SEISMIC ISOLATION: WHY, WHERE, WHEN
Design options for ordinary buildings: the Italian experience

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Summary - Seismic isolation is coming out from its pioneer period and now it is on the way to become a popular system for the seismic protection of ordinary structures. The criteria concerning the architectural morphology, the selection of the structural configurations and other design options of seismic isolated buildings shall be discussed to popularise its use, to improve the effectiveness of ordinary applications, to cut down the construction costs and to open the way to new and wide applications. Moreover, the experts should emphasise the higher reliability of the design procedures commonly used for fixed-base structures, when applied to isolated structures. The target is to avoid that new applications are discouraged by unnecessary and complex analyses required by specific codes. Taking the opportunity of some demonstrative initiatives promoted by the local Government of the Umbria Region after the seismic "swarm" that struck central Italy in 1997 and 1998, this papers deals with practical topics concerning the application of seismic isolation to ordinary residential and commercial buildings.

Introduction

This paper deals with practical considerations and problems concerning the usual design practice, when seismic isolation is applied to design ordinary buildings. Seismic isolation is coming out of its pioneer period and now it is on the way to become a construction technique widely used for seismic protection of many structures in all the seismic areas in the world. Besides the results of theoretical and experimental research, the real effectiveness of seismic isolation was clearly shown by the performance of the isolated buildings recently struck by severe earthquakes. These performances were clearly shown by the records of the real response of the buildings shaken by the earthquakes of Los Angeles in California [1] and Kobe in Japan [2,3,4].

Till now, seismic isolation has been generally applied to protect important or demonstrative buildings, whose design was carried out by structural engineers expert in this field. Due to its excellent performance, we can now foresee that seismic isolation will be soon extended

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to design and construct a large number of buildings. Therefore, an important target is to make the applications of seismic isolation easy to perform, so that it becomes a current practice in architectural and structural design.

The harmonisation of the architectural morphology of the buildings with the specific performance of the isolating systems is an important aspect that has not enough taken into account in order to guarantee the effectiveness and to reduce the cost of the ordinary applications. The architectural design can be a critical aspect to enlarge and popularise the use of seismic isolation. Therefore, it is important to involve the architects in practical and theoretical discussions in this topic.

**Complementary aspects of seismic isolation**

At the present stage of the studies, we have to underline how seismic isolation can be effectively applied in the current design of ordinary buildings. The experts should be engaged in order to popularise its use. This aspect is more important than to illustrate the results of further theoretic or experimental research or to show how seismic isolation has been applied to special structures. We must also underline that, in addition to the reduction of structural stresses (current target of the design practice), there are other aspects that make seismic isolation suitable and profitable for the construction of ordinary buildings in seismic zones.

The base isolation is a simple way to reduce the horizontal accelerations transmitted to floors or to other structural elements. This is an important factor seldom taken into the right consideration. Generally, this aspect is disregarded in the design practice, since it is not considered by the design specifications. On the contrary, the reduction of seismic accelerations is a very important aspect of the seismic design, because it avoids damages of non-structural elements and of the objects inside the buildings.

Another significant aspect is this: the common design procedures and the numerical calculations are more reliable and effective when they are applied to seismic isolated rather than to fixed-base structures. This matter will be examined closer.

Finally, it should be underlined how the seismic performance of the isolated structures mainly depends on the selection of a suitable architectural morphology. It is known that there is a strong correlation between seismic performance and architectural configuration [9]. All the reports always emphasise this aspect when they illustrate the damages due to real earthquakes [1,2,3]. This correlation is stronger when seismic isolation is applied. Both engineers and architects should be involved to optimise this critical point.

**Recent development of seismic isolation in Italy**

During the decade 1982-1992 more than a hundred highway bridges (new constructions and retrofitted existent structures) were equipped with seismic isolation [4,5,6]. This was due to the belief of the technical staff of the "Autostrade" Company (the Italian company that manages the toll roads). According with the performance of the typical bridge configurations, the use of elasto-plastic dissipating devices, having a constant plastic
threshold, was preferred. The target was to cut the seismic force transmitted by the deck to the lower structures (piers, abutments and foundations) and to dissipate a large amount of energy. In the same period, only few applications have concerned the structures other than bridges (residential or commercial buildings, industrial plants, etc.) [7].

During the successive years, the application of seismic isolation was almost disregarded in Italy. This was due to the restriction of the road constructions, but also to a suspicious disbelief of designers, administrators and even owners in the use of this system (sometimes, a long time is necessary to remove prejudices and to apply the results of the scientific research).

