Abstracts

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New advances in seismic risk assessment and disaster mitigation

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Vulnerability and earthquake protection of industrial and residential buildings in Uzbekistan

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In recent years natural disasters, such as earthquakes, landslides, tsunami, etc, rebecoming serious threat for sustainable development. In Uzbekistan several strong earthquakes occurred in the past.

Threats from earthquakes are very serious in Uzbekistan, since considerable part of the country's territory belong to high seismic risk zone where lives more than half of the total population. Such a fact makes very important earthquake protection of buildings and infrastructural constructions in these places. Here we discuss the problems and prospects for seismic vulnerability estimate for different constructions by focusing on residential, industrial buildings, energy-related constructions and architectural heritage constructions. Building type dependent classification of the estimate and threats will be presented in detail.

Recommendations for retrofitting will be discussed. Special focus will be given to the vulnerability estimate, structural health treatment and retrofitting issues for architectural heritage buildings.

Focusing around building damage detections by observation of seismic strong motion

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We have to evaluate the initial and residual seismic performance of the building structures before and after earthquakes. Initial performance can be calculated from the data of structural design data and numerical model though we still have to develop the sophisticated method to evaluate the accurate seismic performance because observed seismic response and response calculated from numerical study using structural design data and the site's grand motion don't correspond. To calculate the residual performance is necessary to prevent a secondary disaster when a large-scaled disaster such as a severe earthquake occurs.

Authors have been developing a new residual seismic capacity evaluation system with few inexpensive accelerometers. Inertia force at each floor is calculated from the assumed mass and measured absolute acceleration. Response displacement is calculated by double integral with measured acceleration. The wavelet transform technique is applied for the integral to reduce the effect of the error contained in the measured acceleration. The damage of a building is evaluated with the performance curve with measured inertia force and derived displacements.

The data from two buildings has been obtained during the 2011 off the pacific coast of Tohoku Earthquake and their performance curve were successfully measured. One was the still linear performance stage and the other was non -linear performance curve in the 7-story R/C building with base isolation system. The data from real damaged buildings are very limited now so we prove the he shaking table test for timber-based houses and numerical study was conducted to evaluate the residual performance from residual story drift.

In this paper, the outline of the proposed structural monitoring system will be introduced. and the measured performance curve on the base isolation system will be shown. The shaking table test for a 2-story timber house will be explained. The maximum story drift of the house reached beyond 1/30 radium. Then the relationship between maximum story drift and residual seismic performance obtained from numerical study will be shown.

Displacement Measurement of Shaking Table Damage Test by Image Processing

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There is an world biggest shaking table testing machine at Hyogo Earthquake Research Center, which constructed for the memorial of Big Earthquake in 1995 at Hyogo/Kobe and disaster victims. Three-dimensional measurements by using several high-resolution high-speed cameras have been developed and carried out for several vibration testings of the real scale structural models at Hyogo Earthquake Research Center from 2004. The author is one of the member of the development project of the 3D measurement system.

The developed measuring system can acquire the three-dimensional coordinates of the target made to emit light by LED. The three-dimensional coordinates of a target are calculated with images of two or more high speed cameras. Measurement accuracy is 0.05 pixels or more on a picture.

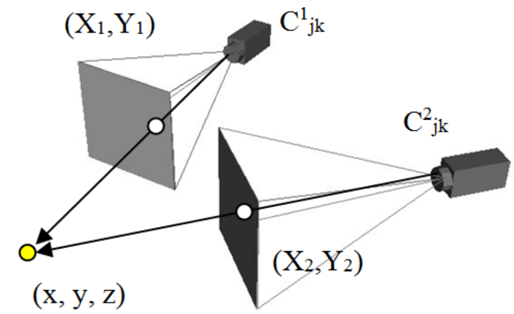


Fig. 1. Principle of the measurement. The obtained 3D coordinate of target (x, y, z) is cross point of two camera line equations.

Fig. 2. Photograph of the real size bridge model on the shaking table. The diameter of the bridge peer was 1800mm, and weight of the specimen was 1500tons.

