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STEEL-EARTH

STEEL-BASED APPLICATIONS IN EARTHQUAKE-PRONE AREAS

PRECASTEEL

PREFABRI**CA**TED **ST**EEL STRUCTUR**E**S FOR LOW-RIS**E** BUI**L**DINGS IN SEISMIC AREAS

TECHNICAL SHEET

FERRIERE NORD SpA CONTRIBUTION

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1. Introduction

The following paragraphs explains the main scope of Ferriere Nord SpA (FeNO) contribution on *Precasteel* research, about the analysis of precast double-slab r.c. wall as alternative bracing system in low-rise steel commercial buildings situated in seismic areas, in particular the definition of shear wall configurations and load levels with reference to an innovative simplified pre-design procedure.

One of the parts of the project research that has deeply developed by FeNO was focused on the comparison between reinforced concrete walls solutions towards concentric and eccentric steel bracing systems, underlining their capacity of dissipating seismic energy and consequently the influence in terms of cost of construction.

2. Design objectives

The mentioned simplified design approach has the aim to accelerate and make easier all the decisions that has to be taken about feasibility of a project and, the last but not the least, provide an economic estimation of the investment.

On the basis of a preliminary statistical data analysis, structural configurations were defined fixing geometries (bays length, storey number, floor configuration or roof slope) in order to be consistent with housed activities, industrial or commercial, and to be competitive with concrete market shares. The selected structural solutions for commercial building activities were iteratively designed varying geometrical parameters and resisting static schemes in order to define the optimum steel and steel-concrete composite solutions.

The iterative design of many structures, integrated with the cost analysis, was transformed in a complete performance analysis where structural performance (assessed applying Eurocode design framework) were harmonized with construction costs. The cost model considered information coming from three different countries (Italy - Southern Europe; Germany - Central Europe; Romania - Eastern Europe), in such a way to adopt standardized reference values and to individuate in which national markets some solutions can be competitive or not.

Concerning commercial buildings, the solutions derived from the statistical analysis and from the cost analysis were in general a modular solution in which two main structures were coupled and devoted to different roles:

- a gravity structure to sustain vertical loads;
- a bracing structure to sustain seismic loads.

The refined numerical simulations and the studies for optimizing the structural performance of commercial building solutions where devoted to the assessment of real seismic performance of different horizontal bracing systems. The following structural configurations were analysed:

- commercial buildings equipped with concentrically braced steel frames (UniCAM);
- commercial buildings equipped with eccentrically braced steel frames (UniCAM);
- commercial buildings equipped with prefabricated reinforced concrete walls (FeNO);
- commercial buildings equipped with high dissipative rubber bearings between gravity structure and prefabricated reinforced concrete walls.

The final part of the research was focused on the definition of a design method (procedure) suitable for supporting practitioners and engineers in the use of solutions studied in *Precasteel*, in order to create an innovative and high quality software for the valorisation and utilization of structural solutions herein considered. The automated software became an internet application that every practitioner and engineer can use from its office in order to preliminary design a complete structure for industrial and commercial activities using *Precasteel* solutions. The web application works as a user-friendly graphical interface, that starting from a finite set of parameterized and optimized set of data, supplies the drawings and estimation of the cost of the structure, floors, roof and connections for industrial and commercial buildings.

3. Design inputs

The definition of a pre-design procedure for commercial buildings, that is able to provide designers some solutions about r.c. walls as alternative bracing systems, is based on some hypothesis concerning geometrical parameters and specific load levels:

Geometrical hypothesis:

- wall inter-storey height:
  H = 6 - 8 m (one-storey buildings);
  H = 4 - 5 - 6 m (two-storey buildings);
- wall width:
  B = 8 - 10 - 12 m (one-storey buildings);
  B = 4 - 5 - 6 m (two-storey buildings);
- wall thickness:
  s = 0.20 - 0.25 - 0.30 - 0.35 - 0.40 m.

Load hypothesis:

- maximum base shear horizontal loads (earthquake, wind) for a single r.c. wall:
  V_b = 500 - 1000 - 1500 - 2000 kN;
- roof/floor dead load:
  G_{1k} = 2.85 kN/m^2 (floor systems self-weight, see Figure 1);

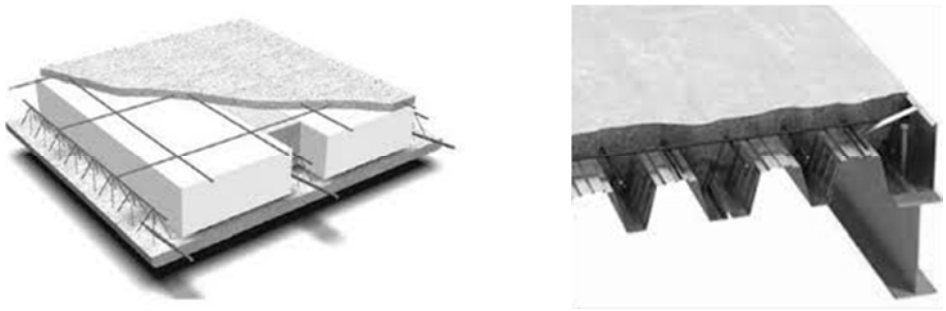


Figure 1: Typologies of r.c. floor (Predalle) and steel sheeting composite floor adopted.

- super-dead load:
  G_{2k} = 1.80 kN/m^2;
- heavy live load:
  Q_k = 8.00 kN/m^2 (commercial activities);
- standard live load:
  Q_k = 5.00 kN/m^2 (commercial activities);
- light live load:
  Q_k = 2.00 kN/m^2 (snow);
- seismicity level (PGA, peak ground acceleration):
  a_g = 0.08 g (low seismicity);
  a_g = 0.16 g (medium seismicity);
  a_g = 0.32 g (high seismicity);

- r.c. walls are designed to resist both seismic and wind actions, assuming four different distributions of the storey forces (distributions A, B, C, D, as explained in Figure 2). In the case of wind, the base shear was distributed so that the force applied at the first storey is twice the one applied at the roof level; in the case of seismic actions, by assuming the first vibration mode to be linear, the base shear was distributed according to the following formulas (where ***M*** represents storey seismic mass):

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

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

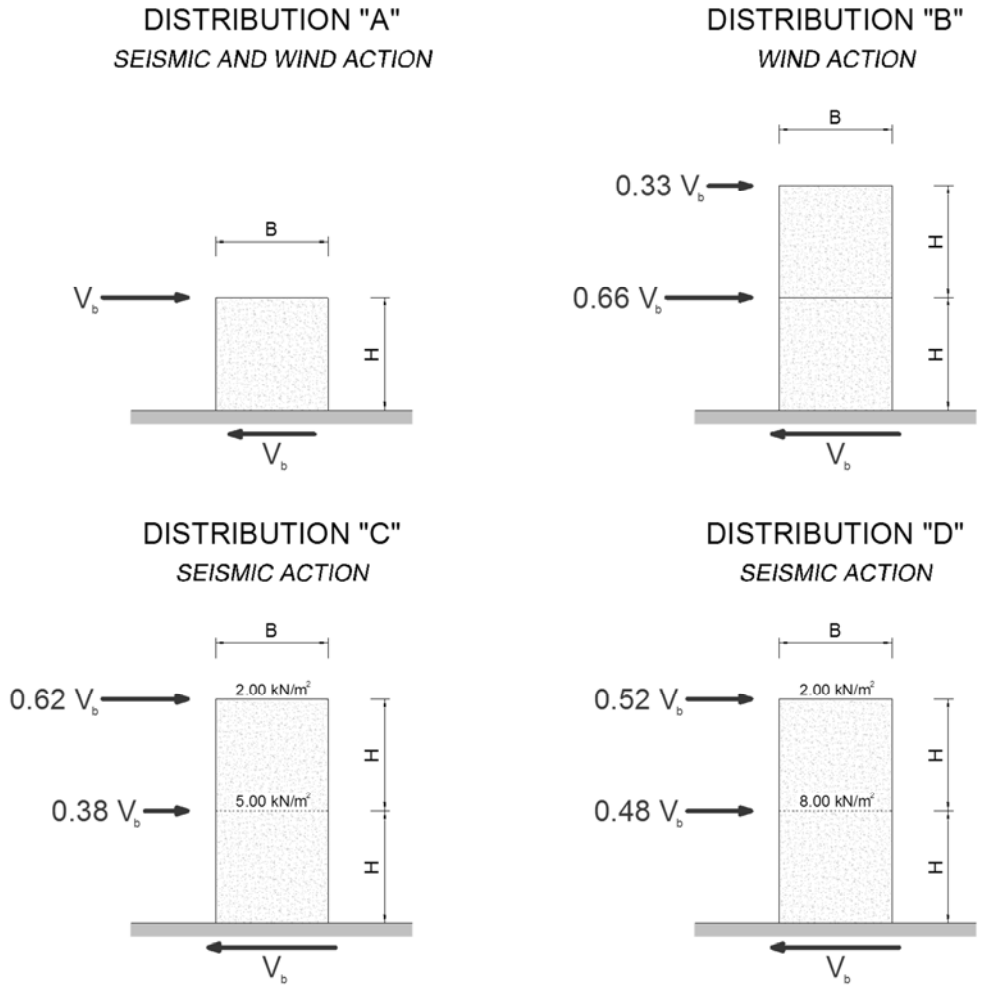


Figure 2: Distribution of horizontal forces.

4. Specific design concept

The definition of the mentioned pre-design method for r.c. walls as alternative bracing systems in steel commercial buildings is based especially on some hypothesis concerning the idealization of the structural behavior:

- simplified static schemes, obtained by extracting substructures with lower complexity but still able to describe the behavior of the whole structure;
- substructures are regular in plant and in elevation, in terms both of the distribution of seismic masses and stiffness;
- floor systems, columns and walls are designed separately considering vertical loads for the first two and horizontal actions (seismic and wind actions) for the third (see Figure 3);

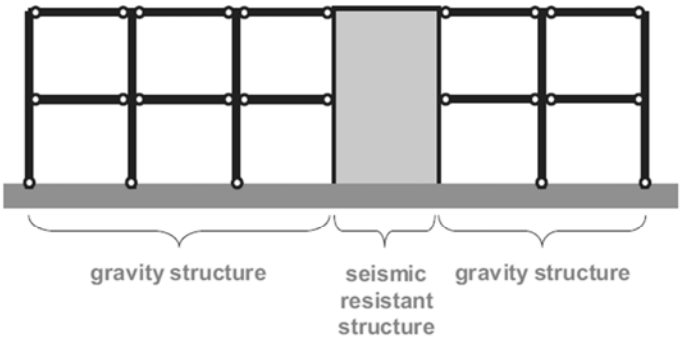


Figure 3: Decoupling of vertical and horizontal loads.

- floor systems are supposed as rigid diaphragms;
- foundation structures are considered and modeled as ideal rigid constraints;
- linear elastic analyses;
- static seismic analyses to pre-design ductile walls (ULS), simplified dynamic seismic analyses to give an estimation about influence area/wall (considering lumped masses for each storey);
- overturning vibration modes are avoided by technical joints (gaps between architectural modules) and a symmetrical disposition of the walls;
- ductile walls are uncoupled (i.e. C or L plan shapes for staircases);
- shear wall deformation is taken into account through a refined wall stiffness model (Timoshenko model);
- limitations imposed by Eurocodes are considered in order to obtain structural performances consistent with standard provisions.

5. Design methodology

In order to obtain the minimum number of seismic-resistant walls, able to withstand assigned base shears V_b and given a specific commercial building area, the following procedure is adopted.

The first vibration mode is assumed to be linear, consistently with the previous storey force distributions adopted, and may be expressed as:

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

Being K the translational stiffness matrix of the walls and M the mass matrix corresponding to a unit area, the fundamental period T of the system can be estimated from the expression:

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

where A is the unknown wall influence area.

The influence area A of the single wall may be evaluated by solving the following nonlinear equation, obtained by equating the assigned V_b to the base shear expected:

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

where S_d is the design spectrum.

This approach is valid only for type "A", "C" and "D" distribution of static forces (see Figure 4), in which base shear is due to seismic actions; for distribution type "B" the forces are originated by wind and the analysis the influence area A of the single wall is unpredictable because it requires knowing the exact form of the building and the surfaces exposed to wind. The obtained results are referred to the design spectra suggested by *Eurocode 8* for soil Type B.