At present, two events are modifying this situation. First of all, the earthquake "swarm" that struck the Umbria and Marche regions in central Italy during 1997 and 1998 has caused a new impulse. Thanks to a persevering action of the author of this paper, carried out with the help of the task group of Enea, the Government of the Umbria Region decided to finance the execution of a wide demonstrative programme in order to promote the use of seismic isolation. At the same time, the Italian Ministry of Works issued a set of special recommendations for the design of seismic isolated structures (no official design recommendations were issued in Italy before). The two initiatives give now the opportunity for general and contrasting comments.

Reliability of the design procedures

Due to the novelty of the isolation criterion, some erroneous and suspicious beliefs often limit the application of the seismic isolation. For example, it is general opinion that the seismic design is more difficult to perform and that the design procedure are less reliable when they are applied to isolated buildings rather than to fixed-base structures. This opinion leads the authorities to ask for complex analytical calculations and waste of time in the approval procedures. Many initiatives are then discouraged. In contrast, to increase the confidence of architects and engineers, we should underline the reliability of the simple design procedures when they are used to design ordinary base isolated structures.

Significant lateral deformations can occur in tall buildings, particularly when they are made of steel structures. Bracing dissipating elements can then be inserted in the structural systems in order to reduce the lateral seismic response. Apart from these particular applications and unlike the case of the bridges, the most effective and cheapest system for ordinary multi-storey reinforced concrete buildings is the base isolation with rubber isolators located at the bottom of the structure (exceptions can be considered for warehouses or industrial buildings). It is known that the target is to achieve a significant increase of the natural period. An effective improvement of the seismic performance is obtained when the following parameters reach high values:

• The magnitude of the fundamental period of the isolated structure should be long. It should reach at least two seconds, or more, in order to maintain the structure out of the range of typical frequencies of the seismic inputs. This makes the base isolation very effective in many Italian seismic zones, like central Italy, where the earthquake focuses are
not very deep and the seismic energy is mainly transmitted in the range of high frequencies\(^1\) (Fig. 1).

- The ratio between the reference period of the base isolated structure and the fundamental period of the same fixed-base structure should be high. It should be greater than three, to obtain a real de-coupling effect of the motion of the structure from that of the soil.

In addition, it is appropriate that the structural materials of the isolated buildings do not undergo significant plastic deformations at the maximum design earthquake\(^2\).

![Fig. 1 - Typical shape of the actual local response spectra in the Umbria region compared with the design spectrum (PGA = 0.25g, soil B).](image)

It is also known that the most favourable seismic responses of the isolated structures depend on the following performances, that comply with the previous requirements:

- The first lateral mode is almost shaped like a rigid body, which moves above the isolating interface.

- The seismic accelerations transmitted through the first lateral mode are considerably reduced, so that non-structural stresses and damages to the inside objects are almost eliminated.

\(^1\) The design spectrum of the Eurocode 8 has a generalised shape to cover all the seismic situations, but the actual shapes related to specific zones can show some differences. The local estimates made in Umbria show that in general EC.8 could be considered relatively safe for the low frequencies and unsafe for the high frequencies.

\(^2\) The Eurocode 8 (not yet an official code in Italy, but assumed as a significant reference) defines the design seismic intensity in terms of PGA (Peak Ground Acceleration) on firm soil \(^10\). It assumes a reference return period of 475 years (that is a probability of 10% in 50 years). In Umbria a PGA=0.25g can be assumed. The ultimate limit states of the (non-isolated) structures (calculated applying the γ-factors 1.15 to the steel reinforcement and 1.6 to the concrete) can be reached for the seismic intensities divided by a q-factor (q=4+5, depending on the structural system). The special recommendations for isolated structures, recently issued by the Italian Ministry of Public Works, requires that the design of the structure above the isolating system, are carried out assuming q=1.5 and γ=1.0 for both steel and concrete.
• The participation factor of the first mode, which practically does not stress the structure, is very high, usually greater than 90%.

• The seismic participation factors of the higher modes, which mainly stress the structure, are very small. They are almost ineffective in the calculation of the real seismic response (Fig. 2).

