Research Programme of the Research Fund for Coal and Steel

Steel RTD

Project carried out with a financial grant of the
Research Programme of the Research Fund for Coal and Steel

Deliverable 3.1

Translations of technical sheets and working examples

Technical Group
TGS 8 “Steel products and applications for buildings, construction and industry”

STEEL-EARTH: Steel-based applications in earthquake-prone areas

Project Acronym	STEEL-EARTH
Grant Agreement Number:	Contract Nº RFS2-CT-2014-00022
Coordinator:	Silvia Caprili, University of Pisa
Authors:	All partners – see inside for specific contributions
Start Date:	01/07/2014
Ed Date:	31/12/2015

STRUCTURES MÉTALLIQUES PRÉFABRIQUÉES POUR BÂTIMENTS DE FAIBLE HAUTEUR EN ZONE SISMIQUE

DESIGN OF STEEL CONCRETE COMMERCIAL BUILDINGS BRACED BY PREFABRICATED REINFORCED CONCRETE WALL SYSTEMS ALSO COUPLED WITH ENHANCED DISSIPATIVE SYSTEMS

Loris Bianco, Roberta Mallardo, Pietro Filipuzzi (Ferriere Nord S.p.A)

1. Introduction

Les paragraphes suivants expliquent la portée principale de Ferriere Nord SpA (FeNO) contribution à la recherche Precasteel, à propos de l'analyse des éléments préfabriqués en double dalle R.C. mur comme système de contreventement alternatif de faible hauteur en acier des bâtiments commerciaux situés dans des zones sismiques, en particulier la définition des configurations de mur de cisaillement et des niveaux de charge en se référant à un procédé innovant de pré-conception simplifiée.

L'une des parties du projet de recherche qui a profondément développé par FeNO a été axée sur la comparaison entre les solutions de murs en béton armé vers des systèmes en acier contreventement concentriques et excentriques, soulignant leur capacité de dissipation de l'énergie sismique et par conséquent, l'influence en termes de coût de la construction.

2. Objectifs du dimensionnement

L'approche de conception simplifiée mentionnée a pour but d'accélérer et de rendre plus facile toutes les décisions qui doivent être prises au sujet de la faisabilité d'un projet et, le dernier mais non le moindre, fournir une estimation économique de l'investissement.

Sur la base d'une analyse statistique des données préliminaires, les configurations structurelles ont été définies géométries de fixation (baies longueur, le nombre de niveaux, la configuration du sol ou pente de toit) afin d'être compatible avec les activités logées, industrielles ou commerciales, et d'être compétitif avec des parts de marché en béton . Les solutions structurelles sélectionnées pour les activités de construction commerciale ont été conçus de manière itérative faire varier les paramètres géométriques et de résister à des systèmes statiques afin de définir l'acier optimale et des solutions mixtes acier-béton.

La conception itérative de nombreuses structures, intégrées à l'analyse des coûts, a été transformé en une analyse de performance complète où la performance structurelle (évaluée l'application cadre de conception Eurocode) ont été harmonisées avec les coûts de construction. Le modèle de coûts considérés comme des renseignements provenant de trois pays différents (Italie - Europe du Sud, Allemagne - Europe centrale, Roumanie - Europe de l'Est), de manière à adopter des valeurs de référence normalisées et à individualiser dans lequel les marchés nationaux des solutions peut être compétitive ou non .

En ce qui concerne les bâtiments commerciaux, les solutions issues de l'analyse statistique et de l'analyse des coûts ont été en général une solution modulaire dans laquelle deux structures principales ont été couplés et consacrés à des rôles différents:

- Une structure de gravité pour supporter des charges verticales;
- Une structure de contreventement pour soutenir les charges sismiques.

Les simulations numériques raffinés et les études d'optimisation de la performance structurelle des solutions de bâtiments commerciaux où consacrés à l'évaluation des performances réelles sismique des

différents systèmes de contreventement horizontal. Les configurations structurales suivantes ont été analysées:

- Bâtiments commerciaux équipés de cadres en acier concentriquement contreventements (Unicam);
- Bâtiments commerciaux équipés de cadres en acier excentriquement contreventements (Unicam);
- Bâtiments commerciaux équipés de murs préfabriqués en béton armé (FeNO);
- Bâtiments commerciaux équipés de paliers en caoutchouc dissipatives élevées entre la structure de la gravité et les murs préfabriqués en béton armé.

La dernière partie de la recherche a été axée sur la définition d'une méthode de conception (procédure) apte à supporter les praticiens et les ingénieurs dans l'utilisation des solutions étudiées dans Precasteel, afin de créer un logiciel innovant et de haute qualité pour la valorisation et l'utilisation de la structure les solutions envisagées ici. Le logiciel automatisé est devenu une application Internet que chaque pratiquant et ingénieur peuvent utiliser à partir de son bureau pour la conception préliminaire d'une structure complète pour les activités industrielles et commerciales en utilisant des solutions Precasteel. L'application Web fonctionne comme une interface graphique conviviale, qui à partir d'un ensemble fini de jeu paramétré et optimisé des données, fournit les dessins et l'estimation du coût de la structure, les planchers, le toit et les connexions pour les bâtiments industriels et commerciaux.

3. Données d'entrée du dimensionnement

La définition d'une procédure de pré-conception pour les bâtiments commerciaux, qui est capable de fournir aux concepteurs des solutions environ R.C. murs que les systèmes de contreventement alternatives, sont basées sur des hypothèses concernant les paramètres géométriques et des niveaux de charge spécifiques:

Hypothèses géométriques:

- Hauteur d'étage:
  H = 6 - 8 m (Bâtiments à un niveau);
  H = 4 - 5 - 6 m (Bâtiments à deux niveaux);
- Longueur de mur:
  B = 8 - 10 - 12 m (Bâtiments à un niveau);
  B = 4 - 5 - 6 m (Bâtiments à deux niveaux);
- Épaisseur de mur:
  s = 0.20 - 0.25 - 0.30 - 0.35 - 0.40 m.

Hypothèses de chargement:

- Cisaillement maximum en base (séisme, vent) pour un mur BA seul:
  V_b = 500 - 1000 - 1500 - 2000 kN;
- Charges permanentes sur plancher/toiture:
  G_{1k} = 2.85 kN/m^2 (Poids propre des planchers, voir Figure 1);

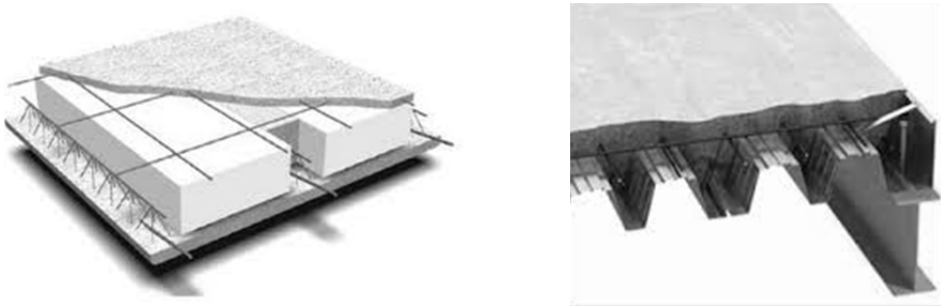


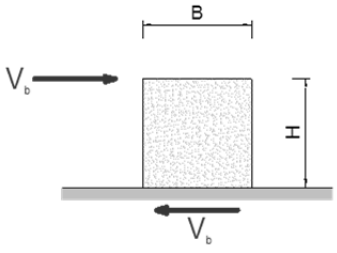
Figure 1: Typologies de plancher BA (Prédalle) et composite adopté.

- Charges permanentes additionnelles:
  G_{2k} = 1.80 kN/m^2;
- Charges variables (lourdes):
  Q_k = 8.00 kN/m^2 (Activités commerciales);
- Charges variables standards:
  Q_k = 5.00 kN/m^2 (Activités commerciales);
- Charges variables légères:
  Q_k = 2.00 kN/m^2 (neige);
- Niveau de sismicité (PGA):
  a_g = 0.08 g (sismicité faible);
  a_g = 0.16 g (sismicité modérée);
  a_g = 0.32 g (sismicité élevée);
- Les murs BA sont conçus pour résister à la fois des actions sismiques et de vent, en supposant que quatre distributions différentes des forces étages (distributions A, B, C, D, comme expliqué dans la figure 2). Dans le cas de vent, le cisaillement à la base a été distribué de telle sorte que la force appliquée au premier étage est le double de celle appliquée au niveau du toit; dans le cas des actions sismiques, en supposant que le premier mode de vibration pour être linéaire, le cisaillement de base a été distribué selon les formules suivantes (où M représente étages masse sismique):

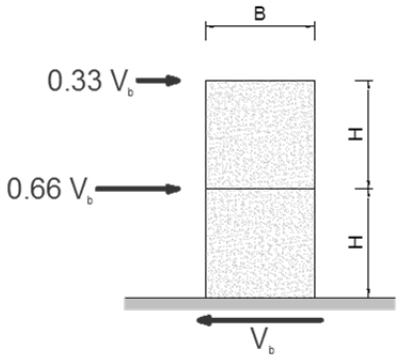
$$F_1 = V_b\left(\frac{M_1 \cdot H}{M_1 \cdot H + 2 \cdot M_2 \cdot H}\right)$$

$$F_2 = V_b\left(\frac{2 \cdot M_2 \cdot H}{M_1 \cdot H + 2 \cdot M_2 \cdot H}\right)$$

DISTRIBUTION "A"
SEISMIC AND WIND ACTION



DISTRIBUTION "B"
WIND ACTION



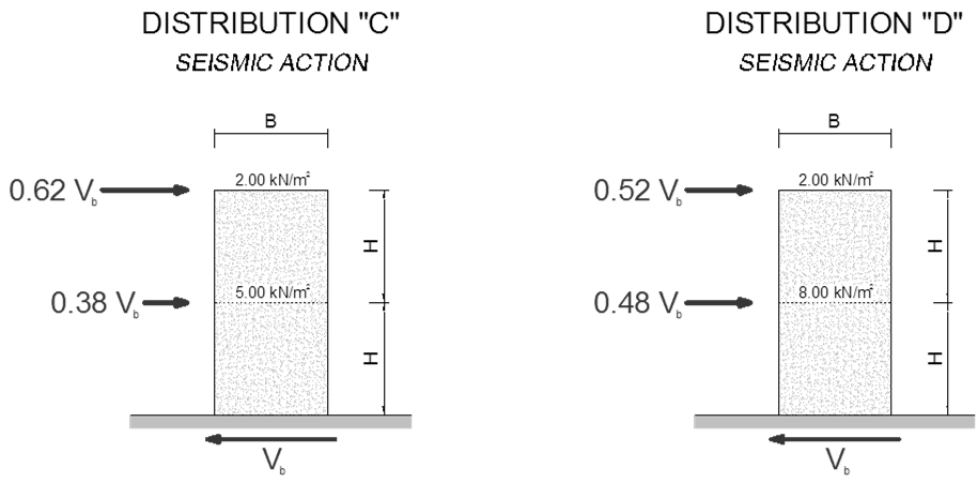


Figure 2: Distribution des forces horizontales.

4. Concepts spécifiques de dimensionnement

La définition de la méthode de pré-conception mentionné pour R.C. murs que les systèmes de contreventement alternatives dans les bâtiments commerciaux en acier est basée notamment sur une hypothèse concernant l'idéalisation du comportement de la structure:

- Simplifier les systèmes statiques, obtenus par extraction de structures avec une complexité plus faible, mais toujours en mesure de décrire le comportement de l'ensemble de la structure;
- Substructures sont réguliers dans l'usine et en élévation, en termes à la fois de la distribution des masses sismiques et la rigidité;
- Systèmes de plancher, des colonnes et des murs sont conçus en tenant compte des charges verticales séparément pour les deux et horizontales premières actions (actions sismiques et de vent) pour le troisième (voir la figure 3);

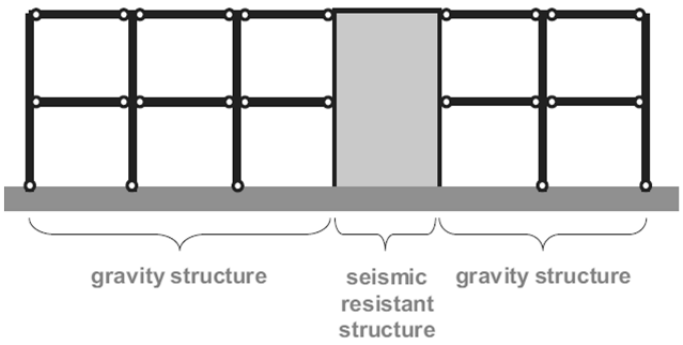


Figure 3: Découplage des charges horizontales et verticales.

- les systèmes de plancher sont supposés comme diaphragmes rigides;
- les structures de base sont considérés et modélisés comme des contraintes rigides idéales;
- linéaires analyses élastiques;
- Analyse sismique statique aux murs ductiles (ULS) de conception pré, sismique dynamique simplifiée des analyses pour donner une estimation de l'influence zone / mur (en tenant compte des masses localisées pour chaque étage);
- Renversement des modes de vibration sont évités par des joints techniques (écarts entre les modules architecturaux) et une disposition symétrique des parois;
- Murs ductiles sont (formes à savoir C ou plan de L pour les escaliers) découplées;
- Mur de déformation de cisaillement est pris en compte par le biais d'un modèle de rigidité de la paroi raffinée (modèle Timoshenko);
- limitations imposées par Eurocodes sont pris en compte afin d'obtenir des performances structurelles conformes aux dispositions standard.

5. Méthodologie du dimensionnement

Afin d'obtenir le nombre minimum de murs sismiques résistant, capable de résister à des cisailles de base attribué Vb et donné une zone spécifique de la construction commerciale, la procédure suivante est adoptée.

Le premier mode de vibration est supposée linéaire, de manière cohérente avec les distributions de force étages adoptées antérieurement, et il peut être exprimé comme suit:

$$a^T = \left[\frac{1}{n} \quad ... \quad \frac{i}{n} \quad ... \quad 1 \right] \qquad i = 1, ..., n \text{ (storey number).}$$

Avec K la matrice de rigidité de translation des murs et M la matrice de masse correspondant à une unité de surface, la période fondamentale T du système peut être estimé à partir de l'expression:

$$T = 2\pi \cdot \sqrt{\frac{a \cdot Ma}{a \cdot Ka}} \cdot \sqrt{A}$$

où A est le mur inconnu zone d'influence.

L'influence la zone A de la paroi unique peut être évaluée en résolvant l'équation non linéaire suivante, obtenue en assimilant Vb affecté à la cisaille de base prévu:

$$V_b = A \cdot \frac{(a \cdot Mr)^2}{a \cdot Ma} \cdot S_d(T)$$

où Sd est le spectre de conception.

Cette approche est valable uniquement pour le type "A", "C" et "D" répartition des forces statiques (voir la figure 4), dans lequel le cisaillement de base est due à des actions sismiques; pour le type de distribution "B" les forces sont originaires par le vent et l'analyse de l'influence la zone A de la paroi unique est imprévisible, car il nécessite de connaître la forme exacte de l'immeuble et les surfaces exposées au vent. Les résultats obtenus sont appelés les spectres de conception proposée par Eurocode 8 pour le type de sol B.

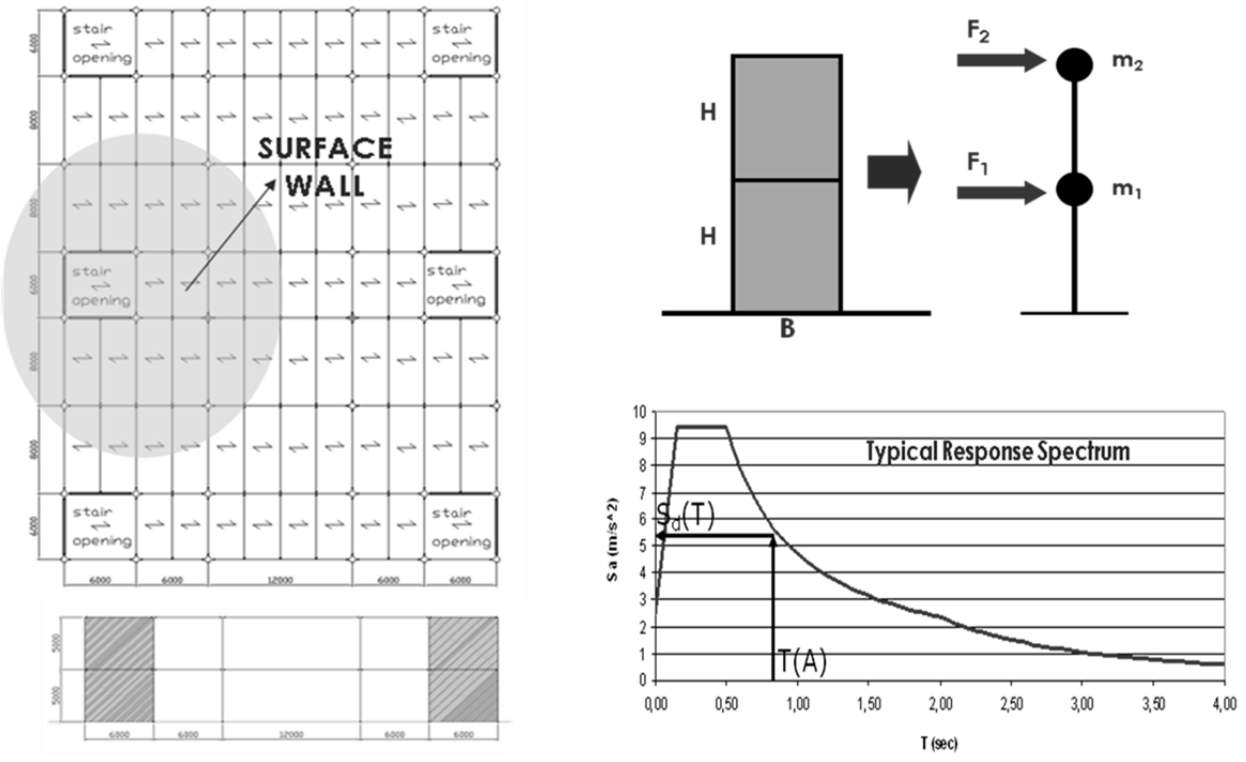


Figure 4: Approche simplifiée pour estimer la surface tributaire A d'un mur donné.

