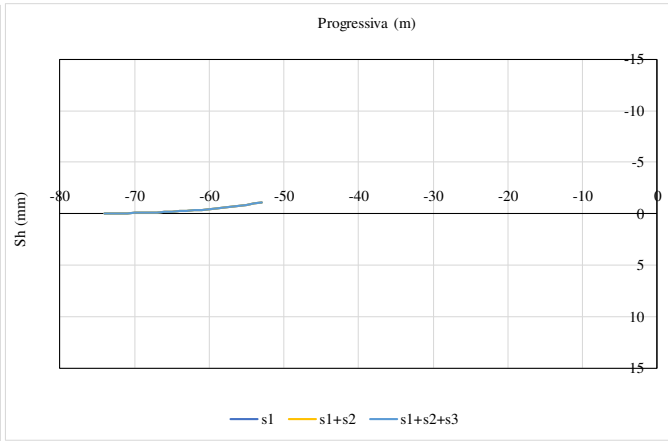
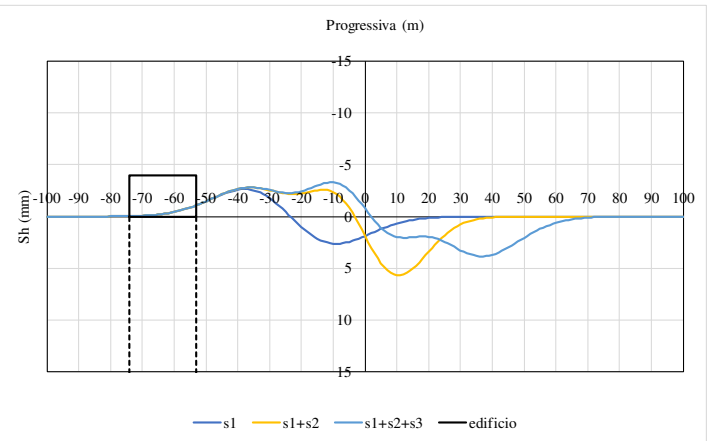
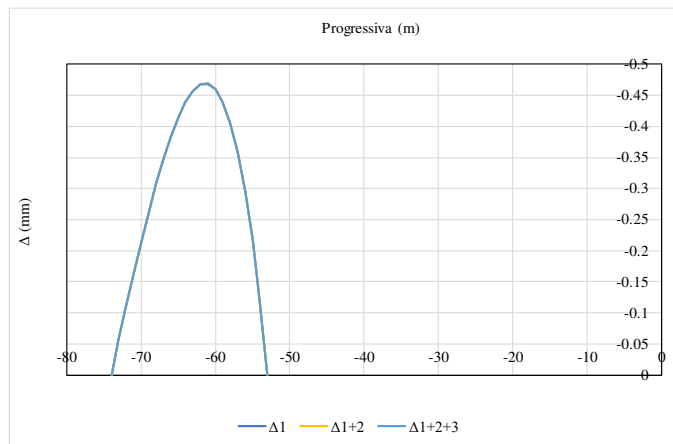
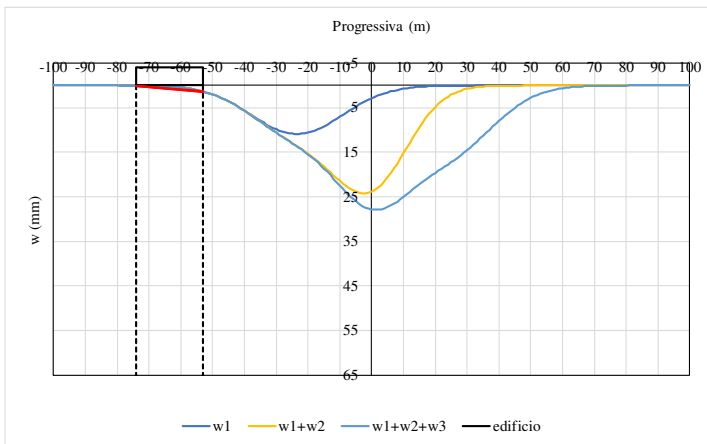




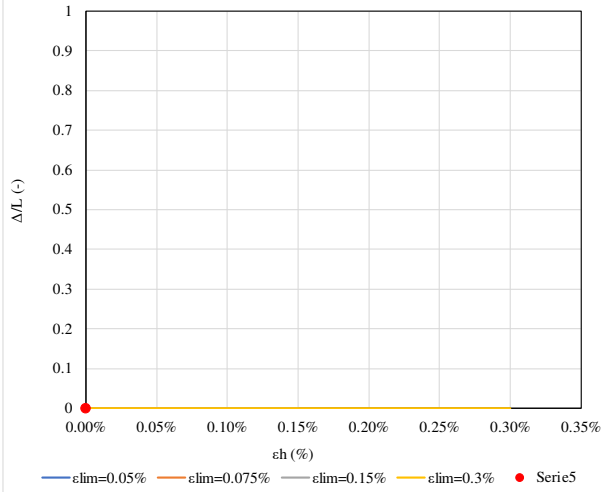
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
107-S2	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.002%	0.002%	0.002%

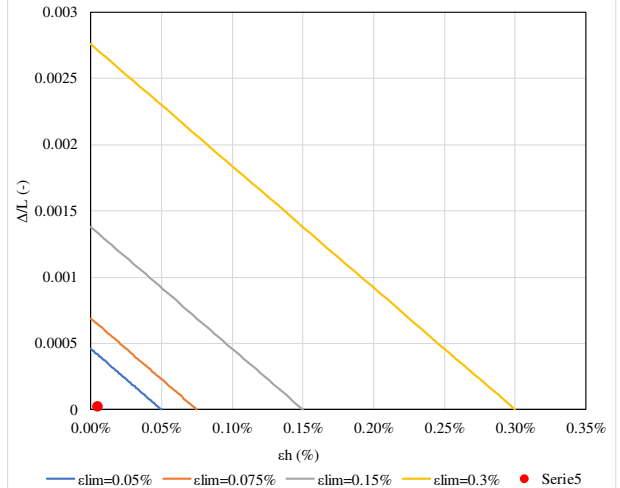
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.005%	-0.005%	-0.005%



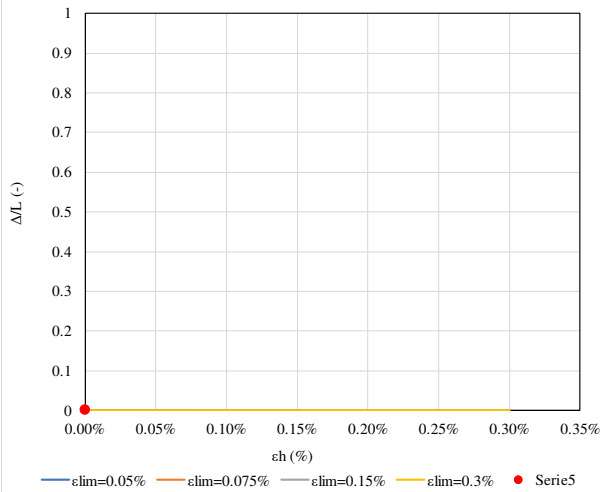
Abaco di danno sagging 1° canna



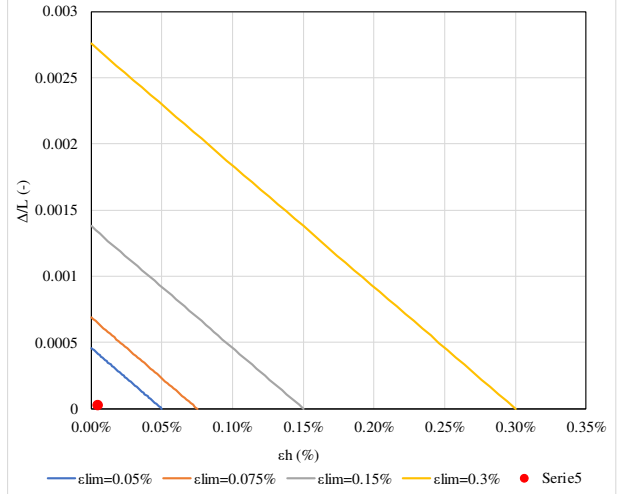
Abaco di danno hogging 1° canna



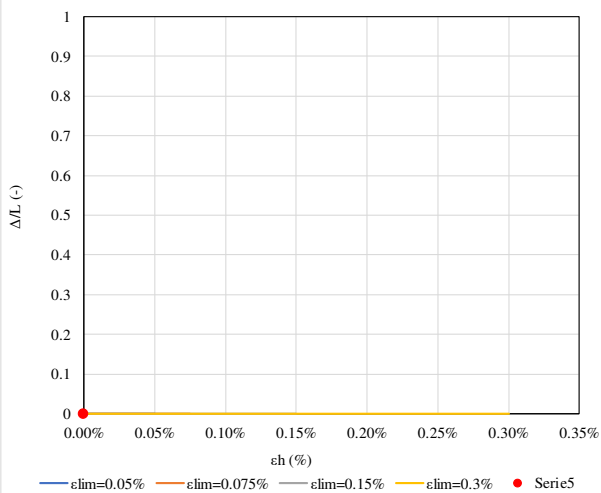
Abaco di danno sagging 1° e 2° canna



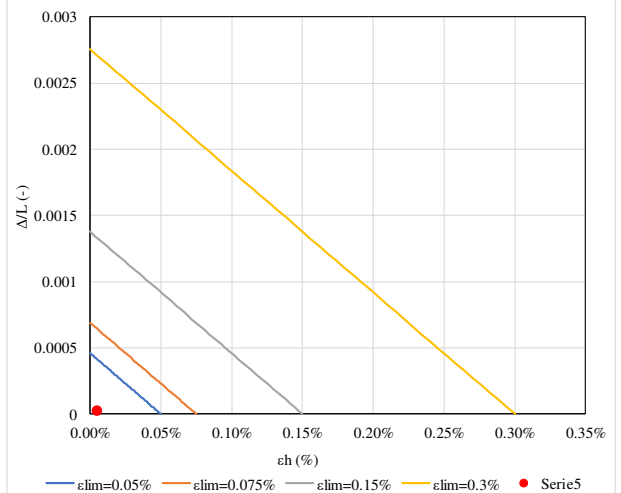
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



Abaco di danno hogging 1°, 2° e 3° canna

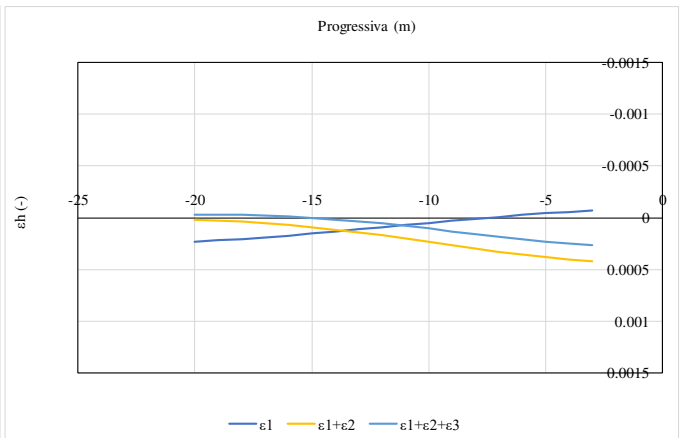
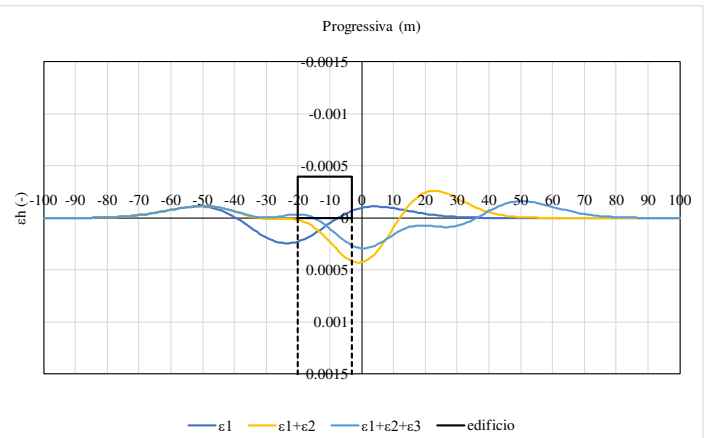
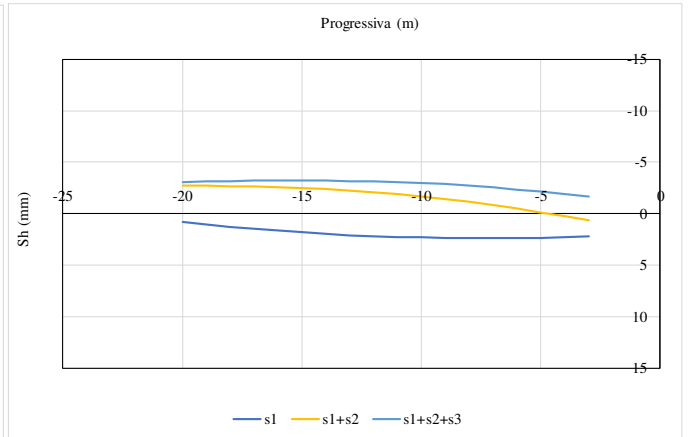
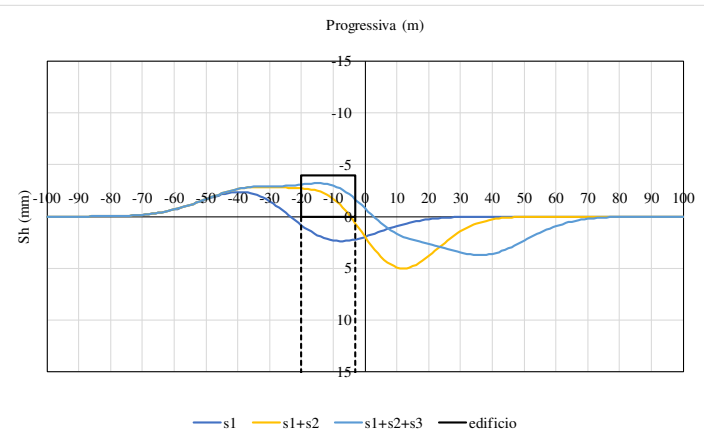
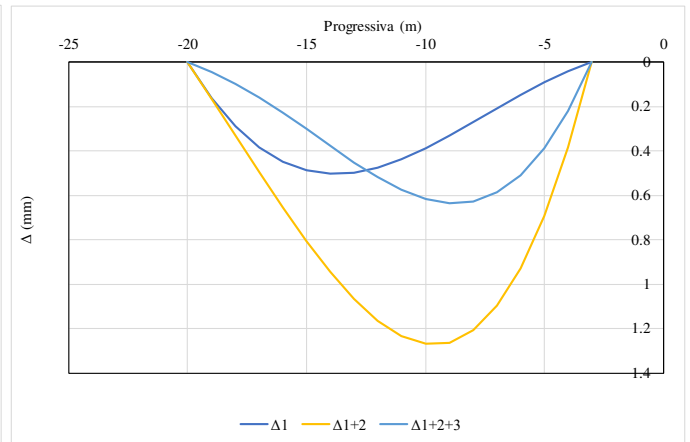
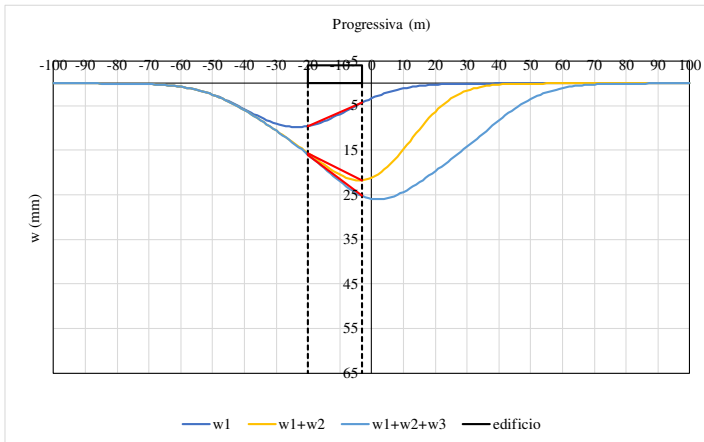


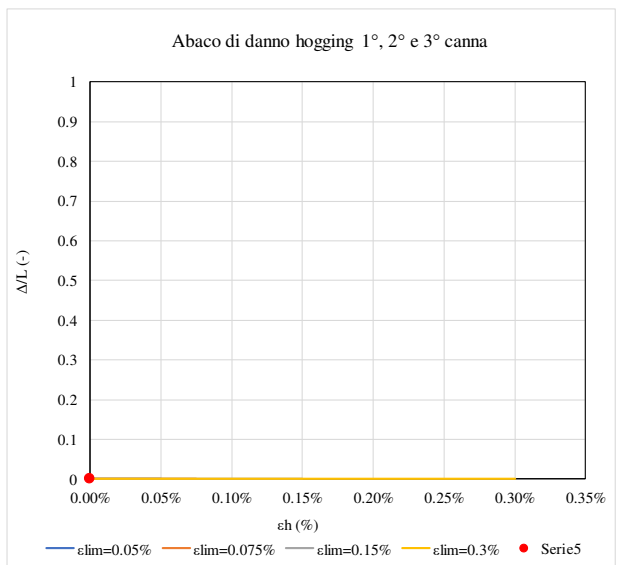
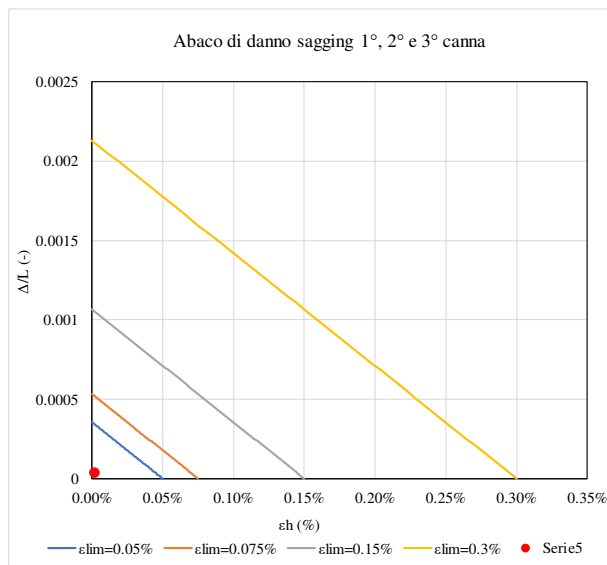
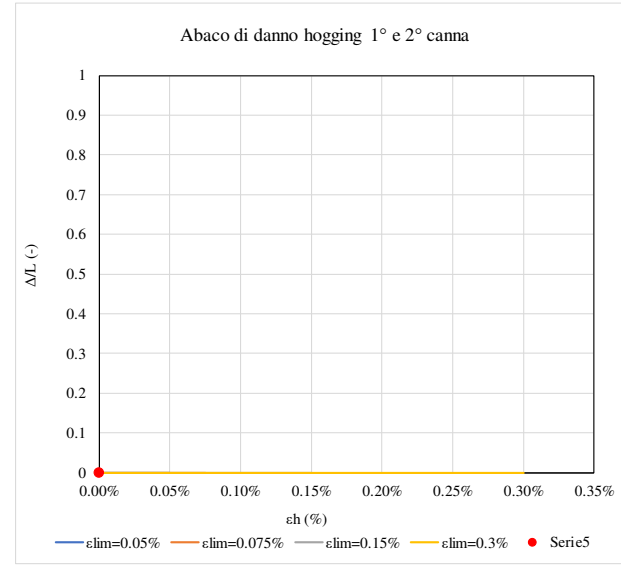
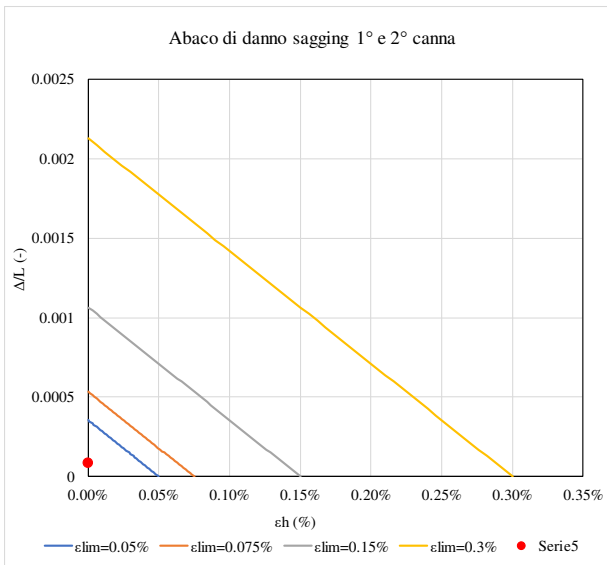
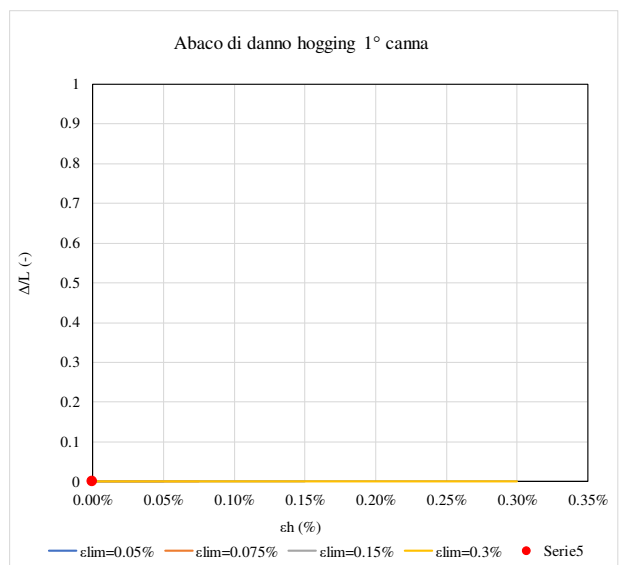
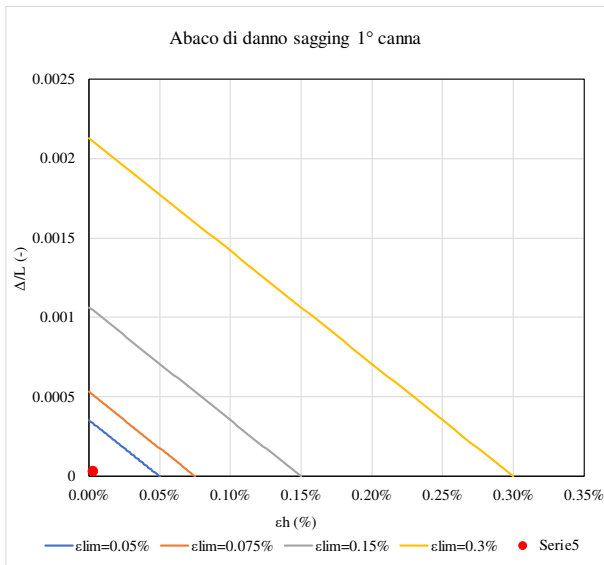


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
108	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.003%	0.008%	0.004%
#DIV/0!	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.003%	#DIV/0!	-0.002%
#DIV/0!	#DIV/0!	#DIV/0!

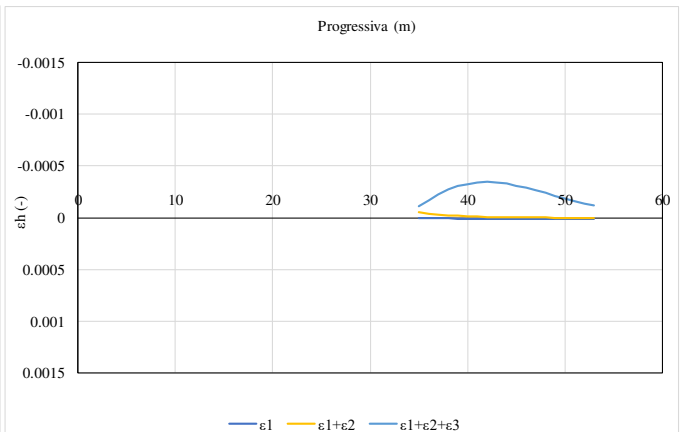
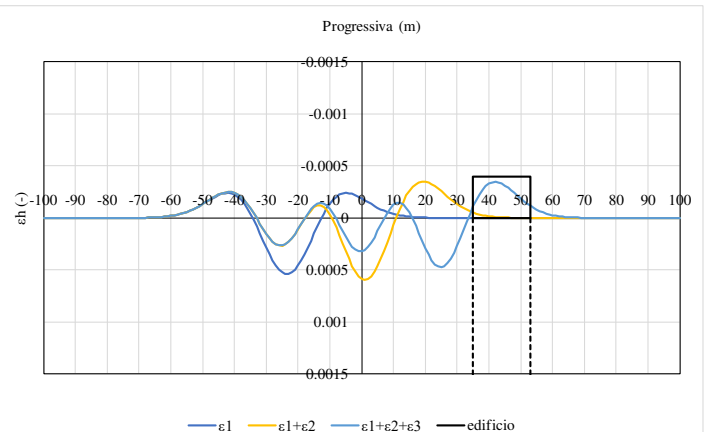
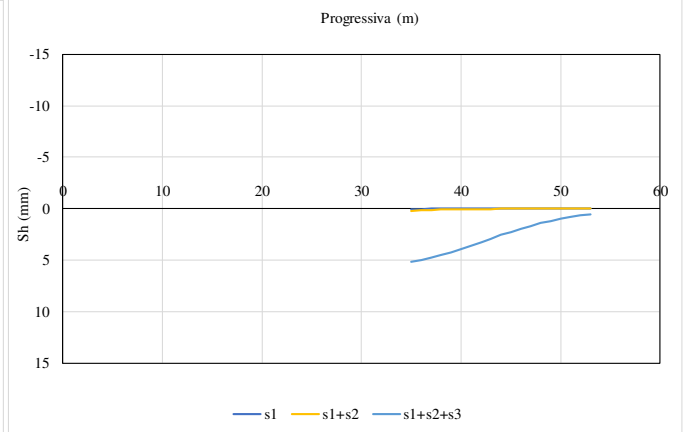
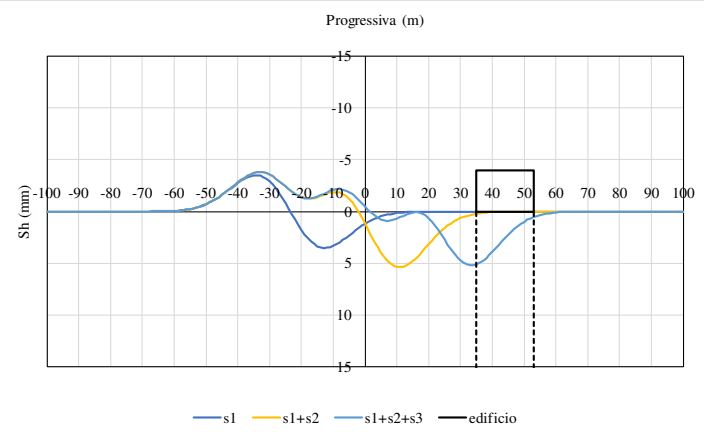
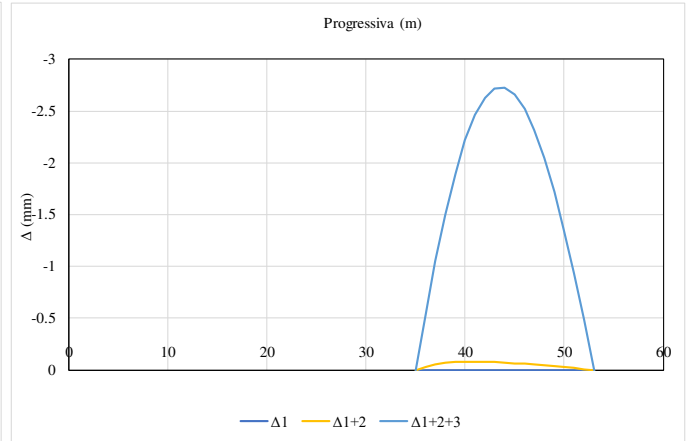
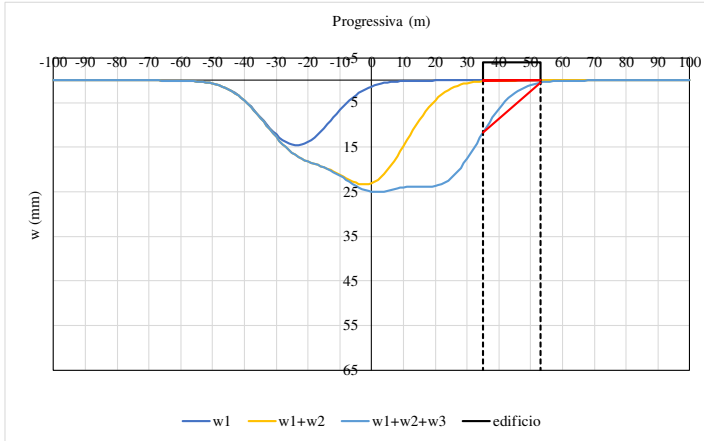




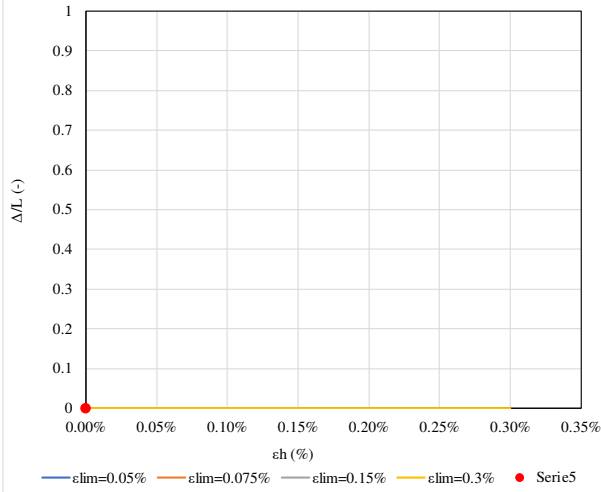
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
109	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.000%	0.016%

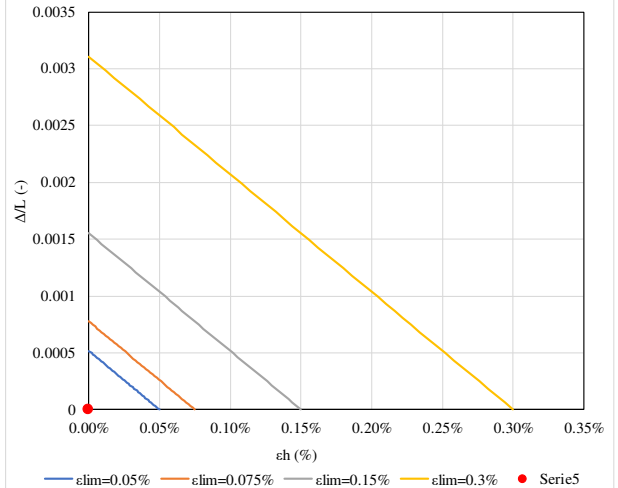
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	-0.001%	-0.026%



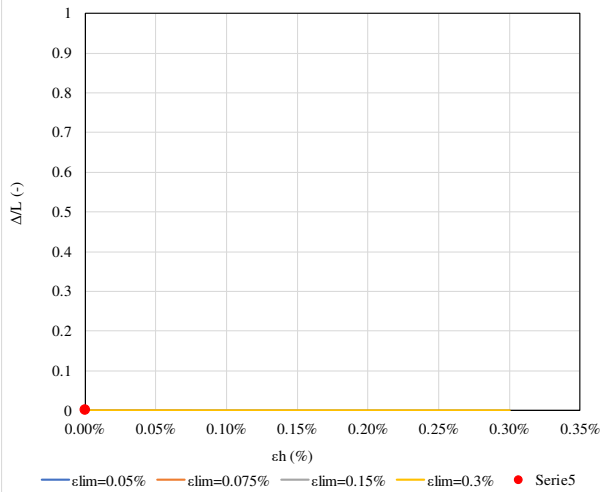
Abaco di danno sagging 1° canna



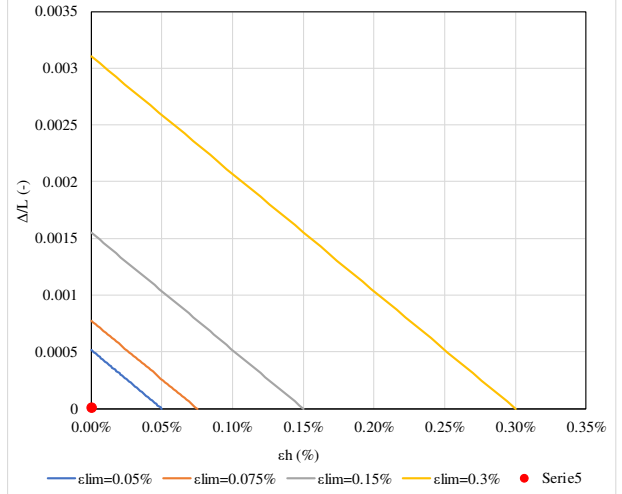
Abaco di danno hogging 1° canna



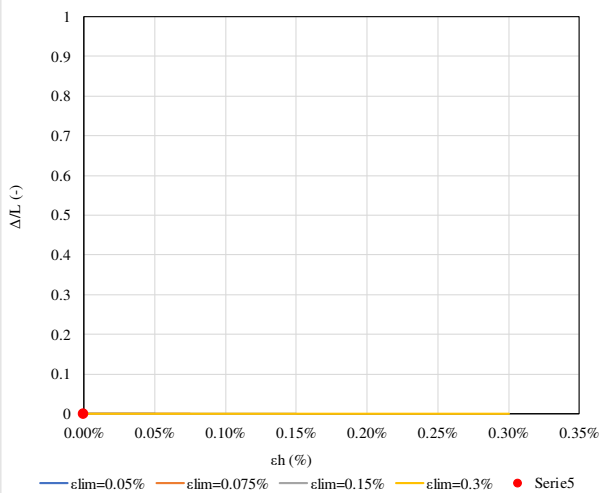
Abaco di danno sagging 1° e 2° canna



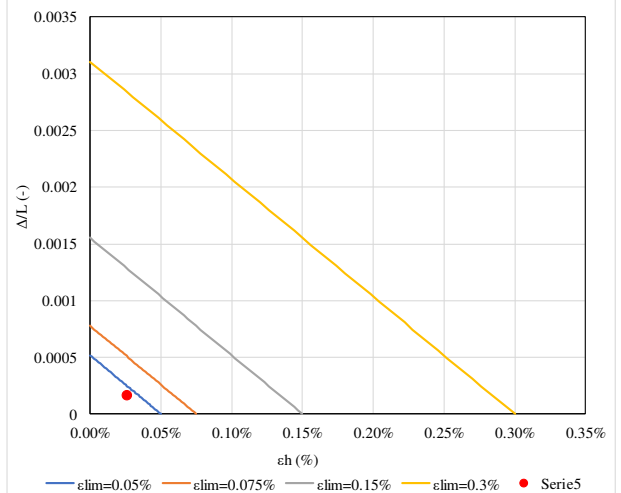
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



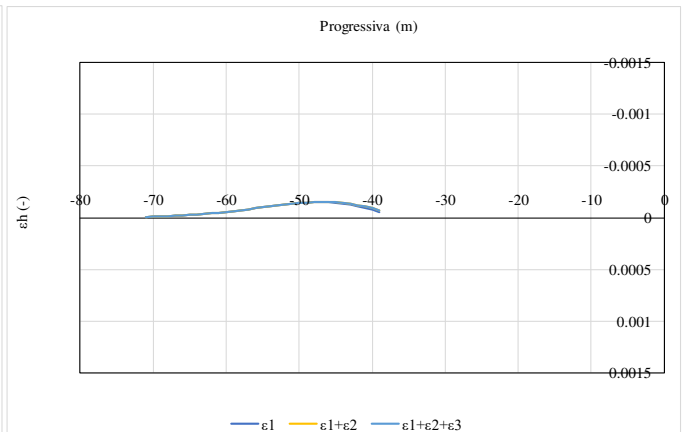
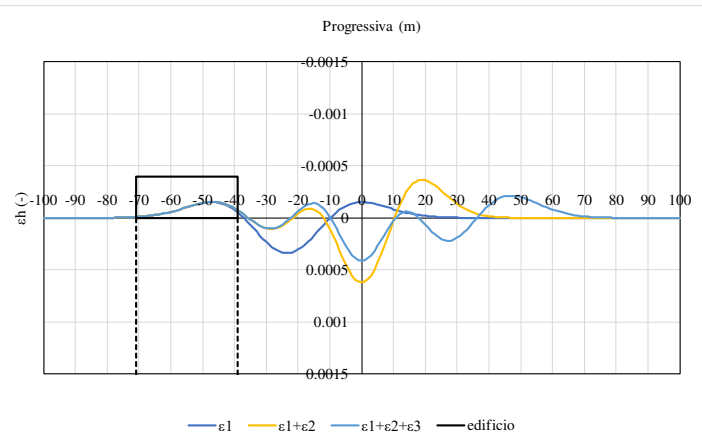
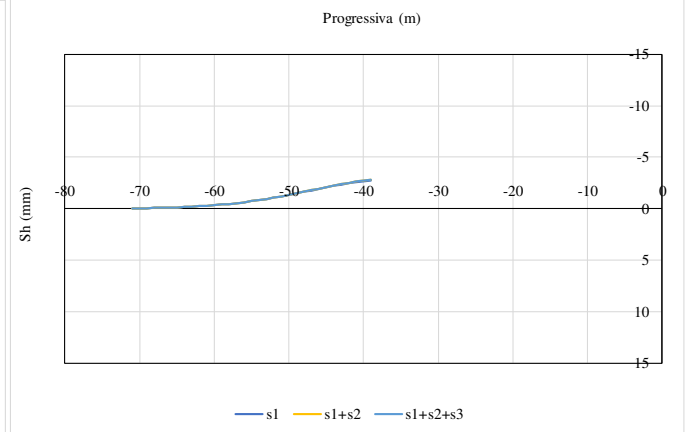
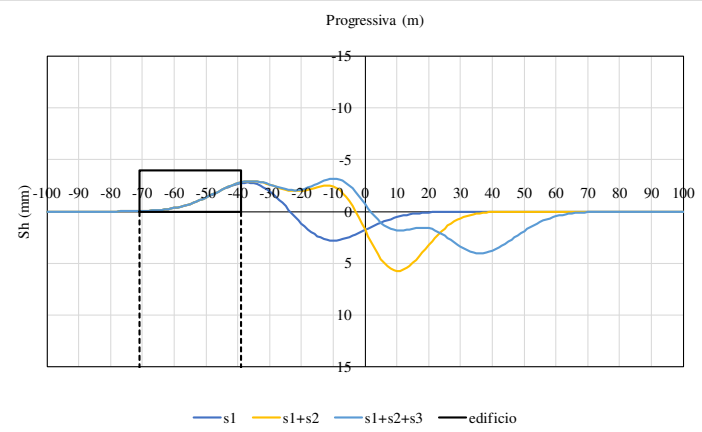
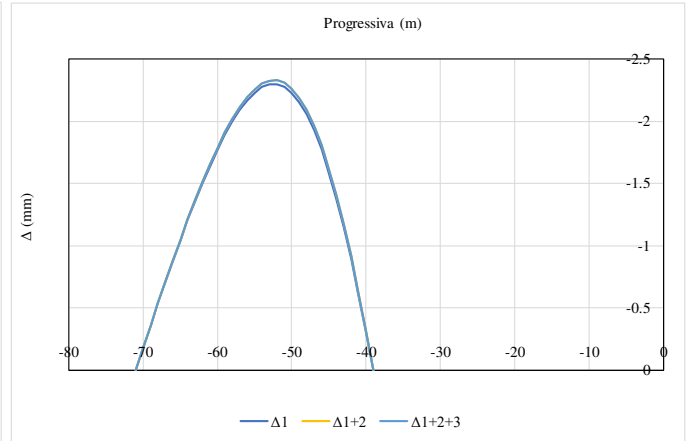
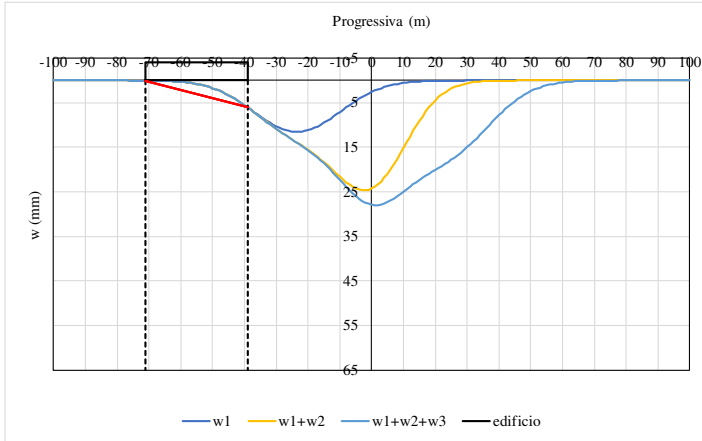
Abaco di danno hogging 1°, 2° e 3° canna



edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
110	atteso	0.4	0.5	1	0.7	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.007%	0.008%	0.008%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.009%	-0.009%	-0.009%







LINEA PALERMO – MESSINA. RADDOPPIO FIUMETORTO – CEFALU'  
CASTELBUONO. TRATTA OGLIASTRILLO - CASTELBUONO  
FERMATA CEFALÙ – VARIANTE RAMPA DI ACCESSO ALLA  
GALLERIA DI SFOLLAMENTO

RELAZIONE SULLE SUBSIDENZE E VERIFICA  
DEGLI EFFETTI INDOTTI SULLE OPERE IN  
SUPERFICIE

COMMESSA	LOTTO	CODIFICA	DOCUMENTO	REV.	ALLEGATI
RS7B	00	D 07 RH	GN 01 00 001	A	2

## ALLEGATO 2

<b>TITOLO</b>	SCHEDE DI ANALISI DEGLI EDIFICI - ANALISI NELLA CONDIZIONE DI CALCOLO
<b>TIPO DI DOCUMENTO:</b>	Documento – Formato A4
<b>CODIFICA:</b>	-
<b>PAGINE:</b>	-
<b>DATA:</b>	Ott 2022
<b>SORGENTE:</b>	Italferr - UO Gallerie
<b>NOTE:</b>	Allegato 2 di 2 alla Relazione sulle subsidenze e verifica degli effetti indotti sulle opere civili

## ALLEGATO 2 – ANALISI NELLA CONDIZIONE DI CALCOLO

Per le analisi svolte in condizioni di calcolo si è valutata la distribuzione dei cedimenti superficiali e la stima del danno indotto dagli scavi sugli edifici interferenti con i seguenti valori di  $V_p$  (in condizioni indisturbate) e di  $k$  (-):

Parametri di $K$ e $V_p$	Condizione di calcolo (previsione degli effetti)
	Coefficiente $K$
	0.40
$V_{pScavo}$ meccanizzato Galleria di linea binario pari	1.0%
$V_{pScavo}$ tradizionale (per galleria centrale)	2.0%
$V_{pScavo}$ meccanizzato Galleria di linea binario dispari	1.4%

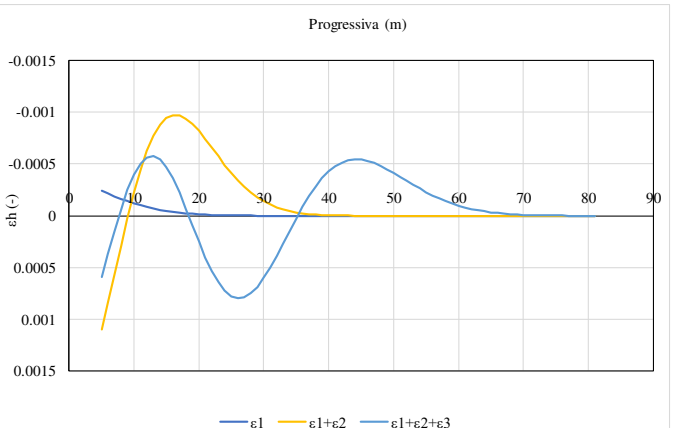
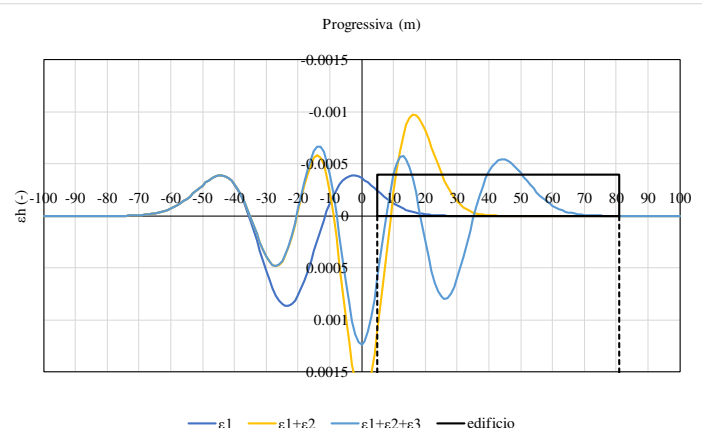
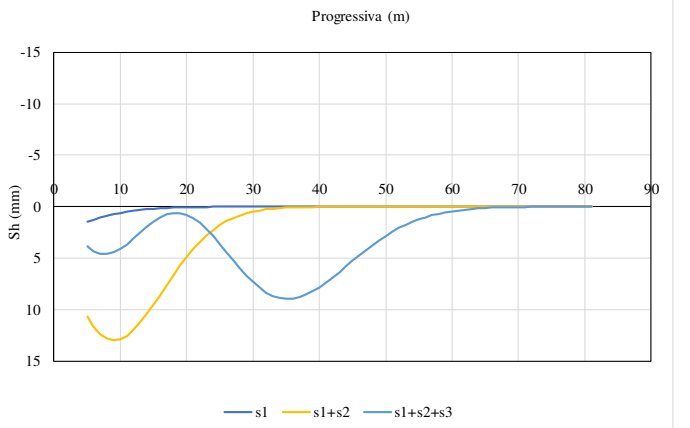
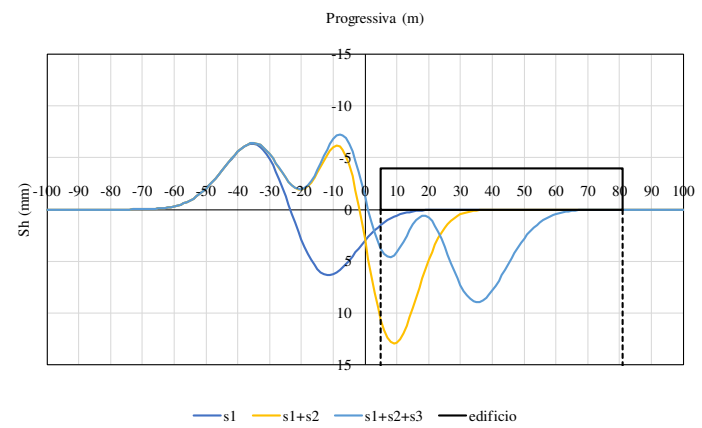
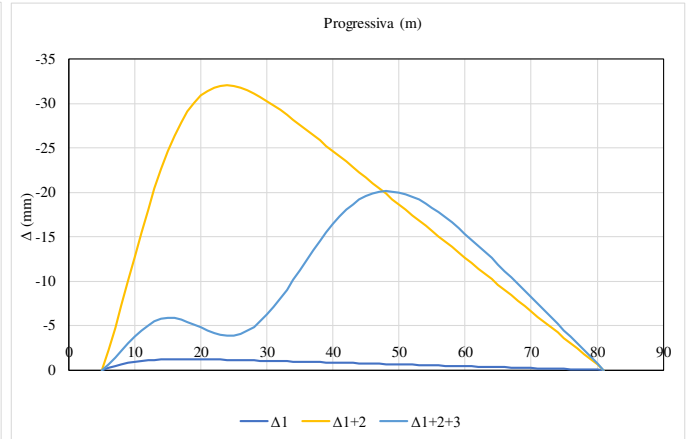
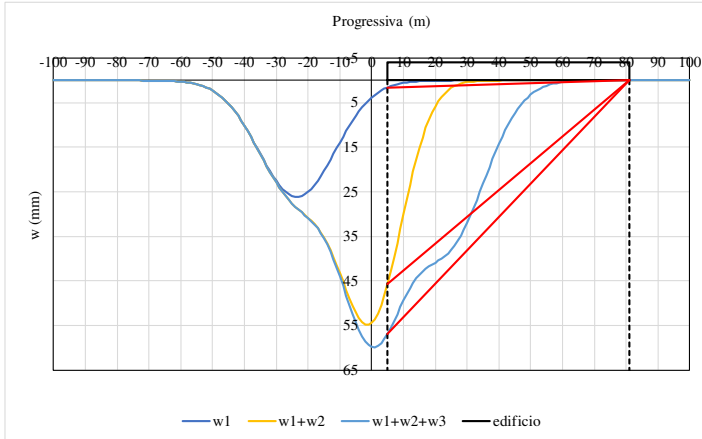
Nelle sezioni di calcolo dove si verifica l'influenza degli scavi precedenti sullo scavo delle gallerie scavate in seguito, sono stati presi in considerazione i nuovi valori di volume perso aumentati del 40%.