These performances that make base isolation effective, also make the numerical analyses of the seismic response more reliable than in the case of the fixed-base structures. Since the actual deformed shape is entirely defined by the first rigid lateral mode, the numerical models reproduce the actual behaviour of isolated structures better than in the case of fixed-base structures. In addition, the lateral stiffness of the rubber bearings, on which natural period and shape of the first mode depend, is well defined by the acceptance tests carried out directly on the isolating devices manufactured through industrial procedures. On the contrary, the real seismic behaviour of fixed-based structures depends on the actual stiffness of the reinforced concrete elements. Their estimation contains a number of uncertain factors which are effective even in the elastic range (elastic modulus of the concrete, flexural stiffness of cracked zones, tension hardening effect, and so on). These uncertainties become more significant when non-linear responses are mobilised (actual behaviour and dimension of plastic hinges, cyclic degradation, etc.). Furthermore, the predominance of the first rigid mode is also suitable to estimate the dissipating effects through a classical damping procedure, since it can be entirely ascribed to the isolating devices. Therefore, the usual numerical calculations give more reliable information when they are applied to a base isolated rather than to a fixed-base structure.

Further significant uncertainties in the estimation of the seismic response of framed structures are also due to the interaction of some non structural elements, like the infilling masonry. Although the infilling masonry is frequently used in framed structures, their interactive effect is disregarded in the design. In spite of this, the effect can make the
actual seismic response of fixed-base structures very different from that expected according to the design. This difference, that can be unsafe when the infilling masonry causes unwanted soft-storey or torsion effects, is practically eliminated with the base isolation. This because the large predominance of the first rigid mode is almost the same with or without the infilling masonry.

When base isolation is applied to ordinary buildings, another favourable point can derive from the design specifications if they take into account all the appropriate seismic requirements (!) In fact, although the code specifications prescribe to check the resistance of the structural elements and to limit their deformations, they do not limit the transmitted accelerations (for example, the floor accelerations of multi-storey buildings). If one pays attention to the real damages caused by earthquakes, this lack appears to be a critical point, since this is one of the most important factors on which non structural damages and repair costs depend [9]. In spite of this, the magnitude of floor accelerations is disregarded in the common design practice.

The floor accelerations are strongly reduced with the base isolation (reductions to 1/10 are even possible at the higher floors!). The simple improvement of the structural resistance of a fixed-base structure can make this more resistant against seismic attacks, but consequently improves the lateral stiffness and the floor accelerations. Therefore, this solution cannot be regarded as the best one from all the points of view. In addition, the reduction of floor accelerations reduces the probability of the collapse out-of-the-plane of the infilling masonry, so that the reliability of its resistant action is improved when the structure is base isolated. A synergetic effect occurs, because the performance of the infilling masonry increases the stiffness of the structural frames and better guarantees the predominance of the first mode and the global resistance of the seismic response.

<table>
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<tr>
<th>Table I Interaction of infilling masonry with reinforced concrete frames</th>
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<td>Required inter-storey ductility and damage of infilling masonry (in-plane actions)</td>
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<td>Actual applied earthquake (EC.8)</td>
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<td>Design criterion (EC.8)</td>
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<td>&quot;A&quot; = framed struct. (PGA=0.25g, q=5)</td>
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<td>&quot;B&quot; = &quot;A&quot; + base isolation elastic</td>
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<td>&quot;AM&quot; = &quot;A&quot; + infilling masonry elastic</td>
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<td>&quot;BM&quot; = &quot;B&quot; + infilling masonry elastic elastic elastic</td>
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[--] the demand can be considered greater than the actual capacity.
To make an example, Table I shows the typical behaviour of reinforced concrete frames with or without infilling masonry, with and without base isolation. The reference framed structure "A" (without infilling masonry) was designed for a design earthquake having a PGA = 0.25g and assuming a behaviour reduction factor q = 5 [10]. If an earthquake having a PGA = 0.25g occurs, this structure undergoes plastic deformations according to the design criteria. Under the same conditions, base isolation guarantees a total protection, and it is effective against greater earthquakes. When the interaction of the infilling masonry actually works, the effect can be even negative for non isolated structures. On the contrary, the synergetic effect with base isolation guarantee the entire elastic behaviour of the structure and masonry even against an earthquake having a PGA = 0.35g (that is 40% greater than the design PGA).

Finally, the base isolation is an easy system to reduce some undesirable seismic effects deriving from the structural irregularities of the buildings, like the torsion effects. The distribution and dimensions (that is the lateral stiffness) of the bearing isolators naturally follow the actual mass distributions of irregular buildings. Significant torsion displacements do not occur even in the upper structure, due to the rigid shape of the motion above the isolating interface.