Alors, pour résumer, l'entrée étapes que le concepteur doit suivre sont:

a) fixant les charges horizontales de cisaillement de base maximale (tremblement de terre, le vent) pour un seul R.C. mur;

b) le choix de l'intensité de la charge vive appliquée aux structures de bâtiments commerciaux (lourd, standard, lumière charge en direct);

c) la définition du niveau site sismicité (PGA, l'accélération maximale du sol);

d) en supposant une distribution des forces d'un étage (A, B, C ou D) en référence aux numéros des histoires et la nature des actions (vent ou sismiques);

e) la fixation de la classe de ductilité de la structure (DCH et DCM pour les structures dissipatives, DCL pour les structures de R.C. qui ne dissipent pas l'énergie sous des charges cycliques générées par un tremblement de terre);

f) l'estimation du coefficient de comportement (q) de la structure en se référant à la classe de ductilité et les propriétés géométriques de la R.C. mur (étages de hauteur, largeur, épaisseur).

Compte tenu de tout l'hypothèse décrite précédente et l'application de la procédure de conception simplifiée, selon les normes Eurocodes, a été possible de construire une base de données (un résumé, à savoir, est rapporté dans le tableau 1) dans lequel le logiciel de Precasteel final sera en mesure de fournir concepteur un variété de solutions possibles pour rc systèmes de murs et de la sismique de surface d'un bâtiment commercial que ce type de R.C. système de contreventement est en mesure de soutenir.

Table 1: Exemple de données d'entrée et de résultats pour un mur BA isolé.

INPUT								
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor
2	**4.00**	**4.00**	**0.20**	**500**	**C**	**0.16 g**	**DCH**	**4.00**
2	**4.00**	**4.00**	**0.20**	**500**	**C**	**0.16 g**	**DCM**	**3.00**
2	**4.00**	**4.00**	**0.20**	**500**	**C**	**0.16 g**	**DCL**	**1.00**

OUTPUT						
Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]
374	**52**	**6**	**553**	**15360**	**6.40**	**32**
307	**52**	**6**	**553**	**15360**	**6.40**	**32**
156	**52**	**6**	**553**	**15360**	**6.40**	**32**

6. Détails

Procédure de pré-conception de R.C. murs que les systèmes de contreventement est facile, intuitif et rapide, également dans la définition des détails structurels proposés et prescrits par Eurocodes, en particulier:

- Eurocode 8 pour plus de détails sur les régions critiques et les zones confinées des murs pour les classes de ductilité DCH et DCM;
- Eurocode 2 pour plus de détails au sujet de faible R.C. dissipative structures (DCL) ou structures isolées par des dispositifs spécifiques.

Les images suivantes décrivent les détails structuraux typiques pour R.C. système de mur de cisaillement sur:

- Coin détail structurel pour R.C. système de contreventement de mur et des configurations de plan commun (voir la figure 5);
- Détail structurel pour la connexion entre R.C. mur et R.C. étage préfabriqué (voir Figure 6);
- Détail structurel pour la connexion entre R.C. mur et sa fondation (voir Figure 7).

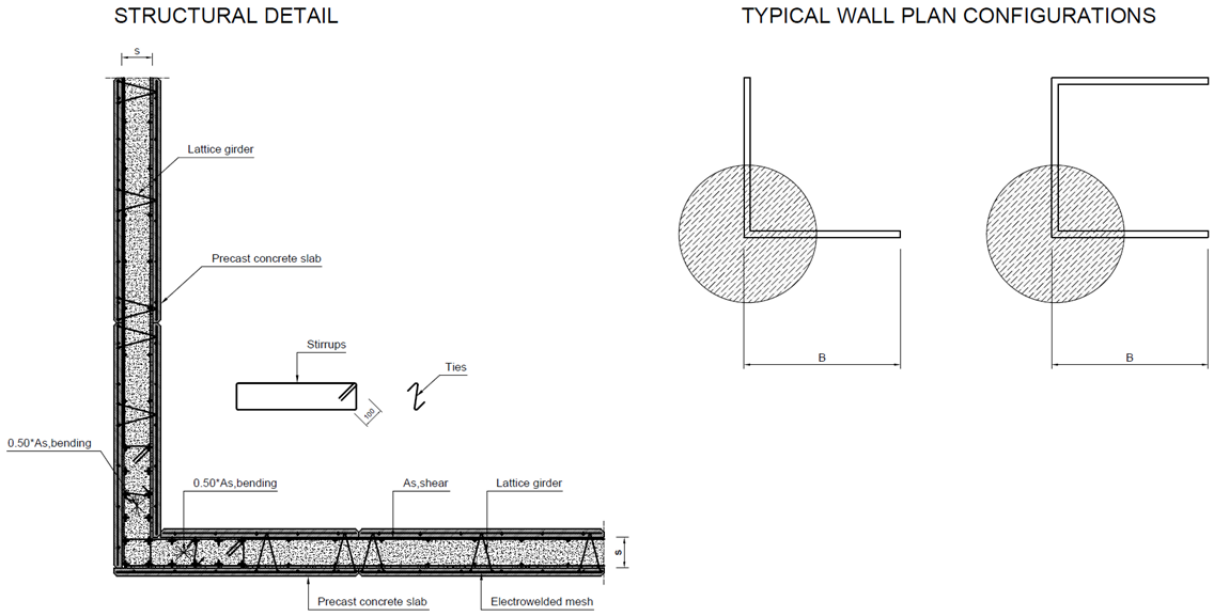


Figure 5: Exemple de détail de structure d'angle pour murs de contreventement BA et vues en plan usuelles.

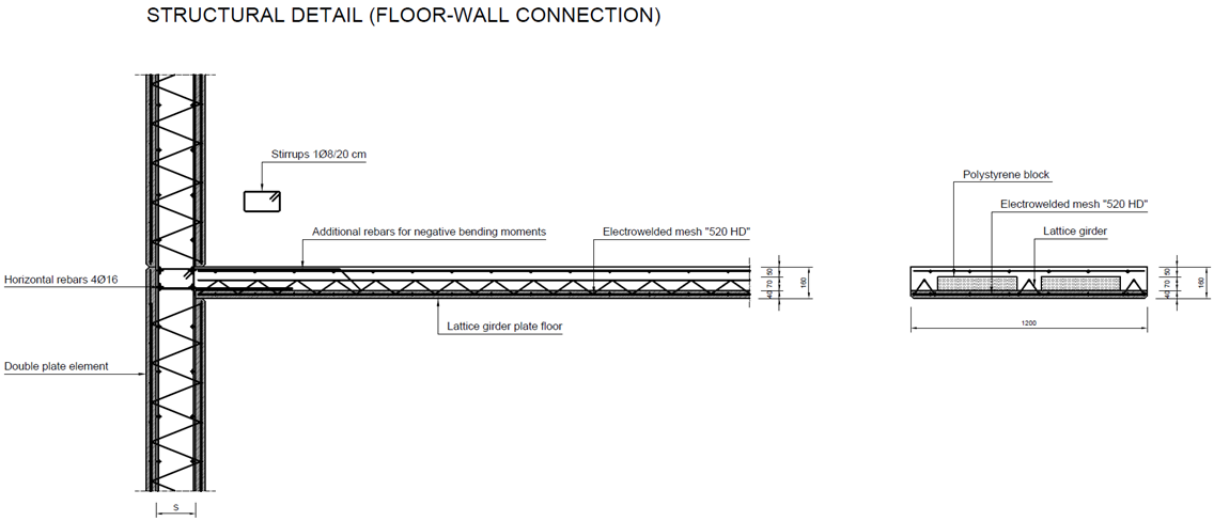


Figure 6:Exempe de détail structurel pour connecxion entre mur BA et plancher préfabriqué en béton (coupe verticale).

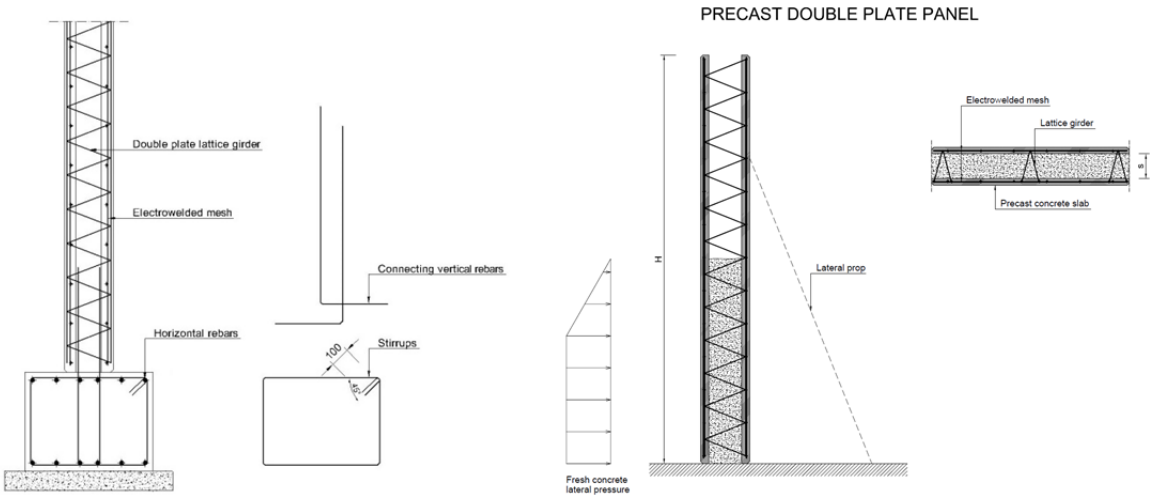


Figure 7: Exemple de détail structurel pour connexion entre mur BA et fondation (coupe verticale).

Avant la coulée du béton à l'intérieur du R.C. mur, l'élément préfabriqué doit être appuyé; accessoires doivent être ancrés dans une plaque en mesure de soutenir leurs efforts de compression et de tension. Dans la correspondance du coin, il est nécessaire de fixer les murs à double dalle avec une plaque d'acier en forme opportunément ou avec d'autres accessoires (voir la figure 8).

Figure 8: Opérations d'assemblage de mur préfabriqués en béton.

Le casting du béton frais doit être supervisé pour vérifier la limite de vitesse supérieure de 50 cm / heure, afin d'éviter que la pression latérale serait supérieure à 2500 daN / m2. Par ailleurs, le plâtre doit être effectuée dans le temps différents, en fonction de la conception des poutres en treillis.

Pour ce qui concerne les détails structurels sur les connexions entre la structure principale en acier (poutres, colonnes) et R.C. murs, il y a deux façons possibles de détail:

<u>Liaison découplant les charges verticales et horizontales</u>

Dans ce cas, nous avons besoin d'un faisceau auxiliaire supplémentaire, qui transfère des charges de gravité vers les principales colonnes d'acier, de sorte que nous pouvons nous connecter notre R.C. système de contreventement à l'armature en acier de découplage des charges verticales et horizontales (voir la figure 9).

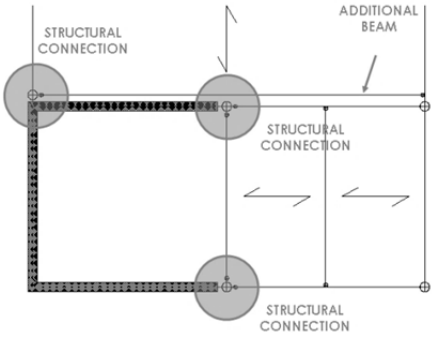


Figure 9: Exemple de connexion entre structure métallique et mur en béton, découplage des charges verticales et horizontale (vue en plan).

Liaison pour à la fois les charges verticales et horizontales

Dans ce cas, on n'a pas besoin d'un faisceau auxiliaire supplémentaire et nous pouvons nous connecter directement notre R.C. système de contreventement à l'armature en acier; alors, il est possible pour les murs supportent même des charges verticales sans compromis leur comportement sismique (voir figure 10).

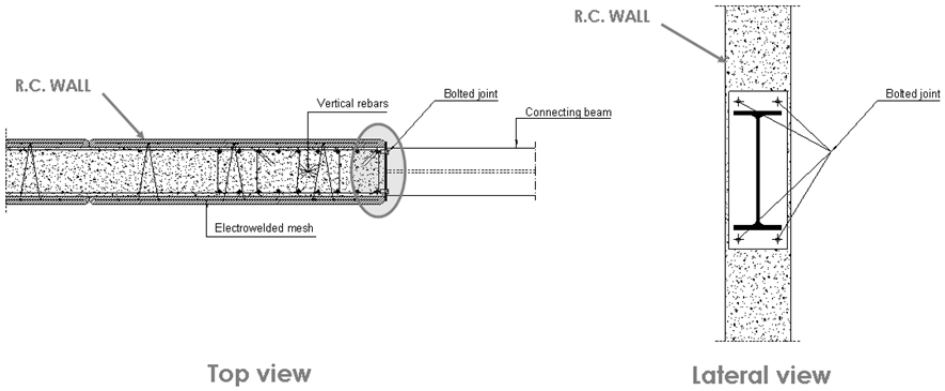


Figure 10: Exemple de connexion entre structure métallique et mur en béton pour charges simultanées horizontales et verticales.

Connexions entre structure en acier (poutres, colonnes) et R.C. murs que les systèmes de contreventement pourraient être réalisées d'une manière simple par des ancrages chimiques ou mécaniques, après l'érection du R.C. structure. Une autre façon de réaliser ce genre d'articulations est la liaison boulonnée classique, en forme et inclus dans le coffrage avant la coulée du béton. Si la structure principale est isolée par des dispositifs dissipatives, à chaque étage, il y a des joints en acier spécifiques pour prévenir le martelage entre les systèmes de murs et structures de plancher.

7. Comparaison entre murs BA et systèmes de contreventements métalliques

L'une des parties du projet de recherche qui a profondément développé par FeNO a été axée sur la comparaison entre renforcés des solutions de murs en béton vers des systèmes en acier contreventement concentriques et excentriques.

Tout d'abord, le modèle du coût a été mis à jour pour l'année en cours compte tenu à la fois une analyse détaillée des prix et des listes de prix officiels des administrations publiques (cette activité a été résumée dans le tableau 2), la collecte des informations provenant de différents pays (Italie - Europe du Sud, l'Allemagne - Europe centrale).

Table 2: Coûts de construction unitaires (Italie – Europe du sud; Allemagne – Europe centrale).

ITEM	Coût unitaire	U.M.	NOTE
Béton pour mur BA (sans coffrage)	**322.22**	€/m^3	C25/30, XC2, S4.
Béton pour dalles BA (sans coffrage)	**222.22**	€/m^3	C25/30, XC2, S4.
Acier pour structure BA	**1.90**	€/kg	
Panneaux doubles préfabriqués pour murs BA	**23.25**	€/m^2	Y compris le coût des poutres treillis, treillis soudés et assemblés, Non compris le coût du béton coulé en place.
Plancher BA préfabriqués (Prédalles)	**32.99**	€/m^2	Solution non étançonnée.
Dalles mixtes sur tôle profilée	**54.57**	€/m^2	Solution non étançonnée.
Acier de charpente	**2.74**	€/kg	S355, y compris traitements de surface, montage, et assemblages boulonnés et soudés.

De la base de données Precasteel complète mise en œuvre par FeNO (pour le système de mur de R.C. contreventement) et UniCAM (pour les systèmes de contreventement en acier), il est important de comprendre la commodité sur le choix d'un type spécifique de système de contreventement. Ensuite, il a été possible de comparer les systèmes de contreventement différents en termes de zone d'influence et en termes de coût total et de l'unité, les paramètres géométriques, les niveaux de charges et la capacité de dissipation d'énergie variable pour chaque type de système de contreventement.

Dans les comparaisons suivantes, il est possible que l'avis R.C. système de plancher (predalle) sont toujours plus pratique que l'acier plancher de bâches en termes de coût, par conséquent, ce type de système de revêtement de sol a été supposé comme un paramètre constant pour chaque évaluation liée aux comparaisons.

Il était possible d'observer, de même pour la distribution A, C ou D, qu'il existe une tendance significative qui font en évidence les principaux avantages dans le choix des R.C. système de contreventement à la place d'acier système de contreventement (concentriques ou excentriques), tant en termes de zone d'influence et en termes de coût unitaire (voir Figure 11 et Figure 12, pour la distribution C).