This report explains the measurement principle and the measurement method of the developed measuring system. Fig. 1 shows the measurement principle. The three-dimensional coordinates of a target are searched for as an intersection of the camera line of sight equations of two cameras. Fig. 2 shows the photograph of a shaking table test of the real size bridge model carried out in 2008. The weight of the examination object of the bridge was about 1500 tons. In this experiment, seven sets of high speed cameras were used, and about 60 points (targets) was measured. Fig. 3 shows the schematic figure of a testing object of the 6-story wooden building in 2015. In this experiment, I used nine sets of high speed cameras, and the three-dimensional coordinates of about 120 targets were acquired. Fig. 4 shows a part of measurement result of an experiment of Fig. 3.

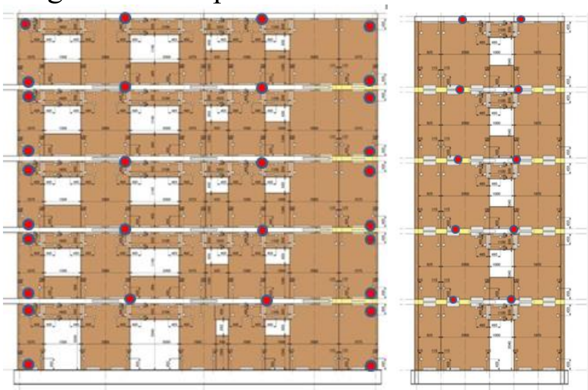
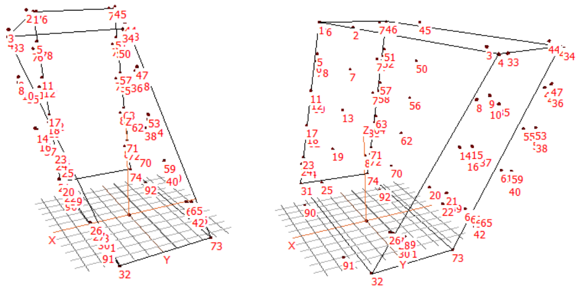


Fig. 3. Schematics of 6-story wooden building. The height of the building was about 17m.



(a) (b)

Fig. 4. The results of the 3D measurement of 6-story wooden building (Fig.3) which was shaken as same 100% kobe earthquake wave. Displacement states of the rightward maximum (a) and leftward maxi

In-situ data collection for structural modelling and assessing seismic vulnerability of existing buildings

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Vulnerability assessment of the existing building stock is an important part of earthquake risk management strategies in communities located in seismically active areas. Proper assessment of the actual state of existing buildings, which commonly might be constructed in different periods of the urban development, under changing conditions and based on different building codes (or sometimes without seismic considerations), is necessary for obtaining a realistic picture of seismic risk level and disaster preparedness in the communities and providing vital information for decision making by administrative bodies and civil protection authorities.

This paper presents preliminary results obtained in the frame of EU project SIBYL (Seismic monitoring and vulnerability framework for civil protection), a core part of which is devoted to developing an operational framework for rapid and low cost in-situ building vulnerability assessment. The test sites of the project are located in Thessaloniki (Greece), Cologne (Germany) and L'Aquila (Italy), where buildings of different occupancy, different age and different structural types are investigated and analyzed. At the same time, in terms of methodology, the present study focuses mainly on reinforced concrete frame buildings.

Generally, structural modelling and assessment of seismic vulnerability of existing buildings is based on available design documentation and construction drawings updated with in-situ collected information. In many cases in practice, however, the documentation can be quite limited or, sometimes, especially for older buildings, not available at all. In such situations, when the structural evaluation of the buildings is based solely on field measurements, the importance of the in-situ data collection procedure (including proper processing and interpretation of the data) increases and becomes decisive for providing the quality and soundness of the vulnerability assessment results.

Taking into account these arguments, the paper describes the developed approach, which includes visual structural survey, non-destructive testing and ambient vibration measurements, and shares the gained experience of in-situ data collection and structural modelling on several university buildings in Thessaloniki and school buildings in Cologne. A special attention is paid to the pitfalls and difficulties arising at different stages of the data collection process, interpretation of the collected data and preparing the input for the structural modelling, taking into consideration existing uncertainties.

Resilience of Timber Post-Beam Structure with Flexible Joint

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1) Collision of Festival Floats
2) Reconsideration of Mechanical Properties of Timber
3) Flexibility of Timber Joint
4) Resilience of Timber Post-Beam Structure

Inspiration obtained through the Resilience of Festival Floats making Collision.
Observing the collision of traditional timber festival floats weighing about 8 tons at Fushiki, Takaoka, Toyama, Japan, it is found that timber post-beam structure can show its resilience as strong as a stunt car.

