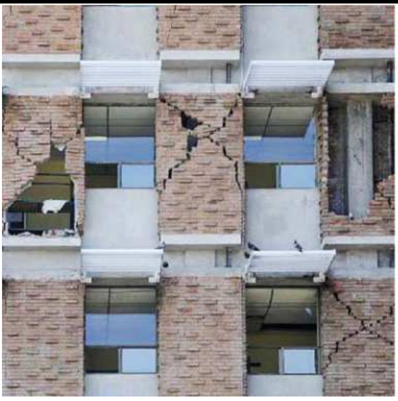
March 2018, Number 1




SPONSE Newsletter

Message from the President

Welcome to the SPONSE Newsletter, the International Association for the Seismic Performance of Nonstructural Components new quarterly e-newsletter for the members of the International SPONSE Association. Four times a year, the SPONSE Newsletter will deliver to your inbox timely news, useful information, and interesting contributions from SPONSE Members. Each issue will also include featured short articles on technical activities and issues contributed by SPONSE Members.

Why a SPONSE Newsletter? In their November 6, 2017 Board of Directors Meeting, SPONSE Directors agreed that it is important for SPONSE Members to hear more about each other's activities in order to engage more interactions. An at-large call for contributions to the SPONSE Membership led to the launch of this first quarterly SPONSE Newsletter containing four technical contributions on wide ranges of SPONSE-related topics.

Of course, face-to-face relationship building is also important; you can use the information sections at the end of each contribution of the newsletter to find out about conferences where you can talk with other SPONSE Members in person.

We hope you like this inaugural issue of the SPONSE Newsletter. We want to hear from you about how we can make it even better in future issues. Please share your thoughts and suggestions with us at info@sponse.eu

Andre Filiatrault, PhD, P.Eng.
SPONSE President

Inside this Issue

SPONSE
INTERNATIONAL ASSOCIATION FOR THE SEISMIC PERFORMANCE OF NON-STRUCTURAL ELEMENTS

DESIGN AND EXPERIMENTAL TESTS ON A SKYLIGHT IN QATAR

By Antonio Formisano[1], Muhammad Tayyab Naqash and Gianfranco De Matteis

The current work deals with an overview on façade industry with the purpose to be useful for the engineers involved in the structural and architectural design of curtain walls.

The research activity has been based on both the structural calculation and the experimental test on the Le Boulevard skylight in Doha (Qatar), measuring 36m by 18m in plan, located at a height of about 42 m and subjected to a wind load of 1.7 kPa. The skylight, composed of steel rectangular curved tubes, glass and aluminum sandwich panels, has been designed for a basic wind speed of 25 m/s as per Qatar Construction Standards. Two types of steel frames have been designed, one to support both the glazing and aluminum sandwich panels, and another to transfer all the loads to the main structure.

Subsequently, a performance testing on a 6.625 m x 3.315 m specimen extracted from the skylight has been performed. It is composed by 2 mm thick top and bottom aluminum metal sandwich panels (honey comb) with 33 mm insulating material interlayer, which have been combined with a roof glazing area of 13.52 mm (lite) laminated glass +16 mm (gap) + 8 mm (lite) fully tempered glass.

The experimental activity has been performed by the Aluminium Technology Auxilliary Ind. (ALUTEC) according to the provisions of ASTM E283, ASTM E331 and ASTM E330 standards.

The test results have been found within the acceptable limits for the skylight components specified by the standards and required by the project specification. About design checks, all the components have been found to be safe at Ultimate and Serviceability Limit States. Also, under the applied water penetration test, carried out before the structural performance test, the mock-up has satisfied the limitations prescribed by ASTM standards, proving the adequacy of the system, as well the sealant used. The structural performance test on the mock-up under a proof load corresponding to the Ultimate Limit State one has been successfully performed, thus recommending to use the same arrangement installed for the tested mock-up in order to guarantee a useful life of this structural system under service conditions. By the visual controls done after dismantling the testing sample, it has been observed that glass, sandwich panels, brackets and fasteners have not revealed any damage.

As a conclusion, the adopted mock-up can be considered suitable to successfully act as a curtain wall system.

