

Proceedings of the Csonka Pál Doctoral School

TÓTH KRISZTINA: Geometric sensitivity of statically determinate planar truss families. PERIODICA POLYTECHNICA-ARCHITECTURE 2: (2011)

Abstract

It is well-known, that the planned geometry and the realized geometry of a structure slightly differ from each other due to minor manufacturing or constructional inaccuracies: for example in the case of trusses a joint's location may change. In order to characterize, how sensitive a truss is to such joint imperfections (i.e. averagely in how many percent of the bars will the barforces change due to a joint's perturbation), we introduced earlier the concept of geometric sensitivity index $0 \leq r^g \leq 1$ of individual trusses. We define a statically determinate truss family T_i by a statically determinate truss T_0 and a recursive step $T_{i+1}=f(T_i)$, such that step $f(T_i)$ is a truss-generating algorithm, that keeps static determinacy. Such recursive algorithms have been broadly discussed in the literature, e.g. the Henneberg operation 1 is a well-known example. Here we investigate the sensitivity of truss families, in particular, the limit sensitivity $\lim_{i \rightarrow \infty} r^g(T_i)$ (as the number of the recursive steps tends to the infinity).

TIBOR JORDÁN, GÁBOR DOMOKOS AND KRISZTINA TÓTH: Geometric Sensitivity of Rigid Graphs. SIAM JOURNAL ON DISCRETE MATHEMATICS

Abstract

Let (G, p) be a minimally infinitesimally rigid d -dimensional bar-and-joint framework and let L be an equilibrium load on p . The load can be resolved by appropriate stresses (normal forces) in the bars of the framework. Our goal is to identify the following parts (zones) of the framework:

(i) When the location of an unloaded joint v is perturbed, and the same load is applied, the stress (and the normal force) will change in some of the bars. We call the set of these bars the influenced zone of v .

(ii) Let S be a designated set of joints and suppose that each joint with a nonzero load belongs to S . The active zone of S is the set of those bars in which the stress, which resolves L , is nonzero.

We prove that if (G, p) is generic, then for almost all loads these zones depend only on the graph G of the framework. These results are extended to arbitrary infinitesimally rigid generic frameworks. We also show that for $d = 2$ these zones can be computed by efficient combinatorial methods.

Bernát Csuka, László P Kollár Fiber-reinforced plastic-confined rectangular columns subjected to axial loading. JOURNAL OF REINFORCED PLASTICS AND COMPOSITES 31:(7) pp. 481-493. (2012)

In this article, a model recently published by the authors is applied for the calculation of the axial resistance of centrally loaded fiber-reinforced plastic-confined rectangular concrete columns. The calculated results of our model agree well with the experimental data found in the literature. It is shown that the stiffness of the confinement has a much stronger effect on the strength than for the case of circular cross sections. Based on the numerical results, a simplified model is introduced which can be used in engineering practice.

Bernát Csuka, László P Kollár FRP confined circular columns subjected to eccentric loading. JOURNAL OF REINFORCED PLASTICS AND COMPOSITES 30:(14) pp. 1167-1178. (2011)

In this article, a new model for eccentrically loaded FRP-confined circular concrete columns is presented. The cross-section is built up by 2D finite elements (where the variation of the stresses and strains is 3D), and the concrete modeled by a confinement-sensitive (non-associated) material law.

The numerical solution of this model showed agreement with the experimental results available in the literature. It is shown that the maximum axial stresses in the cross-section – despite of the big differences in the radial- and hoop confinement stresses – are about the same for concentric and eccentric loadings. It is also shown that the recommended stress–strain curves available in the literature may lead to non-conservative results for eccentric loading, and – based on our numerical calculations – new stress–strain curves are recommended.

Domokos G, Lángi Zs, Szabó T: On the equilibria of finely discretized curves and surfaces. MONATSHEFTE FÜR MATHEMATIK 168:(3) pp. 321-345. (2012)

<http://link.springer.com/article/10.1007%2Fs00605-011-0361-x>

Our goal is to identify the type and number of static equilibrium points of solids arising from fine, equidistant n -discretizations of smooth, convex surfaces. We assume uniform gravity and a frictionless, horizontal, planar support. We show that as n approaches infinity these numbers fluctuate around specific values which we call the imaginary equilibrium indices associated with the approximated smooth surface. We derive simple formulae for these numbers in terms of the principal curvatures and the radial distances of the equilibrium points of the solid from its center of gravity. Our results are illustrated on a discretized ellipsoid and match well the observations on natural pebble surfaces.