Seismic isolation and architectural design

The requirements and the behaviours illustrated above should induce architects and structural engineers, when they design a base isolated building, to give more importance to the lateral stiffness rather than to the mechanical resistance concept, starting from the preliminary design. It is known that in all the cases the seismic performance of the buildings mainly depends on the architectural morphology, on which the structural configuration depends [8,9]. From a general point of view, this is an important subject, but it is not yet entirely applied to improve the seismic effectiveness of ordinary structures. In the usual design practice the importance of the architectural morphology is often underestimated, although the performance of the residential buildings is the major aspect to guarantee the people safety and avoid social disruptions when seismic attacks occur. In the case of the base isolation, the correlation between architectural design and seismic effectiveness becomes more important.

The base isolation modifies the relative importance of some aspects that rule the architectural and structural design. The manufacturing of the devices and the numerical analysis have now reached high standards. At present, the aim is to go deep into the questions of selection and optimisation of the architectural morphologies and structural configurations of the buildings, taking into account their correlation with the behaviour of the isolating systems. The effectiveness of the suitable architectural morphologies and the consequent lay-out of the structure should be recognised, so that the general criteria that guide architects and structural designers become more popular. Therefore, the best performance of the isolated buildings during seismic attacks can be guaranteed and the construction costs can be cut down.
It is commonly believed that seismic isolation requires high costs. The harmonisation of the architectural morphology to the specific requirements of seismic isolation is the only effective procedure to cut down this belief (3).

On the one hand, base isolation can easily correct the negative effects of many architectural irregularities (for instance those related to torsion effects). It has already mentioned that the arrangement of the isolating rubber bearings easily respects the right locations, since it depends on the mass distribution of the upper building. On the other hand, the base isolation should suggest the design of specific architectural and structural configurations according to its specific performances (this is the more important aspect). Therefore, some common design habits should be revised. If the importance of the lateral stiffness relative to the lateral resistance is taken into account in the architectural design, the seismic effectiveness of the base isolation can be very high and the construction costs can be cut down. On the contrary, if the architectural design is carried out before the choice of the seismic protection system, the seismic isolation may not fulfil all its potential capacities. Unfortunately, this wrong procedure is often encouraged in the business sphere in which the design of ordinary buildings is carried out.

It is important that the architects become involved in this matter and that they take into account the typical performance of the isolated structures from the first stage of the conception of the architectural morphologies. Otherwise, structural arrangements are required, and parts of the advantages of seismic isolation are reduced.

**Seismic isolation applied to masonry structures**

The greater importance of the concept of stiffness relative to resistance should modify some common opinions about the application of seismic isolation. In fact, base isolation can be regarded as an effective technique for small buildings and it can suitably be applied to masonry structures, making them safe enough against severe seismic attacks.

Although the shear resistance and ductility of the masonry structures are not very high, brick panels have high shear stiffness, as the base isolation requires. Base isolation can then rehabilitate the use of masonry buildings in seismic areas, giving them a renewed impulse for the constructions in the country and in historical sites. For this reason, a project has been recently proposed in Umbria to reconstruct a country village destroyed by the recent earthquakes, using traditional masonry buildings and seismic isolation (Umbria is one of the richest Italian regions respect to environment and historic worthies).

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(3) Seismic isolation also reduces the expected repair costs of the structures [6]. Unfortunately, it is not easy to persuade administrators and buildings owners of the importance of this aspect, where (like in Italy) the seismic insurance system is not applied to buildings.
Figure 3 shows the design acceleration spectrum of Eurocode 8, plotted versus the displacement spectrum, for a seismic intensity corresponding to a PGA = 0.25g (generalised value to be used in Umbria), assuming a medium stiff soil (soil B) and 5% of damping. The natural periods correspond to the dashed inclined lines. Considering the use of base isolation, the accelerations have been reduced in the range of low frequencies, to take into account the damping effect (10%) due to the use of high damping rubber bearings in the isolated first mode.