For more information:
https://www.researchgate.net/publication/308531184_Design_and_Performance_Testing_of_a_Skylight_in_Qatar

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SIMPLIFIED SEISMIC RISK ASSESSMENT OF WAREHOUSE

By Ennio Casagrande[1]

In Italy there are many industrial buildings used to manufacture and sell products. According to a Tecnoborsa study, in Italy, industrial plants are about 4,0% of the total buildings. Each industrial plant has some type of racking system to store their products.
Fig. 2 shows the total value of production of storage racking in Italy [2]. From 2015 to 2017 the production of racking increased about 5%.
Italy is a nation with a high seismic hazard [3]. In fact, there is a high level of hazard and vulnerability of structures is very important (Fig. 3).

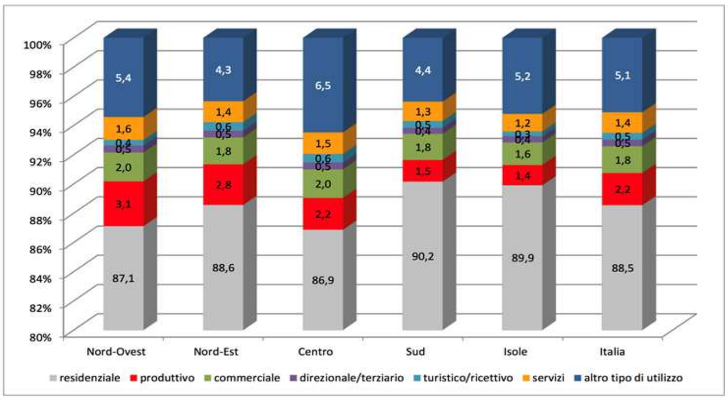


Figure 1 – Industrial plants in Italy [1]

Elaborazione UFFICIO STUDI ANIMA - giugno 2016

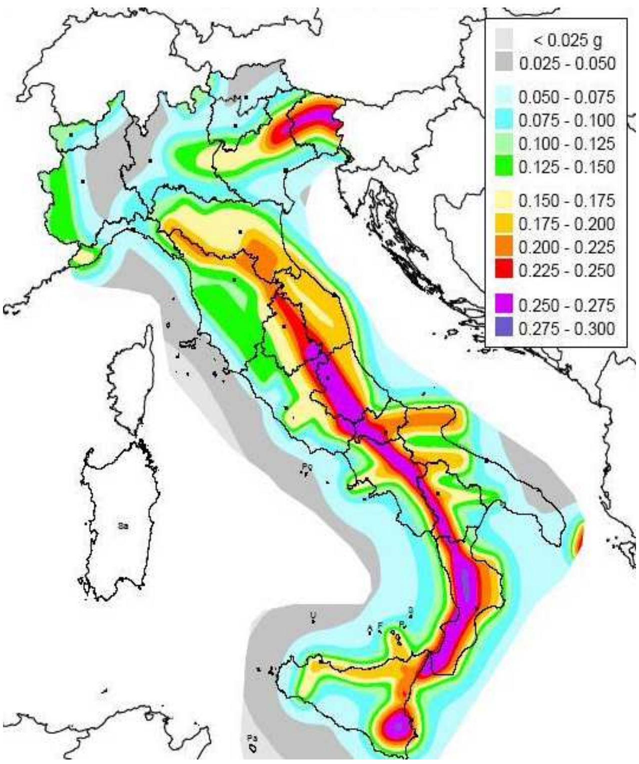
	Produzione			Esportazione			Occupazione		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
	mln euro						unità		
Totale	**4.883,50**	**4.988,00**	**5.184,50**	**1.720,60**	**1.760,80**	**1.841,35**	**18.809**	**18.869**	**18.929**
Impianti ed apparecchi per il sollevamento e trasporto	2.785,00	2.835,00	2.945,00	885,00	895,00	945,00	10.250	10.275	10.295
Carrelli industriali semoventi	1.405,00	1.450,00	1.515,00	435,00	455,00	475,00	4.185	4.200	4.210
Scaffalature industriali	586,50	595,00	615,00	350,00	360,00	370,00	3.600	3.620	3.650
Ruote	107,00	108,00	109,50	50,60	50,80	51,35	774	774	774