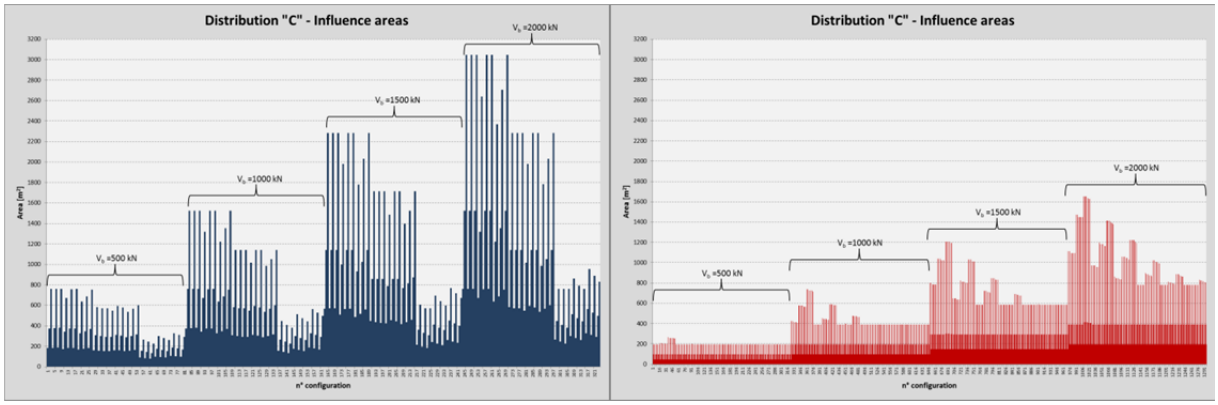


Figure 11: Comparaison en termes de surface d'influence – mur de cisaillement BA (gauche) vs. triangulations métalliques centrées (droit).

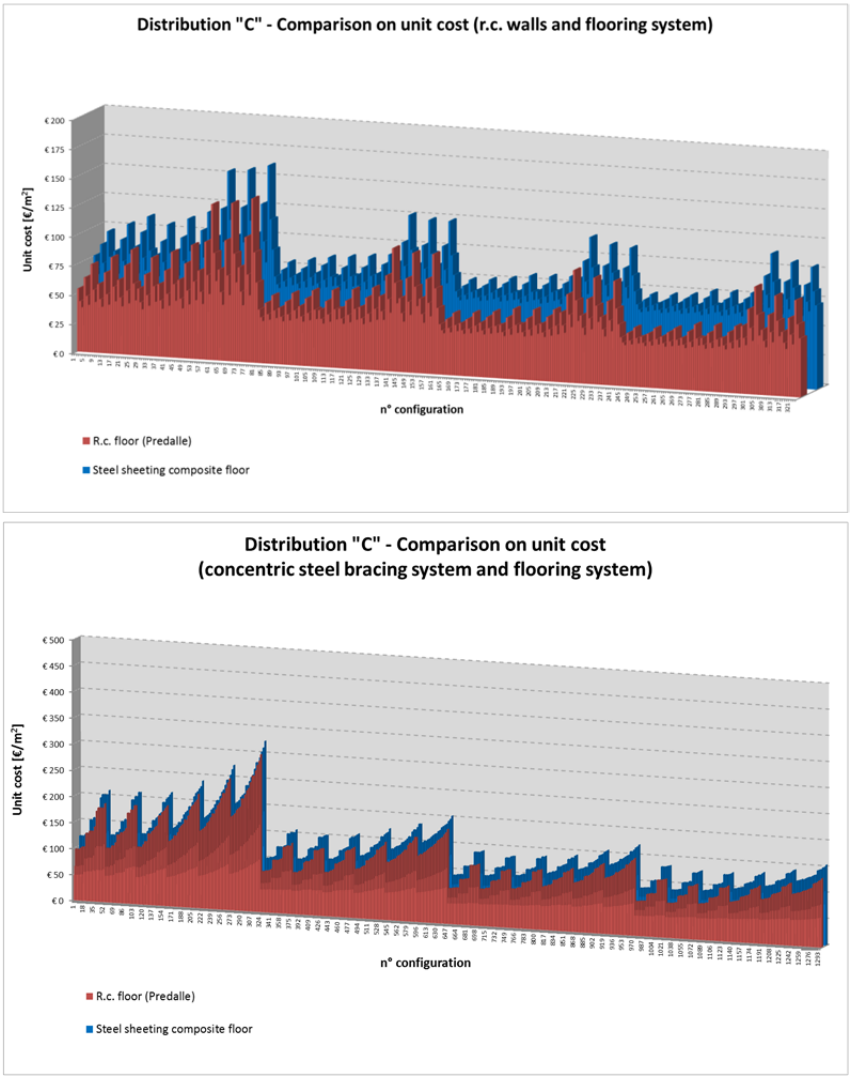


Figure 12: Comparaison en termes de coût unitaire – mur de cisaillement BA (haut) vs. triangulations métalliques centrées (bas).

En outre, la comparaison de toutes les configurations possibles pour R.C. et système de contreventement en acier, il est intéressant de remarquer que l'acier contreventement systèmes ne résistent pas toujours dans la gamme complète de la force de base cisaillement Vb = 500 ÷ 2.000 kN, mais ils sont souvent limités sur les forces supérieures en raison de la conception des limites en termes de géométrie les profilés en acier commerciaux.

Pour confirmer ce FeNO remarqué et a découvert à propos de la commodité générale dans le choix des R.C. mur système au lieu de système de contreventement en acier contreventement (concentriques ou excentriques), dans le tableau 3 suivant est exposée l'activité de l'échantillonnage de base de données et les résultats de la comparaison (extraction 72 cas sur une population de 972 configurations, voir l'annexe 1, 2, 3 pour plus étendue et les évaluations achevées) finalisées pour donner une estimation de la commodité mentionnée. Cette activité de l'échantillonnage de base de données a été effectuée fixant certains paramètres sur les niveaux de géométrie et de la charge, afin d'évaluer les configurations de contreventement les plus représentatives:

- Hauteur d'étage:

  H = 6 - 8 m (bâtiments à un niveau);

  H = 4 - 6 m (bâtiments à deux niveaux);

- Longueur de mur:

  B = 8 m (bâtiments à un niveau);

  B = 4 m (bâtiments à deux niveaux);

- Niveau de sismicité (PGA, peak ground acceleration):
  a_g = 0.16 g (sismicité modérée).

Table 3: Echantillonnage de la base de donnée et comparaison des résultats (distribution C).

ECHANTILLONNAGE DE LA BASE DE DONNEES - COMPARAISON (PARAMETRES: AIRE D'INFLUENCE, COÛT UNITAIRE)											
COMPARAISON n°	DISTRIBUTION	SISMICITE (a_g)	MUR DE CISAILLEMENT BA				CISAILLEMENT EN BASE V_b [kN]	TRIANGULATION METALLIQUE			
			B [m]	H [m]	s [m]	CLASSE DE DUCTILITE		CENTREE	EXCENTREE 2 DIAG.	EXCENTREE 1 DIAG.	
1	C	0.16 g	4.00	4.00	0.20	DCH	500	MUR B.A.	MUR B.A.	MUR B.A.	RESULTATS
2	C	0.16 g	4.00	4.00	0.20	DCM	500	MUR B.A.	MUR B.A.	MUR B.A.	
3	C	0.16 g	4.00	4.00	0.20	DCL	500	MUR B.A.	TRIANGULATION ACIER	TRIANGULATION ACIER	
4	C	0.16 g	4.00	4.00	0.20	DCH	1000	MUR B.A.	MUR B.A.	MUR B.A.	
5	C	0.16 g	4.00	4.00	0.20	DCM	1000	MUR B.A.	MUR B.A.	MUR B.A.	
6	C	0.16 g	4.00	4.00	0.20	DCL	1000	MUR B.A.	MUR B.A.	MUR B.A.	
7	C	0.16 g	4.00	4.00	0.20	DCH	1500	MUR B.A.	MUR B.A.	MUR B.A.	
8	C	0.16 g	4.00	4.00	0.20	DCM	1500	MUR B.A.	MUR B.A.	MUR B.A.	
9	C	0.16 g	4.00	4.00	0.20	DCL	1500	MUR B.A.	TRIANGULATION ACIER	MUR B.A.	
10	C	0.16 g	4.00	4.00	0.20	DCH	2000	MUR B.A.	MUR B.A.	MUR B.A.	
11	C	0.16 g	4.00	4.00	0.20	DCM	2000	MUR B.A.	MUR B.A.	MUR B.A.	
12	C	0.16 g	4.00	4.00	0.20	DCL	2000	MUR B.A.	MUR B.A.	MUR B.A.	
13	C	0.16 g	4.00	6.00	0.30	DCH	500	MUR B.A.	MUR B.A.	MUR B.A.	
14	C	0.16 g	4.00	6.00	0.30	DCM	500	MUR B.A.	MUR B.A.	TRIANGULATION ACIER	
15	C	0.16 g	4.00	6.00	0.30	DCL	500	MUR B.A.	TRIANGULATION ACIER	TRIANGULATION ACIER	
16	C	0.16 g	4.00	6.00	0.30	DCH	1000	MUR B.A.	MUR B.A.	MUR B.A.	
17	C	0.16 g	4.00	6.00	0.30	DCM	1000	MUR B.A.	MUR B.A.	MUR B.A.	
18	C	0.16 g	4.00	6.00	0.30	DCL	1000	MUR B.A.	TRIANGULATION ACIER	MUR B.A.	
19	C	0.16 g	4.00	6.00	0.30	DCH	1500	MUR B.A.	MUR B.A.	MUR B.A.	
20	C	0.16 g	4.00	6.00	0.30	DCM	1500	MUR B.A.	MUR B.A.	MUR B.A.	
21	C	0.16 g	4.00	6.00	0.30	DCL	1500	MUR B.A.	TRIANGULATION ACIER	MUR B.A.	
22	C	0.16 g	4.00	6.00	0.30	DCH	2000	MUR B.A.	MUR B.A.	MUR B.A.	
23	C	0.16 g	4.00	6.00	0.30	DCM	2000	MUR B.A.	MUR B.A.	MUR B.A.	
24	C	0.16 g	4.00	6.00	0.30	DCL	2000	TRIANGULATION ACIER	MUR B.A.	MUR B.A.	

La même considération à propos de comparer l'activité sont valables aussi bien pour A, C, ou la distribution de D et de ce fait confirme les avantages significatifs de R.C. choisir mur système de contreventement à la place d'acier système de contreventement, comme il peut être observé à travers l'analyse des graphiques suivant circulaires (voir la figure 13, pour la distribution C) qui résume tous les résultats de la comparaison et de donner une estimation de l'efficacité de chaque système de contreventement.

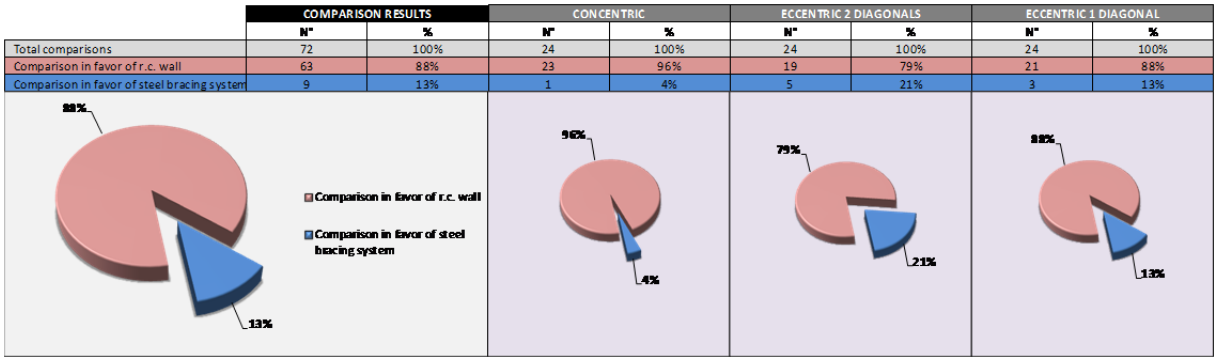


Figure 13: Echantillonnage de la base de données et comparaison – Mur de cisaillement BA vs. système de contreventement métallique (centré ou excentré).

Grâce à la procédure mentionnée, il a été possible obtenu des résultats et des conclusions importantes.

Il est intéressant de remarquer et il est important de souligner l'aspect suivant à propos de l'adoption de R.C. murs que les systèmes d'un bâtiment commercial contreventement: renforcé des solutions de murs en béton sont presque toujours (96%) concurrentiel vers acier concentriques systèmes de contreventement en raison de leur capacité de dissipation de l'énergie sismique, bien que leurs périodes de vibrations fondamentales sont généralement plus courtes; l'examen ci-dessus est souvent vrai (79% et 88%) à comparer les performances de R.C. solutions de murs vers des systèmes de contreventement en acier excentrique, même si ceux-ci ont une capacité potentielle beaucoup plus importante de la dissipation d'énergie due à des actions cycliques (en particulier, les actions sismiques) mais ont une limite supérieure pour résister aux forces de cisaillement qui n'a pas permis de les adapter à de nombreux différents situations.

La principale hypothèse du découplage des charges verticales et horizontales dans la construction de structures commerciales doit être strictement respectée pour l'acier des systèmes, en particulier pour les excentriques contreventement; en fait, ces types de systèmes de contreventement sont capables de dissiper une beaucoup plus grande énergie due à des actions cycliques si elles ne supportent que des

charges latérales, parce que les charges verticales (gravité ou surcharges) pourraient compromettre le comportement optimal de la liaison sismique. Vice versa, R.C. les murs sont en mesure de soutenir également la charge verticale pendant un tremblement de terre, sans compromis leur capacité de dissipation de l'énergie sismique et cette marque en évidence une polyvalence plus large d'employer ces typologie des systèmes de contreventement pour les structures générales; En outre, cette propriété de R.C. murs permet aux concepteurs de réduire le nombre de membres en acier (colonnes, poutres et joints, positionnés autour de contreventement systèmes pour supporter des charges verticales), puis de faire baisser l'estimation du coût total du bâtiment.

ANNEXE 1

COMPARAISON ENTRE MURS B.A. ET TRIANGULATIONS METALLIQUES

Distribution "A"

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=6m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	6.00	8.00	0.30	500	A	0.16 g	DCH	3.33	787	24	4	427	34560	14.40	48	32541	49532	41	63
1	6.00	8.00	0.30	500	A	0.16 g	DCM	2.50	673	24	4	427	34560	14.40	48	28781	43312	43	64
1	6.00	8.00	0.30	500	A	0.16 g	DCL	1.00	408	24	4	427	34560	14.40	48	20023	28826	49	71

Database UNICAM (steel bracing system - concentric, 2 diagonals):

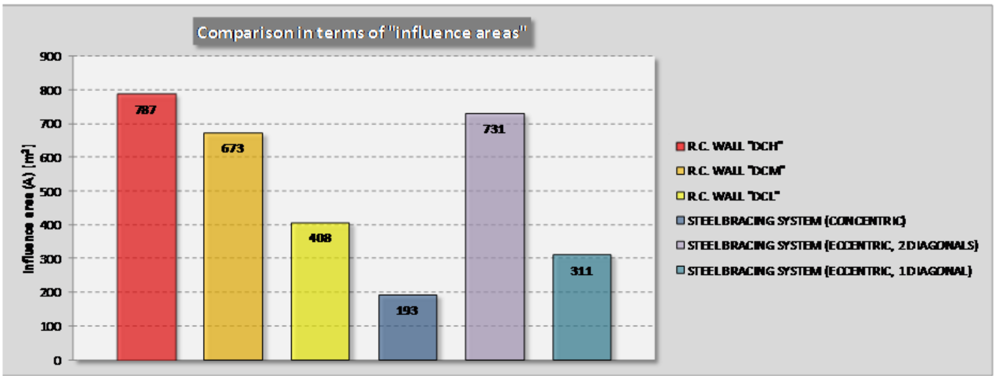
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 160 A	193	1377	10136	14300	53	74
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 160 A	193	1377	10136	14300	53	74
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 180 A	193	1438	10304	14468	53	75
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 180 A	193	1438	10304	14468	53	75
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 200 A	193	1520	10528	14691	55	76
8.00	6.00	2.00	0.16	500	HE 180A	HE 220A	HE 220 A	193	1618	10797	14961	56	78

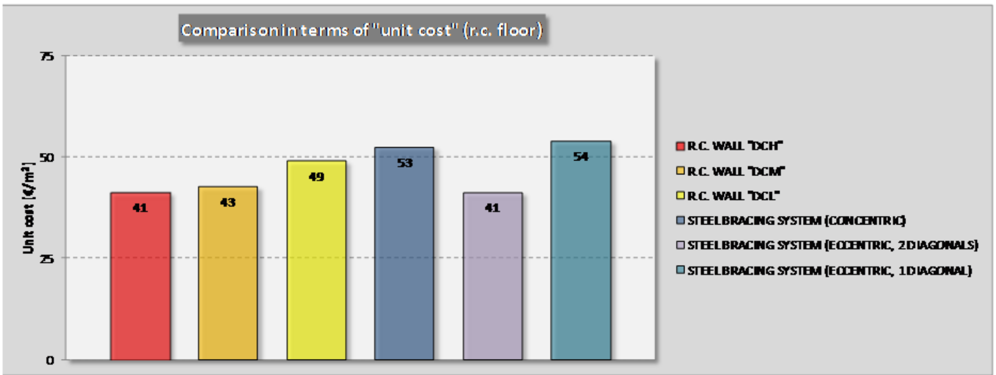
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 160B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 160B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 160B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 180B	732	2351	30580	46374	42	63
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 180B	732	2351	30580	46374	42	63
8.00	6.00	2.00	0.16	500	HE 220B	HE 240B	HE 200B	732	2472	30921	46722	42	64

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 320B	311	2390	16814	23531	54	76
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 340B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 340B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 340B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 340B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160M	HE 240B	HE 340B	330	2481	17678	24798	54	75