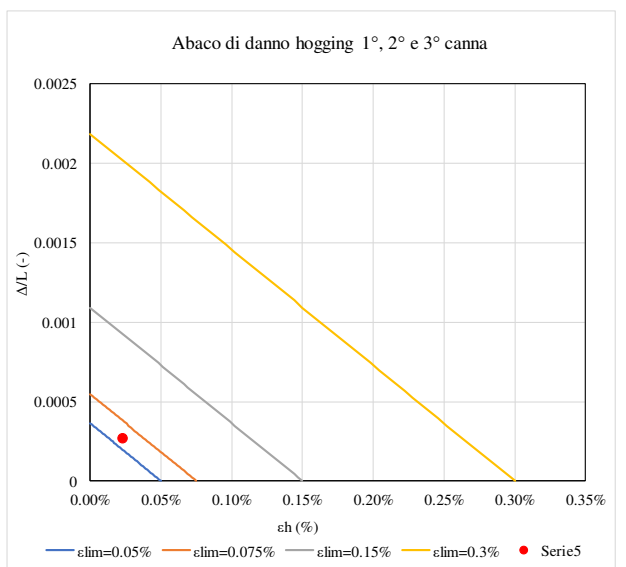
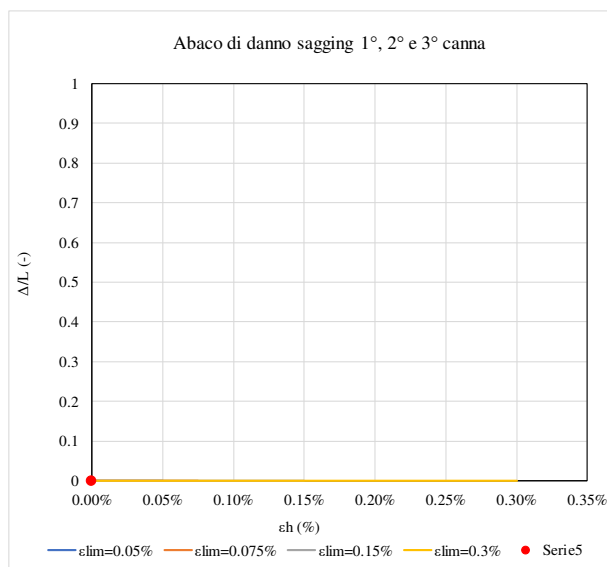
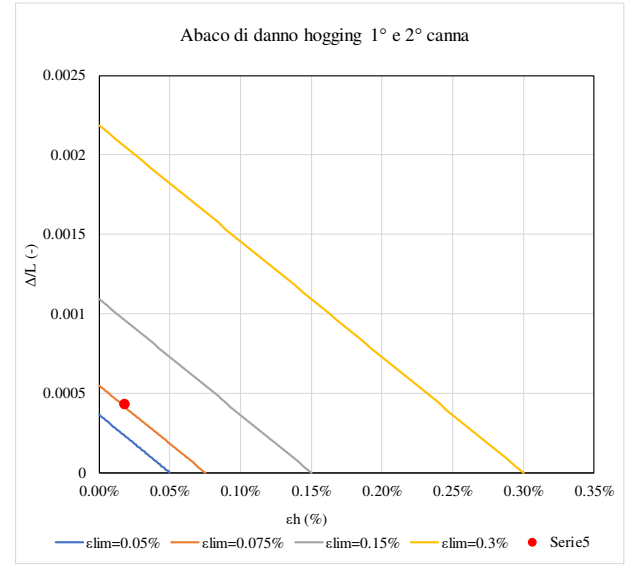
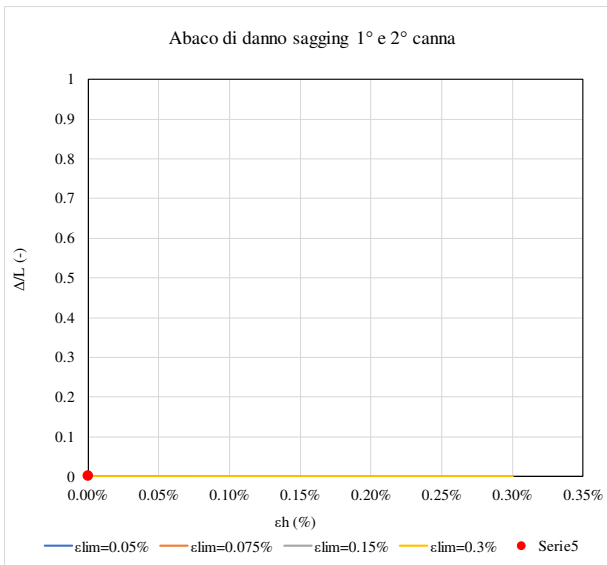
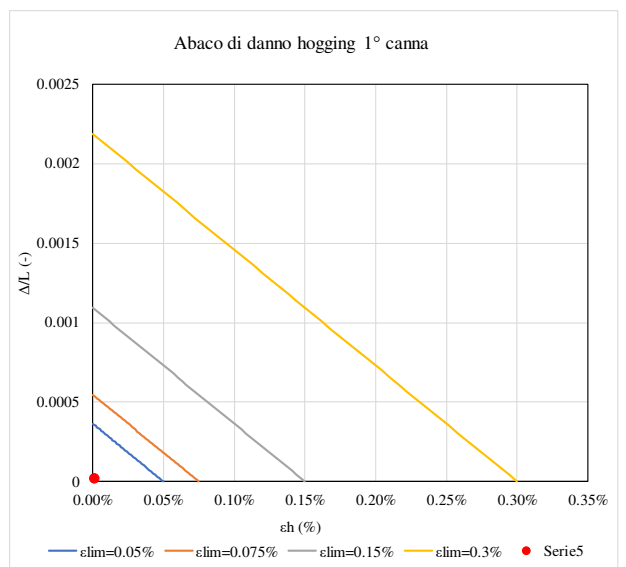
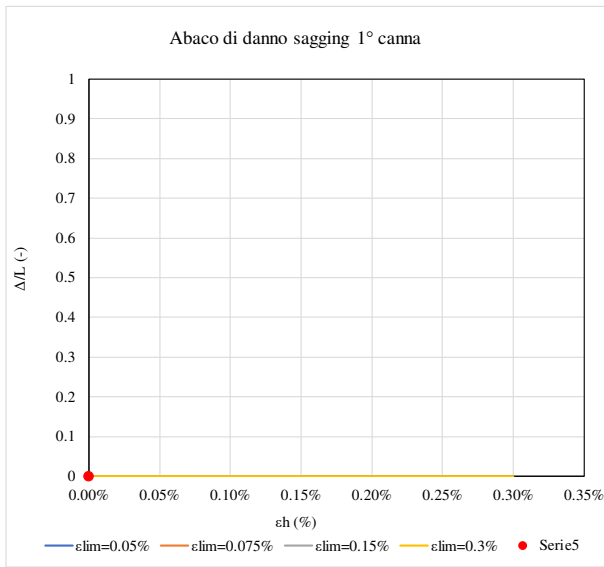


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
1	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.002%	0.043%	0.027%

$\varepsilon_{1,max}$	$\varepsilon_{1+2,max}$	$\varepsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.002%	-0.018%	-0.023%

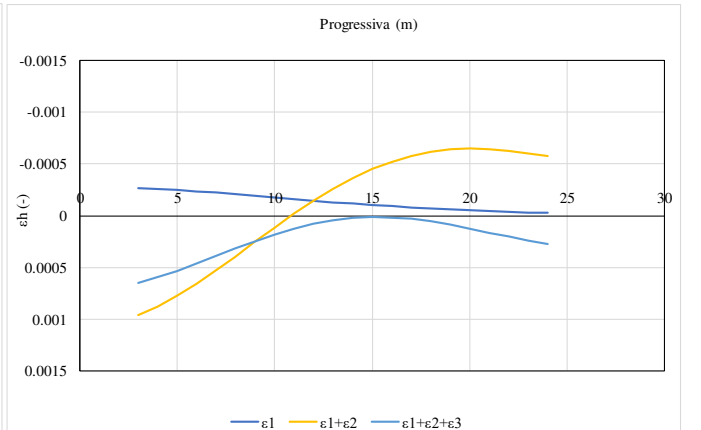
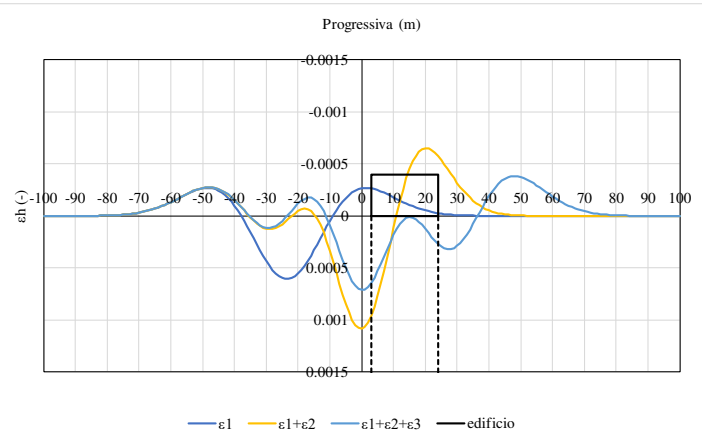
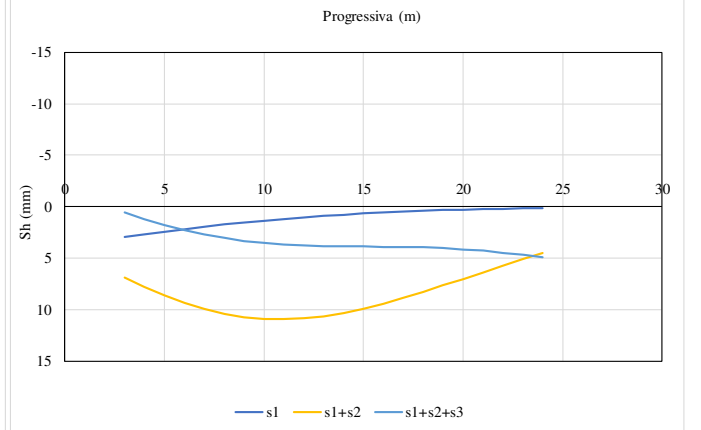
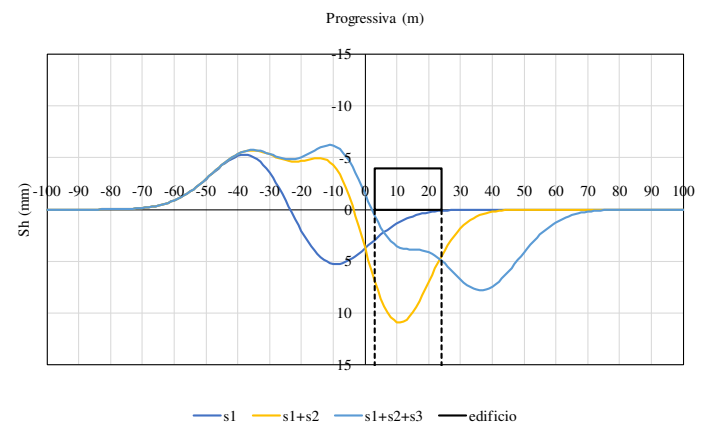
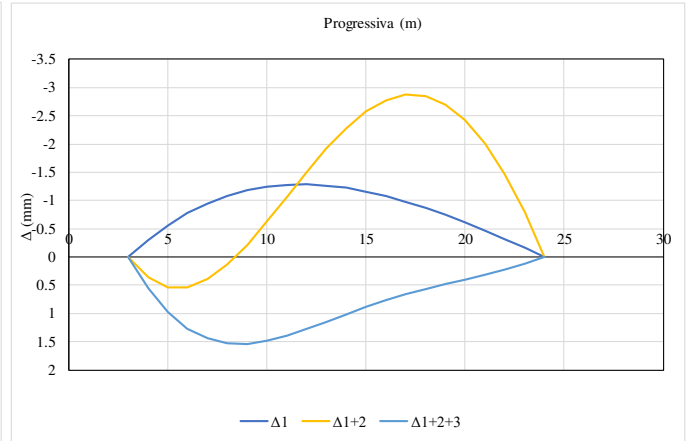
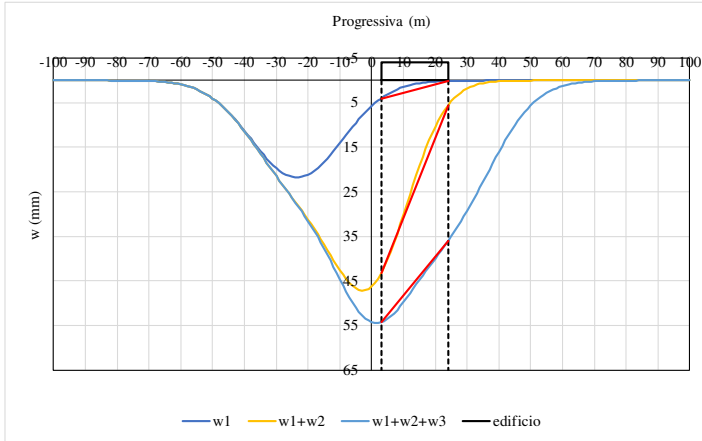




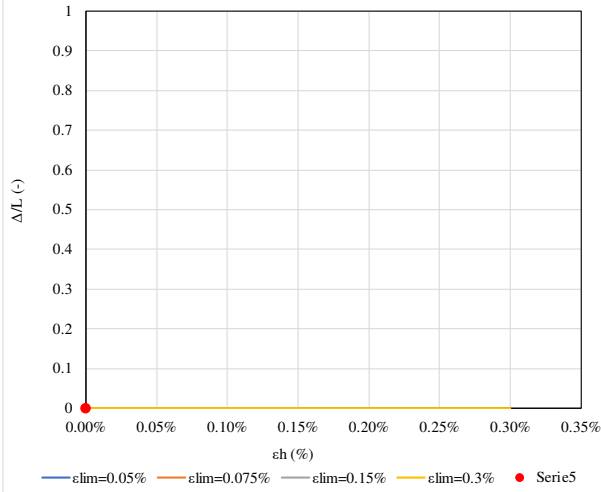
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
2	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.011%	0.008%
0.006%	0.019%	#DIV/0!

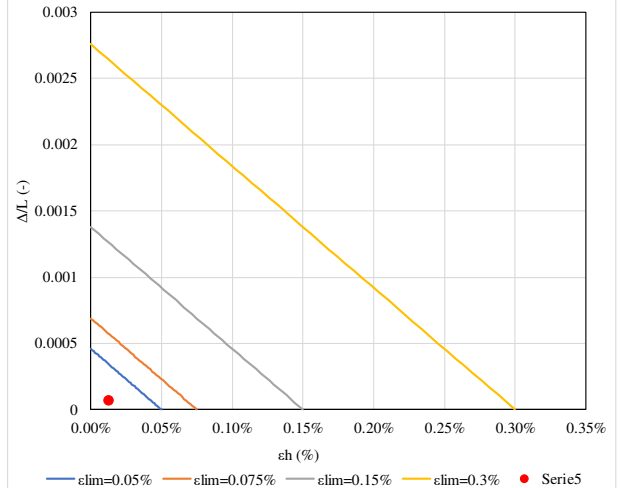
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.013%	-0.047%	#DIV/0!



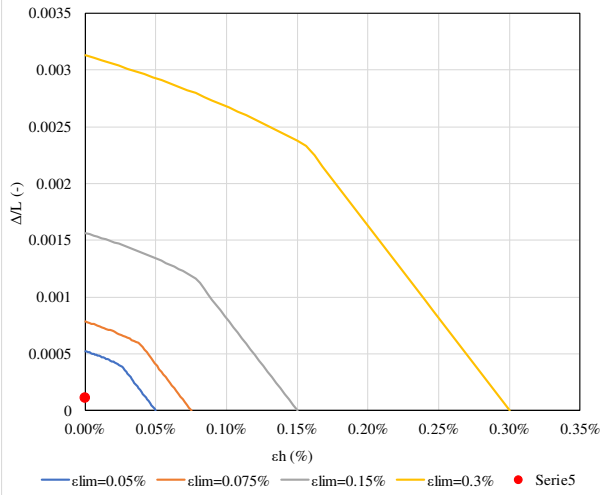
Abaco di danno sagging 1° canna



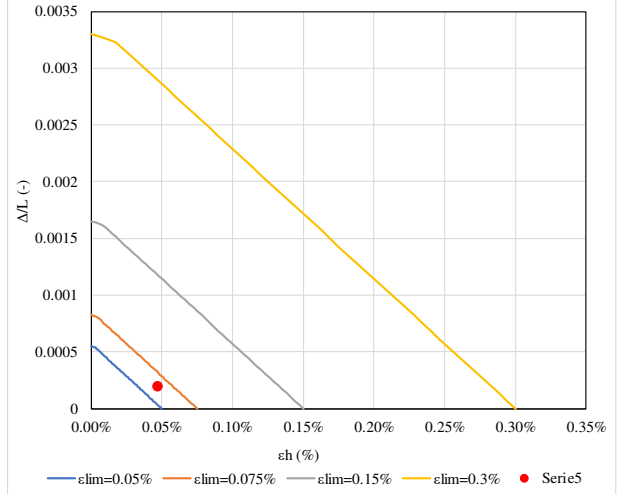
Abaco di danno hogging 1° canna



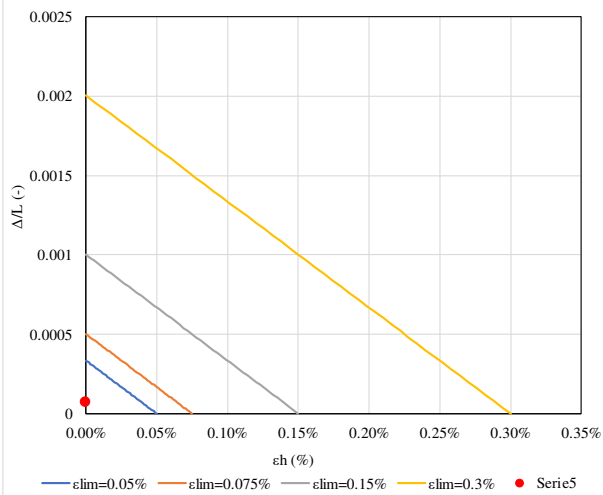
Abaco di danno sagging 1° e 2° canna



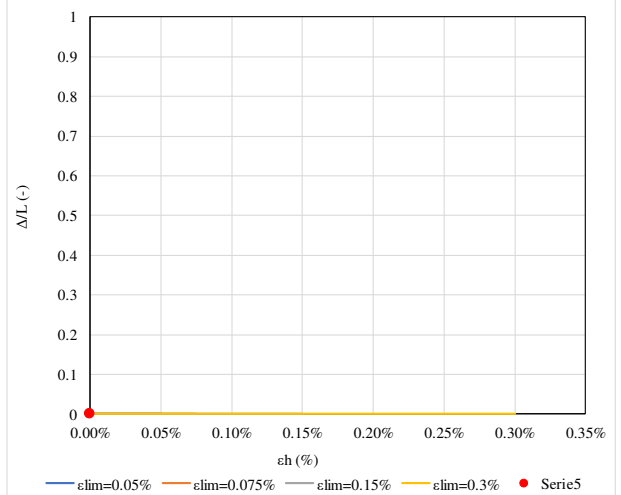
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



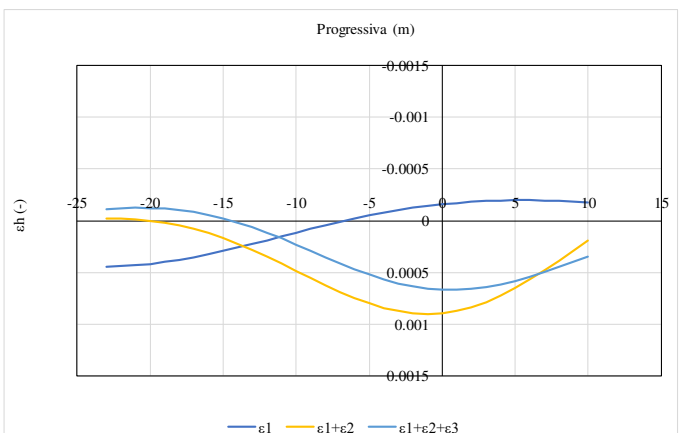
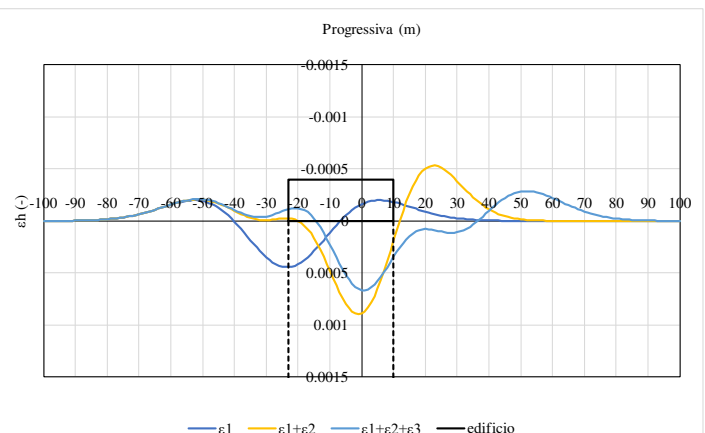
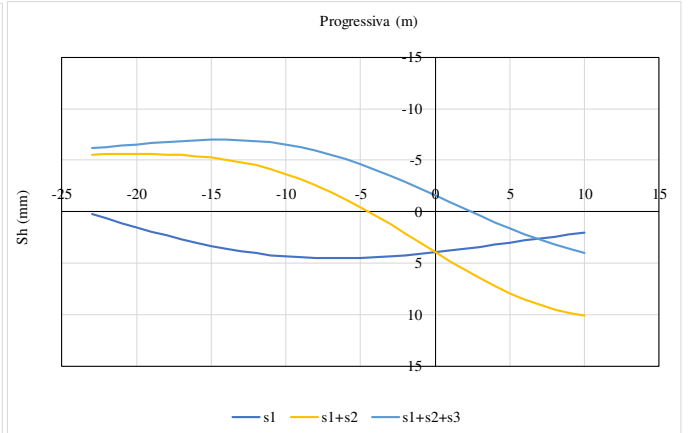
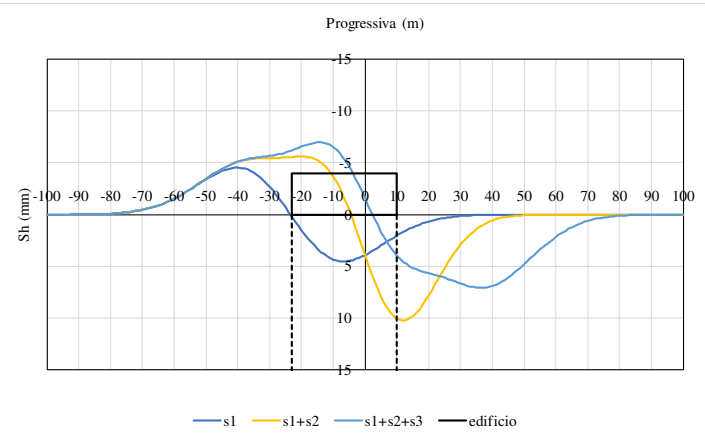
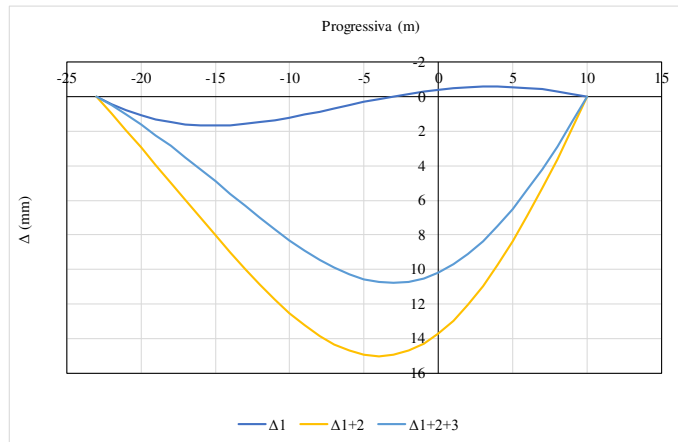
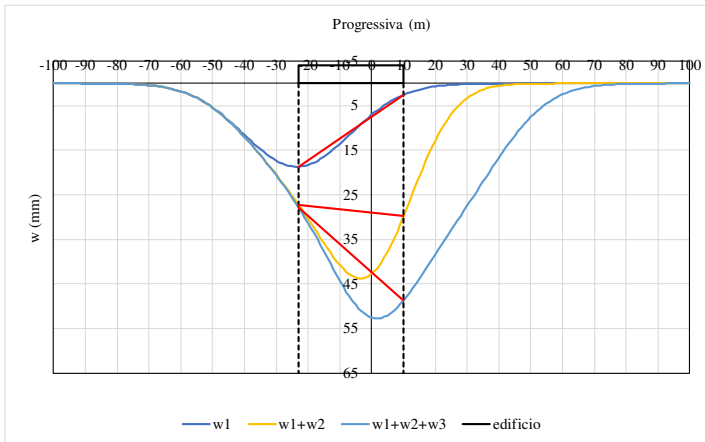
Abaco di danno hogging 1°, 2° e 3° canna

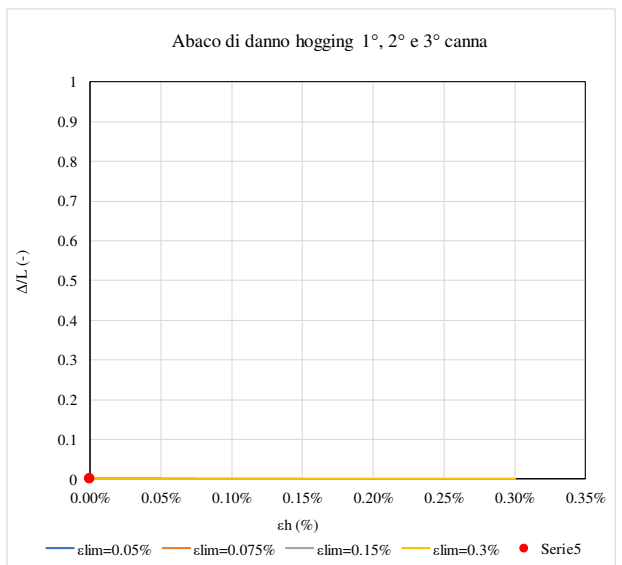
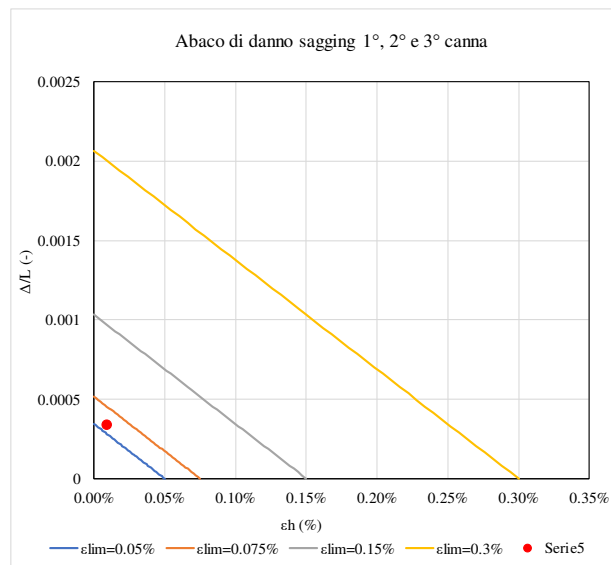
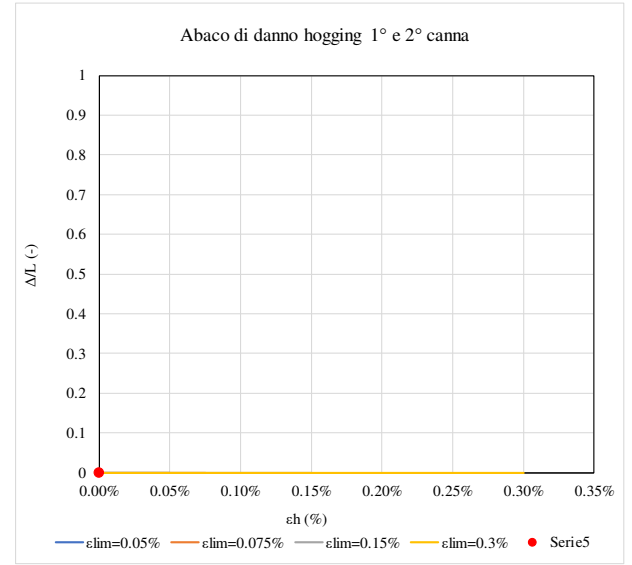
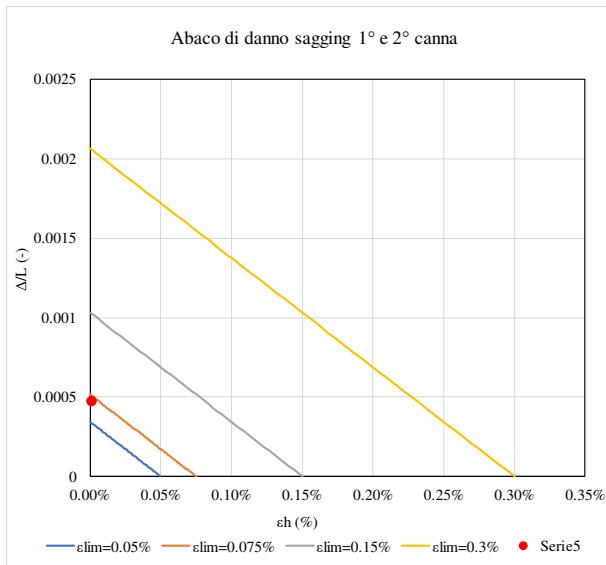
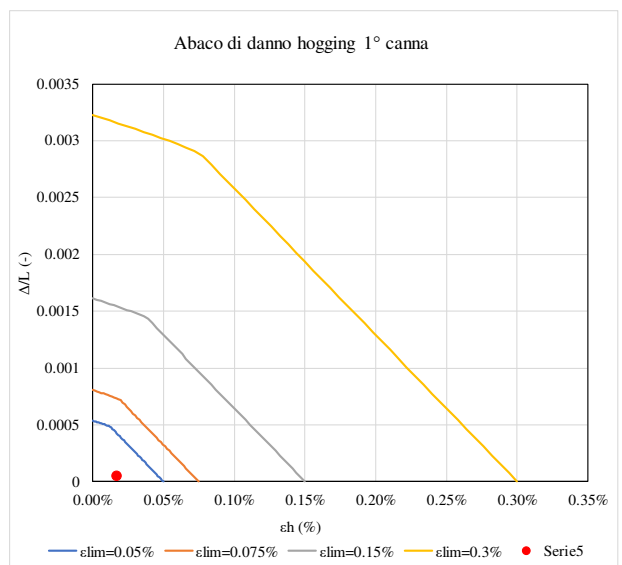
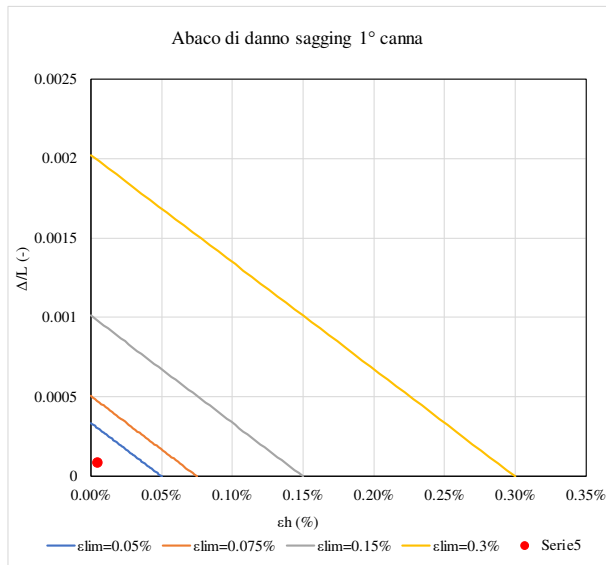


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
3	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.009%	0.047%	0.034%
0.005%	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.005%	-0.002%	-0.009%
-0.017%	#DIV/0!	#DIV/0!