The collision at our running speed means the speed of each float is around 10km/h so that the speed at the collision can be said roughly 20km/h.

What is surprising is that they can repeat the collision. Considering why the timber floats can repeat the collision, two research subjects are occurred.

One is mechanical properties that should be reconsidered. The dynamic properties may be far bigger than those static. The members can bend largely without damage.

Another is the flexibility of timber joints. Though the joints are flexible, the frame should have certain rigidity. If the joints are for example T-shape, the continuous member can be rigid. The rigidity can be obtained in such simple way but with anisotropy. What is important is due to the flexibility of joints, the impacts are mitigated.

Using the Post-Beam Structure having Resilience sufficiently important we can design buildings well resistant against earthquake without infilling walls.
As there is no wall, there is nothing to show damage.

Structural Assessment of Heritage Monuments by Means of Laser Scanning and Numerical Modelling in Uzbekistan: Samarkand, Bukhara, Tashkent and Shakhrisyabz

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The technology of high-definition laser scanning is an essential tool for accurate non-destructive three-dimensional measurements of structures. The object's geometry is captured as a collection of points which is called a "point cloud". The research team used this technology and conducted a program of laser scanning and subsequent structural analysis of major historic monuments in Samarkand, Bukhara, Tashkent and Shakhrisyabz (Uzbekistan). As representative samples, three major historic monuments in Shakhrisabz, Uzbekistan are discussed in more details. The city is located in southern Uzbekistan approximately 80 km south of Samarkand, Uzbekistan. Once a major city of Central Asia, it is primarily known today as the birthplace of 14th century Turco-Mongol conqueror Timur. The scanned monuments are from the Timurid Dynasty era and they are on the UNESCO World Heritage List. The Timur's Summer Palace, the Ak-Saray Palace (White Palace) was planned as the most grandiose of all Timur's constructions and it was started in 1380. Unfortunately, only traces of its gigantic 65 m gate-towers survived. The Kok Gumbaz (Blue Dome) Mosque was built in 1437 and underwent several restorations and reinforcement efforts. East of the Kok Gumbaz, there is another mausoleum complex called Dorus-Saodat (Seat of Power and Might), which contains the Tomb of Jehangir, Timur's eldest and favorite son. A detailed finite element model of each monument was generated from the as-found geometry captured by laser scans. To monitor the buildings' possible settlement due to poor soil conditions, special high-resolution laser targets were permanently installed. The physical properties of the monuments were investigated by material tests of the major components recovered from the historic sites. The calibrated models were used for comprehensive seismic analysis of the monuments and its components. All current reinforcement details were accounted for in the numerical models. Based on the results of numerical simulations, recommendations on further reinforcement of the historic monuments were developed. As one of the valuable options, a use of damping devices is investigated.

Structural Study for Restoration of the Prambanan World Heritage Temple Damaged by Central Java Earthquake of 2006

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A devastating earthquake of magnitude 6.4 that hit Central Java, Indonesia, on May 27, 2006 affected a number of architectural heritages in and around one of the historic cities in Indonesia, Yogyakarta. The serious damage that attracted world wide concern immediately after the earthquake was to the Prambanan Compounds of World Cultural Heritage. Just after the

devastating earthquake, Japanese interdisciplinary expert team was launched to conduct the structural survey for restoration of the damaged cultural heritage in response to Indonesian governmental emergency request. Following this initial architectural structural survey performed for 2 years, scientific research in academic phase had been successfully conducted for their restoration in collaboration with Indonesian experts. There are a total of 8 monuments of stone masonry in the Prambanan World Heritage site, where all of the monuments were damaged and restored. The restoration of those monuments was successively carried out and finally completed in September 2014.

Those heritage structures, of the local andesite blocks, originated in 9th century, which had been ruined during their long centuries. The structures were reconstructed in the 20th century. Dutch engineers first reconstructed Candi Siva, the largest monument, in the period of 1930-50. They employed the structural system of the reinforced concrete technique. The other monuments were reconstructed by Indonesian engineers who followed the same technique utilizing reinforced concrete. After reconstruction of all the monuments, they were inscribed in World Cultural Heritage list in 1993.