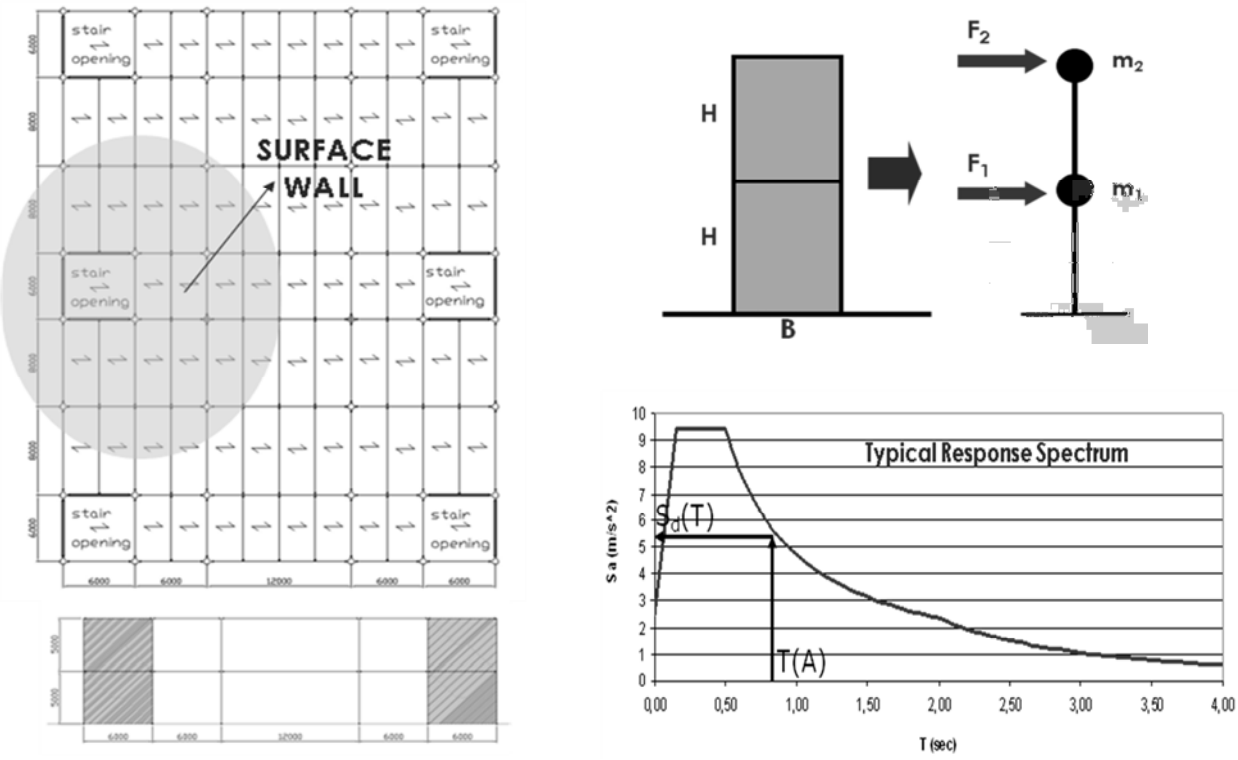


Figure 4: Simplified approach to estimate the influence area A of a single wall.

Then, to sum up, the input steps that a designer has to follow are:

a) fixing the maximum base shear horizontal loads (earthquake, wind) for a single r.c. wall;
b) choosing the intensity of live load applied to commercial building structures (heavy, standard, light live load);
c) defining the site seismicity level (PGA, peak ground acceleration);
d) assuming a distribution of the storey forces (A, B, C or D) with reference to the numbers of the stories and the nature of actions (wind or seismic);
e) fixing the ductility class of the structure (DCH and DCM for dissipative structures, DCL for r.c. structures that does not dissipate energy under cyclic loads generated by an earthquake);
f) estimation of behavior factor (q) of the structure with reference to ductility class and geometrical properties of the r.c. wall (storey height, width, thickness).

Considering all the previous described hypothesis and applying the simplified design procedure, according to Eurocodes standards, has been possible to build a database (an abstract, i.e., is reported in Table 1) in which the final ***Precasteel*** software will be able to provide designer a variety of feasible solutions for r.c. wall systems and the seismic surface of a commercial building that this type of r.c. bracing system is able to sustain.

Table 1: Example of input data and output results for a single r.c. wall.

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 [m^2]	Vertical rebars As,bending [cm^2]	Horizontal rebars As,shear [cm^2/m]	Steel weight [kg]	Concrete weight [kg]	Concrete volume [m^3]	Precast DL wall surface [m^2]
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. Details

Pre-design procedure of r.c. walls as bracing systems is easy, intuitive and fast, also in the definition of the structural details suggested and prescribed by Eurocodes, in particular:

- *Eurocode 8* for details about critical regions and confined zones of the walls for ductility classes DCH and DCM;
- *Eurocode 2* for details about low dissipative r.c. structures (DCL) or isolated structures by specific devices.

The following images describes typical structural details for r.c. shear wall system about:

- corner structural detail for r.c. wall bracing system and common plan configurations (see Figure 5);
- structural detail for connection between r.c. wall and r.c. precast floor (see Figure 6);
- structural detail for connection between r.c. wall and its foundation (see Figure 7).

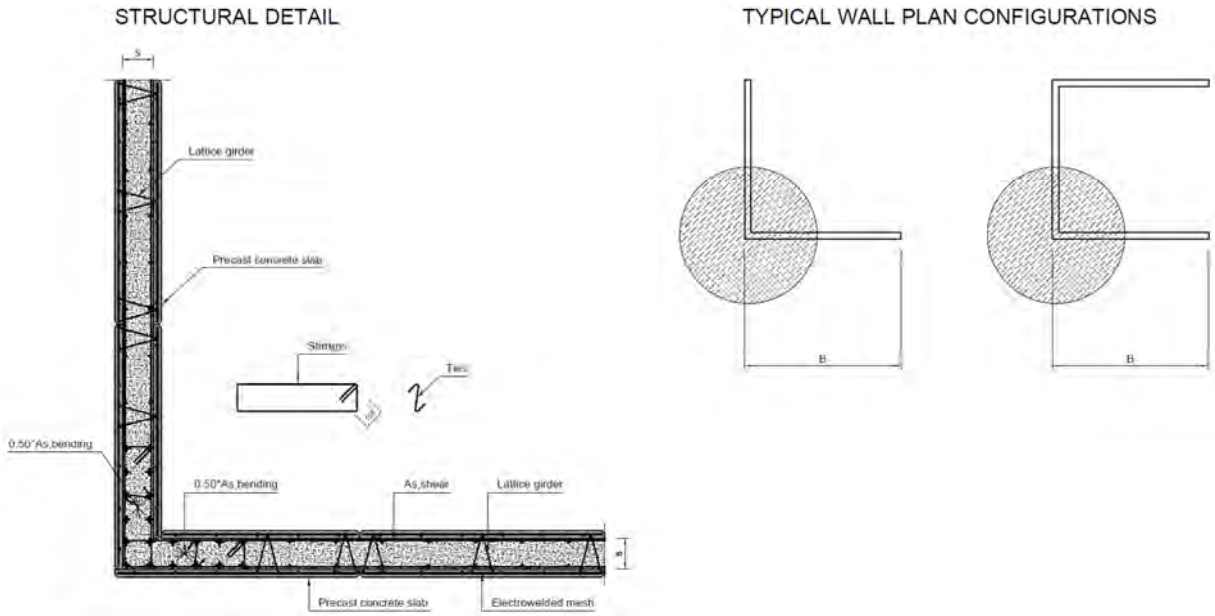


Figure 5: Typical corner structural detail for r.c. wall bracing system and common plan configurations (top view).

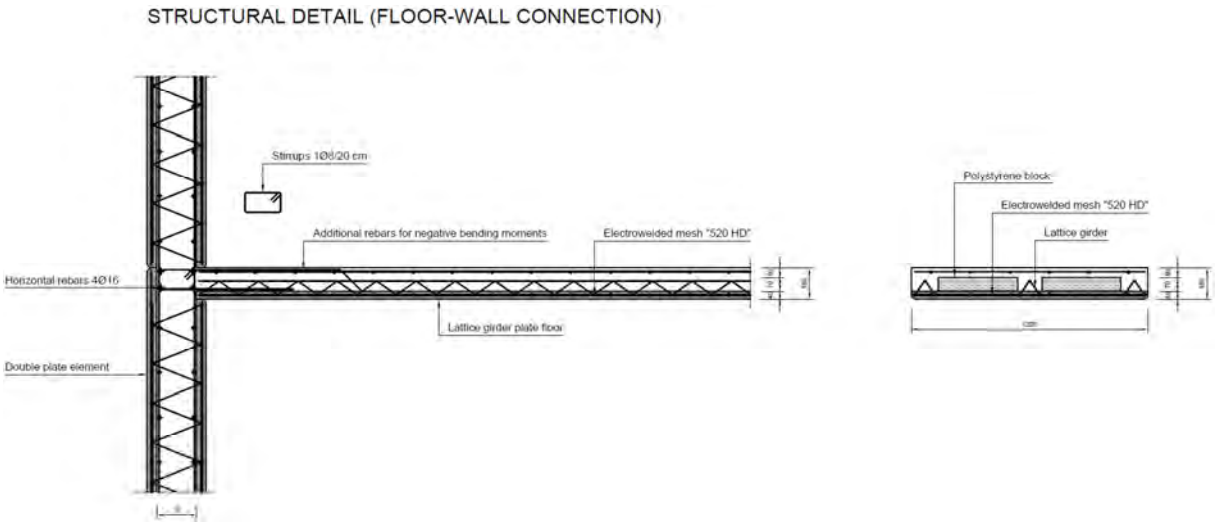


Figure 6: Typical structural detail for connection between r.c. wall and r.c. precast floor (vertical section).

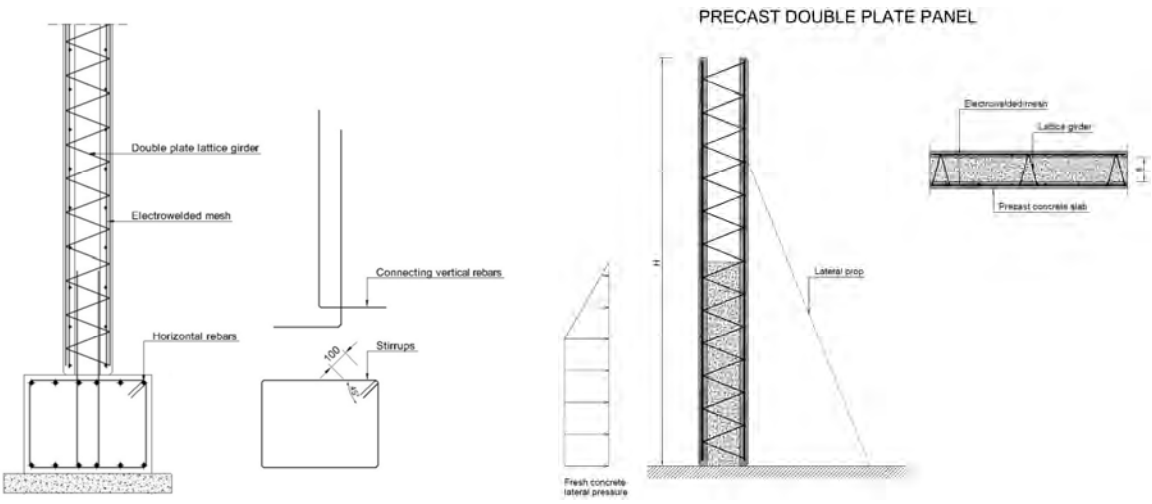


Figure 7: Typical structural detail for connection between r.c. wall and its foundation (vertical section).

Before casting concrete inside the r.c. wall, the precast element must be propped; props must be anchored in a plate able to support their compression and tension stresses. In correspondence of the corner it is necessary to fix the double-slab walls with a steel plate opportunely shaped or with other props (see Figure 8).

Figure 8: Operations of assembling precast r.c. wall.

The cast of the fresh concrete should be supervised to check the upper speed limit of 50 cm/hour, in order to avoid that lateral pressure would be greater than 2500 daN/m^2. Moreover, the cast must be done in different time, according to the design of lattice girders.

For what concerns structural details about connections between the main steel structure (beams, columns) and r.c. walls, there are two possible ways of detailing:

Connection decoupling horizontal and vertical loads

In this case we need an additional auxiliary beam, that transfers gravity loads towards the main steel columns, so that we can connect our r.c. bracing system to the steel frame decoupling vertical and horizontal loads (see Figure 9).

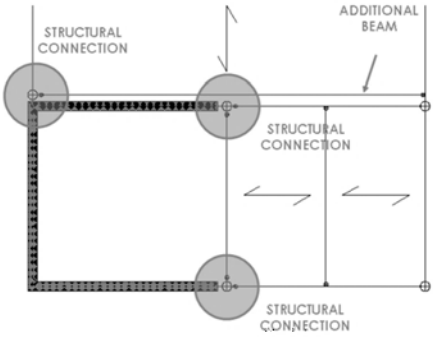


Figure 9: Typical connection between steel structure and r.c. walls, decoupling horizontal and vertical loads (top view).

Connection for both horizontal and vertical loads

In this case we don't need an additional auxiliary beam and we can connect directly our r.c. bracing system to the steel frame; then, it is possible for the walls support even vertical loads without compromise their seismic behaviour (see Figure 10).