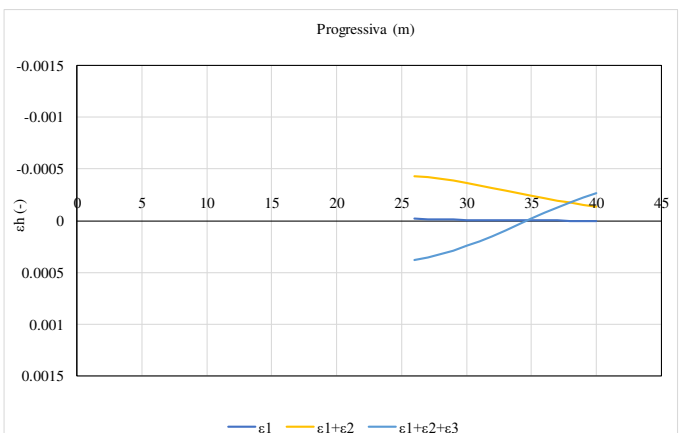
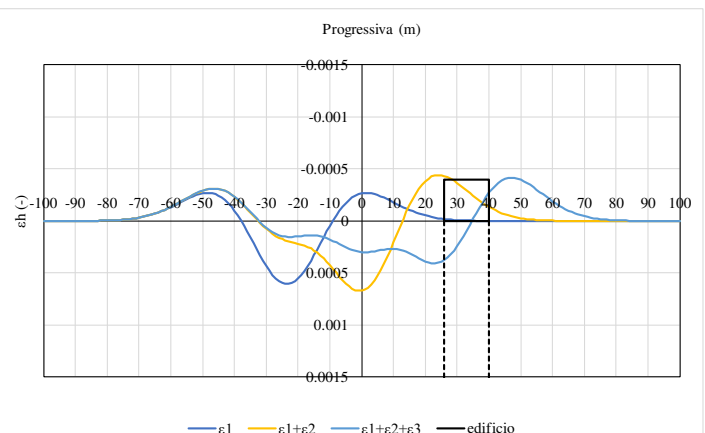
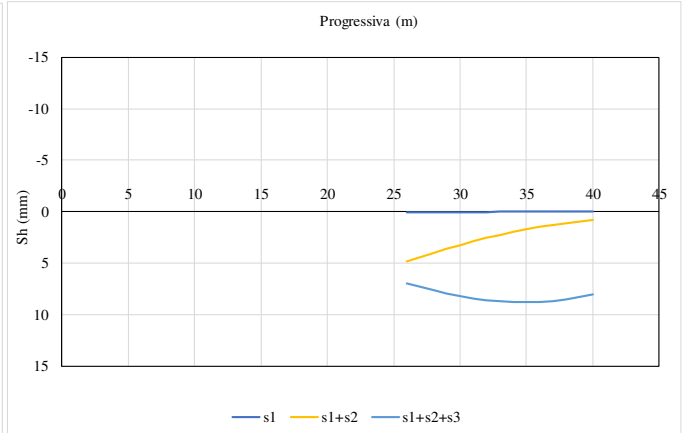
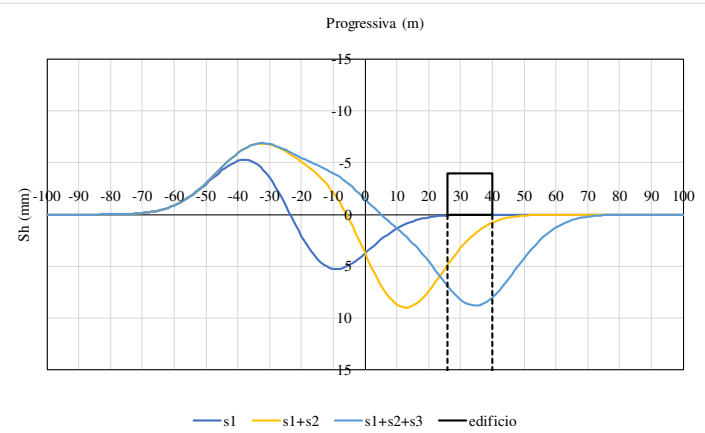
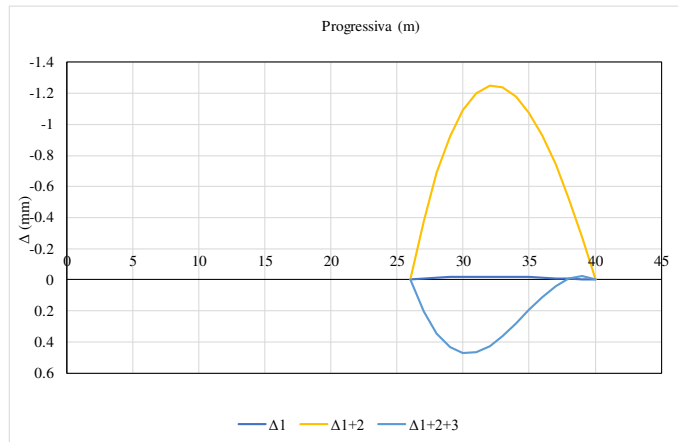
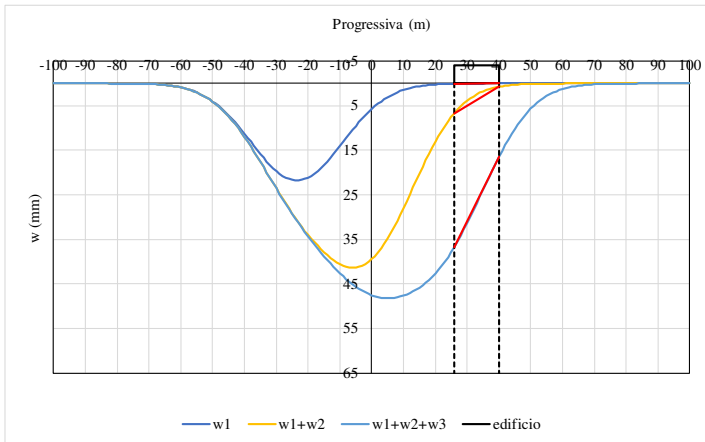


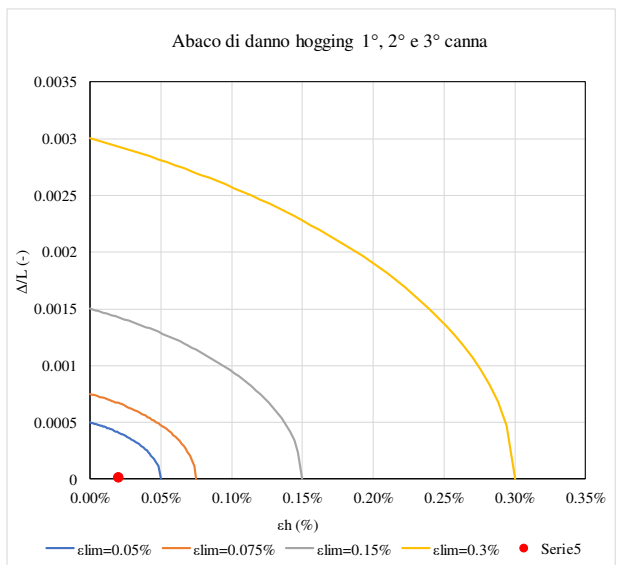
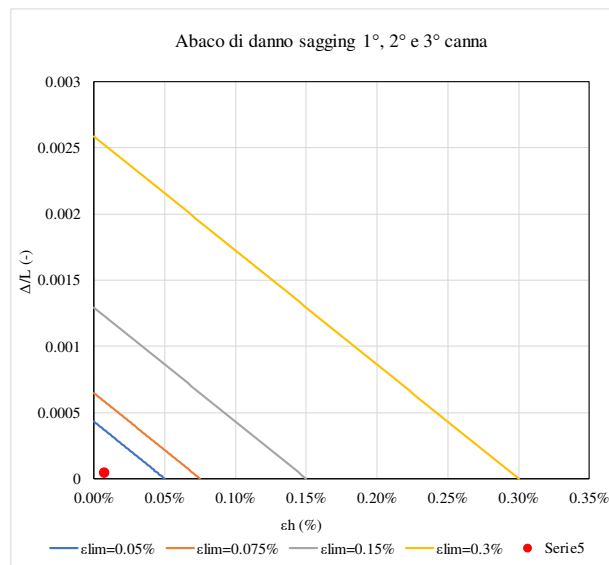
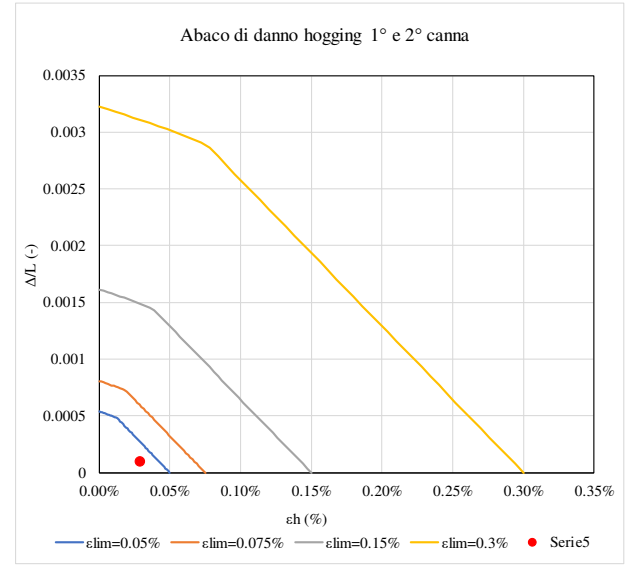
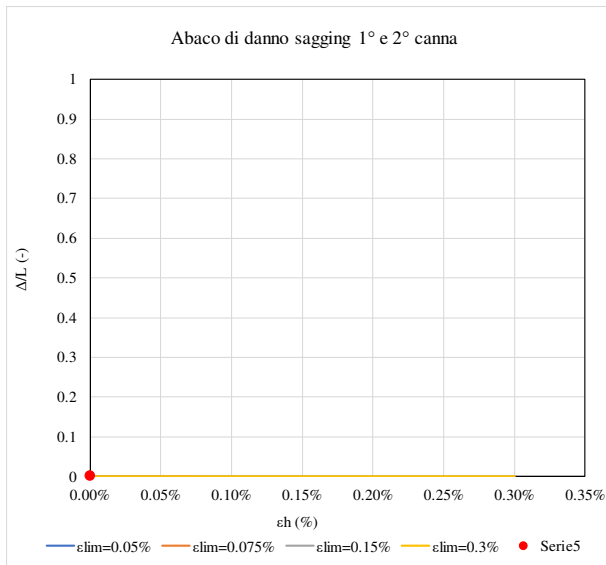
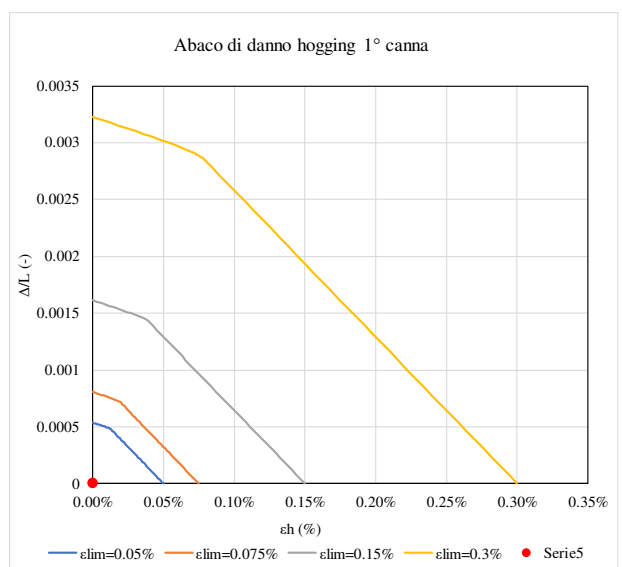
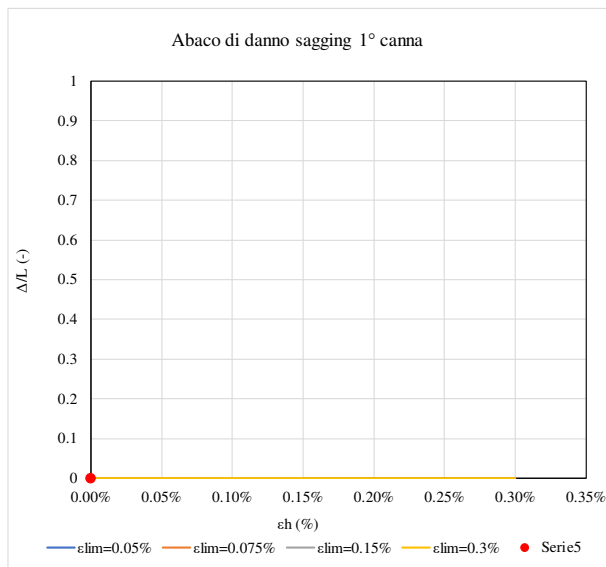


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
4	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.004%
0.000%	0.010%	0.001%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	-0.007%
-0.001%	-0.029%	-0.020%



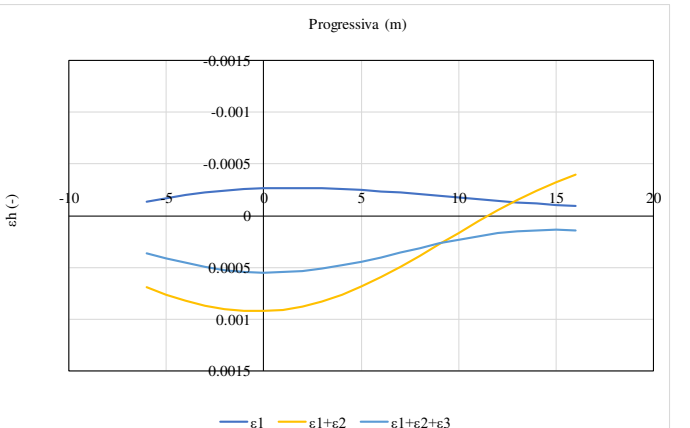
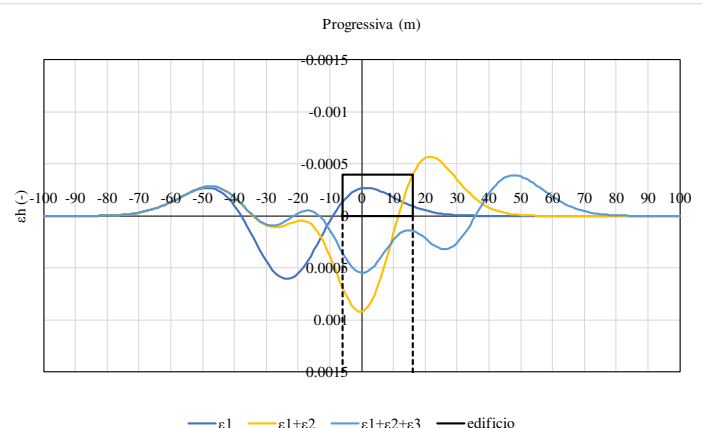
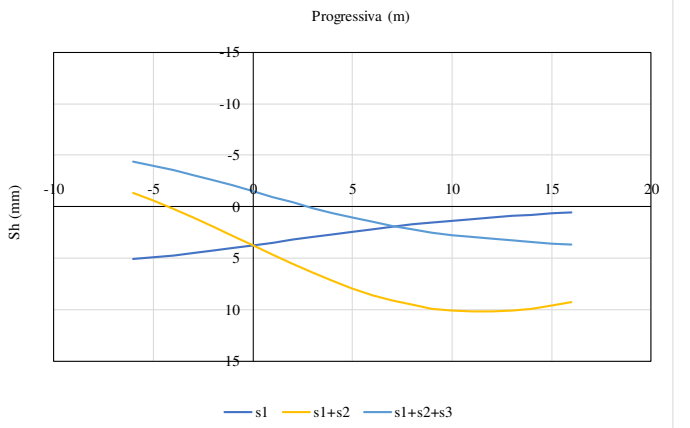
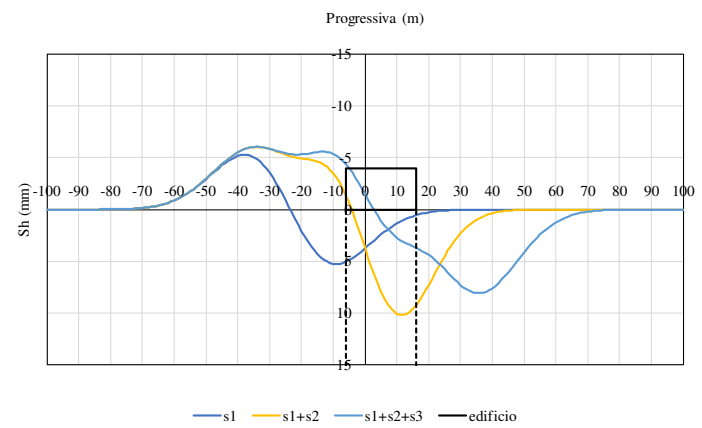
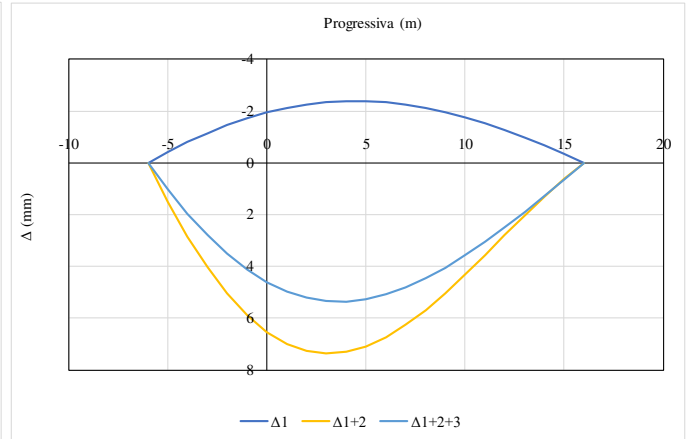
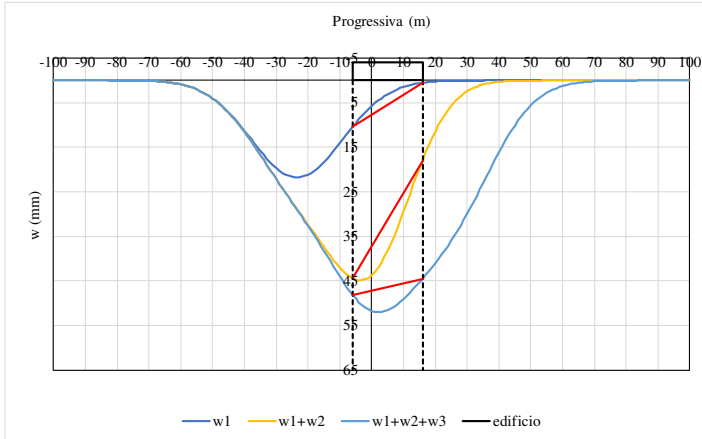




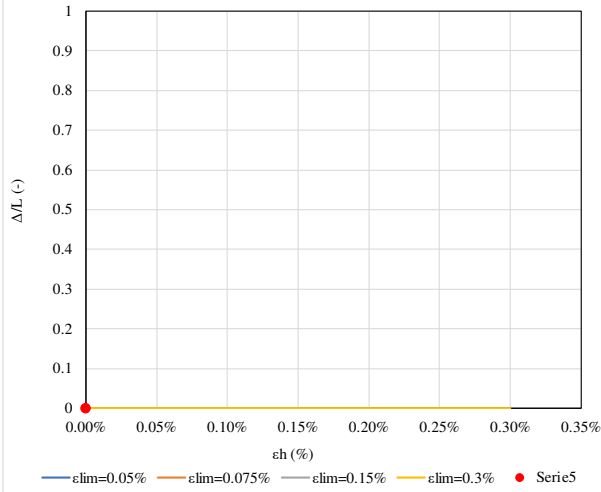
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
5	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.035%	0.026%
0.011%	#DIV/0!	#DIV/0!

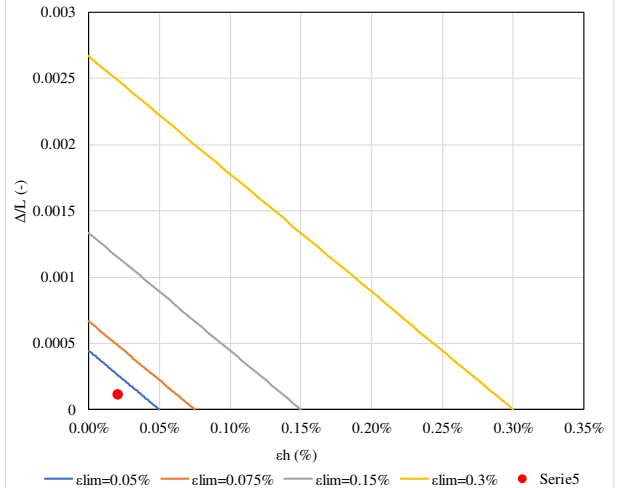
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.020%	#DIV/0!
-0.021%	#DIV/0!	#DIV/0!



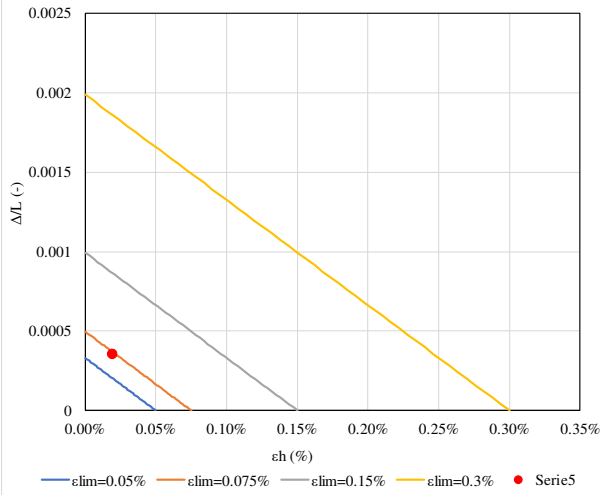
Abaco di danno sagging 1° canna



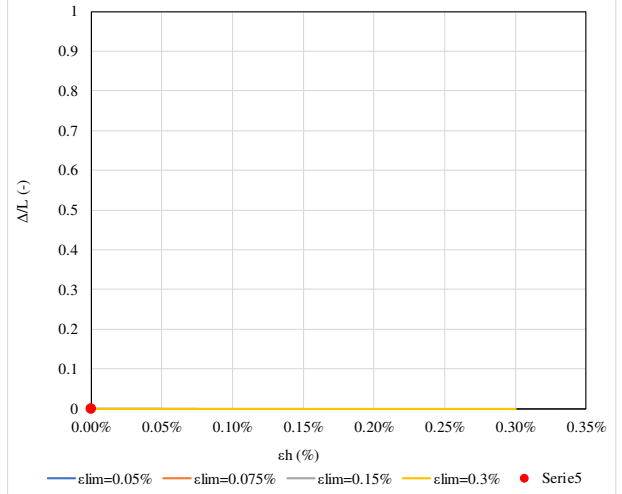
Abaco di danno hogging 1° canna



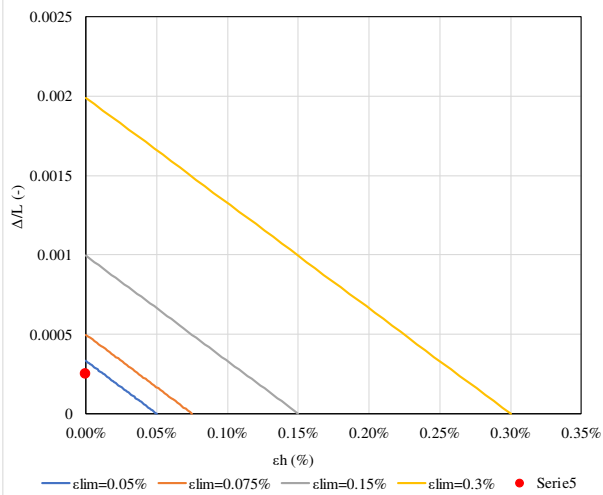
Abaco di danno sagging 1° e 2° canna



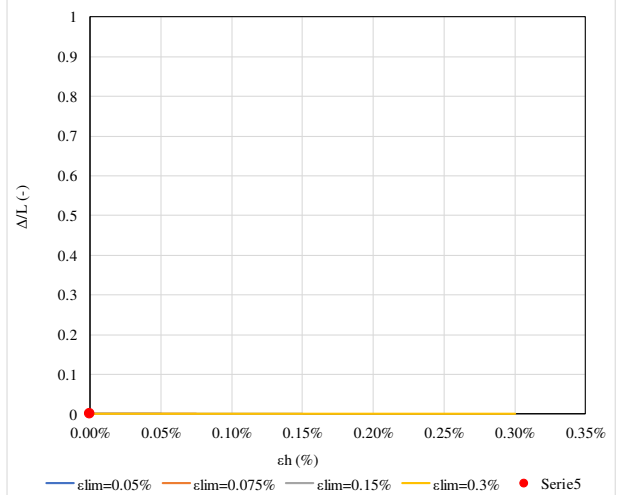
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



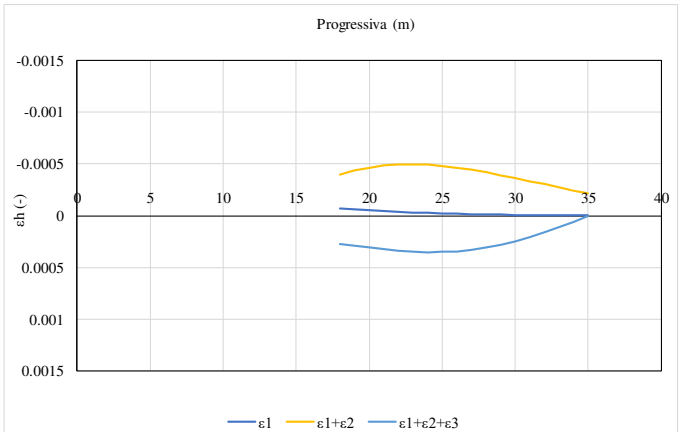
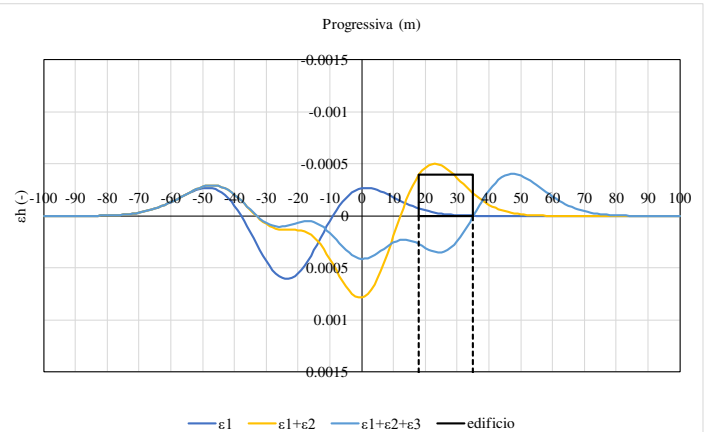
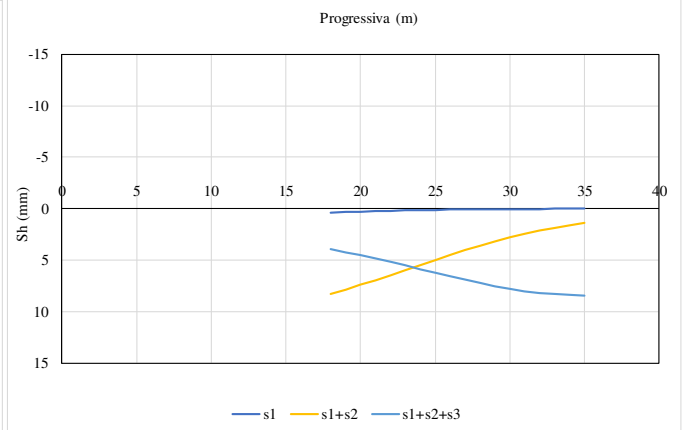
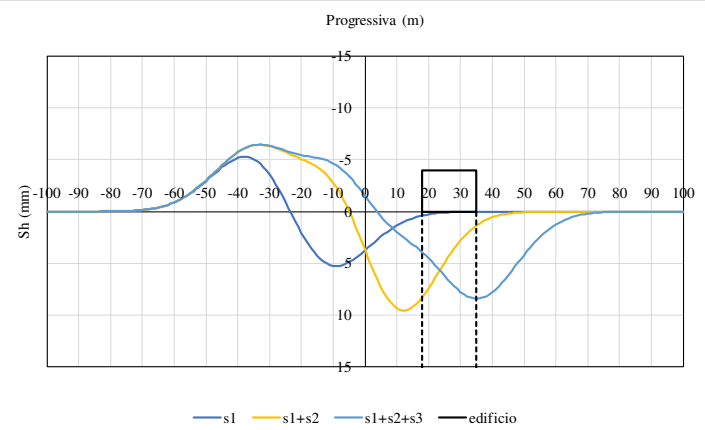
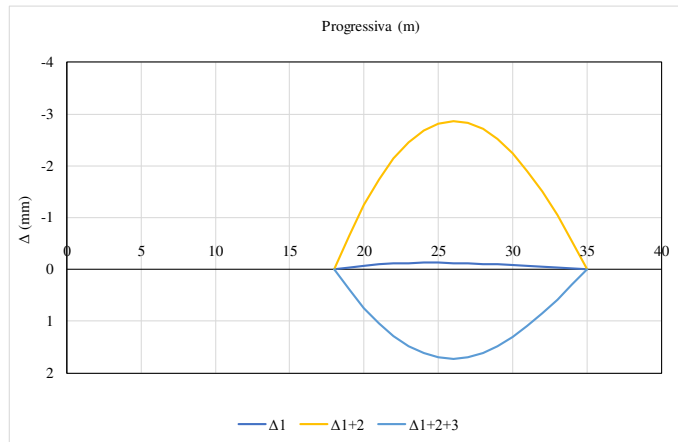
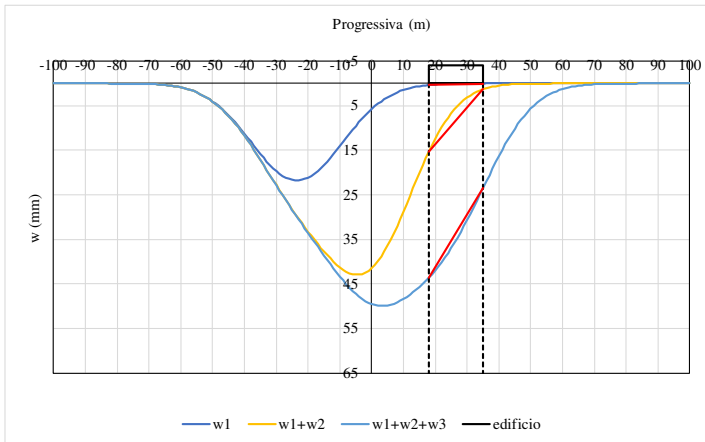
Abaco di danno hogging 1°, 2° e 3° canna



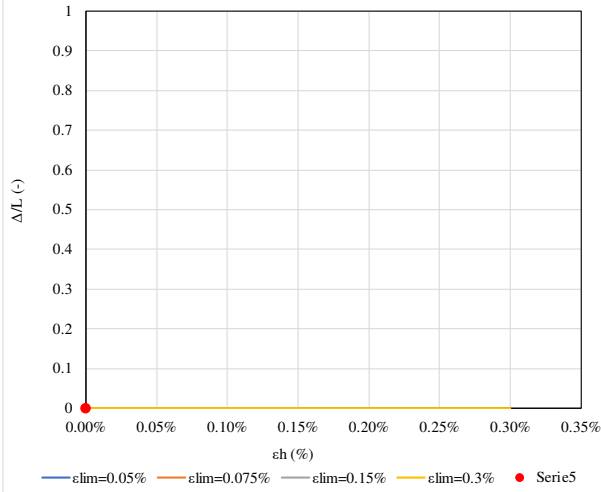
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
6	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.011%
0.001%	0.018%	#DIV/0!

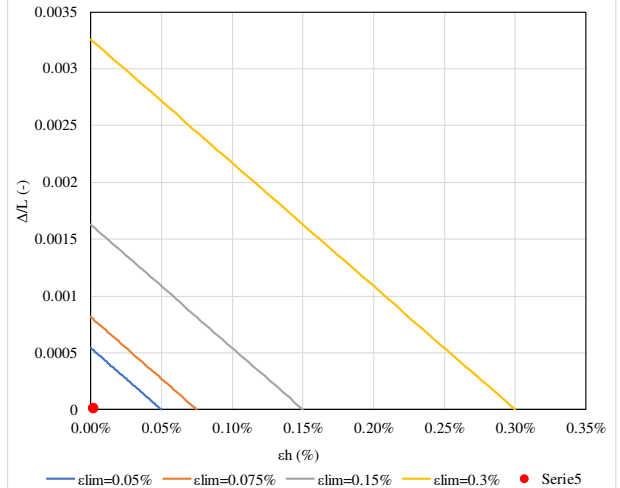
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.002%	-0.041%	#DIV/0!



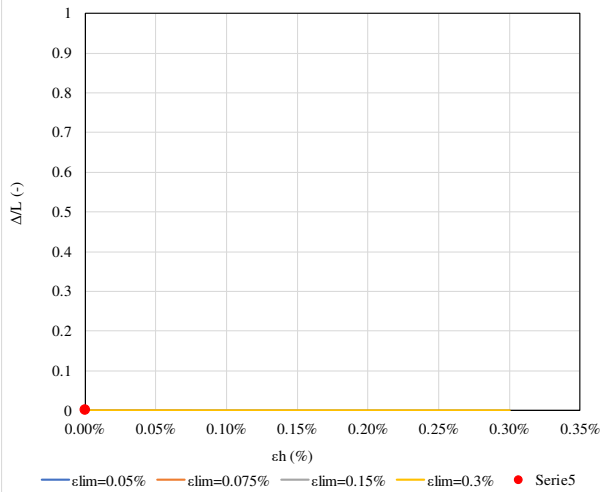
Abaco di danno sagging 1° canna



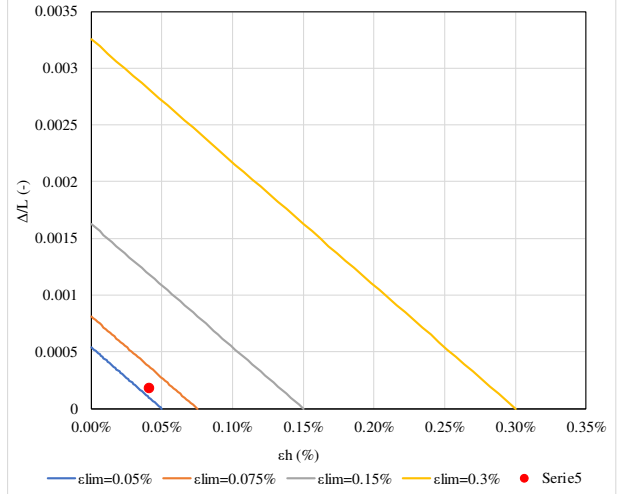
Abaco di danno hogging 1° canna



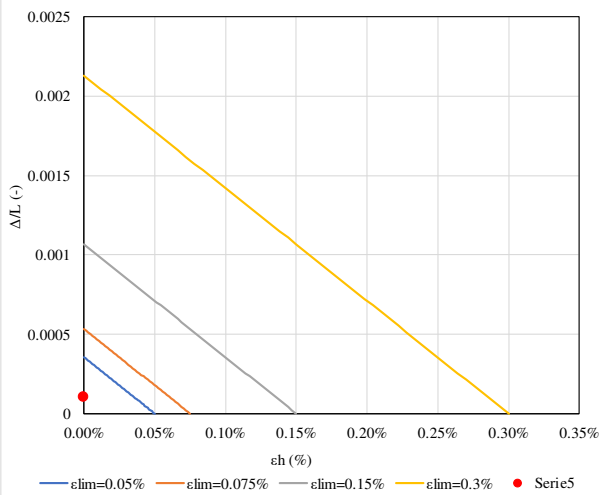
Abaco di danno sagging 1° e 2° canna



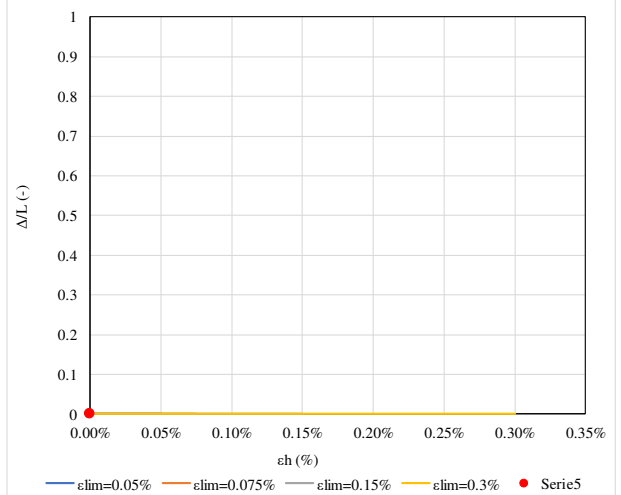
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



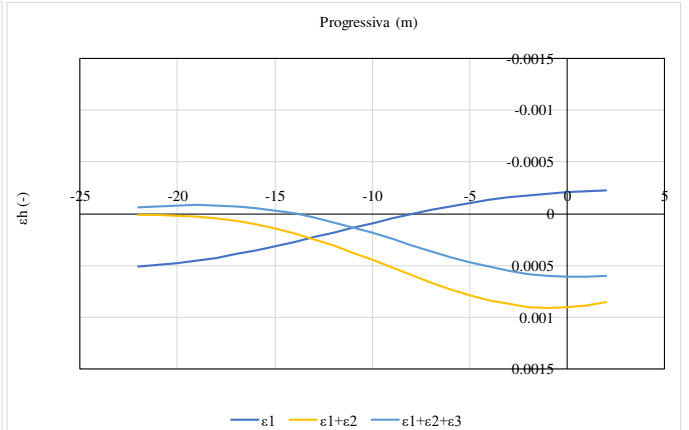
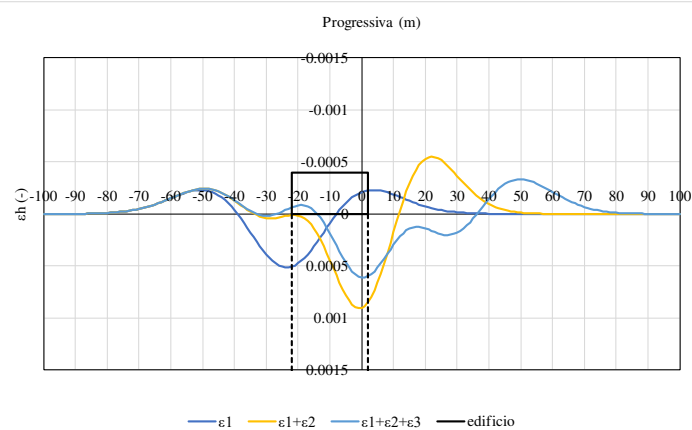
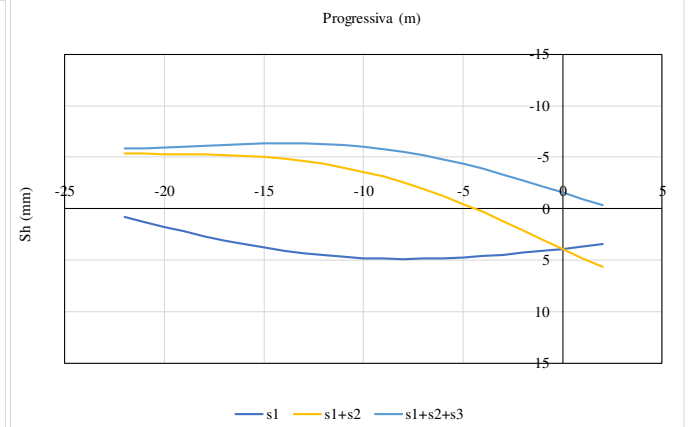
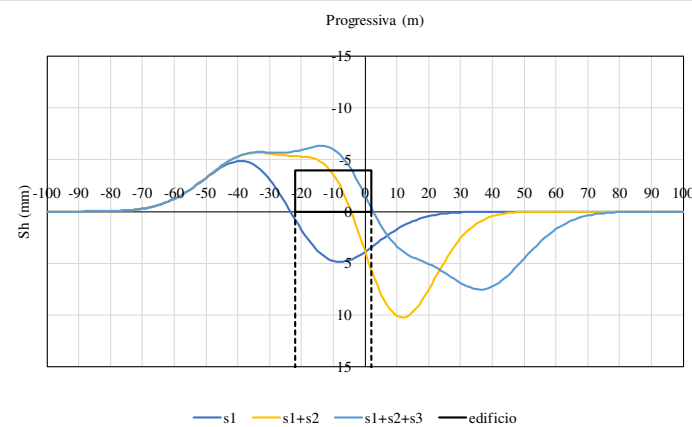
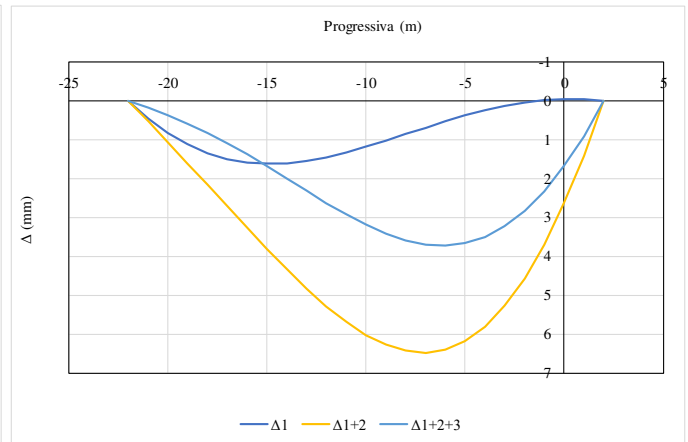
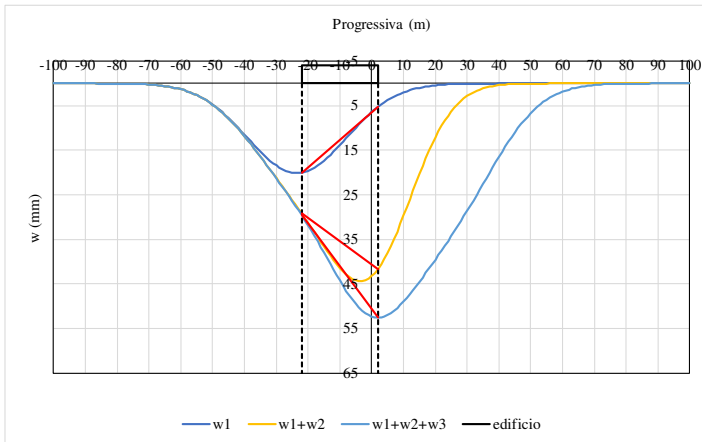
Abaco di danno hogging 1°, 2° e 3° canna

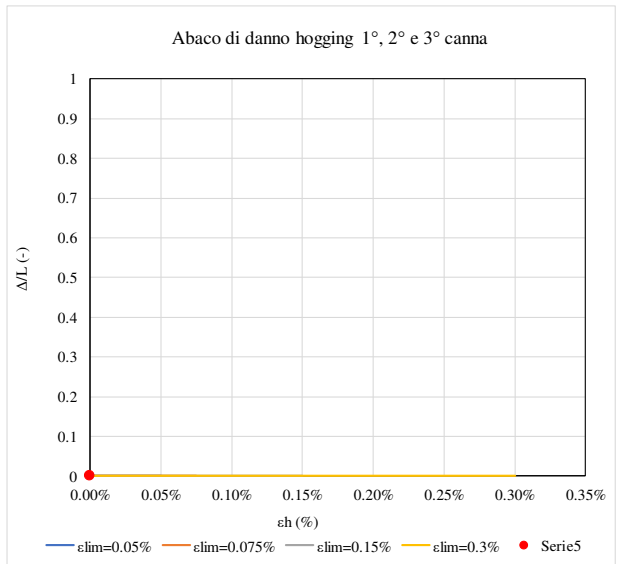
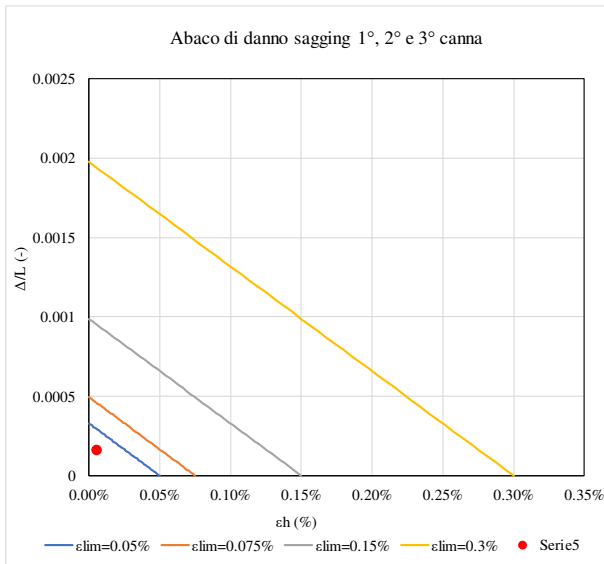
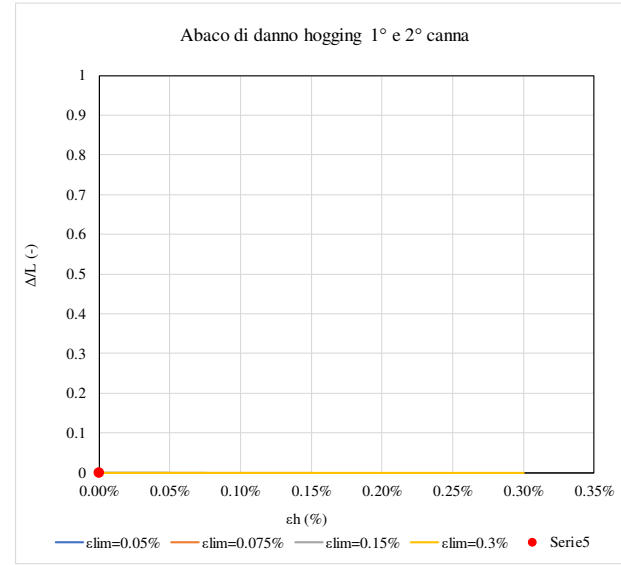
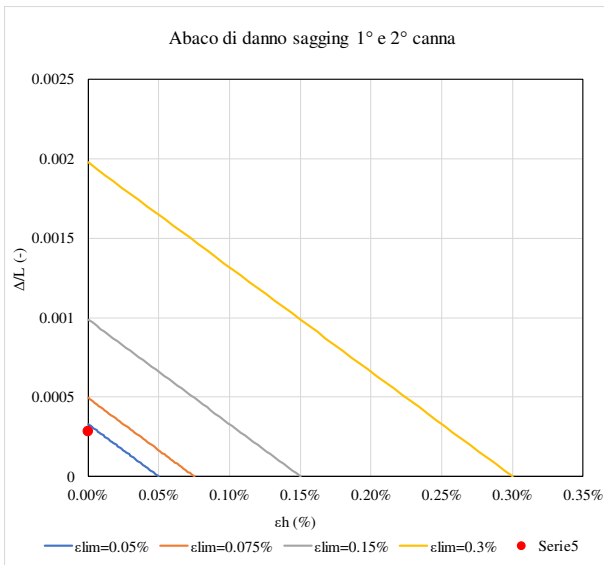
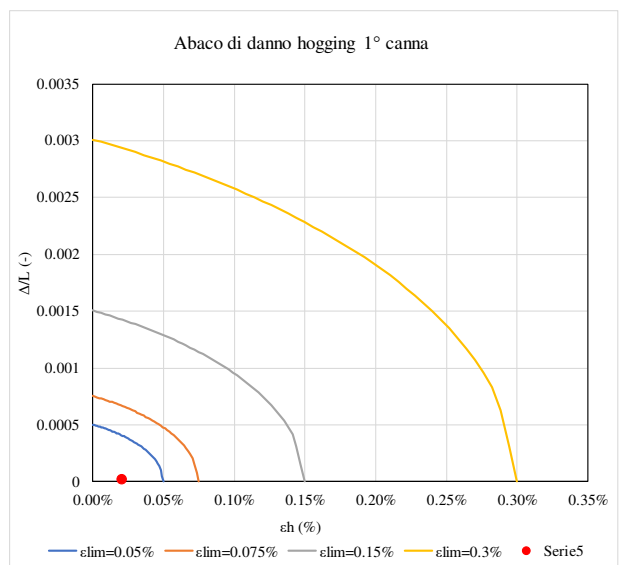
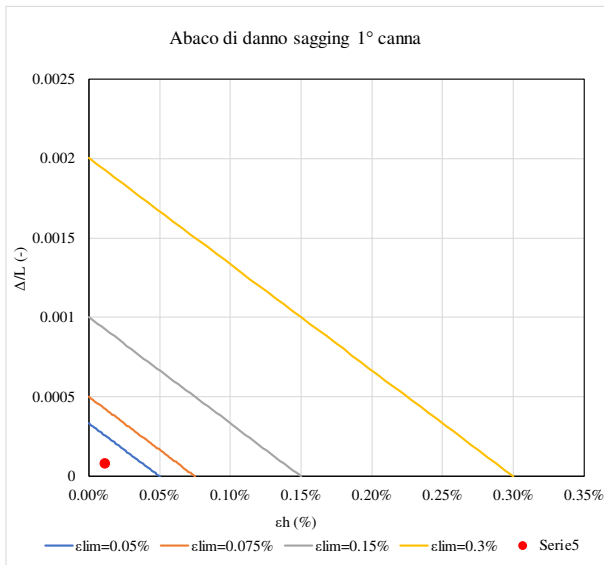


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
7	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.008%	0.028%	0.016%
0.002%	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.011%	#DIV/0!	-0.006%
-0.021%	#DIV/0!	#DIV/0!