The scope of the present paper is to briefly review the above-mentioned unique history of the Prambanan Temples from a structural point of view, 2) to outline the features of the earthquake damage, and 3) to describe the architectural structural survey of the monuments for their restoration. This structural survey was performed to assess the structural stability, as well as, to identify the cause of the earthquake damage.

In the present study, both the earthquake monitoring and the microtremore measurements were performed to understand the actual seismic behaviours and the fundamental dynamic characteristics of the heritage structures. Furthermore, the earthquake response analysis employing the finite the element model and the lumped masses model was done to evaluate the possibility of structural damage to the inner reinforced concrete frame and the inner stones that were not visible. Furthermore, the monitoring of crack displacement with temperature was performed to assess the structural stability.

The mictotoremor and the earthquake records showed that dynamic characteristics of the structure were significantly affected by soil-structure interaction. The analysis indicated that neither the inner reinforced concrete frame nor the inner stones would be damaged during the Central Java Earthquake of 2006. Moreover, displacement monitoring of the cracks demonstrated that the structure was stable.

Seismic protection of a school building by use of a tuned mass and stiffness control system

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An innovative seismic retrofit of a school building in Athens (Greece) by a tuned mass and stiffness control system (TMSCS) has been developed within the collaborative project SEISMOFIT involving GERB company (Berlin) as industrial partner and TU Berlin as research institution. The main idea of the retrofit strategy is to reduce the seismic loading on the building by installing the tuned mass dampers on the top and tuning them according to the dynamic properties of the building. In addition, a stiffness modification can be individually optimized in order to increase the protective effects of the system with a minimum invasion into the carrying structure.
The present contribution explains relevant dynamic effects of seismic protection, shows the modeling tolls developed and applied including a nonlinear fiber model for reinforced concrete members implemented within the finite element software ABAQUS.
A thorough in-situ investigation and vibration measurements on the selected building are discussed

in the context of dynamic modeling. The finite element model has been developed and validated in 3 steps by use of the data of experimental modal analysis on site. Special attention is paid to the uncertainties of the data involved due to unknown material and structural properties as well as limited access to the structural members. Such problems are typical to all assessment procedures of existing buildings.
The efficiency of the protective system is illustrated by means of nonlinear dynamic simulations (time history analysis) of the structure with and without TMSCS. Some general recommendations are also derived.

Experimental manufacturing of a small shaking table in Uzbekistan

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The Capital of Uzbekistan, Tashkent experienced earthquake damage in April 1966, just 50 years ago. In 1988, devastating Armenia Spitak Earthquake occurred in Soviet Union. Therefore, in order to improve seismic stability of structures, reaction walls for seismic tests were constructed in Tashkent. However, Soviet Union disintegrated. The reaction wall facility has left at an university; Turin Polytechnic University in Tashkent (TTPU), Uzbekistan. The university is trying to make shaking table as an useful application of the facility with small construction cost. TTPU tried to manufacture a shaking table with using ready-made hydraulic equipments as practical training for mechanical students. The shaking table is one dimensional in horizontal direction with 2.4m by 2.3m of steel material. Cylinder is single rod with stroke of 30cm and pull side area of about 25cm2. Solenoid valve uses for the oil flow control. Power supply capacity is 37Kw. Operational trial was conducted in open loop control, using an old analog function generator and DC power source. Feedback control devices were not prepared. Test run were conducted in open loop. With different piston areas, responses of actuator are unstable, piston rod make drifts. To avoid piston rod drifts, input wave base line is adjusted with offset variable. In analysis, simple equations of different piston areas were introduced and calculated. In calculations, open loop and closed loop were calculated. As a matter of course, using closed loop, no piston rod drift was confirmed. Devices for closed loop will be prepared to get good reproduction to inputs. In the paper, at first, outlines of TTPU seismic test facility are described. And also, simple history of big shaking table in Japan is presented. The paper is a report of constructing a low-cost one horizontal direction shaking table.