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=6m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	6.00	8.00	0.30	1000	A	0.16 g	DCH	3.33	1536	48	6	618	34560	14.40	48	57614	90771	37	59
1	6.00	8.00	0.30	1000	A	0.16 g	DCM	2.50	1256	48	6	618	34560	14.40	48	48351	75450	39	60
1	6.00	8.00	0.30	1000	A	0.16 g	DCL	1.00	703	48	6	618	34560	14.40	48	30113	45279	43	64

Database UNICAM (steel bracing system - concentric, 2 diagonals):

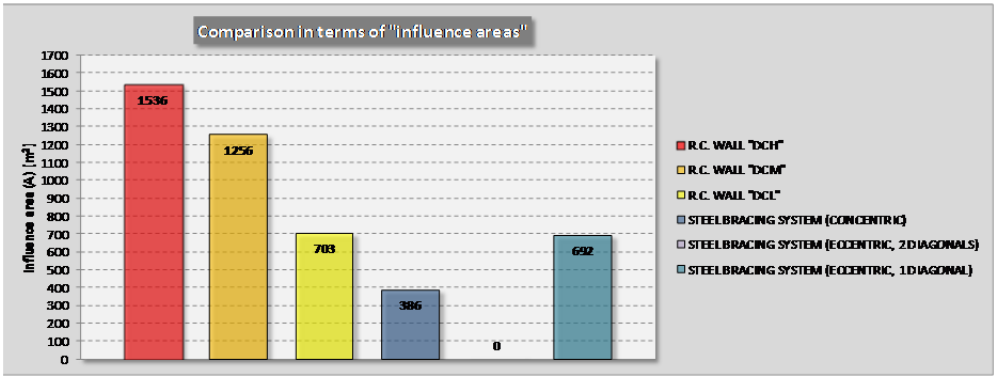
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 160A	386	1752	17528	25855	45	67
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 160A	386	1752	17528	25855	45	67
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 180A	386	1814	17695	26022	46	67
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 180A	386	1814	17695	26022	46	67
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 200A	386	1895	17919	26246	46	68
8.00	6.00	2.00	0.16	1000	HE 220A	HE 260A	HE 220A	386	1994	18189	26516	47	69

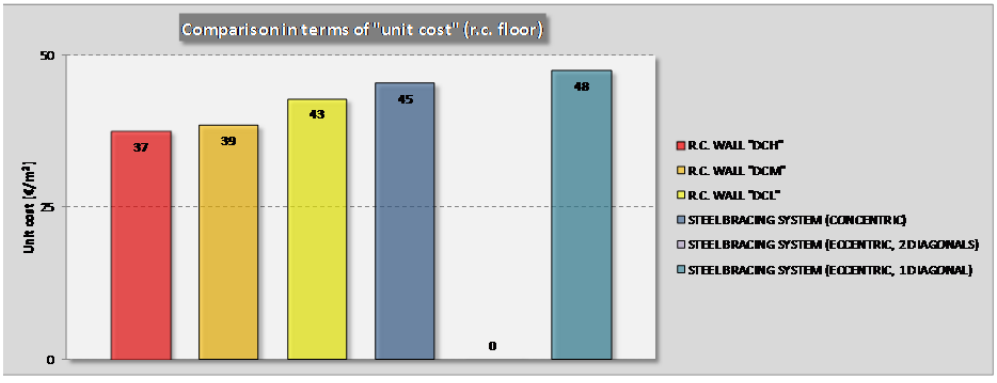
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 500B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 500B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 500B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 550B	665	3816	32396	46752	49	70
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 550B	665	3816	32396	46752	49	70
4.00	6.00	2.00	0.16	500	HE 240M	HE 300B	HE 550B	665	3816	32396	46752	49	70





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=6m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	6.00	8.00	0.30	1500	A	0.16 g	DCH	3.33	2263	72	9	848	34560	14.40	48	82028	130872	36	58
1	6.00	8.00	0.30	1500	A	0.16 g	DCM	2.50	1795	72	9	848	34560	14.40	48	66574	105308	37	59
1	6.00	8.00	0.30	1500	A	0.16 g	DCL	1.00	960	72	9	848	34560	14.40	48	39033	59748	41	62

Database UNICAM (steel bracing system - concentric, 2 diagonals):

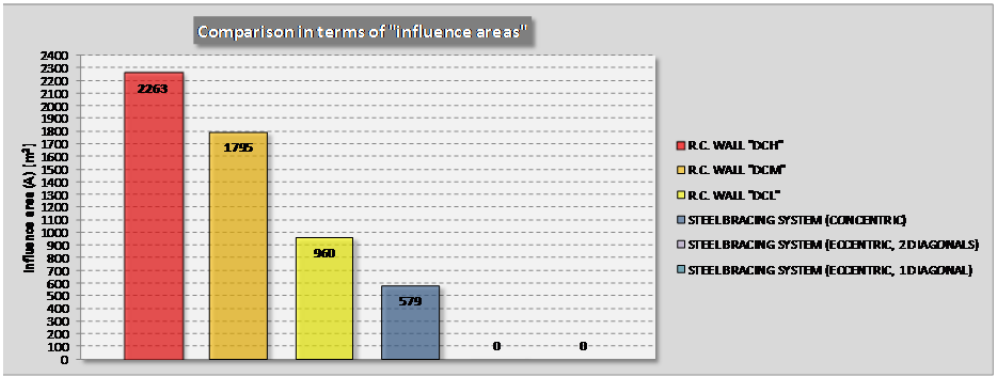
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 160 A	579	2121	24900	37391	43	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 160 A	579	2121	24900	37391	43	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 180 A	579	2182	25068	37558	43	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 180 A	579	2182	25068	37558	43	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 200 A	579	2263	25291	37782	44	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 220 A	579	2362	25561	38051	44	66

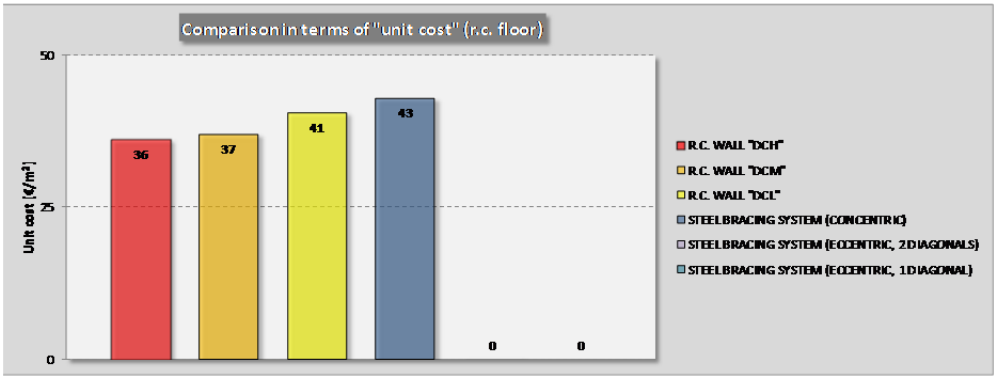
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=6m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT						COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	6.00	8.00	0.30	2000	A	0.16 g	DCH	3.33	2987	96	12	1078	34560	14.40	48	106329	170785	36	57
1	6.00	8.00	0.30	2000	A	0.16 g	DCM	2.50	2305	96	12	1078	34560	14.40	48	83832	133571	36	58
1	6.00	8.00	0.30	2000	A	0.16 g	DCL	1.00	1195	96	12	1078	34560	14.40	48	47207	72985	40	61

Database UNICAM (steel bracing system - concentric, 2 diagonals):

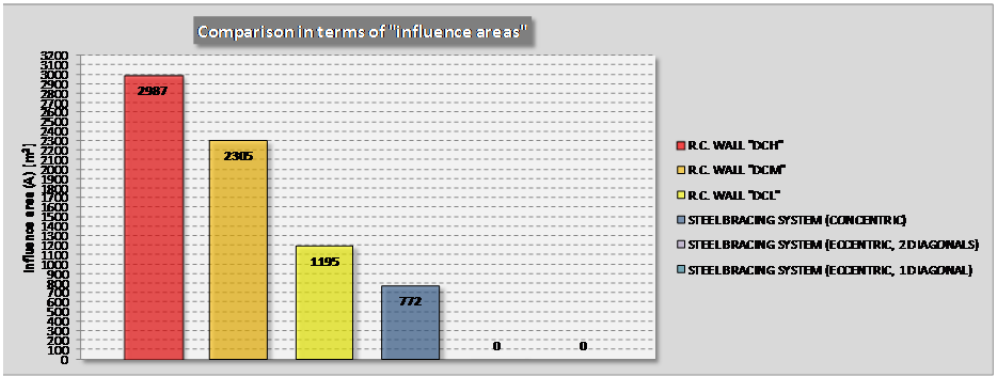
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 160 A	772	2591	32552	49207	42	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 160 A	772	2591	32552	49207	42	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 180 A	772	2652	32720	49374	42	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 180 A	772	2652	32720	49374	42	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 200 A	772	2734	32944	49598	43	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 220 A	772	2832	33213	49867	43	65

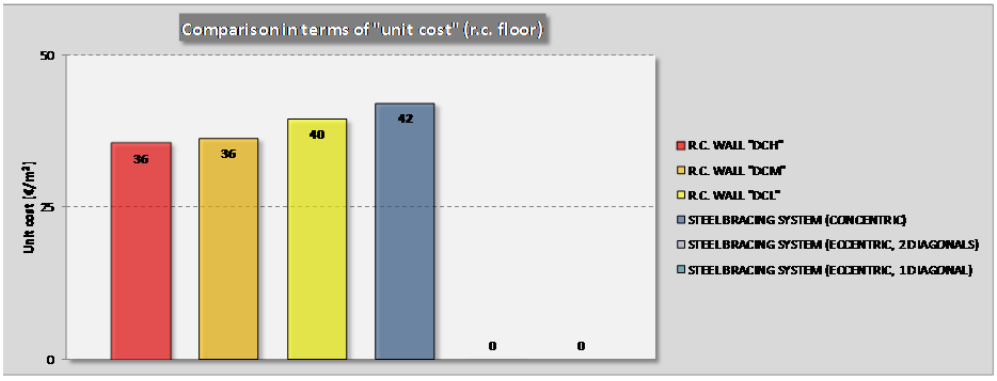
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	6.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=8m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	8.00	8.00	0.40	500	A	0.16 g	DCH	4.00	876	32	4	693	61440	25.60	64	39940	58839	46	67
1	8.00	8.00	0.40	500	A	0.16 g	DCM	3.00	731	32	4	693	61440	25.60	64	35172	50951	48	70
1	8.00	8.00	0.40	500	A	0.16 g	DCL	1.00	384	32	4	693	61440	25.60	64	23723	32012	62	83

Database UNICAM (steel bracing system - concentric, 2 diagonals):

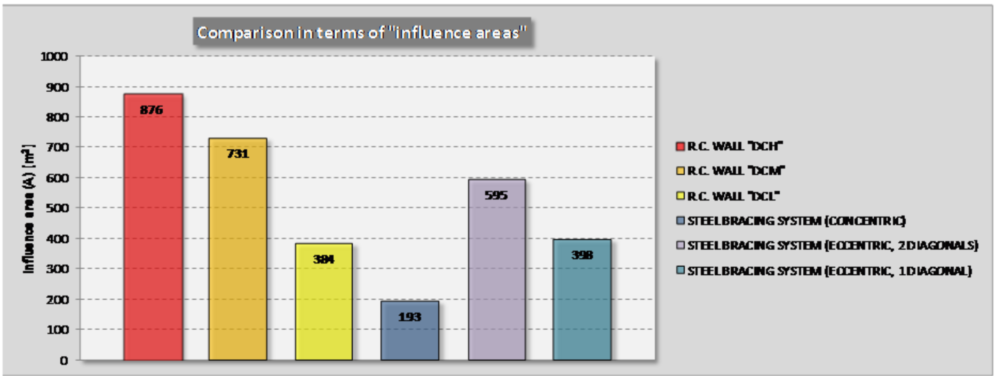
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312	12698	16861	66	87
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312	12698	16861	66	87
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312	12698	16861	66	87
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312	12698	16861	66	87
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312	12698	16861	66	87
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 240 A	193	2469	13128	17291	68	90

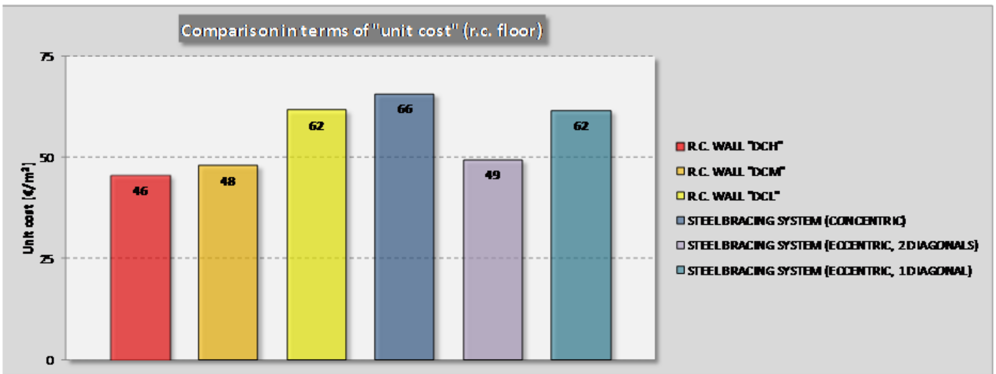
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 180 B	595	3583	29433	42267	49	71
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 200 B	595	3745	29886	42728	50	72
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 200 B	595	3745	29886	42728	50	72
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 220 B	595	3908	30342	43189	51	73
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 220 B	595	3908	30342	43189	51	73
8.00	8.00	2.00	0.16	500	HE 180 M	HE 300 B	HE 220 B	595	3908	30342	43189	51	73

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 450 B	398	4159	24514	33098	62	83
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 450 B	398	4159	24514	33098	62	83
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 450 B	398	4159	24514	33098	62	83
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 450 B	398	4159	24514	33098	62	83
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 450 B	398	4159	24514	33098	62	83
4.00	8.00	2.00	0.16	250	HE 200 M	HE 300 B	HE 500 B	423	4418	26055	35184	62	83





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=8m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	8.00	8.00	0.40	1000	A	0.16 g	DCH	4.00	1784	64	6	999	61440	25.60	64	70476	108970	40	61
1	8.00	8.00	0.40	1000	A	0.16 g	DCM	3.00	1394	64	6	999	61440	25.60	64	57604	87679	41	63
1	8.00	8.00	0.40	1000	A	0.16 g	DCL	1.00	658	64	6	999	61440	25.60	64	33336	47534	51	72

Database UNICAM (steel bracing system - concentric, 2 diagonals):

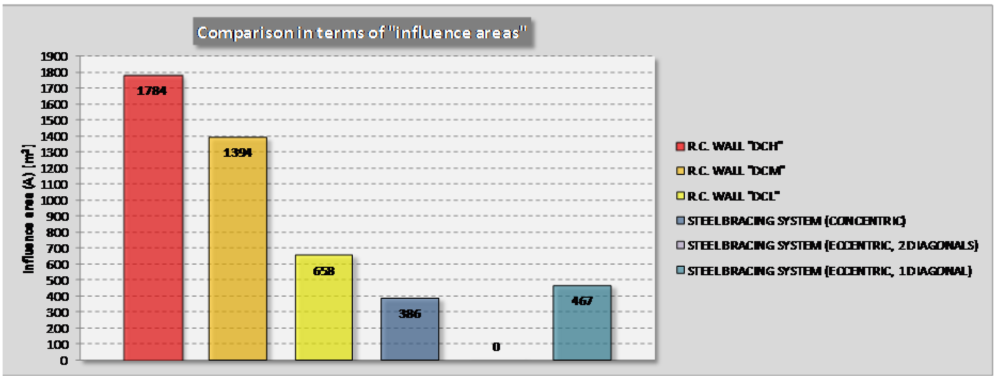
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958	20831	29158	54	76
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958	20831	29158	54	76
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958	20831	29158	54	76
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958	20831	29158	54	76
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958	20831	29158	54	76
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 240 A	386	3115	21260	29588	55	77

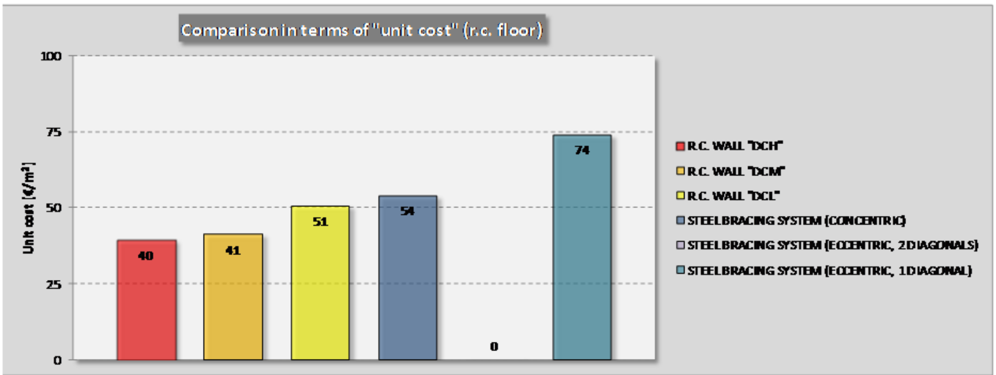
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1000	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	8.00	2.00	0.16	500	HE 500 A	HE 650 B	HE 550 M	467	7008	34604	44682	74	96
4.00	8.00	2.00	0.16	500	HE 500 A	HE 650 B	HE 550 M	467	7008	34604	44682	74	96
4.00	8.00	2.00	0.16	500	HE 500 A	HE 650 B	HE 550 M	467	7008	34604	44682	74	96
4.00	8.00	2.00	0.16	500	HE 500 A	HE 650 B	HE 550 M	467	7008	34604	44682	74	96
4.00	8.00	2.00	0.16	500	HE 500 A	HE 650 B	HE 600 M	443	7125	34133	43693	77	99
4.00	8.00	2.00	0.16	500	HE 500 A	HE 600 B	HE 650 M	456	7140	34595	44430	76	98





