TEORIJA IN PRAKSA UREJANJA PROSTORA

IGRA USTVARJALNOSTI

THE CREATIVITY GAME

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THEORY AND PRACTICE OF SPATIAL PLANNING

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UVODNIK

EDITORIAL

Alenka Fikfak, Alma Zavodnik Lamovšek
»NOVA« ŠTEVILKA

»NEW« ISSUE

Uvodni nagovori k novim številkam revij - znanstvenih, strokovnih ali poljudnih - se običajno začnejo: »Pred nami je nova številka revije …«. Tudi revija Igra ustvarjalnosti kot »nova številka« ponuja nekaj zanimivosti, še vedno pa sledi nagovoru »ustvarjalnosti in inovacij« kot modelu raziskovanja na vseh poljih prostorskega delovanja. Številka z letnico 2017, 5. številka, se ne osredotoča na posebno tematiko, čeprav je bila sprva zastavljena kot številka z usmeritvijo v prispevke, namenjene raziskovanju »naravnega in grajenega okolja – vloge ekoloških kazalnikov«. Pri pripravi te številke smo se znova srečali s problemom objavljanja, ki je danes obremenjeno - prej kot z željo po odkrivanju novosti in raziskovanju, ki spodbuja miselno ali ročno kreativnost -, z nabiranjem točk, objav in meril za doseganje numerično in znanstveno preverljivih ciljev točkovanj, ki so osnova skoraj vsakega raziskovalnega okolja. Igra ustvarjalnosti želi slediti odkrivanju inovacij, ki se zgodijo v prepletu dela med akademskim in pedagoškim znanjem. Zato je tudi številka pred nami raznolika, pestra in pokriva široko polje prostorskega raziskovanja.

Številki namenjamo dva posebna uvodnika, ki pojasnjujeta kreativnost s teh dveh vidikov razvoja, torej v teoriji in praksi. Luka Skansi opisuje igrivost kot srečanje zunanjega motiva in njen vpliv na domišljijo arhitektov. Kot sam pravi, so »podoba, slika ali izkustveni prostor, urbani kompleks« pogojevali življenje arhitekta, kot »srečanje«, ki je vzgib prelomnice v kulturi osebnosti. Urednici imava takšno izkušnjo še iz časov študentskih let. »Delavnica Žetale« je namreč vplivala na vse najino kasnejše snovanje in ustvarjanje. Enotedenski odmik od fakultete je v študijskem obdobju pomenil poseben odnos do raziskovanja prostorskih značilnosti. V spominu nama je predvsem ostalo delo na maketi tik pred zaključno predstavitvijo. Naselje Žetale, v 90. letih odmaknjeno od vseh trgovskih centrov in večjih središč, brez fotokopirnic, sodobnih 3D tiskalnikov, kapa plošč, barvnih paspartujev, barv, sprejev in podobnega, samo domišljija, lokalni material in roke. Domišljija je sledila ideji, kako predstaviti model hiše po načelih prepletanja tradicionalnih elementov v sodobno kompozicijo. Lokalni materiali so se razvili ob ideji izdelave makete. Roke vseh udeležencev pa

Editorials to new issues of journals, whether scientific, professional, or popular publications, typically start off by saying: "We are pleased to announce that the new issue of ..." The "new issue" of Creativity Game offers interesting subject matter, still mostly addressing "creativity and innovation" as a model of exploration in all fields of spatial activity. This 5th issue, volume 2017, does not focus on any specific topics, even though it was initially dedicated to exploring "the natural and built environment – the role of ecological indicators". When preparing this issue, we once again encountered the problem of scholarly publishing, which rather than with the desire to discover new things, to research, and to encourage creativity of the mind and hands, it is burdened by collecting points, publications, and meeting the criteria for achieving quantifiable goals of scoring, underlying almost each research environment. This journal is trying to pursue the discovery of innovations that occur as an interplay of academic and educational knowledge. The issue in front of us is therefore diverse and covers a wide field of spatial research.

This issue features two Editorials explaining creativity from the two aspects of development, in theory and practice. Luka Skansi describes creativity as the encounter of an external motif and its impact on architects' imagination. According to him, "the image, picture, experiential space, the urban complex" conditioned the life of the architect, as an "encounter", triggering a crossroads in the culture of personality. The Žetale workshop was such a crossroads for us, both editors-in-chief, which affected all our further endeavours. Spending a week away from the faculty during our study period meant we could build a special relationship to studying spatial characteristics. Our work on the model right before the final presentation is particularly memorable. In the 1990s, the Žetale settlement was located far away from commercial centres and major towns, there were no print shops, state-of-the-art 3D printers, foam boards, coloured passepartouts, paints, sprays – all that remained was creativity, local materials, and our hands. Creativity followed the idea of how to present the model of a house using the principles of mixing the traditional elements into a modern composition. Local materials were developed along with the idea of constructing a model. The hands of everyone involved provided the only

so bile edini »3D tiskalnik« v dani situaciji. Maketa, ki je nastala kot tradicionalni model participacije javnosti, z vsemi vključenimi ekološkimi kriteriji. Kako? Hrib smo ustvarili z drvmi, ki so lokalni material, teren pa je nastal s pomočjo pridnih kuharic OŠ Žetale, iz testa za kruh. Lahko bi našteli še več drugih »ekoloških meril«, ki smo jih nezavedno vpletli. A pomembno je, da smo sledili igri in motivu ustvarjanja nečesa skupnega, za ljudi in z ljudmi, ki so verjeli v našo domišljijo. Ta delavnica je najin osebni nagovor usmerila v vključevanje »igrivosti in ustvarjalnosti« v vsakdanje pedagoško delo.

Drugi uvodnik pa to misel nadaljuje v sodobno izvedbo – japonski paviljon, ki ga predstavljata Tadej Glažar in Vid de Gleria. Tovrstnega dela ne moremo nadomestiti z obsežno literaturo, le praksa nam pojasni razumevanje in prikaže svet domišljije v novi luči. Čudovit izdelek, ki bo nedvomno pustil za vsa naslednja leta vsem, ki so sodelovali pri razvoju modela, neponovljivo zgodbo znanja in izkušnje poetike prostora. To so prelomnice, ki se z združenimi močmi razvijejo v neponovljivo zgodbo in spodbudijo željo po še naslednji, novi izkušnji. V duhu igre ustvarjalnosti. In v duhu raziskovanja ekologije naravnega in grajenega okolja.

Uvodnikoma sledijo prispevki različnih avtorjev, ki v svoji zgodbi raziskovanja prav tako odkrivajo drobce osebnosti, znanja in novega pogleda na prostorske razsežnosti. Sledijo predstavitve delavnic in raziskovalnih projektov.

Želiva vam prijetno branje in raziskovanje ekoloških meril v raznolikih prikazih te številke.

izr. prof. dr. **Alenka Fikfak**
doc. dr. **Alma Zavodnik Lamovšek**
glavni urednici revije IU

3D printer. The model was produced as a traditional model of public participation, by considering all ecological criteria. And how did we do it? The hill was created from locally available wood logs, while the terrain was made with the helping hands of the cooks from the Žetale primary school – from bread dough. We could list many other "ecological criteria", which we subconsciously used. What really matters is that we followed the game and motive to create something together, for people and with people who believed in our creativity. This workshop directed our personal stance towards including "games and creativity" into everyday educational activities.

The second Editorial takes this thought further, as a contemporary manifestation of it – the Japanese Pavilion as presented by Tadej Glažar and Vid de Gleria. This kind of work cannot be replaced by extensive literature review, only practice can deepen understanding and show the world of imagination in a new light. This wonderful product will be remembered as a unique story of knowledge and experience of poetics of space for everyone who took part in developing the model. Such milestones evolve, as a joint effort, into unique stories and encourage the desire for the next, new experience. In the spirit of a creativity game. And in the spirit of exploring the ecology of the natural and built environment.

The Editorials are followed by papers by various authors who discover, through their own exploration of stories, various bits of personality, knowledge, and new perspectives on spatial dimensions. This is followed by presentations of workshops and research projects.

We wish you a pleasant reading and exploration of ecological criteria, as they are diversely represented in this issue.

Assoc. Prof. **Alenka Fikfak**, PhD
Assist. Prof. **Alma Zavodnik Lamovšek**, PhD
Editors-in-chief

Luka Skansi

OPOMBE O IGRIVOSTI

NOTES ON PLAYFULNESS

Zelo veliko je fascinantnih primerov iz zgodovine arhitekture, v katerih so obisk neke arhitekture oziroma vizija specifične skice, fotografije ali slike odločilno vplivali na domišljijo arhitektov. Pogosto se je to dogajalo v posebnih trenutkih življenja neke pomembne osebnosti, v študijskem obdobju ali v času prvih profesionalnih korakov arhitekta. Videna podoba, slika ali izkustveni prostor oziroma urbani kompleks so pogojevali, neposredno ali posredno, življenje arhitekta in nadaljnji razvoj arhitektovega okusa, senzibilnosti ali naklonjenosti. Tega »srečanja« ne smemo dojemati le kot enostavne, trenutne, vizualne hevreke, torej kot vzklik navdiha, temveč kot neko vrsto prelomnice, ki se usede v arhitektovi kulturi v nekem že ustaljenem procesu oblikovanja principov in ki se racionalizira šele po določenem času in znotraj določenega zgodovinskega prostora.

Vsak od nas lahko našteje svoja poznanstva in primere, ki jih je srečal v svojih raziskovanjih, in o teh lahko ustvari svoj nauk oziroma interpretacijo tega pojava. Peter Behrens je imel, na primer, na enem svojih prvih potovanj v Italijo možnost obiskati cerkev San Miniato al Monte v Firencah, dragulj toskanske romanske arhitekture. Šele vizija te arhitekture, spoznanje tektonskih odnosov med marmornimi površinami in konstrukcijo, zaporedja različnih notranjih prostorov in parietalne dekoracije, ki vrhunec doseže v čarobni apsidi z okni iz alabastra, v njem – scenografu, umetniku in oblikovalcu – porodi občutljivost do tridimenzionalnega potenciala arhitekture in do njene »fakture«, in sicer tem, ki bodo zaznamovale njegovo kasnejšo poklicno pot. Obenem se lahko neskončnokrat sklicujemo na pomembnost italijanskih potovanj za dozorevanje mladega Le Corbusierja, še posebej na njegova doživetja klasične arhitekture: v tem smislu so izredno zanimive njegove skice in fotografije antične rimske arhitekture (še posebej Pompejev in Hadrijanove vile (Villa Adriana)) in mestne morfologije oziroma členjenja javnih prostorov zgodovinskih mest (npr. Trga svetega Marka v Benetkah). Avantgardni prostori tega švicarskega arhitekta, ki jih je razvijal od sredine 20. let prejšnjega stoletja

There are many fascinating cases from the history of architecture when getting to know a certain architecture or the vision of a specific sketch, photograph, or image had a profound influence on an architect's imagination. This typically happened at a special time in the life of an important figure, during their studies or during their first steps as an architect. An image seen, a picture taken, or an experiential place or an urban complex influenced, directly or indirectly, the lives of architects and the development of their taste, sensibility, or affinity. These "encounters" should not be perceived as a simple, instantaneous, visual eureka, as a burst of inspiration, but rather as a crossroads in the architect's culture, in an already established process of formation of principles, which is rationalised only after a certain period, within a certain historical space.

Anyone can list such cases encountered during their explorations, where a lesson was learnt, or a phenomenon was interpreted. On one of his early travels to Italy, Peter Behrens visited the San Miniato al Monte church in Firenze, a gem of Tuscan Romanesque architecture. Only after seeing this architecture and learning about the tectonic relationships between the marble surfaces and the structure, sequences of interiors and parietal decoration, reaching its pinnacle in the magical apse with alabaster windows, did he – a set designer, artist, and designer – start to develop sensitivity towards the three-dimensional potential of architecture and its "composition", which will leave a mark on his future professional career. There are endless references to the significance of visits to Italy for the young Le Corbusier, particularly his encounters with classical architecture, e.g. his sketches and photographs of Ancient Roman architecture (particularly Pompeii and Villa Adriana), urban morphology, and articulation of public spaces of historical cities (e.g. the St Mark's Square in Venice). The avantgarde spaces of this Swiss architect, who developed them from the mid-1920s onwards in his villas, urban complexes, and public buildings are none other than the result – albeit in different scales and articulation – of the same tools as those used by Ancient Roman architects: complexity of sequen-

v svojih vilah, urbanističnih kompleksih in javnih zgradbah, niso nič drugega kot rezultat – seveda v drugih merilih in z drugimi arhitekturnimi izrazi – istih orodij, ki so jih uporabljali antični arhitekti: kompleksnost zaporedij, policentričnost in politematskost prostorov, projektiranje z različnimi plani, uporaba sence oziroma kontrasta med osvetljenimi in osenčenimi površinami.

Če se kronološko približujemo današnjim časom, se lahko spomnimo strasti, ki jo je Peter Eisenman v 60. letih razvil do velikega italijanskega modernega arhitekta Giuseppeja Terragnija. Eisenman je imel v svojem popotovanju po Italiji, še kot študent Colina Rowea, priložnost obiskati znamenito Casa del Fascio v Comu, kjer je bral, s svojimi merili in navdihi, kompleksni tridimenzionalni skelet, ki ga je uprizoril Terragni, kot svojevrstno taksonomijo odnosov med arhitekturnimi elementi, površinami in prostori. To branje ga je usmerilo v eksperimentalno projektiranju serije hiš *Houses of Cards* v 70. letih in realizacije štirih, med katerimi je najbolj vredno omeniti *House II* v Vermontu.

Šele v zadnjem obdobju univerzitetnega izobraževanja sem imel priložnost na beneškem IUAV-u spoznati Alda van Eycka, Alison Smithson in Petra Smithsona in na sploh raziskovati t. i. Team X. V vsekakor navdihujočem, ampak zelo malo igrivem vzdušju šole, ki je v teh zgodnjih 90. letih še vedno delno narekovala mednarodno arhitekturno teorijo, enostavno ni bilo prostora za inovativne in ustvarjalne projektne metode 60. let. Monumentalnost arhitekturnih potez in urbanističnih tipologij Alda Rossija, doslednost projektiranja na velikem merilu Vittoria Gregottija ali rigoroznost zgodovinskih in teoretičnih poukov, ki sta jo razvijala Manfredo Tafuri in Francesco Dal Co, so s svojo sublimno logičnostjo dominirali prenos znanja študentom o arhitekturi. Vse, kar je bilo rezultat razmišljanja, kar je bilo podprto s teoretično analizo in refleksijo, vse, kar se je naslanjalo na arhitekturne ali literarne izvore, je bilo videno in ocenjeno kot »dobra arhitektura«. Nikoli ni bilo dovolj prostora namenjenega improvizaciji, za osebni okus, za navdih. Odvračala so se Holleinova misel »Alles ist Architektur«, De Carlovi prostorski labirinti, vsaka oblika neoutopije (od Superstudia do Archizooma in Archigrama) in tudi – pod kar se vsekakor lahko še danes podpišemo – sovražila se je vsaka jezična banalizacija arhitekture, v tistih katastrofalnih časih postmodernističnih tendenc, ki ga je sprožil Portoghesijev bienale.

Dolgo časa sem mislil, pod ideološkim vplivom svoje šole, da arhitektura ne sme biti igriva. Potem sem med svojim raziskovalnim romanjem po nizozemski arhitekturi spoznal igrišča Alda van Eycka. Več sto igrišč za otroke, izgrajenih med letom 1947 in poznimi 60. leti, je preplavilo Amsterdam, in tako na enostaven način zapolnilo luknje, ki so nastale po razdejanju nizozemskih pristanišč med drugo svetovno vojno. Daleč od prevzetosti nad kakovostjo posameznih posegov je najbolj zanimiv vidik te urbanistične pobude predstavljala ideja, da je bilo celotno mesto mišljeno kot prostor za igro, kot ena sama obsežna in razvejena mreža, ki povezuje točke, ki so ustvarjene za otroško raziskovanje in odkrivanje.

Čeprav so danes ta igrišča večinoma izginila in pozabljena, se v zgodovinskem in teoretičnem smislu nanje še vedno gleda kot na enega od

ces, polycentricism and polythematics of spaces, use of various plans, use of shadow or contrast between illuminated and shaded surfaces.

