Curriculum Vitae

Prof. Eng. Rosario Montuori

Rosario Montuori is a Professor of Structural Engineering at the Department of Civil Engineering of the University of Salerno, Italy, since 2005. He received a M.S/B.S. in Civil Engineering from the University of Salerno in 1997 and the PhD in Structural Engineering from the same University in 2001. He is author of more than 200 journal articles, conference papers and scientific reports. His principal research activities are devoted to the control of the collapse mechanism of structures by means of a rigorous application of "capacity design". In particular, the research activity concerns the following structural typologies: Concrete Moment Resisting Frames, Steel Moment Resisting Frames with semi-rigid joints, Steel Irregular Moment Resisting Frames, Concentrically "X" and "V" Braced Frames, Concentrically "X" Braced Frames with Reduced Section (based on the reduction of the cross section area at the ends of the bracing members aiming to calibrate the axial resistance to a value equal to the internal action occurring under seismic load combination), Eccentrically Braced Frames, Moment Resisting Frame-Concentrically Braced Frame dual systems and Truss Moment Frames with special devices located at the bottom chord level at the ends of the truss girders. For several of the considered structural typologies, also the seismic structural reliability defined as the mean annual frequency (MAF) of exceeding a threshold level of damage, i.e. a limit state has been investigated and compared with reference both to the proposed design methodologies and to EC8 provisions. He developed theoretical fiber models able to predict the Moment-curvature behaviour of RC columns confined by means of angles and battens and of Concrete Filled steel Tubular columns (CFT) with Square Hollow Section (SHS). The proposed models have been validated by means of experimental tests. He developed a design procedure for some Tensegrity Structures able to account both for local and global stability in order to find the optimal design of minimum mass. In the activities of the "FREEDAM" research project he developed the design guidelines able to assure an optimal engagement of all dissipative devices in the dissipative mechanism. He has participated as research staff member in various research projects funded by the Italian Ministry of Education and the Italian Network of Seismic Engineering Laboratories (ReLUIS).He serves as a reviewer for several international journals(Engineering Structures, Journal of Constructional Steel Research, Structures, Thin-Walled Structures, Buildings, Earthquake Engineering and Structural Dynamics, etc). He is Associate Editor of the International Journal ***"Ingegneria Sismica - International Journal of Seismic Engineering"*** (www.ingegneriasismica.org) since January 2015. In addition he is (or has been) an Editorial Board Membership of the following journals: ***"The Open Construction & Building Technology Journal"*** (https://benthamopen.com/TOBCTJ/editorial-board/, ***"American Journal of Mechanical Engineering",*** (http://www.sciepub.com/journal/AJME/editors), ***"American Journal of Civil Engineering and Architecture"***, (http://www.sciepub.com/journal/AJCEA/editors), ***"Advances in Civil Engineering"*** – Hindawi (https://www.hindawi.com/journals/ace/editors/).

He is in the Scientific Committee of the journal "Costruzioni Metalliche" (the Italian Journal of Steel Structure).

He has been teaching since 2001 in several courses of Structural and Seismic Engineering at the University of Salerno.

INVITED LECTURES

Plenary Lecture titled "***Problem of Minimum Mass for a Particular Tensegrity Structure*"** at the "4th International Conference on OPTIMIZATION TECHNIQUES in ENGINEERING (OTENG '16)" organized by WSEAS (World Scientific and Engineering Academy and Society). October 22, 2016, Rome.

Keynote Lecture titled "***Design of Steel Moment Resisting Frames With Special Mechanical Devices: the Free from Damage Structure***" at the "3rd annual International Conference on Mechanics and Mechanical Engineering (MME 2016)" December 17, 2016 in Sichuan, Chengdu, China.at the

Expert Talk titled **"*The Use of Reduced Beam Section for the Design of Steel Structures in Seismic Zone*"** at the "Sixth International Conference on Advances in Civil, Structural and Environmental Engineering (ACSEE 2017)". 09 – 10 December, 2017. Hotel Novotel Roma Eur, Viale dell'Oceano Pacifico, 153, 00144 ROME, ITALY. Organized by Institute of Research Engineers and Doctors (IRED) Headquarters, 42 Broadway, Suite 12-217, New York, NY 10004, USA.