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=8m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	8.00	8.00	0.40	1500	A	0.16 g	DCH	4.00	2688	96	9	1357	61440	25.60	64	100988	158999	38	59
1	8.00	8.00	0.40	1500	A	0.16 g	DCM	3.00	2020	96	9	1357	61440	25.60	64	78953	122548	39	61
1	8.00	8.00	0.40	1500	A	0.16 g	DCL	1.00	896	96	9	1357	61440	25.60	64	41867	61201	47	68

Database UNICAM (steel bracing system - concentric, 2 diagonals):

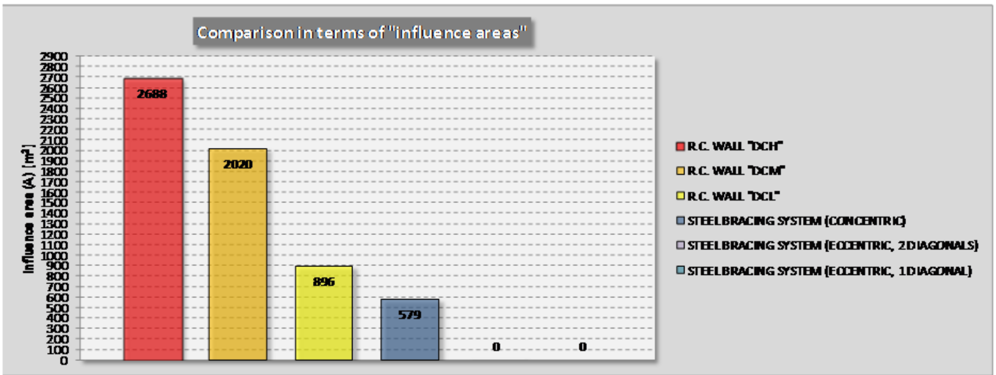
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831	29585	42076	51	73
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831	29585	42076	51	73
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831	29585	42076	51	73
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831	29585	42076	51	73
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831	29585	42076	51	73
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 240 A	579	3987	30015	42505	52	73

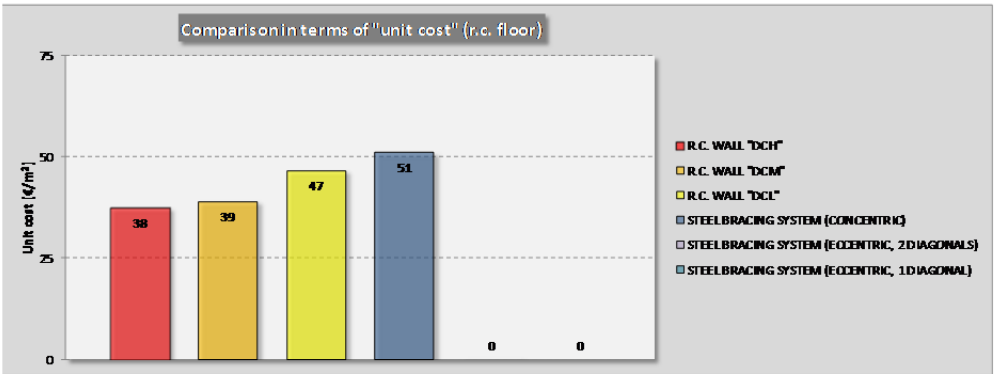
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	1500	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=8m; H=8m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
1	8.00	8.00	0.40	2000	A	0.16 g	DCH	4.00	3584	128	12	1716	61440	25.60	64	131227	208574	37	58
1	8.00	8.00	0.40	2000	A	0.16 g	DCM	3.00	2688	128	12	1716	61440	25.60	64	101669	159680	38	59
1	8.00	8.00	0.40	2000	A	0.16 g	DCL	1.00	1113	128	12	1716	61440	25.60	64	49695	73703	45	66

Database UNICAM (steel bracing system - concentric, 2 diagonals):

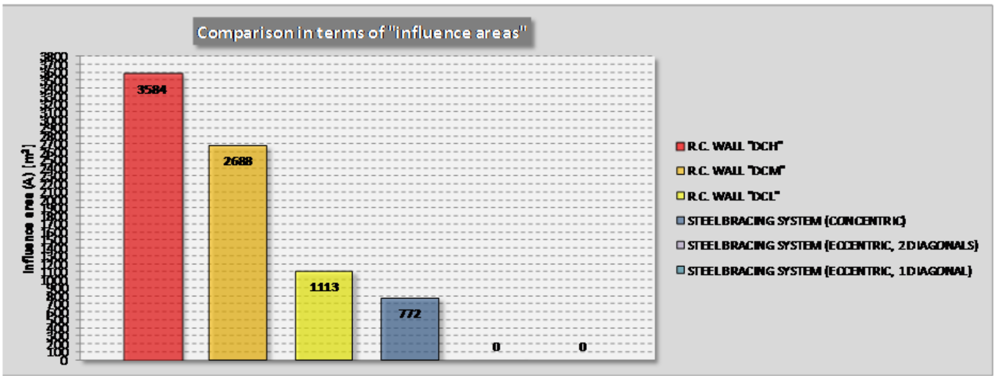
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800	38605	55259	50	72
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800	38605	55259	50	72
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800	38605	55259	50	72
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800	38605	55259	50	72
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800	38605	55259	50	72
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 240 A	772	4957	39034	55688	51	72

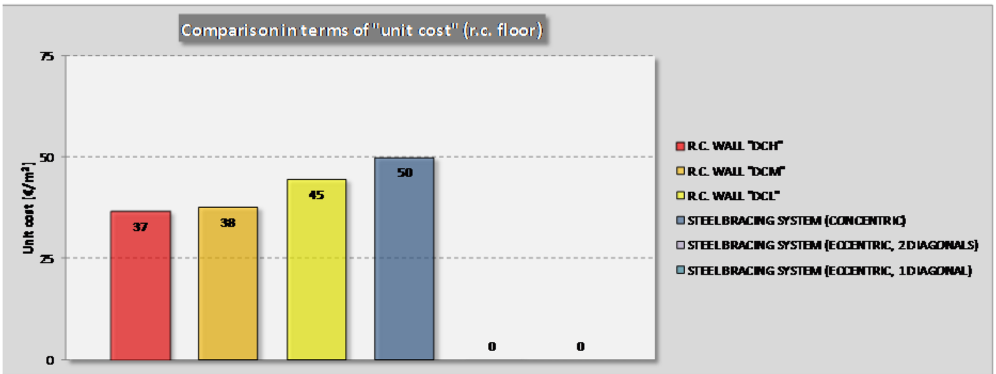
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
8.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-
4.00	8.00	2.00	0.16	2000	-	-	-	-	-	-	-	-	-





ANNEXE 2

COMPARAISON ENTRE MURS B.A. ET TRIANGULATIONS METALLIQUES

Distribution "C"

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	500	C	0.16 g	DCH	4.00	374	52	6	553	15360	6.40	32	16190	24257	43	65
2	4.00	4.00	0.20	500	C	0.16 g	DCM	3.00	307	52	6	553	15360	6.40	32	13970	20585	46	67
2	4.00	4.00	0.20	500	C	0.16 g	DCL	1.00	156	52	6	553	15360	6.40	32	9002	12367	58	79

Database UNICAM (steel bracing system - concentric, 2 diagonals):

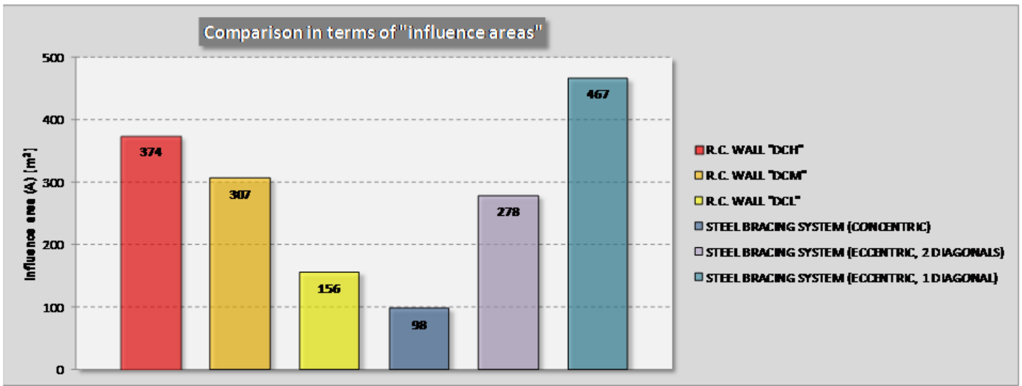
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	98	1166	6422	8532	66	87
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	98	1166	6422	8532	66	87
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	98	1166	6422	8532	66	87
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 120 A	HE 200 A	98	1221	6571	8682	67	89
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 140 A	HE 200 A	98	1259	6676	8787	68	90
4.00	4.00	5.00	0.16	500	HE 100 A	HE 100A	HE 160 A	HE 180 A	HE 140 A	HE 200 A	98	1259	6676	8787	68	90

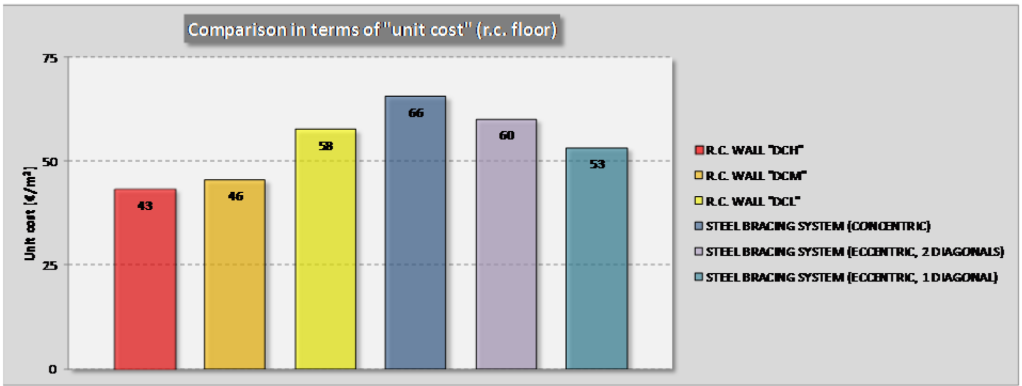
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 120 B	HE 180 B	278	2763	16750	22756	60	82
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 120 B	HE 180 B	278	2763	16750	22756	60	82
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 140 B	HE 180 B	278	2819	16903	22909	61	82
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 140 B	HE 200 B	278	2900	17118	23120	62	83
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 160 B	HE 200 B	278	2971	17313	23316	62	84
8.00	4.00	5.00	0.16	500	HE 180 B	HE 180B	HE 180 B	HE 220 B	HE 160 B	HE 220 B	278	3053	17533	23532	63	85

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 320 B	467	3461	24878	34952	53	75
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 320 B	467	3461	24878	34952	53	75
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 320 B	467	3461	24878	34952	53	75
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 320 B	467	3461	24878	34952	53	75
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 340 B	467	3521	25061	35147	54	75
4.00	4.00	5.00	0.16	500	HE 140 M	HE 300B	HE 200 B	HE 260 B	HE 300 B	HE 340 B	467	3521	25061	35147	54	75





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	1000	C	0.16 g	DCH	4.00	761	104	12	1036	15360	6.40	32	29891	46321	39	61
2	4.00	4.00	0.20	1000	C	0.16 g	DCM	3.00	582	104	12	1036	15360	6.40	32	23976	36537	41	63
2	4.00	4.00	0.20	1000	C	0.16 g	DCL	1.00	266	104	12	1036	15360	6.40	32	13551	19292	51	73

Database UNICAM (steel bracing system - concentric, 2 diagonals):

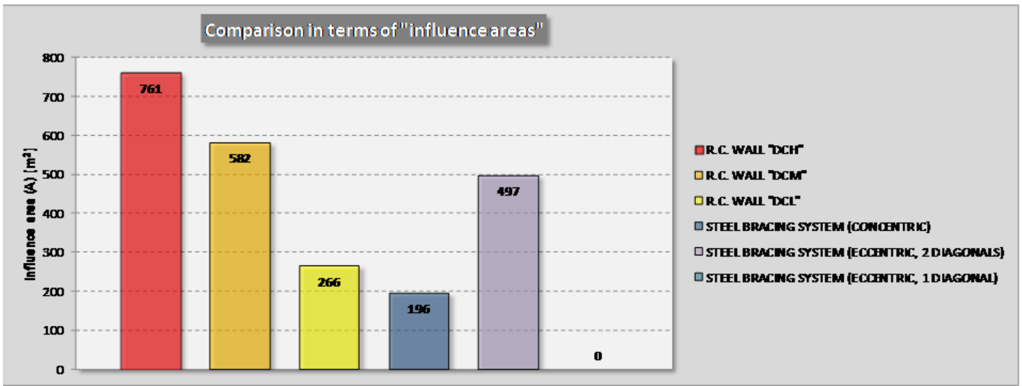
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 120 A	HE 200 A	196	1613	10871	15093	56	77
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 120 A	HE 200 A	196	1613	10871	15093	56	77
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 120 A	HE 220 A	196	1678	11051	15273	56	78
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 120 A	HE 220 A	196	1678	11051	15273	56	78
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 140 A	HE 220 A	196	1717	11156	15378	57	79
4.00	4.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 200 A	HE 240 A	HE 140 A	HE 240 A	196	1795	11371	15593	58	80

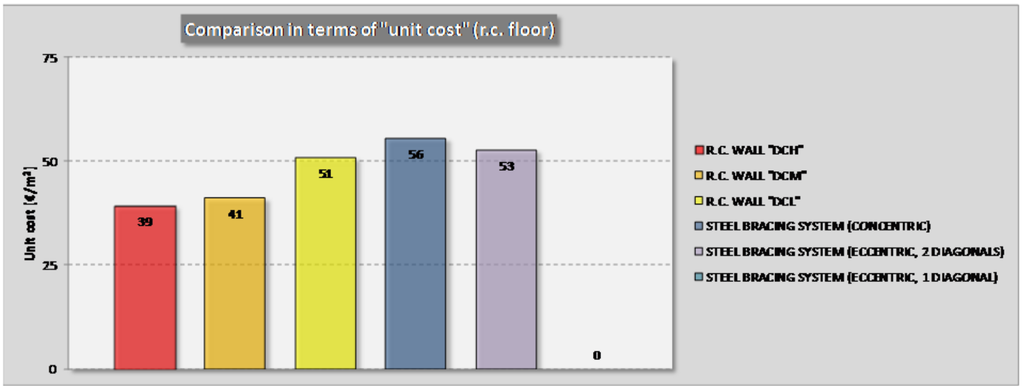
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 120 B	HE 180 B	497	3595	26243	36969	53	74
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 140 B	HE 200 B	496	3732	26598	37311	54	75
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 140 B	HE 200 B	496	3732	26598	37311	54	75
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 140 B	HE 220 B	496	3814	26808	37511	54	76
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 160 B	HE 220 B	496	3885	27003	37707	54	76
8.00	4.00	5.00	0.16	1000	HE 200 B	HE 180M	HE 220 B	HE 260 B	HE 160 B	HE 240 B	496	3978	27247	37943	55	77

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	1500	C	0.16 g	DCH	4.00	1142	155	18	1519	15360	6.40	32	43366	68012	38	60
2	4.00	4.00	0.20	1500	C	0.16 g	DCM	3.00	857	155	18	1519	15360	6.40	32	33948	52432	40	61
2	4.00	4.00	0.20	1500	C	0.16 g	DCL	1.00	361	155	18	1519	15360	6.40	32	17617	25418	49	70

Database UNICAM (steel bracing system - concentric, 2 diagonals):

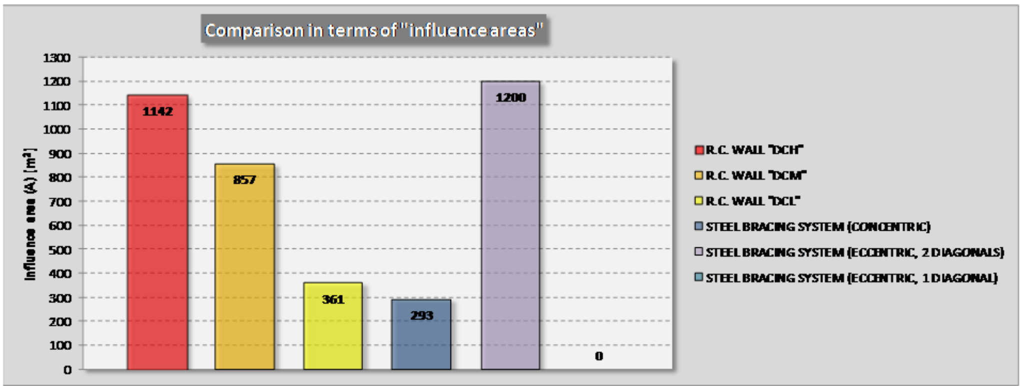
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 220 A	293	1888	14853	21185	51	72
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 220 A	293	1888	14853	21185	51	72
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 240 A	293	1967	15067	21400	51	73
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 240 A	293	1967	15067	21400	51	73
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 140 A	HE 240 A	293	2005	15173	21505	52	73
4.00	4.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 140 A	HE 240 A	293	2005	15173	21505	52	73