Coming nearer to the present day, we can remember the passion that Peter Eisenman in the 1960s developed towards the great Italian modernist architect Giuseppe Terragni. In his Italian travels, Eisenman, then a student of Colin Rowe, had the opportunity to visit the famous Casa del Fascio in Como, where he studied, with his own criteria and inspirations, the complex three-dimensional skeleton staged by Terragni, as a unique taxonomy of relationships between architectural elements, surfaces, and spaces. This analytical reading led him to experimental design of a series of *Houses of Cards* in the 1970s, though only four were actually completed; particularly worth mentioning is House II in Vermont.

I had the opportunity to get to know Aldo van Eyck and Alison and Peter Smithson, and study Team X in general, only during the final period of my university studies at the Venice IUAV. In the school's clearly inspiring, but not very playful, atmosphere, which in the early 1990s still partially dictated international architectural theory, there simply was no room for innovative and creative design methods from the 1960s. The monumentality of architectural articulation and urban typologies by Aldo Rossi, the consistency of grand-scale design by Vittorio Gregotti, or rigorous historical and theoretical lessons developed by Manfredo Tafuri and Francesco Dal Co dominated with their sublime logic the transfer of knowledge to the students of architecture. Everything that was the result of thinking, supported by theoretical analysis and reflection, everything that touched upon architectural and literary origins, was considered and estimated as "good architecture". There was never enough room for improvisation, personal taste, or inspiration. Hollein's Alles ist Architektur, De Carlo's spatial labyrinths, and any type of Neotopia (from Superstudio to Archizoom and Archigram) were rejected, and – which we still agree with today – any kind of linguistic trivialising of architecture was shunned, as triggered by the Portoghesi biennale during the catastrophic times of postmodernist tendencies.

For a long time I thought, under the ideological influence of my school, that architecture cannot be playful. Then, during an explorative pilgrimage of Dutch architecture, I got to learn about Aldo van Eyck's playgrounds. Several hundreds of playgrounds for children, built between 1947 and the late 1960s, were built throughout Amsterdam and thus in a simple way filled the gaps that occurred after the devastation of Dutch ports during World War II. Apart from being fascinated by the quality of individual developments, the most interesting aspect of this urban design initiative was the idea to develop the whole city as a play area, as one large, branched-out network connecting points, which are created for a child's exploration and discovery.

Even though these playgrounds have now mostly disappeared and are forgotten, in the historical and theoretical sense they are still understood as one of the key paradigmatic projects of the 20th century urban planning. Van Eyck's initiative is a symbolic shift from modernist methodologies of integrated planning, used by architects to spatially determine practically each segment of human lives – an ideal which was part of my formative years at IUAV. My encounter with black and white photography, documenting this vast number of various playgrounds, played in this sense – in terms of my

ključnih, paradigmatskih projektov v urbanističnem planiranju 20. stoletja. Van Eyckova pobuda predstavlja simbolični premik od modernističnih metodologij integralnega načrtovanja, s katerimi so arhitekti prostorsko determinirali praktično vsak segment človekovega življenja – ideal, s katerim sem deloma tudi sam odrastel na beneški šoli. Moje srečanje s črno-belimi fotografijami, ki dokumentirajo to ogromno število med seboj različnih igrišč, je bilo v tem smislu, za oblikovanje moje osebnosti, za moje razumevanje arhitekturnega in urbanističnega projekta, odločilno: otroci nasmejani skačejo po gugalnicah, visijo po igralih, tečejo po igriščih, znotraj goste urbane strukture Amsterdama; z ene strani njihova aktivnost ustvarja urbanost, z druge pa arhitekt ustvari pestrost urbanega prostora brez poseganja v avtorsko arhitekturo. Te fotografije so v meni odprle nove poglede na arhitekturno in urbanistično prakso ali, bolje rečeno, na *akcijo*, ki temelji na ideji planiranja od spodaj navzgor, ki je dobesedno namenjena ideji odprte funkcije ter igrive in domiselne uporabe urbanih prostorov.

Tudi sam sem odraščal na takih igriščih, ampak tega, do srečanja z Van Eyckom, nisem dojel. Kot otrok nisem vedel, da nima vsak takih privilegijev, kot sem jih imel jaz. Zrastel sem na ulicah Splita III, v ulici Dinka Šimunovića na Trsteniku, eni najbolj izdelanih sosesk gigantskega projekta, ki ga je izdelala projektna skupina Urbanističnega inštituta Socialistične republike Slovenije, pod vodstvom Vladimirja Brace Mušiča, Marjana Bežana in Nives Starc. Govorimo o širitvi modernega Splita, sestavljenega iz polifunkcionalnih sosesk, ki so se razvijale prek mreže pešpoti, ki so povezovale paralelne stanovanjske lamele. Prav v tem raju za pešce smo vsi mi, otroci Splita III, čutili, da je *svet naše igrišče*, če se znova navežem na Van Eycka (*the world was our playground*). Uporabljali smo in odkrivali nešteto med seboj različnih odprtih prostorov, ki so nam jih omogočili arhitekti. Vsaka igra je imela svoj prostor in vsak prostor je bil odprt za naše inovacije. S teras betonskih lamel so naše matere lahko vseskozi kontrolirale razigrano skupino otrok, pomirjene zaradi ločenosti naših igrišč od avtomobilskega prometa. Vrtci, šole, ambulante, nakupovalna središča so nam bili dostopni prek pešpoti, ki so se razvijale po smernicah stare rimske centuriacije, katere sledi so bile še v 60. letih na teh zemljiščih prisotne, sledi, ki so jih projektanti spretno izkoristili in prostorsko interpretirali že od natečajnega projekta. Same stanovanjske lamele (od današnje hrvaške populacije ideološko sovražene le zaradi njihovega socialističnega izvora) so bile koncentrat prebivalstva in seveda prijateljev in so prostorsko delimitirale ulice na tak način, da so merila, dimenzije in razvoj peš ulic spominjale na *kale* dalmatinskih zgodovinskih središč. Počutili smo se varno, poistovetili smo se s tem delom mesta in živeli smo tako, kot je najbolje prikazal film Janeta Kavčiča in Vitana Mala *Sreča na vrvici*, ne naključno, posnet v prvi realizirani soseski Mušiča, Bežana in Starčeve: tretja Bežigrajska soseska BS3.

V Splitu III, daleč od neposrednega citiranja zgodovinskega izročila, so projektanti uporabljali orodja starih gradbenikov, s popolnoma novimi merili in materiali. Opazovanje italijanskih in jadranskih mest, kot se spominja Mušič, in njihova interpretacija, je bil eden od temeljnih vidikov Ravnikarjevega poučevanja, v pogostih seminarskih ekskurzijah po Italiji in jugoslovanskem primorju, kjer, kot navaja Mušič, »ni šlo le za odnose

formation, my understanding of architectural and urban design – a decisive role: laughing children having fun, swinging, and running in playgrounds inside Amsterdam's dense urban structure; on the one hand, their activities created urbanity, on the other hand, the architect created the diversity of urban spaces without interfering with the authorship of the architecture. These photographs opened in me new views of architectural and urban design practice or, better put, action based on the idea of bottom-up planning, which is literally supporting the idea of an open-ended function and playful and imaginative use of urban spaces.

I, too, grew up on such playgrounds, but I was not aware of this until my encounter with Van Eyck. As a child I was not aware that other people did not have the same privileges as I did. I grew up on the streets of Split III, on Dinka Šimunovića street at Trstenik, one of the most elaborate neighbourhoods of a gigantic project designed by the design team at the Urban Planning Institute of the Socialist Republic of Slovenia, headed by Vladimir Braco Mušič, Marjan Bežan, and Nives Starc. Here we refer to the expansion of modern-day Split, composed of polyfunctional neighbourhoods, which developed through a network of pedestrian-only streets that connected parallel residential buildings. In this pedestrian paradise all of us, children of Split III, felt that the world was our playground, to paraphrase Van Eyck. We used and discovered countless, different, open spaces, as conceived by the architects. Each game had its space and its space was open to our innovations. From the terraces of the concrete lamellas, our mothers could look over us playing, feeling calm because of the separation of our playgrounds and traffic. Kindergartens, schools, health clinics, shopping centres were all within our reach via pedestrian-only streets, which followed the old Roman centuriation, whose traces were still present in the 1960s, while designers skilfully exploited, and spatially interpreted, them from the design competition onward. The housing buildings per se (disliked by Croatians today only due to their socialist origin) provided home to people, among which, of course, were friends, and spatially delimited streets so that the scale, dimensions, and development of pedestrian-only streets were reminiscent of the kalas (narrow streets) in Dalmatian historic old towns. We felt safe, we identified with the part of the city, and lived in the same way as depicted in the movie *Sreča na vrvici* (Happiness on a Leash) by Jane Kavčič and Vitan Mal, which was shot in the first completed neighbourhood by Mušič, Bežan, and Starc: BS3 – Bežigrad Neighbourhood Number 3.

In Split III, far away from any direct references to historical heritage, designers used tools of ancient builders, but using completely new scales and materials. According to Mušič, the observation and interpretation of Italian and Adriatic towns were among the fundamental aspects of Ravnikar's studies during his frequent seminar field trips in Italy and Yugoslavian coast, where "rather than relationships between buildings and open city spaces, this involved the behaviour of citizens and what was wittily called *espresso* urbanism: an array of attractive extrovert cafés, unlike introvert Slovenian bars".

In this sense, the revisiting of historical architecture or urban complexes once again strongly affected the culture of designers, which in the years of discussions about the crisis of modernist methodologies in design looked for new tools and new spatial inspirations. Indeed, Van Eyck, playfulness, and creative

med zgradbami in odprtimi mestnimi prostori, šlo je tudi za opazovanje vedenja ljudi v mestu in še za nekaj, kar smo hudomušno imenovali *espresso* urbanizem: množico privlačnih ekstravertiranih »kafičev«, za razliko od naših introvertiranih bifejev«.

V tem smislu je obisk zgodovinske arhitekture ali urbanega kompleksa še enkrat močno vplival na kulturo projektantov, ki so v letih diskusije o krizi modernističnih metodologij planiranja iskali nova orodja in nove prostorske inspiracije. In prav Van Eyck, igrivost, kreativno planiranje so bile ključni navdih slovenskih projektantov.

Toda upam si trditi, da je bolj kot kateri koli obisk arhitekture, urbanega kompleksa ali vizije podobe, prav formacija - proces učenja najbolj intenzivni proces igre, kar jih poznam. Ne samo učiti se od tistih, ki so se naučili, ampak dojeti prav učenje kot igro, v kateri radovednost, potrpljenje in upornost pripeljejo do neznanih in nepričakovanih rezultatov. S tem destabilizira vsako gotovost, ki se je ustvarila v specifičnem zgodovinskem času.

Ta uvod je posvečen spominu na Marjana Bežana, ki nas je zapustil v letu 2017.

design were the key inspirations for Slovenian designers.

Nevertheless, more than any visit of architecture, urban complex, and vision of an image the formation – the learning process itself is the most intensive process of playing that I am aware of. Not only to learn from those who possess knowledge, but to see learning as a game, where curiosity, patience, and resilience lead to unknown and unexpected results. This destabilises each certainty created in a specific period in history.

This Editorial is dedicated to the memory of Marjan Bežan who passed away in 2017.

Vid de Gleria
PAVILJON PRIJATELJSTVA IN MINIMALNA ENOTA ZA KRIZNE RAZMERE
FRIENDSHIP PAVILION AND A MINIMUM HOUSING UNIT

Mednarodna študentska delavnica v Slovenj Gradcu, september 2017

Japonski paviljon – *paviljon prijateljstva in minimalna enota za krizne razmere* v Slovenj Gradcu sta plod sodelovanja ljubljanske Fakultete za arhitekturo, tokijske Univerze Keio, Mestne občine Slovenj Gradec in Srednje šole Slovenj Gradec in Muta. Študentje so pod vodstvom arhitekta in profesorja mag. Tadeja Glažarja in gostujočega profesorja dr. Hirota Kobajašija postavili prvi japonski leseni zgradbi v Sloveniji. Pri izvedbi so sodelovali japonski in slovenski študenti arhitekture ter dijaki Srednje šole Slovenj Gradec in Muta . Paviljon prijateljstva in paviljon kot minimalna enota sta prvi izvedeni japonski arhitekturi v Sloveniji in hkrati donatorski projekt dveh univerz, ki brez tesne podpore in sodelovanja slovenskih podjetij ne bi bil mogoč. Paviljona sta izdelana za študijske namene, prvi paviljon kot učilnica na prostem, razstavni prostor ali kot prostor za druženje dijakov ter za promocijske in turistične namene, drugi paviljon pa kot študijski primer bivališča za krizne razmere.

Paviljon prijateljstva je od temeljev do strehe zasnovan kot razstavljiva lesena konstrukcija in modularna zgradba. Navdih in znanje o gradnji sta povzeta po tradicionalni japonski in slovenski leseni arhitekturi, ki temelji na lesnih zvezah in jo lahko razstavimo in sestavimo na drugem mestu. Gradnja se navezuje na tradicijo, ki jo reinterpretiramo in prilagajamo sodobnemu duhu časa. Za konstrukcijo smo uporabili sodoben in napreden material – tehnološko obdelani les furnirnih plošč, ki je ekološki, cenovno ugoden in enostaven za uporabo. Z uporabo napredne tehnologije CNC in s pomočjo pripravljenih kosovnic so se v delavnici srednje šole izdelali vsi deli paviljona, ki so se na lokaciji kot sestavljanka le še postavili na svoje mesto. Prednost uporabe tehnologije CNC pri gradnji lesenega paviljona je, da je izdelava vseh kosov do milimetra natančna. Če je treba kakšen del zaradi dotrajanosti zamenjati, ga izdelamo le s pritiskom na gumb CNC-stroja in vgradimo v pravo mesto.

International students' workshop in Slovenj Gradec, September 2017

The Japanese pavilion, i.e. *the Friendship Pavilion, and the Minimum Housing Unit for use under emergency conditions* in Slovenj Gradec resulted from the collaboration of the Faculty of Architecture of the University of Ljubljana, The Keio University in Tokyo, the Municipality of Slovenj Gradec, and the Slovenj Gradec and Muta High School. These two structures, being the first Japanese timber structures in Slovenia, were constructed by students, under the direction of architect and professor Tadej Glažar, MA, and the guest professor Dr Hiroto Kobayashi. Japanese and Slovenian students of architecture and the students from the Slovenj Gradec and Muta High School took part in the implementation. The Friendship Pavilion and the pavilion as a minimum housing unit are the first Japanese architectural projects taking place in Slovenia and, at the same time, a donor project of two universities, which could not have been possible without the close support and cooperation of Slovenian companies. Both pavilions were built for study purposes; the first pavilion is an outdoor classroom, an exhibition area, a meeting space for pupils as well as for promotion and tourist purposes, while the second pavilion is a case study of an emergency housing unit.

From its foundation to the roof, the Friendship Pavilion is designed as a timber, modular structure that can be disassembled. The inspiration and knowledge about the construction come from traditional Japanese and Slovenian timber architecture, using timber joints, which can be dismantled or assembled elsewhere. The construction relates to the tradition that is reinterpreted and adapted to the zeitgeist. A state-of the-art, advanced material was used for the construction – technologically processed veneered panels, which are affordable and very simple to use. By using advanced CNC technology and based on the parts list, all elements of the pavilion were manufactured in the high school workshop and were then, as a puzzle, pieced together at the site. The advantage of using the CNC technology in building the wooden pavilion

Okolica objekta je oblikovana po načelih japonskega vrta. Od glavne ceste nas med bukvami, macesni in brezami vodi prodnata pot, ki nam paviljon odkriva po sekvencah. Na južni strani paviljona smo oblikovali stožčasto prodnato odsevno površino, katere funkcija je odboj sončne svetlobe v notranjost. Severno stran zaznamujeta prodnata reka in jezero – skrbno zloženi dravski prodniki, ki prestrežejo deževnico s strehe in jo vodijo do ponikovalnice. Glavni vhod v paviljon je z juga in vzhoda. Na južni strani vhod zaznamujejo večji kamni, preko katerih vstopamo v paviljon, na vzhodni strani pa dva masivna lesena ploha, ki služita kot stopnici in prostor za odlaganje obutve pred vstopom v notranjost paviljona.