Keynote Lecture titled ***New Design Methodology for Steel Moment Resisting Frames Equipped with Dissipative Devices*** at the 2018 International Conference on Construction, Aerotropolis and Environmental Engineering(ICCAE 2018) - November 23-25,2018 - Vanung University, Taoyuan City, Taiwan, Organized by: Vanung University, Society of Construction Engineers and Guangdong Academy of International Academic Exchange, School of Civil Engineering and Architecture of Wuhan University of Technology.

Keynote Lecture titled ***Progress on Seismic Isolation and Energy Dissipation*** in collaboration with Gianmario Benzoni and Giuseppe Lomiento at the "16th World Conference on Seismic Isolation, Energy Dissipation and Regulation of Dynamic Characteristics of Structures" 2019 July, 01-06, Saint-Petersburg.

Keynote Lecture dal titled ***Advances in the Design of Steel Structure for Seismic Protection*** at teh 5th International Conference on New Advances in Civil Engineering (ICNACE'19) Kyrenia, North Cyprus 8 – 10 November 2019.

Plenary Lecture dal titled ***Innovative Design Strategies for Building Seismic Protection*** alla 3rd International Conference on Basic Sciences, Engineering and Technology (ICBASET) Marmaris, Turkey 27 – 30 April , 2023 Marmaris, Turkey.

RESEARCH TOPICS

A) SEISMIC MOMENT RESISTING FRAMES, DOG-BONES AND FAILURE MODE CONTROL

According to the traditional design philosophy of seismic resistant structures, structures have to remain in elastic range during frequent seismic events having a return period comparable with the service life of the structure. Conversely, in the case of destructive earthquakes having low probability of occurrence (usually a 475 years return period is considered), it is accepted the damage of both structural and non-structural elements which derives from the development of dissipative mechanisms. Therefore, the plastic reserves of the structure have to be exploited, only in the case of rare major earthquakes, to dissipate the earthquake input energy in some zones of the structure, namely dissipative zones, which have to be properly selected.
The column hinging has to be absolutely avoided, because, due to the action of axial forces and the premature occurrence of local buckling, they exhibit poor ductility. Moreover, the failure modes which can result from column hinging could involve a limited number of dissipative zones. For these reasons, aiming at the complete development of the plastic reserves of the structure, modern seismic codes provide simple design criteria whose goal is the prevention of local failure modes and, instead, the promotion of a global mechanism, i.e. a collapse mechanism characterised by the hinging of all the beam ends and the hinging of the base sections of the first storey columns.
In the case of moment resisting frames, the design criterion suggested by seismic codes is the adoption of columns having a flexural resistance greater than that of the connected beams. However, the fulfilment of this design criterion, namely member hierarchy criterion, is only able to prevent the development of storey mechanisms, but is not sufficient to guarantee the formation of a collapse mechanism of global type.
Within this design framework, aiming at the safeguard of brittle elements and to the maximisation of the ductile elements engaged in dissipating the earthquake input energy, the idea of realising the so-called "dog-bones", i.e. the weakening of the beam at its ends by reducing the flange width, is born. This structural detail is aimed at the promotion of the beam end hinging to prevent yielding of columns and/or of connections. In addition, by means of this structural detail, it is possible to promote a collapse mechanism of global type.
The goal of the proposed procedure is the setting up of design rules regarding the magnitude of the weakening to be realised and the location of the weakened beam sections. In particular, the location of the weakened section has to be selected in order to assure the development of the plastic hinges in "dog-bones" and/or in intermediate beam sections, while the yielding of the beam-to-column connections has to be prevented.