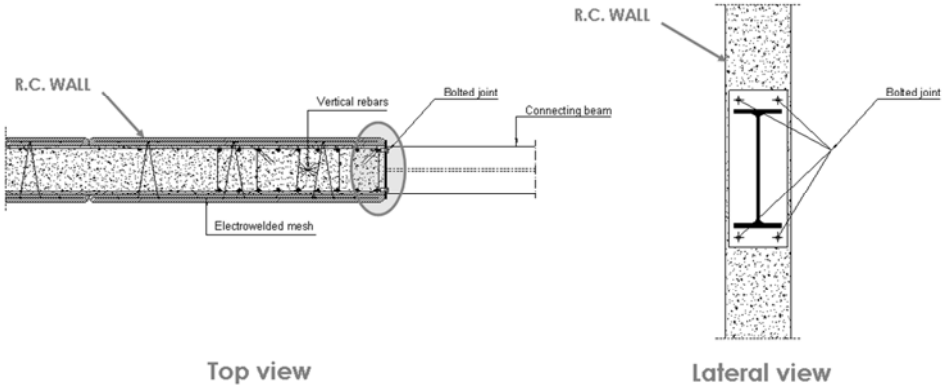


Figure 10: Typical connection between steel structure and r.c. walls for both horizontal and vertical loads.

Connections between steel structure (beams, columns) and r.c. walls as bracing systems could be realized in an easy way by chemical or mechanical anchors, after the erection of the r.c. structure. Another way to realize this kind of joints is the classical bolted connection, shaped and included in the formwork before the concrete pour. If the main structure is isolated by dissipative devices, at each floor there are specific steel joints to prevent hammering between wall systems and floor structures.

7. Comparison between r.c. wall and steel bracing systems

One of the parts of the project research that has deeply developed by FeNO was focused on the comparison between reinforced concrete walls solutions towards concentric and eccentric steel bracing systems.

First of all, the cost model was updated to the current year considering both detailed price analysis and official price lists of the public administrations (this activity was summarized in Table 2), collecting information coming from different countries (Italy - Southern Europe; Germany - Central Europe).

Table 2: Update of unit construction costs (Italy - Southern Europe; Germany - Central Europe).

ITEM	UNIT COST	U.M.	NOTE
Concrete for r.c. walls (without formwork)	**322.22**	€/m^3	C25/30, XC2, S4.
Concrete for r.c. slabs (without formwork)	**222.22**	€/m^3	C25/30, XC2, S4.
Steel for r.c. structures	**1.90**	€/kg	
Precast double plate r.c. walls	**23.25**	€/m^2	Included cost of lattice girders, electrowelded meshes and assembling. Excluding fresh concrete cast in place.
Precast r.c. floor (Predalle)	**32.99**	€/m^2	Unpropped solution.
Steel sheeting composite floor	**54.57**	€/m^2	Unpropped solution.
Steel for frame structures	**2.74**	€/kg	S355, included surface treatments, erection, bolted and welded joints.

From the complete *Precasteel* database implemented by FeNO (for r.c. wall bracing system) and UniCAM (for steel bracing systems), it is important to understand the convenience on the choice of a specific type of bracing system. Then, it was possible compare different bracing systems in terms of influence area and in terms of total and unit cost, varying geometrical parameters, loads levels and capacity of energy dissipation for each type of bracing system.

In the following comparisons, it is possible notice that r.c. flooring system (Predalle) are always more convenient than steel sheeting floor in terms of cost, therefore this kind of flooring system was assumed as a constant parameter for each evaluation related to the comparisons.

It was possible to observe, the same for distribution A, C or D, that there is a significant trend which make in evidence the main advantages in the choice of r.c. bracing system instead steel bracing system (concentric or eccentric), both in terms of influence area and in terms of unit cost (see Figure 11 and Figure 12, for distribution C).

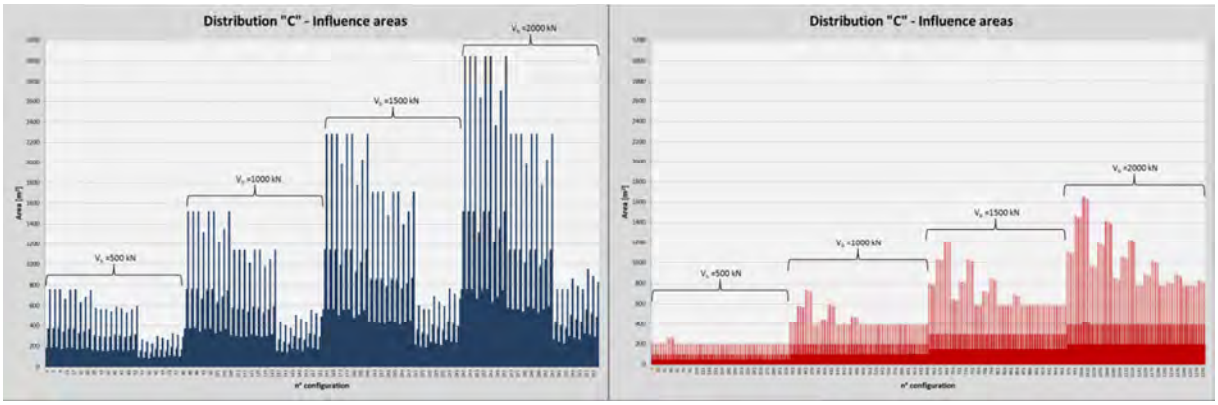


Figure 11: Comparison in terms of influence area - r.c. bracing system (left) vs. steel concentric bracing system (right).

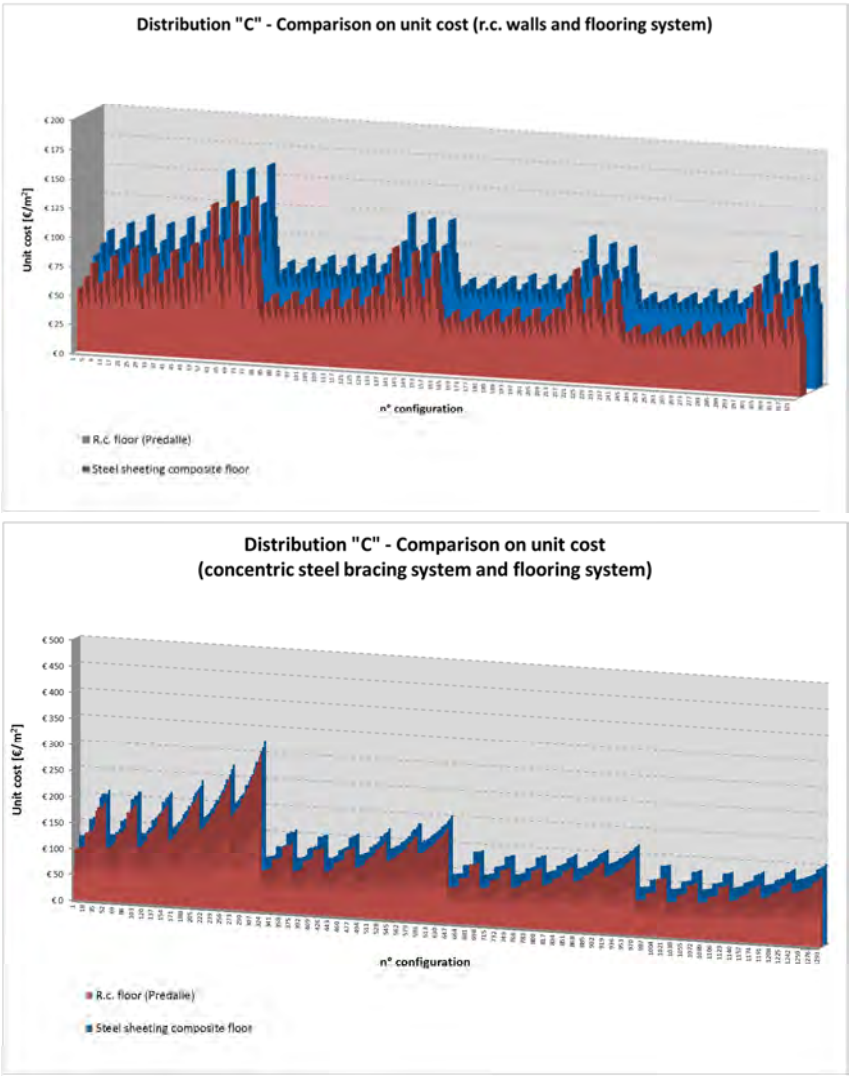


Figure 12: Comparison in terms of unit cost - r.c. bracing system (top) vs. steel concentric bracing system (bottom).

Moreover, comparing all the possible configurations for r.c. and steel bracing system, it is worth noticing that steel bracing systems do not always resist in the complete range of shear base force V_b = 500÷2000 kN, but they are often limited on the upper forces due to design limits in terms of geometry of the commercial steel profiles.

To confirm what FeNO noticed and discovered about the general convenience in the choice of r.c. wall bracing system instead of steel bracing system (concentric or eccentric), in the following Table 3 is exposed the activity of database sampling and comparison results (extracting 72 cases on a population of 972 configurations; see Annex 1, 2, 3 for more extended and complete evaluations) finalized to give an estimation about the mentioned convenience. This activity of database sampling was conducted fixing some parameter about geometry and load levels, to evaluate the most representative bracing configurations:

- wall inter-storey height:

  H = 6 - 8 m (one-storey buildings);

  H = 4 - 6 m (two-storey buildings);

- wall width:

  B = 8 m (one-storey buildings);

  B = 4 m (two-storey buildings);

- seismicity level (PGA, peak ground acceleration):

  a_g = 0.16 g (medium seismicity).

Table 3: Database sampling and comparison results (distribution C).

DATABASE SAMPLING - COMPARING ACTIVITY (PARAMETERS: INFLUENCE AREA, UNIT COST)											
COMPARISON n°	DISTRIBUTION	SEISMICITY (a_g)	R.C. WALL BRACING SYSTEM				BASE SHEAR V_b [kN]	STEEL BRACING SYSTEM			RESULTS
			B [m]	H [m]	s [m]	DUCTILITY CLASS		CONCENTRIC	ECCENTRIC 2 DIAGONALS	ECCENTRIC 1 DIAGONAL	
1	C	0.16 g	4.00	4.00	0.20	DCH	500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
2	C	0.16 g	4.00	4.00	0.20	DCM	500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
3	C	0.16 g	4.00	4.00	0.20	DCL	500	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	STEEL BRACING SYSTEM	
4	C	0.16 g	4.00	4.00	0.20	DCH	1000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
5	C	0.16 g	4.00	4.00	0.20	DCM	1000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
6	C	0.16 g	4.00	4.00	0.20	DCL	1000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
7	C	0.16 g	4.00	4.00	0.20	DCH	1500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
8	C	0.16 g	4.00	4.00	0.20	DCM	1500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
9	C	0.16 g	4.00	4.00	0.20	DCL	1500	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	R.C. WALL SYSTEM	
10	C	0.16 g	4.00	4.00	0.20	DCH	2000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
11	C	0.16 g	4.00	4.00	0.20	DCM	2000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
12	C	0.16 g	4.00	4.00	0.20	DCL	2000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
13	C	0.16 g	4.00	6.00	0.30	DCH	500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
14	C	0.16 g	4.00	6.00	0.30	DCM	500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	
15	C	0.16 g	4.00	6.00	0.30	DCL	500	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	STEEL BRACING SYSTEM	
16	C	0.16 g	4.00	6.00	0.30	DCH	1000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
17	C	0.16 g	4.00	6.00	0.30	DCM	1000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
18	C	0.16 g	4.00	6.00	0.30	DCL	1000	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	R.C. WALL SYSTEM	
19	C	0.16 g	4.00	6.00	0.30	DCH	1500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
20	C	0.16 g	4.00	6.00	0.30	DCM	1500	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
21	C	0.16 g	4.00	6.00	0.30	DCL	1500	R.C. WALL SYSTEM	STEEL BRACING SYSTEM	R.C. WALL SYSTEM	
22	C	0.16 g	4.00	6.00	0.30	DCH	2000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
23	C	0.16 g	4.00	6.00	0.30	DCM	2000	R.C. WALL SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	
24	C	0.16 g	4.00	6.00	0.30	DCL	2000	STEEL BRACING SYSTEM	R.C. WALL SYSTEM	R.C. WALL SYSTEM	

The same consideration about comparing activity are valid both for A, C, or D distribution and this fact confirms the significant advantages of choosing r.c. wall bracing system instead steel bracing system, as it can be observed through the analysis of the next pie charts (see Figure 13, for distribution C) that summarized all the comparison results and give an estimation about the efficiency of each bracing system.

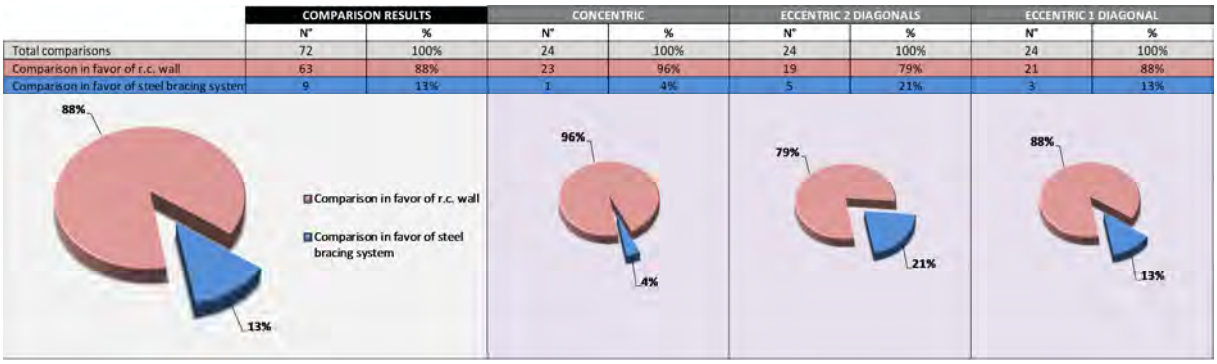


Figure 13: Database sampling and comparison - r.c. bracing system vs. steel bracing system (concentric, eccentric).