Szabo T, Domokos G, Sipos A: Rocking Stones – Equilibrium Points through the Magnifying Glass. In: Marschallinger R, Zobl F (szerk.) Proceedings of IAMG 2011, the Annual Conference of the International Association for Mathematical Geosciences. Salzburg, Austria, 2011.09.05-2011.09.09. pp. 688-693.

http://www.cogeo.at/publications/iamg2011/IAMG2011_proceedings/mobile/files/assets/seo/page689.html

Rocking stones (i.e. large stones that are balanced in counter-intuitive positions) have not only interested geologists but also were associated with a wide variety of beliefs in the past. In this paper we give a simple mechanical explanation for the existence of rocking stones. We show that on many-faceted polyhedral surfaces e.g. on the convex hulls of rocks and pebbles, we can observe many micro-equilibria. Based on high-precision 3D scans of pebbles we identify these micro-equilibria and show that rocking stones correspond to a rare and therefore counter-intuitive equilibrium-position when the rock is balanced on a stable micro-equilibrium which is located at an unexpected part of the surface.

Szabó T, Fityus S, Domokos G: Pebble abrasion in the Williams River, Australia. In: Janina Horváth , Andrea Wágenhoffer , János Geiger, Marko Cvetković , Tomislav Malvić (szerk.) Proceedings, XVI. Congress of Hungarian Geomathematics and the V. Croatian-Hungarian Geomathematical Conference. Hungary, 2013.05.30-2013.06.01. pp. 1-4. Paper 21. ISBN: 978-963-8221-49-0

A controversial question in fluvial geomorphology is connected to the size diminution of pebbles observed along numerous recent gravel-bed rivers, a phenomenon called downstream fining (Ferguson et al., 1996). That phenomenon has been attributed to two main processes: abrasion and size-selective transport of clasts. We collected basalt particles along a 100 km reach of the Williams River, New South Wales, Australia and measured their size and shape. Compared to some other natural streams, the small downstream fining rate observed in the river indicates that abrasion may play a key role. In addition, we demonstrate that pebbles get flatter and thinner due to abrasion along the river, also, so-called aquafacts, i.e. pebbles with sharp edges and planar faces emerge in the downstream reaches.

T Szabó, S Fityus, G Domokos: Abrasion model of downstream changes in grain shape and size along the Williams River, Australia. JOURNAL OF GEOPHYSICAL RESEARCH: EARTH SURFACE, VOL. 118(4), 2059–2071, doi:10.1002/jgrf.20142, 2013

<http://onlinelibrary.wiley.com/doi/10.1002/jgrf.20142/abstract>

Modeling pebble abrasion during bed load transport is of fundamental importance in fluvial geomorphology, as it may help to understand downstream fining patterns along gravel bed rivers. Here we review a recently published analytical abrasion model called box equations, which can simultaneously track the shape and size evolution of large pebble populations as the cumulative effect of binary collisions between particles. The model predicts that pebble shapes move away from the sphere and develop sharp edges due to collisional abrasion by sand. We present a field study on the downstream evolution of basalt particle shape and size along the Williams River in the Hunter Valley, Australia. Pebbles get flatter and thinner, and several aquafacts (i.e., abraded pebbles with sharp edges) emerge in the downstream reaches, both suggesting the importance of abrasion by sand. Applying box equations with a few fitted parameters, we present a numerical simulation which reproduces both the shape and size evolution of pebbles along the Williams River. The simulation allows tracking of the shape and size evolution of individual particles as well, revealing an interesting phenomenon that particle size controls shape evolution. Box equations, in combination with existing transport concepts, provide a framework for future shape and size evolution studies in sedimentary environments. In particular, they may help to assess the relative importance of size selective transport versus abrasion in causing downstream fining in gravel bed rivers.

Baku Eszter, Vető Dániel: Centralized Spaces in Hungarian Church Architecture between the World Wars: Historical and Structural Survey of the Dome of Ottokár Prohászka Memorial Church. PERIODICA POLYTECHNICA-CIVIL ENGINEERING 57:(2) pp. 211-222. (2013)

Abstract

Architectural research, focusing on Hungarian architecture in the inter-war period so far, have mainly analysed buildings and architects regarding the international modern architecture and the path leading to development of modern Hungarian architecture. The present article undertakes complex research on an emblematic, but less discussed building of the era with the related competition, the sacral buildings with similar structure and space arrangement. The social and art historical research is supplemented with the analysis of the behaviour of the structure and the circumstances of the construction. Besides investigating the era of the construction of the church, a brief description of the planning competition is presented with archetypes of the architectural history and the structures, also showing the construction process. The description is complemented with the results of the examination on the spot and the reconstruction of the presumable original statics calculation.

Józsa Anna Ildikó: The beginnings of public theatre architecture in Hungary in the age of Enlightenment. POLLACK PERIODICA Vol.8:(No.2) pp. 1-14. (2013)

The theatres investigated in this paper represent a particular building type in Hungary in the 18th-19th century, and make it possible to detect the impact of Western European public theatre architecture solutions. It was the time the social organiser role of theatre was just about to emerge in Hungary. Departing from the religious culture and tradition of the Baroque, the theatres followed the way of thinking of Enlightenment. The historical fact namely that the Habsburg political and related German-language dominance became more and more influential in cultural life and theatres, attenuated in the middle of the 18th century, only, when Hungarian-language public theatre became strong enough to enable the construction of the first permanent Hungarian-speaking theatre building, located at Pest-Buda.