B) ECCENTRICALLY BRACED FRAMES AND FAILURE MODE CONTROL

Eccentrically braced frames (EBFs) constitute a suitable compromise solution between seismic resistant MR-frames and concentrically braced frames. In fact, they exhibit both adequate lateral stiffness and ductile behavior due to the dissipation mechanism, which is characterized by cycling shearing and/or cycling bending of the link.
However, the energy dissipation capacity of a structure is strongly influenced by the kinematic mechanism developed at collapse. Partial mechanisms undermine the global ductility supply and are responsible of lower energy dissipation capacity. Therefore, the development of a collapse mechanism of the global type becomes a relevant design goal in plastic design of structures.
The goal of the research activity is to set up a design methodology able to guarantee a collapse mechanism of global type for EBFs, which is characterized by the yielding of the link at each storey of the EBF.
In the proposed design methodology, it is assumed that beam and link sections are already dimensioned to resist the design seismic actions and vertical loads. Therefore, the unknowns of the design problem are constituted by the plastic section modulus of columns and diagonals which

have to be defined so that the mechanism equilibrium curve corresponding to global mechanism has to lie below those corresponding to the undesired mechanisms within a range of displacements compatible with the local ductility supply. It means that, according to the upper bound theorem, the true collapse mechanism is the global failure mode.
The proposed design methodology has been developed only for split-K typology of EBF. For other typologies the same procedure can be applied taking into account the different geometrical conditions.

C) CONCENTRICALLY BRACED FRAMES, FAILURE MODE CONTROL AND SEISMIC RELIABILITY ANALYSES

In the seismic areas, it is generally not economically feasible to design conventional structures to remain in elastic field during severe earthquake ground motions. To this scope, it is possible to take advantage of inherent ability of many type of structures and dissipate the input seismic energy by means of inelastic deformations.
Moment resisting frames (MRFs) are widely recognized as being highly efficient in the absorbing such earthquake energy demands. In fact this typology, the most important type of action is the bending moment, so that the energy dissipation, which takes place in plastic hinges, is due to the inelastic cyclic bending behaviour. Conversely the structural scheme are characterized by large horizontal displacements when subject to a strong earthquake, for this reason they are unable to fulfillment of the serviceability requirements.
Concentrically braced frames (CBFs) are among the most common steel structural systems for resisting lateral force due to wind or to earthquake. The relative economy of their design and construction along with their good performance in terms of stiffness makes CBFs an attractive choice for designers. Some uncertainty, however, arise about the adequacy of such structures to resist to strong seismic actions by undergoing severe excursions in the non linear range. Energy dissipation capabilities of CBFs are, in fact, almost completely related to non linear hysteretic behaviour of diagonal braces under alternate tension and compression internal forces. This behaviour is affected by a number of quite complex and not easily predictable aspects such as the performance of end connections, the in-plane and out-of-plane overall buckling of compressed members and all the local damage phenomena (local buckling, low cycle fatigue, fracture propagation) related to the inelastic cycling under axial and bending forces.
The energy dissipation capacity of a structure is strongly influenced by the kinematics mechanism developed at collapse. Partial mechanisms undermine the global ductility supply and are responsible of a lower energy dissipation capacity. Therefore, the development of a collapse mechanism of the global type becomes a relevant design goal in a plastic design of seismic – resistant structures. For this reason, the need to prevent collapse mechanism having limited dissipation capacity and to promote the development of a global mechanism of global type is universally recognized. Moreover, it is always necessary the design of structural details, i.e. connections between dissipative zones and non dissipative zones, able to guarantee an high local ductility supply. The problem of the failure mode control is faced by modern seismic codes by means of recommendations which are based on the simple hierarchy criterion. Anyway, such design recommendations do not lead the frames failing in global mode but allow to avoid the develop of soft storey mechanisms. Aiming to guarantee, under destructive seismic actions, to design a structure able to assure the development of a mechanism of global type, a more sophisticated design procedure has to be defined.
In particular, in this work a new method for designing concentrically braced frames is presented.
This method is based on “capacity design” philosophy which requires that non dissipative zones have to be designed to withstand the internal actions coming from the seismic design horizontal forces; while the non dissipative zones have to be designed considering the maximum internal actions that the dissipative zones, yielded ad strain-hardened, are able to transmit. The new design issue covered by the proposed design procedure is the need to account for the contributions of the compressed diagonals deriving the design axial force of non dissipative members. For this reason, also an hysteretic cyclic model for diagonal brace has been presented. In particular a refined model (i.e Georgescu Model) have been developed and successively applied for modeling CBFs.
The idea of bracing members with reduced section solution has been suggested by the need to overcome the drawbacks coming from the design of conventional concentrically braced frames. In