Through the mentioned procedure, it has been possible achieved some important results and conclusions.

It is worth noticing and it is important to underline the following aspect about the adoption of r.c. walls as bracing systems of a commercial building: reinforced concrete walls solutions are almost always (96%) competitive towards concentric steel bracing systems due to their capacity of dissipating seismic energy, although their fundamental vibration periods are usually shorter; the above consideration is often true (79% and 88%) comparing performances of r.c. walls solutions towards eccentric steel bracing systems, although these ones have a much bigger potential capacity of energy dissipation due to cyclic actions (in particular, seismic actions) but have an upper limit to resist shear forces that does not allowed to adapt them to many different situations.

The main hypothesis of decoupling vertical and horizontal loads in commercial building structures must be strictly respected for steel bracing systems, especially for eccentric ones; in fact, these types of bracing systems are able to dissipate a much bigger energy due to cyclic actions if they support only lateral loads, because vertical loads (gravity or live loads) could compromise the optimal behavior of the seismic link. Vice versa, r.c. walls are able to support also vertical load during an earthquake, without compromise their capacity of dissipating seismic energy and this make in evidence a wider versatility of employing these typology of bracing systems for general structures; moreover, this property of r.c. walls allows designers to reduce the number of steel members (columns, beams and joints, positioned around bracing systems to sustain vertical loads) and then to bring down the total cost estimation of the building.

ANNEX 1

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS

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 [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):

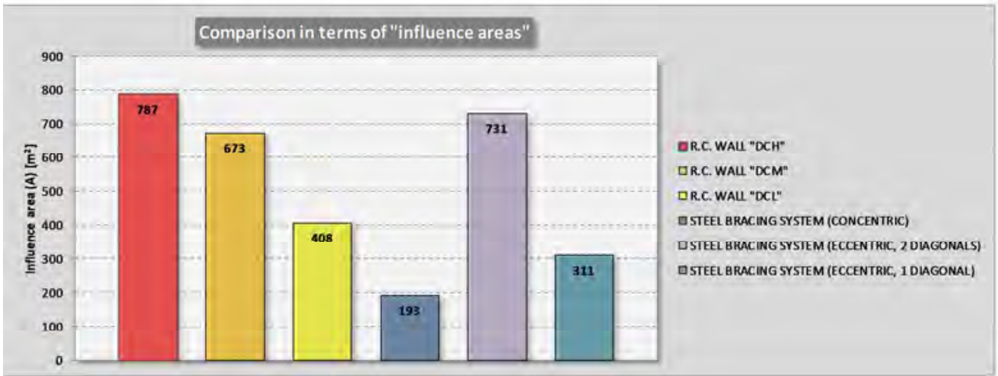
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 160 A	193	1377	10136	14300	53	74
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 160 A	193	1377	10136	14300	53	74
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 180 A	193	1438	10304	14468	53	75
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 180 A	193	1438	10304	14468	53	75
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 200 A	193	1520	10526	14691	55	76
8.00	6.00	2.00	0.16	500	HE 180 A	HE 220 A	HE 220 A	193	1618	10797	14961	56	78

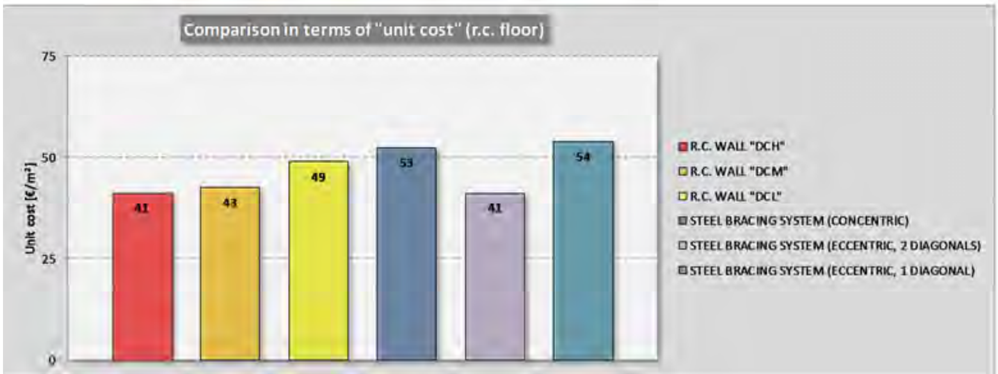
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 220 B	HE 240 B	HE 160 B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220 B	HE 240 B	HE 160 B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220 B	HE 240 B	HE 160 B	731	2248	30285	46072	41	63
8.00	6.00	2.00	0.16	500	HE 220 B	HE 240 B	HE 180 B	732	2351	30580	46374	42	63
8.00	6.00	2.00	0.16	500	HE 220 B	HE 240 B	HE 180 B	732	2351	30580	46374	42	63
8.00	6.00	2.00	0.16	500	HE 220 B	HE 240 B	HE 200 B	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 160 M	HE 240 B	HE 320 B	311	2390	16814	23531	54	76
4.00	6.00	2.00	0.16	250	HE 160 M	HE 240 B	HE 340 B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160 M	HE 240 B	HE 340 B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160 M	HE 240 B	HE 340 B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160 M	HE 240 B	HE 340 B	330	2481	17678	24798	54	75
4.00	6.00	2.00	0.16	250	HE 160 M	HE 240 B	HE 340 B	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 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	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):

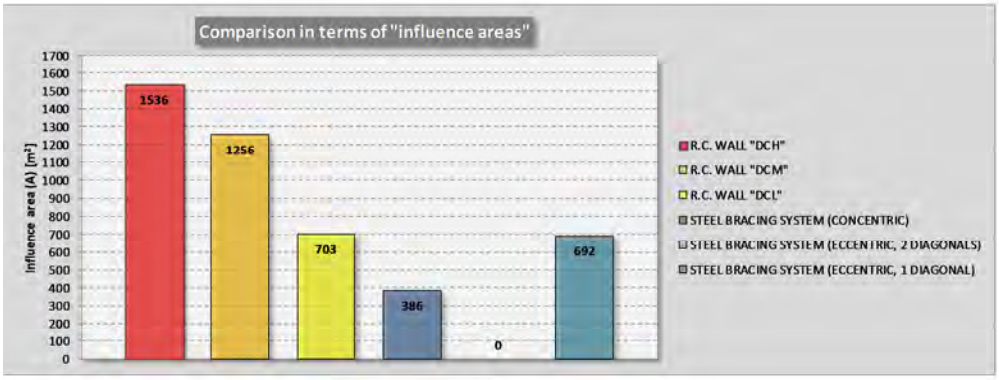
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1000	HE 220 A	HE 260 A	HE 160 A	386	1752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

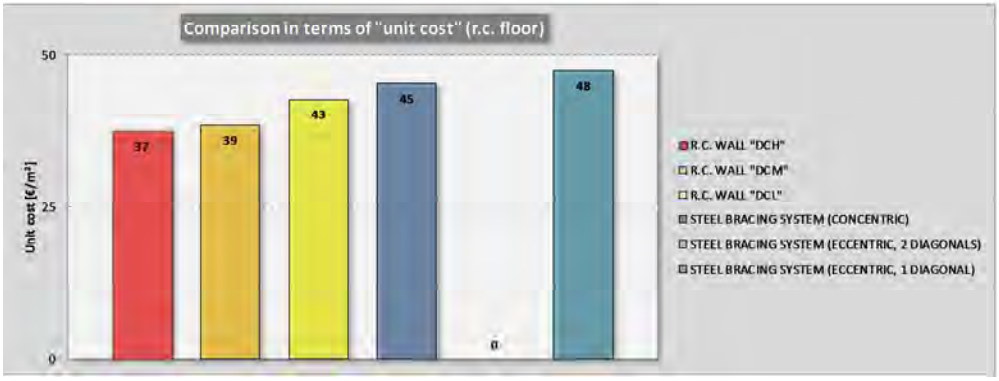
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 240 M	HE 300 B	HE 500 B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240 M	HE 300 B	HE 500 B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240 M	HE 300 B	HE 500 B	692	3670	32897	47842	48	69
4.00	6.00	2.00	0.16	500	HE 240 M	HE 300 B	HE 550 B	665	3816	32398	46752	49	70
4.00	6.00	2.00	0.16	500	HE 240 M	HE 300 B	HE 550 B	665	3816	32398	46752	49	70
4.00	6.00	2.00	0.16	500	HE 240 M	HE 300 B	HE 550 B	665	3816	32398	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):

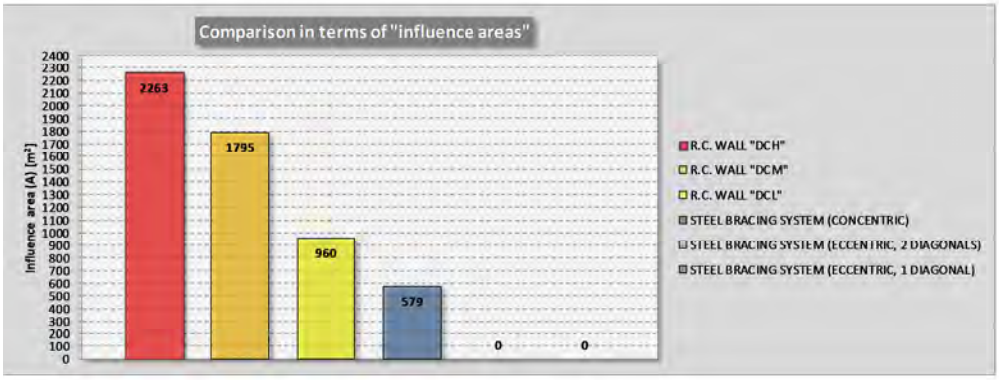
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 160 A	579	2121	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	37556	43	65
8.00	6.00	2.00	0.16	1500	HE 240 A	HE 300 A	HE 180 A	579	2182	25068	37556	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

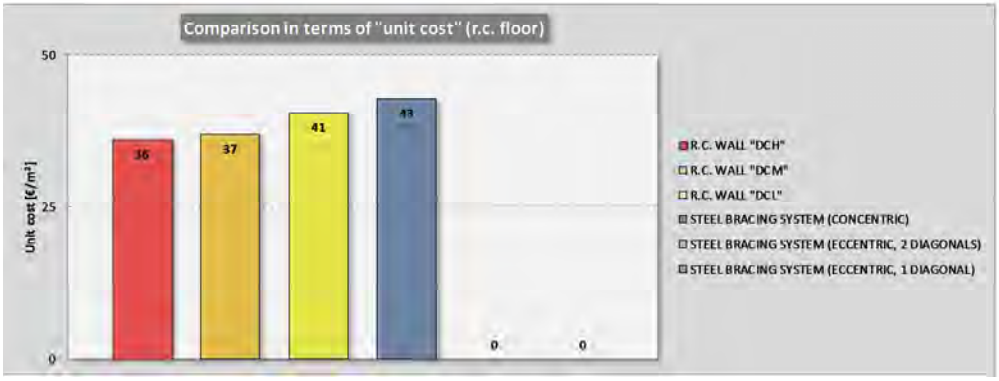
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	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):

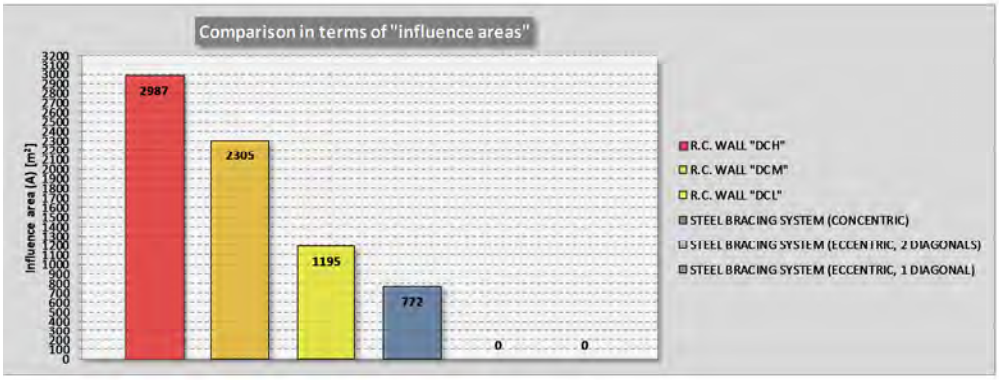
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 160 A	772	2591	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 160 A	772	2652	32720	49374	42	64
8.00	6.00	2.00	0.16	2000	HE 280 A	HE 360 A	HE 160 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