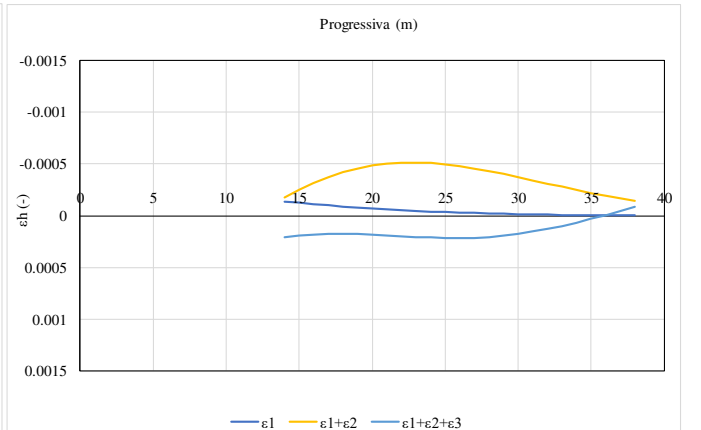
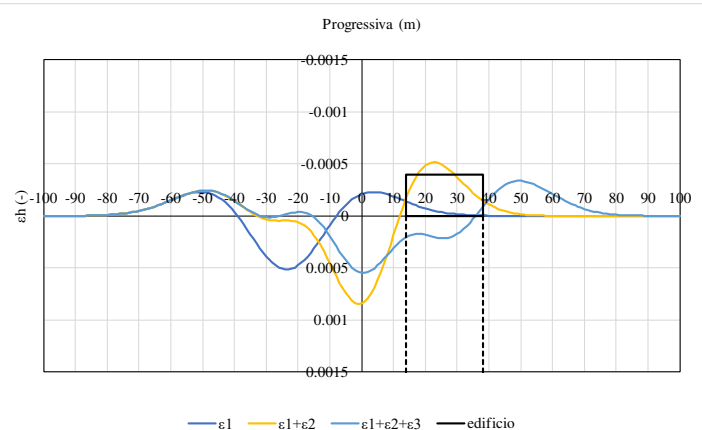
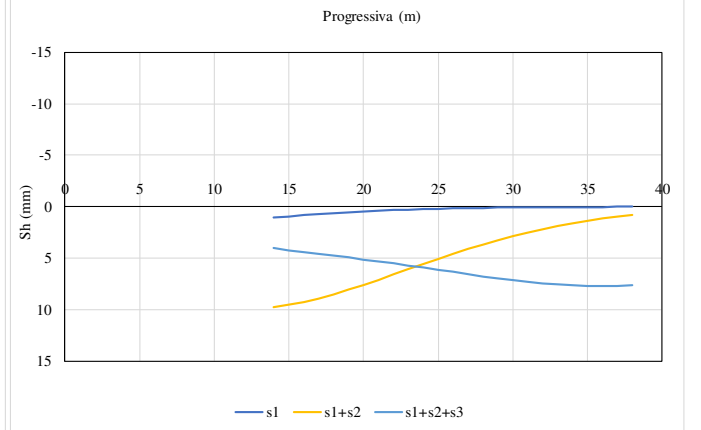
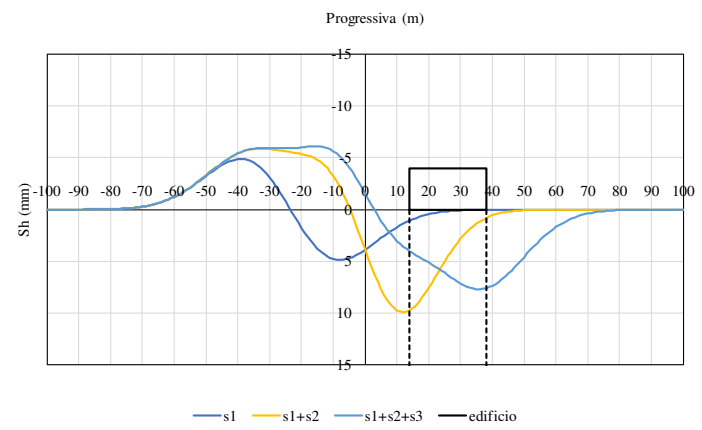
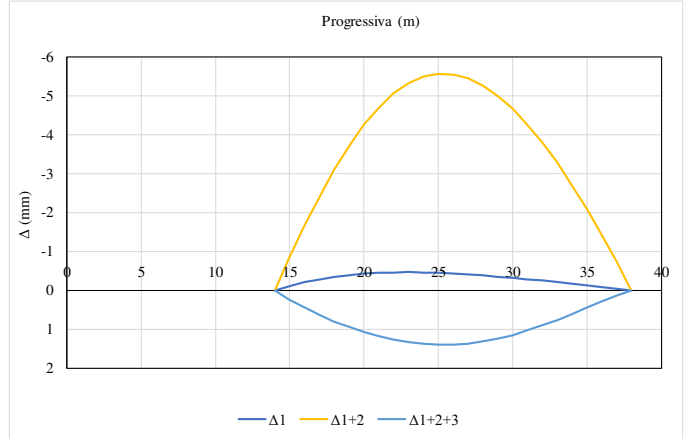
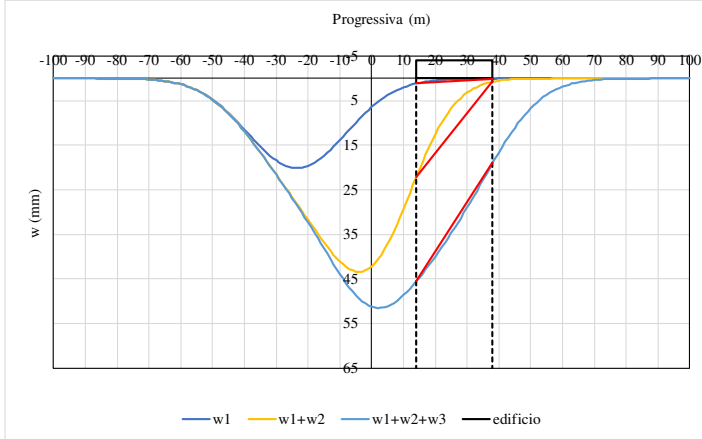


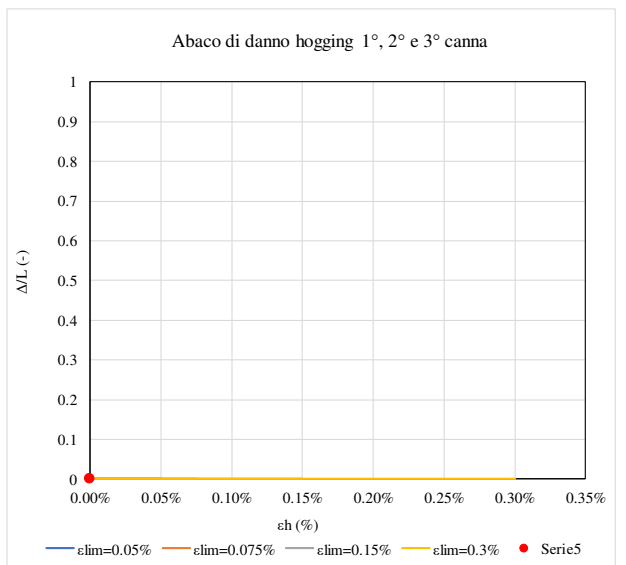
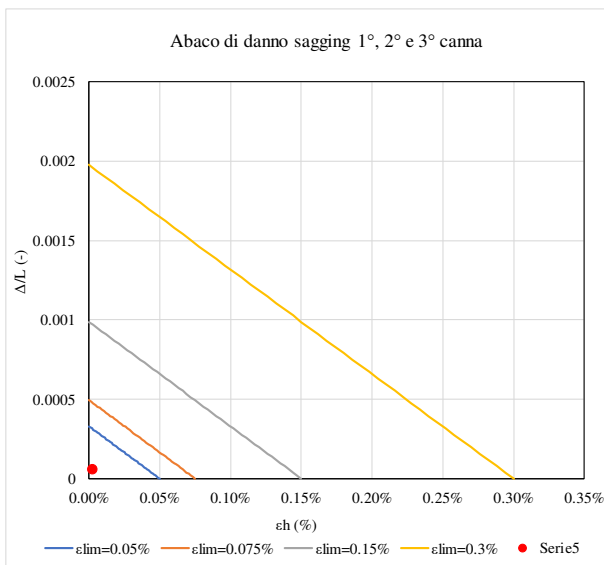
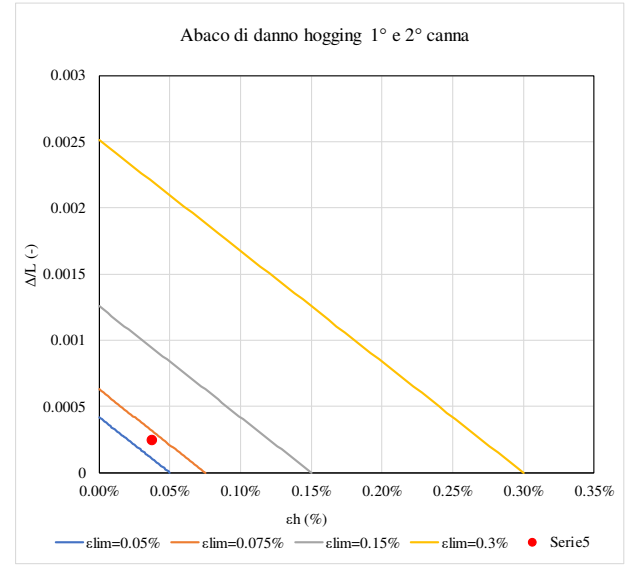
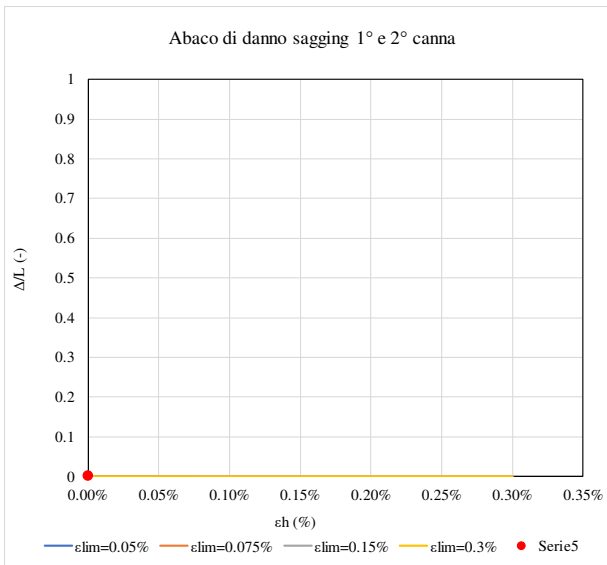
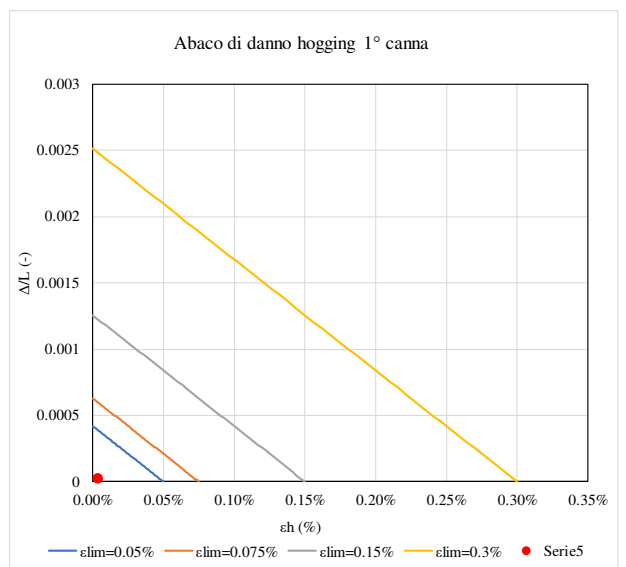
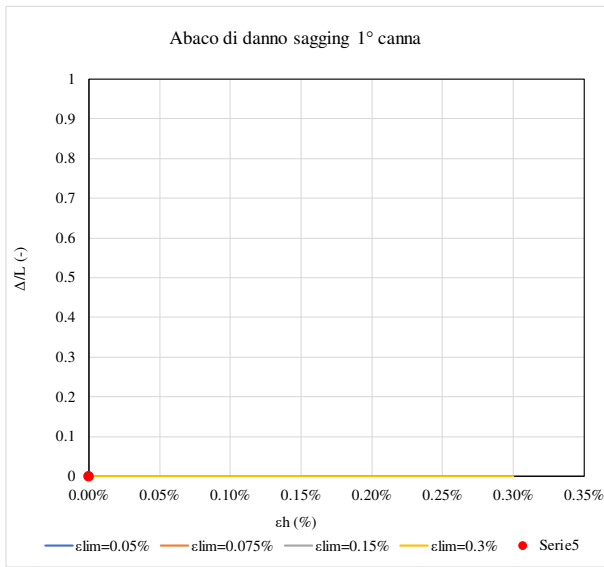


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
8	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	0.006%
0.002%	0.024%	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	-0.003%
-0.004%	-0.038%	#DIV/0!



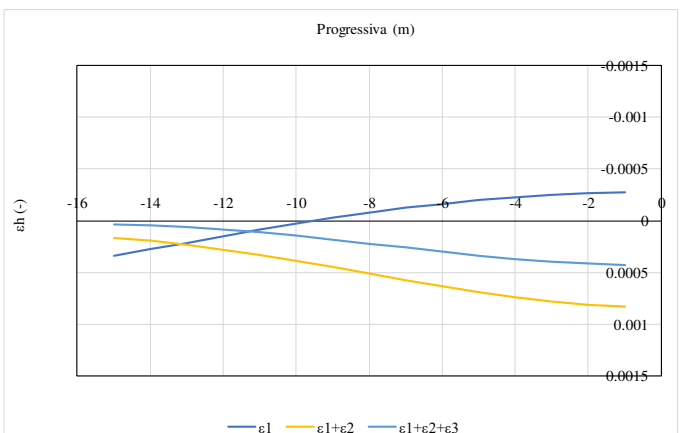
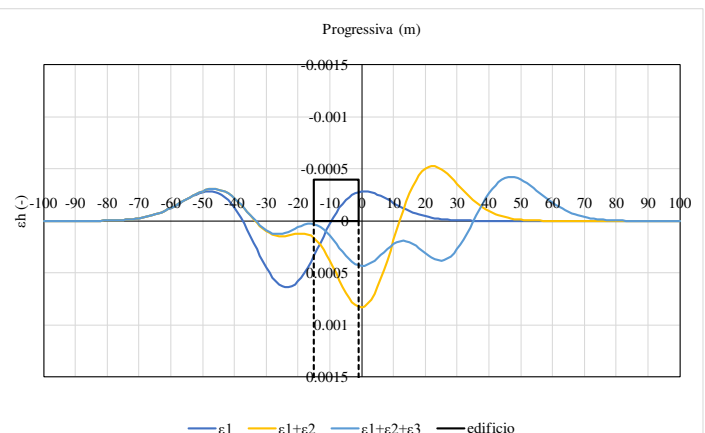
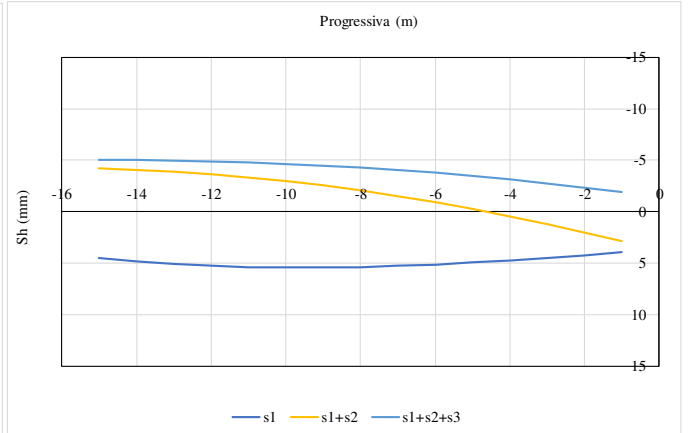
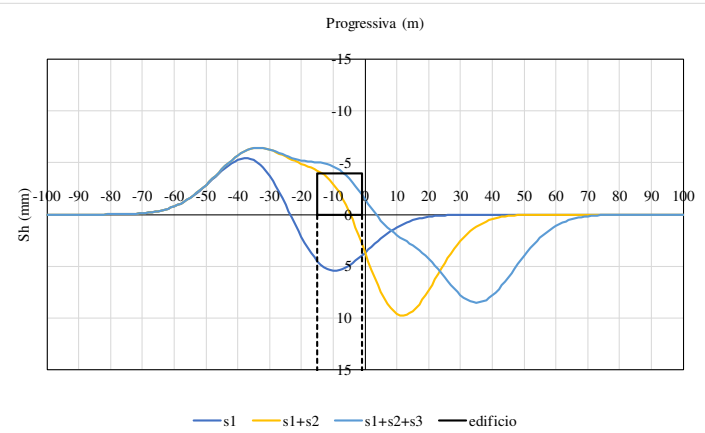
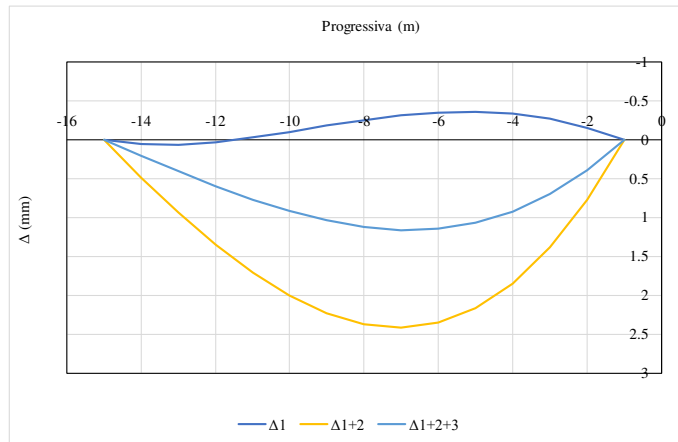
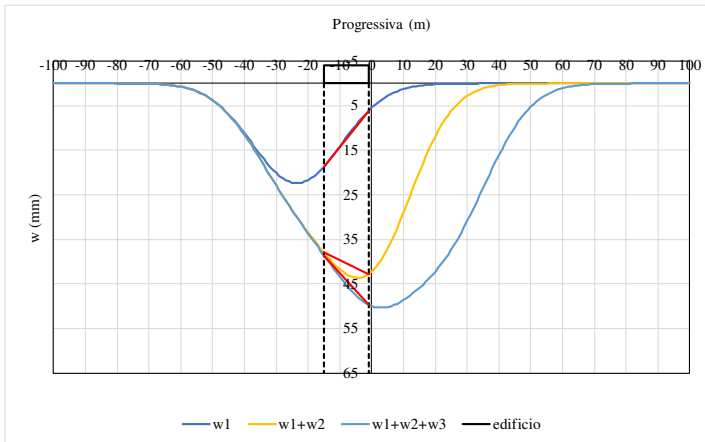


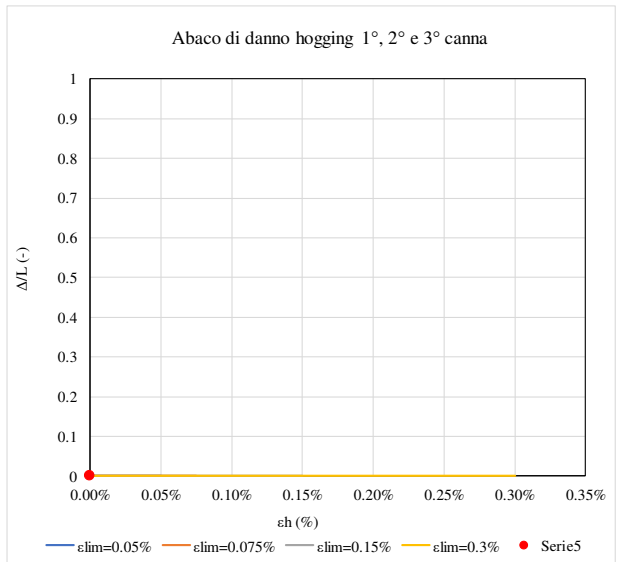
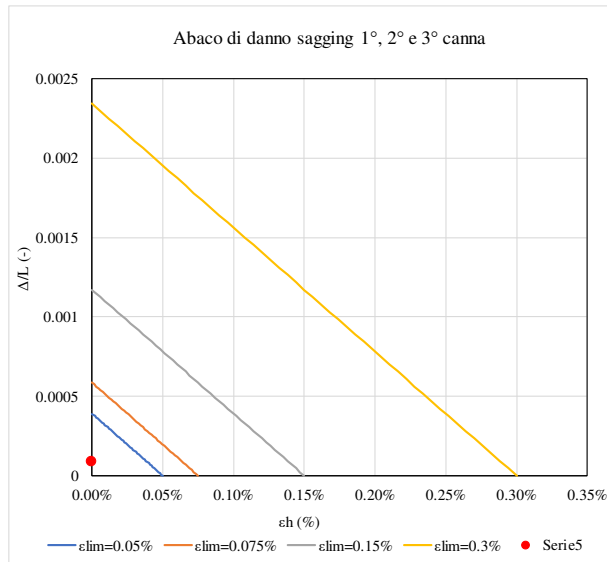
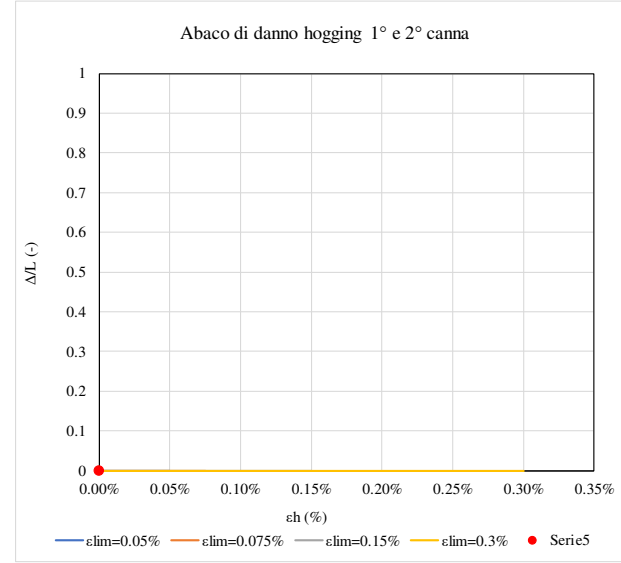
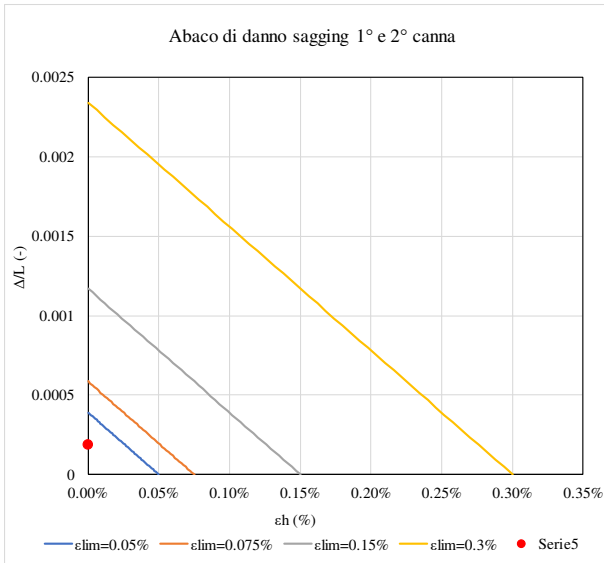
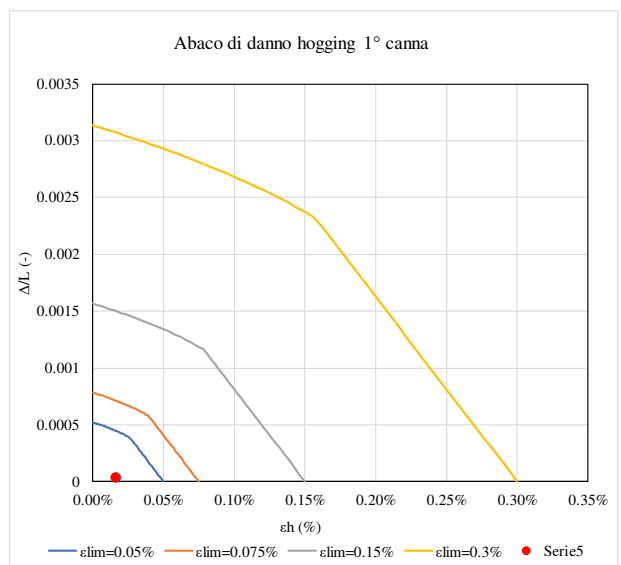
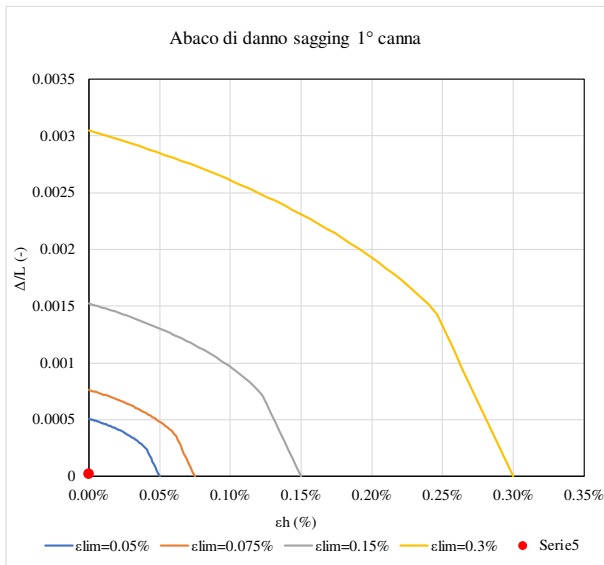


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
9	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.002%	0.019%	0.009%
0.004%	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.017%	#DIV/0!	#DIV/0!

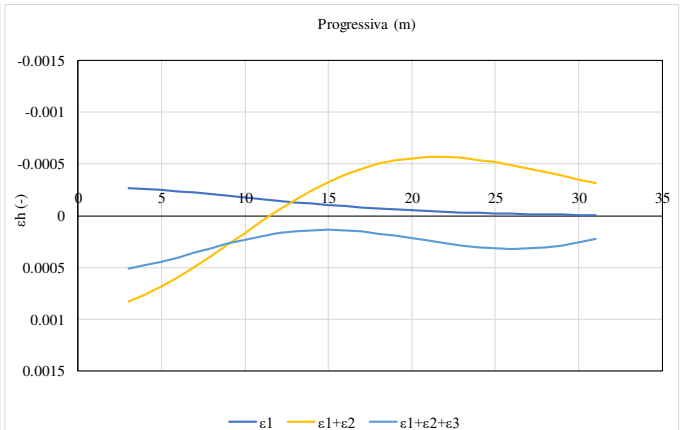
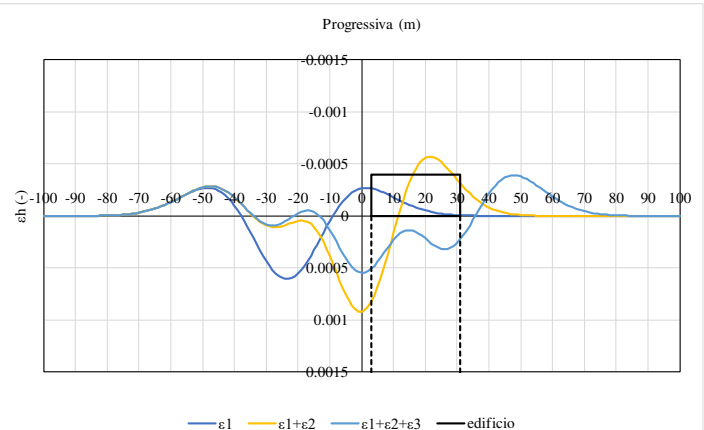
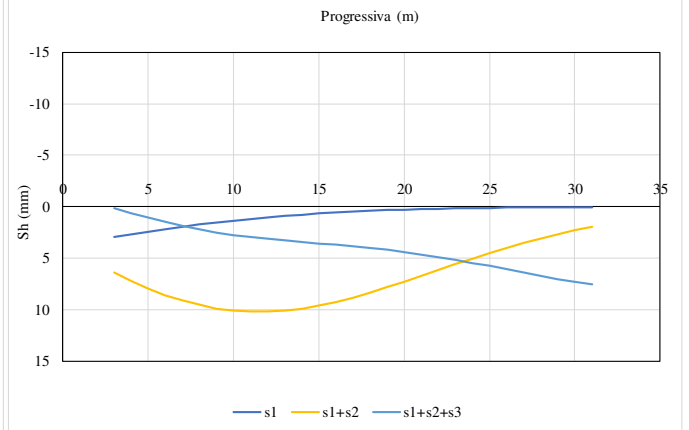
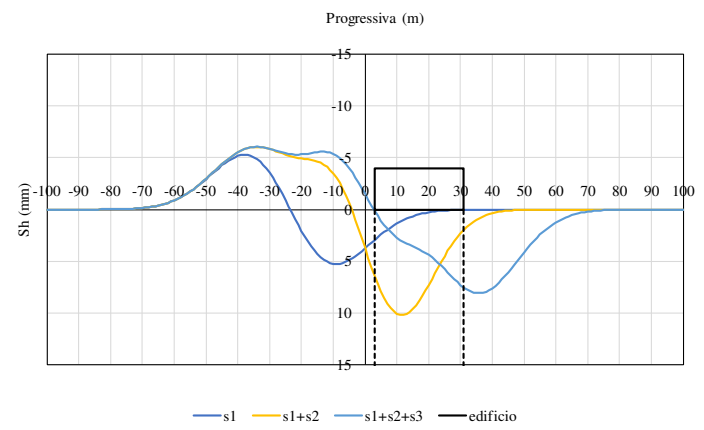
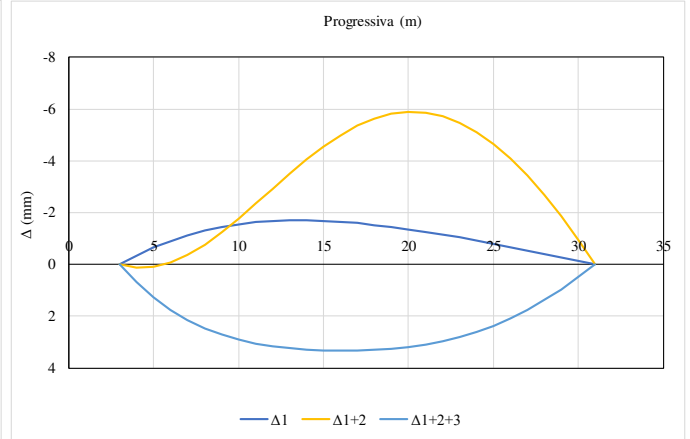
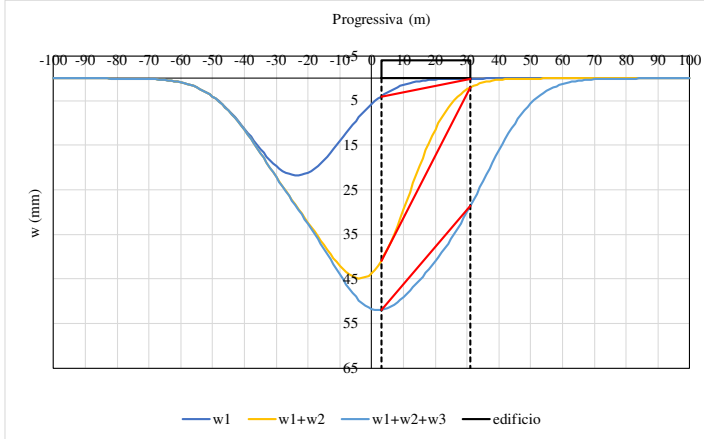


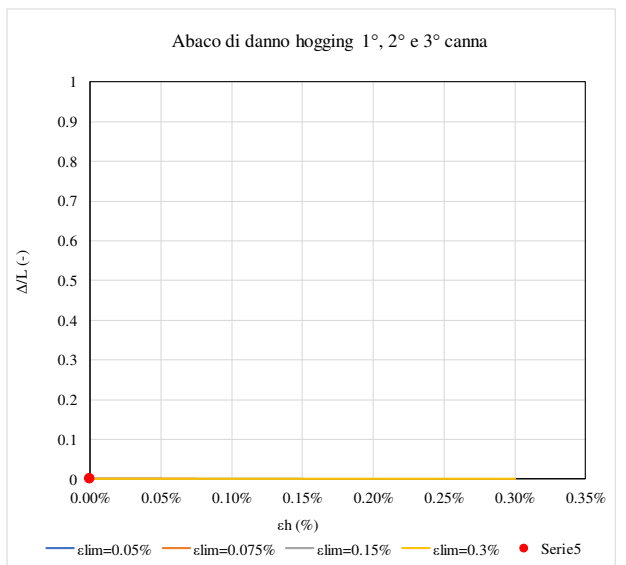
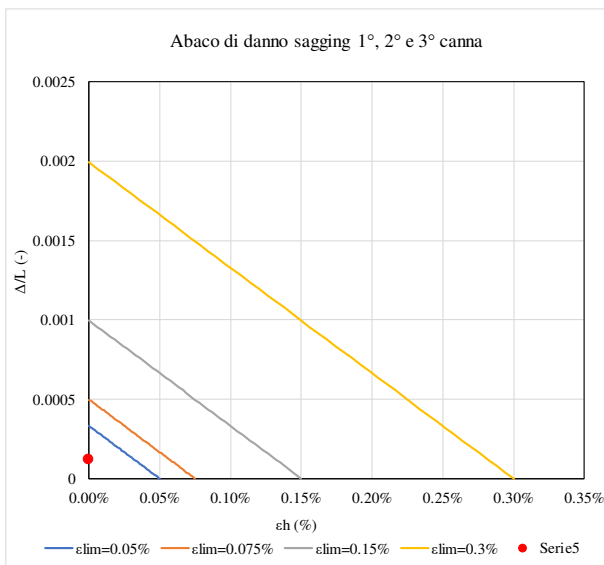
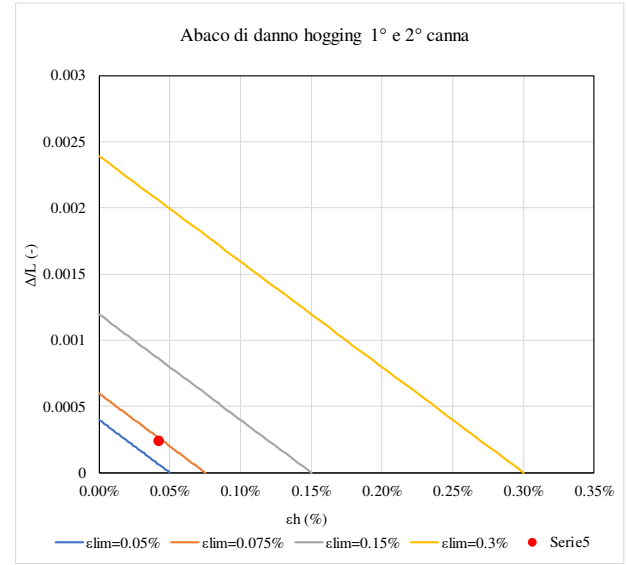
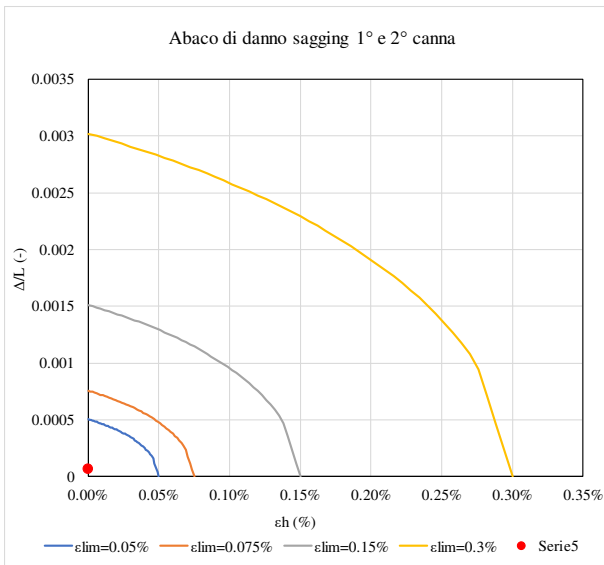
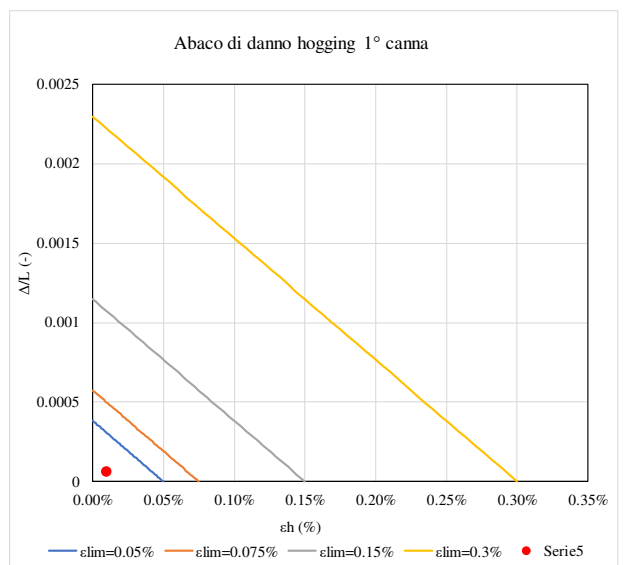
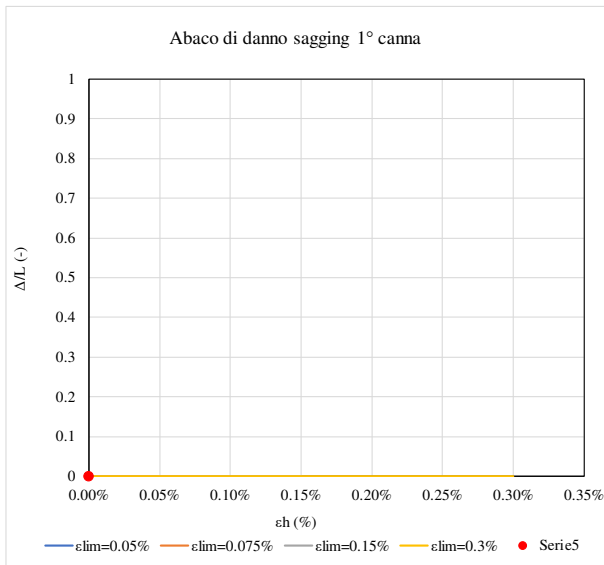


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
10	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.006%	0.012%
0.006%	0.024%	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.010%	-0.042%	#DIV/0!

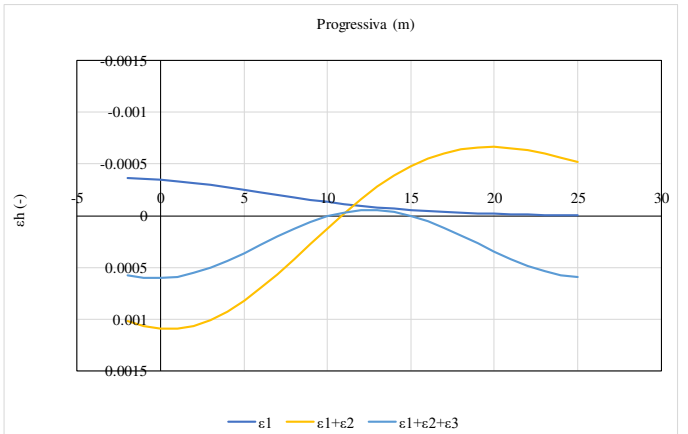
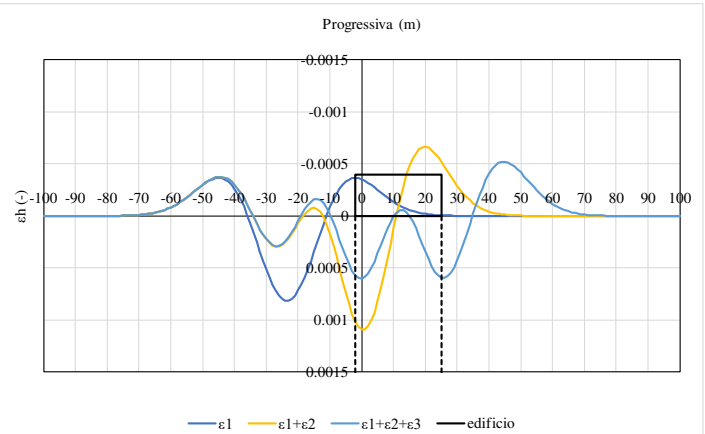
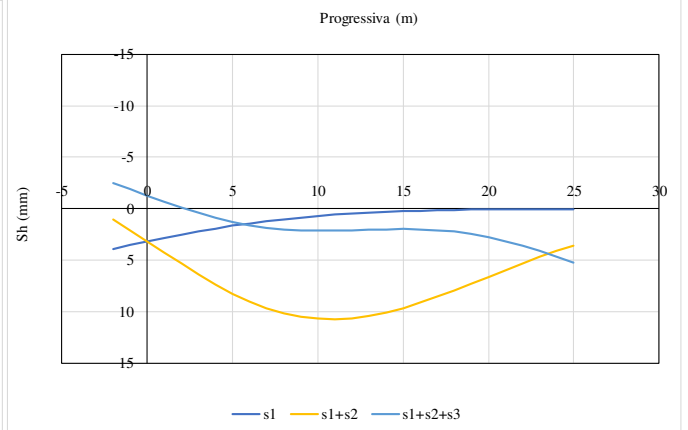
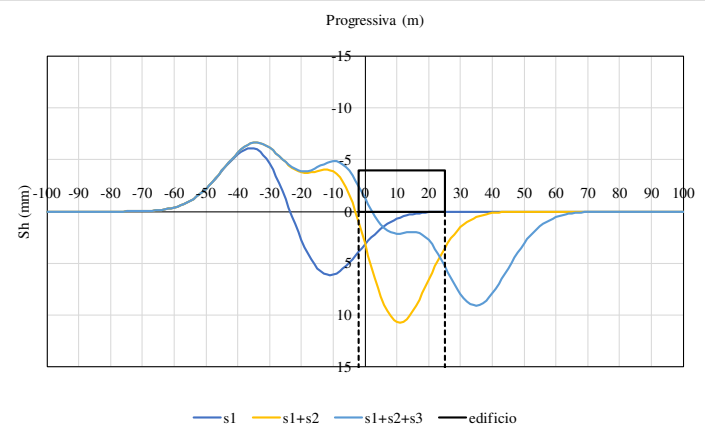
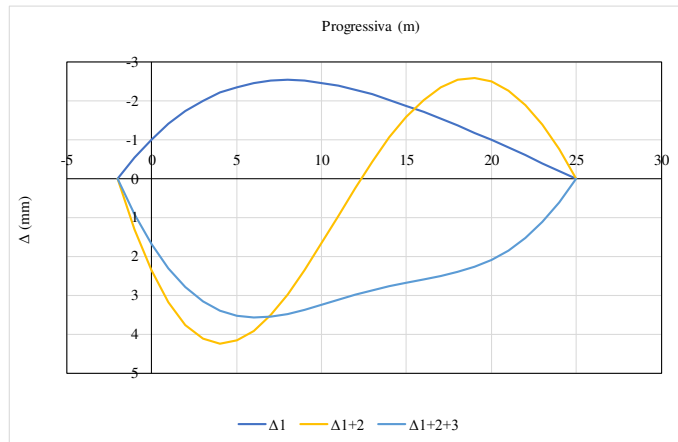
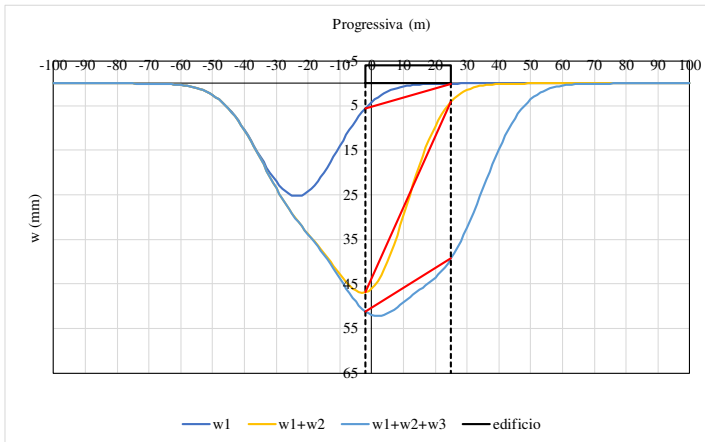




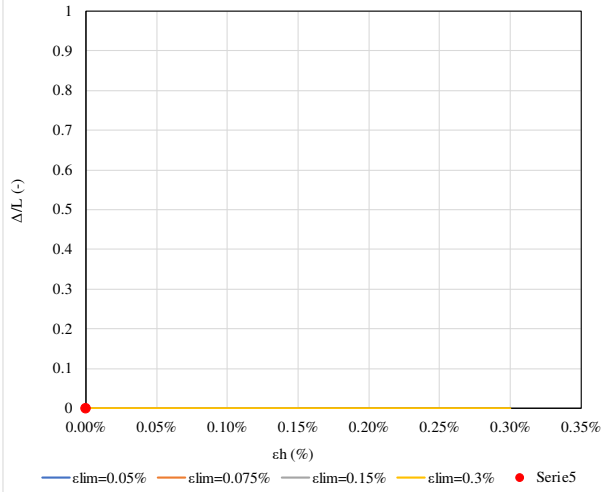
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
11	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	0.030%	0.014%
0.010%	0.022%	#DIV/0!