fact, the use of code suggested design criteria and the fulfilment of the limitation to the normalized slenderness of bracing members $\overline{\lambda}$ leads to oversize the upper storey diagonals.
As a consequence, non-linear dynamic analyses show that, the energy dissipation mechanism is not global, because the oversized braces of the top storey remain in elastic range. Conversely, on one hand, the use of bracing members without any slenderness limitation leads to a more uniform distribution of the overstrength coefficients along the building height and a collapse mechanism of global type can be obtained provided that of properly conceived design procedures are applied for the failure mode control. However, on the other hand, the use of excessively slender braces can lead to the premature collapse of diagonal braces due to the out-of-plane bending which, in turn, gives rise to the low cycle fatigue fracture of the gusset plates connecting the braces to the primary members. Therefore, in order to limit the slenderness of diagonal members, without oversizing them, to safeguard the brace-to-column connections, RSS can be suggested.
In order to evaluate the seismic performance obtained by means of the considered design methodologies, a probabilistic method has been adopted. The comparison between different structural solutions, such as the proposed methodology and Eurocode 8 provisions, of the same design problem is immediately understandable when it is made in terms of mean annual frequency of exceeding pre-defined limit states.
Even though the methodology provides the designer with the theoretical basis to account for all the sources of uncertainty, only the aleatory uncertainty (due to record-to-record variability) is considered.

D) Reinforced Concrete Columns Strengthened with Angles and Battens

The strengthening of reinforced concrete columns with angles and battens has been described in a lot of engineering manuals since several decades ago, but the problem is often dealt with in a qualitative way with only rough suggestions devoted to the evaluation of the load carrying capacity of the strengthened member.
With reference to the problem of retrofitting of existing buildings, the need is evident to provide designers with a valid calculation model accounting for all the parameters affecting the ultimate behaviour of reinforced concrete columns strengthened with angles and battens, as most of them are often neglected in current design practice.
The methodology presented accounts for the following issues which are relevant to an accurate evaluation of the ultimate resistance of the strengthened column: the deformations resulting from the loads acting on the original pre-existing section; the effect of the different behavior of effectively confined concrete with respect to the unconfined one; the variation of the effectively confined concrete area as a consequence of the strengthening intervention; the variation of the σ-ε law for the effectively confined concrete considering the difference between the concrete effectively confined only by the battens, the concrete effectively confined only by the existing hoops, and the concrete effectively confined by both the battens and the existing hoops; the possibility of buckling of longitudinal bars. In addition, depending on the kind of structural detail adopted at the beam-to-column joint location or for the column-to-foundation connection, the angles can be considered as acting both in tension and in compression, only in compression or, finally, they can be considered as providing a confining effect only. With reference to an intermediate storey, the angles can be considered acting both in tension and in compression provided that the angles strengthening a column are effectively connected to those strengthening the columns of the adjacent storeys. As, it is almost impossible to create such connection through the floor slabs without producing significant damages to the non structural elements, the designers could provide the angles with an end plate to be connected to the floor slabs aiming to assure the transmission of the compression forces only. As an example, this is the case of a retrofitting intervention where the building resistance to gravitational loads only is of concern. Obviously, in this case the model has to account just for the angles acting in compression. Finally, when no attention is devoted to the structural detail regarding the connection between the angles and the floor slabs, the angles have to be considered only as confining elements, as the confinement is due to the batten action, restrained by the angles.
Finally, the degree of accuracy of the proposed model is investigated by means of the comparison between the results of an experimental program carried out at the Material ad Structure laboratory

of Civil Engineering Department of Salerno University and the numerical predictions of the ultimate resistance.