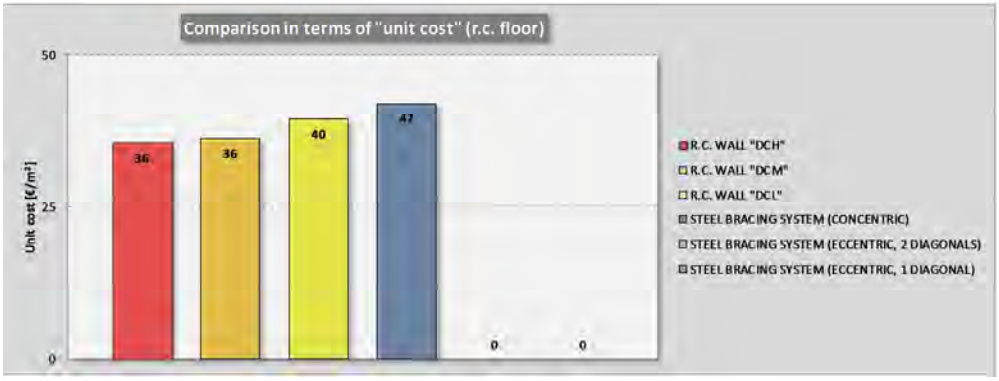
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 [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):

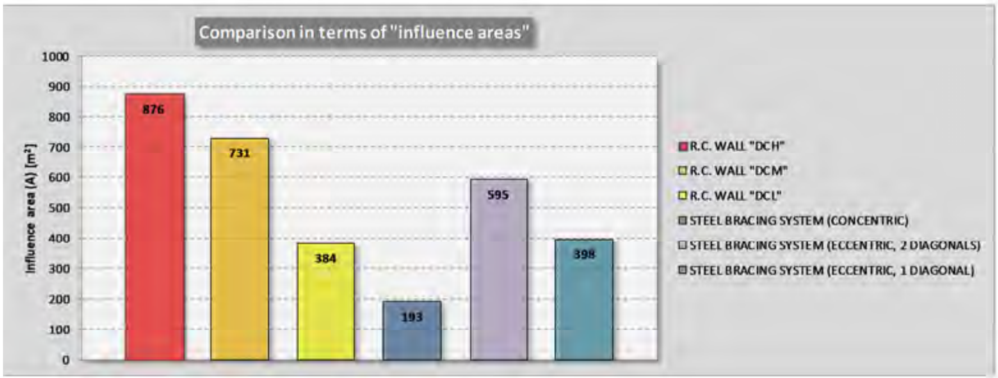
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	500	HE 180 A	HE 260 A	HE 220 A	193	2312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

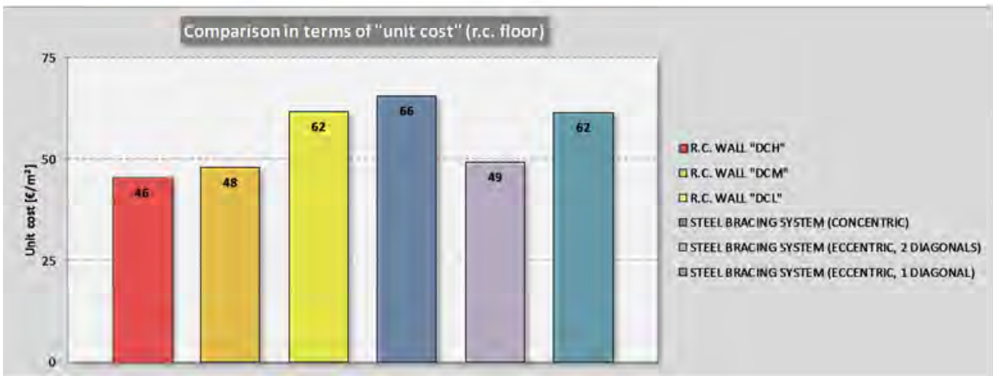
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 [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):

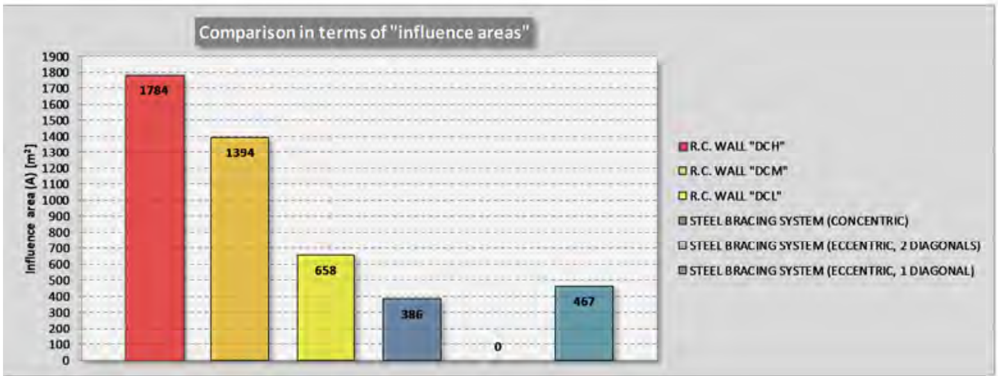
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1000	HE 220 A	HE 320 A	HE 220 A	386	2958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

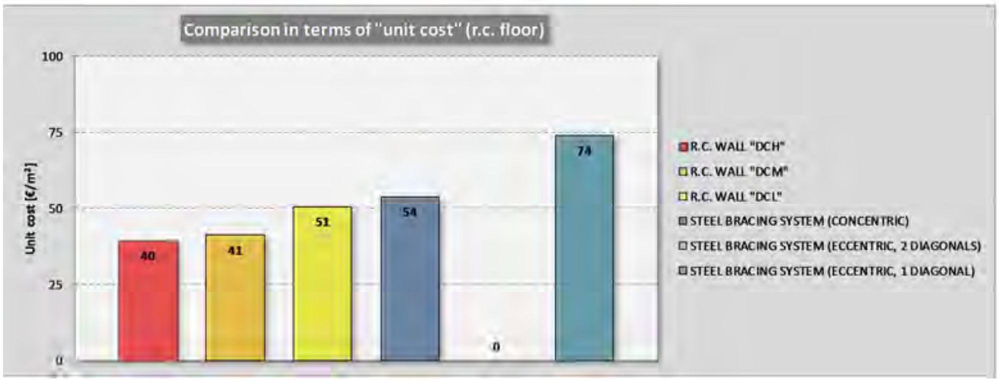
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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	43883	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 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	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):

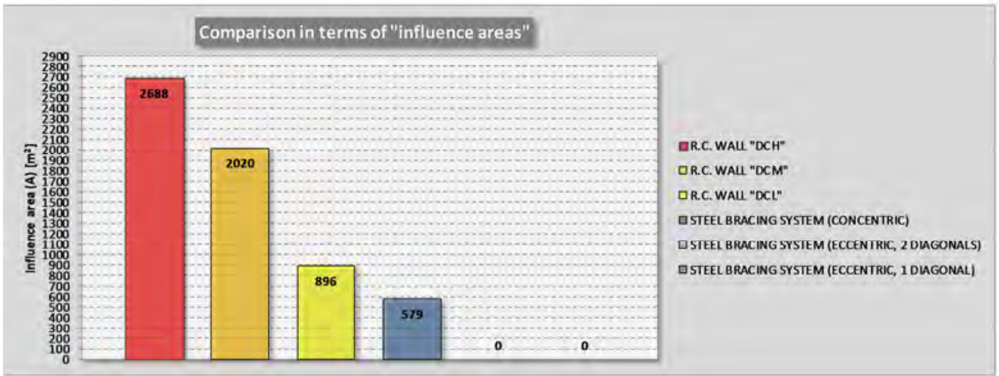
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	1500	HE 240 A	HE 360 B	HE 220 A	579	3831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

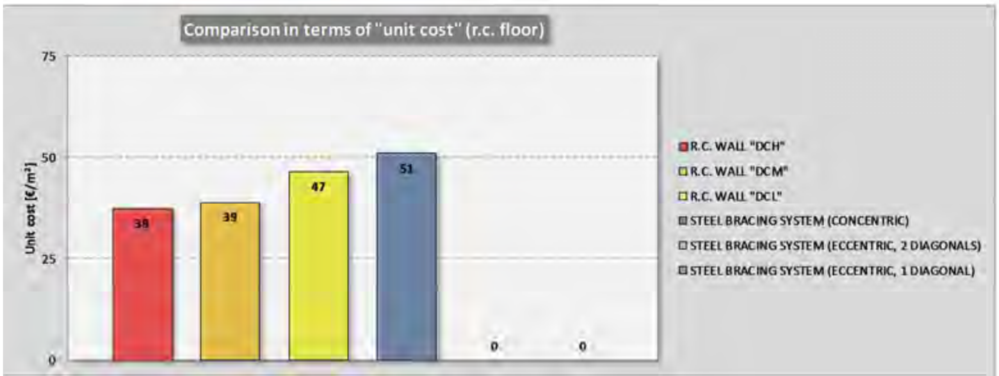
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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):

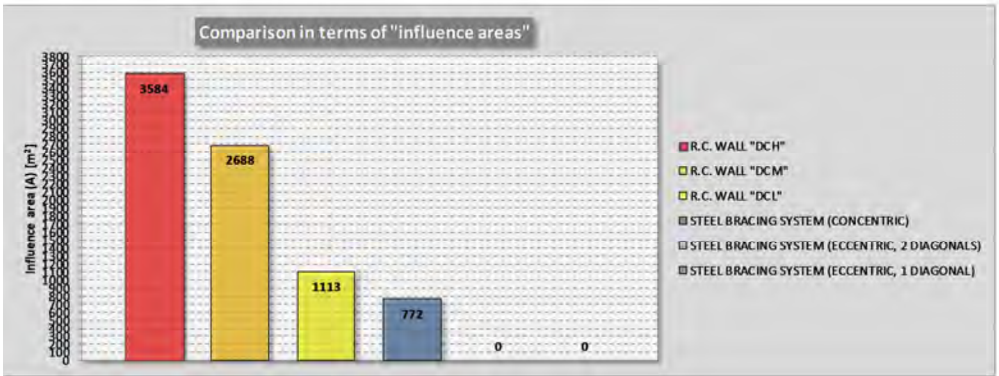
INPUT					OUTPUT					COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	DIAG [ ]	COL [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
8.00	8.00	2.00	0.16	2000	HE 280 A	HE 280 M	HE 220 A	772	4800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

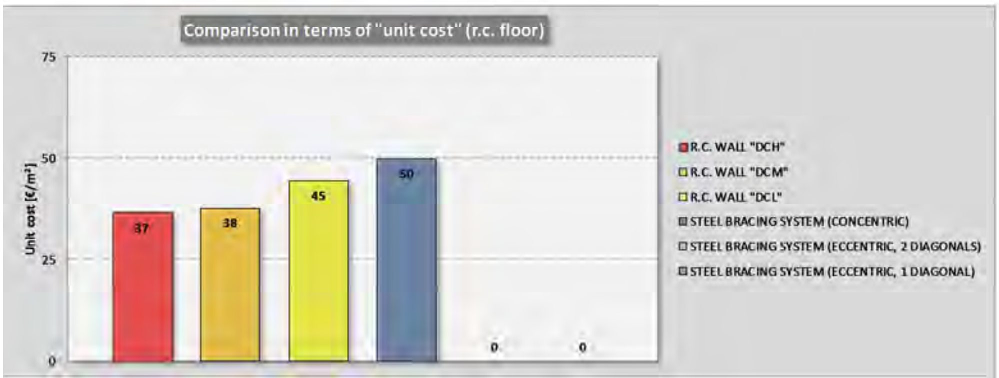
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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	-	-	-	-	-	-	-	-	-





ANNEX 2

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS

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 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	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):

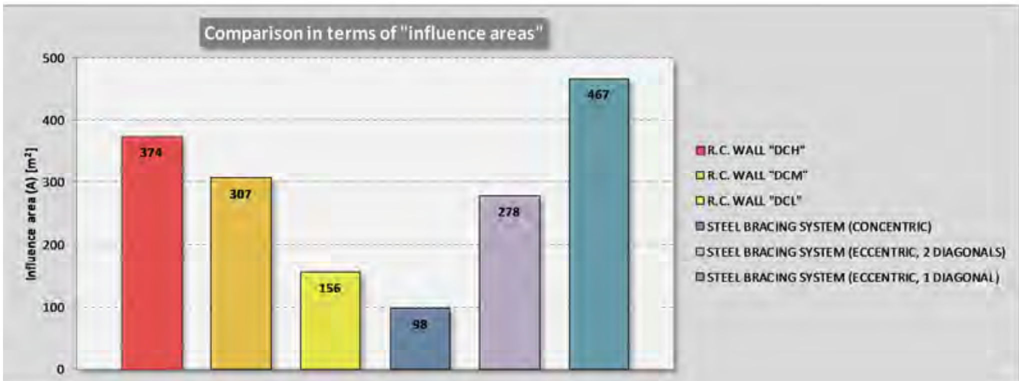
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	500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