Notranjost je oblikovana zelo skromno. Središče zaznamujejo preproga iz kokosovih vlaken - tatami in tri manjše oblazinjene klopi, ki so jih izdelali za ta projekt. Prazna notranjost vabi uporabnika, da se usede in odmakne od vsakdanjega vrveža.

Trenutno smo zaključili prvo fazo projekta – leseno konstrukcijo, tla in streho. Po obodu je še treba vstaviti drsne in vrtljive stene, izdelane iz lesenih okvirjev in navzven obložene s transparentnimi polikarbonatnimi ploščami, ki spominjajo na tradicionalne japonske stene iz riževega papirja. Fasadna opna bo omogočala uporabo paviljona tudi v hladnejših mesecih. V naslednjem šolskem letu bodo dijaki Srednje šole Slovenj Gradec in Muta, programa lesarstvo, paviljon uporabili kot razstavni prostor in ga zapolnili s svojimi lesenimi izdelki.

is that all elements can be manufactured with precision to the millimetre level. Should, due to deterioration, any part be replaced, by pressing the CNC push button the part is manufactured and installed in the right place.

The principles of Japanese garden design were used in the structure's surroundings. From the main road a gravel path takes us past beech, larch, and birch trees, revealing the pavilion in sequences. In the pavilion's south side, we designed a cone-shaped, gravel reflective surface, whose function is to reflect sunlight inside. The north side features a gravel river and a lake – carefully stacked pebbles from the Drava River, which intercept rainwater from the roof and lead it to the sink. The main entrance into the pavilion is from the south and the east. The south side entrance features large rocks through which we enter the pavilion, while in the eastern side there are two massive wooden planks serving as stairs and as a place for removing footwear before entering the pavilion.

The interior design is very modest. The central part features a coconut fibre mat – a tatami and three small upholstered benches that were custom-made for this project. The empty interior invites the user to have a seat and enjoy some time away from the everyday hustle and bustle.

The first stage of the project has been completed – the wooden structure, floor, and roof. Around the perimeter, it is still necessary to install sliding and rotating walls, made of wooden frames and lined on the outside with transparent polycarbonate sheets reminiscent of traditional Japanese walls made of rice paper. The facade shell will allow for the use of the pavilion during the colder

Projekt paviljona prijateljstva je donatorski projekt s humano noto. Njegov začetek sega v leto 2011, ko je Japonsko stresel potres, obalo pa so zalili popotresni valovi cunamija. Japonska vlada je prosila univerze, naj vsaka na svojem področju priskoči na pomoč. V laboratoriju prof. Hirota Kobajašija z Univerze Keio so se odzvali s projektom Veneer House. Od takrat so po svetu postavili že trinajst podobnih, a vedno različnih projektov, ki se prilagajajo okolju. Zadnjega tudi v Sloveniji.

Poleg izgradnje paviljona prijateljstva je vzporedno potekal tudi projekt raziskovanja in postavitve minimalne bivanjske enote za krizne razmere, razvite posebej za primere naravnih ali humanitarnih (begunci) katastrof. Ta manjša enota predstavlja bistvo delovanja laboratorija prof. Kobajašija, katerega temeljna skrb je vedno bila humanitarna pomoč najranljivejšim skupinam.

S pomočjo začasnih minimalnih bivalnih enot prebivalcem prizadetih območij pomagajo v hujših ujmah, kot so plazovi, potresi in poplave. Enota omogoča hitro postavitev, ki je namenjena začasnemu bivanju v varni bližini doma. Na ta način se vez z domačim okoljem in socialne vezi med ljudmi ne prekinejo. V zadnjih dneh enomesečne delavnice smo s pomočjo tehnologije CNC izdelali tri enote, ki se med seboj lahko združujejo ali postavijo kot samostojne enote. Vsaka izmed njih je primerna za lahek transport, saj so njeni deli izrezani iz vsega 15 vezanih plošč velikosti 2500 mm × 1250 mm. Vsako enoto lahko sestavita najmanj dve osebi v manj kot eni uri. Teža celotnega objekta je le 200 kilogramov.

Cilj obeh projektov je raziskovanje novih tehnologij gradnje, ki bi jih bilo možno aplicirati na stanovanjsko gradnjo, objekte za rabo v primeru naravnih katastrof, begunske krize in mnogih drugih situacij. Vsak del obeh enot je bil zasnovan s pomočjo 3D-modela. Po zaključenem projektiranju so se naredile kosovnice. Raba tehnologije CNC, delo v delavnici in modularna zasnova so elementi, ki omogočajo hitro in natančno gradnjo. Ker tehnološki proces izdelave skoraj vseh kosov poteka v delavnici, je nadzor nad gradnjo na terenu dosti lažji, končni izdelek pa kakovostnejši. Paviljon prijateljstva in minimalna bivanjska enota nista primerni za neposreden prenos v stanovanjsko gradnjo, uporabna pa sta njuna tehnologija in način izgradnje. V prihodnosti bi z nekaj konstrukcijskimi prilagoditvami in izboljšavami ta način gradnje lahko uporabili pri reševanju stanovanjskega problema mladih. V resnici gre pri paviljonu prijateljstva in minimalni enoti za povečano trodimenzionalno sestavljanko, ki jo z malo spretnosti in z osnovnim orodjem lahko postavi vsak sam.

Izgrajena raziskovalna projekta – paviljon prijateljstva in minimalna bivanjska enota za krizne razmere se uspešno spogledujeta z bogato tradicijo japonske in slovenske gradnje z lesom. Uporaba sodobnih in naprednih tehnologij in materialov odpira nov pogled na leseno arhitekturo in način gradnje pri nas.

month as well. During the next school year, the secondary students enrolled in the carpentry programme will use the pavilion as an exhibition area and fill it with their own wooden products.

The Friendship Pavilion project is a donor project with a humanitarian note, which began in the wake of the 2011 earthquake that hit Japan and unleashed tsunami waves that inundated the coast. The Japanese Government asked the universities to help, each in its own field. Thus, Hiroto Kabayashi's laboratory at Keio University launched the Veneer House Project. So far, they have assembled 13 similar, yet different, projects, which are adjusted to the surroundings. The most recent one is from Slovenia.

Along with the Friendship Pavilion, the project of exploring and assembling the Minimum Housing Unit for use under emergency conditions was underway, developed for regions affected by natural disasters or humanitarian crises (refugee crises). This compact unit showcases the essence of Professor Kobayashi's laboratory, whose primary concern has always been to deliver humanitarian aid to the most vulnerable groups.

Using temporary minimum housing units, they help the people from the regions affected by major natural disasters, such as landslides, earthquakes, and floods. The unit allows for a quick assembly intended for temporary stay close to home – within the bounds of safety. In this way the links with the home environment and social bonds are not broken. In the last days of the one-month workshop we built three units, using CNC technology, that can be combined with each other or assembled as independent units. Each of them is light to transport as its parts are cut out from altogether 15 composite panels of a size of 2500 mm × 1250 mm. Each unit can be assembled, by at least two persons, in less than one hour. The total structure's weight is a mere 200 kg.

The goal of both projects was to study new construction technologies that could be applied to housing construction, for use in case of natural disasters, refugee crises, and many other situations. Each part of both units was designed using a 3D model. After the completion of the design, parts lists were created. The use of CNC technology, work in the workshop, and modular design allow for quick and precise construction. The technological manufacturing of almost all parts took place in the workshop, so it was much easier to oversee the construction in the field and the final product was better. The Friendship Pavilion and the Minimum Housing Unit are not directly transferable to housing construction; their technology and construction method, however, are. In the future, with a few structural adjustments and improvements, this construction method could be used to provide a solution to young people's housing problem. In fact, the Friendship Pavilion and the Minimum Housing Unit are an enhanced three-dimensional puzzle which anyone, with some skill and basic tools, can build.

Both research projects – the Friendship Pavilion and the Minimum Housing Unit – successfully evoke the rich tradition of Japanese and Slovenian timber construction. State-of-the-art, advanced technologies and materials open a new view of timber architecture and construction in Slovenia.

Organizatorji
Keio University, Tokijo, Mestna občina Slovenj Gradec, Srednja šola Slovenj Gradec in Muta, Univerza v Ljubljani, Fakulteta za arhitekturo

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II.

ČLANKI

ARTICLES

Linda Hildebrand, Philip Schwan, Anya Vollpracht, Sigrid Brell-Cockan, Magdalena Zabek: METHODOLOGY TO EVALUATE BUILDING CONSTRUCTION METODOLOGIJA ZA OCENO GRADNJE STAVB GLEDE REGARDING THE SUITABILITY FOR FURTHER APPLICATION PRIMERNOSTI ZA NADALJNJO UPORABO

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IZVLEČEK

Z večanjem potreb po energiji postajajo vse pomembnejši okoljski učinki, povezani z grajenim okoljem, zato podnebne cilje lahko uresničujemo le, če upoštevamo oboje. V zadnjem desetletju so začeli veljati predpisi in standardi, ki spodbujajo zmanjšanje porabe primarnih virov. Arhitekti in prostorski načrtovalci so se te tematike lotili z različnimi strategijami, s ponovno uporabo gradbenih elementov, razvojem novih izdelkov ali uporabo povezav, ki bodo v prihodnosti omogočale enostavno demontažo. V zadnjem desetletju so instrumenti za merjenje ekoloških vplivov napredovali – od podatkov v razpredelnicah o oceni življenjskega cikla (life cycle assessment – LCA) do orodij, ki povezujejo ekološke podatke z gradbenimi volumni in rešitvami, ki temeljijo na samooptimizaciji. Veliko je ugibanj glede ravnanja z gradbenim materialom po uporabi, saj se bodo okvirni pogoji v prihodnosti še razvijali. V primerjavi z rušitvijo se razgradnja danes le redko uporablja, tudi raziskave o tem so omejene. Vrsta gradbenega objekta in izbira materiala vplivata na okoljske kvalitete z energijo in emisijami, povezanimi s proizvodnjo in scenarijem ravnanja ob koncu življenjskega ciklusa. Ob upoštevanju tega negotovega ozadja potrebujemo metodo, ki bi prikazovala vplive na okolje z oceno primernosti za nadaljnjo uporabo, kot sta ponovna uporaba in recikliranje. Članek obravnava tri pristope k prikazovanju parametrov, ki so na voljo v fazi načrtovanja, v zvezi z možnostmi ravnanja z materialom po uporabi, glede na praktičnost in zanesljivost. Najučinkovitejšo metodo smo vključili v programsko opremo za arhitekturno načrtovanje in ocenili.

KLJUČNE BESEDE

razgradnja, zasnova demontaže, ocena življenjskega cikla (LCA), sekundarni viri, vrsta povezave

ABSTRACT

With decreasing energy demand, the ecological impact related to the building fabric becomes more relevant and climate goals can only be reached when considering both. In the last decades, political regulation and standards were released to promote the reduced consumption of primary resources. Architects and planners approached this topic with different strategies by working with reused building elements, developing new products or using types of connection which provide easy disassembly in the future. In the last decade, the instruments to quantify the ecological impact advanced from life cycle assessment (LCA) data in spreadsheets to tools which connect ecological data with building volume and self-optimizing solutions. The treatment of the building materials after the use phase is subject to speculations as framework conditions in the future will develop. Today deconstruction (in difference to demolition) is rarely executed and research is limited. Construction and material choice impact the environmental qualities by the energy and emissions related to the production and the treatment scenario at the end of life. Against this uncertain background, a method is needed to indicate the environmental impact by evaluating the suitability for further use, like reuse or recycling. The paper introduces three approaches to indicate parameters available in the planning phase to possible treatment paths for the material after usage regarding practicability and reliability. The most sufficient method was integrated in an architectural drawing software and evaluated.

KEY-WORDS

deconstruction, design for disassembly, LCA, secondary resources, type of connection

1. INTRODUCTION

1.1 Background

In the last three decades, strategies to reduce the environmental impact in building sector focussed on the reduction of not renewable energy for the building operation by regulating the thermal quality of the building envelope and shift in the energy generation infrastructure. With decreasing energy demand for building operation, the ecological impact related to the construction of buildings becomes more relevant and climate goals can only reached when considering both. The commitment to integrate climate conditions into the architectural planning process started with decreasing the amount of non-renewable energy sources for the operation phase of the building and is now targeting nearly zero not renewable energy (European Parliament, 2010). As a follow up, resource efficiency and circularity are focussed on as the next potential to decrease the ecological footprint of the building sector. In the last decades, political regulation and standards where released to promote the reduced consumption of primary resources.

Political context of resource efficiency

Sustainability and later circularity became a topic of social and political interest due to recognizable effects of climate change. The growing population with increasing need of space and resources on the background of climate change goals stressed the question for resource-efficient solutions (WBGU et al., 2016). The United Nations formulated within the 17 Sustainable Development Goals (SDG) resource efficiency as one aspect to protect the environment (United Nations, 2015). Resource efficiency is a principle rather than a benchmarked definition. The VDI 4800-2 Resource efficiency-Evaluation of the use of raw materials (VDI, 2016) describes it as the relation of effort to utilization which promotes to either optimize the utilization or to decrease the effort. In the building context, it can include a variety of aspects such as usage time span or material intensity. Within the scope of this research the implication of the planning phase to the resource condition and utilization scenarios of unused building substance are focused on.

Different activities to protect the environment were established in the last decade, for example the conferences World, European and National Resources Forum to initiate exchange for (political) stakeholders. On European and national level strategies to achieve this SDG where developed which included the promotion of secondary resources and the multiple use of products. Standards promote the use of secondary resources, for example the EU Framework Waste Directive that states 70 % of each demolished building should be recycled (European Commission, 2013) and the use of recycled products should be integrated where suitable. These two aspects are also reflected in the criterion by the German Green Building certificate DGNB Tec 1.6 Suitability for deconstruction and recycling. The recycled content is addressed on material level, the suitability for multiple usage cycles is applied on construction level (DGNB, 2015).

The integration of reused and recycled material and the suitability for reuse and recycling are related to different planning phases; Recycled materials are applied in the current situation and the ecological benefits - primary resource conservation, landfill area and emission reduction- are activated right away. The integration of the suitability for reuse and recycling is a strategic decision to provide a variety of choices on product level for the future.

Figure 1: Hierarchy of planning decisions.

Figure 1 shows the different planning paths: *Conventional* planning includes the use of primary resources which are assembled without considering the scenario after the end of live of a building (first usage phase). In this case a major share of materials is thereby degraded in quality and is not accessible for the same level of quality after the end of live. Providing easy disassembly in future can be considered as strategic path as the application cannot be guaranteed but enables a broader variety of choices. The ideal process of saving primary material is a circular flow in which a material can be used multiple times. The transition from one usage cycle to the next should need minimal effort (energetic and financial) to avoid annulling the positive effect (that is the case when the amount of energy for treatment exceeds the amount for production). Prototype projects for reuse in architecture, like the Platten Palast in Berlin could be illustrated in the figure by the blue line (from secondary resources to end of use cycle). The paths can be organized in an ecological hierarchy lead by the ideal path followed by the strategic and last, the conventional path.

The suitability for reuse and recycling is part of the strategic path and is more complex as future scenarios include increasing uncertainty with progressing time. The framework conditions will develop; electricity will use an increased share of renewable resources and the technological progress will advance. Ideally, circularity would be applied by integrating the building function, construction, material and available technology in an integrated concept in which the information is controlled over time by one stakeholder. In the building sector, long usage spans result in changes of stakeholders and thereby loss of information and responsibility.

Different formats can support the integration of material's condition in the end of life phase. In the early design phase strategies can help for guidance. When frame work conditions, like functions and estimated usage span are defined, methods are used to evaluate different solutions against each other.