E) COMPOSITE STRUCTURES

The ultimate behaviour of Concrete Filled Tubular (CFT) columns subjected to axial force and bending moment is strongly influenced by several factors. In fact, the interaction between the two materials is responsible of transversal effects which cannot be neglected in the prediction of the structural response.

First of all, the confinement of concrete due to the steel profile gives rise to a significant increase of resistance, which can be accounted for by means of an adequate analytical relationship for the concrete constitutive law. In addition, the radial stress state acting on the concrete core is equilibrated by circumferential in-plane stresses in the tube, which act contemporary to the axial ones. As a consequence, a bi-axial stress state arises in the steel tube, so that it is not possible to reach the mono-axial yield stress, and the yielding condition in compression is anticipated. Moreover, the behaviour of the member is influenced by the local buckling occurring in the plate steel elements. In fact, the presence of the concrete filling the steel tube avoids the inward buckling of the steel plates, but the local buckling is yet possible due to the outward instability. Therefore, the prediction of the ultimate behaviour of the member has to account for outward local buckling.

The combination of all these issues is generally responsible of a significant increase of resistance of the member, if compared to the sum of the resistances of the concrete section and the steel profile separately. From this point of view the CFT column typology is more effective than the CEC (Concrete Encased Composite) one, in which the steel profile constitutes the core of the concrete member, so that the confinement of concrete is not activated. On the other hand, in the case of CEC columns, local buckling of steel plates is almost completely avoided, but the steel is not effectively centrifuged, so that its contribution to the resistance capacity is not optimised.

Consequently, all the previous aspects have to be considered in the definition of analytical models able to foresee the behaviour of CFT columns. The first step towards this objective is the evaluation of the moment-curvature relationship of the member, carried out by means of a fiber model. Then, a procedure able to provide the force-displacement curve of the member has been implemented in a computer program. The reference scheme is represented by a cantilever beam-column subjected to a constant axial load and a varying horizontal force applied at its end. The force-displacement curve is obtained under displacement control by means of the secant stiffness method.

As a first step, the analytical models have been developed with reference to Square Hollow Sections (SHS), and can be easily extended to Rectangular Hollow Sections (RHS), under monotonic loading conditions. However, the procedures have a general relevance and they can be adapted also to the case of Circular Hollow Sections (CHS) and to cyclic loading conditions.

The validation has been carried out by means of the comparison between the numerical results and those obtained from an experimental program carried out at the Material ad Structure laboratory of Civil Engineering Department of Salerno University a devoted to the evaluation of the ultimate behaviour of SHS-CFT beam-columns under monotonic loading conditions.

F) TRUSS MOMENT FRAMES WITH SPECIAL DEVICES FOR THE SUPPLEMENTARY DISSIPATION OF SEIMIC ENERGY

Truss moment frames have been developed in USA, and not yet spread in Europe. This structural typology has been used in seismic zone for mid-rise structures because of its economy especially for long spans (15-20m) and for the simple details required by the truss girders. In addition, the structural system provides architectural benefits which allow its use in a large variety of mid-rise structures. As a consequence, researchers have been encouraged to investigate on the seismic performance of this structural typology. Aiming to improve the dissipation capacity of traditional TMFs, Special Truss Moment Frames have been proposed again in USA. This typology is able to dissipate the seismic input energy by means of special segments located in the midspan of the truss girders. The use of damping devices in TMFs was successfully adopted in the design of World Trade Center twin towers where special visco-elastic devices were placed at the ends of

each truss girder at the bottom chord level, aiming to reduce the structural lateral vibrations due to wind actions.
In the same way, friction or hysteretic devices can be located at the ends of truss girders of a new typology of STMFs, namely Dissipative Truss Moment Frames (DTMFs), so that they can constitute the dissipative zones of the structure aiming to avoid the yielding of the primary structure constituted by the truss girders and the columns. The aim of the proposed design methodology is the development of a global collapse mechanism assuring the participation of all the dissipative devices to the dissipation of the earthquake input energy.
The proposed design methodology, already developed for the failure mode control of Moment Resisting Frames, Eccentrically Braced Frames and for MRF-CBFs dual systems is herein extended to this new structural typology aiming to the optimization of the seismic performance of the structure.
The robustness of the proposed design procedure relies on the main theorems of plastic design, because, in particular, it is based on the kinematic theorem of plastic collapse and on second order plastic analysis. Finally, it is important to consider that dissipative zones can be easily substituted after an earthquake.