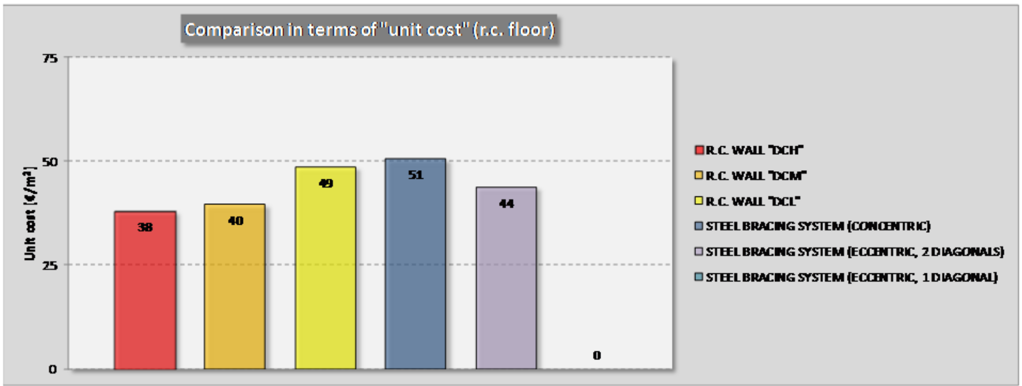
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 200 B	1200	4731	52558	78467	44	65
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 200 B	1200	4731	52558	78467	44	65
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 220 B	1198	4812	52698	78552	44	66
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 160 B	HE 220 B	1198	4884	52893	78747	44	66
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 160 B	HE 240 B	1196	4977	53078	78886	44	66
8.00	4.00	5.00	0.16	1500	HE 260 B	HE 340 B	HE 240 B	HE 300 B	HE 160 B	HE 240 B	1196	4977	53078	78886	44	66

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	2000	C	0.16 g	DCH	4.00	1523	207	24	2002	15360	6.40	32	56841	89703	37	59
2	4.00	4.00	0.20	2000	C	0.16 g	DCM	3.00	1142	207	24	2002	15360	6.40	32	44284	68930	39	60
2	4.00	4.00	0.20	2000	C	0.16 g	DCL	1.00	448	207	24	2002	15360	6.40	32	21397	31071	48	69

Database UNICAM (steel bracing system - concentric, 2 diagonals):

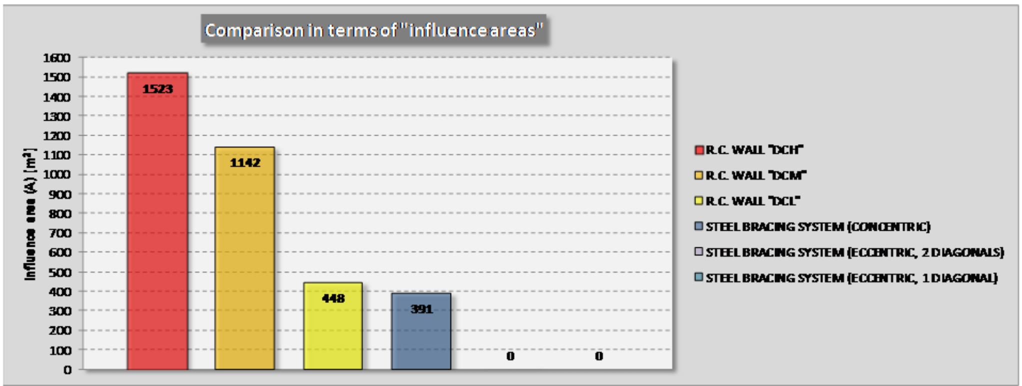
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 120 A	HE 240 A	391	2380	19425	27869	50	71
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 120 A	HE 240 A	391	2380	19425	27869	50	71
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 120 A	HE 260 A	391	2443	19598	28042	50	72
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 120 A	HE 260 A	391	2443	19598	28042	50	72
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 140 A	HE 260 A	391	2481	19703	28147	50	72
4.00	4.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 260 A	HE 300 A	HE 140 A	HE 260 A	391	2481	19703	28147	50	72

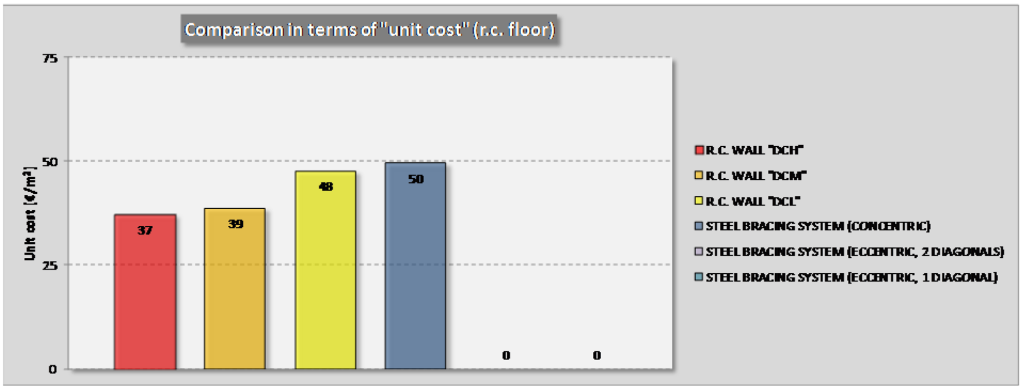
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	500	C	0.16 g	DCH	4.00	381	78	6	1132	34560	14.40	48	20465	28680	54	75
2	6.00	4.00	0.30	500	C	0.16 g	DCM	3.00	292	78	6	1132	34560	14.40	48	17546	23851	60	82
2	6.00	4.00	0.30	500	C	0.16 g	DCL	1.00	135	78	6	1132	34560	14.40	48	12345	15248	92	113

Database UNICAM (steel bracing system - concentric, 2 diagonals):

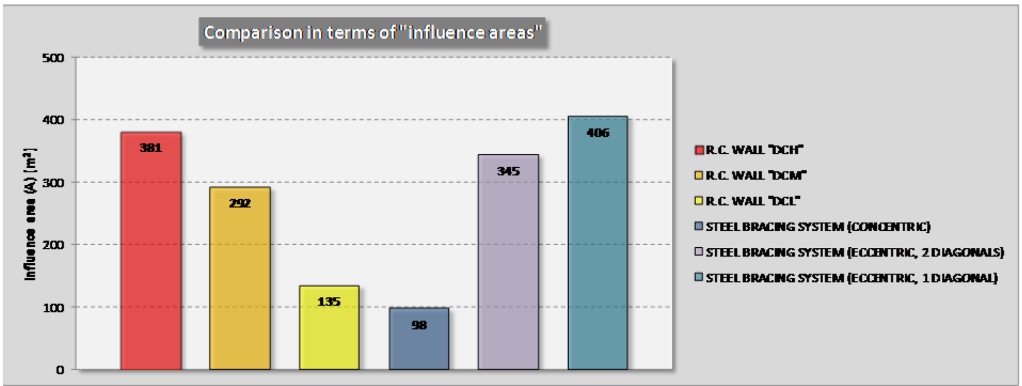
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 160 A	HE 220 A	98	2506	10092	12203	103	125
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 160 A	HE 240 A	98	2624	10415	12525	106	128
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 160 A	HE 240 A	98	2624	10415	12525	106	128
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 160 A	HE 240 A	98	2624	10415	12525	106	128
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 160 A	HE 240 A	98	2624	10415	12525	106	128
4.00	6.00	5.00	0.16	500	HE 100 A	HE 100 A	HE 220 A	HE 240 A	HE 180 A	HE 260 A	98	2780	10842	12953	111	132

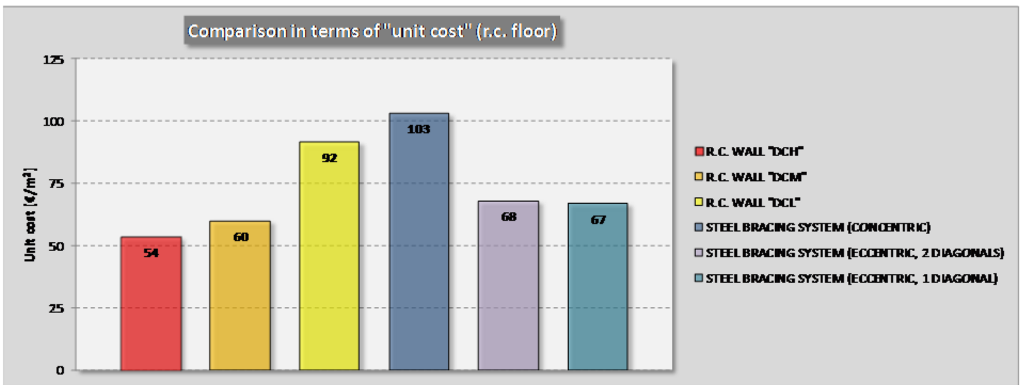
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 140 B	HE 220 B	345	4409	23445	30882	68	90
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 160 B	HE 220 B	345	4516	23738	31174	69	90
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 160 B	HE 220 B	345	4516	23738	31174	69	90
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 180 B	HE 240 B	344	4759	24392	31820	71	92
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 180 B	HE 260 B	344	4877	24706	32128	72	93
8.00	6.00	5.00	0.16	500	HE 180 B	HE 220B	HE 220 B	HE 240 B	HE 200 B	HE 260 B	344	4998	25038	32460	73	94

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 550 B	377	4900	25877	34024	69	90
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 550 B	377	4900	25877	34024	69	90
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 600 B	406	5050	27221	35979	67	89
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 600 B	406	5050	27221	35979	67	89
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 600 B	406	5050	27221	35979	67	89
4.00	6.00	5.00	0.16	500	HE 240 B	HE 360B	HE 240 B	HE 300 B	HE 100 B	HE 600 B	429	5050	27977	37229	65	87





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	1000	C	0.16 g	DCH	4.00	761	155	12	2106	34560	14.40	48	34873	51304	46	67
2	6.00	4.00	0.30	1000	C	0.16 g	DCM	3.00	571	155	12	2106	34560	14.40	48	28594	40917	50	72
2	6.00	4.00	0.30	1000	C	0.16 g	DCL	1.00	227	155	12	2106	34560	14.40	48	17241	22137	76	98

Database UNICAM (steel bracing system - concentric, 2 diagonals):

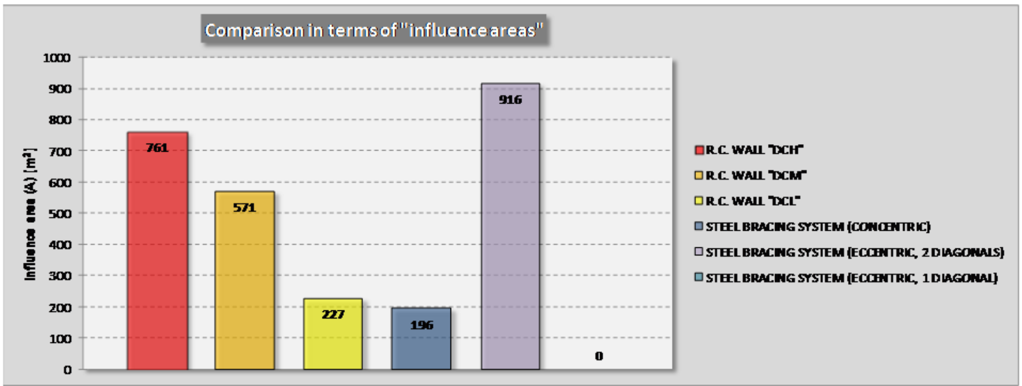
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 160 A	HE 260 A	196	3360	15660	19881	80	102
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 160 A	HE 260 A	196	3360	15660	19881	80	102
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 160 A	HE 280 A	196	3459	15929	20151	81	103
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 160 A	HE 280 A	196	3459	15929	20151	81	103
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 160 A	HE 280 A	196	3459	15929	20151	81	103
4.00	6.00	5.00	0.16	1000	HE 140 A	HE 140 A	HE 260 A	HE 300 A	HE 180 A	HE 300 A	196	3663	16488	20710	84	106

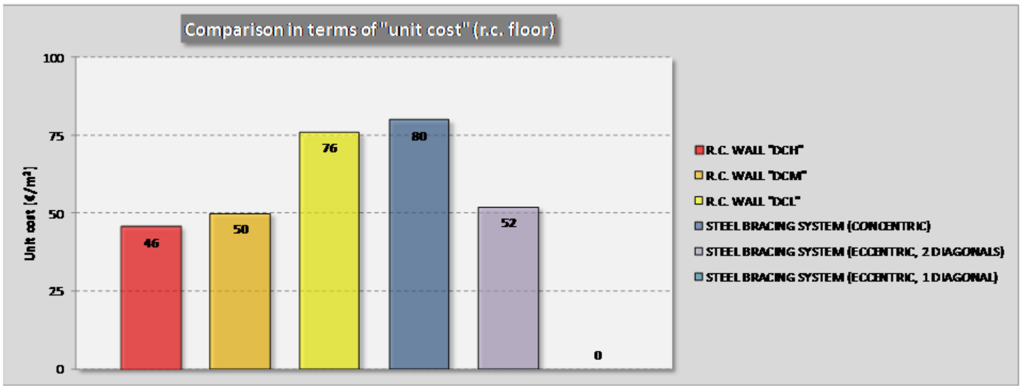
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 160 B	HE 240 B	916	6404	47753	67517	52	74
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 160 B	HE 240 B	916	6404	47753	67517	52	74
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 180 B	HE 260 B	914	6625	48299	68024	53	74
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 180 B	HE 260 B	914	6625	48299	68024	53	74
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 200 B	HE 280 B	912	6866	48909	68602	54	75
8.00	6.00	5.00	0.16	1000	HE 260 B	HE 340 B	HE 260 B	HE 320 B	HE 200 B	HE 280 B	912	6866	48909	68602	54	75

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	1500	C	0.16 g	DCH	4.00	1142	233	18	3080	34560	14.40	48	49281	73927	43	65
2	6.00	4.00	0.30	1500	C	0.16 g	DCM	3.00	857	233	18	3080	34560	14.40	48	39862	58347	47	68
2	6.00	4.00	0.30	1500	C	0.16 g	DCL	1.00	306	233	18	3080	34560	14.40	48	21715	28328	71	92

Database UNICAM (steel bracing system - concentric, 2 diagonals):

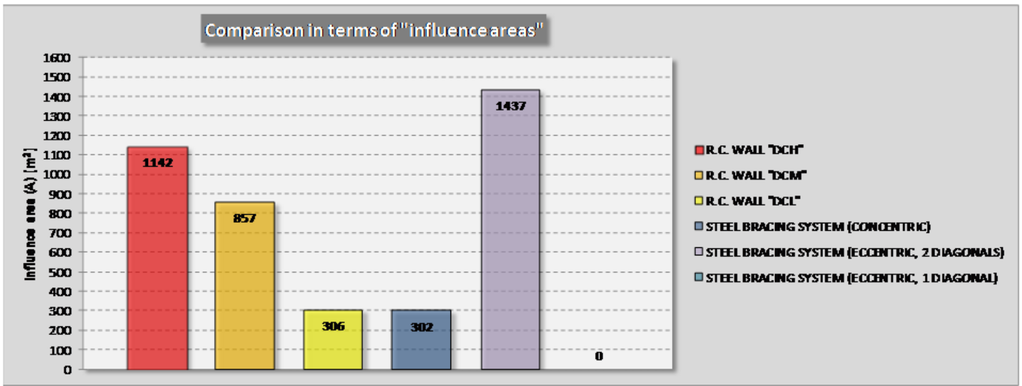
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 160 A	HE 300 A	302	4386	21982	28502	73	94
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 160 A	HE 300 A	302	4386	21982	28502	73	94
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 160 A	HE 300 A	302	4386	21982	28502	73	94
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 160 A	HE 300 A	302	4386	21982	28502	73	94
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 160 A	HE 320 A	298	4498	22162	28600	74	96
4.00	6.00	5.00	0.16	1500	HE 160 A	HE 180 A	HE 300 A	HE 400 A	HE 180 A	HE 320 A	298	4559	22330	28768	75	96

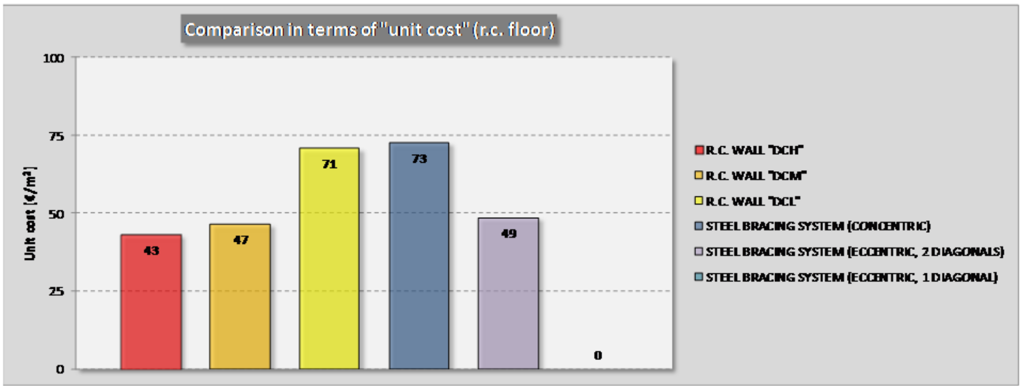
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 160 B	HE 260 B	1437	8265	70036	101044	49	70
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 180 B	HE 280 B	1463	8489	71521	103100	49	70
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 180 B	HE 280 B	1463	8489	71521	103100	49	70
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 180 B	HE 280 B	1463	8489	71521	103100	49	70
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 200 B	HE 300 B	1492	8778	73280	105492	49	71
8.00	6.00	5.00	0.16	1500	HE 320 B	HE 450 B	HE 300 B	HE 500 B	HE 200 B	HE 300 B	1492	8778	73280	105492	49	71