One strategy to integrate the material's condition in the end of life phase is design for disassembly (DfD) in which ideally all products can be connected and disconnected to become part of follow-up usage cycle. For electronical equipment strategies and methods for evaluation, all as challenges are well discussed in (Rios, Chong, & Grau, 2015; Sabaghi, Mascle, & Baptiste, 2016) and regulated in (VDI, 1991). (Durmisevic, 2006) introduced the *design for transformation* in the building context which relates material and function in a complex system based on Crowther's layer scheme that indicated the relevance of different life spans. This strategy can be applied in the planning phase to integrate these with end of life treatment. (Brenner, 2010) provides a hierarchy of connection techniques and the reusability and recycabilty. While DfD aims in the total separation of components, functional requirements suggest a strongly connected (rather than easy to disassemble) solution. A process of consideration must include the ecological and financial investment. In this context, it is worth mentioning that circularity and resource efficiency are considered as two strategies with the same goal, rather than competitors.

Methods which try to integrate the condition and value of material at the end of their life cycle base either on the material or the type of construction. The method of life cycle assessment (LCA) calls the last phase *end of life* phase and databases provides categories for this based on a material group, for example mineral material is predominantly considered as building rubble. This leaves the construction and the differences in the ability for deconstruction disregarded. While the ecological impact of material can be expressed by embodied energy and emissions, the suitability for deconstruction due to the choice of material and construction cannot be quantified and communicated.

Ideally the suitability for reuse and recycling is indicated in the planning phase to aim at maximum impact for the reduction on environmental interference.

1.2 Aim and methodology

This research aims to provide a method to evaluate building element variants against each other regarding the suitability for reuse and recycling. It addresses architects and planners in the design phase, when material and construction decisions are made. Secondary, the method can support judgement of the suitability for deconstruction for existing buildings.

The paper is structured in four chapters. The first one provides background and motivation. The second chapter introduces connection in building construction and relates them to categories for end-of-life scenarios. A method to indicate the end-of-life path based on material and construction is introduced and evaluated in chapter three with case studies. The parts of the method found to be sufficient are applied further in the fourth chapter. The results are discussed and conclusion derived here.

This research is part of two projects. The first part was developed within a programme at RWTH Aachen University between the chair of Reuse in Architecture, the chair of Individualized Production and the Institute of Building Materials Research (ibac) enabled through DFG funding Robotic disassembly of facades and refurbishment system. The second part, which included the methods specification and transfer into a software tool, was developed within a Blended Learning Project founded by RWTH Aachen University conducted by Reuse in Architecture.

2. METHOD TO EVALUATE THE SUITABILITY FOR RECYCLING AND REUSE

In the architectural planning phase, ecological information is increasingly used with growing performance of digitals tools. Interface to LCA databases enable the integration into planning decision. Ecological information is most commonly used to compare different building elements against each other and base design decision on it while the first programs occur, which use algorithm to optimize the shape and material choice.

In the context of architectural planning and LCA practise, the suitability for reuse and recycling is associated to the material. As mentioned before, this includes two critical aspects; the materials are considered to be a collection ("material pile") regardless the type of construction. Secondly, the future end of life scenarios are subject to high uncertainty as the frame work conditions will vary essentially. These two aspects are addressed in the next two paragraphs.

Studies have shown that for the energy and emissions embodied in the building fabric the production phases from the resource extraction until the factory gate is linked to the highest ecological impact. (Frischknecht, 2009; Hildebrand, 2014; Ortiz, Castells, & Sonnemann, 2009). The standard EN 15804 differentiates the life cycle phase in more detail and name the previously mentioned A1 to A3 (EN, 2012). The assembly on site is neglectable and presumably so is the demolition (no data are available) which are called A5 and C1 regarding the energy and emissions associated in these phases (Kellenberger & Althaus, 2009). Comparing production and end of life phase, for most materials the production phase embodies a significantly higher share. Both phases are typically included in LCA in the building context. Looking at the A5 and C1, energy and emission contribution are not relevant but it is their strategic condition that impacts the type of product at the end of a usage phase. The phases waste processing (C3), disposal (C4) and re-use recovery and recycling potential (D) are part of the end of life. Here reuse and recycling potential is mentioned by grouping the material. In order to evaluate the potential of the products after a usage phase, two approaches are shown which address the relevance of the construction and deconstruction. The method will be briefly described in this chapter and the application follows in the subsequent one.

2.1. Approaching environmental aspects of deconstruction

This approach aims to quantify the ecological burden related to the deconstruction phase and is set as benchmark for suitability: A material which after deconstruction embodies more energy and emissions is suitable for deconstruction, a material with less ecological burden would not be suitable as the new production would initiate lower burden and be in this case the better solution.

Deconstruction is not a common technique and so no data on the primary energy and green house gases related to process are available. In this context it is tested whether it is possible to define the deconstruction steps for a building element by

1. defining building context
2. deconstruction steps by machine type and time the machines are used
3. calculating the energy and emissions by relating machine capacity and used time
4. comparing it to the material which can be retrieved

This aims in the distinction between building element which include different processing.

2.2 Connections between different building materials

The second approach addresses the planning process and the information the planer can provide in the construction phase. It uses the type of connection and relates it to the condition the material has in the end of life phase. The type of connection is a functional aspect defined by the choice of material and the construction typology. Connections can be categorized by the following techniques shown in Figure 2 according to DIN 8580 (DIN, 2003).

The influence of the construction of the ability for disassembly are discussed in (Brenner, 2010; Jäger et al., 2013) and three of the categories shown below are mentioned in these sources (2.-4.). Based on this, information on the condition is provided (destructible/non-destructible, mixed/pure). When the building is deconstructed or demolished four conditions of materials can be distinguished:

- Non-destructively detachable
- Destructively detachable (pure material)
- Destructively detachable (mixed material)
- Critical materials

Non-destructively detachable materials remain in their initial condition as product or element with only little maintenance for further application. *Destructively detachable (pure material)* includes destroyed products but only one material group is formed. *Destructively detachable (mixed material)* is similar to the one before but impurities are part of the material pile. The category *critical materials* contains all products which are critical at any step of the further process, such as direct threat to human health or special treatment for final landfill is required.

The connection types are linked to an end of life condition as in this, the material purity is predefined; When materials with different recycling paths are connected non-detachably, the treatment for mixed instead of pure material is proceeded Pure fraction enable cycling on the same or similar value in contrast to mixed, which limit the applicability.

Figure 3: Joints and material condition in end of life phase.

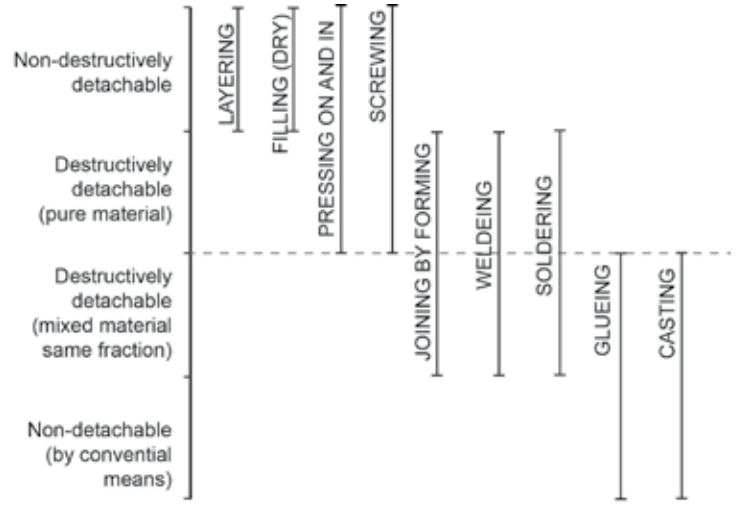
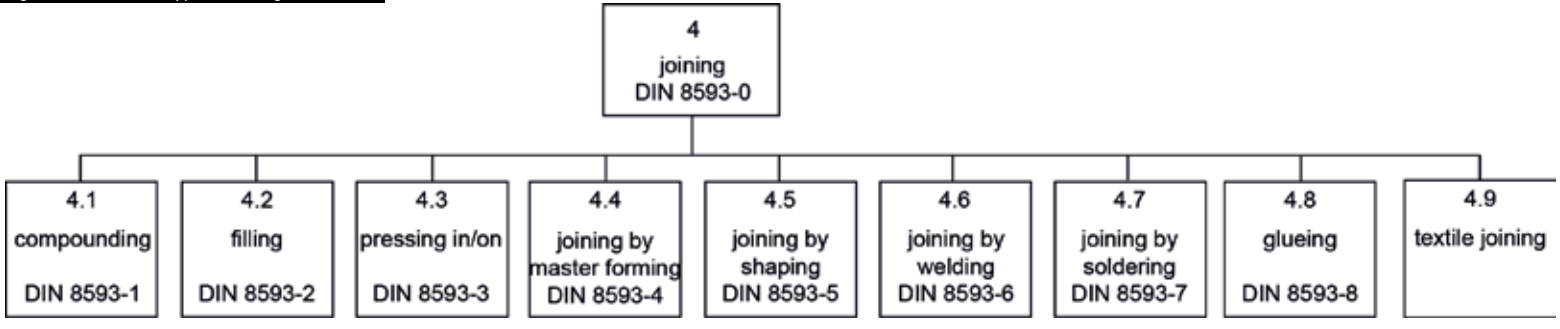


Figure 2: Construction types according to DIN 8580.



Whether materials with different recycling paths can be disconnected is subject to framework conditions such as the available technology. Here the most common scenario is assumed. If the method proves to be sufficient, future scenarios with different links are possible to reflect different scenarios.

2.3 LCA and fraction groups

While the approaches described in 2.1. and 2.2. can be regarded as parallel, 2.3. builds on 2.2. According to the conditions of the materials further treatment processes are possible. The German Waste Key describes the variety of materials groups (fraction) which are classified by the follow-up steps. Table 1 shows an excerpt of the waste key.

Table 1: Excerpt from German Waste Key, according to waste directory (Abfallverzeichnis-Verordnung - AVV) released by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), 2001.

Number	Material names
1701	Concrete, brick, tiles and ceramics
170101	Concrete
170102	Tiles
170103	tiles and ceramics
17 06 01	Insulation material containing asbestos

The broad variety of fractions can be distinguished regarding their further application in four groups which are here called fraction groups (FG):

- FG A: Ready for reuse (170102)
- FG B: contains a pure material (for example 170101)
- FG C: fraction with more than one material (for example 1701)
- FG D: contains critical materials like hazardous material (for example 170601)

To illustrate it, in FG A products are gathered that are technically capable of a subsequent use phase. Steel beams or prefabricated concrete structure fall into that category. FG B contains pure material from only one origin. Aluminium profile with the same alloy composition forms one fraction. It is important that the fraction is pure and not mixed with impurities. This is different in FG C; materials from different origin are gathered here. The most common example is building rubble which can consist of a mixture of bricks, mortar and render. This fraction is processed further without any sorting. In FG D materials are associated which need special treatment in deconstruction (regarding health concerns or environmental issues) or need to be stored on landfill as it has no prospect of recycling.

Concrete elements can be cut in different sizes. Insulation is considered to be recycled when separated from render. The products within the ventilated façade (substructure, cladding) are assumed to be reusable with low loss due to impurities.

The emissions associated and the energy invested in a building material can be referred to as the ecological value. Similar to the economic value, this indicates potential to preserve natural resources and limit emissions. Materials with high embodied energy and emission need to be accessible before the ones with relatively less ecological impact.

In order to reflect the environmental impact, the waste fraction groups does not refer to the mass but are linked to the embodied energy of a building element. By this, the necessity to change the connection of a more valuable material is indicated. Different strategies are possible; either the reduction based on the LCA (sufficiency) or improving the future scenario (circularity).

In summary, first an LCA for the production phase is done with the indicators primary energy not renewable and global warming potential. Based on the construction and thereby linked material condition, the waste scenario is per material associated with a fraction group. The suitability for further application decreases from group A to D.

3. APPLICATION

The approaches above are now applied and evaluated regarding the aspects of practicability and reliability by using case studies. For this, building elements in existent buildings are investigated. Existent building substance is chosen as its functional period will most likely end sooner than the one of new construction. As said before, information on deconstruction is rare and the lack of documented experience results in uncertainty. This is growing when statements about the future are contained. To limit this as much as possible, existent construction are taken into account by today's and near future's technology. When the method proves to be suitable for existing construction, it can be used for planners in the design phase for future deconstruction, too.

Before the choice of the case studies, the building stock in Germany is investigated to understand the quantitative distribution of the material and construction. It is focused on residential buildings as these represent the majority of building types and data on construction type and area is available. The context of the case example includes relevant background information for this topic and is therefore described extensively.

3.1 Most relevant building elements - Anthropogenic material stock Germany

Materials in the building sector remain a part of a construction for multiple decades. This can be considered as storage, material banks or the anthropogenic material stock. In Germany, it accounts for 15,7 billion tons (**Figure 4**), infrastructure accounts for 9.4 billion tons (Schiller, Ortlepp, & Krauß, 2015). The most significant part (weight-based) is of mineral origin: 13.81 million tons (mt), that account for 88% in total. The material group with the second highest share are metals with 883 mt.

The material stock grows with input flows and decreases with output. The total annual material flow in the building sector accounts for 121 mt (input).

Figure 4: Material stock in building industry Germany (based on: Schiller, Ortlepp & Krauß, 2015).

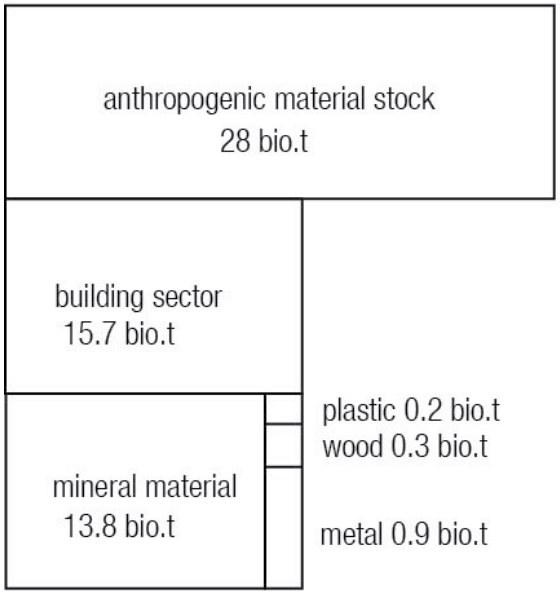
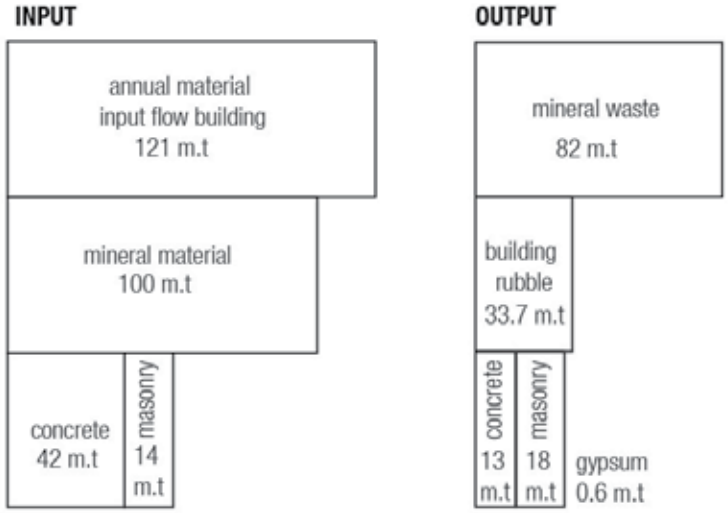


Figure 5: Anthropogenic material flow (based on (Schiller, Ortlepp & Krauß, 2015).



In spite of this large amount only 9-11 % are substituted by recycled material (Dechantsreiter et al., 2015).

Considering the waste flow of materials (output), mineral materials also account for the highest share with 82.2 mt per year including road construction waste (Basten, 2015) (Figure 5). The building rubble accounts for approximately 50-60 mt per year in Germany of which 33.7 mt are mineral. For annual data, the main shares are concrete with 13.2 mt and masonry rubble with 17.6. The amount of metals varies from 3.1 mt (Deilmann, Krauß, & Gruhler, 2014) to 7.3 mt (Basten, 2015). Wooden rubble accounts from 2.1 mt (Deilmann, 2010) to 2.9 mt (Basten, 2015) and plastic rubble accounts for 0.3 mt (Deilmann, 2010). Glass rubble varies between 0.2 mt (taking only flat glass into account) and 1.2 mt (glass rubble in general). Gypsum rubble accounts for 0.7 mill t/a (Deilmann, Krauß, & Gruhler, 2014).