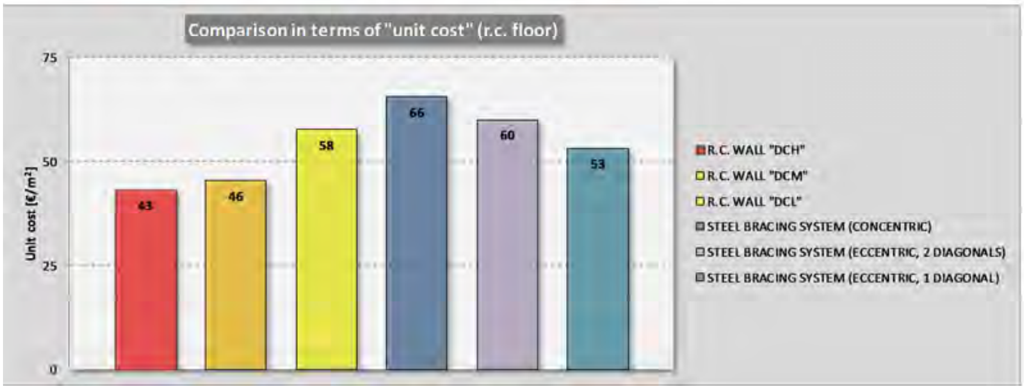
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 180 B	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 180 B	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 180 B	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 180 B	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 180 B	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 180 B	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 300 B	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 300 B	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 300 B	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 300 B	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 300 B	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 300 B	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):

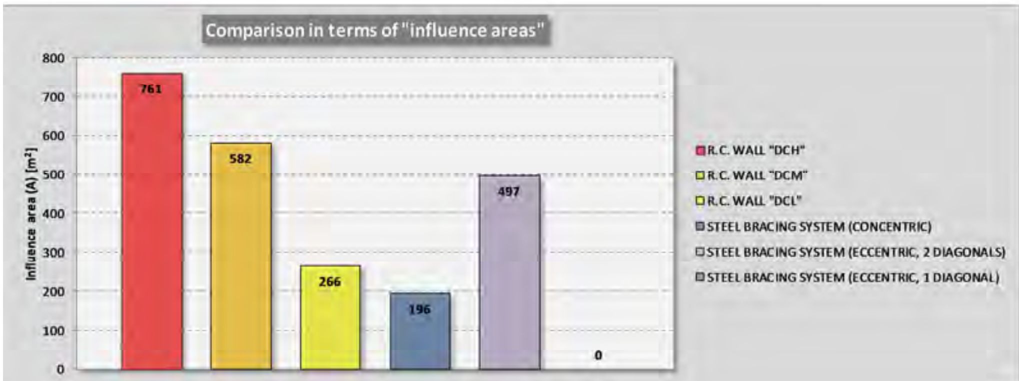
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1000	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

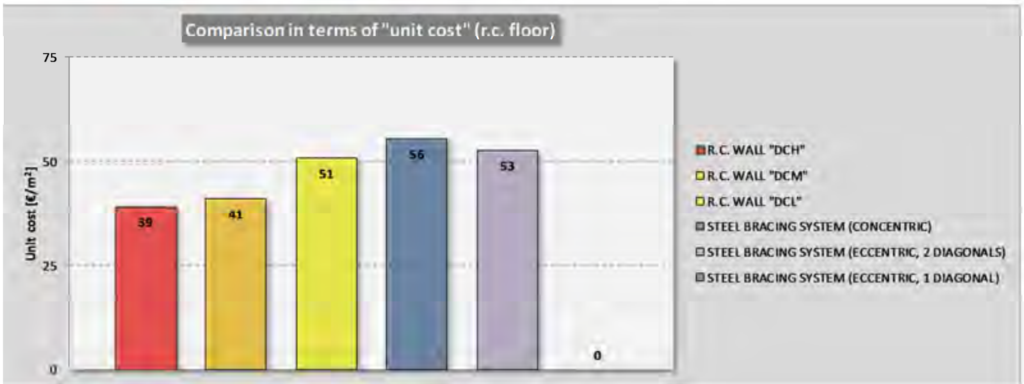
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 180 M	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 180 M	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 180 M	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 180 M	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 180 M	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 180 M	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 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	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):

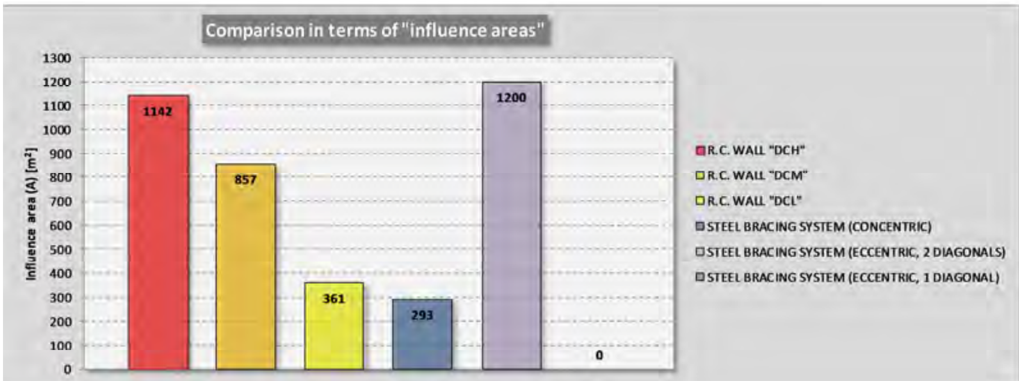
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	1500	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

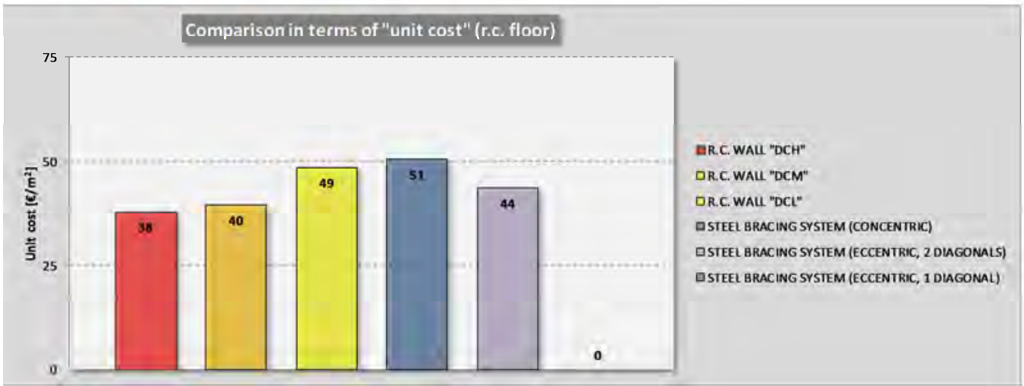
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	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):

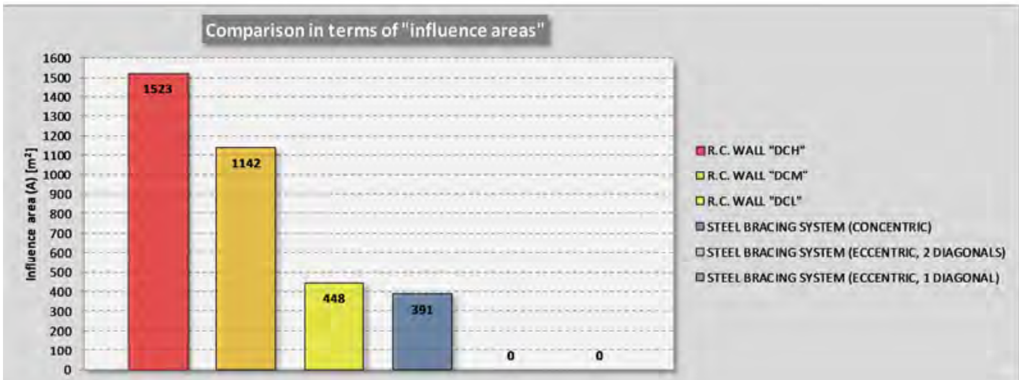
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	5.00	0.16	2000	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

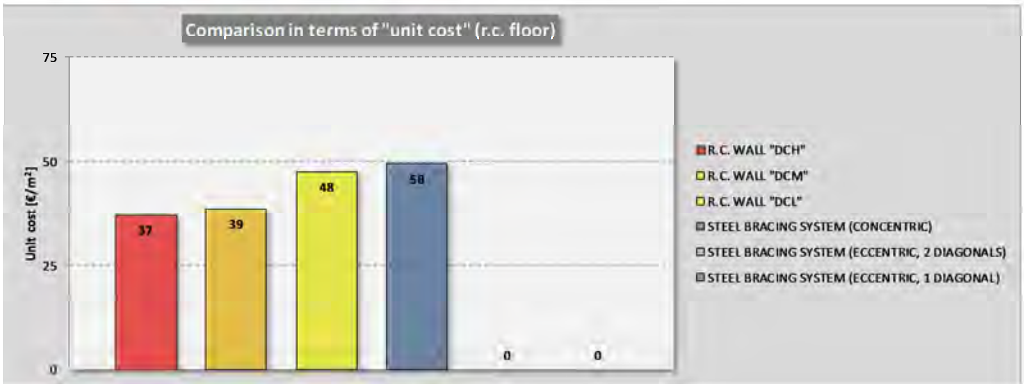
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	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):

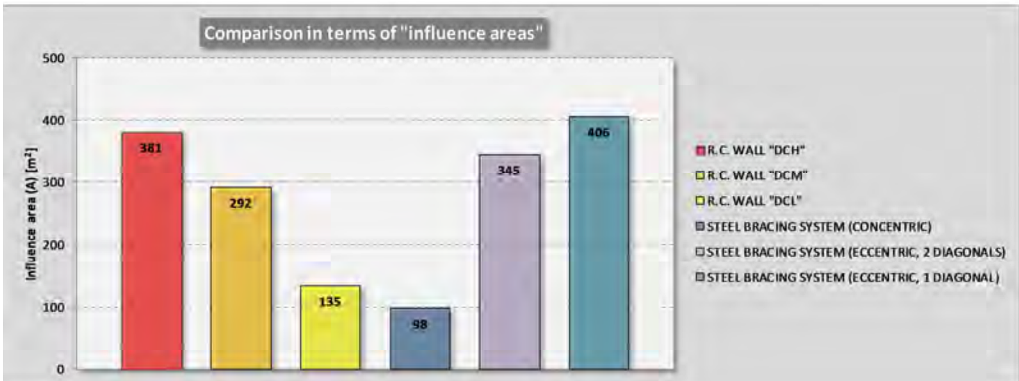
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	500	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

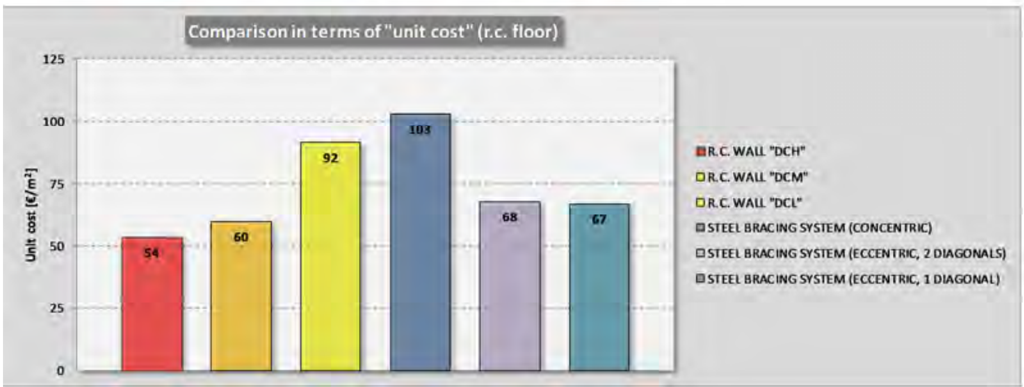
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 220 B	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 220 B	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 220 B	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 220 B	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 220 B	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 220 B	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 360 B	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 360 B	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 360 B	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 360 B	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 360 B	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 360 B	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 [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):

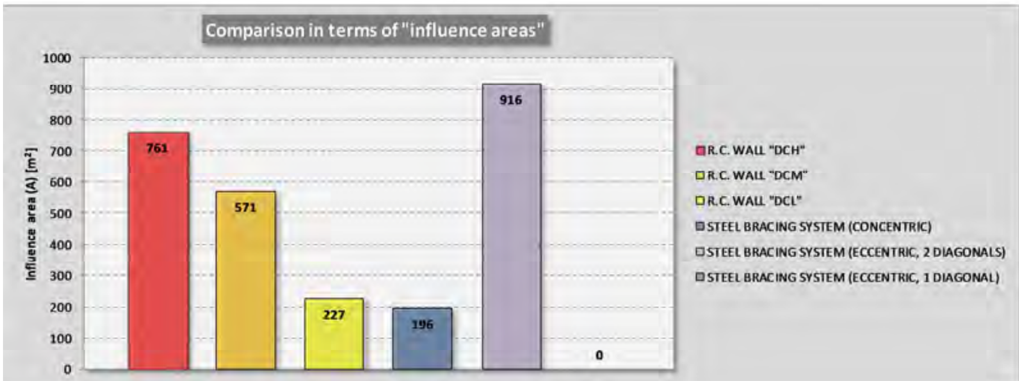
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1000	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