G) MRF-CBF DUAL SYSTEMS

Moment Resisting Frames–Concentrically Braced Frames dual systems constitute a reliable structural scheme for designers since they allow to combine the advantages of both structural typologies. MRFs are characterised by high global ductility due to the high number of dissipative zones under cyclic bending represented by the beam ends. Nevertheless, a low lateral stiffness is provided so that code requirements dealing with the serviceability limit state are not easily satisfied.
Conversely, CBFs are characterised by high lateral stiffness, due to the contribution of diagonal members. Therefore, MRF–CBF dual systems, because of the exploitation of the local ductility supply of beams and the lateral stiffness provided by diagonal members, constitute an effective structural solution able to satisfy both ultimate and serviceability limit state requirements.
Notwithstanding, in order to obtain high global ductility, the need to control the location of dissipative zones, i.e. the control of the failure mode, is of primary importance.
In fact, soft storey mechanisms or collapse mechanisms involving only few storeys, are characterized by a low dissipative capacity, so that an effective design procedure should be able to obtain a global collapse mechanism. At this aim, design rules suggested by actual seismic codes, among which Eurocode 8, are based on the hierarchy criteria. Unfortunately, in some cases, they are not able to prevent the development of soft storey mechanisms.
Therefore, in order to design structures able to assure the development of a collapse mechanism of global type under destructive seismic actions, a rigorous application of capacity design principles is needed, requiring more sophisticated design procedures. For this purpose, the theory of plastic mechanism control can be applied.
In addition, the influence of the seismic action percentage withstood by diagonals has also been investigated.
It can be observed that by reducing the percentage of the design seismic actions entrusted to diagonals, the weight of MRF-CBF dual systems increases. This result is the consequence of the reduction of the contribution of the bracing members to the lateral stiffness, so that more robust beams and columns are needed to satisfy serviceability requirements, leading to the increase of constructional steel weight. Therefore, the greatest saving in constructional steel weight can be gained by designing bracing elements to withstand the whole seismic action, even if, in this case, also a reduction of structural dissipative capacity is obtained.

H) FRP REINFORCED CONCRETE SECTION SUBJECTED TO AXIAL LOAD AND BENDING MOMENT.

Many researchers have developed and proposed different constitutive laws for concrete confined with FRP. As preliminary research activity, a comparison among the main constitutive laws which can be found in literature has been performed.
One of the main problem of these constitutive laws is due to the fact that they depends not only on the concrete class, on the fiber type and on the number of layers, but also on the analyzed

sections' dimensions. The results show a significant variability in terms of ultimate stress and strain values, as well as a significant scatter along the whole development of $\sigma - \varepsilon$ curves.
Probably many sophistications, introduced to be able to better fit the set of testing results used to calibrate the models, could be eliminated aiming to simplicity and consistency.
In fact, almost all the proposed constitutive laws are the result of calibration on testing results coming from more or less extensive experimental campaigns due to the authors. An additional research activity concerns the influence of the constitutive law variability on the ultimate resistance and ductility of a section subjected to both axial load and bending moment.
In fact, it is evident that, for sections subjected to axial load only, the ultimate strength exhibits the same variability highlighted for the constitutive laws. Conversely in case of members subjected to axial force and bending, almost the totality of practical cases, the part of the concrete section subjected to high compression stresses which, therefore, takes advantage from confinement effects appears quite low so that a significant reduction of the scatter coming from the application of different constitutive models is expected. In order to analyze this influence a theoretical model, able to evaluate the moment-curvature diagram for a concrete section confined with FRP, has been developed and accordingly, a computer program has been built. The obtained results show that the influence on the whole section behaviour in terms of flexural strength is significantly attenuated, being the obtained increase of resistance not greater than 11%. Conversely, a more significant increase in curvature ductility has been obtained (up to 540%). According to this results, it is evident that the attention and the efforts of researchers should be mainly devoted to the improvement of the accuracy of the formulations for predicting the ultimate strain of confined concrete.