日本の地震の歴史と木造基準の改正、最近の地震の被害の特徴
History of Seismic Disaster and Revision of Regulation for Timber Construction in Japan, and Properties of Recent Seismic Disaster

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Building Standard Law (BSL) of Japan was established in 1950, based on the seismic disaster caused by the Fukui Earthquake in 1943. Many of timer and other construction damaged by the earthquake. The primitive BSL required that the braces were set up in the wood houses, but the quantity of the brace were much less than the present regulation. After that, the revisions of BSL were repeated. For example, the approach of the shear wall length with wall ratios of brace and

structural sheathing panels has installed in the BSL.
On 1978, Miyagi-ken Oki Earthquake occurred. Many of timer and other construction damaged by the earthquake again. New seismic regulation has provided. The required shear wall length in wood house was increased.
On 1995, Hanshin and Awaji great seismic disaster has occurred. Many people died under the collapsed wood houses. The new regulations for the joints among structural members and the eccentricity of shear wall arrangements in wood houses have been provided.
After that, 2011 East Japan seismic disaster has occurred. Many people died due to great tsunami. The regulation for wood houses has never changed, because the re-occurrence period of the great tsunami was considered to be 1,000 years. However, we researched the way to calculate the wave force due to tsunami and published the design examples of wood construction against the tsunami wave force.
On April, Kumamoto Earthquake has occurred, and many wood houses collapsed. We quickly report the damage of wood houses due to the earthquake.

Overview of Projects on Earthquake Disaster Management by JICA and Future Perspective in Central Asia and Neighboring Countries

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JICA has been conducting various activities on earthquake disaster management covering whole range of fields which are necessary to mitigate risks and disasters.Those could be categorized into 7 as below.
1) Risk assessment and development of comprehensive disaster management program
2) Establishment of research and development center
3) Support for reconstruction from disasters
4) Capacity development for disaster management
5) Development and dissemination of seismic design technology
6) Group training programs on seismology and earthquake engineering
7) Science and Technology Research Partnership for Sustainable Development (SATREPS)
Outline of each of the categories are to be presented which illustrates total perspective of earthquake disaster management.
Following this, projects implemented in Central Asia and its neighboring countries are introduced including recent country-specific group training course on “Earthquake Disaster Management and Seismic Design”, which is expected to lead to next-step cooperation activities by JICA and other donor organizations.

The engineering analysis of design feature of minaret Islom Hoja

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The level of seismic activity in Central Asia is recognized as one of highest on a planet. The initial seismicity is estimated as 7 mark for territory on which Xiva is located. Here mainly a sandy and clay soils serve as basis for buildings and structures. The results show that seismic intensity increments in this region, depending on a season (summer, winter etc.) are in range $3,0 \geq \Delta I \geq 2,0$. It specifies that the danger of earthquakes, and also all extreme situations, accompanying them, for cities is rather high.

In this work a constructive system of Islam Hoja minaret is considered, the intense deformed condition and durability of a structure is analyzed. Results of size measurement, description of technical condition, engineering analysis of minaret from point of view of seismic vulnerability and compressing pressure dependence on high of minaret is presented.
The description of a technical condition and engineering analysis минарета is resulted results of measurements of a structure, from the point of view of seismic vulnerability, diagrams of dependence of compressing pressure(voltage) in the bottom sections минарета depending on their height минарета.
As a result of external aggressive influences in a body of a structure some traces of damages of designs are marked. In the bottom part a humidifying brick are appreciable, the vertical cracks are serious too. This indicate significant stretching efforts in stacking of a structure, that sharply reduces seismic durability and increases seismic vulnerability of construction.
For investigation of maximal seismic stability of minaret it is required research dynamic features, except for static. The most authentic forecast is possible only by carrying of complex investigation of technical condition of minaret from point of view of seismic durability.

Influence of non-linear properties of the foundation with the ground seismic vibrations of adjacent buildings

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It is considered seismic oscillations of the "building-stack-like structure" system which connected to each other by damper with accounting elastic and elasto-plastic properties of the interaction of the foundation with soil. Dynamic characteristics of the system " building-stack-like structure" before and after connection by damper under the influence of seismic forces are researched.

Earthquakes from space: examples of lithosphere-atmosphere-ionosphere coupling before large earthquakes detected by the ESA Swarm satellite mission

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We investigate here the possibility to detect some pre-earthquake magnetic anomalous signals, likely due to a lithosphere-atmosphere-ionosphere coupling, in the magnetic signal recorded by the Swarm magnetic satellites prior to large M7+ earthquakes. Different techniques have been applied to Swarm data available during two months around earthquake occurrence. From the detected magnetic anomalies series (during night and magnetically quiet times), we show that the cumulative number of anomalies follows the same typical power-law behavior of a critical system approaching its critical time, and hence recovers as the typical recovery phase after a large event. The similarity of this behavior with that obtained from seismic data analysis provides a strong support for a lithospheric-linked origin of the observed magnetic anomalies. We suggest that they might be connected to the preparation phase of large earthquakes.