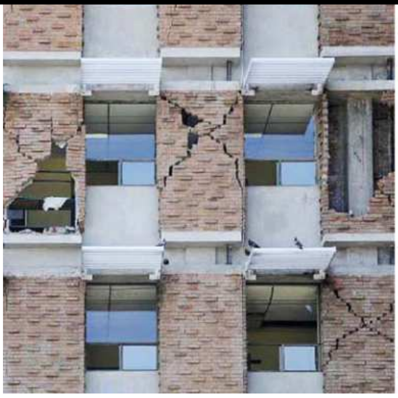
Figure 2 – Production of racking systems in Italy [2].

Industrial plant sites in the high seismic zone, must evaluate their warehouse (racking and general non-structural elements) with a specific risk map. To reduce seismic risk of warehouses, in the 2009 UNI acknowledged the European code EN 15635 [4] regarding the application and maintenance of storage equipment.
This code introduces a new professional figure called person responsible for storage equipment safety (PRSES). In accordance with the code, PRSES must organize the warehouse and oversees structural components of steel storage racking into warehouse.
In fact, new storage racking must be calculated with attention to the seismic map of Italy in accordance with last structural code called NTC [3].
Before the introduction the new seismic map, some zones of Italy were not classified as "seismic" and furthermore, actually, a lot of storage racking was not able to resist any earthquake.
In accordance with EN 15635 there are two problems of storage racking:

- storages racking must be controlled by PRSES with continuous maintenance operations;

- existing storage racking must be adjusted to the according seismic zone.






The problems are connected because deformations can be caused by the impact of a forklift or excessive unit load (UDC). For example, if storage racking has a high deformation at the column (post), seismic safety of the structure decreases. Furthermore, an accurate maintenance is necessary to guarantee a perfect static condition and increase the response to seismic conditions.

In particular, static condition is guaranteed by PRSES in accordance to the deformations control prescribed in the code UNI EN 15635. Fig. 3 shows damage measurement of structural member deformations in accordance with code EN 15635. The principal deformations are localized around columns (posts) and frame diagonals or frame horizontals.

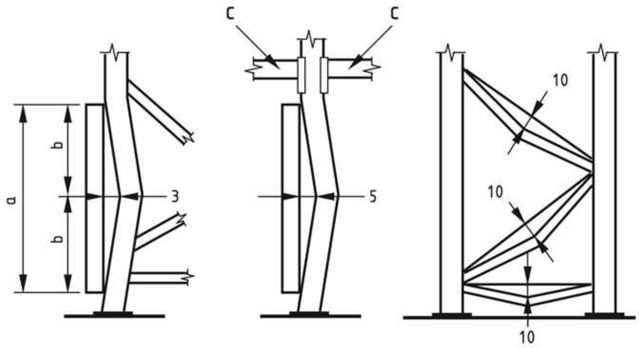


Figure 4 - damage measurements by EN 15635.

These members are very important in seismic conditions because:

- columns are the principal system of the frame. If deformations increase, racking collapses under the same load;
- diagonal and horizontal members increase stiffness of a systems and avoid the total lability of racking.

To increase seismic performance of storage racking, then employer must:

- nominate a PRSES for correct maintenance of structural members;
- adapt structures according to the seismic zone where the systems are positioned.