Starting from these input data, the average characteristics of masonry buildings three floors high (gross weight, density, arrangement and distribution of bearing walls, etc.) were considered to obtain generalised results. Natural periods lower than 0.6 seconds are certainly real values for fixed-base buildings. Assuming a reduction factor $q=4$, that leads to a design acceleration of 0.156g, consistent with the ultimate shear resistant capacity of masonry panels, a ductility demand $\mu=4$ should be undergone in this range of frequencies. This demand is certainly greater than the ductility capacity of the masonry panels. If a base isolation system is considered, a natural period of $T=2.0$ seconds should be achieved to make this structure safe without plastic deformations under the same design earthquake. The displacement of 182 mm is then required to the bearing devices. These values are consistent with the use of small isolating rubber devices (for example, $\varnothing = 300\div 400$ mm of a soft rubber compound) located under the ground floor at an average distance of $2.0\div 2.5$ meters. These results demonstrate the feasibility of the use of seismic isolation to achieve a high protection level of masonry structures. The actual configurations of the design spectra previously shown for the regions of central Italy (Fig. 1) also guarantee a real safety level of the system that is higher than the one that corresponds to the application of the EC.8 spectrum.
A special configuration: the isolated bell-building

Seismic isolation can make specific architectural configurations effective in seismic zones. This is the case of the "bell-building" system, in which a set of floating storeys is suspended to the head of a central reinforced concrete core (Fig. 4). A special study was carried out by a pool of industrial builders under the scientific supervision of the author of this paper [10]. The Italian Research Department committed the research. The feasibility of this scheme (unusual in seismic zones) was carefully analysed and the optimum design requirements were defined. The results are very attractive, although a practical realisation has not yet been possible.

This is an architectural configuration that leaves the area at base of the building free, as it is often required in urban areas. The building can be easily built using industrialised procedures. The results of the research have shown that the most effective configuration is achieved when the following conditions are satisfied:

• a packet from 8 to 12 storeys is suspended to a reinforced concrete central core,

• the suspended storeys are rigidly connected each other by a peripheral bracing system, so that inter-storey drifts are practically eliminated,

• the lateral elasto-plastic dissipating restraints of the suspended storeys are located at the top and bottom of the suspended rigid packet,

• if the horizontal restraints behave in elasto-plastic mode, their elastic stiffness can be designed so that the storey packed swings without rotations.

![Fig. 4 - Structural lay-out of a seismic isolated bell-building.](image-url)
The Italian recommendations for seismic isolated building

In 1998 the Italian Ministry of Works issued the first official recommendations for the design of seismic isolated structures, in which particular attention was paid to the use of rubber bearings. This is a significant step that allows and popularises the use of seismic isolation in Italy. Differently from the present Italian seismic code that generally rules the design of non-isolated structure, these recommendations are based on the seismic input defined by the Eurocode 8. This makes the design of seismic isolated buildings feasible(4). Nevertheless, some requirements of these recommendations also show a suspicious and questionable attitude with which the novelty of the system is still taken in consideration, even in contrast with the criteria of the optimum design.

Apart from the details of the single requirements, only one simple consideration can put us in the frame of the problem and show how prejudices and mental habits can be hard to remove. A common idea in non-seismic structural design is that over-dimensioned cross sections of the structural elements certainly work on the safety side. This concept is not always true in the seismic design(5) and it can be in the opposite direction if it is applied to define the dimensions of the base isolating rubber bearings. This wrong idea is still present in these recommendations and leads to perform the structural design under too restricted conditions, and it partially limits the effectiveness of the base isolation. Some requirements lead to build too stiff actual devices, even stiffer than those that should be considered in the design. So, the real natural period of the isolated building can be a bit shorter and the real seismic forces a bit greater than those assumed to design the upper structure (!) The same suspicious attitude also appears from some general advises given by the recommendations. For example, they recommend that the isolated structures should have regular configurations. This is a good advice for the design of any anti-seismic structure, but why it is recommended only for the isolated structures? Differently from the fixed-base structures, seismic isolation can reduce the importance of this aspect. An indication like this leads again to erroneous doubts against seismic isolation in comparison with the traditional construction systems.

The demonstrative programme of the Umbria Government

After the recent seismic swarm that struck the Umbria region, the local Government financed a wide demonstrative project to promote the use of seismic isolation. The entire programme is being carried out by different groups of architects and engineers, under the direction of the author of this paper. The project is composed of different initiatives. All the buildings of this project will be provided with seismic isolation systems. The target is to develop architectural and isolating arrangements suitable for each different situation, depending on the structural configuration and specific use of the buildings. The project includes the following initiatives:

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(4) The present Italian code for the design of fixed-base structure is not yet harmonised with the Eurocode 8.

(5) The capacity design concept clearly shows this aspect.
• Construction in Città di Castello of a residence building for 32 flats, shops and garages, to be built by the IERP (the local Institute for the design and construction of public houses). This town of the Umbria region is the one where the greatest seismic intensities are expected.