The two most significant fractions are concrete and masonry rubble. In comparison to concrete rubble, masonry rubble includes a variety of materials as it is often a mix of brick, gypsum, ceramics, mortar or plaster leftovers. Both fractions account as building rubble and can be used as filling material for roads. Since 1990 68 – 73 % of concrete rubble is being recycled, hardly 5 % of the material is being used for higher or equal purpose (Deilmann et al., 2014). There are no figures for reusing or recycling material in buildings yet.

3.2 Case study

Based on the data illustration above, eleven building element case studies where derived. The façade was chosen as an example because it is a complex building element with a mix of material. Results from this research are assumed to be transferrable to elements with less material combinations. Focuses lies on the opaque part of the building envelope as this is mass-based the most significant. Due to the high volume of mineral material flows, all façade examples include a loadbearing wall from mineral origin.

The eleven façade elements reflect four loadbearing materials, lime-sand--stone (LS), brick (B), aerated concrete (AC) and reinforced concrete (RC). According to the year of construction, the physical properties were adapted by addition of insulation and cladding.

The facades built up from wall and plaster/render can be distinguished as mono – layered, the cases built up from wall, insulation and plaster/render are considered multi- layered. The latter group consist of the types with ventilation (rear facades) and without (exterior insulation façade system) (Figure 6).

3.3 Including C1 in the evaluation

The relation of type of construction and effort for deconstruction are investigated in this section. According to the description in paragraph 2.1 the energy and emissions related to the deconstruction are calculated and compared to the embodied energy in the material.

Context (1st step according to paragraph 2.1)

The research here focusses on the material and construction and excludes the properties of the building and site. The accessibility for heavy machinery is key for deconstruction. (Motzko, Klingenberger, Wöltjen, & Löw, 2016) discussed this in the context of the documentation of disassembly projects.

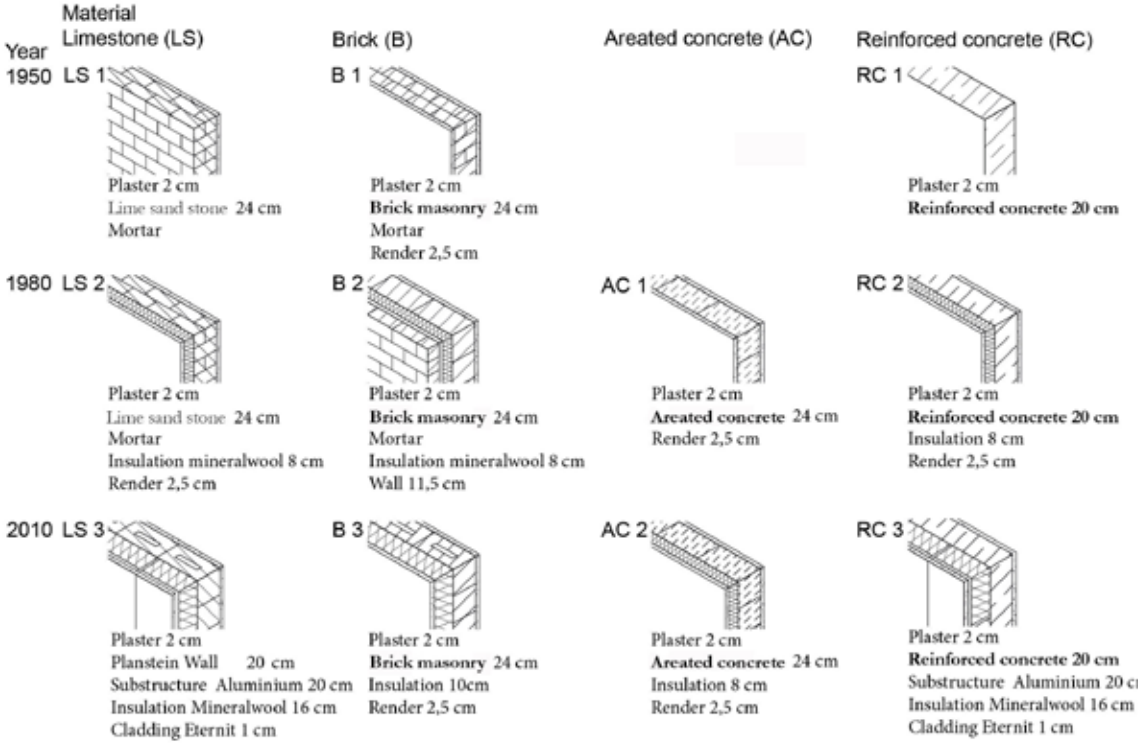


Figure 6: Overview of case study facades.

An overview of the steps for deconstruction are listed in Table 2.

Table 2: Demolition and deconstruction in the building context. Demolition according to the specification of tender (Motzko et al., 2016).

Demolition	Deconstruction
1.1 Construction site equipment	
1.2 Scaffolding, crane	
1.3 Demolition scrap material	Deconstruction of building elements:
1.4 Demolition other material	Removing building service installation
1.5 Demolition mineral material	Resolving the not-loadbearing interior (surfaces and walls)
	Dismantling the windows and doors
	Stripping the roof, removing the roof structure
	Dissolving slap
	Deconstruction façade
	Separating foundation

The context is chosen to be of easy access and the same for all case studies. The building is three floors high and has ten-meter distance from the building edge to the property line.

Deconstruction steps (2nd step)

A deconstruction scenario was planned in which only the deconstruction of the facades is planned in detail. The choice of tools and time estimations are based on literature descriptions, experience gained in years of practical courses including interviews with three craftsmen (plumber, electrician and brick layer). It follows the construction steps in reverse. The time and electricity used add up to an approximate ecological evaluation. The appendix shows the full table displaying the machine name and time, including the energy spent on the deconstruction. Heavy machinery is shown separately.

Energy and emissions related to the selective deconstruction (3rd step)

In Table 3 the results of the energy used to deconstruct the façade types on site is shown. The energy used for machines can relate to the type of façade (Figure 7, 8). The ventilated facades use less energy for deconstruction, while the ones with interconnected layers use more.

Energy for deconstruction and retrieved secondary material (4th step)

Comparing the energy effort of deconstruction (considering only the machines that are used for deconstruction) to the embodied energy of the harvested material, it appears to be very small in the context of the production of the façades (**Figure 8**). Looking at the energy for deconstruction, it makes sense to prefer controlled disassembly over demolition from an ecological point of view.

Table 3: List of tools and end energy (kwh/m^2) according to the façade type.

	LS1	LS2	LS3	B1	B2	B3	AC1	AC2	RC1	RC2	RC3
Drill hammer	3,5	3,5	1,9	3,8	4,0	0,8	1,6	1,6	0	0,5	0,3
Angle grinder	0,0	2,2	0,4	0	0,2	0,6	0,0	0,6	2,6	4,2	3,0
Cordless skrewdriver	0,0	0	0,0	0	0	0	0,0	0	0	0	0,0
total	**3,5**	**5,6**	**2,3**	**3,8**	**4,2**	**1,4**	**1,6**	**2,1**	**2,6**	**4,7**	**3,3**

Figure 7: Energy for the deconstruction steps.

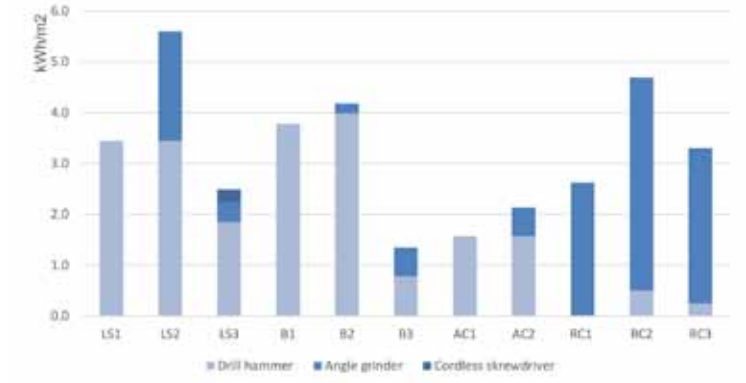
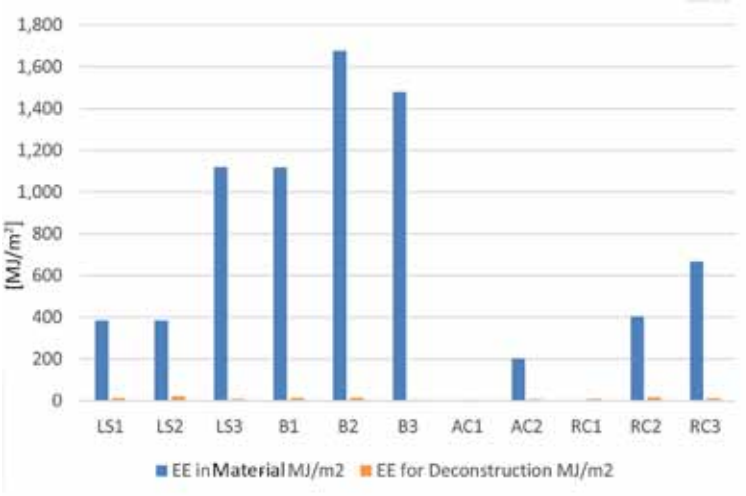


Figure 8: Primary energy for production in reuse and recycled content (minus 15% safety addition) and deconstruction according to façade type (for deconstruction energy 1,8 primary energy factor according to DIN 15899, 2016).



Comment on the method

This method is suitable to include end of life steps in a comparison between for example an exterior insulation façade system and a ventilated façade. It is a method to express the effect of the type of connection for the end of life scenario. For façade case studies, the values for deconstruction are below the material value, which makes it ecologically beneficial to sort and reuse the material. If heavy machinery such as cranes or bulldozer were included, this relation changes but the energy for deconstruction does not exceed the embodied energy in this theoretical case study.

It appears to be a useful approach putting the value of secondary materials in the context of the effort to harvest them. A method to indicate the suitability as secondary resource needs to embody both but the data it is based on need to be reliable and established ideally in academia and economy. The value of the material should reflect the ecological investment – embodied energy and emissions – and the functionality of the secondary material resource. These aspects need to be specified.

The absence of data bases is a serious weakness to this method. With growing experience in deconstruction, data availability will become more likely. An alternative is a LCA professional who could model and calculate different scenarios, but this involves high consulting costs.

The practicability of this method is limited and so is reliability.

3.4 Connection

In this section, the connection and end of life scenario are referred to one another. The type of connection is classified according to DIN 8580. In this context, two scenarios for the end of the building function are described; A *conventional demolition* process in which the materials are broken according (Müller, 2011, 2016; Weimann et al., 2013) [cd] and a path called *ultimate deconstruction* [ud] in which all maximum of materials is disassembled to be reused as building product. The later path might be sufficient in the future supported by automation. The condition of the material after the end of phase is differentiated in the four categories mentioned in paragraph 2.2.

Table 4 shows the type of connection with increasing level of connectivity from left to right. The four categories to indicate the condition of the material in the end of life phase are underlined by colour. The scenario *ultimate deconstruction* contributes to sorted material fraction. Building elements which include detachable connection are not affected by this process. Materials with low strength like aerated concrete will most likely be destroyed in any case and deconstruction might contribute in this case to better sorting.

Comment on the method

For this approach, information about the type of connection needs to be provided as part of the design process. The method communicates the association of connection and end of life scenario transparently. Research on the treatment process for a variety of building material is available.

Table 4: Façade elements and condition after usage phase for the scenario conventional deconstruction [cd] and ultimate deconstruction [ud].

		Layering	Filling (dry)	Pressing into sth		Primary shaping		Deforming	Welding	Soldering	Glueing		Casting
LS 1	Plaster 2 cm					3 [cd]	2 [ud]						
	Lime sand stone 24 cm					3 [cd]	1 [ud]						
	Mortar					3 [cd]	2 [ud]						
LS 2	Plaster 2 cm					3 [cd]	2 [ud]						
	Lime sand stone 24 cm					3 [cd]	1 [ud]						
	Mortar					3 [cd]	2 [ud]						
	Insulation mineralwool 8 cm										4 [cd]	1 [ud]	
	Render 2,5 cm										4 [cd]	2 [ud]	
LS 3	Plaster 2 cm					3 [cd]	2 [ud]						
	Lime sand stone 20cm					3 [cd]	1 [ud]						
	Substructure Aluminium 24 cm			1 [cd]	1 [ud]								
	Insulation Mineralwool 16 cm			1 [cd]	1 [ud]								
	Cladding Eternit 1 cm			1 [cd]	1 [ud]								
B1	Plaster 2 cm					3 [cd]	2 [ud]						
	Brick masonry 24 cm					3 [cd]	1 [ud]						
	Mortar					3 [cd]	2 [ud]						
	Render 2,5 cm					3 [cd]	2 [ud]						
B2	Plaster 2 cm					3 [cd]	2 [ud]						
	Brick masonry 24 cm					3 [cd]	1 [ud]						
	Mortar					3 [cd]	2 [ud]						
	Insulation mineralwool 8 cm			1 [cd]	1 [ud]								
	Wall 11,5 cm					3 [cd]	1 [ud]						
	Mortar					3 [cd]	2 [ud]						
B3	Plaster 2 cm					3 [cd]	2 [ud]						
	Brick masonry 24 cm					3 [cd]	1 [ud]						
	Insulation 10cm										4 [cd]	1 [ud]	
	Render 2,5 cm										4 [cd]	2 [ud]	
AC1	Plaster 2 cm					3 [cd]	2 [ud]						
	Areated concrete 24 cm					3 [cd]	2 [ud]						
	Render 2,5 cm					3 [cd]	2 [ud]						
AC2	Plaster 2 cm					3 [cd]	2 [ud]						
	Areated concrete 24 cm					3 [cd]	2 [ud]						
	Mortar					3 [cd]	2 [ud]						
	Insulation 10cm										4 [cd]	1 [ud]	
	Render 2,5 cm										4 [cd]	2 [ud]	
RC1	Plaster 2 cm					3 [cd]	2 [ud]						
	Reinforced concrete 20 cm					3 [cd]	2 [ud]						
RC2	Plaster 2 cm					3 [cd]	2 [ud]						
	Reinforced concrete 20 cm					3 [cd]	2 [ud]						
	Insulation 8 cm										4 [cd]	1 [ud]	
	Render 2,5 cm										4 [cd]	2 [ud]	
RC3	Plaster 2 cm					3 [cd]	2 [ud]						
	Wall 20 cm					3 [cd]	2 [ud]						
	Substructure Aluminium 20 cm			1 [cd]	1 [ud]								
	Insulation Mineralwool 16 cm			1 [cd]	1 [ud]								
	Cladding Eternit 1 cm			1 [cd]	1 [ud]								

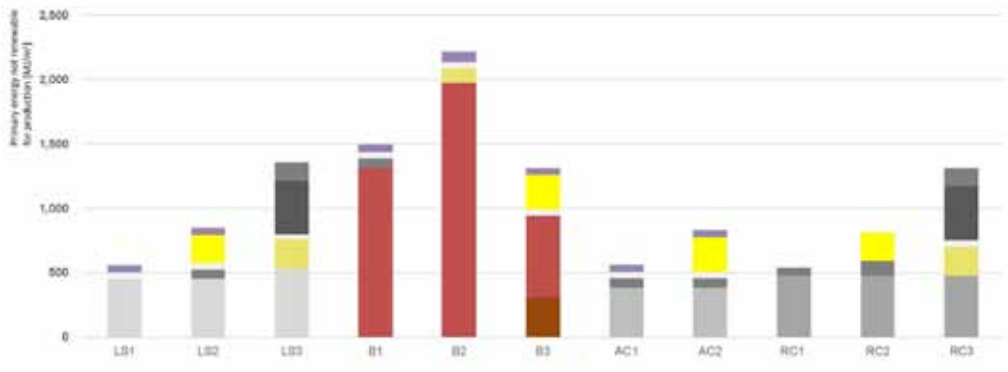


Figure 9: Primary energy not renewable for production according to materials.