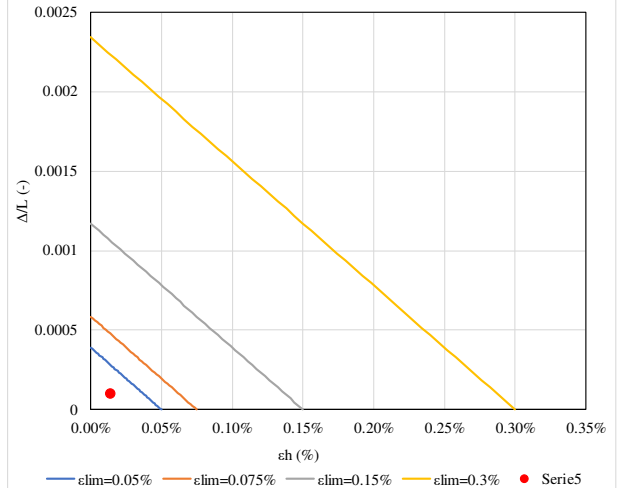
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.009%	-0.004%
-0.014%	-0.056%	#DIV/0!



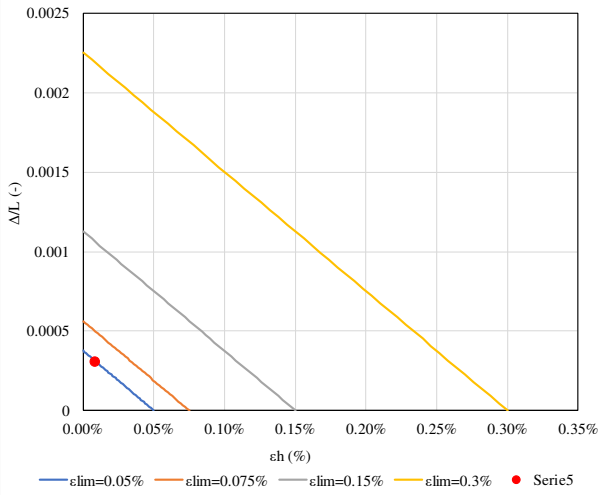
Abaco di danno sagging 1° canna



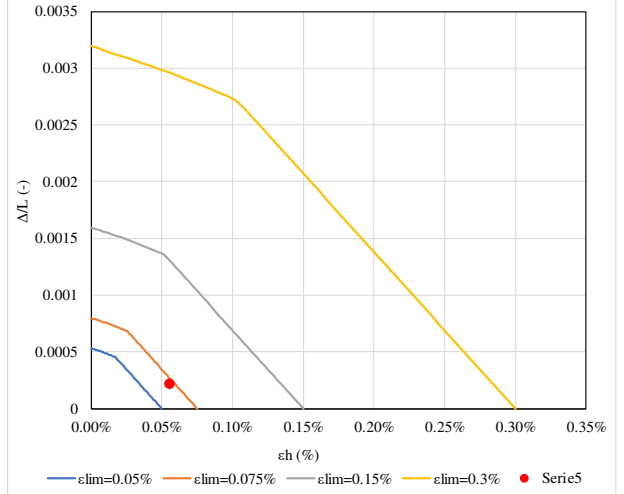
Abaco di danno hogging 1° canna



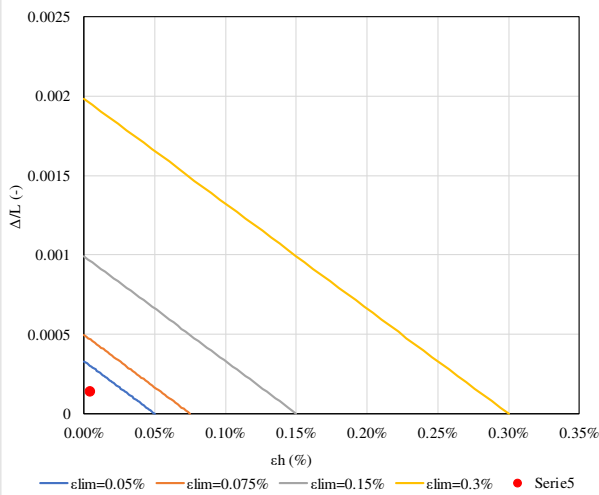
Abaco di danno sagging 1° e 2° canna



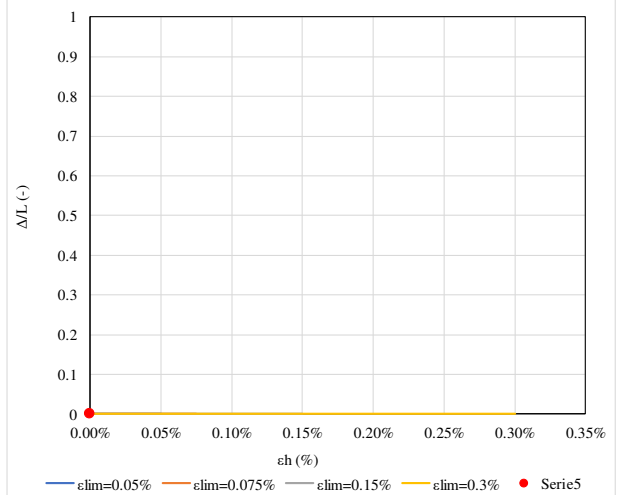
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



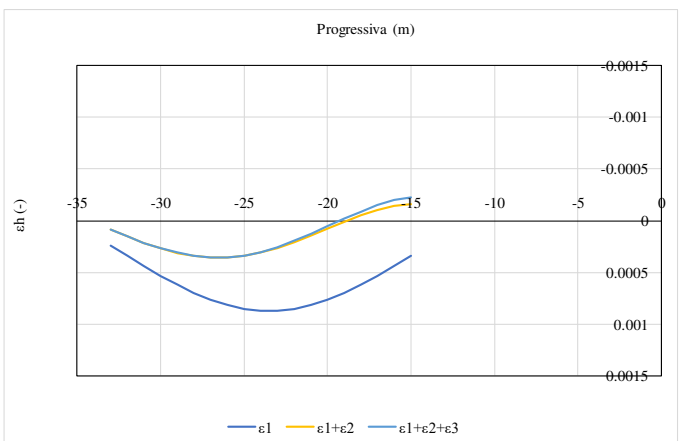
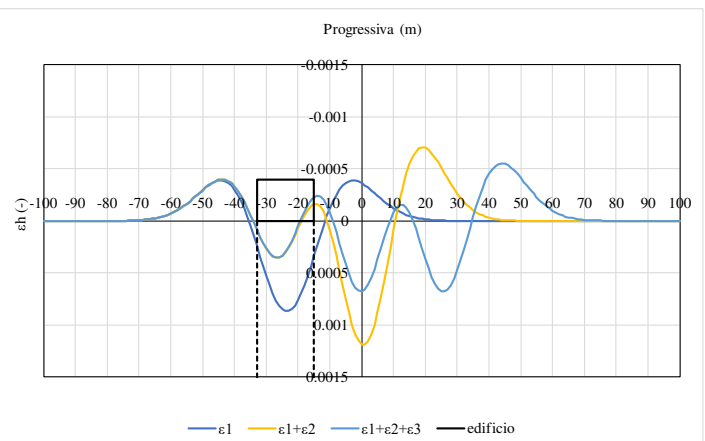
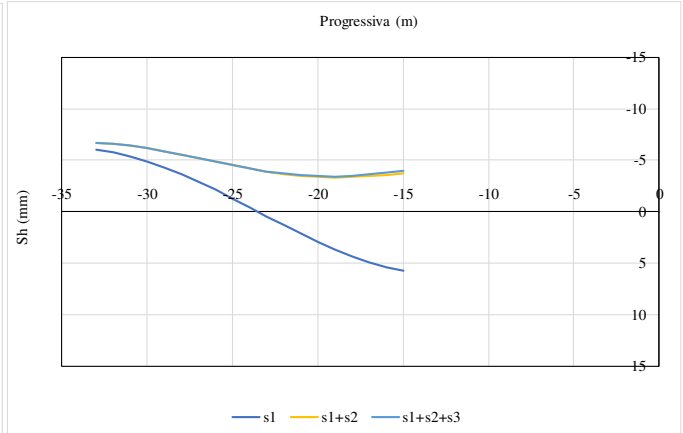
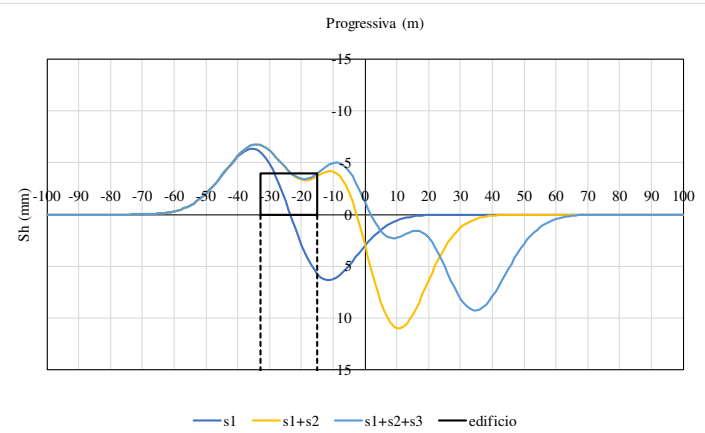
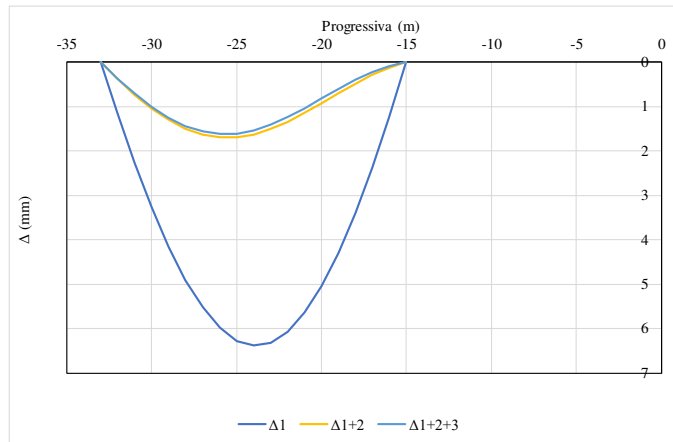
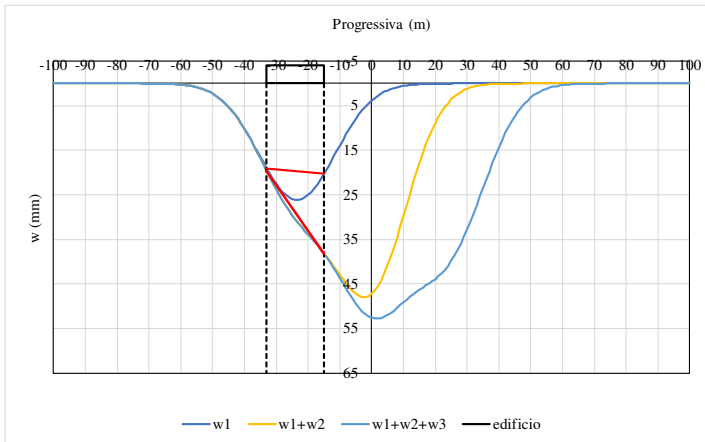
Abaco di danno hogging 1°, 2° e 3° canna

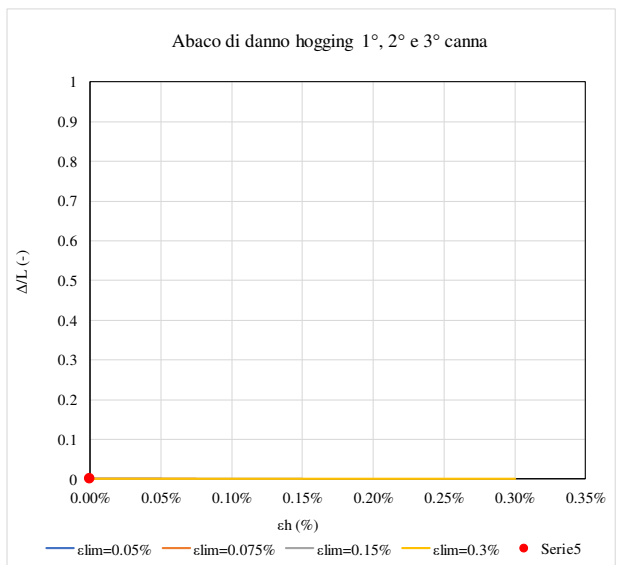
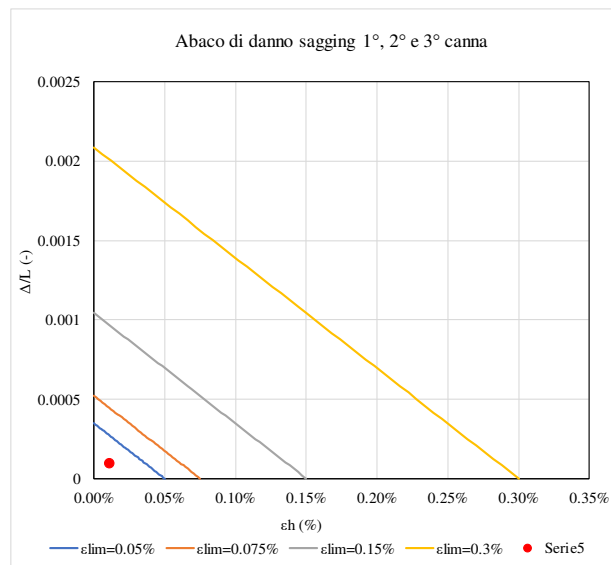
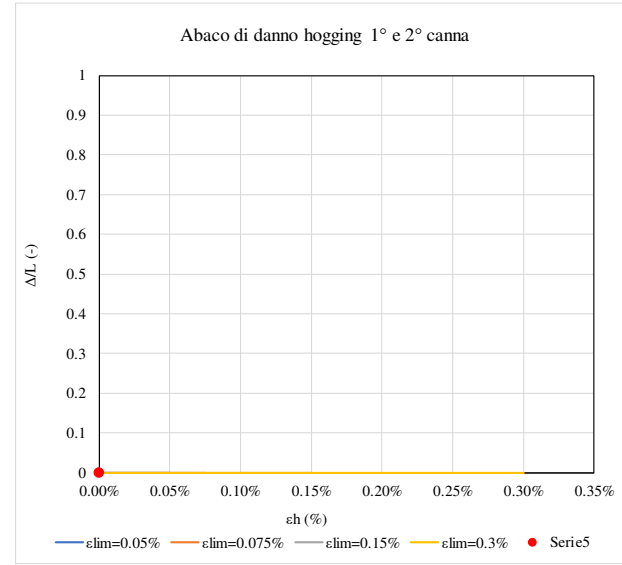
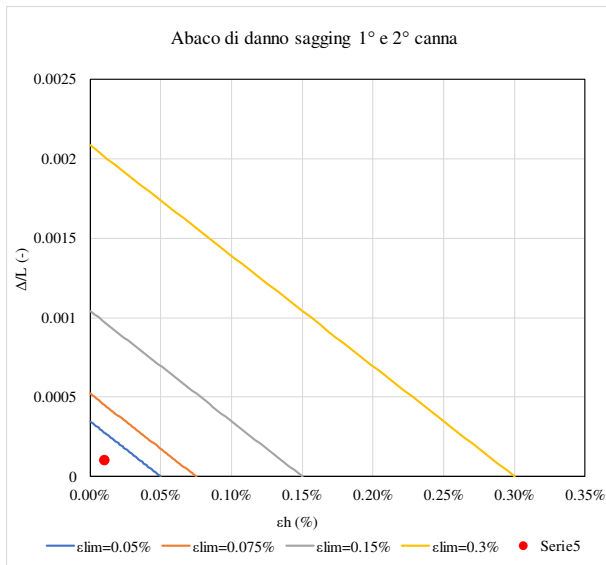
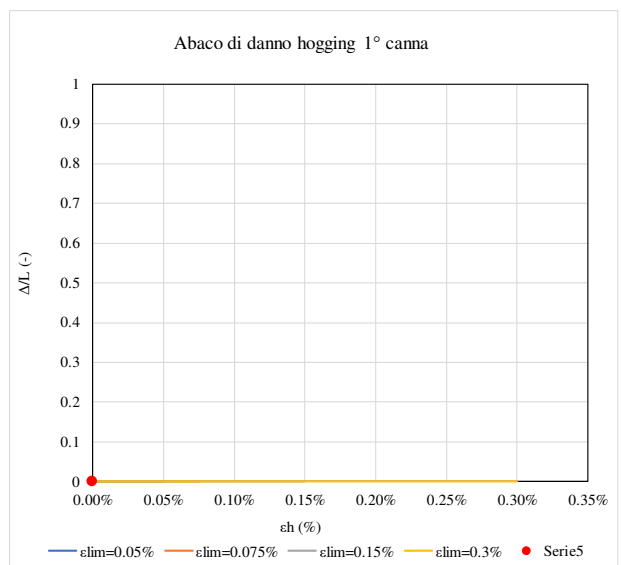
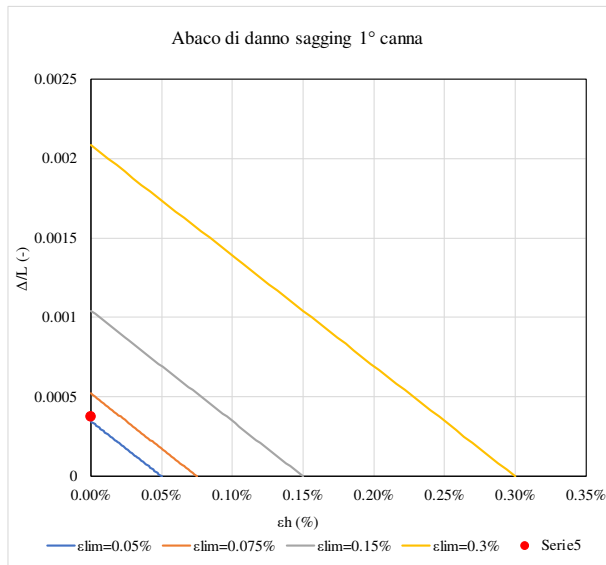


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
11bis	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.038%	0.010%	0.010%
#DIV/0!	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	-0.010%	-0.011%
#DIV/0!	#DIV/0!	#DIV/0!



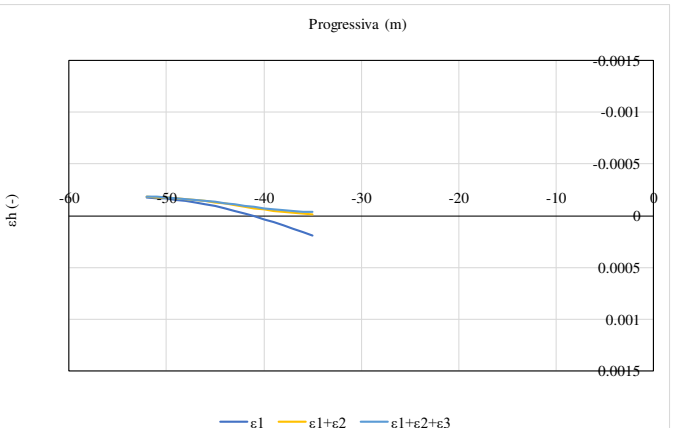
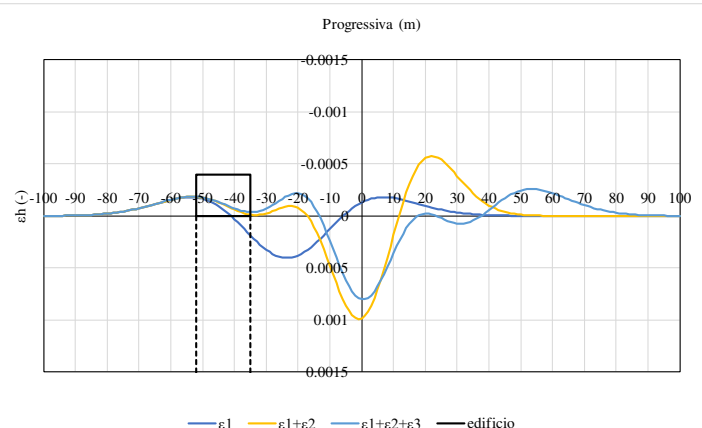
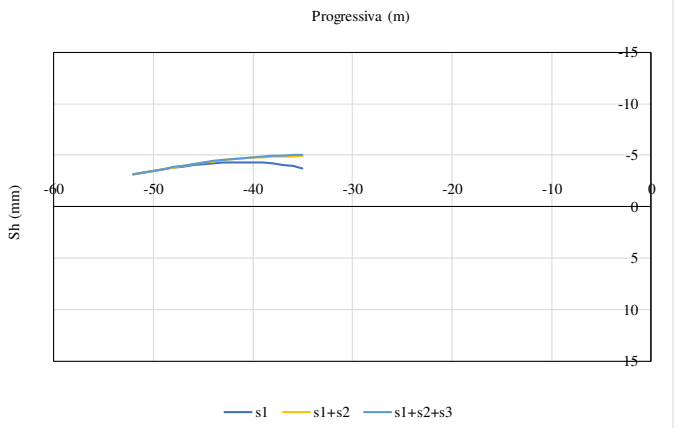
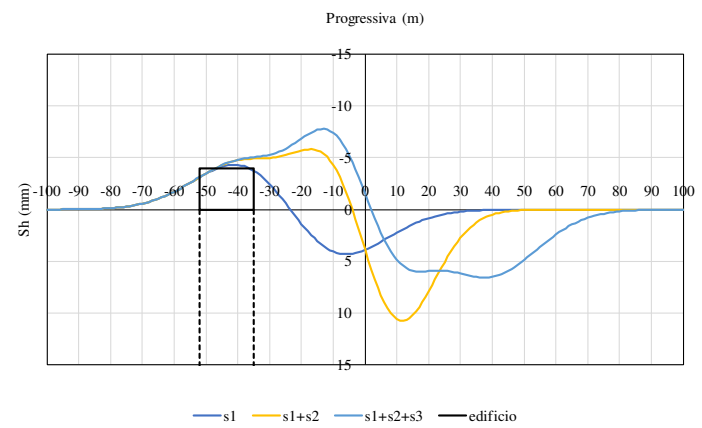
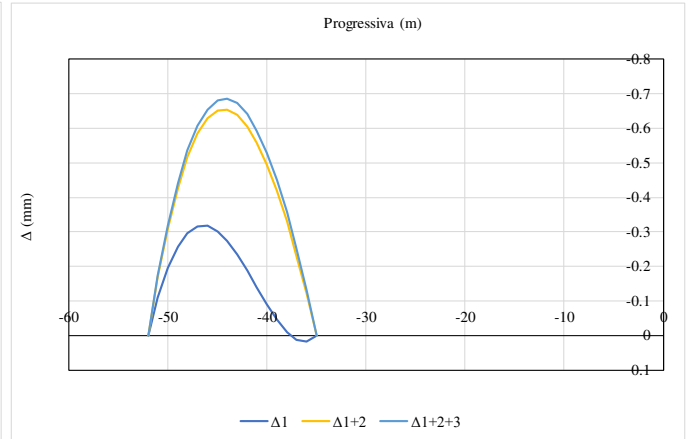
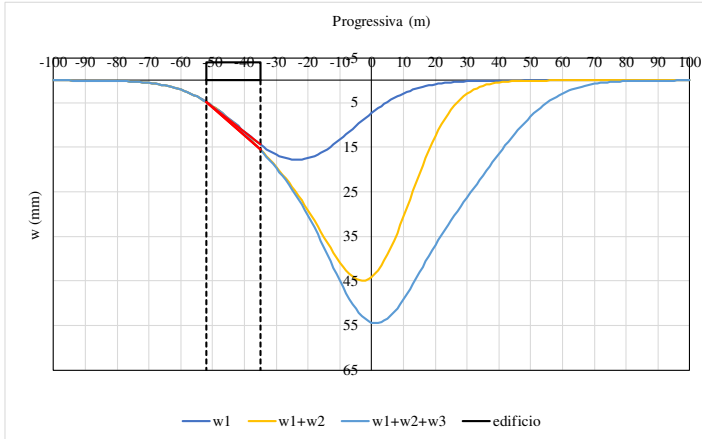


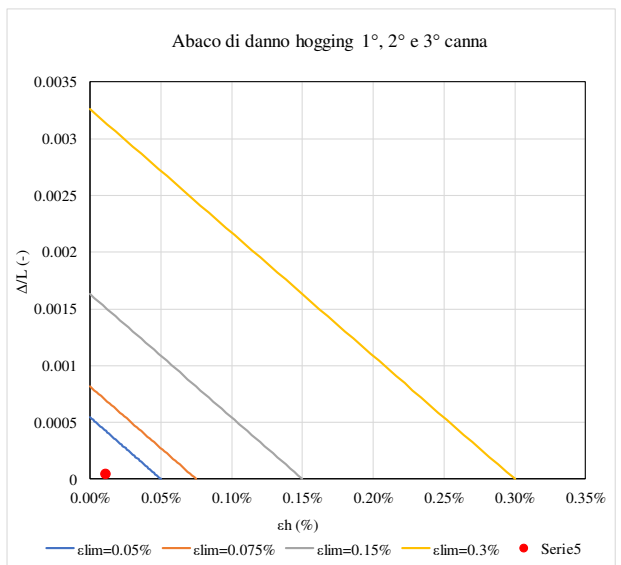
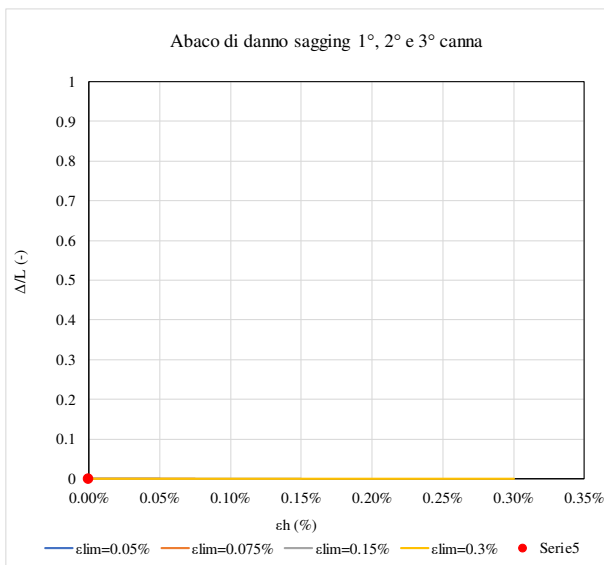
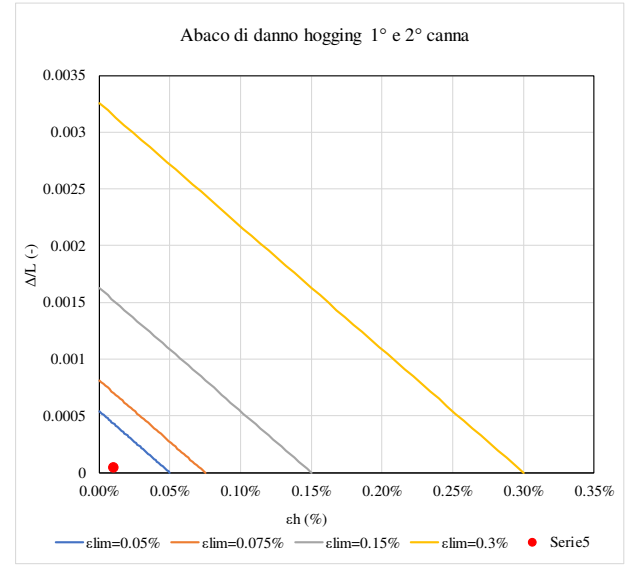
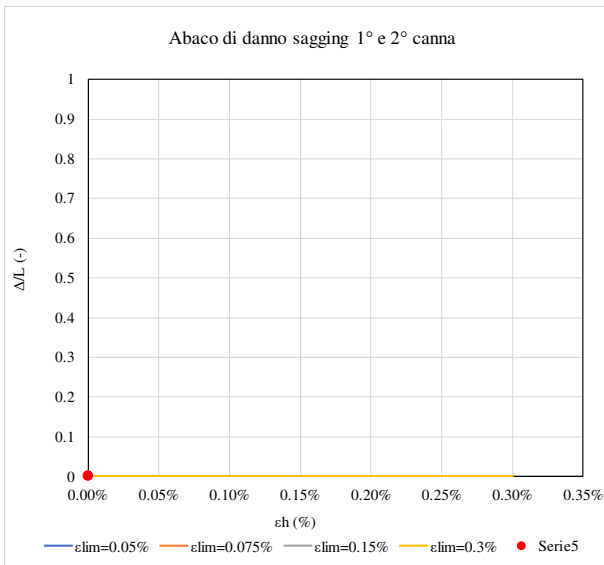
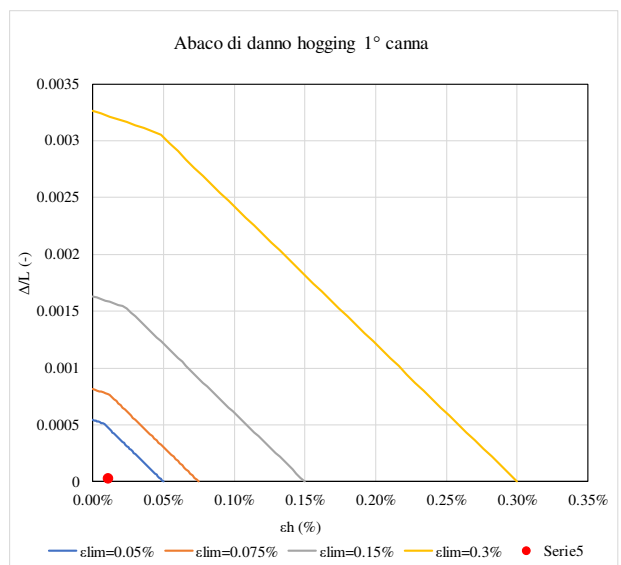
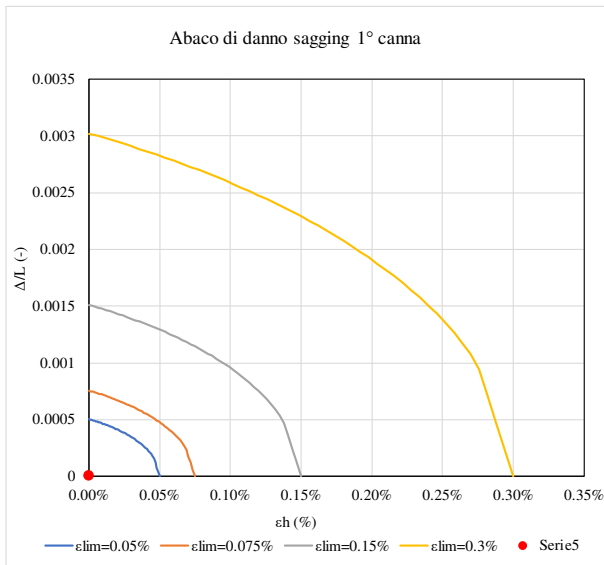


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
101	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.001%	#DIV/0!	#DIV/0!
0.002%	0.004%	0.004%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.011%	-0.011%	-0.011%

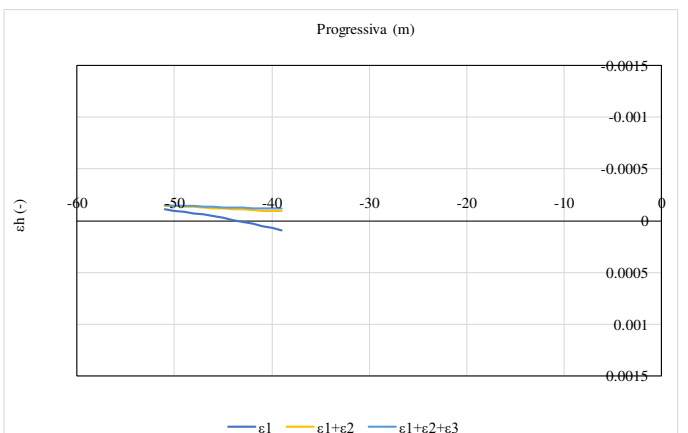
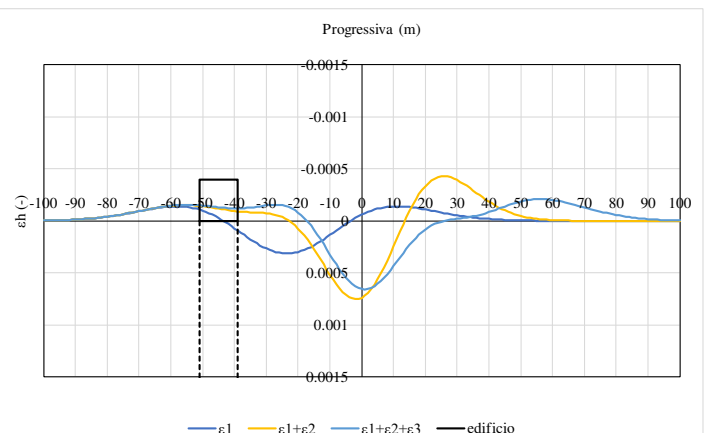
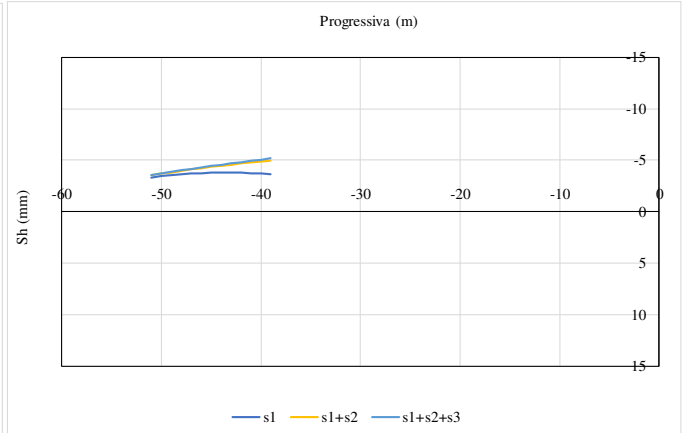
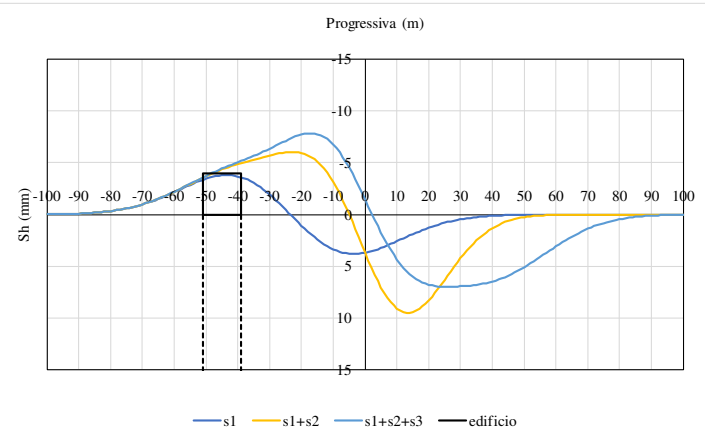
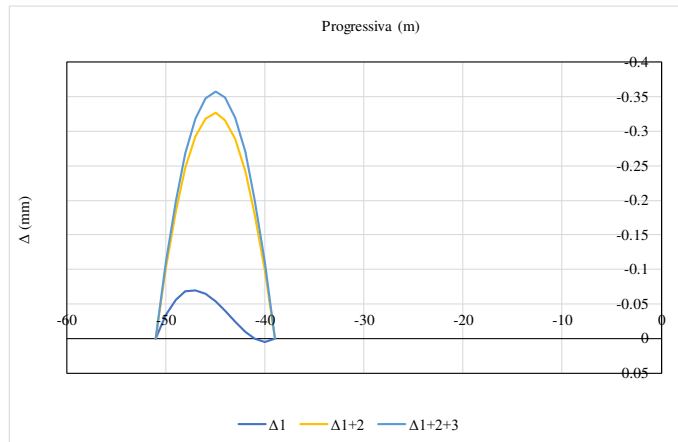
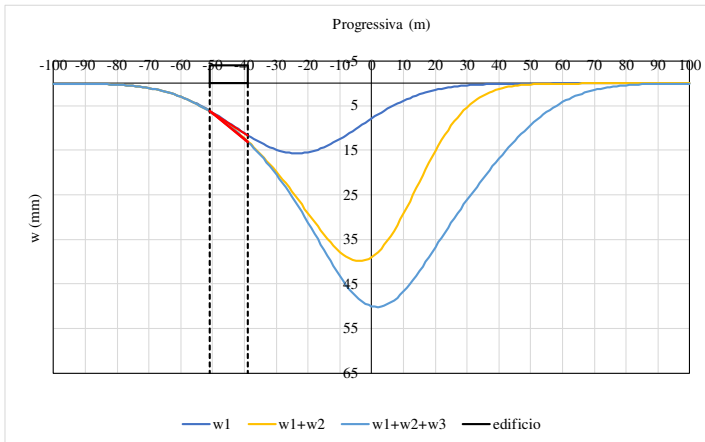