• Construction of the Centre for the activities in central Italy of the Department of the Protezione Civile (Civil Protection Service) and other related activities. It will be built in an area of 13.5 hectares, near the town of Foligno for an estimated cost of 20,000,000 US$. The Centre includes the construction of a number of different structures. They are:

  • An operative main building for the Protezione Civile, with offices, rooms for training activities and public services.

  • A fire station equipped with lodging rooms, garages, training centre and repair shop.

  • Offices and warehouse buildings of the regional Centre of the Red Cross.

  • Offices, laboratories and warehouse buildings of the Government Department for the safeguard of the cultural and artistic worthies (safeguard and maintenance of historic and artistic buildings, paintings, frescos, sculptures, and other cultural worthies).

  • Buildings of the Forest Department.

  • A central car parks for public services.

  • Other minor buildings for the service activities of the Centre.

• Construction of a base isolated 9-storey hospital building in Perugia (about 40,000 cubic meters) beside another twin building already built without seismic isolation. Both the two buildings will be provided with a permanent monitoring system (this project is not yet entirely defined).

Fig. 5 - Transverse section of the IERP building in "Città di Castello".
The IERP building was the first initiative. This is the renewal of a previous project that was not possible to realise before the recent earthquakes occurred. One of the design targets is to demonstrate the low cost of the use of base isolation compared to other similar anti-seismic fixed-base buildings built by the same Institute. The cost in place of the isolating devices is about 140,000 US$ for a building of 20,000 cubic meters, that is about 7 US$ per cubic meter. Since the garages and the basement floors are located underground, their structures do not require to be isolated. Some transverse shear walls located at the open approaching side guarantee the required rigid behaviour. Therefore, only the structure above this level has been isolated (Fig. 7). Complementary experimental tests were carried out at the Joint Research Centre of the European Communities in Ispra (Italy) for demonstrative purposes. The pseudo-dynamics procedure was applied to a hybrid model to calibrate the numerical models of the isolating devices. In the frame of this initiative, IERP has also organised a training activity for its young engineers. The municipality of Città di Castello is now approving the design of the building from the town-planning point of view.

![Fig. 6 - General lay-out of the main building of the Centre of the "Protezione Civile" to be built in Foligno (Prof. Ing. A. Parducci, Arch. G. Tommesani).](image)

The design of the Centre for the Protezione Civile in Foligno has being carried out by a co-ordinate staff of young architects and engineers. This work will be completed with the appreciated collaboration of Mrs. Naaseh of the Forrel Elsesser Company in San Francisco. From the design point of view, we consider this Centre like a workshop. Different kinds of buildings (office, residential, warehouse and industrial buildings) have to be designed taking into account the specific architectural and seismic isolated requirements. Our target is to arrange the architectural requirements and the isolating strategies to reach the best solution for both these points of view and to prepare a set of paradigms for further applications of seismic isolation. The most significant example is the designed structural scheme of the main building. Figure 6 reproduces the present stage of this design together with the foreseen construction procedure.
Fig. 7 - Preliminary scheme of the library of the University of Perugia: vertical section.

Fig. 8 - Preliminary scheme of the library of the University of Perugia: horizontal section.

**Other initiatives**

The impulse given by the demonstrative initiatives of the Government of the Umbria Region has already given the first results. Among them there is the preliminary design of the library building of the University of Perugia, carried out by the local Institute of Architecture. Its cross-section is shown in Figure 7. The idea is a challenge to use base isolation in a very irregular structural building (Fig. 8).
Conclusion

At present, considering the point of view for the design of ordinary residential and office buildings, it is important that the main commitment of expert designers of seismic isolated structures carefully follow these aspects:

• To recognise the characteristics of the architectural morphologies and structural configurations with which the maximum effectiveness of the seismic performance and the reduction of the construction cost can be achieved. These should be done according to the available performances of the isolating and dissipating devices.

• To recognise the optimum strategy for the location of the isolating devices (base isolation, partial isolation, etc.), considering the architectural and structural characteristics of the buildings and their use.

• To make popular the usual seismic design procedures and to show why they are more reliable and more simple when they are used in the design of base isolated buildings, rather than in the case of fixed-base structures.

• To avoid that persistent prejudices may lead to require useless complex design methods and too long approval procedures, so that the applications are discouraged.

The initiatives set up by the Regional Government of the Umbria, illustrated in this paper, can be considered as a significant step in this direction.

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