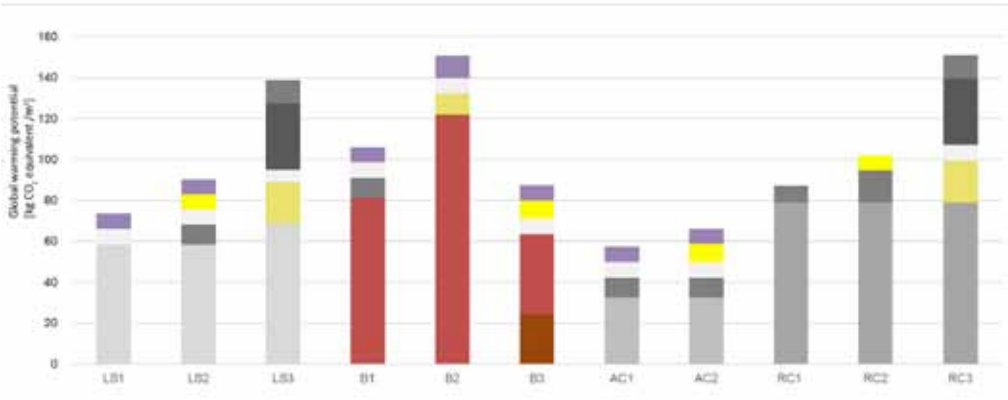


Figure: 10 GWP for production according to materials.

This approach is useful to inform the planer about the condition of the material when the building is demolished.

3.5 LCA and fraction groups

This approach includes the LCA to calculate the primary energy not renewable and global warming potential for one square meter façade, building on the association of material connection and material condition in the end of life phase. This serves to include the ecological value of material and provides a hierarchy for materials which are more suitable to be deconstructable.

LCA

LCA based on the production (A1-A3) with the German database Ökobau.dat data has been calculated. Figure 9 and 10 display the results. The LCA shows the brick construction (B1-3) and the ventilated façade (LS 3, RC3) to embody the five highest values of energy among the façade case studies. In most cases, the load bearing layer indicates the highest share of impact. Naturally, with adding layers (facing shell B2 or cladding on substructure LS3/RC 3) the values increase. The façades made of concrete show a high GWP due to the cement share. The materials stored in LS3, B2 and RC3 are of great ecological value.

LCA and waster fraction groups

The condition shown in paragraph 3.4 is connected here with the LCA results. Building on Table 4, here the materials are weighed regarding the ecological relevance. Figure 11 shows the embodied energy and emissions associated with a conventional [cd] and in Figure 12 with maximum deconstruction scenario [ud].

Some case studies, like the brick masonry construction, embody a high amount of embodied energy and emission. If reuse is an option, from an ecological point of view deconstruction should be proceeded.

The ventilated systems (LS3, RC3) also embody a high amount of energy but also include reuse and high value recycling options. The aerated concrete and lime stone variants show lower values and in the conventional treatment lower value recycling.

Comments on the method

Beyond the qualities described in paragraph 3.4, this part evaluates the relevance of each building material. For products with low embodied energy and emissions the connection is of lower relevance while the ones with higher environmental impact can contribute to a better performance

Figure 11: Embodied energy and fraction groups [ultimate deconstruction].

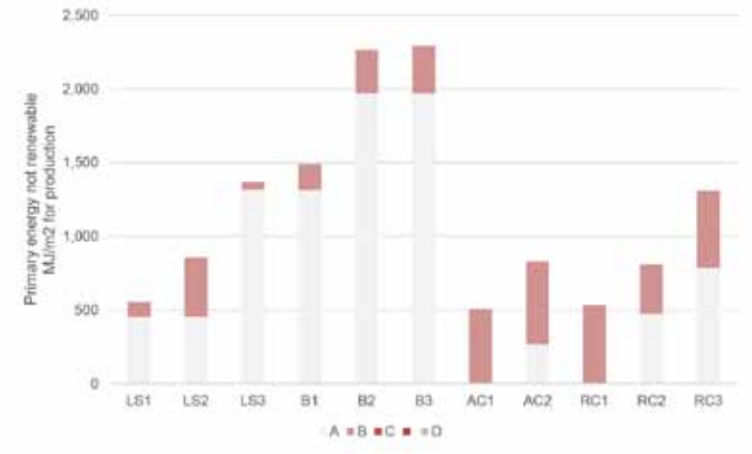
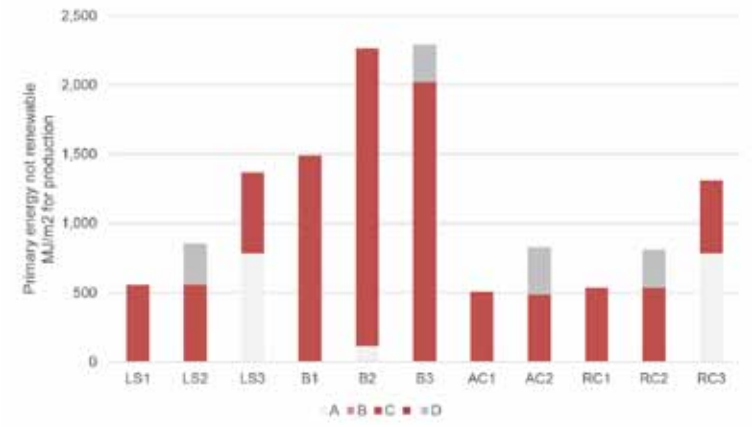


Figure 12: Embodied energy and fraction groups [conventional demolition].



when the connection releases the building element with low investment, energetic and financial.

This method uses information provided in the planning phase and provides practicable application. The association to the end of life treatment is transparent and reliable. This approach is considered suitable to indicate the further use of building substance.

4. FURTHER APPLICATION AND DISCUSSION

The previous section introduced the indication of an end of life scenario on building element level by using a reference table which relates the type of connection and the material group to a treatment scenario (reuse or recycling, landfill). This method was integrated in a BIM tool by the chair of Reuse in Architecture at the RWTH Aachen University. It is used to validate the method introduced previously.

4.1 Validation by transfer into a BIM add-on

The software add-on was developed to inform the planner by LCA and end of life scenario. While a variety of software solutions is available which connect the building cubature with ecological information (for example CAALA, Tally, 360optimi and other) the end of life scenarios are based on the material level or the relation between construction and end of life scenario is not transparent. The developed "*rb tool*" by the chair of Reuse in Architecture is based on Autodesk Revit and was developed for student application to evaluate building element alternatives regarding the environmental impact. The Revit interface uses 150 selected LCA flows from database Ökobau.dat to connect it to the building volume/weight and the type of connection is referenced to the condition and an end of life scenario (Figure 13).

The results are presented (without data export) in real-time so a design decision (reduction or change of materials and connection) is graphically indicated by a distribution within the fraction groups and absolute values for embodied energy and emissions. Based on this, the architecture master students designed floor, building envelope and an interior wall element.

The interface worked for different levels of background knowledge. Students with knowledge on LCA and end of life consideration and those who were new to the subject could design the building element and iteratively improved the elements by different strategies. 30 students used the plug-in for the building elements optimisation.

Practicability

The integration of environmental parameter in the architectural planning phase is often associated with complex information. In this research, the material and the type of connection needed to be specified. Distinguishing one type of connection to another needed careful attention at first, but was then easy to transfer to the individual construction. The material and connection could be chosen by a drop-down menu. Alternatives were compared using real-time graphs.

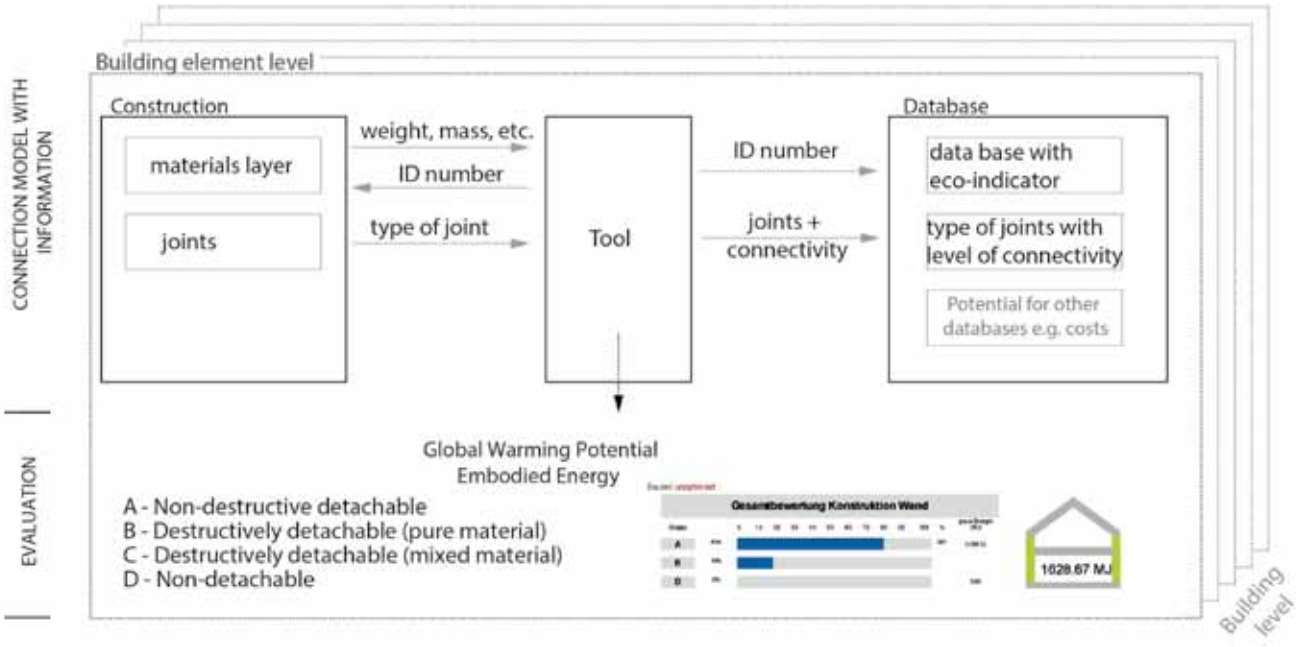
The frame work conditions were predefined, such as using A1-A3, excluding the life span and using the four fraction groups instead. The limited information provided helped to focus on the application. Before using the rb-tool the students calculated the LCA and fraction groups manually to A) gain understanding and B) have control values for the BIM based evaluation. Students who did not do the manual calculation could not answer the questions in the exams but still showed environmentally improved solutions supported by the tool.

While some students reduced the environmental impact by exchanging materials or optimizing the profile, others focussed on the circularity aspect by choosing the most suitable type of connection.

Reliability

The reliability of the tool was controlled by the manual calculation. Deviating results were iteratively adjusted. The comparison is useful to check the

Figure 13: Structure rb tool.



accuracy of the tool rather than the method. The reliability of the method can be deduced related to the LCA data and the fraction groups. While LCA is established, end of life scenarios depend on the LCA conductor.

Potential and Outlook

The three approaches shown, represent different potential for further application. Monitoring the steps of deconstruction and referring them to the construction type can be relevant when more experience on deconstruction and subsequently more data are generated. With essentially improved data availability for example by information from deconstruction professionals this approached can be reconsidered. In the current situation, it is not further applied.

The combination of LCA and fractions groups shows potential for further investigation. The hierarchy for deconstruction suitability can advise a planner to integrate materials of high ecological value with a connection which is easy to disassemble. Using LCA allows to change indicators; while today primary energy not renewable and global warming potential are most common, this could change to other indicator for example biodiversity considering the decline of insects and other factors.

The application in the tool shows good applicability. The focus on building element level enabled the analyses on specific qualities, like environmental, safety, sound and visual aspects. This advantage needs to be transferred and tested on building level, too. Spatial issues as well as process integration needs to be further investigated.

Further research is needed on the scenarios which associate the type of connection with the condition in the end of life phase per material group. Additionally, the building context needs to be included as well as impact on the reuse and recycling paths are expected.

While this evaluation focuses on environmental aspects only, a transfer to economical parameters is needed, too. The value of the material before and after the use phase can be considered. Financial information on waste fractions are available.

The introduced method highlights the significance of resources in the built environment and the relevance of strategies to reduce the impact associated to them. While strategies provide orientation, methods on different levels are needed to apply circularity and resource efficiency. The method here shows one way of quantifying environmental impact as decision-bases by displaying the resources and emission associated with the condition the material is in after one usage phase. It contributes to the discussion and delivers support for planners with different level of knowledges on sustainable aspects to support preservation of primary resources and reduce low value-recycling.

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POTENCIALI IN OMEJITVE OKOLJSKIH VIDIKOV ZASNOVE Z UPORABO ORODIJ ZA OCENO ŽIVLJENJSKEGA CIKLA

POTENTIAL AND LIMITATIONS OF ENVIRONMENTAL DESIGN WITH LCA TOOLS

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IZVLEČEK

Grajeno okolje ima velik vpliv na okolje. Arhitekti v načrtu lahko v veliki meri določijo, kakšne vplive na okolje bo imela stavba v svojem življenjskem ciklusu. Na izbiro materiala in vrsto gradbenih objektov lahko vplivamo že v začetnih fazah načrtovanja. Za merjenje vplivov na okolje se uporabljajo orodja za oceno življenjskega cikla (angl. life cycle assessment – LCA). Članek obravnava rezultate štirih študij primera, v katerih so bila uporabljena štiri nova orodja za oceno življenjskega cikla, in sicer pri štirih akademskih predmetih na različnih univerzah. Rezultati kažejo, da je uspeh orodij za oceno življenjskega cikla v veliki meri odvisen od časa, ko se orodje v procesu načrtovanja uporabi, in strategije za načrtovanje, ki ji študent sledi. Če se ob pravem času uporabi pravo orodje, in to ustreza strategiji načrtovanja, lahko izboljšamo kakovost arhitekture in zmanjšamo vplive na okolje. V večini primerov pa čas uporabe ni bi ustrezen, posledica tega pa so bili dodatni napori ob uporabi orodja za oceno življenjskega cikla. Arhitekturno načrtovanje in izboljšanje okoljske uspešnosti zato med seboj konkurirata. Pri tem pa trpi kakovost arhitekture ali pa se orodje uporabi (pre)pozno in okoljske uspešnosti ni več mogoče izboljšati. Četudi je čas uporabe orodja pravi, je uspeh v veliki meri odvisen od strategije načrtovanja. Število orodij narašča, za vsako fazo projektiranja je na voljo ustrezno orodje. Strategija načrtovanja se moram ujemati z orodjem, to pa zahteva pripravljenost, da pristope k načrtovanju prilagajamo. V preteklosti so bila vprašanja okoljskih vidikov načrtovanja povezana s pomanjkanjem ustreznih orodij, danes pa problem predstavlja pomanjkanje ustreznih pristopov k načrtovanju. Poučevanje o uporabi orodij na seminarjih je enostavno. Strategije okoljskega načrtovanja moramo vključevati v projektiranje in jih razvijati v vseh fazah načrtovanja, da postanejo tudi del arhitekturnega izobraževanja.

KLJUČNE BESEDE

orodja za oceno življenjskega cikla (LCA), okoljski vidiki zasnove, faza arhitekturnega načrtovanja

ABSTRACT

The built environment has a very high impact on the environment. Architects can largely define the environmental impact a building will cause throughout its lifetime through its design. Especially the choice of material and the type of construction can be influenced in early design stages. To quantify the environmental impact, tools for Life Cycle Assessment (LCA) are used. This paper discusses the results of four case studies of applying four different novel LCA tools in four different academic courses at different universities. The results show that the success of applying LCA tools highly depends on the point of time during the design process and the design strategy the student pursues. If the right tool is used at the right moment and matches the design strategy, it can help to improve the architectural quality and reduce environmental impacts. In most cases however, the time of application did not fit, resulting in additional effort for applying the LCA tool. In consequence, the architectural elaboration of the design and the improvement of environmental performance compete against each other. Either the architectural quality suffers or the tool is employed late and the environmental performance cannot be improved. Even if the point in time of the tool application is right, the success depends highly on the design strategy. The number of tools is growing and there is an adequate tool available for each design stage. The design strategy has to match the tool and this requires a willingness to adapt the design approach. The issue of environmental design shifted from a lack of adequate tools to the lack of adequate design approaches. Tools can be easily taught in seminars. Environmental design strategies, however, have to be included in design studios and developed throughout the entire design phase to become part of architectural education.