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	2000	C	0.16 g	DCH	4.00	1523	311	24	4054	34560	14.40	48	63689	96550	42	63
2	6.00	4.00	0.30	2000	C	0.16 g	DCM	3.00	1142	311	24	4054	34560	14.40	48	51131	75777	45	66
2	6.00	4.00	0.30	2000	C	0.16 g	DCL	1.00	381	311	24	4054	34560	14.40	48	26016	34231	68	90

Database UNICAM (steel bracing system - concentric, 2 diagonals):

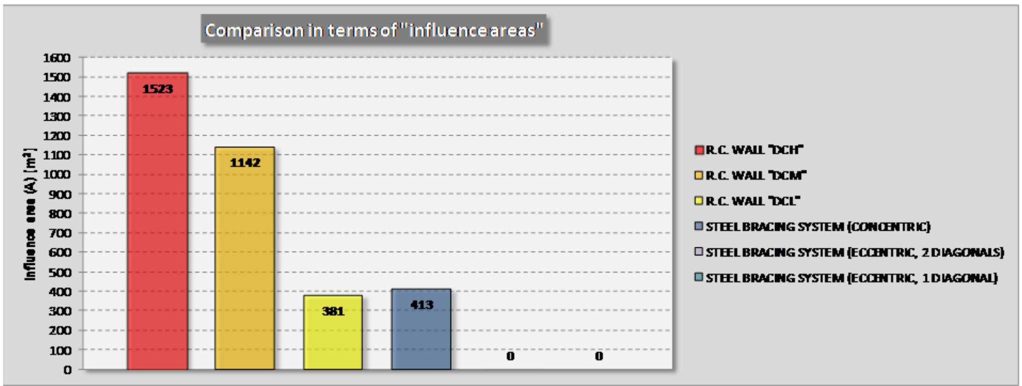
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 160 A	HE 340 A	413	5454	28561	37471	69	91
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 160 A	HE 340 A	413	5454	28561	37471	69	91
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 160 A	HE 340 A	413	5454	28561	37471	69	91
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 160 A	HE 360 A	409	5538	28682	37520	70	92
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 160 A	HE 300 B	407	5598	28778	37571	71	92
4.00	6.00	5.00	0.16	2000	HE 200 A	HE 200 A	HE 340 A	HE 450 B	HE 180 A	HE 300 B	407	5660	28945	37738	71	93

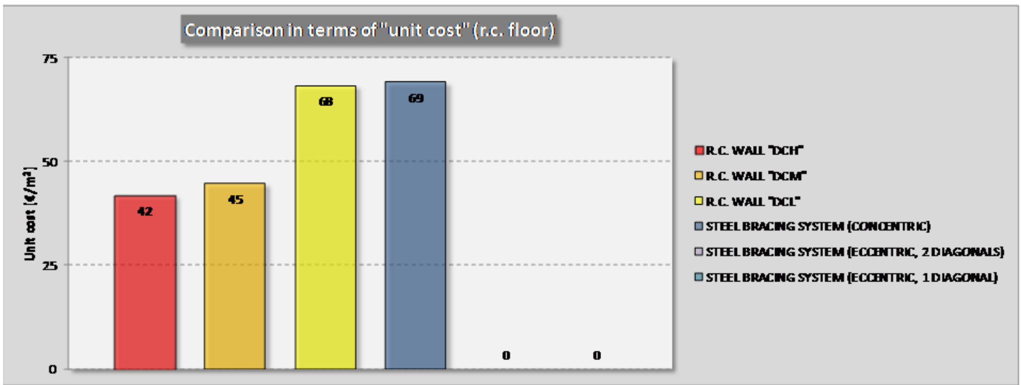
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-





ANNEXE 3

COMPARAISON ENTRE MURS B.A. ET TRIANGULATIONS METALLIQUES

Distribution "D"

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	500	D	0.16 g	DCH	4.00	326	49	6	533	15360	6.40	32	14571	21604	45	66
2	4.00	4.00	0.20	500	D	0.16 g	DCM	3.00	269	49	6	533	15360	6.40	32	12690	18493	47	69
2	4.00	4.00	0.20	500	D	0.16 g	DCL	1.00	138	49	6	533	15360	6.40	32	8380	11364	61	82

Database UNICAM (steel bracing system - concentric, 2 diagonals):

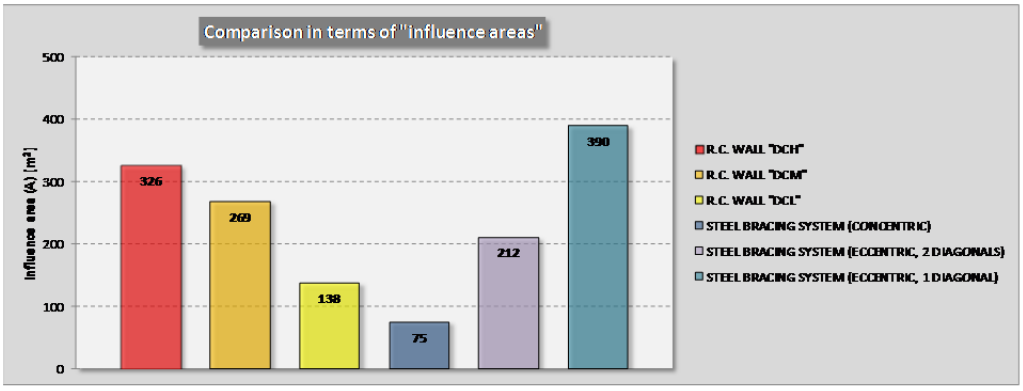
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	75	1179	5721	7350	76	97
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	75	1179	5721	7350	76	97
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 120 A	HE 180 A	75	1179	5721	7350	76	97
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 120 A	HE 200 A	75	1233	5870	7500	78	99
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 140 A	HE 200 A	75	1272	5975	7605	79	101
4.00	4.00	8.00	0.16	500	HE 100 A	HE 120 A	HE 160 A	HE 180 A	HE 140 A	HE 220 A	75	1337	6155	7785	82	103

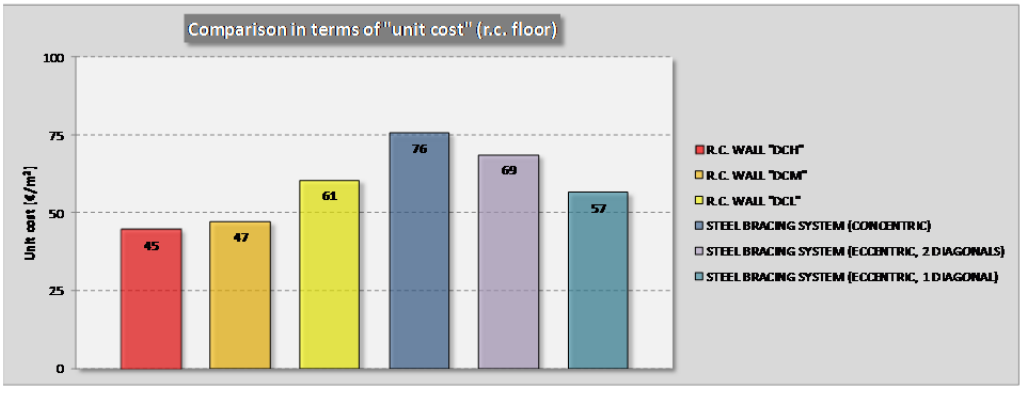
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 120 B	HE 180 B	212	2763	14548	19114	69	90
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 120 B	HE 180 B	212	2763	14548	19114	69	90
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 140 B	HE 200 B	211	2900	14919	19482	71	92
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 140 B	HE 200 B	211	2900	14919	19482	71	92
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 160 B	HE 220 B	211	3053	15335	19897	73	94
8.00	4.00	8.00	0.16	500	HE 180 B	HE 180 B	HE 180 B	HE 220 B	HE 160 B	HE 240 B	211	3146	15589	20149	74	95

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 340 B	390	3362	22091	30519	57	78
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 340 B	390	3362	22091	30519	57	78
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 360 B	404	3423	22690	31400	56	78
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 360 B	404	3423	22690	31400	56	78
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 360 B	404	3423	22690	31400	56	78
4.00	4.00	8.00	0.16	500	HE 180 B	HE 300 B	HE 200 B	HE 260 B	HE 280 B	HE 400 B	427	3531	23770	32994	56	77





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	1000	D	0.16 g	DCH	4.00	665	97	12	996	15360	6.40	32	26631	40979	40	62
2	4.00	4.00	0.20	1000	D	0.16 g	DCM	3.00	511	97	12	996	15360	6.40	32	21563	32596	42	64
2	4.00	4.00	0.20	1000	D	0.16 g	DCL	1.00	236	97	12	996	15360	6.40	32	12490	17586	53	74

Database UNICAM (steel bracing system - concentric, 2 diagonals):

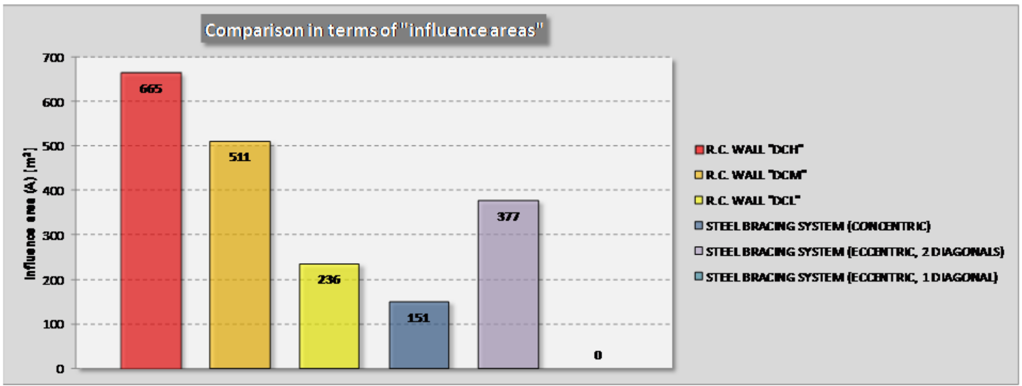
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 120 A	HE 200 A	151	1636	9463	12722	63	84
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 120 A	HE 200 A	151	1636	9463	12722	63	84
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 120 A	HE 220 A	151	1701	9642	12901	64	85
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 120 A	HE 220 A	151	1701	9642	12901	64	85
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 140 A	HE 220 A	151	1740	9748	13007	65	86
4.00	4.00	8.00	0.16	1000	HE 140 A	HE 160 A	HE 200 A	HE 240 A	HE 140 A	HE 240 A	151	1818	9962	13221	66	88

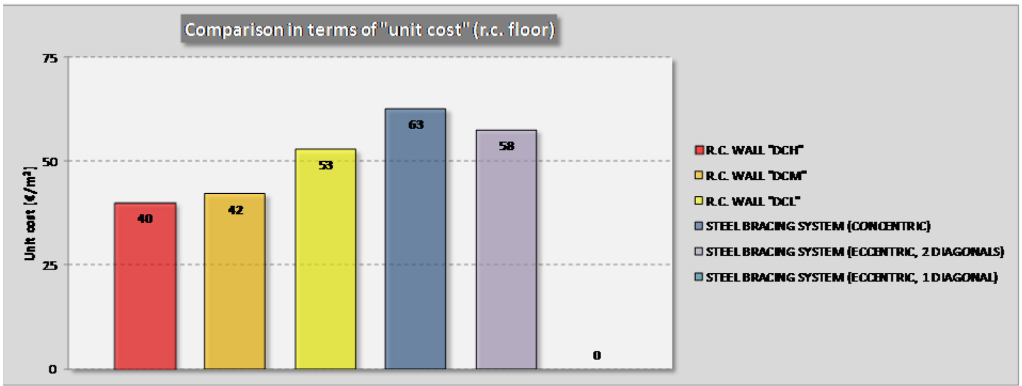
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 120 B	HE 180 B	377	3405	21778	29924	58	79
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 120 B	HE 200 B	377	3486	21988	30126	58	80
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 140 B	HE 200 B	377	3542	22141	30279	59	80
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 140 B	HE 220 B	377	3623	22356	30489	59	81
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 160 B	HE 220 B	377	3694	22551	30684	60	81
8.00	4.00	8.00	0.16	1000	HE 180 B	HE 180M	HE 200 B	HE 260 B	HE 160 B	HE 240 B	377	3788	22801	30929	61	82

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	1500	D	0.16 g	DCH	4.00	997	146	18	1459	15360	6.40	32	38477	59999	39	60
2	4.00	4.00	0.20	1500	D	0.16 g	DCM	3.00	748	146	18	1459	15360	6.40	32	30252	46394	40	62
2	4.00	4.00	0.20	1500	D	0.16 g	DCL	1.00	321	146	18	1459	15360	6.40	32	16172	23102	50	72

Database UNICAM (steel bracing system - concentric, 2 diagonals):

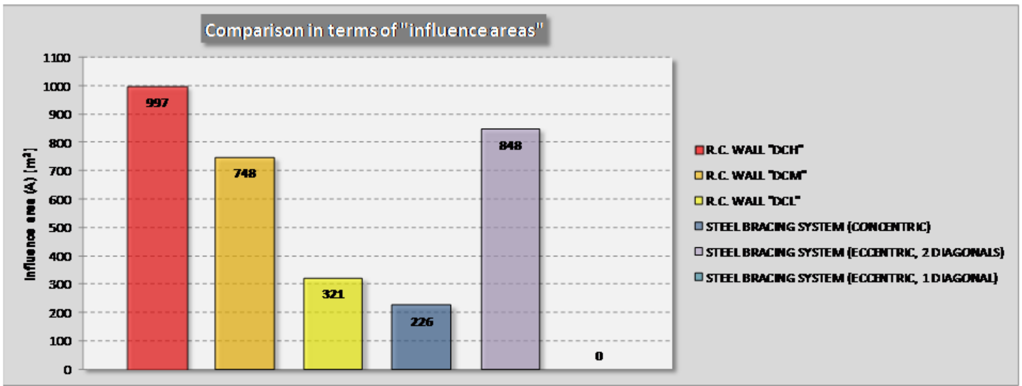
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 220 A	226	1888	12646	17534	56	77
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 220 A	226	1888	12646	17534	56	77
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 220 A	226	1888	12646	17534	56	77
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 120 A	HE 240 A	226	1967	12860	17749	57	78
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 140 A	HE 240 A	226	2005	12966	17854	57	79
4.00	4.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 220 A	HE 260 A	HE 140 A	HE 240 A	226	2005	12966	17854	57	79

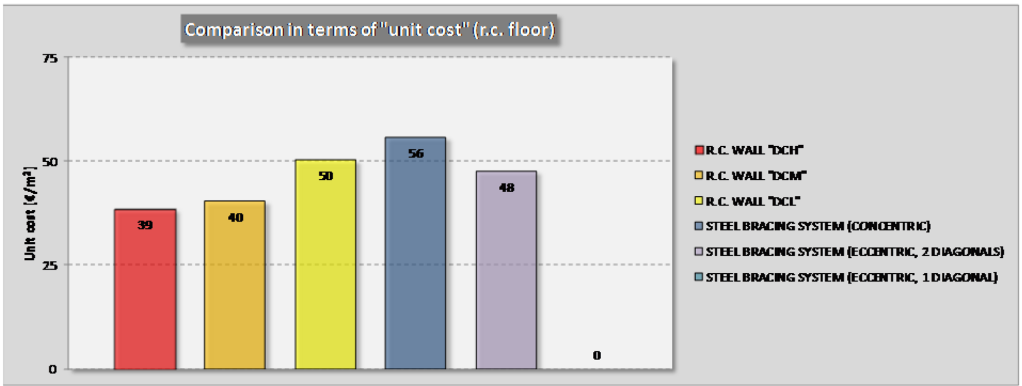
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 120 B	HE 200 B	848	4503	40316	58623	48	69
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 200 B	849	4559	40496	58821	48	69
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 220 B	865	4640	41263	59944	48	69
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 140 B	HE 220 B	865	4640	41263	59944	48	69
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 160 B	HE 240 B	881	4805	42215	61223	48	70
8.00	4.00	8.00	0.16	1500	HE 220 B	HE 340 B	HE 240 B	HE 300 B	HE 160 B	HE 260 B	890	4884	42740	61951	48	70

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=4m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	4.00	4.00	0.20	2000	D	0.16 g	DCH	4.00	1330	194	24	1922	15360	6.40	32	50322	79019	38	59
2	4.00	4.00	0.20	2000	D	0.16 g	DCM	3.00	997	194	24	1922	15360	6.40	32	39356	60879	39	61
2	4.00	4.00	0.20	2000	D	0.16 g	DCL	1.00	398	194	24	1922	15360	6.40	32	19600	28198	49	71

Database UNICAM (steel bracing system - concentric, 2 diagonals):