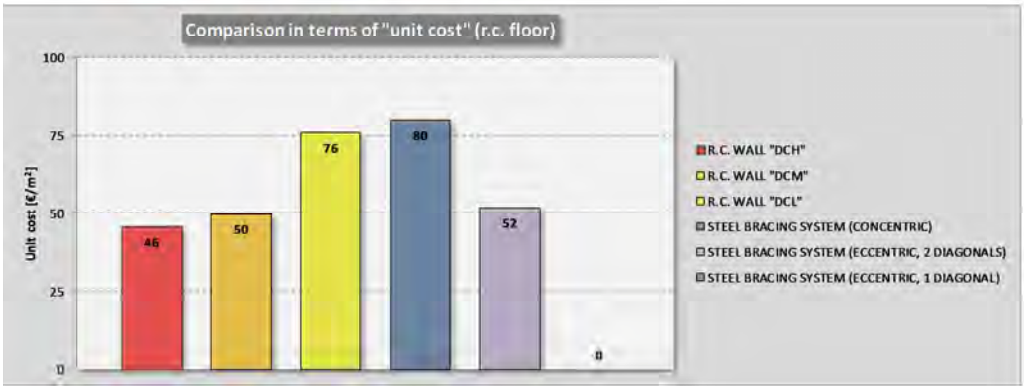
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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	6868	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	6868	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 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	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):

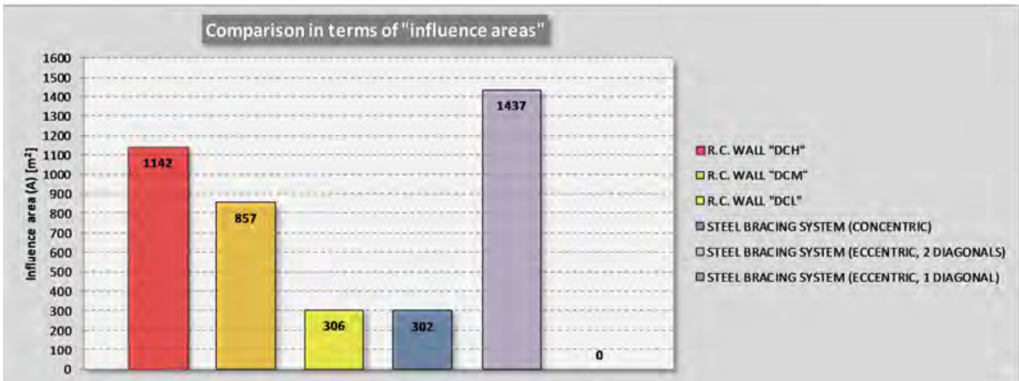
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	1500	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

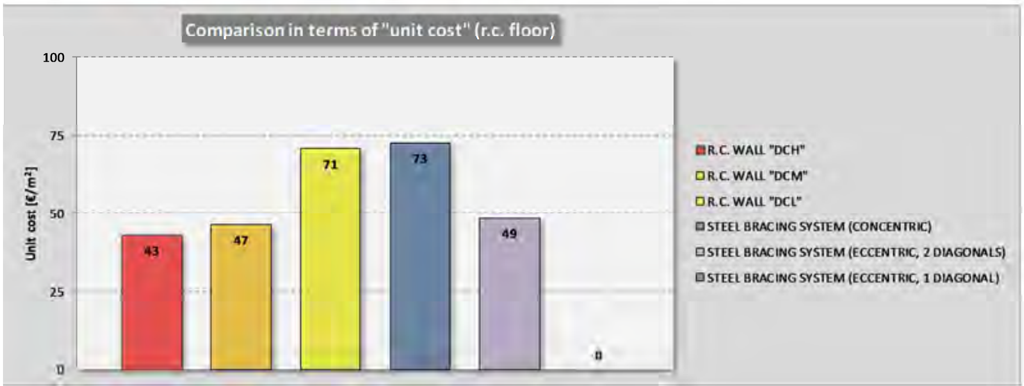
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	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):

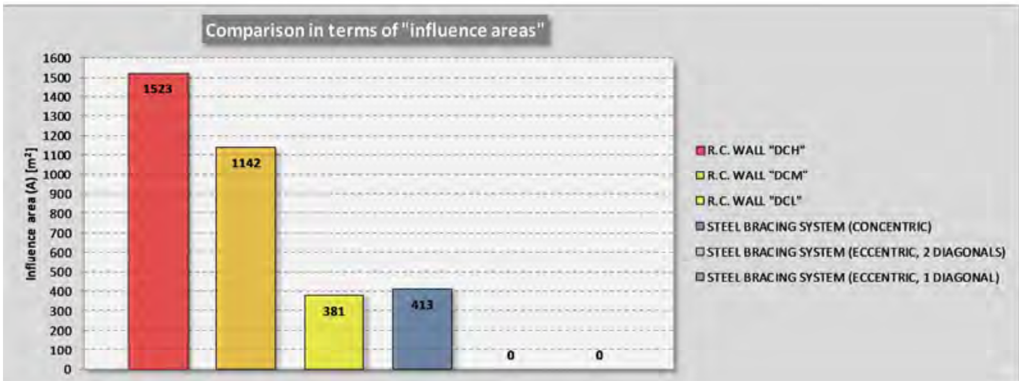
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	5.00	0.16	2000	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

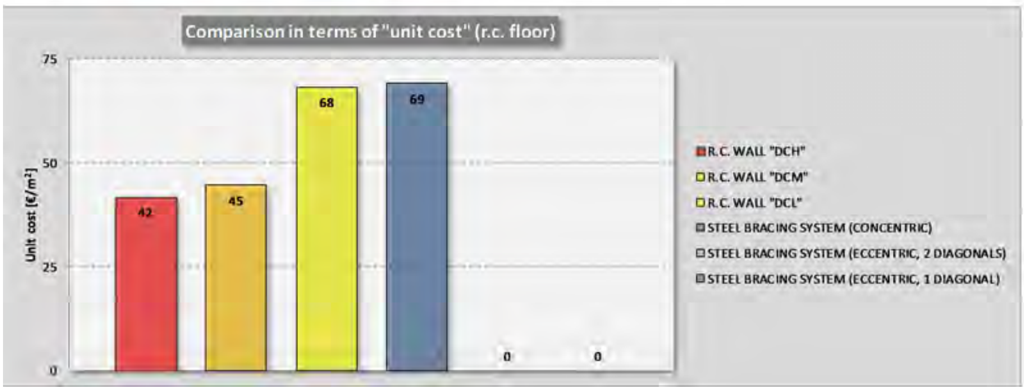
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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	-	-	-	-	-	-	-	-	-	-	-	-





ANNEX 3

COMPARISON BETWEEN R.C. WALL AND STEEL BRACING SYSTEMS

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):

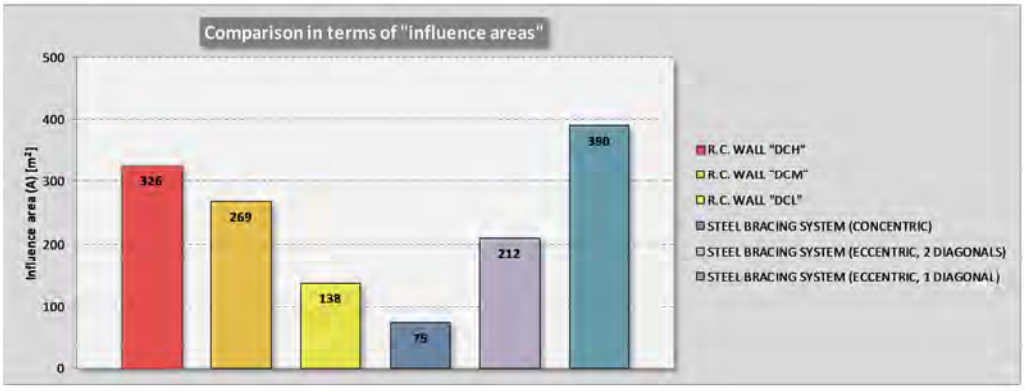
INPUT					OUTPUT							COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	500	HE 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	98
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

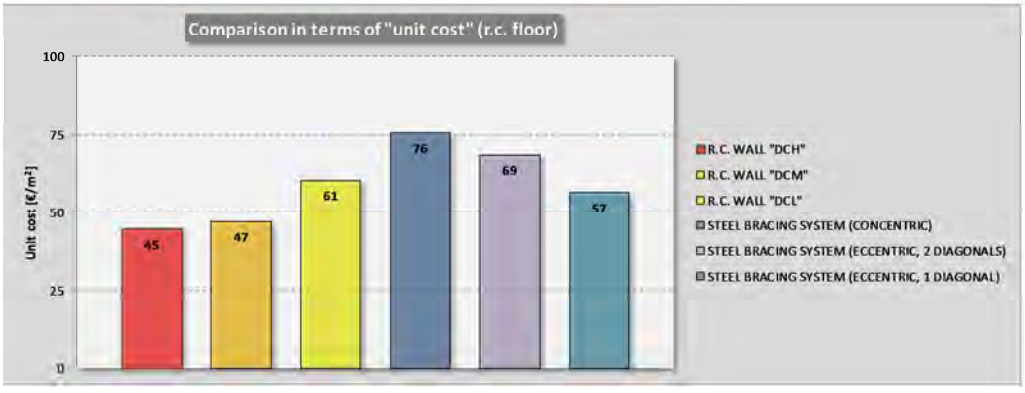
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	D	0.16 g	DCH	4.00	665	97	12	996	15360	6.40	32	28631	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):

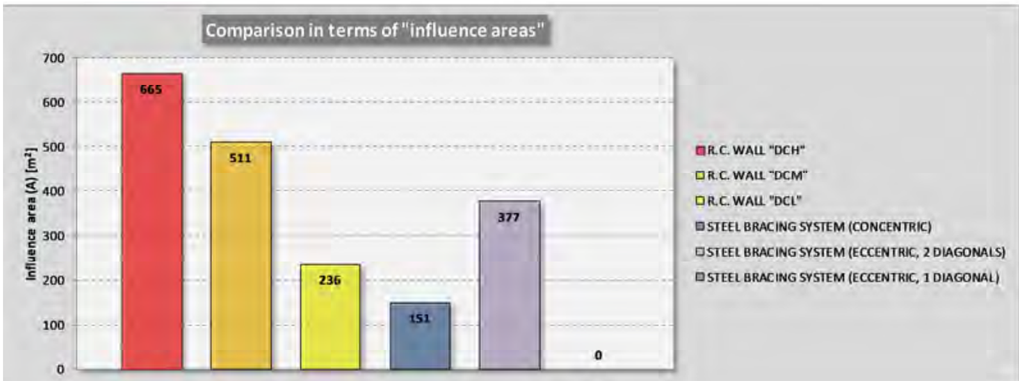
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1000	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

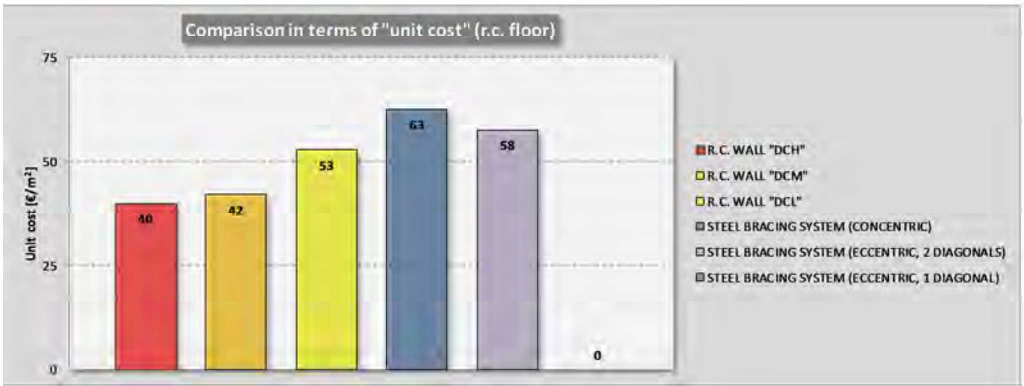
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 180 M	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 180 M	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 180 M	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 180 M	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 180 M	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 180 M	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):

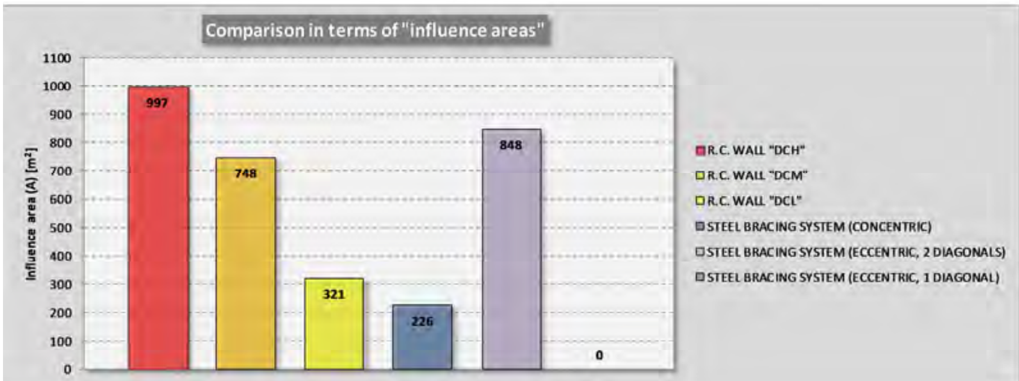
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	1500	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