KEY-WORDS

LCA, -tools, environmental design, architectural design phase,n

1. INTRODUCTION

1.1 Scope of environmental impact by architects

The built environment is responsible for one third of the global greenhouse gas emissions and more than 40% of the world's primary energy demand (UNEP SBCI, 2009). Additionally, approximately 50% of the world's processed raw materials are used for construction (Hegger, Fuchs, Stark, & Zeumer, 2007). Architects largely define the resource demand and environmental impact a building will cause within the next 50 to 100 years. While the energy to operate the building is influenced by user behaviour, the embodied energy and emissions are predefined by the building geometry, material choice and construction. To assess the energy embodied in the material and the emissions released during production and disposal, waste processing or recycling, the internationally standardized method of Life Cycle Assessment (LCA) is commonly used. LCA involves the evaluation of the environmental aspects of a product or service throughout all stages of its life cycle. It has originally been developed in the 1970s to evaluate consumer products such as beverage packaging (Klöpffer & Grahl, 2014). Since then LCA has become a widespread method for environmental impact assessment of consumer products and services. In the last ten years, it has also increasingly been applied for the assessment of buildings, especially in an academic context (Weißenberger, Jensch, and Lang 2014). However, evaluating the building design through LCA is not sufficient on its own, as it does not improve the design (Wittstock et al. 2009). To minimize environmental impacts, an integration of LCA into the architectural design process is needed.

1.2 Architectural Design Stages

In general, the planning process of a building can be divided into three main phases, namely pre-design, design, and execution. According to the plans developed in the planning phase, the building is realized, handed over to the client and the use phase begins. During pre-design the client defines the design task or it is developed in collaboration between architect and client. During the design phase, most parameters that influence the environmental performance of a building are defined. Therefore, this paper focusses on the design stage. In addition, architectural education in universities focusses mostly on the design stage. In most industrialized countries, the design phase is divided into several parts which serve as a basis for the calculation of architects' fees (El Khouli, John, & Zeumer, 2014). For this paper, the structure described by Royal Institute of British Architects (RIBA, 2013) is employed, which divides the design process into three parts, namely:

- Concept design
- Developed design
- Technical design

The main tasks of each phase are described in the following. In concept design the general design idea is developed, functional requirements are described and the design tasks are defined by geometric parameters including volume, orientation, etc. The developed design can include decisions on the type of construction, for example whether a skeleton structure or monolithic walls will be used. Definition of the building materials, the connections between different materials, and the HVAC systems occur in the technical design with increasing level of detail. The circularity (re-use or recycling potential) is defined by the type of connection and the material choice in these phases.

In general, decisions made in the early stages of the design process, have the greatest influence, as they set general conditions for the subsequent design process (Paulson Jr. 1976, p.588). As such, the concept and developed design phase have the highest influence on both operational energy demand (Hegger et al. 2007, p.180) and the environmental impacts (Schneider 2011, p.39). This highlights the important role architects and designers play in climate change mitigation and resource efficiency even if they might not always be aware of it. Clearly, there is the demand for integrating environmental aspects in the design process.

The decisions taken in each part depend on the strategy of the designer and are individual. The phases introduced provide comparability for the decisions made in the architectural planning process.

1.3 Relevance of tools in environmental design

For the integration of environmental concerns, architects need to be informed about the interdependencies between design decision and environmental impact. They can be advised by engineers or environmental scientist or use tools that calculate and visualise the effects of design decisions. In concept and developed design, architects usually work alone, without advising engineers or scientists. Therefore, they often have to rely on simplified computational tools. In the last 10 years, software programs have been developed to include an increasing number of functions, among them the calculation of the operational energy demand and the integration of energy and emission embodied in the building materials. Due to the increasing use of 3D models and the rapid development of computation power, it is now possible to provide real-time feedback on analysis results during the design. This enables architects to receive quantified information during the design process without much additional effort. To allow for design-integrated application, tools need to match the level of detail of current design stage and support decision necessary according to the process of the project.

1.4 Student course as case studies for environmental design

Architectural education has a long tradition of teaching in design studios. The students develop solutions, receive feedback from professors and other students and refine their solutions based on the feedback (Kvan & Yunyan, 2005). In the last two decades, design studios have increasingly focussed on environmental aspects in a qualitative way, for example energy efficiency (Heidenreich & Schütz, 2010), eco-design (Suau, 2013) and reuse projects (for example the student design and built projects "Recycling Mies" (designbuildxchange, 2016) in Aachen or "Die Lücke" (Baunetz, 2016)) in Weimar). The approach of research-lead teaching provides advantages for both,

Table 1: Overview on courses.

Case study	I	II	III	IV
Course name	Sustainable Construction	Cycle-oriented Construction	Link-in-Energy	Environmental Design Strategies
LCA tools	Lixcel	rb-tool	PLCA-tool	CAALA, rb-tool
Assignment	Design of an office building, optimisation using LCA	Optimising type of construction and material choice using LCA and recycling aspects	Definition of design task, Design of a building, optimisation using LCA	Design of student housing, optimisation using LCA
Design stages	Concept design, developed design, technical design	Developed design, technical design	Pre-design, concept design, developed design	Concept design, developed design
Number of students	49	28	36	11
Stage of education	Bachelor	Master	Master	Master, Bachelor
University	Detmolder Schule für Architektur und Innenarchitektur, Germany	RWTH Aachen, Germany	Bauhaus University Weimar, Germany; University of Mersin, Turkey	Bauhaus University Weimar; ETH Zurich, Switzerland; RWTH Aachen
Month /year the course was held	Sep./10 to Feb./11	Oct./16 to Jan/17	Oct./14 to Jan. /15	August/17

teacher and students; Students gain access to latest findings and lecturers and researcher receive feedback on questions they are working on. In this context, the student courses presented in this paper have not been specifically designed to answer the research questions. Years of using LCA tools in student education reflected the interaction of the design phases and the LCA tool. To evaluate the relationship between the design process and the LCA tools, case studies where selected which used different tools in different phases of the design process. The student courses as case studies embody the advantage to include the phases from concept to technical design. The completeness in a defined time period mimics the design process in an architectural office.

While environmental aspects of the project can be collected and quantified by the LCA tools, the architectural dimension is non-quantifiable and up to the creativity of the designer. The evaluation of architectural quality is always a complex task and part of any design assignment in architectural studies. In the scope of this research, the critical feedback of professors and lecturers of the student courses are taken as bases for the integration of architectural design.

This paper discusses the potential and limitations of applying different LCA software programs in the architectural design process based on four student courses. It characterizes different tools and reflects the stage of its useful application. It discusses the relevance of each design phase and the depth of information in different tools needed for each stage. The findings can improve the education in architectural design courses. The suitable combination of LCA tools and design phase can help to develop sustainable buildings including a reliable review of the environmental quality. Additionally, the insights can be used for practising architects who want to apply LCA tools in early design phases.

The paper is structured in three parts: The first provides background and motivation. The second introduces the three case studies (chapter 2) and shows their results (chapter 3), while the third and last includes the discussion (chapter 4) and the conclusion (chapter 5).

2. CASE STUDY DESCRIPTION

In this chapter, the case study courses are described regarding their content, the assignment and goal, the number of students and the university as well as the LCA tool used. Table 1: Overview on courses. provides an overview of the basic parameters of each course.

The case studies are chosen to provide a variety of LCA tools and stages in which they were introduced. Beyond that, the knowledge levels of the students differed (in some courses the assignment was embedded in lectures on sustainability and LCA in particular others came without any prior knowledge) and different time spans to work on the project, too. The focus on environmental design and the focus on the design stage was common for all courses.

2.1 LCA tools

LCA software programs in architecture became common in the last decade as environmental data on building material was increasingly available in the form of Environmental Product Declarations (EPDs) (Passer et al., 2015) or national databases. Institutions provide open access to databases like Ökobau.dat (BBSR, 2016) and Wecobis (Haas & Asam, 2014) and with knowledge on the method of LCA, the data can be linked to the building substance. The first software programs providing this link were based on spreadsheets. The second generation of LCA tools are based on 3D CAD models and include functions like the export of volumes and finally the integration of LCA databases.

Bach & Hildebrand (2017) describe differences in LCA software products in architecture by the eight categories product origin, data source, required user's knowledge, default settings, accessibility, entry format, level and life cycle settings. A brief overview of the tools is given structured according to these differences (Table 2: Overview on LCA tools.). The tools used here have the same origin (Germany) and use the same data source (Ökobau.dat). The required user's knowledge on environmental design varies among the tools

Table 2: Overview on LCA tools.

	Lixcel	Rb-tool	PLCA-tool	CAALA
Product origin	Germany	Germany	Germany	Germany
Data source	Ökobau.dat 2011	Ökobau.dat 2016	Ökobau.dat 2013	Ökobau.dat 2016
Required user's knowledge	High	Basic	Medium	basic
Default settings	No	Yes	Yes	yes
Accessibility	Free	Free	Free	Free (educational version)
Entry format	Spreadsheet	3D model	3D model	3D model
Level	Whole building	Building component	Whole building	Whole building
Life cycle settings	Production End-of-life	Production, use End-of-life	Production, use, End-of-life, recycling	Production, use, End-of-life, recycling
Life cycle modules (EN 15978)	A1-A3 C3, C4	A1-A3, B4, C3, C4	A1-A3, B4, B6, C3, C4, D	A1-A3, B4, B6, C3, C4, D

and is related to the default settings. Lixcel needs very detailed information and delivers reliable results only when all data is filled in correctly which leads to a comparable high level of user knowledge. The rb-tool, PLCA and CAALA include default settings and the user needs only basic knowledge. The accessibility is less relevant in this context as the software products were made available to all students. The format to enter information is geometric for the three tools rb-tool, PLCA and CAALA. Lixcel works spreadsheet based. Lixcel, PLCA and CAALA calculate the environmental performance on building level. Rb-tool only looks at the materials and construction on building element level. Lixel considers the life cycle phases production and end of life, PLCA and CAALA include production, building operation and end of life while rb-tool contains the use phase and the end of life.

In the following, the programs are introduced by brief description.

2.1.1 Lixcel

In the beginning of this century, a variety of excel-based spreadsheets was developed to calculate the embodied energy and embodied global warming potential of buildings. Their main purpose was the connection of a database with environmental information referring to one kilogram or one square meter of material and the volume or mass of the material in the construction. The spreadsheet tables could be customised to the scope of the task. Factors, like the life span of materials and the building, the indicators and the information depth could be adjusted. *Lixcel* was developed at the Detmolder Schule für Architektur und Innenarchitektur, Chair for Building Construction and Design specifically for student application.

Lixcel consists of three spreadsheets; results, entry format and life span of buildings materials. The entry table is organised in cost groups following DIN 276 (DIN, 2008).

Lixcel was subject to a high error rate and eliminating these made the use time-consuming and inconvenient. It was limited to university use only from 2009-2014 when 3D programs with LCA plug-in where insight but the embedded LCA was not reliable yet.

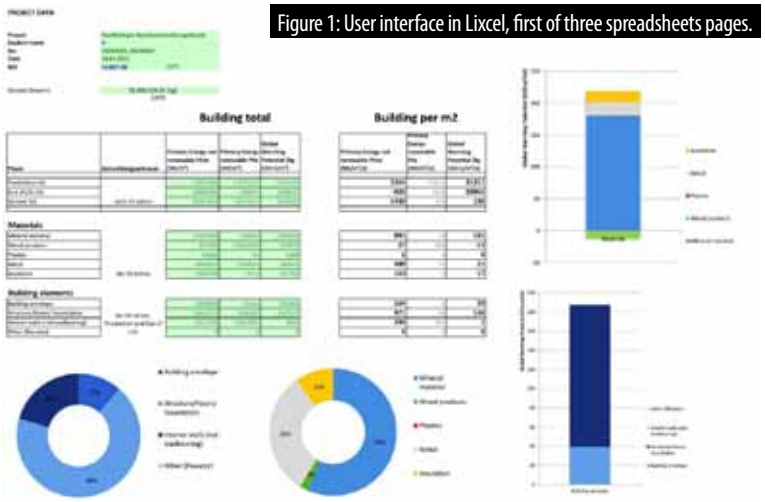


Figure 1: User interface in Lixcel, first of three spreadsheets pages.

2.1.2 rb-tool

The capabilities of 3D CAD software programs grew in the last years and plug-ins for different functions were programmed. The *rb-tool* was developed at RWTH Aachen University, Institute for Reuse in Architecture as a plug-in for Autodesk Revit for student application. The aim is to calculate the embodied energy and embodied global warming potential of building elements and indicate the ability for further use, namely reuse, recycling and landfill. The tool includes LCA values from the Ökobau.dat (2014) for the production phase and connects the further use scenario and on the LCA results in one graph (Figure 2: User interface of the rb-tool in Revit.). It includes the Revit user interface and graphical illustration which provides results in real-time. The building elements are drawn in 3D, the materials are chosen from a library and so are the type of connection between material layers. The students did not need basic knowledge of the LCA method and of reuse and recycling scenarios as the library automatically associates LCA data and information on further use scenario based on material and type of connection.

Figure 2: User interface of the rb-tool in Revit.

2.1.3 PLCA-tool

To make LCA applicable for parametric design, a method named *Parametric life cycle assessment* (PLCA) has been developed (Hollberg, 2016). The prototype tool was developed in Grasshopper, a parametric plug-in for the 3D CAD software Rhinoceros. The main difference to other LCA or building energy performance tools is the combined calculation of operational and embodied energy (and other environmental indicators). The 3D model is drawn in Rhinoceros (Figure 3). The materials and HVAC systems are input in Grasshopper using drop down lists and sliders (Figure 4). The simulation of the operational energy demand is based on the EnergyPlus (DOE, 2015) engine. A self-develop script calculates the embodied impact using the German Ökobau.dat database 2013 (Hollberg & Ruth, 2016). The results are visualized in a Rhinoceros viewport showing the non-renewable primary energy and global warming potential (Figure 5).

Figure 5: Visualization of results in Rhino.

2.1.4 CAALA

A cloud-based plug-in for SketchUp called *CAALA* was developed based on findings from using the PLCA-tool. The software automatically collects the areas of different building components from SketchUp and calculates both, operational and embodied environmental impacts. For the operational energy demand calculation, a simplified monthly quasi-steady approach based on DIN V 18599 (DIN, 2011) is employed (Hollberg, Lichtenheld, Klüber, & Ruth, 2017). The embodied impact is calculated using the database Ökobau.dat 2016 and the simplification rules of the DGNB system (German Sustainable Building Council, 2015) are employed.

Figure 3: Geometry model in Rhino.

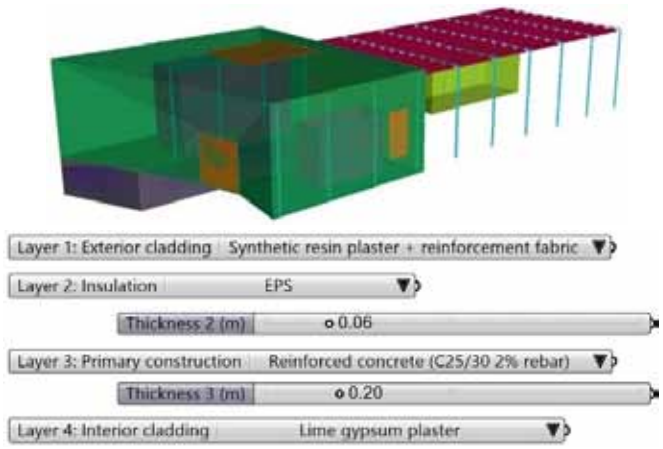
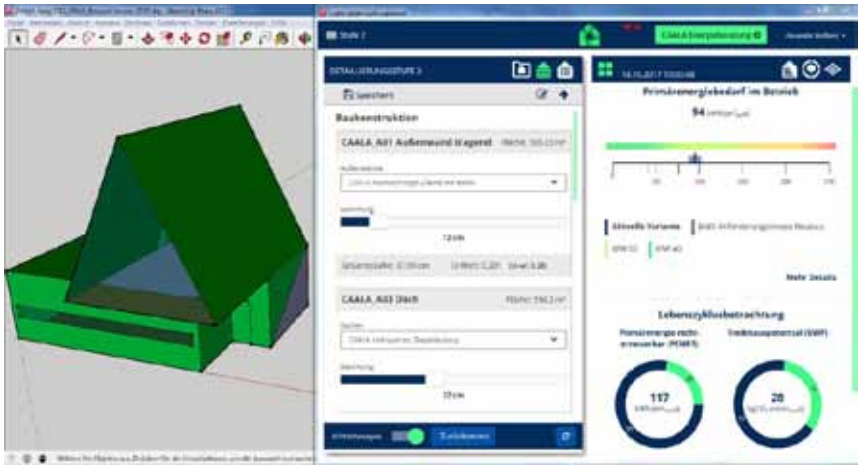


Figure 4: Parametric material definition in GH.