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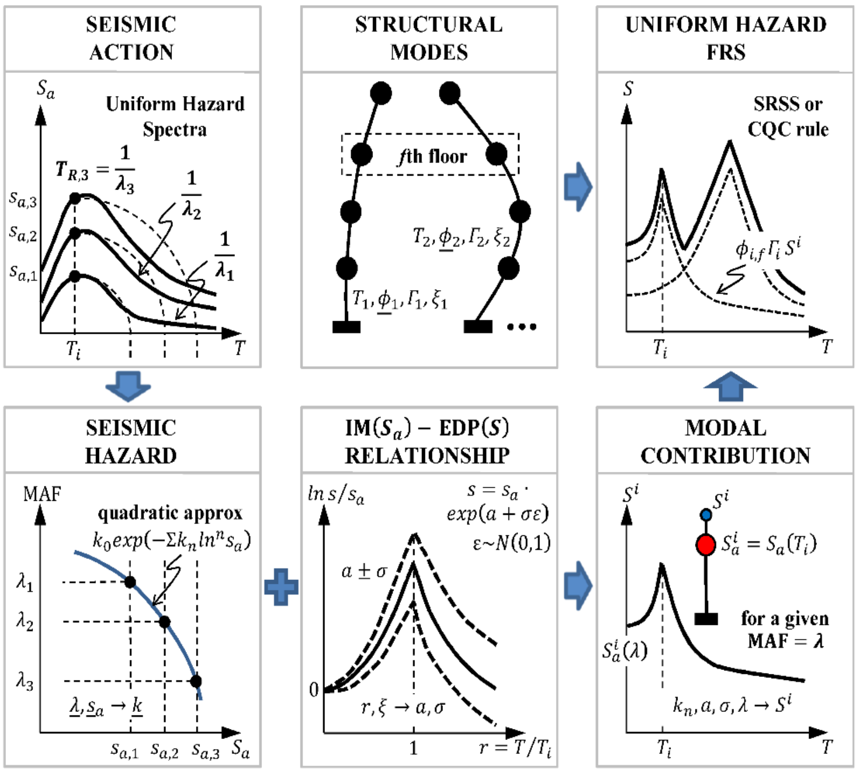
UNIFORM HAZARD FLOOR RESPONSE SPECTRA

By Andrea Lucchini[1], Fabrizio Mollaioli[1], Paolo Franchin[1]

While for deformation-sensitive nonstructural components seismic demand is expressed in terms of interstory drifts, in the case of acceleration-sensitive components floor response spectra in terms of pseudo-acceleration are commonly used to define the seismic action. Drift demand is calculated from the analysis of the structure, either static or dynamic. Floor response spectra, instead, may be derived rigorously from floors' acceleration histories, based on structural response-history analysis, or estimated approximately using a predictive equation and a ground response spectrum. Among the two alternatives, the latter is preferred in common practice, and is widely adopted in seismic codes. Its appeal consists in the fact that a response-history analysis of the building is not required, and only a standard response spectrum, rather than a set of ground motion time-series, is needed to model seismic action at the site. In particular, in the case of codes' equations, seismic input is usually represented simply by the peak ground acceleration. The price for this simplicity is the generally poor approximation of the predicted floor spectra.



Several researchers have worked on predictive equations, employing a range of approaches, from analytical to numerical, deterministic or probabilistic. Those derived from deterministic models for the nonstructural demand generate floor spectra by amplifying the pseudo-acceleration of the structure with factors which do not explicitly account for the record-to-record variability of the amplification. Floor spectra are usually calculated directly from the ground spectrum, and the methods are denoted as "spectrum-to-spectrum" methods.




Probabilistic approaches have evolved in parallel. Many of them, the so-called "stochastic" methods, have used random vibration theory to produce probabilistically-characterized floor spectra. More recently efforts have been directed at quantifying the uncertainties in the estimation of floor spectral ordinates due to ground motion variability, which are based on response-history analyses. In general, the problem inherent with probabilistic approaches is the lack of closed-form expressions for calculating floor spectra, or their limited range of applicability dependent on simplifying assumptions made for the seismic excitation, such as the stationary of the ground motion process.

In order to face the above mentioned limitations, a closed-form probabilistic seismic demand model has been recently proposed, which can be used to predict the pseudo-acceleration response of a linear single-degree-of-freedom oscillator, with any period and damping, attached to a multi-degree-of-freedom linear structure. The model has been used to develop a practice-oriented analytical method for direct generation of uniform hazard floor response spectra, namely, of floor response spectra whose ordinates are characterized by a given value of the mean annual frequency of being exceeded. As shown by the reported figure, the method requires seismic input in terms of uniform hazard spectra of base motion, and can be easily implemented within conventional modal response spectrum analysis.

For more information:

"Analytical evaluation of floor-response spectra for non-structural component design and analysis" (https://www.researchgate.net/project/Analytical-evaluation-of-floor-response-spectra-for-non-structural-component-design-and-analysis).