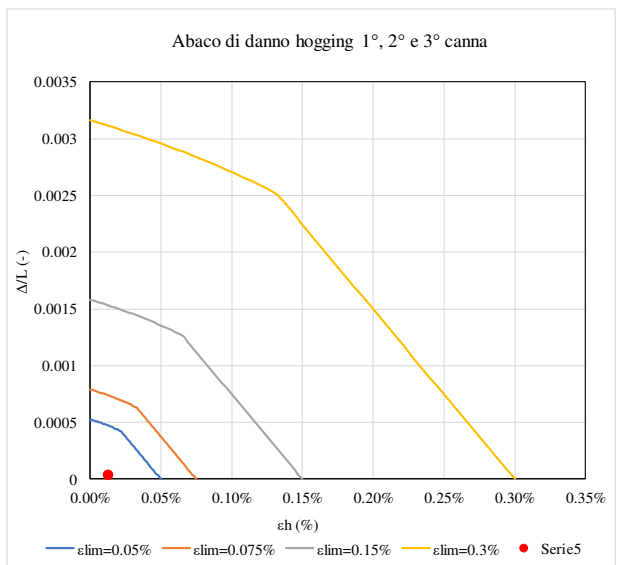
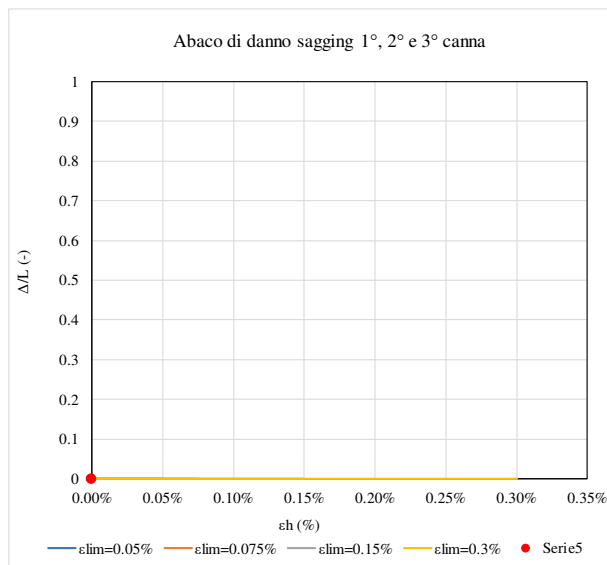
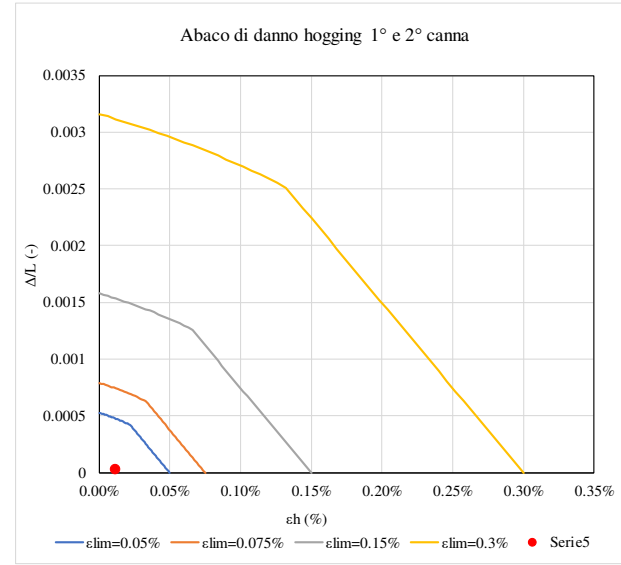
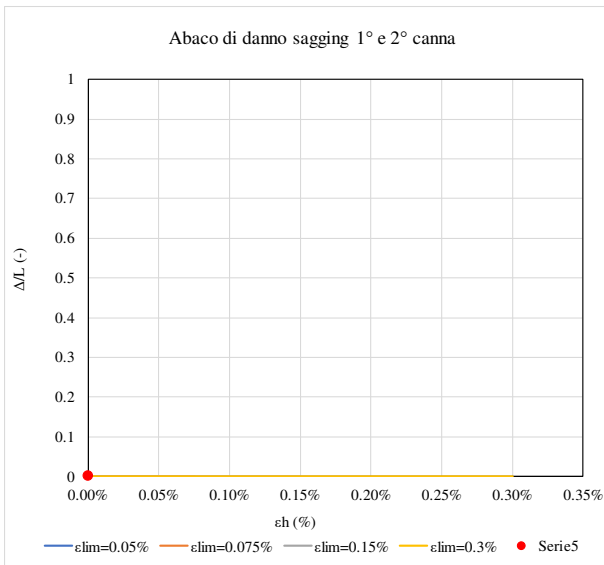
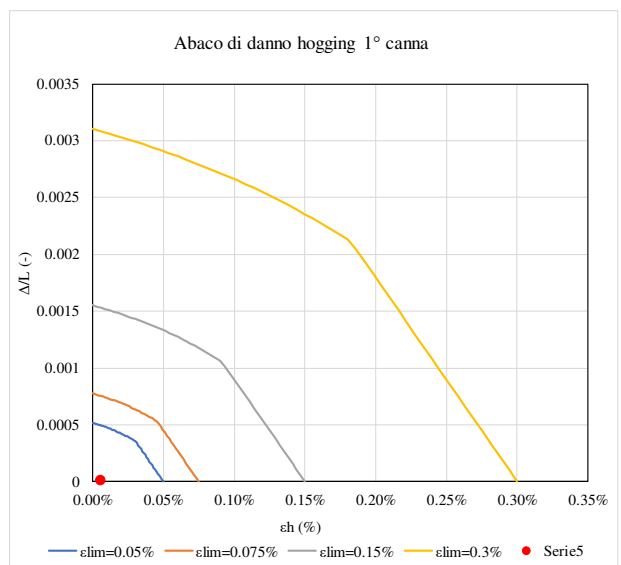
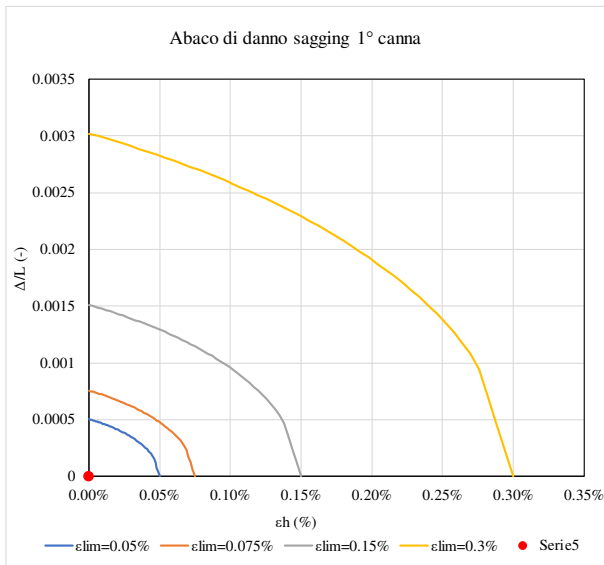


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
102A	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.000%	#DIV/0!	#DIV/0!
0.001%	0.003%	0.003%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.006%	-0.012%	-0.013%

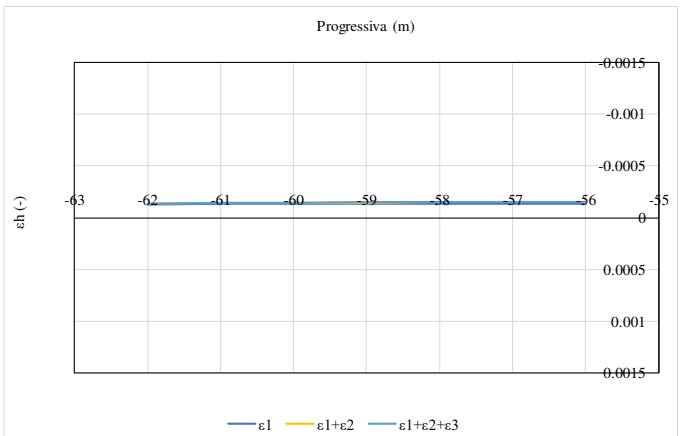
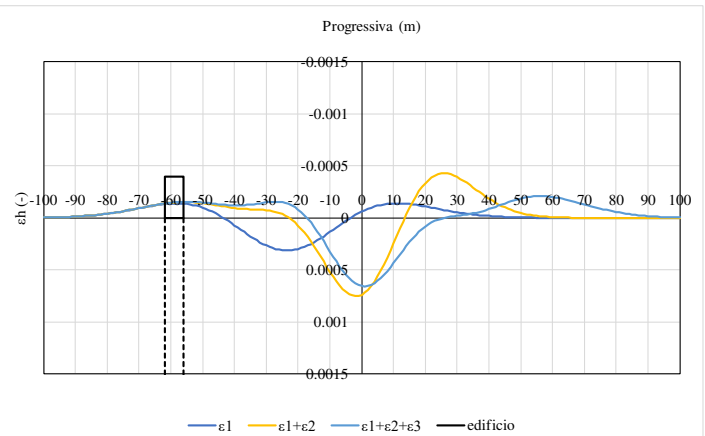
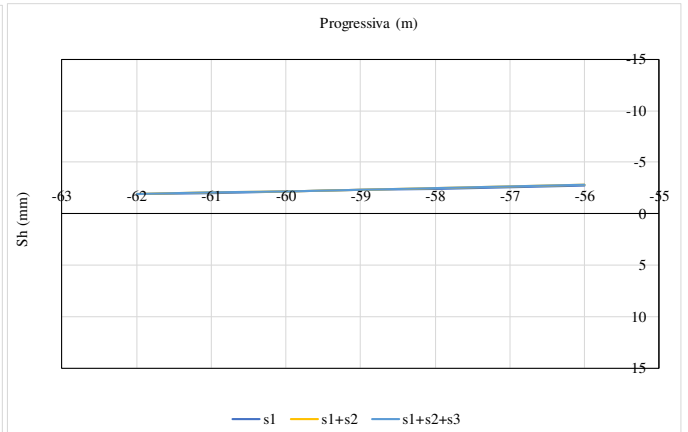
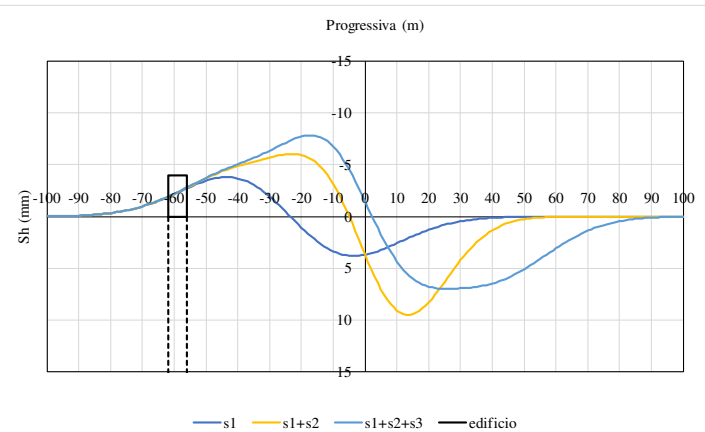
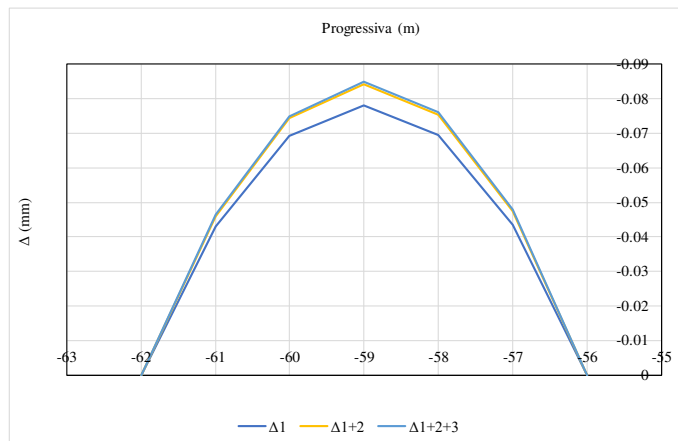
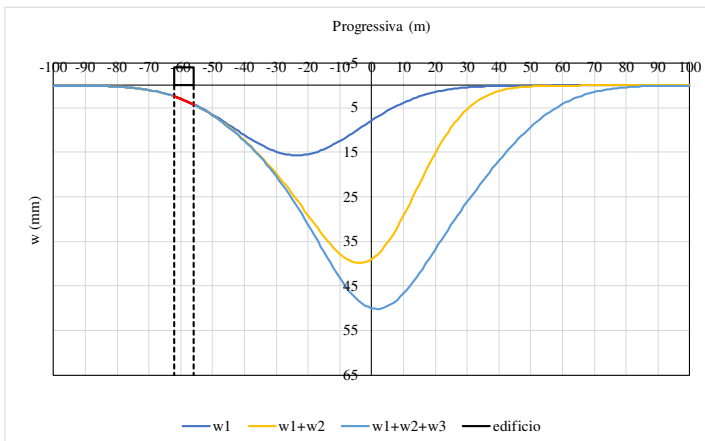




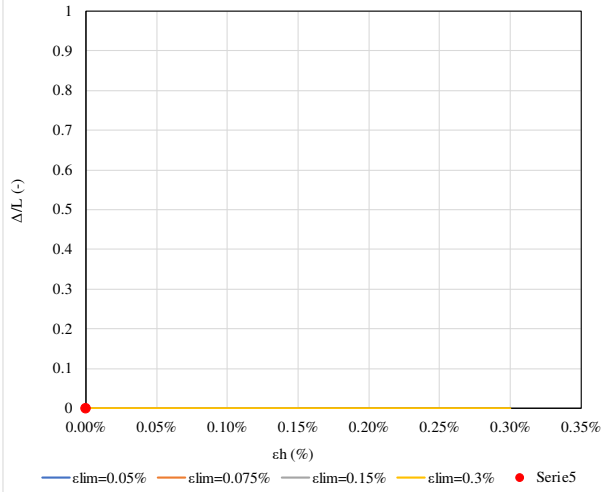
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
102B	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.002%	0.002%	0.002%

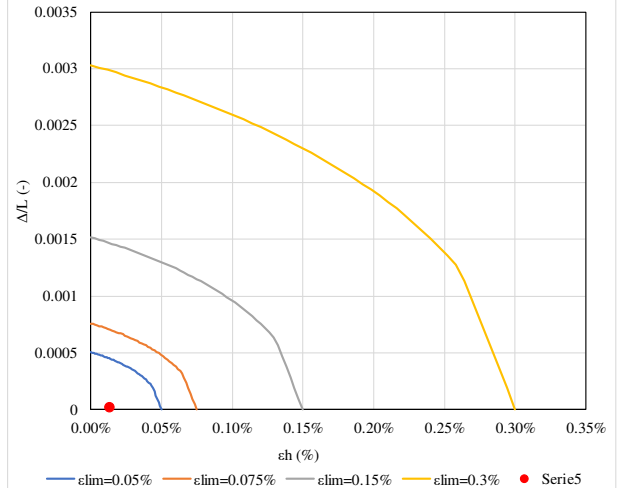
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.014%	-0.015%	-0.015%



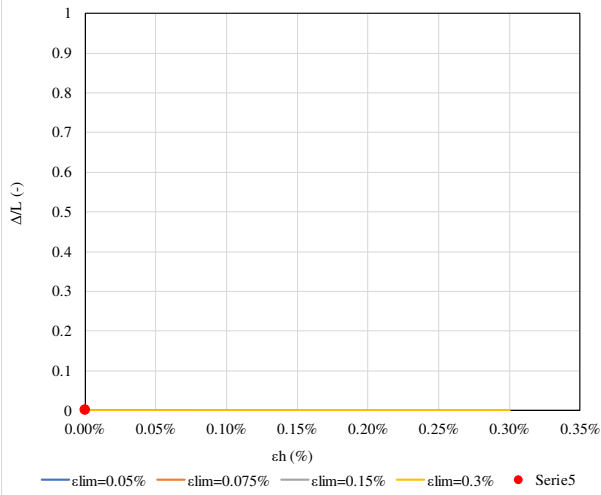
Abaco di danno sagging 1° canna



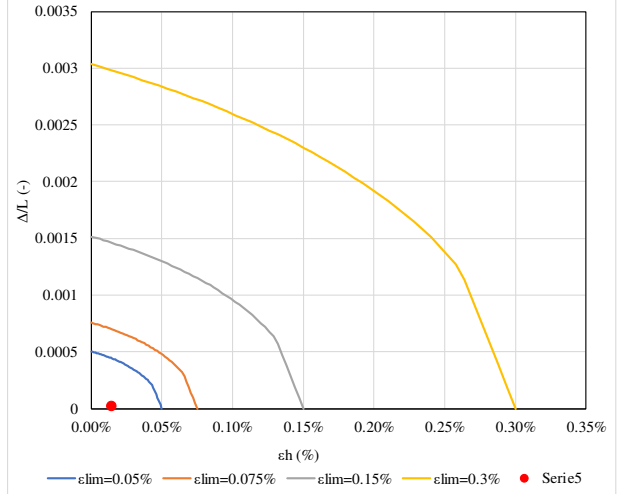
Abaco di danno hogging 1° canna



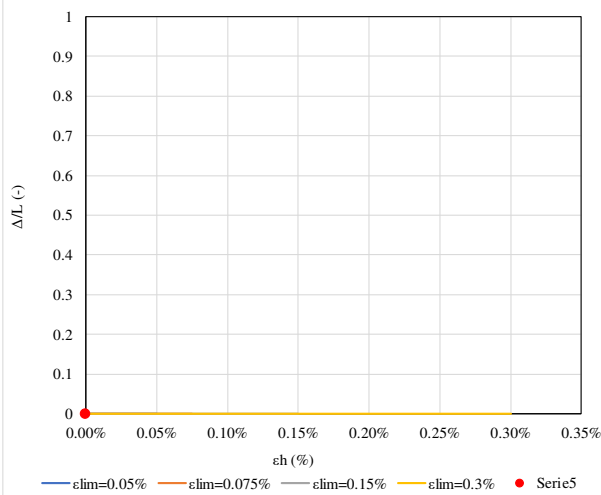
Abaco di danno sagging 1° e 2° canna



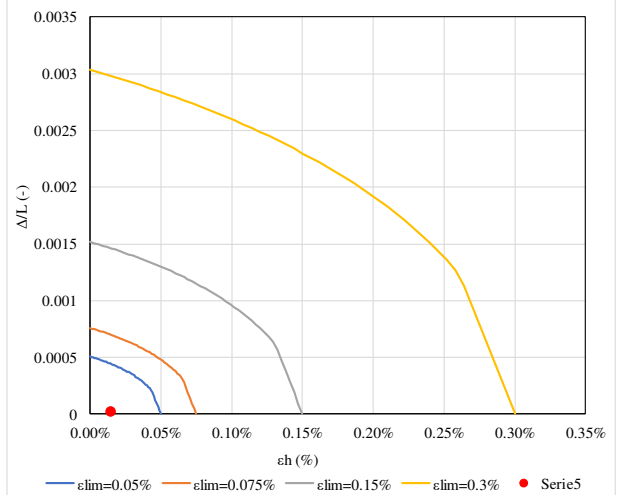
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



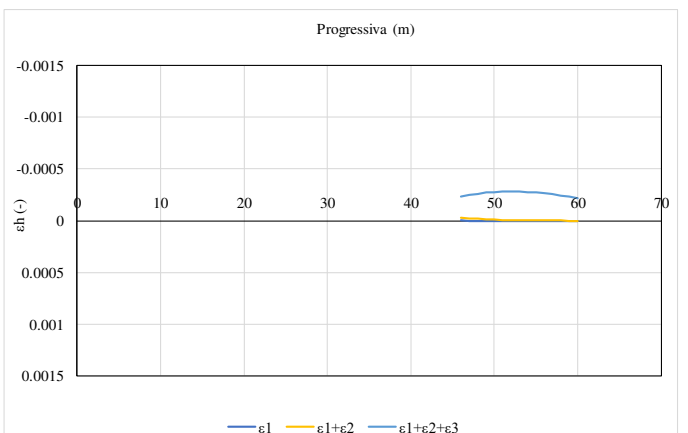
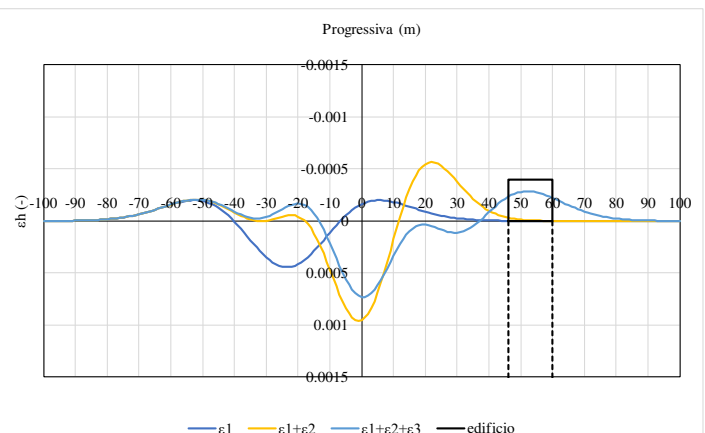
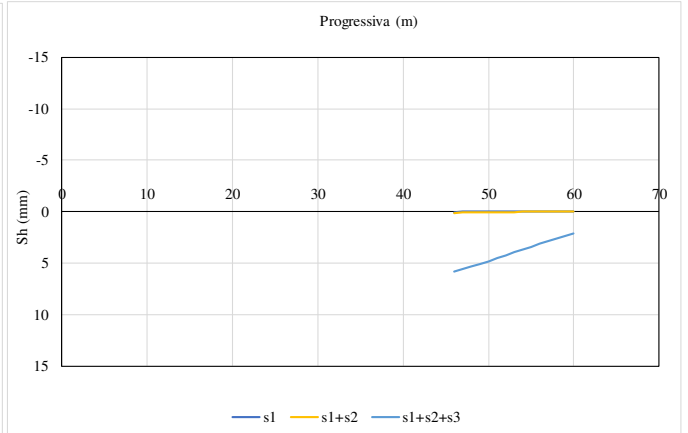
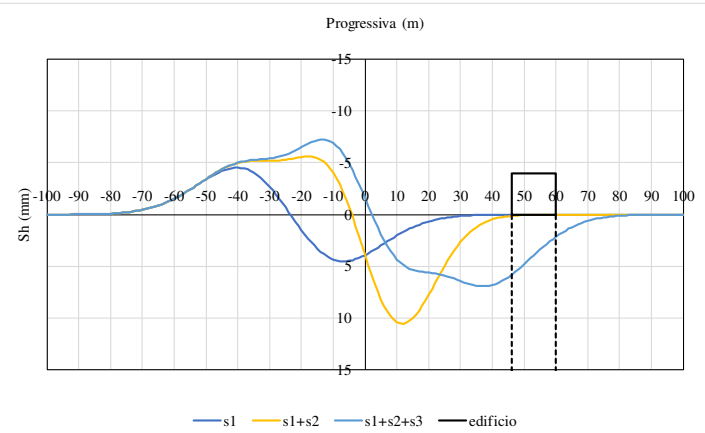
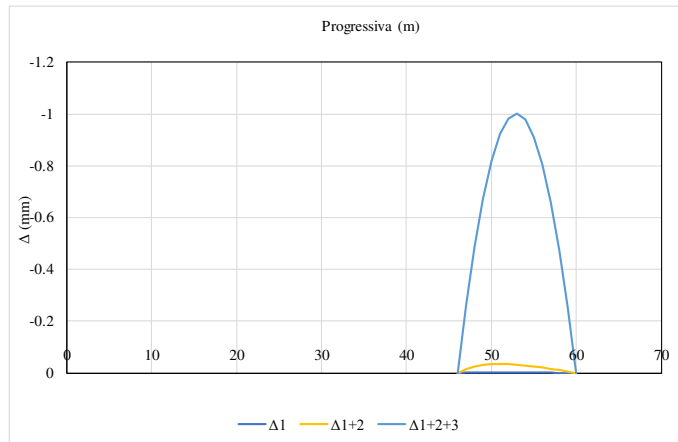
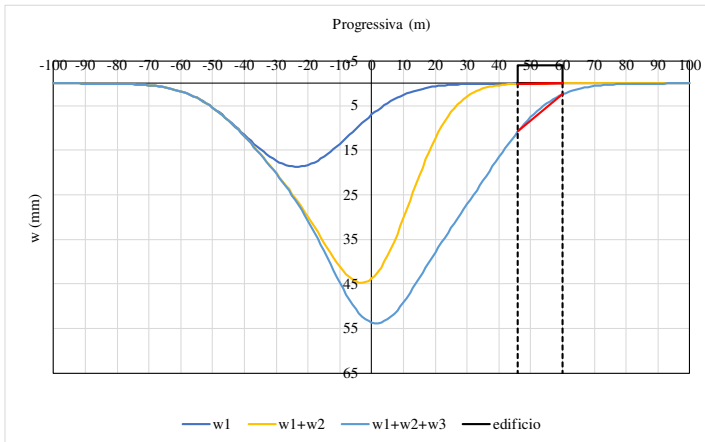
Abaco di danno hogging 1°, 2° e 3° canna

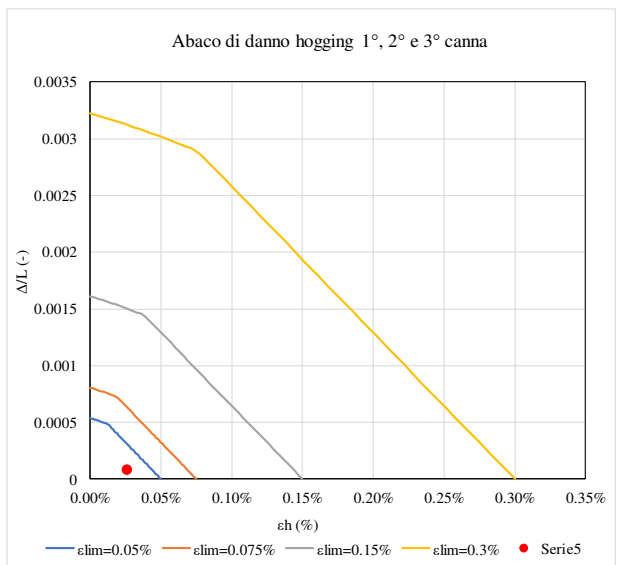
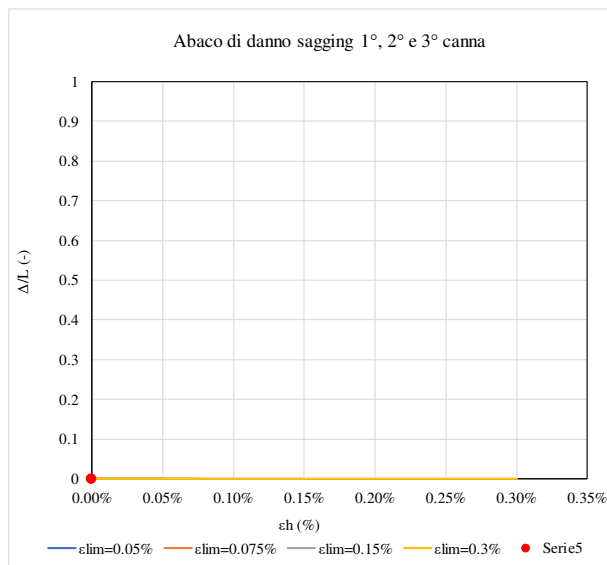
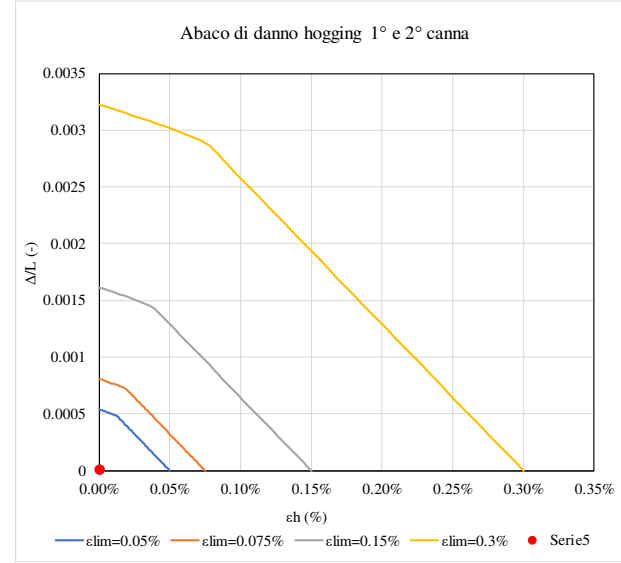
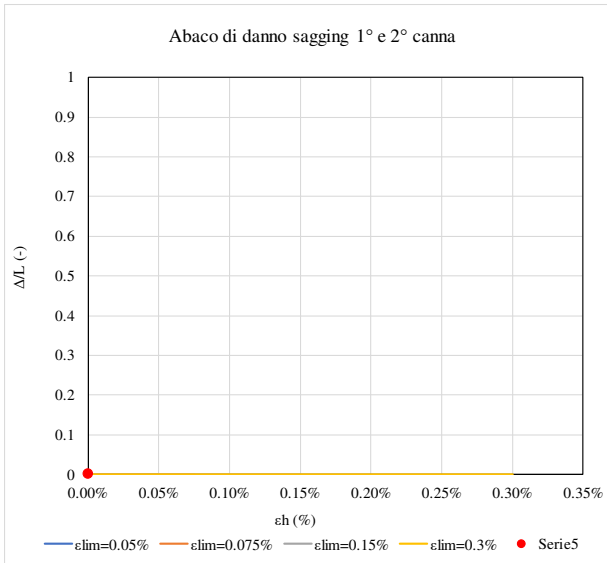
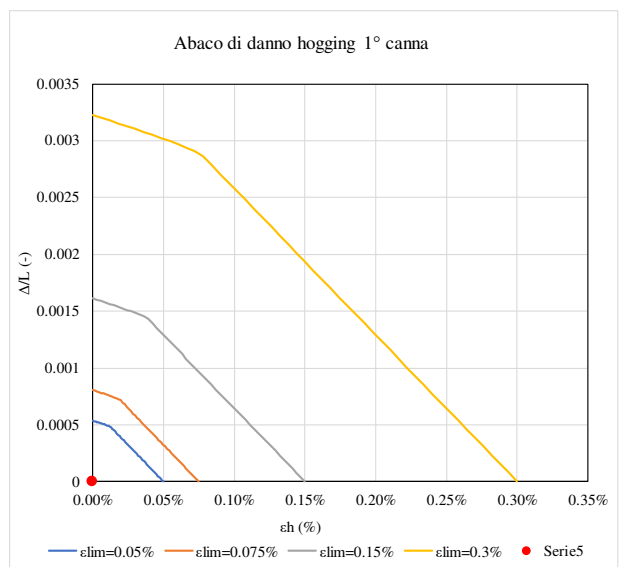
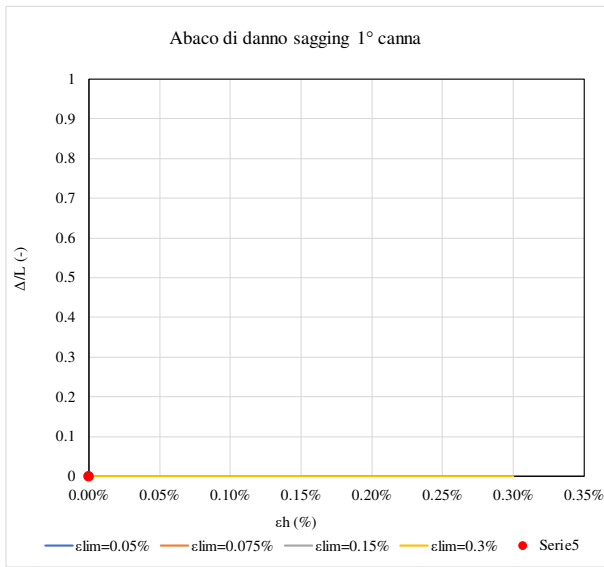


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
103	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.000%	0.008%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	-0.001%	-0.027%



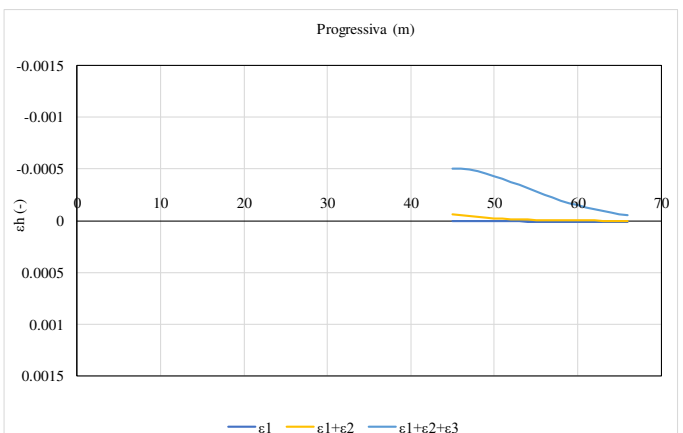
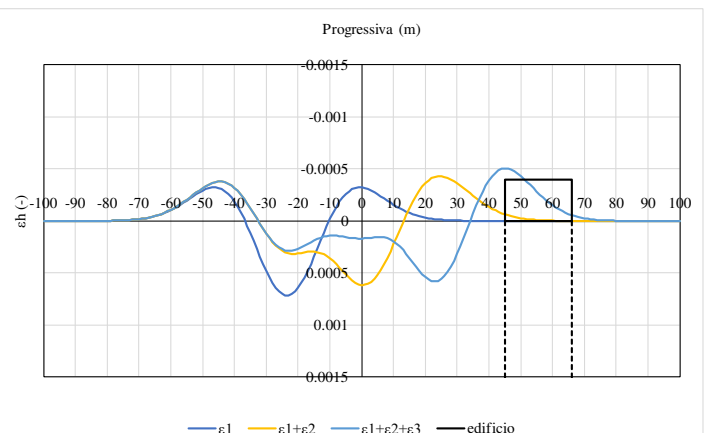
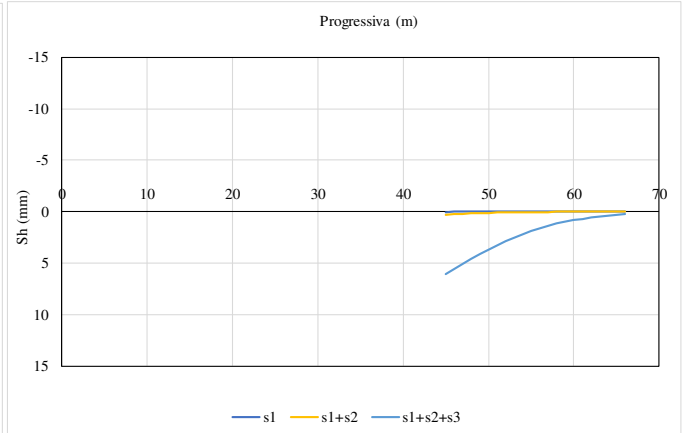
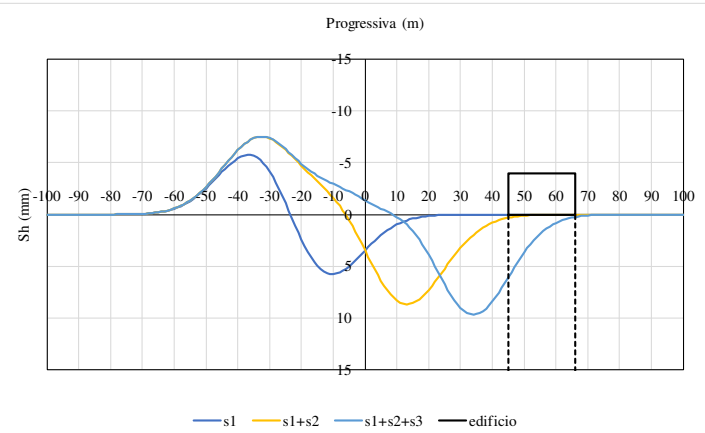
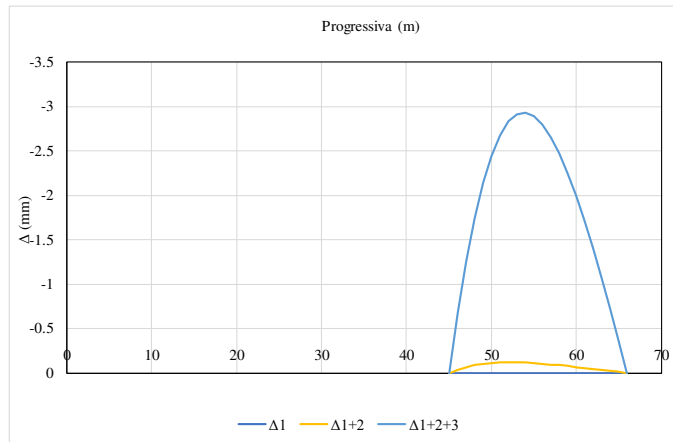
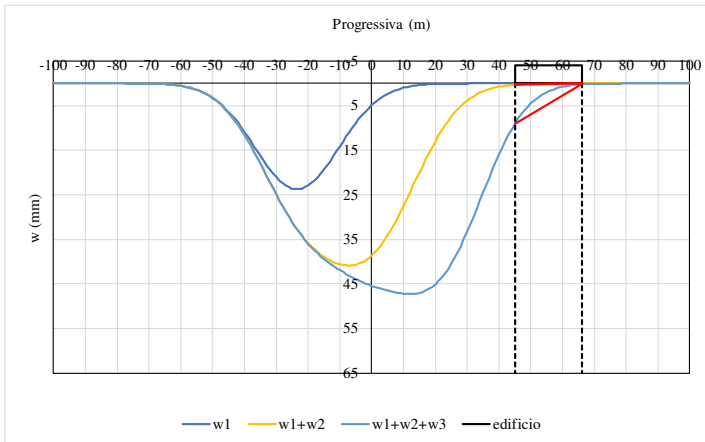


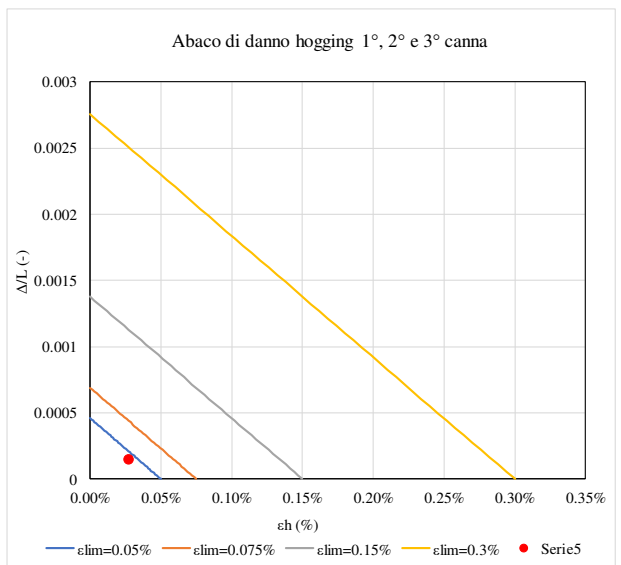
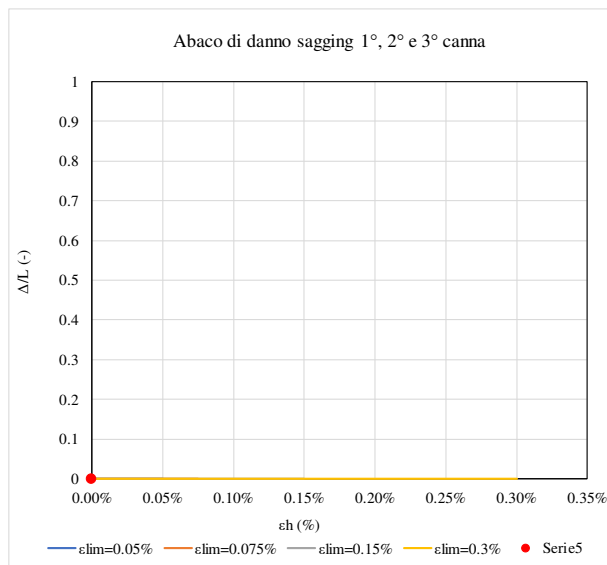
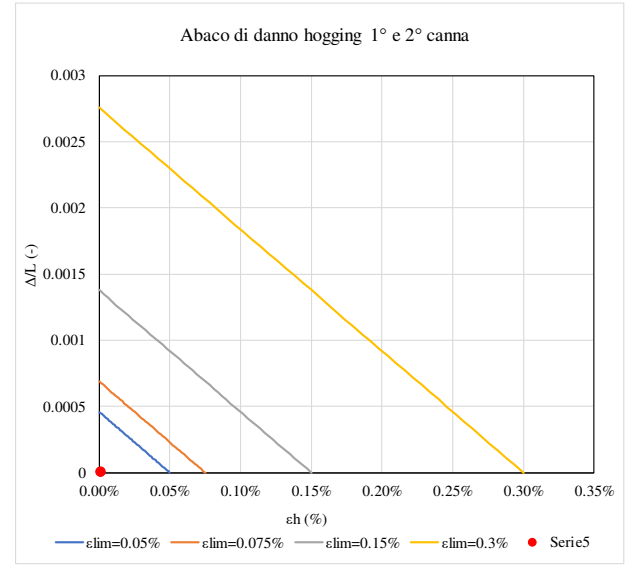
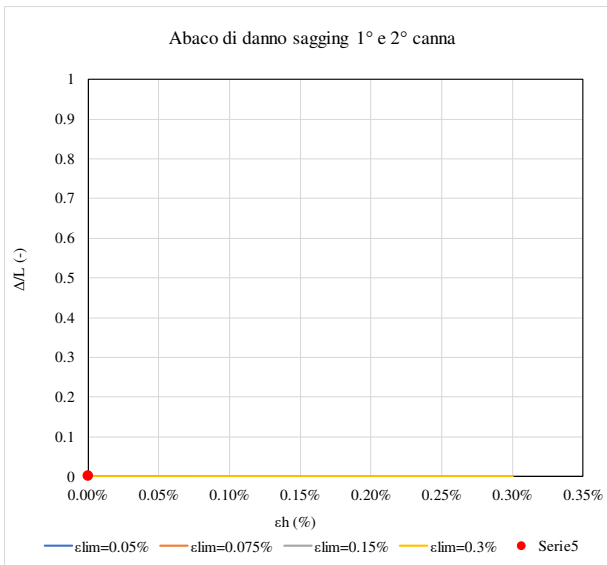
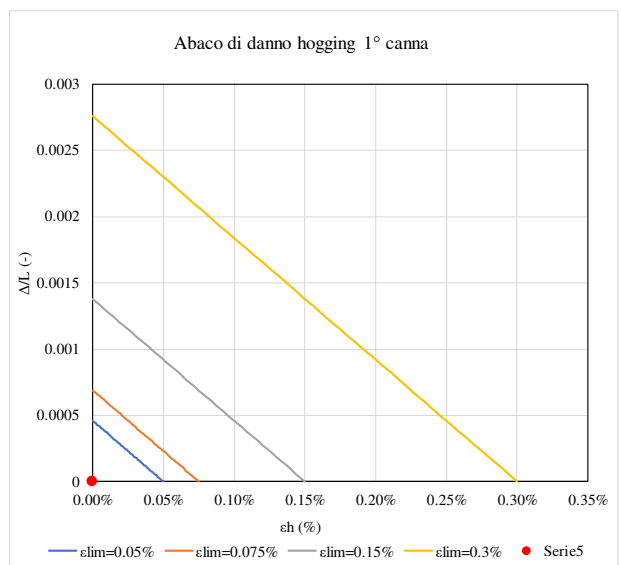
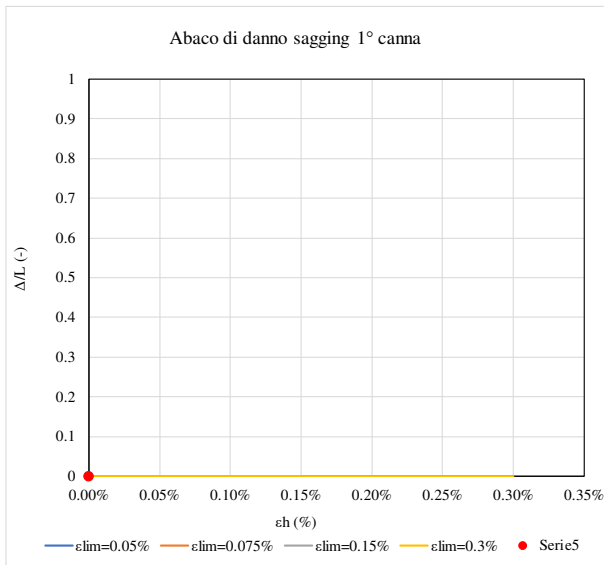


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
104	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.001%	0.015%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	-0.001%	-0.028%