I) TENSEGRITY STRUCTURES

Tensegrity structures are composed of bars and cables, with bars typically loaded in compression, and cables in tension. Theory exists for minimal mass tensegrity structures under compressive loads, constrained against local buckling of members. This research activity extends that theory to include constraints against global buckling. In addition, it determines the conditions that allow the designer to neglect this kind of instability. The obtained results allow one to better understand and design this fundamental structure. In fact, the role played by the geometrical configuration and material properties constituting the strings in avoiding global instability is now explained.

J) FREEDAM STRUCTURES

In the activities of the "FREEDAM" research project he developed the design guidelines able to assure an optimal engagement of all dissipative devices in the dissipative mechanism. The basic idea of the research work is inspired to the strategy of supplementary energy dissipation, but it is based on the use of the damping devices under a new perspective. In fact, while passive control strategies have been commonly based on the integration of the energy dissipation capacity of the primary structure by means of a supplementary dissipation coming from damping devices; conversely, the new design strategy, which could be named "Free From Damage Design", is based on the use of friction dampers conceived in such a way to substitute the traditional dissipative zones of MRFs, i.e. the beam ends.
The FREEDAM project is devoted to the development of innovative beam-to-column connections equipped with friction dampers which are located at the bottom flange level of the connected beam to dissipate the earthquake input energy. The friction resistance is calibrated by acting on the number and diameter of bolts and their tightening torque governing the preloading. The flexural resistance results from the product between the damper friction resistance and the lever arm. Such connections exhibit wide and stable hysteresis loops without any damage to the connection steel plate elements, so that they can be referred as "Free from Damage Connections".

L) ULTIMATE ROTATION OF R.C. COLUMNS

The accuracy and reliability of formulations reported in current codes for the evaluation of ultimate rotation of R.C. columns subjected to cyclic load has been investigated. In particular, the relationships proposed by Eurocode 8-3 and Italian Seismic Code has been compared with the original one proposed by Biskinis and Fardis.

Since the model proposed by codes are amply used in the evaluation of the vulnerability of structures they seem to be inaccurate and should be improved. For this reason, a new proposal for the empirical formulation has been made. The main difference between this new proposal and the code models based on an empirical approach are that the new one relationship has been made dimensionless, in addition the influence of the volumetric longitudinal reinforcement ratio has been accounted for. This new relationship shows higher correlation and lower dispersion if compared with relationship of codes, configuring as a new tool to estimate the ultimate rotation of RC columns. In particular, with respect to Biskinis and Fardis formulation the standard deviation of values is reduced of more than 20% for specimens failing in flexure only. In addition, this proposal is suitable not only for RC columns failing in flexure but also for columns failing with a shear or flexure-shear behaviour.

M) FLOOR JOISTS INFLUENCE ON THE ELASTIC AND INELASTIC RESPONSE OF R.C. STRUCTURES

The only assumption usually made in the analysis for modelling the seismic response of buildings is that the deck can act as an infinitely rigid diaphragm playing a fundamental rule in the distribution of horizontal seismic forces. On the contrary, no consideration is made on the actual contribution of joists in terms of strength and stiffness. The formulation proposed fills this lack allowing the designer to account also for joists contribution. Laboratory tests are now confirming the theoretical relationships.