The role of geodynamic conditions in unloading of intraplate stresses (on example of Southern Tienshan)

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Present-day Central Asia is perhaps the best location to investigate compression tectonics resulting from multiphase continental collision. This zone is geologically complex, and is also known as zone of occurrence of strong earthquakes with M>7. Subduction-related accretion in the Tien Shan paleooceanic basins, mainly in the Paleozoic, gave rise to the present 2400 km-long Tien Shan orogenic collage that extends from the Aral Sea eastwards through Uzbekistan, Tajikistan, Kyrgyzstan, to Xinjiang in China. This paper presents a re-evaluation of the tectonic setting of the orogenic part of the Southern Tien Shan and parts of the Amu Darya basin based on seismic, gravity and magnetic data. Linear positive magnetic anomalies and sharp gravity gradients reflect the position of associated deep faults, which define the location of palaeosubduction zones. Mantle-rooted structures represent pathways favorable for the transfer of heat, magma and ore-forming fluids towards the Earth's surface. Such mantle-rooted structures usually observed in intersections of subduction zones with transverse faults where there are formed zones of increased permeability, serving as channels for mantle degassing and fluids relieve.
North ophiolite belt of the Southern Tien Shan, can be traced from the north - western Uzbekistan to western China, tracing suture of Turkestan paleoocean, closed at the end of Carboniferous period. The length of the Southern Tien Shan is nearly 2500 km. In Uzbekistan this suture zone approximately coincides with Bukantau - South - Fergana deep fault zone. Many strong earthquakes with M>6 occurred within this suture zone at intersections with transverse faults: 1823 M = 6.2; 1902 M = 6.4 (Andijan); 1903 M = 6.1 (Aim); 1924 M = 6.4 and M = 6.5 (Kurshab); 1929 M = 6.6 (Chiili); 1982 M = 5,6 (Chimion), 2008 M = 6.6 (Nura), 2011 M = 6.1 (Kan).

Southern ophiolite suture of Turkestan paleoocean is the boundary structure of the Southern Tien Shan with Karakum - Tajik unit. Continued border westward under the sedimentary cover is fixed by an intense positive linear anomalies considered as buried ophiolite belt in zone of Mangishlak - Bukhara - Gissar fault. Many strong earthquakes with M>7 occurred within this suture zone: the largest known earthquakes occurred in 1902 in Kashgar in the border of Tajikistan and China, M = 7.8. In this place in 1955 and 1985 occurred earthquakes with M = 7.1 and 7.0, respectively. At the opposite end of the active part of zone, in the spurs of the Gissar Range, in 1907 there were two Karatag earthquakes M=7.4 and 7.3. Other large earthquakes are Khait 1949 (M=7.4), which occurred at the territory of Tajikistan to the east from Karatag earthquakes, and almost the same in magnitude (M = 7.3) earthquake in 1949 in the west of China. In 1974, in the border of Tajikistan and China happened Markansu earthquake with M= 7.3. The three large earthquakes that have shaken Gazli in 1976 and 1984 (M >7) occurred in intraplate region that had previously exhibited a relatively low level of seismic activity.

Fragmented and subjected to intense faulting deformation crust of Southern Tien Shan not able to accumulate large stresses sufficient to provoke very large earthquakes. Exceptions are stronger peripheral areas of suture zones containing ophiolites. Thus, above-mentioned earthquakes occurred in the border of the South Tien Shan with Kazakh- Kyrgyz, Karakum- Tadjic and Tarim plates, where seismic activity of moderate earthquakes are relatively low.

Earthquake Early Warning and Rapid Response Systems in Central Asia: the roadmap of Kyrgyzstan

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In the last years increasing attention has been paid by the international community to the topic of Earthquake Early Warning Systems (EEWS), as a viable solution to protect critical infrastructure, major cities or even entire regions against harmful seismic events. Few systems have been actually implemented and are currently operational. Examples of regional applications are the systems operating in California, Japan and Taiwan, while targeted systems have been developed for instance in Mexico, Irpinia (Italy), and Vrancea (Romania).