For the very first theatre called Rondella an existing round bastion was used, instead of constructing a brand new theatre building. While it shows rather modest quality, the second significant theatre Castle Theatre, though following the same principle, met much higher social and cultural demands. The most considerably theatre of that time was the German Theatre of Pest, reaching the Western European theatre architecture standard. Further cultural centres of contemporary Hungary such as Pressburg, Kassa, Kolozsvár were characterized by theatre buildings with simple architectural design. They all used traditional Baroque stage technology but did not apply illusionary structures. As demand for representation was low, no attention was paid to access and service areas and to decorate the foyer. The exterior was in general dominated by Classicism, with some late Baroque elements appearing at places.

The research will continue to look at the typical theatres of the 19th and 20th centuries, such as summer theatre and people's opera buildings. The actual relevance of the research is linked to the expected near future renovation of Erkel Theatre in Budapest, as a remarkable example of people's opera house.

Haba Péter, Simon Mariann: A Difficult Person for Socialism: Elemér Zalotay and his strip building. In: Ines Weizmann szerk.: Architecture and the Paradox of Dissidence. Routledge – Abingdon, Oxford 2013. 45-58.

In 1958 the Ministry of Building Affairs launched a program on development in building technology for public housing in Hungary. Though without an official commission, architect Elemér Zalotay began to work on a project in the spirit of 'techno-utopia'. He proposed a residential construction based on so-called 'strip buildings' as residential blocks: units with a flexible structure, about two miles long and thirty to fifty storeys high, surrounded by forests. His departure was Le Corbusier's Unité d'Habitation as far as the strip building also contained residential, service and communal facilities, however in size and especially in structure it was radically different. Together with a structural engineer they developed an extremely lightweight, special supporting structure to which residential boxes could be attached. As Zalotay said, "the objective was to create a system uniting collective living and a kind of separate home that is organically interlinked with nature". The concept followed the ideal of socialism on collectivism, and according to the calculations it was cheaper than the traditional even standardised housing systems. However the building authorities didn't support the experiment: by 1960 the question had been decided that the planned one million flats by 1975 should be constructed from large slab panels. Zalotay had been fighting for his ideas for years and took every opportunity to both disseminate his proposal and convince the authorities, so finally he left Hungary in the 1970s.

The radical dissidence inherent in the strip building concept inspired many prominent representatives of Hungarian intellectual life to express their opinions and thus invited response from the official organisations. The paper analyses the 'strip building debate' as a model for confrontation between socially driven architectural techno-utopia and rigid system of socialist state. The considerably ramifying debate involving sharp attacks became an important part of the wide ranging architectural discourse that analysed the new relationship that existed between the significant change in lifestyle experienced by several strata of society in the Kádár era and the built environment. By the middle of 1960s Zalotay became the symbol of the 'difficult person' in socialism. The experimental block was never built, so it still remains secret if it had worked or not, if it had been as cheap as promised, or not. In the last decade Zalotay's name occurred in the Hungarian architectural circles, articles and interviews were launched and an exhibition was also arranged from his designs. He became a legend like many of his contemporaries – Constant, Yona Friedman or the Archigram group – we hardly keep up with the show of exhibitions and monographs. The reinvention of Zalotay fits well into the international trend. The dissident project of the strip building doesn't have any reality and doesn't mean political challenge now, so it doesn't threaten either professional practice or political will. Zalotay represents an architectural attitude, the lonely hero – and the fading memories of socially engaged architecture.

Haba Péter: Expression of energy. The architecture of power stations in Hungary between 1945 and 1970 Part I. PERIODICA POLYTECHNICA ARCHITECTURE 43:(1) pp. 17-32 (2012)

Abstract

The study in two parts discusses the architectural characteristics of power stations built in Hungary from 1945 to 1970, reviewing the period's social, architectural and technological background, as well as those factors that exerted an influence on power station architecture in these 25 years. The study points out that despite the dominance of technological systems in the case of this building type, Hungarian architects were able to create autonomous designs by their various interpretations of monumentality as a unique aesthetic quality. The first part of the study focuses on the processes that took place in the Rákosi era (1948-1956). It mainly explores the interplay between the structural and formal characteristics resulting from on-site concrete precasting, the technological demands imposed by the electricity industry and the stylistic expectations of socialist realist ideology, and shows how this led to a kind of classicizing monumentality that also manifested in the area of engineering.