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MEMBERSHIP

There are four categories of Membership within the SPONSE Association, as follows:

1. Admitted Research Organizations
2. Admitted Industrial Organizations
3. Individual Researchers
4. Individual Industry representatives

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The requirements of eligibility for each membership category can be found on the SPONSE Association Web Site: www.sponse.eu

SEISMIC PERFORMANCE OF NON-STRUCTURAL ARCHITECTURAL LIGHT WEIGHT STEEL DRYWALL SYSTEMS

By Raffaele Landolfo[1], Luigi Fiorino[1], Vincenzo Macillo[1], Tatiana Pali[1], Maria Teresa Terracciano[1], Bianca Bucciero[1], Sarmad Shakeel[1]

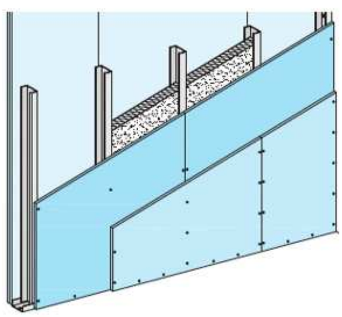
Recent earthquakes occurred in the most advanced countries demonstrated the vulnerability of nonstructural elements to relatively low seismic intensity levels and showed that their damage or collapse can have severe consequences in terms of economic, social and human life losses, even in the case in when no damage occurred in structural elements. In this framework, lightweight steel drywall products can represent a valid alternative to traditional systems for nonstructural architectonic applications in seismic areas. In fact, lightweight steel drywall products can guarantee a very good seismic behaviour with respect to damage limit states, mainly thanks to their lightness and the possibility to easily improve their seismic response by means of relatively simple constructional details. Typical lightweight steel products, usually combined with gypsum, wood and cement based panels, can be used to build non-structural systems such as non-load bearing partition walls, suspended ceiling systems, façade constructions etc. Non-load bearing partitions are mainly stud frames made of lightweight steel profiles pre-fabricated in U and C cross-section formats.

The examination of the state of the art in terms of studies and research carried out on the seismic response of lightweight steel constructions shows that the most of efforts are focused on the assessment of the lateral response of resisting structures, whereas the activities dealing with the behaviour of non-structural systems are more limited. In addition, from the critical overview of the current seismic codes, big differences emerge between North America and Europe. In fact, Eurocode 8 (EN 1998-1) is certainly less developed and updated than North American seismic specifications for both structural and non-structural systems.

Out-of-plane partition wall tests

In-plane partition wall tests

Shake table tests



Typical configuration of Lightweight steel drywall partition




SEISMIC PERFORMANCE OF NON-STRUCTURAL ARCHITECTURAL LIGHT WEIGHT STEEL DRYWALL SYSTEMS

To this end, researchers at University of Naples Federico II have conducted an extensive experimental campaign to characterize the seismic response of light weight steel partition walls and ceilings. The activity was mainly grouped into four different phases: ancillary tests, out-of-plane tests of partition walls, in-plane tests of partition walls and tests of subsystems. In the end, dynamic shake table tests of subsystems representative of partition walls, façade walls and suspended continuous ceilings were also conducted. Different configurations of partition walls were selected in order to study the effect of different constructive parameters: type of horizontal and vertical connections used for connecting the indoor partition walls to the surrounding elements (fixed or sliding connections), stud spacing, type of sheathing panels and type of jointing finishing. In particular, sliding connections are an Enhanced anti-earthquake solution adopted in order to isolate the wall from the surrounding elements, whereas fixed connections are a common (Basic) solution used in the common practice. From the examination of test results it was concluded that if no specifications are given on the connections between partition walls and surrounding elements, an inter-storey drift of 0.75% can be considered as an adequate limit for damage limit states related with limited level of damage and required repair action (serviceability limit states), whereas if appropriate connections are used (i.e. sliding-connection), an acceptable limit of the inter-storey drift for serviceability limit states can be assumed equal to 1.00%. The main findings of this experimental activity also showed that showed that Basic solutions affected the response from the initial phases, providing an additional stiffness and strength, whereas the contribution of Enhanced solutions is lower due the presence of an adequate gap in the sliding connections.

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