Despite the potential benefits of EEWS, several factors so far hindered their widespread application, especially in eonomically-developing countries. When the distance between the seismic sources and the exposed target is too short for instance, or there is no technological infrastructure supporting real-time, automatic operations, the information provided by the EEWS cannot be exploited for pre-event actions. In these cases, which occur remarkably often in many seismic regions, the level of ground shaking predicted by the system can still be used as input for generating risk scenarios in near real-time, leading to the generalized concept of Earthquake Early Warning and Rapid Response Systems (EEWRRS).

Within the scope of national and international projects, the German Research Centre for Geosciences GFZ-Potsdam has started several scientific activities related to EEWRRS in collaboration with Central Asian research institutes and Civil Protection Authorities. In particular, in the Kyrgyz Republic the ongoing projects aim at implementing an operational Early Warning and Rapid Response System which is expected to significantly improve the level of preparedness of the Civil Protection Authorities with respect to the occurrence of damaging earthquakes.

The concept of the proposed system, whose roadmap will be outlined in the talk, might be extended to other Central Asian countries, where decision-makers and risk practitioners would greatly benefit from prompt and reliable loss estimations for mitigating earthquakes´ consequences.

Earthquakes in Central Asia in 2014-2015

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We discuss results of monitoring of seismic activity in Central Asia and neighboring area in seismic laboratory of TPUT by SeisComp3 system during 2014-15 years. This earthquake registration system was installed for accumulation all available seismic data with maximal nicety and reliability in region of interest – all Central Asia (territory of Kazakhstan, Uzbekistan, Tadjikistan, Kyrgystan and Turkmenistan). The necessity for installing such a system is motivated by the lack of reliable catalogs for the region. During last two years registration by SeisComp3 up to 30 stations was located more than 5000 EQ with definitely better accuracy and reliability. Accumulated data in the form of standard MySQL database can be used for construction of statistical distribution and time-series analysis of seismic events occurred during last two years.

Seismic wave propagation in branched tectonic faults

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In many cases tectonic faults are branched, i.e. have the forms of Y-or T junctions, or have a network structure. In such faults propagation of seismic waves are different than those in linear (unbranched) faults. Modelling of seismic wave propagation in branched faults requires solving the sine-Gordon equation on networks, or on metric graphs. During last few years we developed an approach for nonlinear wave dynamics in networks. In this talk we discuss modelling of seismic wave dynamics in branched tectonic faults by using sine-Gordon equation on metric graphs.

Seismic activity in Central Asia

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Central Asia belongs to Mediterranean-Asia Seismic Belt. To have estimates for expected earthquakes probability one needs detailed analysis of eismic situation in the region that takes into account seismic sycles in Asian part of Mediterranean-Asia Seismic Belt. Since from 1998 Central Asia is on the seismically active phase which can go on until 2018.

In the study of seismicity in Central Asia region we used Interactive Catalogue of earthquakes which is based on SeisComP3 for processing seismic data from 38 seismic stations located in Uzbekistan neighboring countries.

For estimate of seismic activity of Central Asia region the analysis of the change of quantity of earthquakes in time by parameter Σ_N. Analysis of the seismic events flow in the region with M≥2.8 in the period 06.05.2015-23.03.2016 show fluctuation of parameter seismic background Σ_N with 2σ and 3σ deflections from longterm contour of seismic regime with occured 5 strong earthquakes with the magnitude M≥6.5: 1) Southeren Tsinzyuan (China), 03.07.2015, M=6.9, h=104km.; 2) Eastern Kashmir, 16.09.2015, M=6.5, h =250km.; 3) Hindukush, 26.10.2015, M=7.2, h=207km.; 4) Pamir, 07.12.2015, M_W=7.2, M_B=7.7; h=22km.; 5) Afghanistan-Tajikisan boundary, 25.12.2015, M=6.8, h=104km.

On the calculation of thermal strain state of reinforced concrete constructions in seismically active regions

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The study of temperature effects on the construction of buildings and structures in seismically active regions is very popular. An objective consideration of these two most important factors in the calculation and design of reinforced concrete structures is extremely necessary.
Therefore, based on studies and experiments we have developed a method of calculation of reinforced concrete structures, buildings and structures with the assessment and forecasting their reliability and durability.