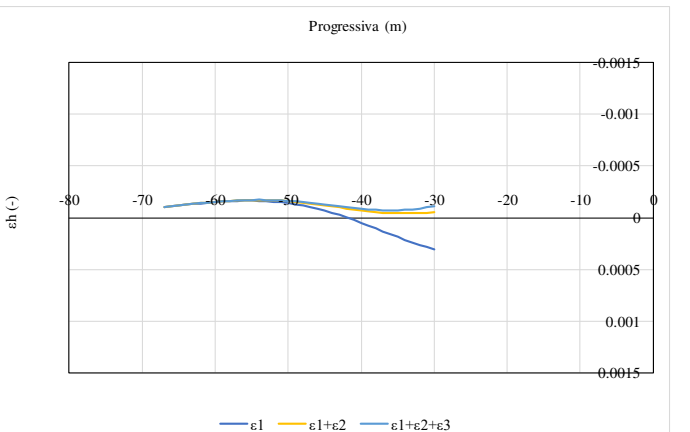
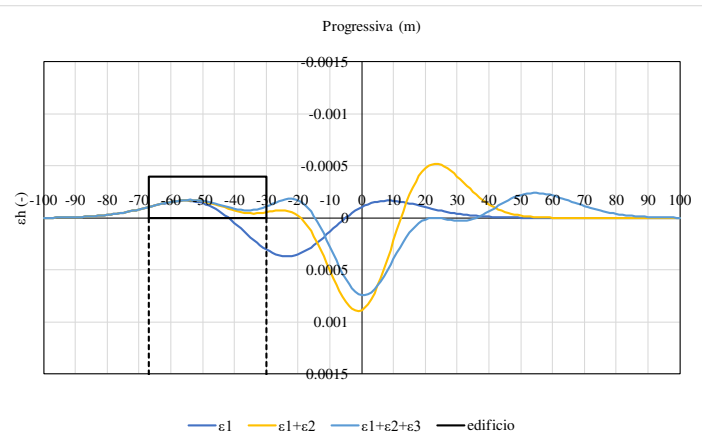
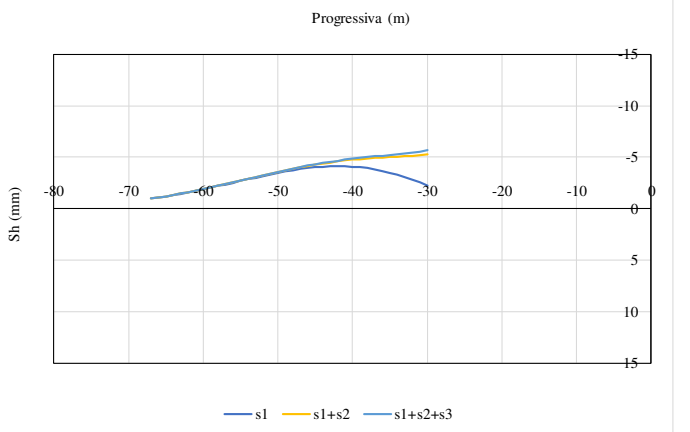
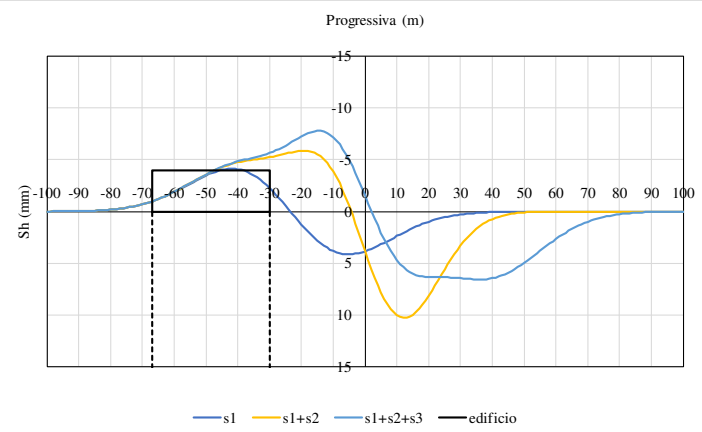
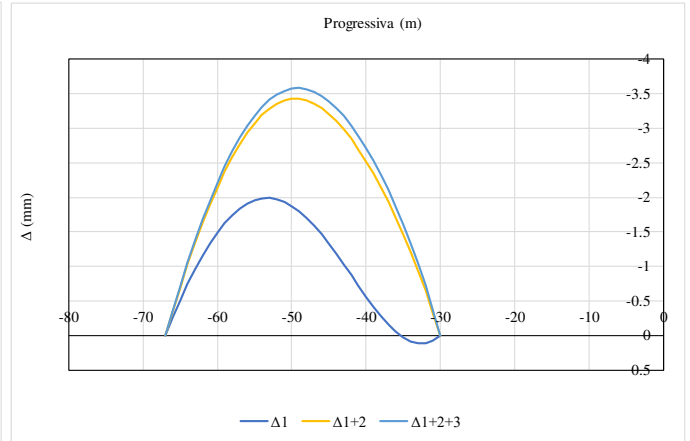
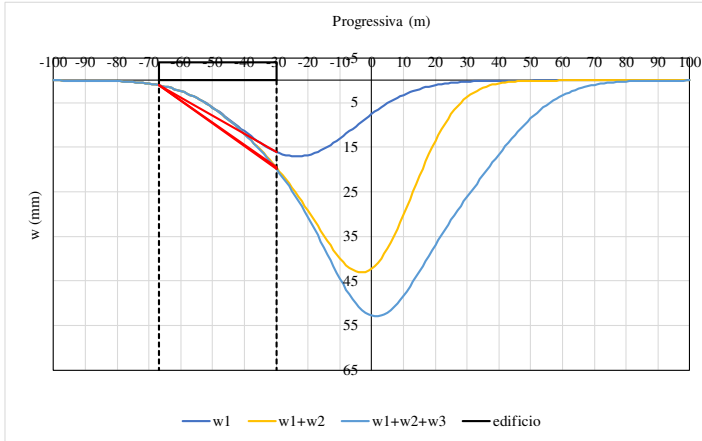


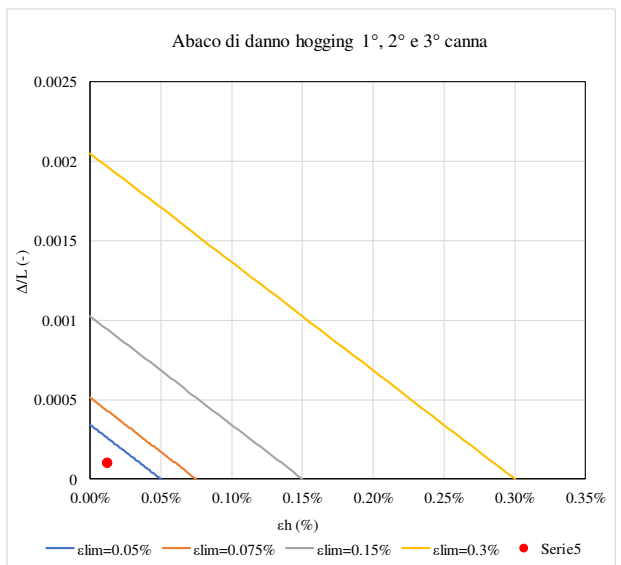
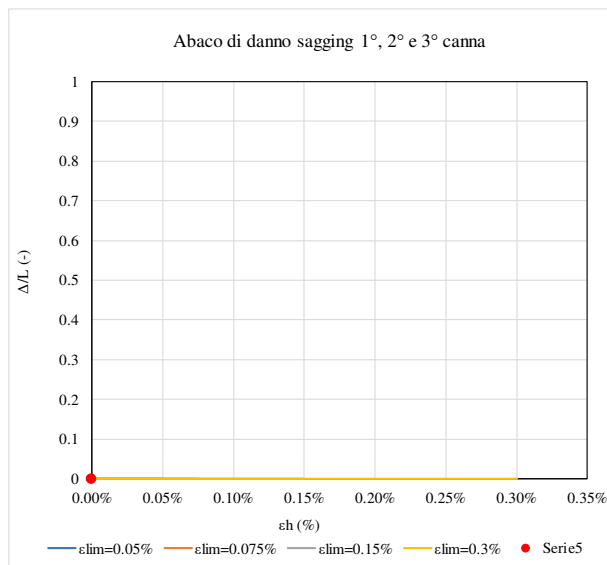
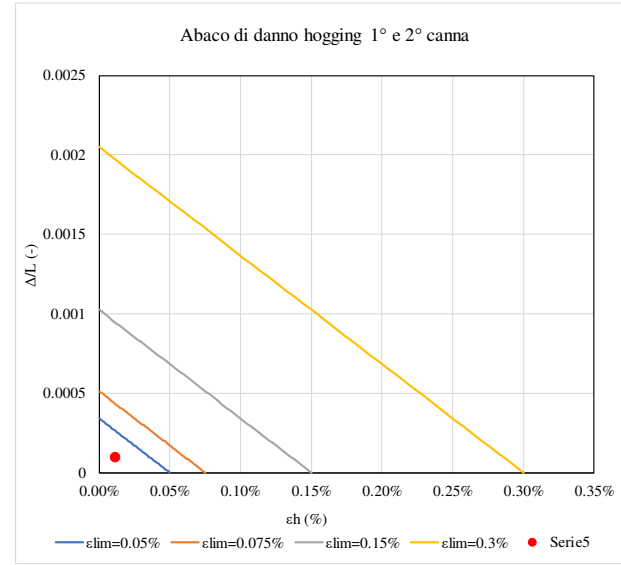
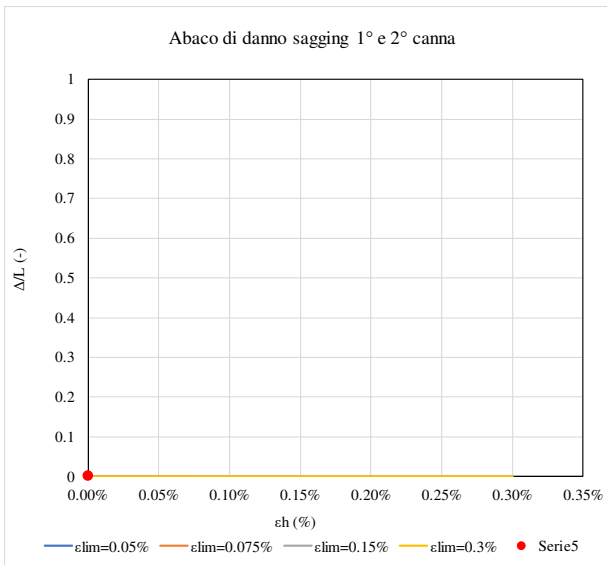
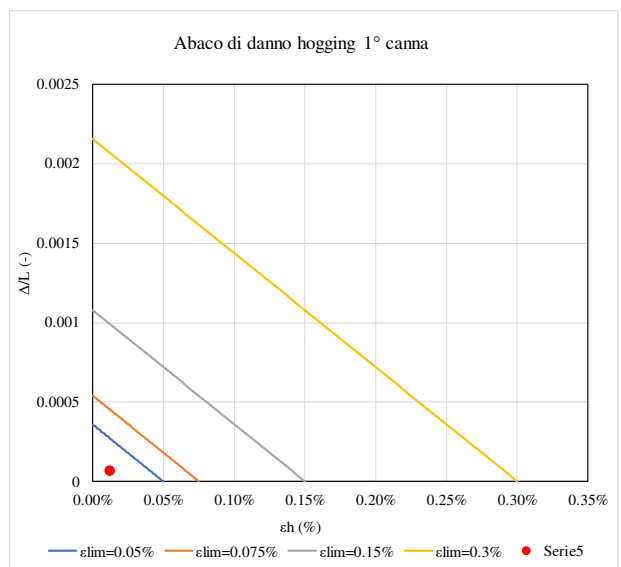
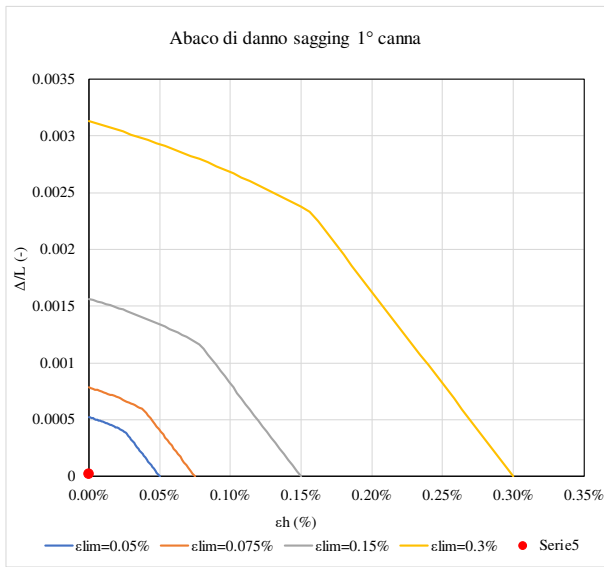


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
105	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.002%	#DIV/0!	#DIV/0!
0.006%	0.010%	0.010%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.012%	-0.012%	-0.013%

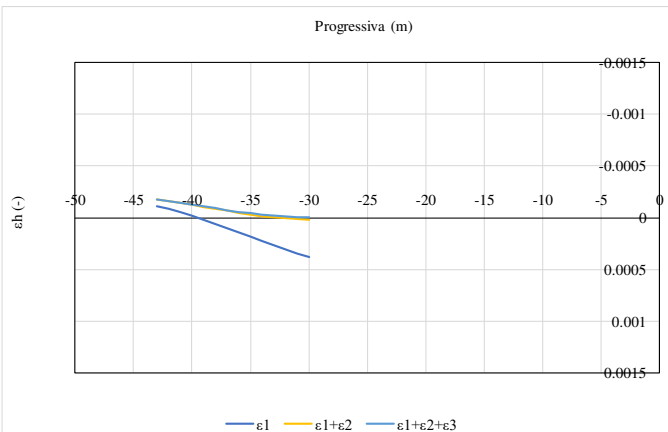
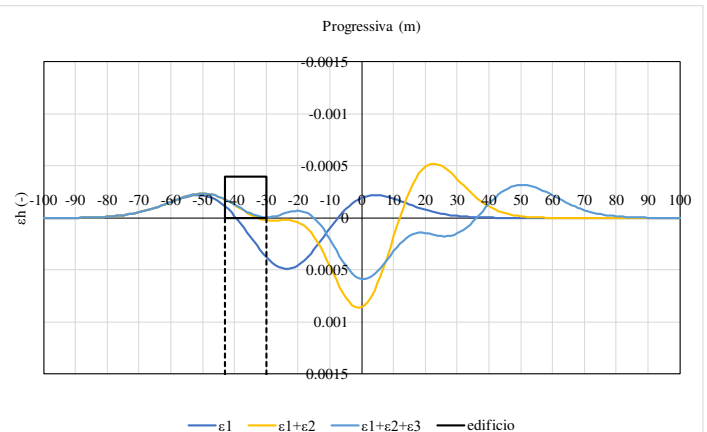
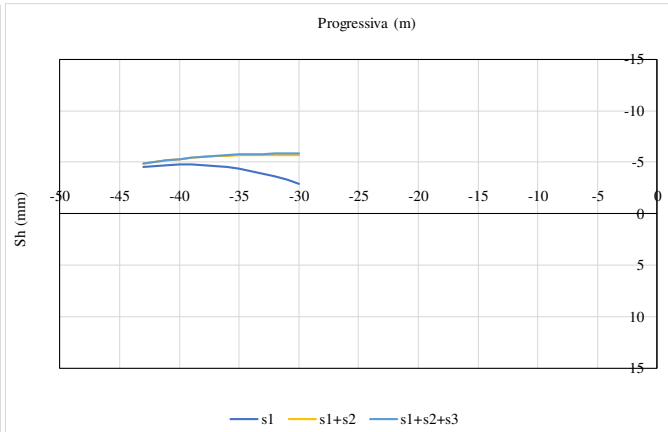
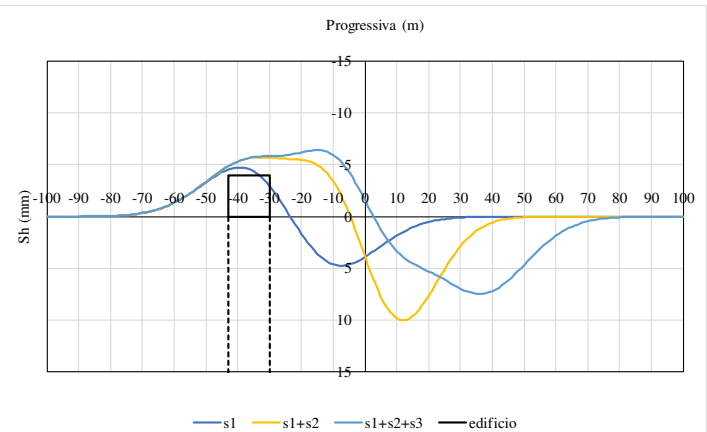
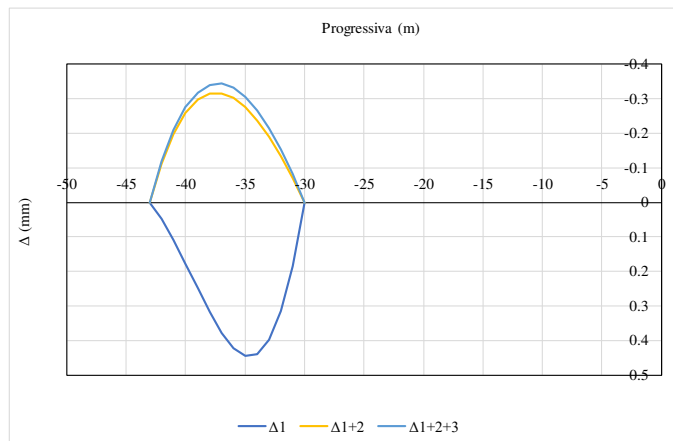
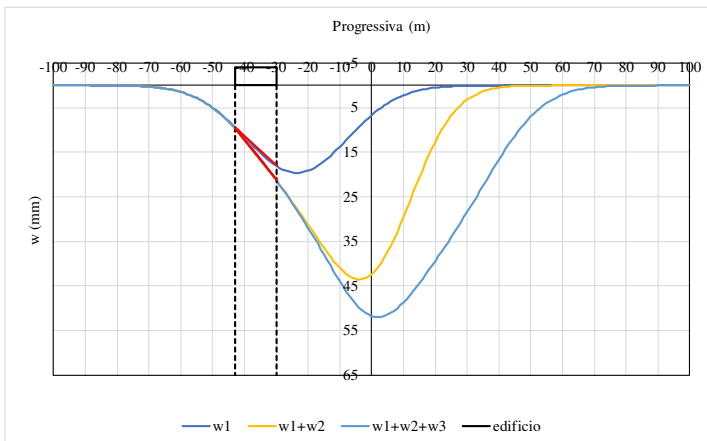


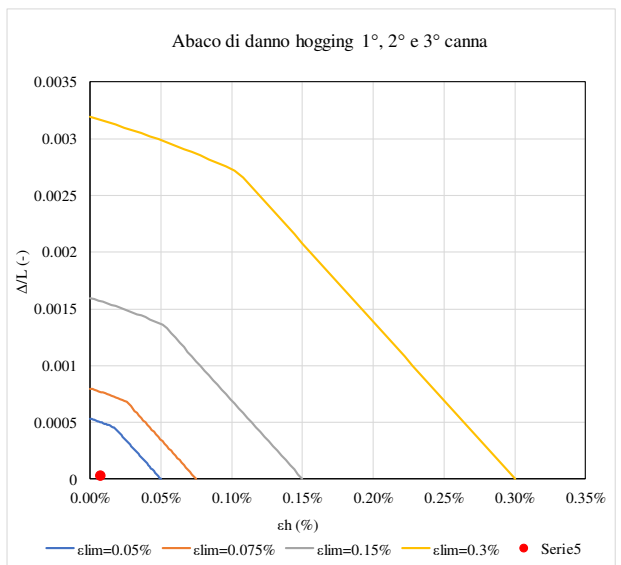
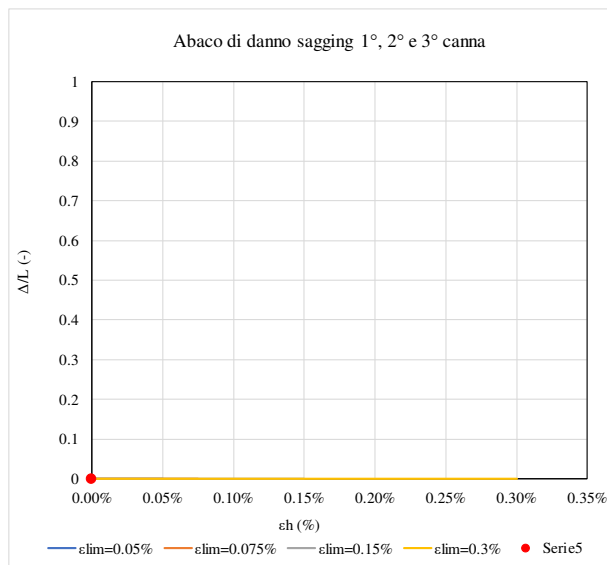
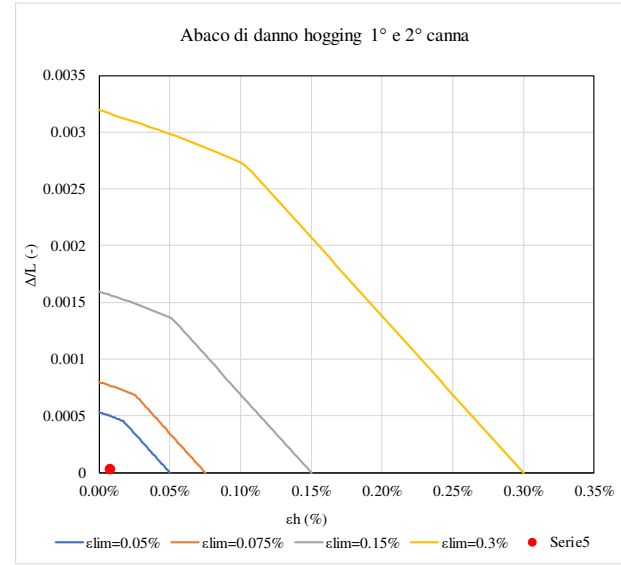
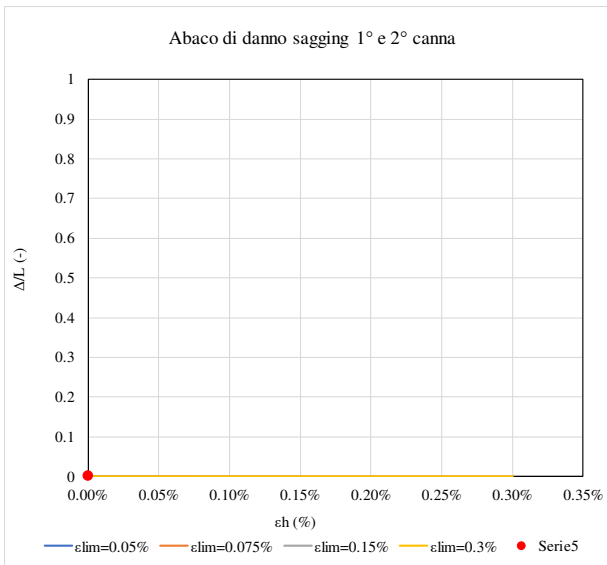
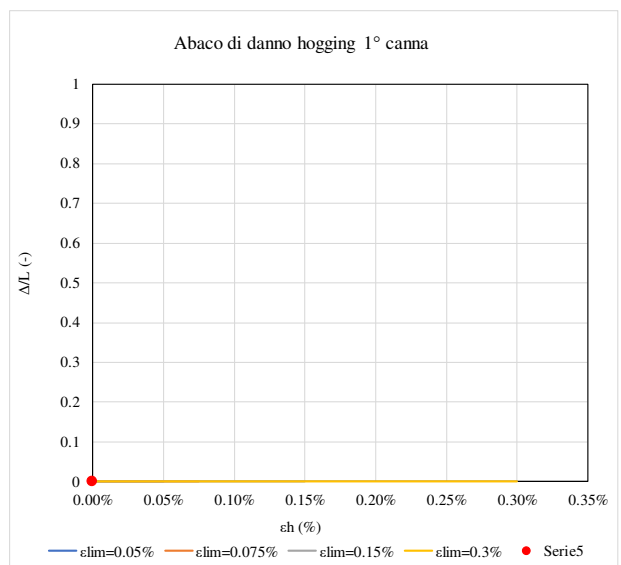
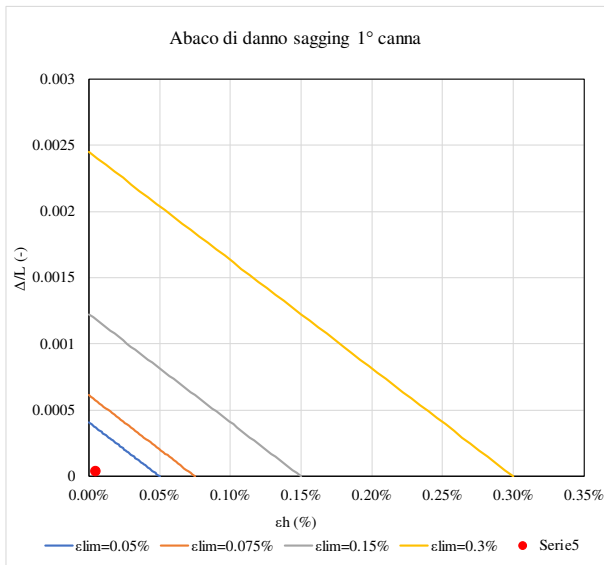


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
106-S1	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.004%	#DIV/0!	#DIV/0!
#DIV/0!	0.003%	0.003%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.005%	#DIV/0!	#DIV/0!
#DIV/0!	-0.008%	-0.007%

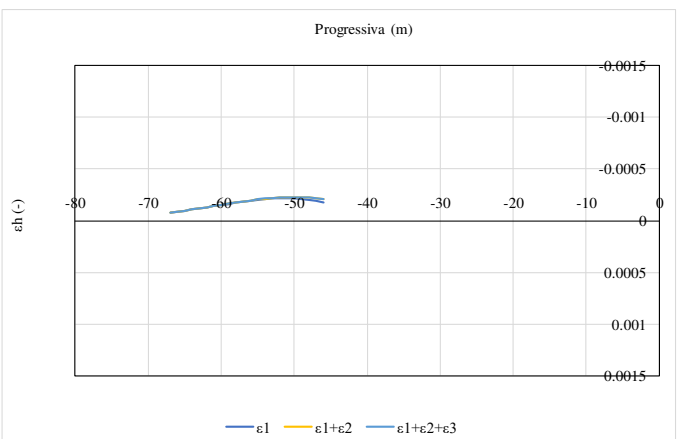
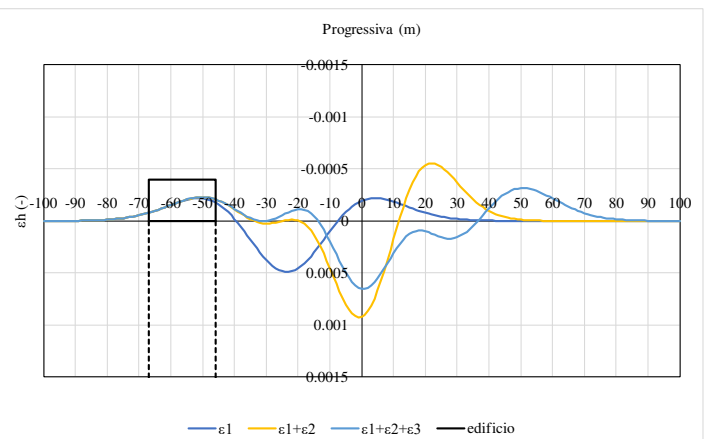
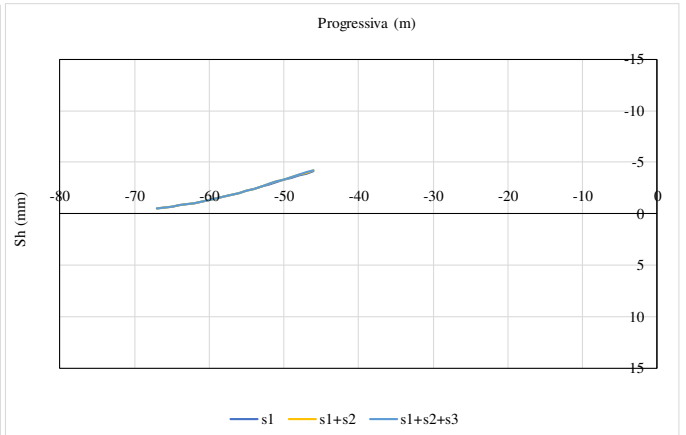
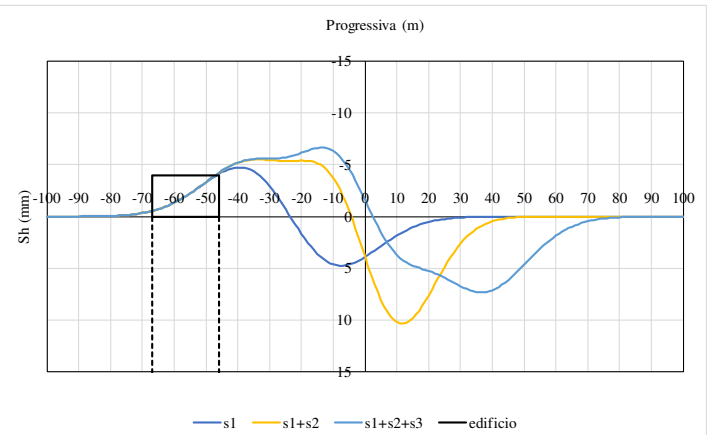
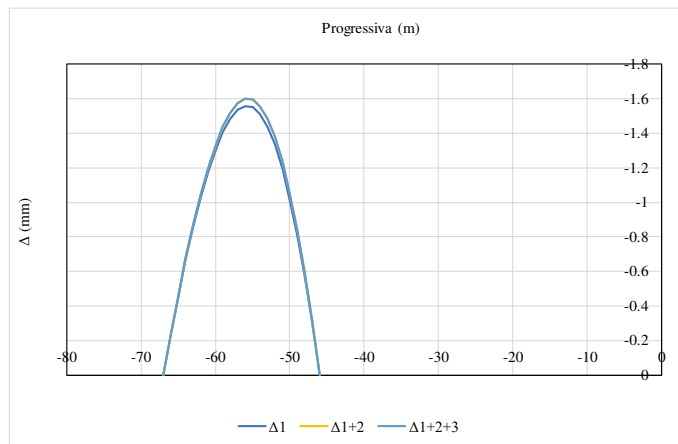
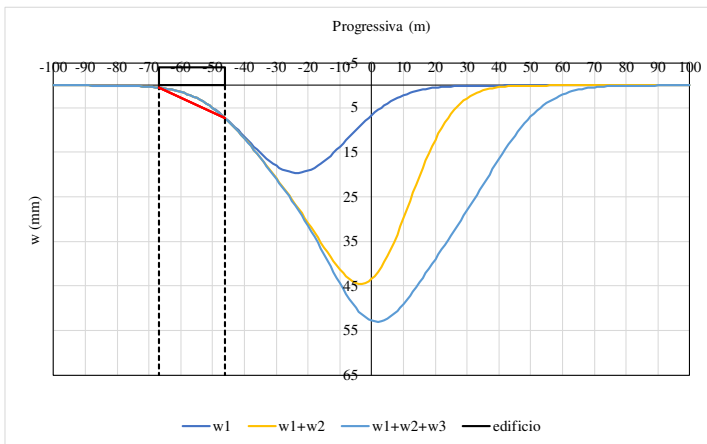




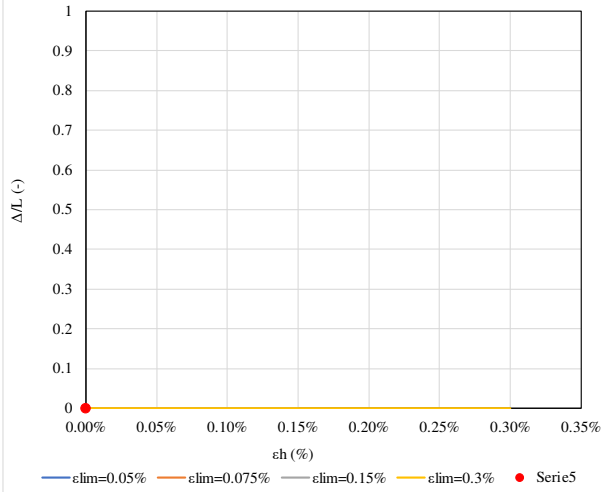
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
106-S2	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.008%	0.008%	0.008%

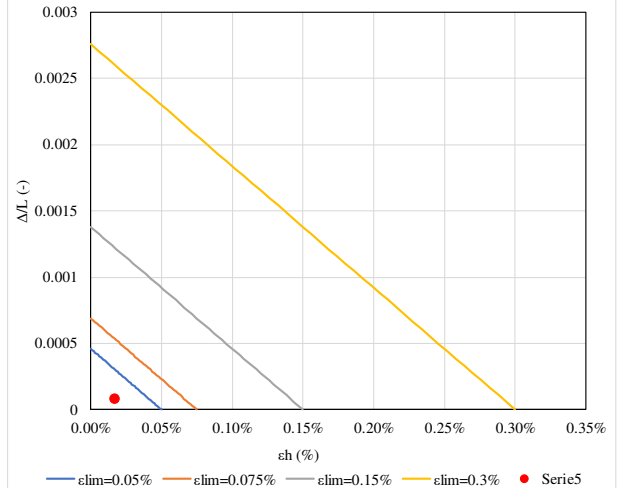
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.017%	-0.018%	-0.018%



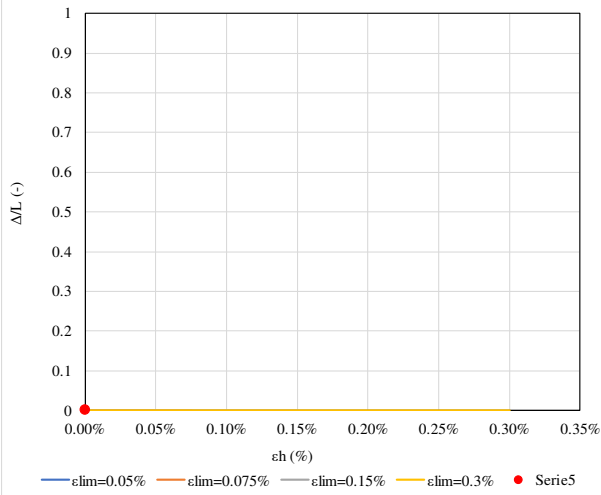
Abaco di danno sagging 1° canna



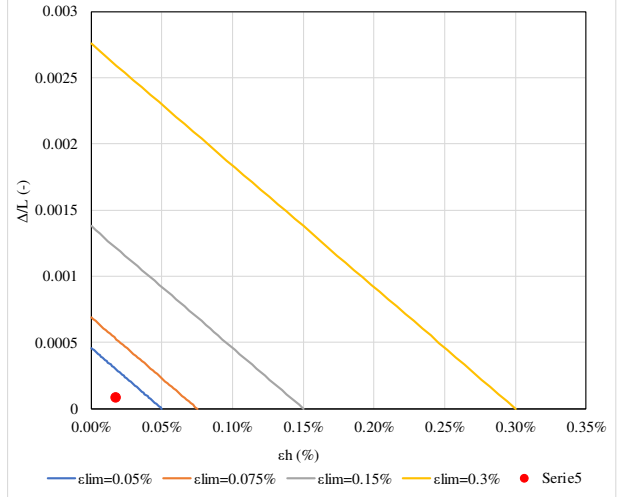
Abaco di danno hogging 1° canna



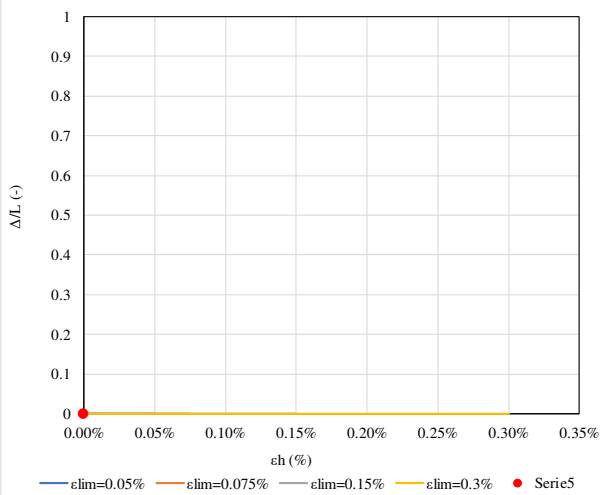
Abaco di danno sagging 1° e 2° canna



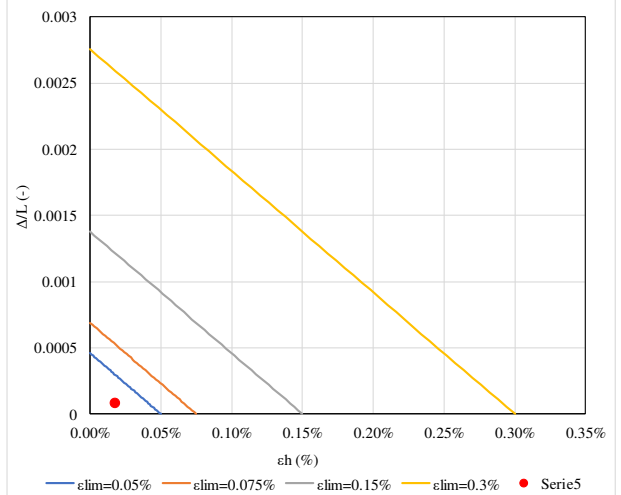
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



Abaco di danno hogging 1°, 2° e 3° canna

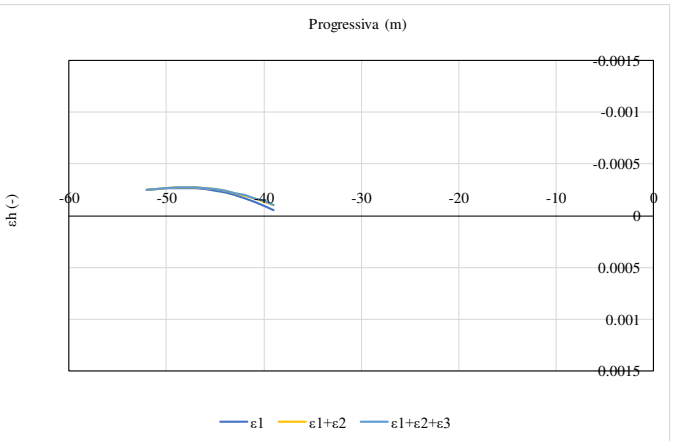
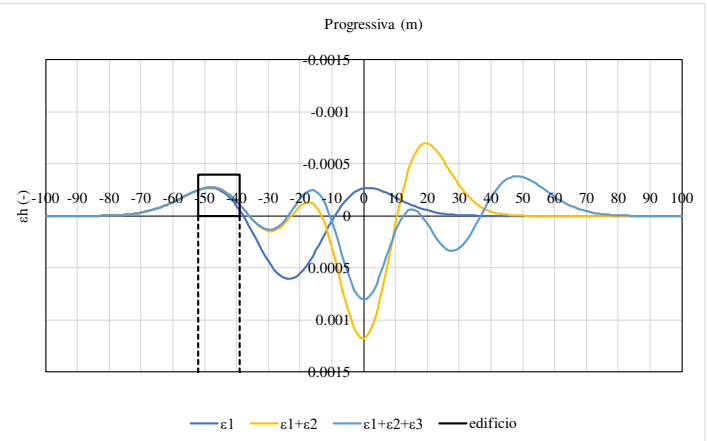
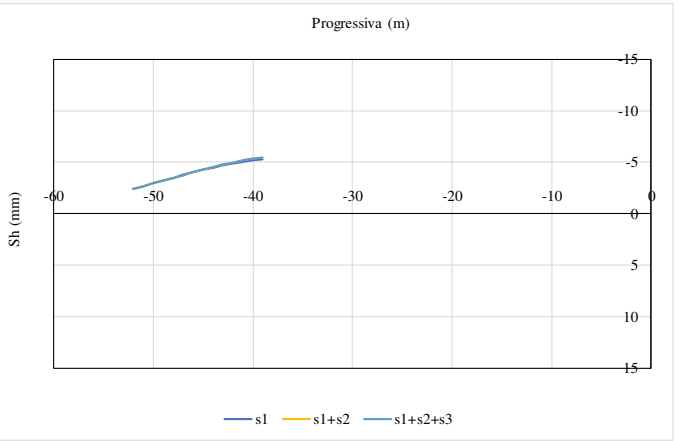
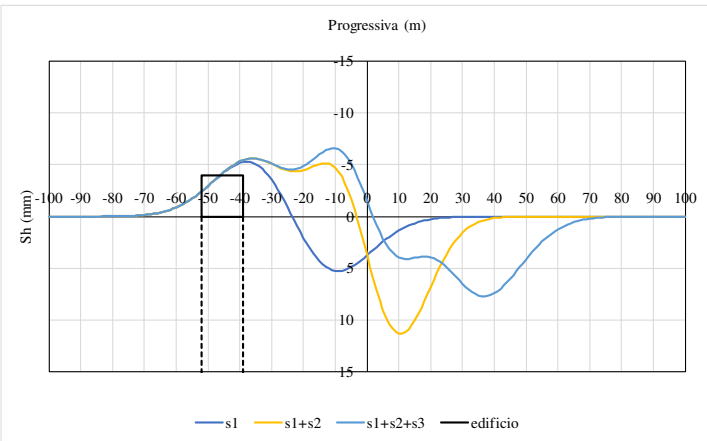
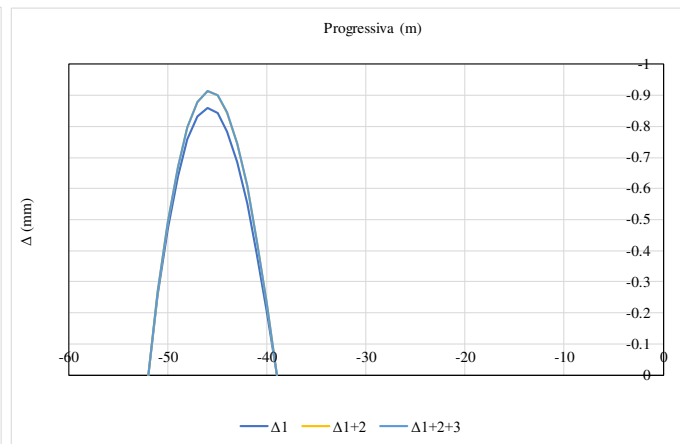
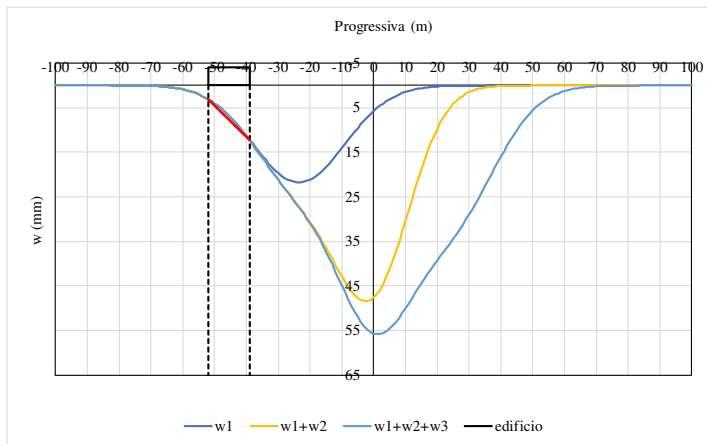




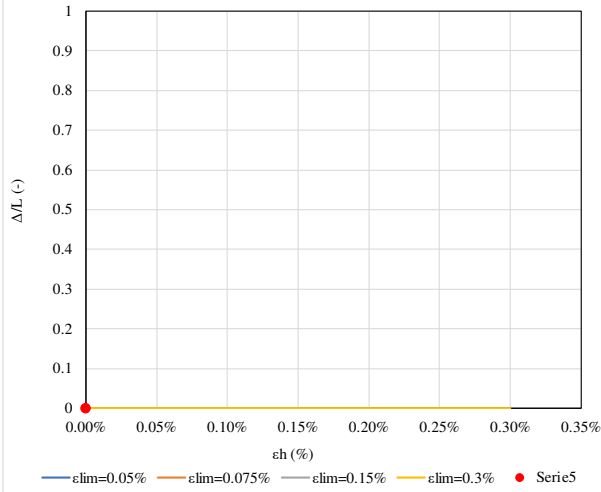
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
107-S1	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.007%	0.008%	0.008%

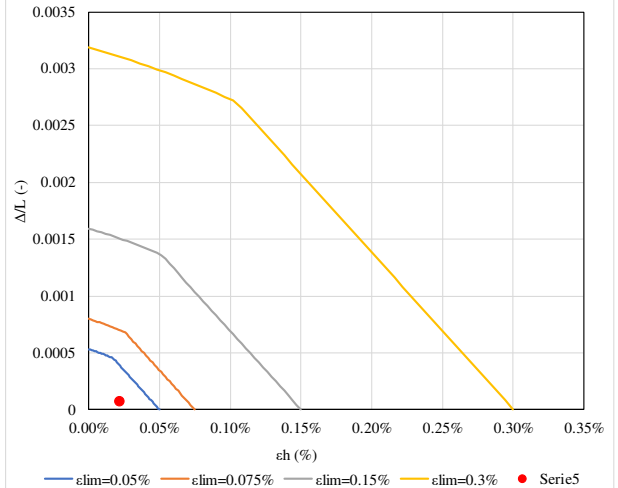
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.022%	-0.024%	-0.024%