Haba Péter: Expression of energy. The architecture of power stations in Hungary between 1945 and 1970 Part II. PERIODICA POLYTECHNICA ARCHITECTURE 43:(2) pp. 57-75. (2012)

Abstract

Part I of this study reviewed the architecture of power stations in Hungary in the period from 1945 to 1955. The introductory sections gave a summary of the architectural and technological background to power station design in the quarter of a decade that followed World War II. Through the analysis of power stations in Inota, Dunaújváros, Kazincbarcika and Tiszapalkonya, the first part highlighted the interplay between the structural and formal characteristics resulting from on-site concrete precasting – which defined industrial architecture in Hungary in the Rákosi era –, the technological requirements imposed by the electricity industry and the stylistic expectations of socialist realist ideology that led to a kind of classicizing monumentality, which also manifested in the area of engineering. The second part of the study discusses the developments from the mid-1950s to around 1970. From a structural, technological and aesthetic point of view, these fifteen or so years can be divided into two periods. The first and shorter one, lasting up to 1960, was characterised by new solutions linked to a change of direction in structural innovation and to the fresh ambitions of Hungarian architecture that returned to modernism. This stage represents a type of transition between the period of 1949-1955 and the 1960s, burdened by serious architectural problems created by the so-called open-air technological systems.

Simon Mariann, Haba Péter: A Difficult Person for Socialism – Legend for Today. Elemér Zalotay and his strip building for 70.000. 'Architecture and the Paradox of Dissidence' – The 9th International Architectural Humanities Research Association International Conference, London Metropolitan University, 2012. november 15-17.

In 1958 the Ministry of Building Affairs launched a program on development in building technology for public housing in Hungary. Though without an official commission, architect Elemér Zalotay began to work on a project in the spirit of 'techno-utopia'. He proposed a residential construction based on so-called 'strip buildings' as residential blocks: units with a flexible structure, about two miles long and thirty to fifty storeys high, surrounded by forests. His departure was Le Corbusier's Unité d'Habitation as far as the strip building also contained residential, service and communal facilities, however in size and especially in structure it was radically different. Together with a structural engineer they developed an extremely lightweight, special supporting structure to which residential boxes could be attached. As Zalotay said, "the objective was to create a system uniting collective living and a kind of separate home that is organically interlinked with nature". The concept followed the ideal of socialism on collectivism, and according to the calculations it was cheaper than the

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Kóródy Anna: Legacy and Revival – Reinterpretation of Tradition in Contemporary Spanish Churches. Fialat Kutatók és Doktoranduszok III. Nemzetközi Teológuskonferenciája, Károli Gáspár Református Egyetem Hittudományi Kar, Budapest, 2012.11.02-04. (2012)

The research is focusing on the contemporary role of sacral spaces in Spain where a great number of newly built high-quality projects point out the main tendencies of the utilization of church spaces. The three significant streams are the creation, the reformation and the transformation of sacral spaces depending on the needs of the local community: creation of new churches for new suburbs, reformation of former facilities for developing dioceses, and transformation into other functions where the church as religious space was no longer needed. Three examples from all categories illustrate the tendencies and with their help the transcription of tradition is observable: what kind of ways the designers found to maintain the historic continuity besides serving the contemporary social, technical and aesthetic demands.

Kóródy Anna: Új kulturális közösségi terek - városi ipari területek rehabilitációja Spanyolországban. In: Fazekas István, Szabó Valéria (szerk.) A környezettudatos települések felé. Debrecen, Hungary, 2012.11.22-2012.11.23. Debrecen: pp. 166-172.(ISBN: 978-963-08-5294-4)

The paper is focusing on contemporary utilization of abandoned industrial spaces in Spain. The respect for historical industrial heritage is originated in the 1980s when declining of heavy industry resulted in problems in industrial cities like Bilbao or Barcelona. The protection and further utilization of these factories and buildings is important not just from an economical point of view but also for social-psychological reasons. They are important for the identity of the community living in the neighborhood so cultural use is one of the most efficient solutions. The paper is presenting some of the most successful Spanish interventions of the last decade, for example the Matadero in Madrid, a developing cultural complex in the heart of the capital.

Kóródy Anna, Vukoszávlyev Zorán: Modernism Today.: The Fate of Modernist Buildings Mirroring the Changes of Social Demands. In: Timo Tuomi (szerk.) The Survival of Modern: From Coffee Cup to Plan. Espoo, Finland, 2012.08.07-2012.08.10. p. 105. Paper 1773. (ISBN: 978-952-93-0935-1)

The paper concerns the history of the modernist buildings compared to the changes of social demands. The appearance of the “international style” was everywhere connected to the educated elite class; however, the character of the realized works was strongly related to the financial - economical background. The peculiarity of the Central European modernism is based on the contradiction between new forms and floor plans following the trend and the traditional materials and structures. The demands and changes of the society are recognizable in the contemporary use and transformation of modern buildings.