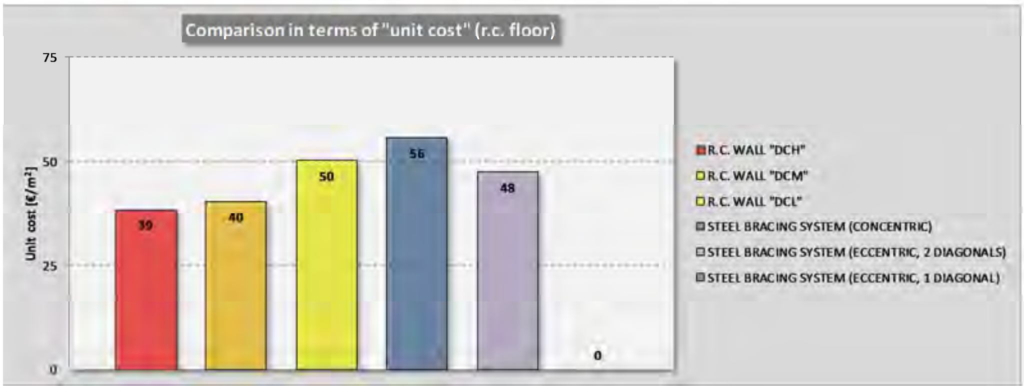
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 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	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):

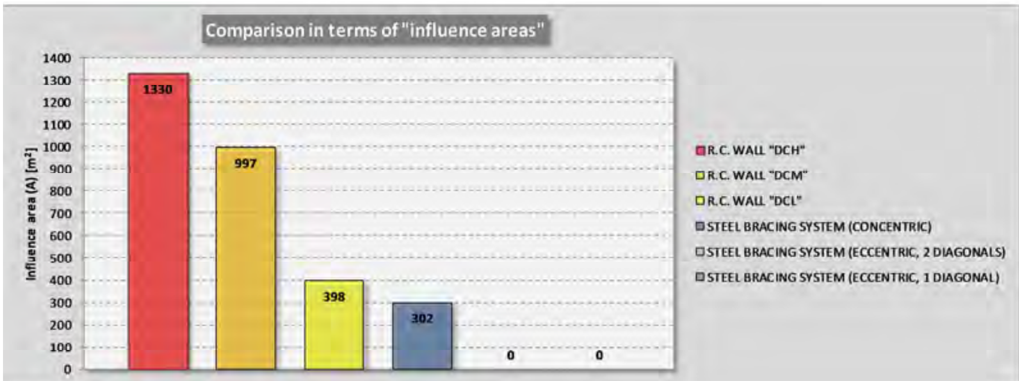
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	4.00	8.00	0.16	2000	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	22985	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

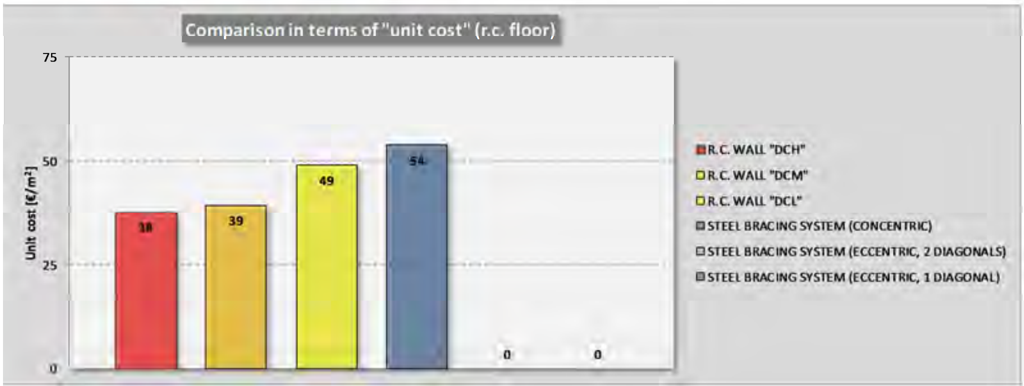
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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):

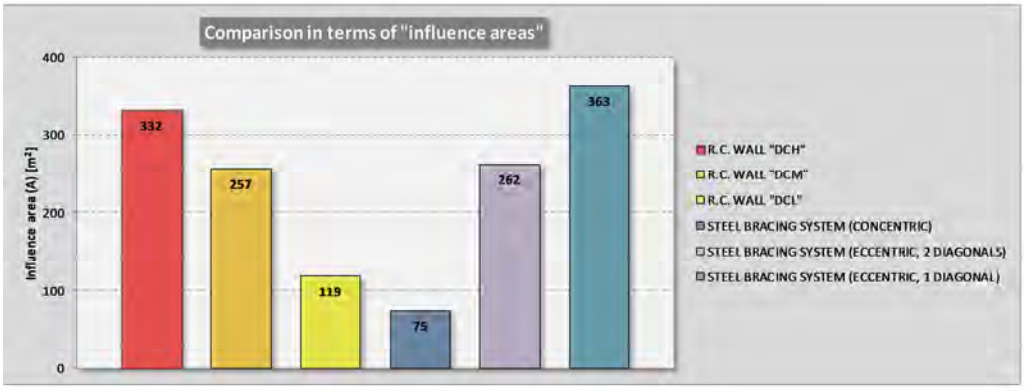
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	500	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	8.00	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	8.00	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	8.00	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	8.00	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	8.00	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

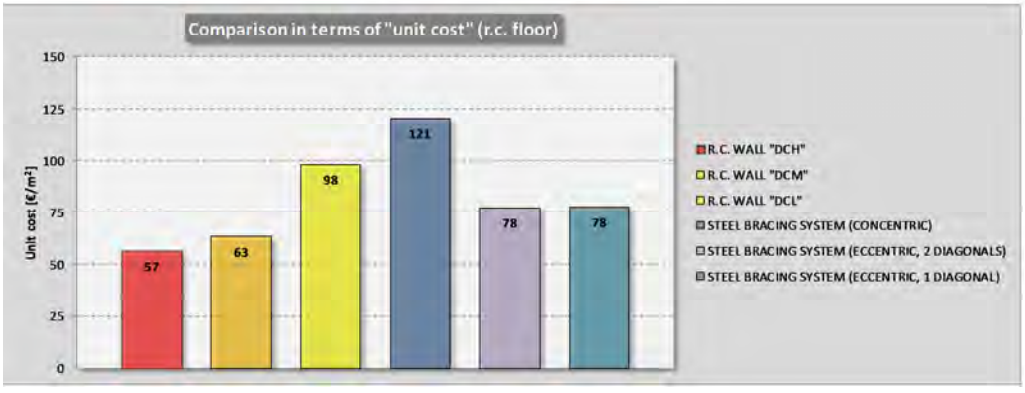
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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	8.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 140 B	HE 220 B	262	4286	20348	26014	78	99
8.00	6.00	8.00	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	8.00	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	8.00	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	8.00	0.16	500	HE 180 B	HE 220 B	HE 200 B	HE 240 B	HE 160 B	HE 260 B	262	4734	21618	27275	82	104
8.00	6.00	8.00	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	8.00	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	8.00	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	8.00	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	8.00	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	8.00	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	8.00	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):

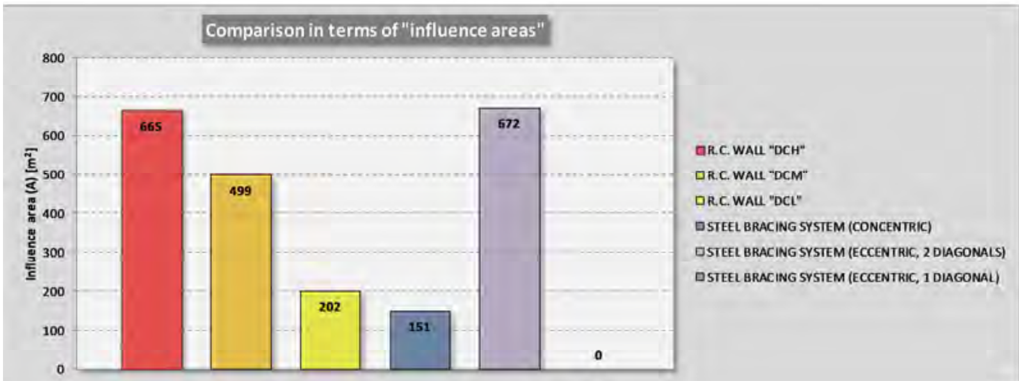
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	1000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

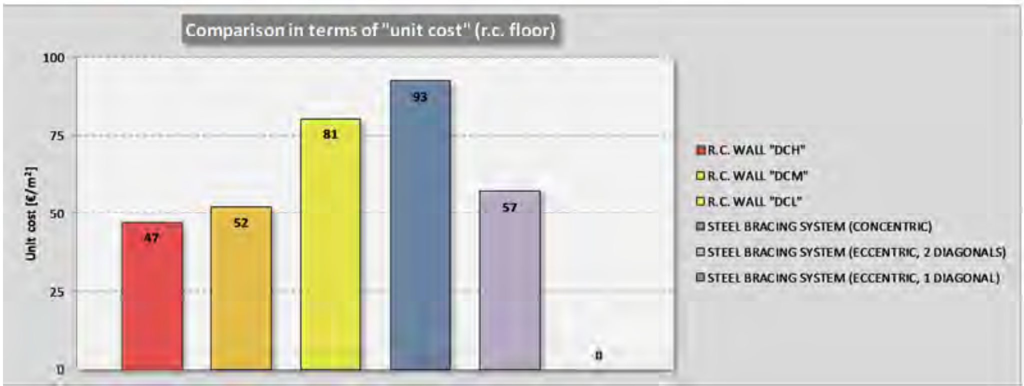
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 340 B	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 340 B	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 340 B	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 340 B	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 340 B	HE 240 B	HE 300 B	HE 160 B	HE 280 B	670	6296	39346	53804	59	80
8.00	6.00	8.00	0.16	1000	HE 220 B	HE 340 B	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 [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	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):

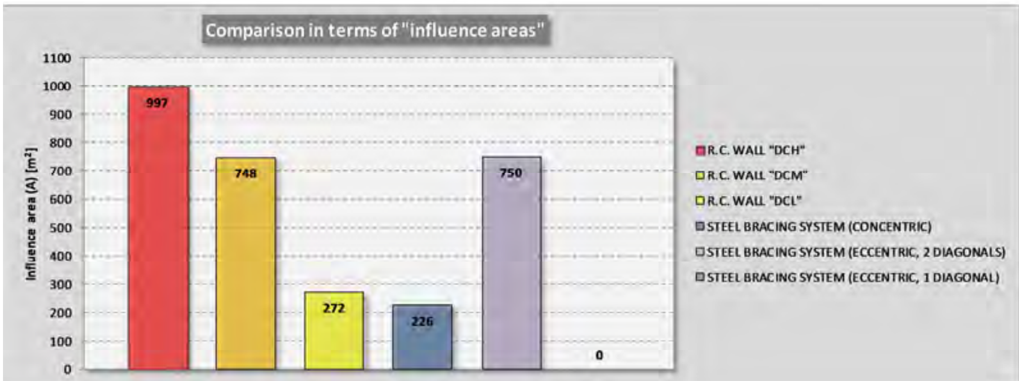
INPUT					OUTPUT								COST ESTIMATION			
B [m]	H [m]	Qk1 [kN/m²]	ag/g [ ]	Vb [kN]	BEAM2 [ ]	BEAM1 [ ]	DIAG2 [ ]	DIAG1 [ ]	COL2 [ ]	COL1 [ ]	A [m²]	Weight [kg]	Total cost (r.c. floor) [€]	Total cost (s.s. floor) [€]	Unit cost (r.c. floor) [€/m²]	Unit cost (s.s. floor) [€/m²]
4.00	6.00	8.00	0.16	1500	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

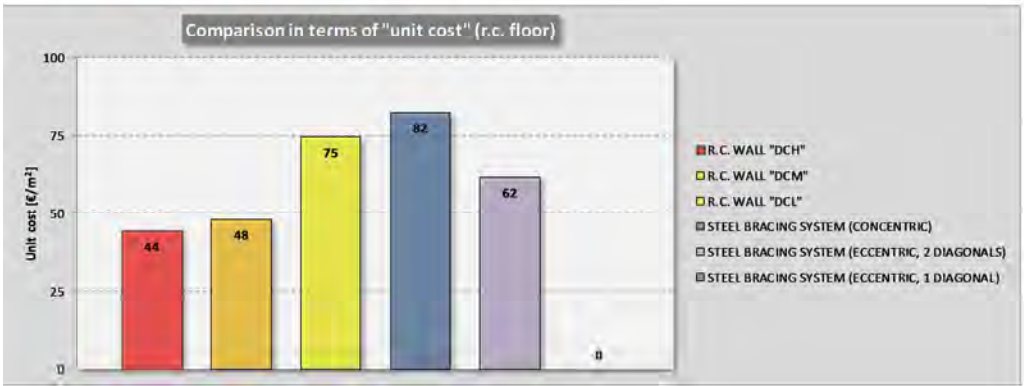
Database UNICAM (steel bracing system - eccentric, 2 diagonals):

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 450 B	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 450 B	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 450 B	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 450 B	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 450 B	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 450 B	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	58979	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	-	-	-	-	-	-	-	-	-	-	-	-