Research Projects

Reliability of Moment Resistant Connections of Steel Building Frames in Seismic Areas (RECOS) (as sub-contractor)	1997-1999	Inco-Copernicus 4th Framework Program
Experimental Analysis and Component Based Modelling of Beam-to-Column Connections subjected to Low-Cycle Fatigue	1998-1999	UNISA FARB
Innovative Strategies for the Seismic Protection of Beam-to-Column Connections	2000-2001	UNISA FARB
Analysis of the Plastic Rotation Supply of Bolted Beam-to-Column Connections	2002-2003	UNISA FARB
Steel-Concrete Composite Buildings: Modelling, Analysis and Performance Based Design	2004-2005	PRIN 2003
Innovative Methodologies for the Design of Concentrically Braced Frames	2004-2005	UNISA FARB
Seismic Reliability of Braced Steel Structures	2006-2007	UNISA FARB
Research Line N.5: "Development of Innovative Approaches for the Design of Steel and Steel-Concrete Composite Structures" - Research Unit N.6: "Seismic Response and Design Rules for Steel-Concrete Composite Bridges"	2006-2008	DPC - RELUIS
Theoretical and Experimental Analysis of Buckling Restrained Braces	2008	UNISA FARB
Plastic Design for Failure Mode Control of Steel Frames equipped with Friction Dampers	2009-2010	UNISA FARB
Beam column dissipative connection: experimental analyses and theoretical model of innovative typologies	2011-2012	UNISA FARB
Research Line N.1: "Seismic Design Issues Concerning New Buildings"	2010-	DPC - RELUIS

- Task 2 "Steel and Steel-Concrete Composite Structures" - Task 2.1 "Design Criteria and Methodologies for Predicting the Ultimate Behaviour of Beam-to-Column Connections and Column-Base Connections"	2013	
Design of concrete moment resisting frame with a global collapse mechanim	2014-2015	UNISA FARB
Comparison between different design methodology for the design of Reinforced Concrete Frames	2016 2017	UNISA FARB
European Research Project – Research Fund Coal and Steel - GRANT AGREEMENT No. RFSR-CT-2015-00022: FREEDAM Project "FREE from DAMage steel connections" ***Responsible for Task 3.4 - Design rules for frames*** (Task of WP 3 Seismic Response of Frames with friction joints, robustness and sustainability). ***Responsible for Task 4.3 - Definition of design tools*** (Task of WP 4 Development of prototypes for industrial production). Coordinatore Prof. Vincenzo Piluso	2015 2018	Research Fund for Coal and Steel European Research Commission
EQUALJOINTS Plus (2017-2019) "Valorisation of knowledge for European pre-QUALified steel JOINTS". Grant Agreement No. 754048 - RFCS - Research Fund for Coal and Steel.	2017-2019	Research Fund for Coal and Steel European Research Commission
DPC-RELUIS 2019-2021 - PR3 – Steel structures and steel-concrete composite structures. WP12 – Task 12.1.	2019-2021	DPC – RELUIS

Publications

[1] - C. Faella, R. Montuori, V. Piluso, G. Rizzano
"Failure Mode Control: Economy of Semi-Rigid Frames", XI European Conference on Earthquake Engineering, Paris, 6-13 September, 1998.

[2] - R. Montuori, V. Piluso
"L'Uso dei «Dog-Bones» nella Progettazione a Collasso Controllato dei Telai Sismo-Resistenti", XVII Congresso C.T.A., Italian Conference on Steel Construction, Napoli, 3-5 Ottobre, 1999.

[3] - R. Montuori, V. Piluso
"Design of Semi-Rigid Steel Frames for Failure Mode Control", **capitolo 7.1** del libro*: "Moment Resistant Connections of Steel Frames in Seismic Areas*, *Design and Reliability"* (RECOS), Edited by F.M. Mazzolani, E & FN Spon, London, 2000.

[4] - R. Montuori, V. Piluso
"Plastic Design of Steel Frames with Dog-Bone Beam-to-Column Joints", Third International Conference on Behaviour of Steel Structures in Seismic Areas, STESSA 2000, Montreal, Canada, 21-24 August, 2000.

[5] – F. M. Mazzolani, R. Montuori, V. Piluso
"Performance Based Design of Seismic-Resistant MR-Frames", Third International Conference on Behaviour of Steel Structures in Seismic Areas, STESSA 2000, Montreal, Canada, 21-24 August, 2000.

[6] – R. Montuori,
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