Earthquake protection of architectural heritage buildings in Uzbekistan

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In the thesis of the report describes the methods of calculation of structures of architectural monuments on static and seismic impacts, as well as the results of VAT structures.

One of the problems of the theory of strength and seismic stability lies in the fact that seismic efforts, determined by different methods do not agree with each other, whereby the reliability of the calculations performed in the design of structures remains insufficiently understood. Accordingly, the task of ensuring the safety of buildings and structures during strong earthquakes is still far from a final decision and requires further research, especially various issues of seismic stability structures of instrumental methods.

The majority of the territory of our Republic refers to vasoactive seismic areas(7-9 points), where there are large cities.

The aim of the work is based on the calculation methods of architectural monuments for seismic effects using experimental and theoretical studies.

Monuments in most cases refers to the massive buildings, and their architectural-planning and constructive solutions otlichaetsya modern buildings. In addition, our ancestors in the design of monuments used geometric harmonization.

The walls were made of square bricks with usage of treasure mortar, which produced the jugs at the construction site. Square brick works on both the main Central axis of the same. The basis of the absorption of seismic free was the elasticity of the masonry material.

To study the strength, stability and seismic resistance constructions of various configurations in terms of applied computing complex "LIRA 9.6", based on the finite element method. Program complex LIRA allows you to consider many factors approximating model of a building or structure to more realistic conditions. The features provided by the results of calculation when displaying the stress-strain state of an object, allow for a detailed analysis of the data in the fields of displacements and stresses, the efforts and plots of deflections, in the mosaics of the destruction of the elements on the main and equivalent stresses and many other parameters.

The calculation results showed sufficient margin of safety designs of the mausoleum on the example of the Emir Hussein (major tensile stresses from its own weight -3,22 kg/cm2, and seismic - of 9.54 kg/cm2)when the calculated resistance of the masonry 11 kg/cm2. The most vulnerable areas were the junction of the main bearing wall of the dome structure and the Foundation.

The calculations were checked by hand and the difference is 8-10% (at a bodyweight of 3.5 kg/cm2, and seismic - of 10.54 kg/cm2).

Structural analysis and health assesment for heritage buildings Barakkhan, Kukaldash and Kaffol Soshi in Tashkent

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The report provides the results of complex studies of the structure of the monuments of Barakhan, Kukaldosh and mausoleum Kafal shashi. As a result of engineering surveys detected strain state of constructions of the research objects. A significant strain state of structures. The results of instrumental researches of the dynamic characteristics of the objects. Based on comprehensive studies will be developed by constructive measures on strengthening of designs of monuments.

Instrumental method for the evaluation of deformity and efficiency of structures strengthening of architectural monuments

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This paper presents the results of experimental research of dynamic characteristics of the monuments in the cities of Samarkand, Bukhara and Khiva.

Serial instrumental field studies of dynamic characteristics of historical monuments.

As a result of earthquakes and other influences in the buildings and structures show signs of damage and deformation to various extent. Therefore, there is a need to develop methods of assessing the degree of deformation and the efficiency of designs gain architectural monuments. Through the study of the natural values of the dynamic characteristics, as well as improvements to existing methods of experimental researches, development of new methods, experimental information about the properties of the structures, identify new properties which are impossible to detect and anticipate without instrumental methods of research is one of the urgent tasks of earthquake-resistant construction in General.

The horizontal stiffness of buildings of architectural monuments sufficiently reliably can be estimated by the results of field studies of periods of oscillations. In this case integrally takes into account all the factors (spatial work of the structure, the influence of the supporting structures, the effect of Foundation compliance, etc.), which are evaluated by calculation much more difficult.

Field sequential studies of dynamic characteristics of architectural monuments of Samarkand, Bukhara and Khiva and their analysis the degree of deforming structures of the monuments. It should be noted that the adopted method of instrumental study of the dynamic characteristics of the monuments like in terms and this formulation is applied for the first time. Measurements of amplitudes and periods of oscillations is performed using ultra-sensitive seismographs of the electrodynamics type ВЕГИК the oscillograph H-700, with a mirror galvanometer GW-III with a frequency of 5 Hz.

As a result of the analysis of the received waveform to estimate in situ values for the period of oscillation, mode shape and etc.

Monitoring instrument study of dynamic characteristics and their analysis will allow estimating the degree of deformation and effectiveness of the applied structural measures to strengthen.