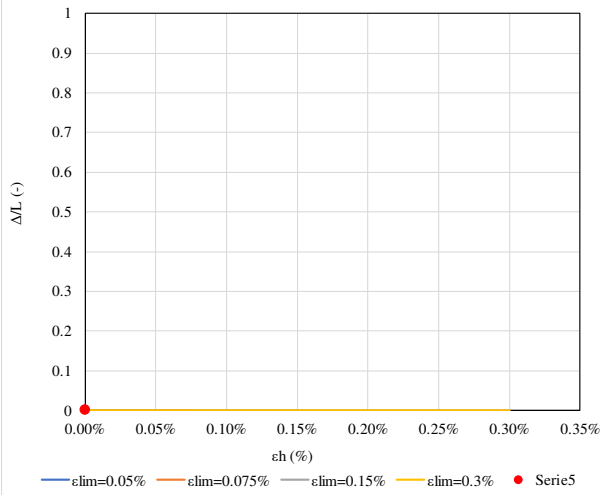
Abaco di danno sagging 1° canna



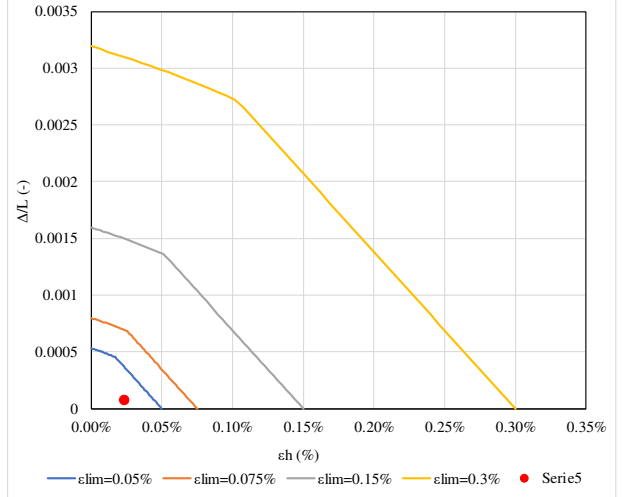
Abaco di danno hogging 1° canna



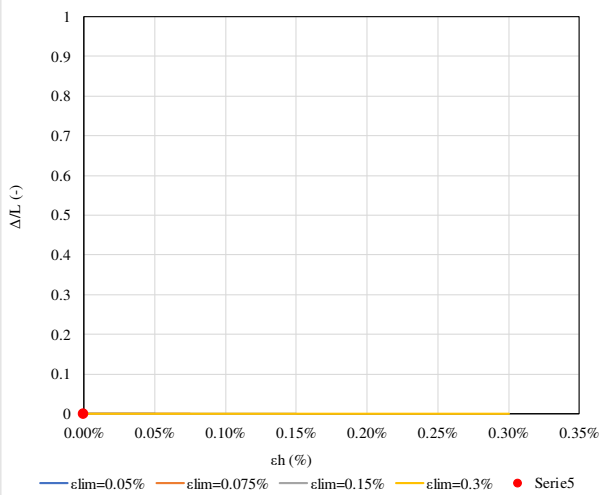
Abaco di danno sagging 1° e 2° canna



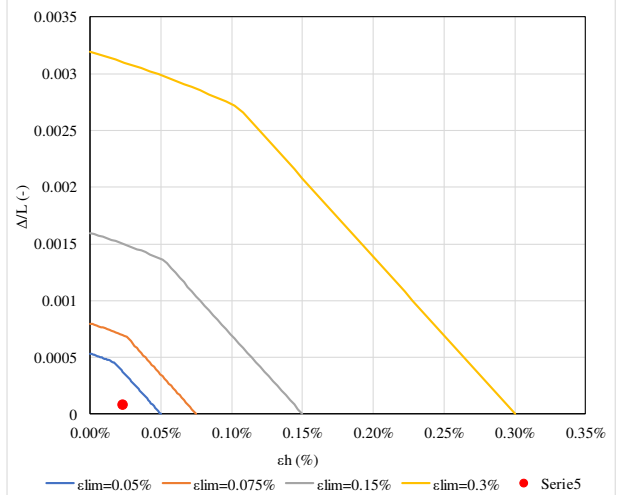
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



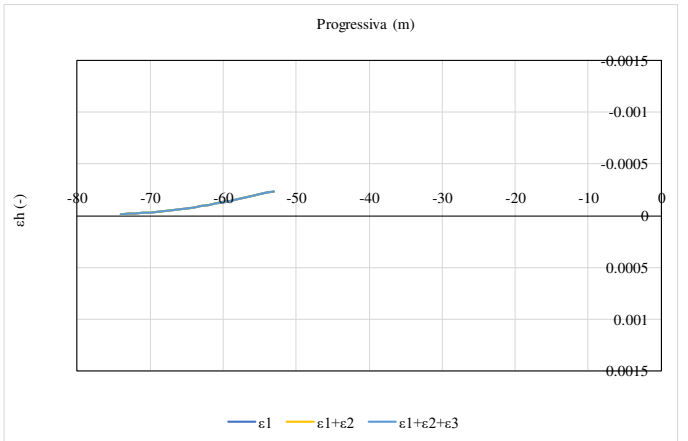
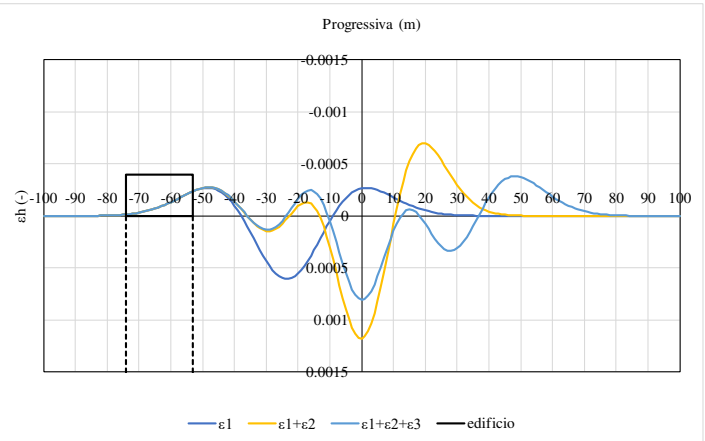
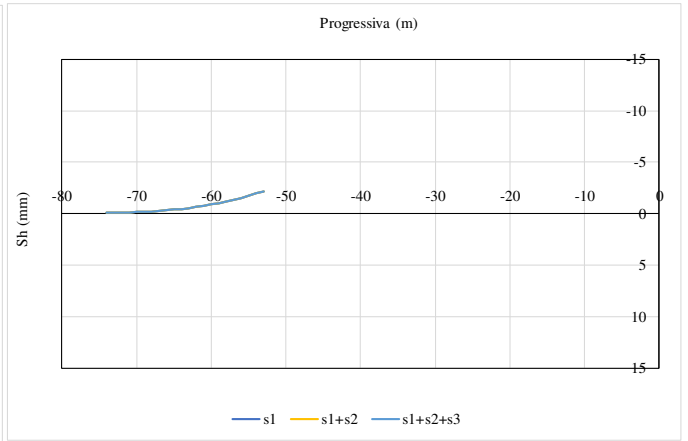
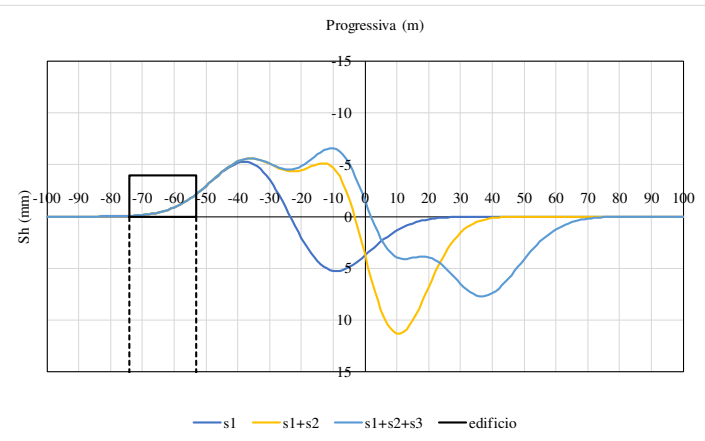
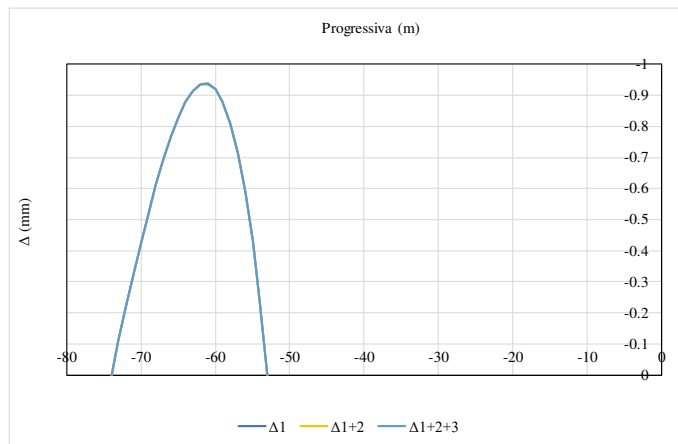
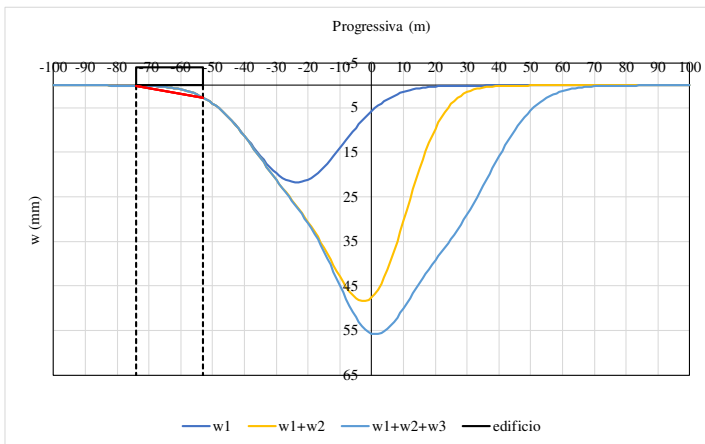
Abaco di danno hogging 1°, 2° e 3° canna



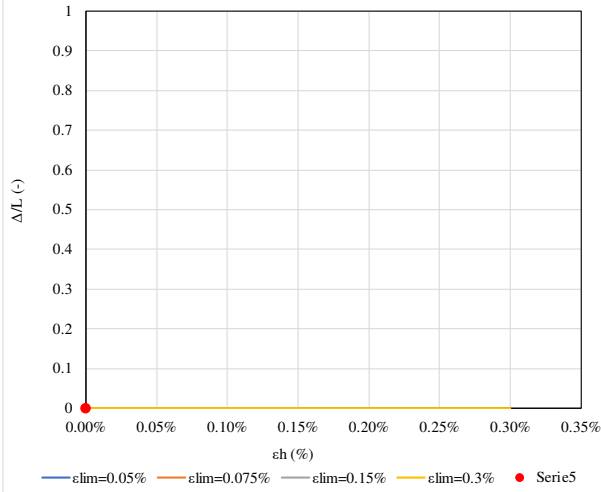
edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
107-S2	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.005%	0.005%	0.005%

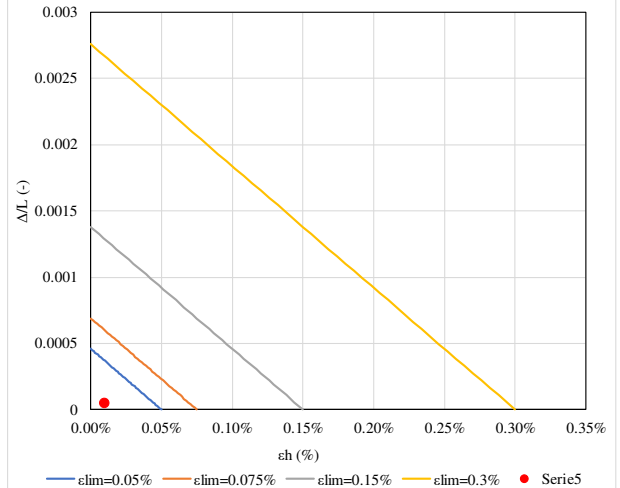
$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.010%	-0.010%	-0.010%



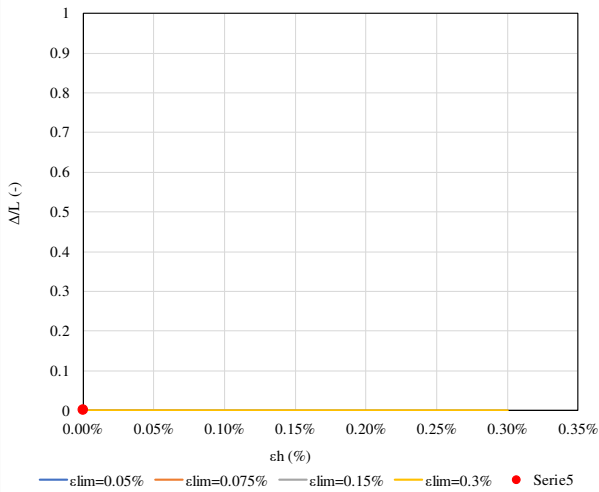
Abaco di danno sagging 1° canna



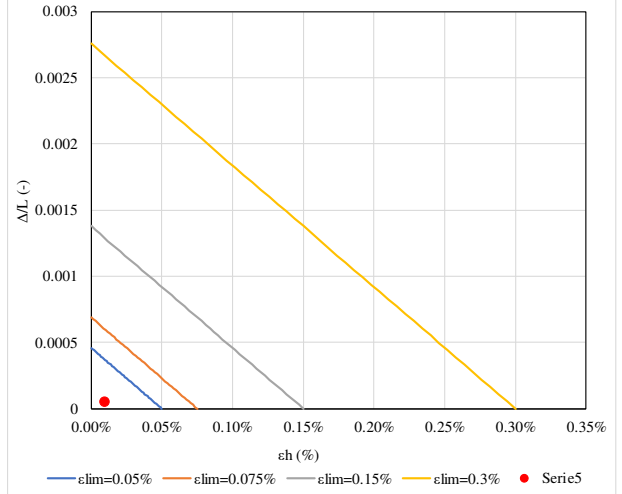
Abaco di danno hogging 1° canna



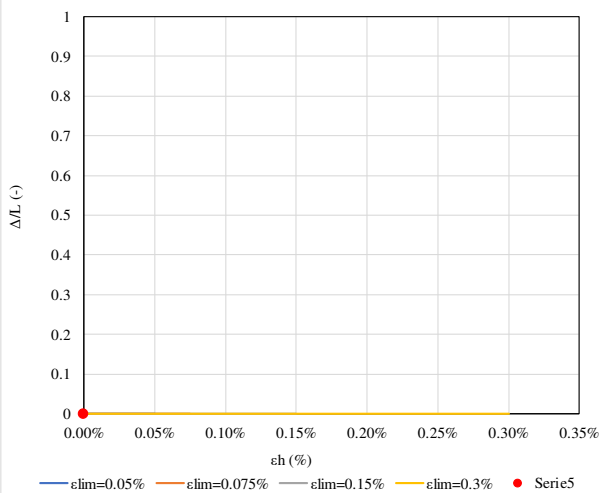
Abaco di danno sagging 1° e 2° canna



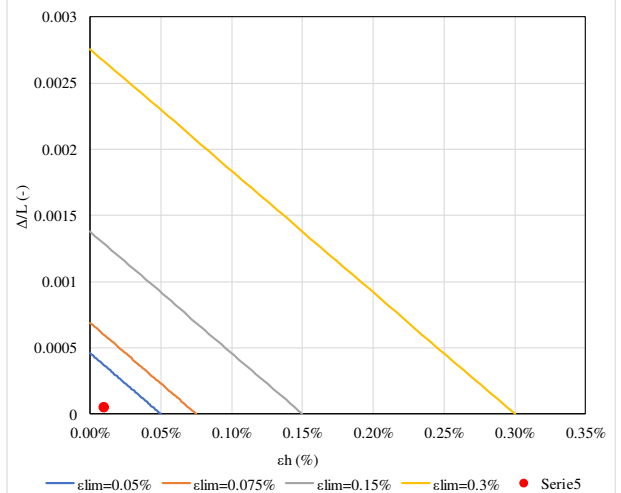
Abaco di danno hogging 1° e 2° canna



Abaco di danno sagging 1°, 2° e 3° canna



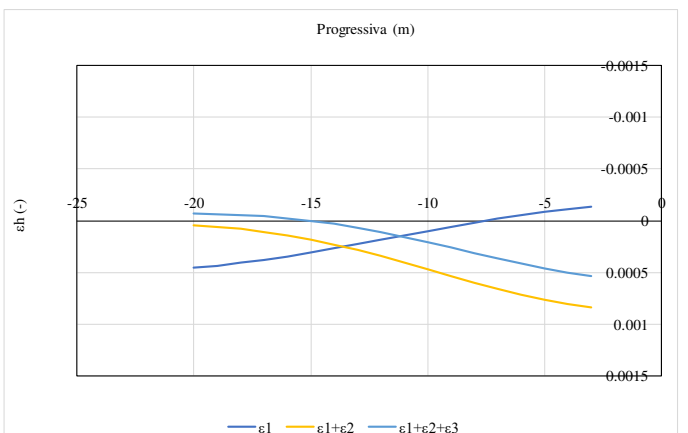
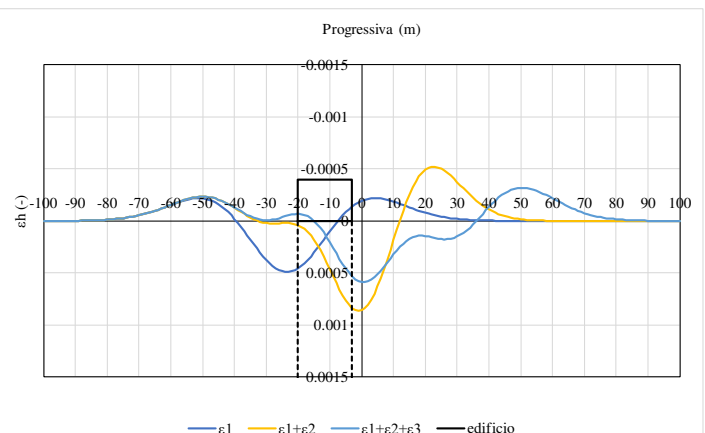
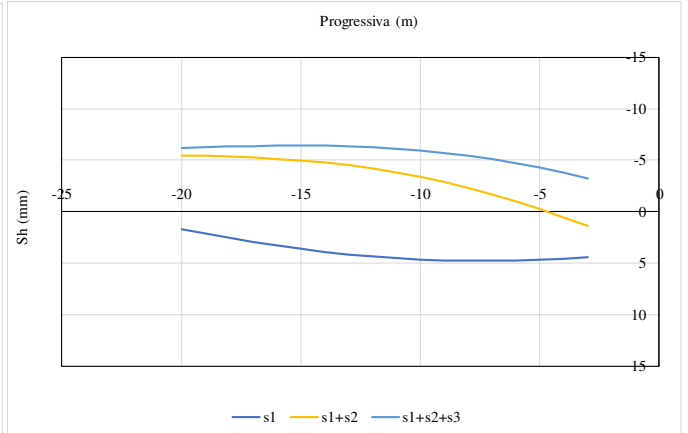
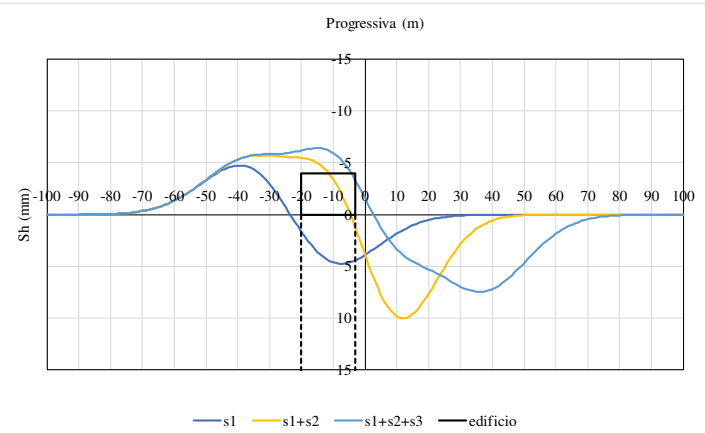
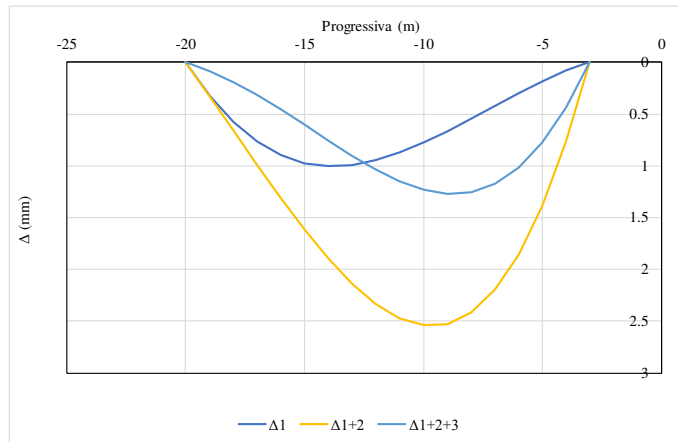
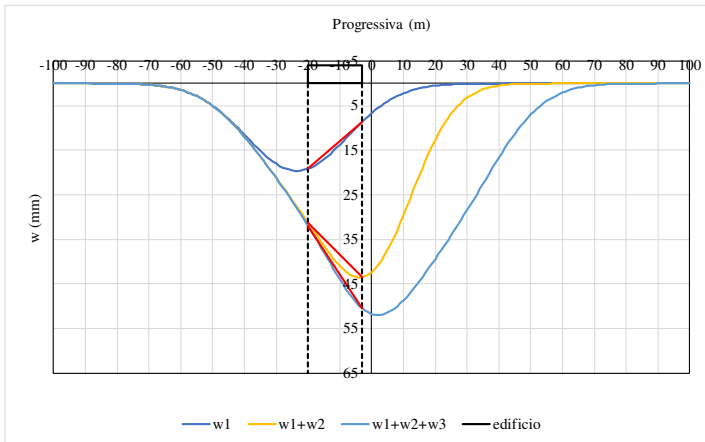
Abaco di danno hogging 1°, 2° e 3° canna

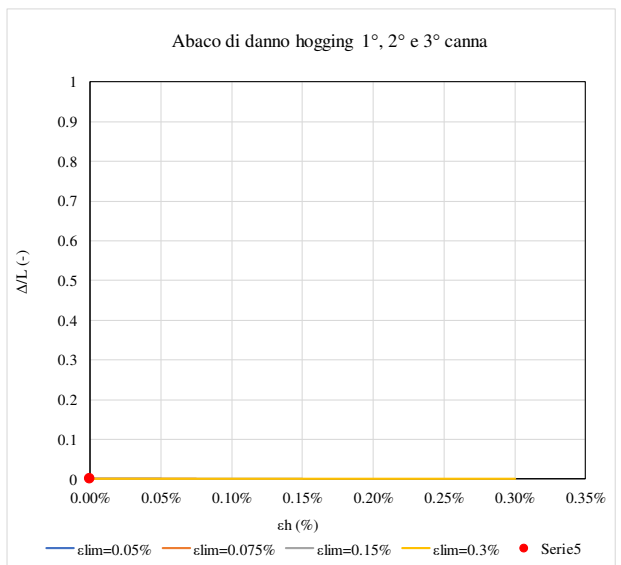
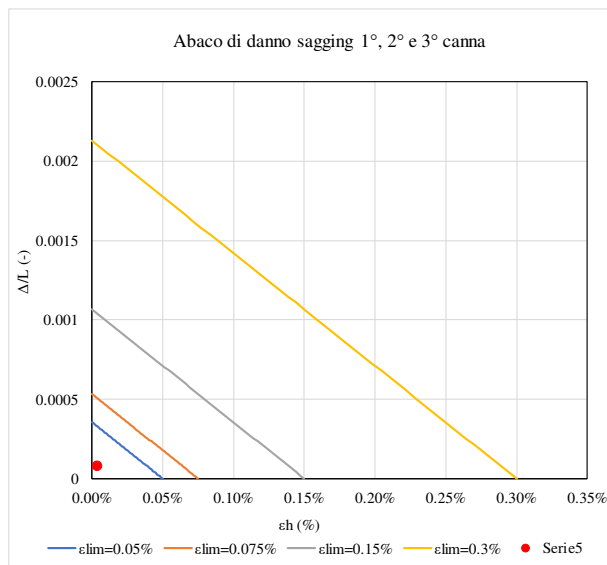
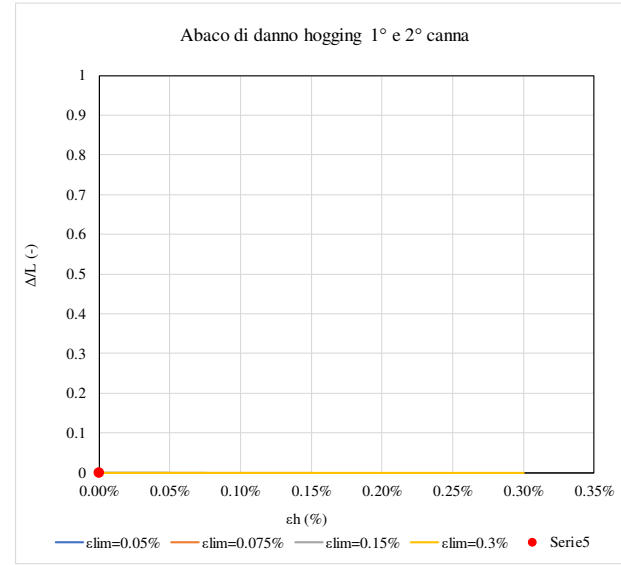
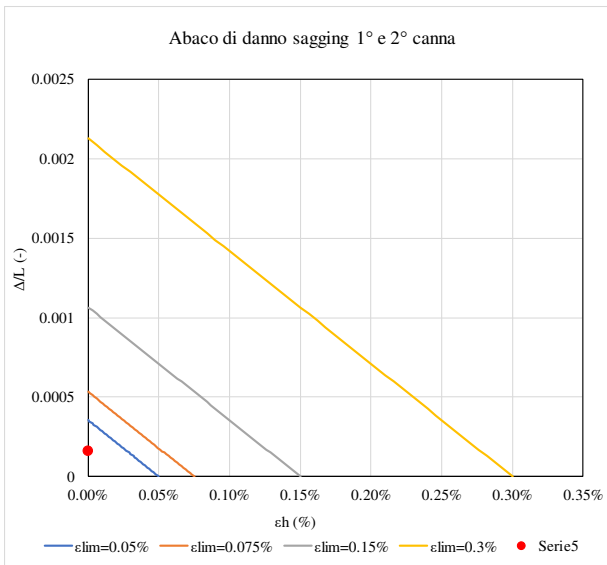
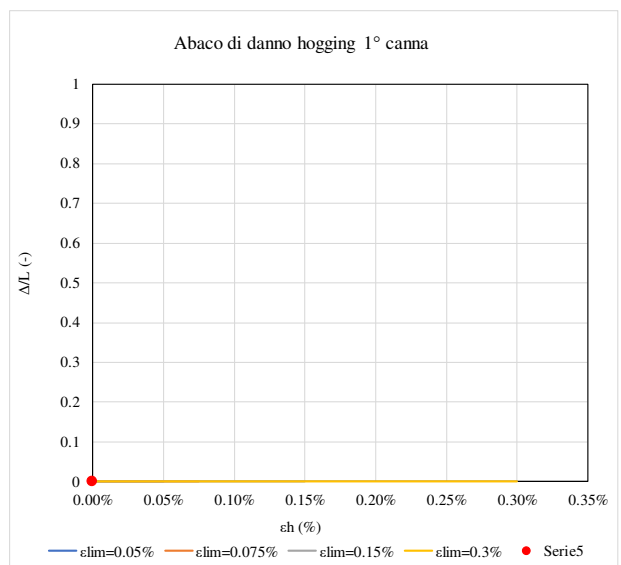
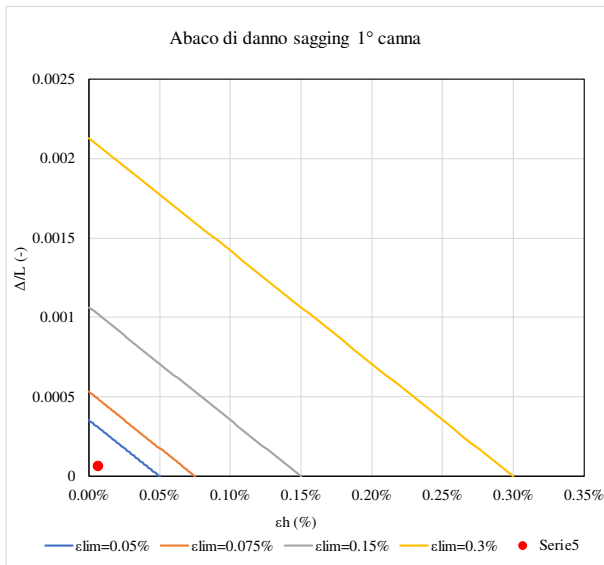


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
108	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
0.006%	0.016%	0.008%
#DIV/0!	#DIV/0!	#DIV/0!

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
-0.007%	#DIV/0!	-0.004%
#DIV/0!	#DIV/0!	#DIV/0!

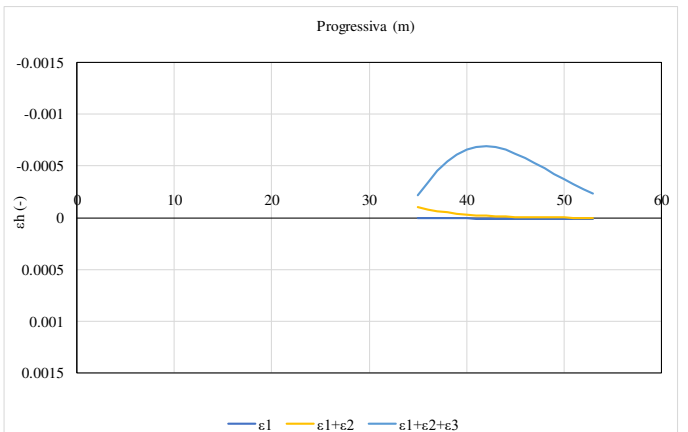
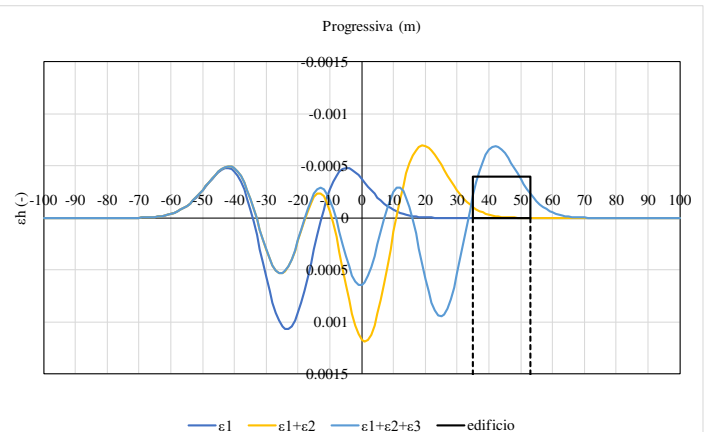
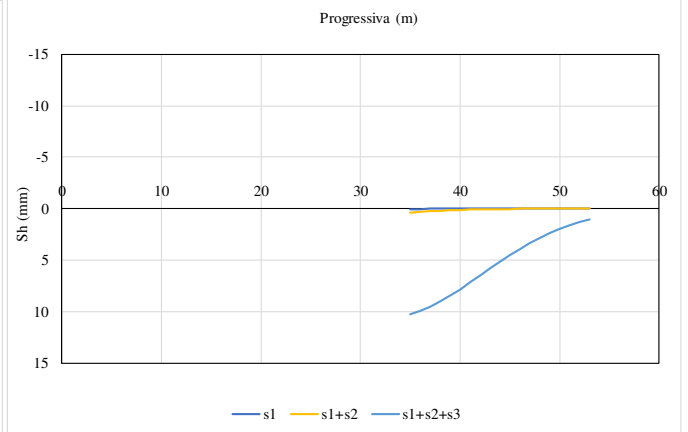
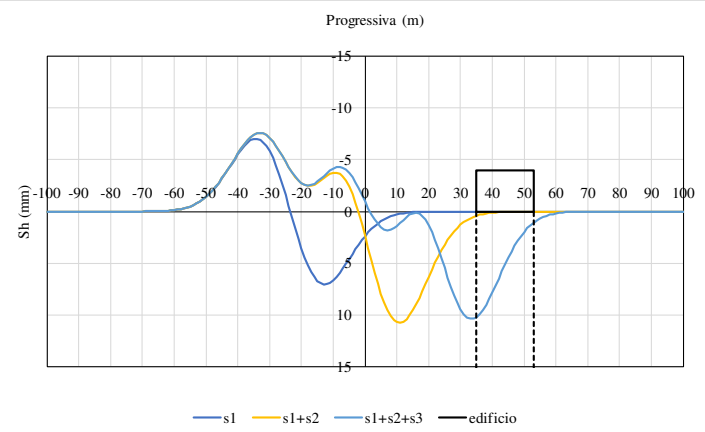
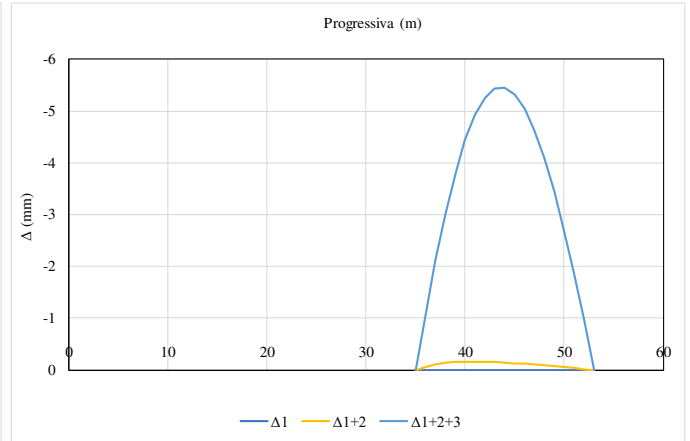
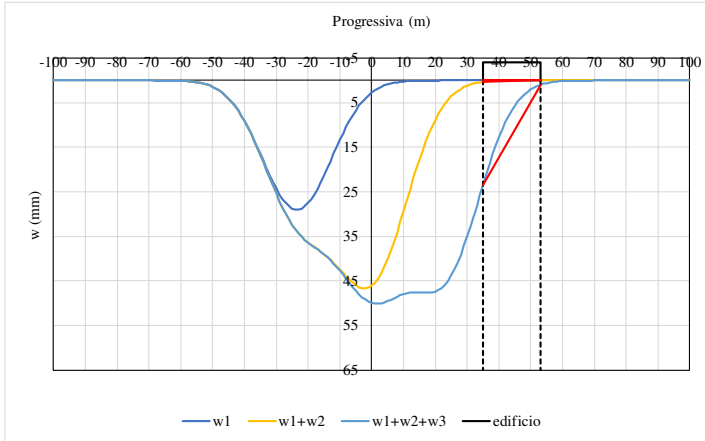


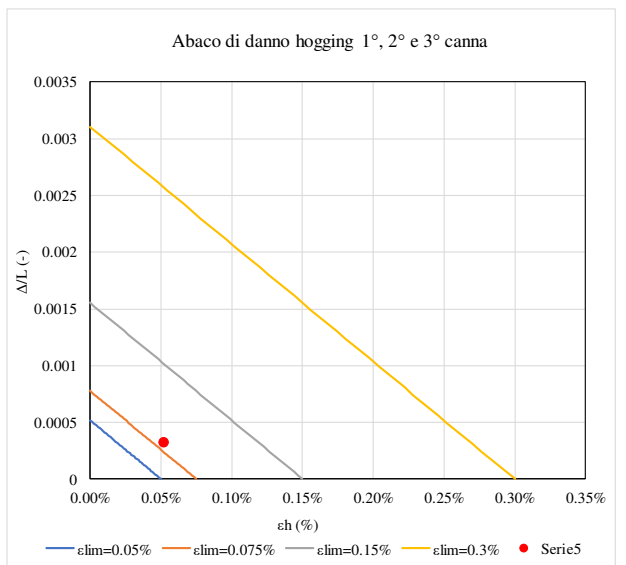
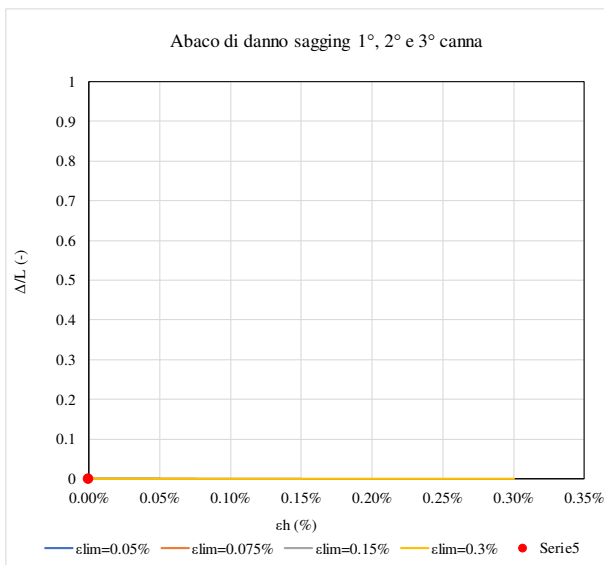
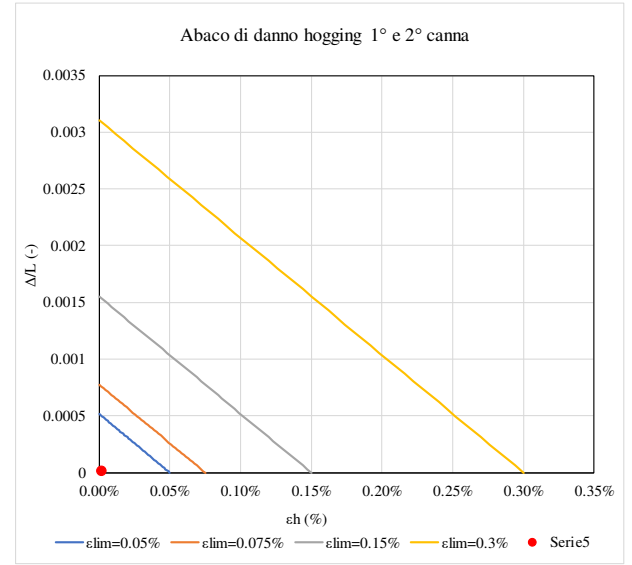
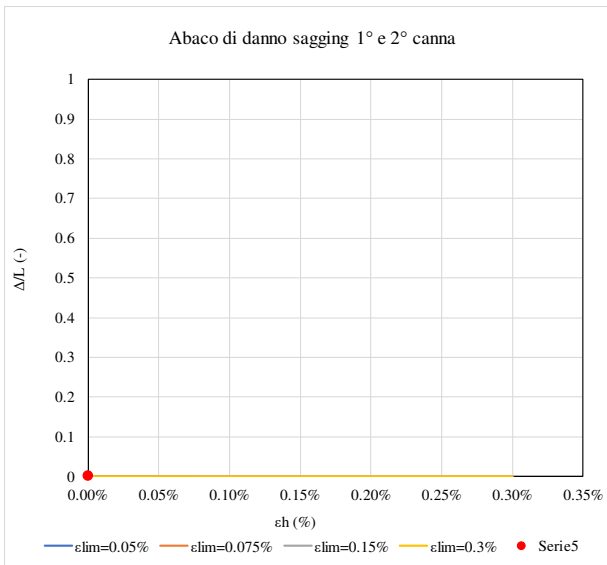
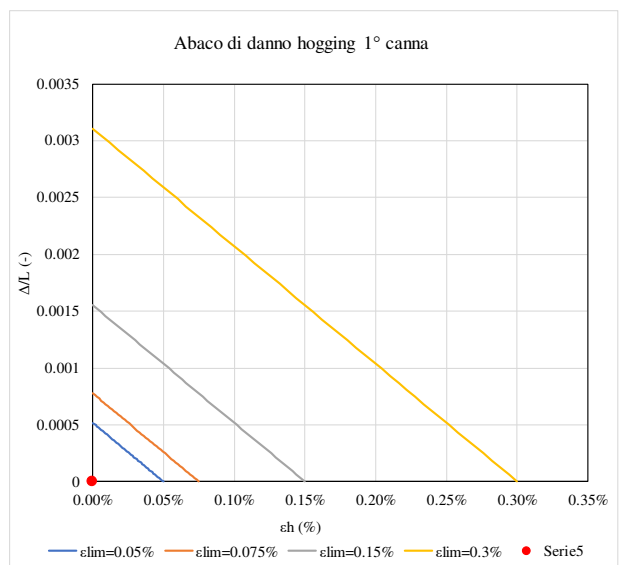
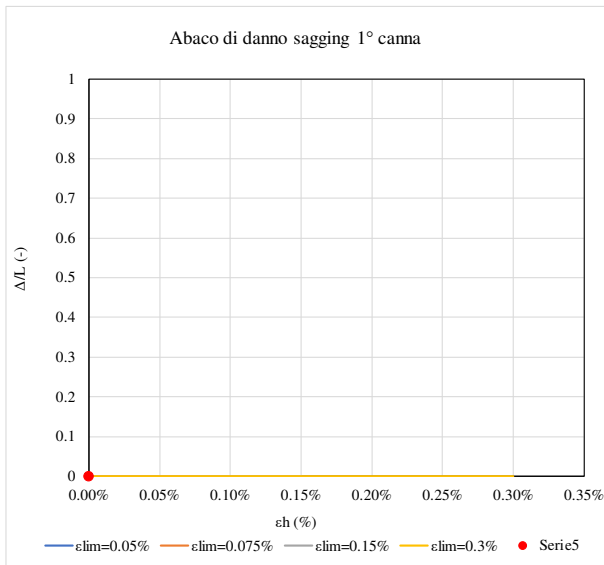


edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
109	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	0.001%	0.032%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
0.000%	-0.002%	-0.052%







edificio	scenario	K	V <sub>L,1</sub>	V <sub>L,2</sub>	V <sub>L,3</sub>	H	piani fuori terra	piani sotto suolo	d <sub>v</sub>	L <sub>ED</sub>	z <sub>0,GL</sub>	z <sub>0,SF</sub>
-	-	-	%	%	%	m			m	m	m	m
110	calcolo	0.4	1	2	1.4	12	3	1	5	76	30	24

$\Delta_1/L_1$	$\Delta_{1+2}/L_{1+2}$	$\Delta_{1+2+3}/L_{1+2+3}$
mm	mm	mm
#DIV/0!	#DIV/0!	#DIV/0!
0.015%	0.015%	0.015%

$\epsilon_{1,max}$	$\epsilon_{1+2,max}$	$\epsilon_{1+2+3,max}$
-	-	-
#DIV/0!	#DIV/0!	#DIV/0!
-0.017%	-0.018%	-0.018%