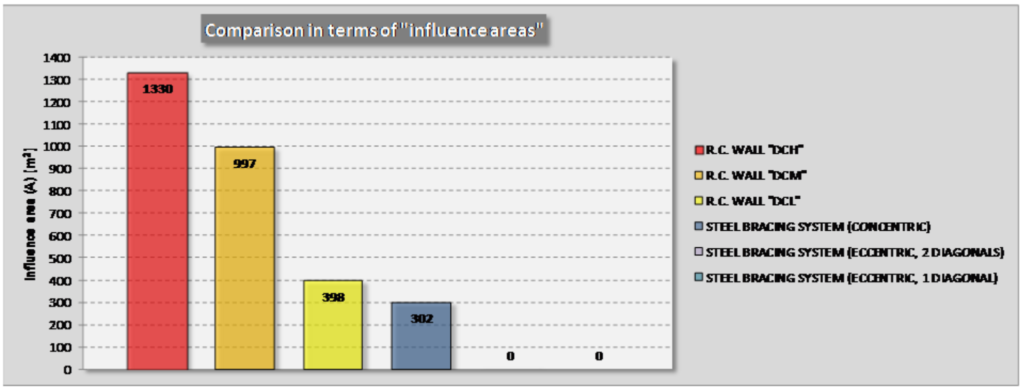
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 120 A	HE 240 A	302	2315	16304	22822	54	76
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 120 A	HE 240 A	302	2315	16304	22822	54	76
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 120 A	HE 240 A	302	2315	16304	22822	54	76
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 120 A	HE 260 A	302	2378	16477	22995	55	76
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 140 A	HE 260 A	302	2416	16582	23101	55	76
4.00	4.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 240 A	HE 300 A	HE 140 A	HE 260 A	302	2416	16582	23101	55	76

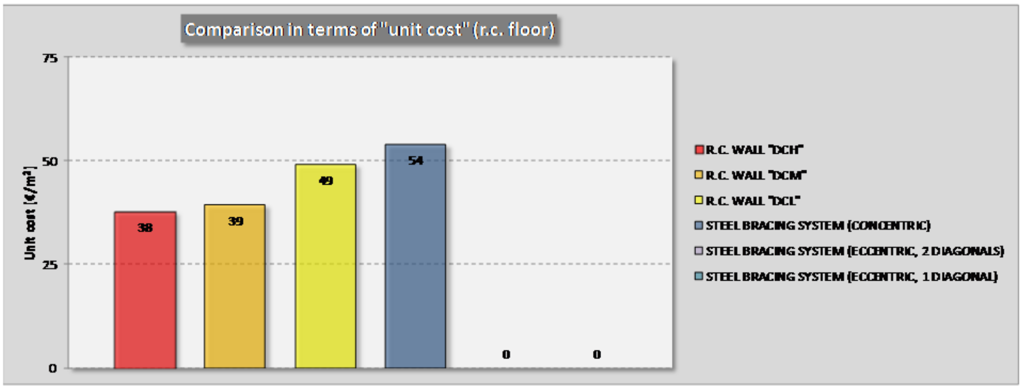
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	4.00	5.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	500	D	0.16 g	DCH	4.00	332	73	6	1087	34560	14.40	48	18770	25932	57	78
2	6.00	4.00	0.30	500	D	0.16 g	DCM	3.00	257	73	6	1087	34560	14.40	48	16286	21824	63	85
2	6.00	4.00	0.30	500	D	0.16 g	DCL	1.00	119	73	6	1087	34560	14.40	48	11761	14338	98	120

Database UNICAM (steel bracing system - concentric, 2 diagonals):

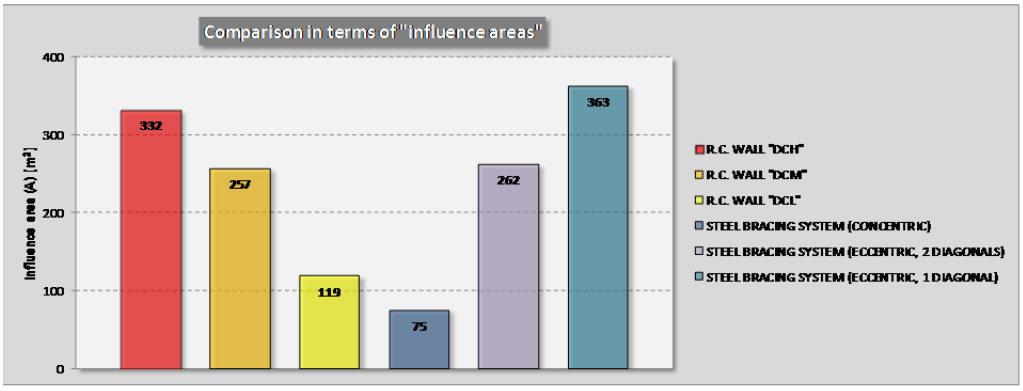
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 160 A	HE 220 A	75	2415	9108	10737	121	142
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 160 A	HE 220 A	75	2415	9108	10737	121	142
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 160 A	HE 240 A	75	2533	9430	11059	125	146
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 160 A	HE 240 A	75	2533	9430	11059	125	146
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 160 A	HE 260 A	75	2627	9689	11319	128	150
4.00	6.00	3.00	0.16	500	HE 100 A	HE 120 A	HE 200 A	HE 240 A	HE 180 A	HE 260 A	75	2689	9857	11487	131	152

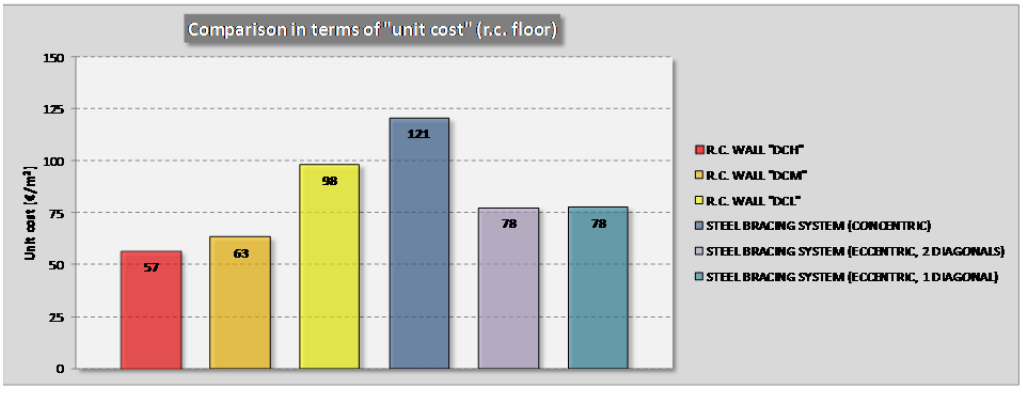
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 140 B	HE 220 B	262	4266	20348	26014	78	99
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 160 B	HE 220 B	262	4373	20641	26307	79	100
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 160 B	HE 240 B	262	4513	21018	26678	80	102
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 180 B	HE 240 B	262	4617	21300	26961	81	103
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 180 B	HE 260 B	262	4734	21618	27275	82	104
8.00	6.00	3.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 200 B	HE 280 B	262	4975	22274	27929	85	107

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 300 B	HE 500 B	346	5799	27297	34762	79	101
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 300 B	HE 550 B	363	5945	28272	36112	78	99
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 300 B	HE 550 B	363	5945	28272	36112	78	99
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 320 B	HE 550 B	365	6060	28632	36503	79	100
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 320 B	HE 600 B	381	6210	29579	37800	78	99
4.00	6.00	3.00	0.16	500	HE 220 B	HE 400 A	HE 240 B	HE 300 B	HE 320 B	HE 600 B	381	6210	29579	37800	78	99





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=1000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	1000	D	0.16 g	DCH	4.00	665	146	12	2016	34560	14.40	48	31518	45866	47	69
2	6.00	4.00	0.30	1000	D	0.16 g	DCM	3.00	499	146	12	2016	34560	14.40	48	26035	36796	52	74
2	6.00	4.00	0.30	1000	D	0.16 g	DCL	1.00	202	146	12	2016	34560	14.40	48	16237	20588	81	102

Database UNICAM (steel bracing system - concentric, 2 diagonals):

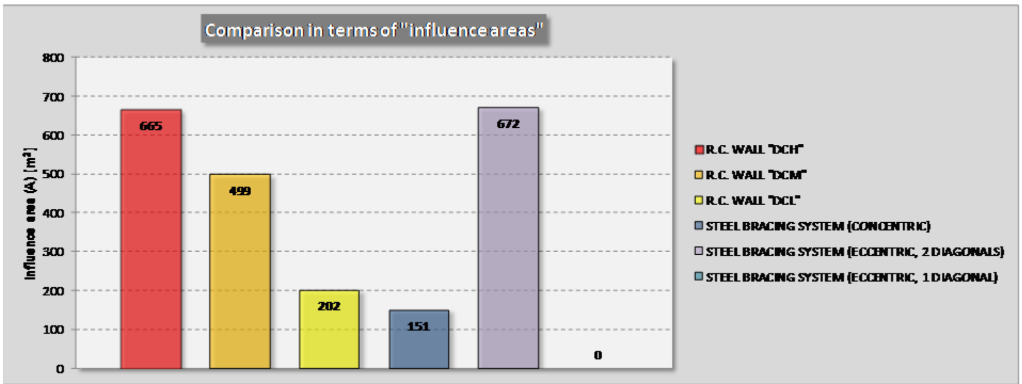
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 160 A	HE 260 A	151	3283	13977	17236	93	114
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 160 A	HE 260 A	151	3283	13977	17236	93	114
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 160 A	HE 260 A	151	3283	13977	17236	93	114
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 160 A	HE 280 A	151	3382	14247	17506	94	116
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 160 A	HE 280 A	151	3382	14247	17506	94	116
4.00	6.00	8.00	0.16	1000	HE 140 A	HE 160A	HE 240 A	HE 300 A	HE 180 A	HE 300 A	151	3586	14806	18065	98	120

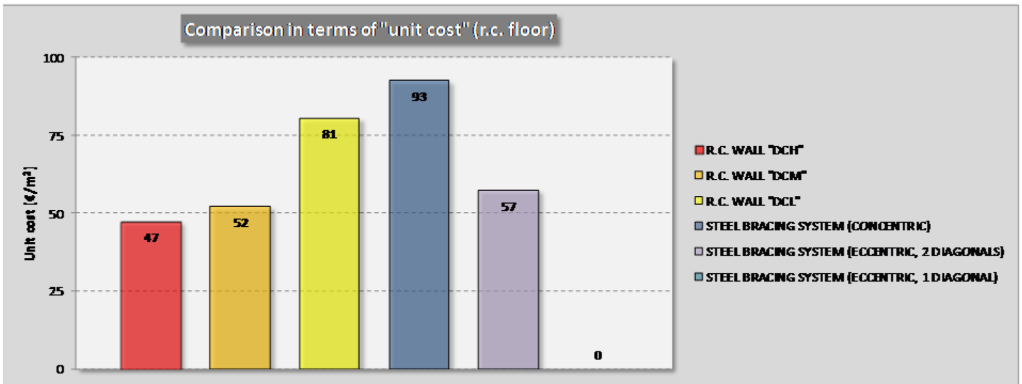
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 160 B	HE 240 B	672	5955	38473	52971	57	79
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 160 B	HE 240 B	672	5955	38473	52971	57	79
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 160 B	HE 260 B	671	6073	38763	53238	58	79
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 180 B	HE 260 B	671	6176	39045	53521	58	80
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 180 B	HE 280 B	670	6296	39346	53804	59	80
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340B	HE 240 B	HE 300 B	HE 200 B	HE 300 B	669	6585	40109	54547	60	82

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	5.00	0.16	1000	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=1500 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT							COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/ Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wal surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	1500	D	0.16 g	DCH	4.00	997	219	18	2944	34560	14.40	48	44248	65771	44	66
2	6.00	4.00	0.30	1500	D	0.16 g	DCM	3.00	748	219	18	2944	34560	14.40	48	36024	52166	48	70
2	6.00	4.00	0.30	1500	D	0.16 g	DCL	1.00	272	219	18	2944	34560	14.40	48	20339	26219	75	96

Database UNICAM (steel bracing system - concentric, 2 diagonals):

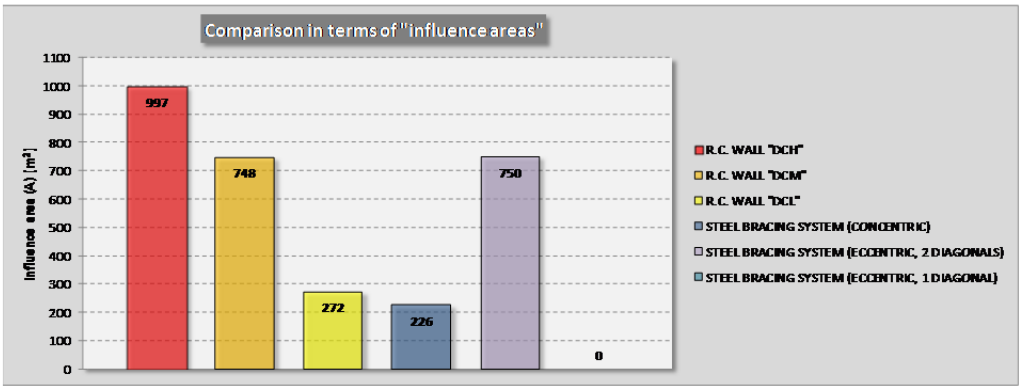
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 160 A	HE 280 A	226	4093	18685	23574	82	104
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 160 A	HE 280 A	226	4093	18685	23574	82	104
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 160 A	HE 300 A	226	4236	19077	23965	84	106
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 160 A	HE 300 A	226	4236	19077	23965	84	106
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 160 A	HE 300 A	226	4236	19077	23965	84	106
4.00	6.00	8.00	0.16	1500	HE 160 A	HE 180 A	HE 280 A	HE 400 A	HE 180 A	HE 320 A	226	4408	19550	24439	86	108

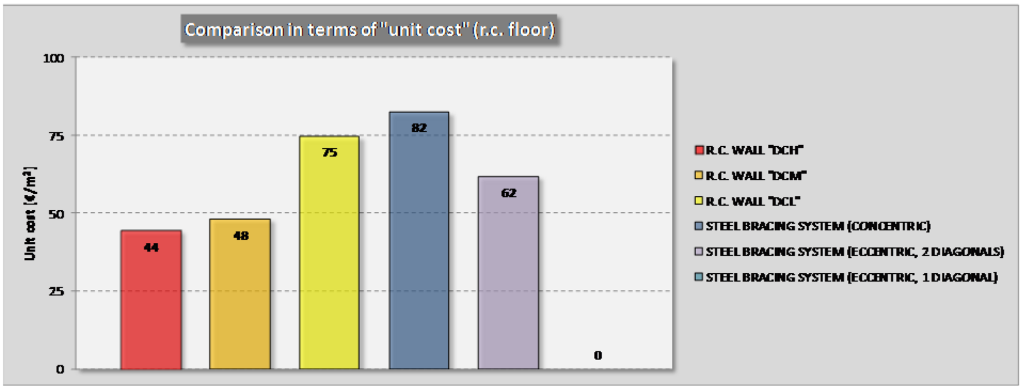
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 160 B	HE 260 B	750	7878	46333	62527	62	83
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 160 B	HE 260 B	750	7878	46333	62527	62	83
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 180 B	HE 280 B	766	8101	47450	63974	62	84
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 180 B	HE 280 B	766	8101	47450	63974	62	84
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 200 B	HE 300 B	782	8390	48799	65687	62	84
8.00	6.00	8.00	0.16	1500	HE 200 M	HE 450B	HE 280 B	HE 500 B	HE 200 B	HE 300 B	782	8390	48799	65687	62	84

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 [ ]	link1 [ ]	diag2 [ ]	diag1 [ ]	pil2 [ ]	pil1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	1500	-	-	-	-	-	-	-	-	-	-	-	-





COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS (B=4m; H=6m; V_b=2000 kN)

Database FENO (r.c. wall bracing system):

INPUT									OUTPUT								COST ESTIMATION			
Number of storeys	Storey height H [m]	Width B [m]	Thickness s [m]	Base shear Vb [kN]	Distribution type	Seismic/Wind action	Ductility class	Behaviour factor	Surface/Wall [m²]	Vertical rebars As,bending [cm²]	Horizontal rebars As,shear [cm²/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m³]	Precast DL wall surface [m²]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
2	6.00	4.00	0.30	2000	D	0.16 g	DCH	4.00	1330	291	24	3873	34560	14.40	48	56979	85676	43	64
2	6.00	4.00	0.30	2000	D	0.16 g	DCM	3.00	997	291	24	3873	34560	14.40	48	46013	67536	46	68
2	6.00	4.00	0.30	2000	D	0.16 g	DCL	1.00	337	291	24	3873	34560	14.40	48	24221	31487	72	94

Database UNICAM (steel bracing system - concentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 160 A	HE 300 A	302	5048	23794	30312	79	100
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 160 A	HE 300 A	302	5048	23794	30312	79	100
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 160 A	HE 320 A	302	5160	24100	30618	80	101
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 160 A	HE 320 A	302	5160	24100	30618	80	101
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 160 A	HE 340 A	302	5249	24343	30861	81	102
4.00	6.00	8.00	0.16	2000	HE 180 A	HE 220 A	HE 300 A	HE 450 B	HE 180 A	HE 360 A	302	5394	24741	31259	82	104

Database UNICAM (steel bracing system - eccentric, 2 diagonals):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
8.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-

Database UNICAM (steel bracing system - eccentric, 1 diagonal):

INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	link2 []	link1 []	diag2 []	diag1 []	pil2 []	pil1 []	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-
4.00	6.00	8.00	0.16	2000	-	-	-	-	-	-	-	-	-	-	-	-