Figure 6: User interface of CAALA (left: SketchUp modelling environment, right: input of materials and visualization of results in browser window).



2.2 The student courses and assignments

All courses aimed at teaching architectural students LCA and its application for environmental design. They were held at and in cooperation with different universities, namely the Bauhaus University Weimar, Detmolder Schule für Architektur und Innenarchitektur, ETH Zürich, University of Mersin and RWTH Aachen University. All courses were supervised by at least one of the authors. The duration of the course varied from semester-long to two full-time weeks. Lectures on sustainable design with different extent accompanied the design assignments. The level of knowledge on environmental design strategies or LCA in particular varied among the students.

2.2.1 Course and assignment – Sustainable Construction

The course *Sustainable Construction* was held between the years 2008-2013 by the Chair of Building Technology and Design for 65-80 bachelor students of architecture at the Detmolder Schule. The students heard lectures on Sustainable Construction and the method of LCA was taught. The students were expected to have basic knowledge of LCA when working with Lixcel. The case study includes the winter semester 2010 after Lixcel underwent its first optimisation cycle. The assignment included the design of an office building and an LCA for the building materials. The course was structured in three parts. In the first phase, the design concept was developed, in the second the type of construction was planned and in the third, the LCA calculation was made. The students worked in groups of two. The assignment was the same during five years with only little variation. In one aspect, this course was different to the others. By mistake, the LCA tool Lixcel was made available to the students during the concept-phase while it was planned to be handed out in the developed-phase. Most of the students used the LCA tool without the supervisor's knowledge, filled in the materials and copied LCA flows from a prepared spreadsheet. The assignment included the definition of the material, the volume, its density and the expected life span. Data were inserted for the LCA phases production and end-of-life. Lixcel then calculated the exchange cycles and showed the results on the first sheet. The level of required information was very detailed.

2.2.1 Course and assignment – Cycle-Oriented Construction

The master-course *Cycle-Oriented Construction* was held in the winter semester 2016. 30 architecture students joined the weekly course for lectures. The assignment was structured in three parts. First, a reference building was defined and the relevant building elements were identified. Each material and type of construction were planned in detail for one square meter of the chosen building elements. Based on this, LCA values for the production were calculated manually and the further-use-scenarios after the end-of-life of the specific building element were defined manually. In this way, the students learn to apply the LCA method and the scenarios for further use. In a second step, the rb-tool was used to do the same, LCA calculation and referencing the further use scenarios. In the third phase, the building elements were optimised regarding their environmental impact by decreasing the LCA values or improving the further-use scenario.

2.2.2 Course and assignment – Link-in-Energy

The third case study is based on the design studio called *Link-in-Energy* held at Bauhaus University Weimar and University of Mersin in 2015 (Hollberg et al., 2016). The 36 students were all in the master programme of architecture. The design task consisted in developing a use scenario and designing a building for the historic city of Tarsus, south Turkey. The environmental aspect was one of the main criteria from the beginning of the project and all students received introductory lectures on sustainability, energy concepts, LCA and the importance of embodied energy in building materials. Nine students (Group 1) took part in a seminar for design-integrated LCA using the PLCA-tool. The students were asked to improve the environmental performance of their building by generating and comparing different design variants. The goal was to lower the environmental impact as far as possible. The first part of the semester focused on the improvement of the geometry. A default material configuration had been provided for the students, which served as a baseline scenario. For the second part of the semester, the students should model their individual materials to improve the environmental performance further. The 27 students that did not take part in the LCA seminar (Group 2) had the same design task and were asked to base their environmental concept based on the qualitative information they received in the lectures. They had to hand in a 3D model of the geometry and a list of materials at the end of the project. The supervisors used the PLCA-tool to calculate the LCA results.

2.2.3 Course and assignment - Environmental Design Strategies

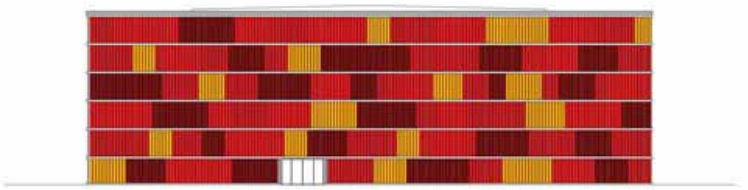
The course *Environmental Design Strategies* took place in Weimar as part of the Bauhaus Summer School in August 2017. During two weeks, an international group of 11 students worked in interdisciplinary pairs of two. The task was to develop an environmentally friendly design for a student apartment house for 45 students in Weimar. The course focused on the environmental aspects of the building design, including an energy- and a material concept. The students received an introductory lecture and then started developing a concept on the first day. This concept was refined on day two after a visit to the building site. On the third day, all students were introduced to CAALA. They presented their projects roughly every second day and could acquire feedback from the supervisors at any time.

3. CASE STUDY RESULTS

The challenge of the course assignments was the integration of both, the design and functional requirements with environmental performance. In this chapter, the courses' results are documented and discussed regarding both aspects.

Next to the description of the outcome, for each course a graph summarizes the environmental performance on the y-axis and the architectural quality on the x-axis. The indicator for the environmental performance depends on the tool applied, for example minimum embodied primary energy. The architectural quality can only be evaluated in a qualitative way. The graphs represent the grades given by the individual supervisors for the

Figure 7: left design by Group 1, right design by Group 2.



architectural design. Clearly, the aim of each course was to achieve results in the upper right quarter – high environmental performance combined with high architectural quality.

3.1 Results - Sustainable Construction

The results for the course included an office design, documented by drawings and the LCA results. Sub-grades were given for the three parts of the assignment "concept and design", "definition of the type construction" and "LCA". Compared to the results from the previous semesters and the ones following, the "concept and design" grades where approximately 30% worse. Partly, the concept was poorly elaborated or the ideas for the building design were lost when using the LCA tool.

The initial assignment of the course included to first finish the work on the architectural characteristics including volume, openings, organisation of the functions, then elaborating this further on the type of construction and apply the LCA tool to exchange materials or compare different construction types. In this course, often the first design idea was calculated in Lixcel and design parameters, like geometry and orientation, were used to improve the environmental performance. The results the tool provides improve when reducing the building volume and all building elements with high values for embodied energy, like windows. The students did not reflect the consequences this had on the architectural characteristics. Some groups continued working on the initial architectural concept, probably as entering data for design alternatives was time intensive. Entering the building information in Lixel requires the definition of each material with its dimension up to millimetres. In their own judgement, students worked approximately four weeks to integrate one full building alternative in Lixcel. The average time supervisors needed to correct errors in the calculation was three hours, which lead to limited correction cycles.

Student Group 1 used the results in Lixcel to argue for design decisions: The building volume was optimized regarding the area-to-volume ratio, the window area was reduced and the spatial efficiency is very high. The narrow floorplan with endless corridors gave a pressed impression in the interior and provoked the nickname „office machine". Different student groups presented similar designs. Group 2 was an exception to this as they used the LCA tool at the very end of the semester. They started to use it after finishing the drawings. Findings from the LCA calculation were made available too late to be integrated into the construction and material choice. Architectural aspects were well reflected, while the environmental performance was under its

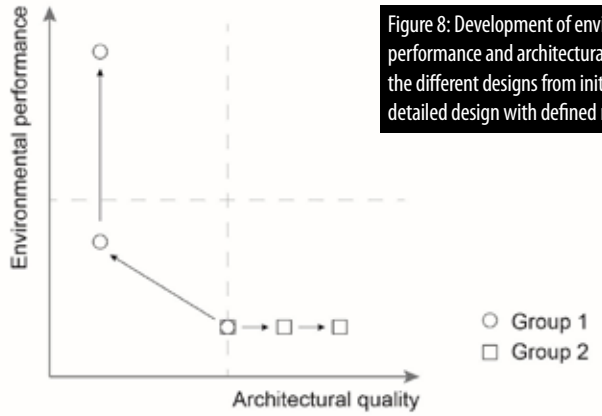


Figure 8: Development of environmental performance and architectural elaboration of the different designs from initial concept to detailed design with defined materials.

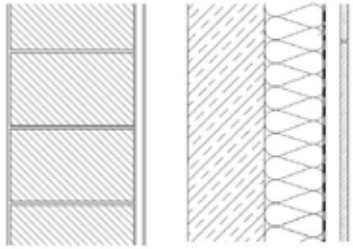
potential. In both groups only one aspect was considered, either the environmental or the architectural quality. (Figure 8: Development of environmental performance and architectural elaboration of the different designs from initial concept to detailed design with defined materials.)

3.2 Results - Cycle-Oriented Construction

The results in the course *Cycle-oriented Construction* included a documentation of the chosen building elements and their optimisation regarding the embodied energy (primary energy not renewable), the embodied greenhouse gas emissions (global warming potential) and the potential for further use of the building materials. The diagrams of the further-use scenarios refer to the results of the embodied energy and emissions calculation: If a material has a high ecological impact, it is more relevant to prepare it for reuse or recycling compared to a material which might have relevant weight share but shows low ecological impact. The functions of the building element remained the same. Optimising the environmental performance on building element level included an analysis of the required functions. The most relevant aspects include the surface quality following the interior design (and for the façade the building outside design), acoustics, fire resistance, load-bearing and the thermal capacity. Two approaches could be observed: while some of the students exchanged the materials to decrease the embodied energy and emissions (Figure 9), others worked on the type of connection to improve the share of reusable and recyclable material (Figure10). For the optimisation, different strategies were used. Solid construction was modified to a stick-and-beam system in order to decrease weight

Figure 9: The embodied carbon was reduced by changing to renewable materials.

Figure 10: Bevor (left) and after the optimisation (right).



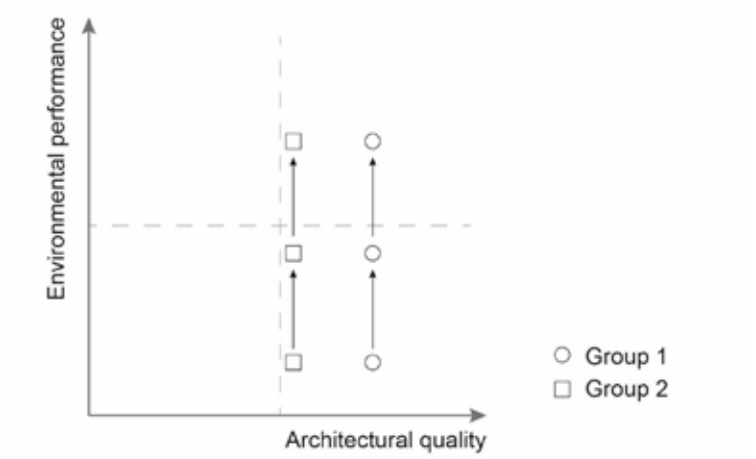


Figure 11: Development of environmental performance and architectural elaboration of the different designs from initial concept to detailed design with defined materials.

and hence, embodied energy and emissions. Integral systems were modified towards a separation of functions. For example, solid walls with render and plaster were developed to be separable. Non-renewable materials were replaced with renewable ones. All students achieved a significant optimisation by using the rb-tool. The real-time graphical feedback supported decision making. In the exam situation, this did not necessarily correlate to the level of understanding. While all showed good results only two thirds of the course could explain where the improvement came from and transfer this to other examples. However, integrating an ecological evaluation after the design parameter were set, supported an essential optimisation while not corrupting the function of the building element in the design context.

3.2 Results- Link-in-Energy

In the first phase of the semester, the students of Group 1 used the predefined standard materials to develop their designs. These results were compared to the designs of Group 2. The average of the results of both groups did not diverge. In the second phase, the students of Group 1 chose their individual materials and were able to save an average of 8.2% of primary energy and 16.2% of global warming potential compared to the baseline scenario. However, with the individual choice of material the designs of Group 2 performed worse than using the standard material. In consequence, the designs of Group 1 perform more than 40 % better when using the individual material.

At the beginning, the students taking part in the seminar (Group 1) had some difficulties in modelling the geometry. First, it was difficult for some students to draw abstract 3D massing models. Around half of the students had 2D floorplans of their design including wall thicknesses when they started modelling in 3D. It seemed difficult for them to reduce the complexity of their model for an energy "shoebox" model. Second, many issues arrived from the requirement of a watertight volume for the EnergyPlus calculation. Almost all students needed help in the beginning to fulfil the specific model requirements for thermal simulation. Throughout the semester they learned to find the errors themselves, however, it was a frustrating process for them. Finally, simulation time of one to five minutes seemed to be a problem, because they felt like they had to wait for the results and felt interrupted in their work. In consequence, they seemed to have simulated less variants than they desired, because they wondered whether it was worth investing the time. As such, the idea of an intuitive, playful, iterative optimization did not work out. As a result, the tool was not applied in early design stages and the geometry was not optimized using the tool. This can be seen in the results, because for the standard material the design of groups 1 and 2 perform equally well on average (see Figure 11).

However, the tool helped to take informed material decisions. Although both groups had the same task and attended the same lectures of sustainable construction and materials, the designs of Group 1 performed 40% better. Apparently, the environmentally friendly choice of material within the complex interactions between building equipment, insulation thickness, operational energy demand and embodied impact is not evident. Figure 11 summarizes the results for the start and end of the project. With the standard material provided as default the design of both groups perform similarly on average. Choosing individual material Group 1 managed to lower the GWP while Group 2 caused high results. However, Group 1 did not compare many variants and therefore did not reach the theoretical optimum of 100% environmental performance.

3.4 Results - Environmental Design Strategies

All six groups were able to model their design and to calculate a simplified LCA with predefined construction elements within half a day. The goal for the next days was to optimize their design through generating and comparing lots of variants, for both, geometry and material. One group did a thorough comparison of several geometries (see Figure 14: Comparison of the environmental performance of different geometries.). Another group compared two different geometric variants; however, the other groups did not generate design alternatives. They kept their initial concept and mainly used the results provided by the tool to argue the supposed environmental benefits of their

Figure 12: Perspectives of three exemplary student projects.

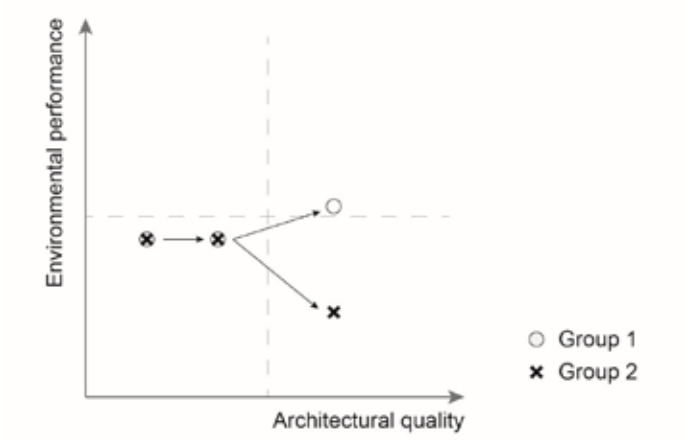


Figure 13: Development of environmental performance and architectural elaboration of the different designs from initial concept to detailed design with defined materials (Group 1 with tool, Group 2 without tool).

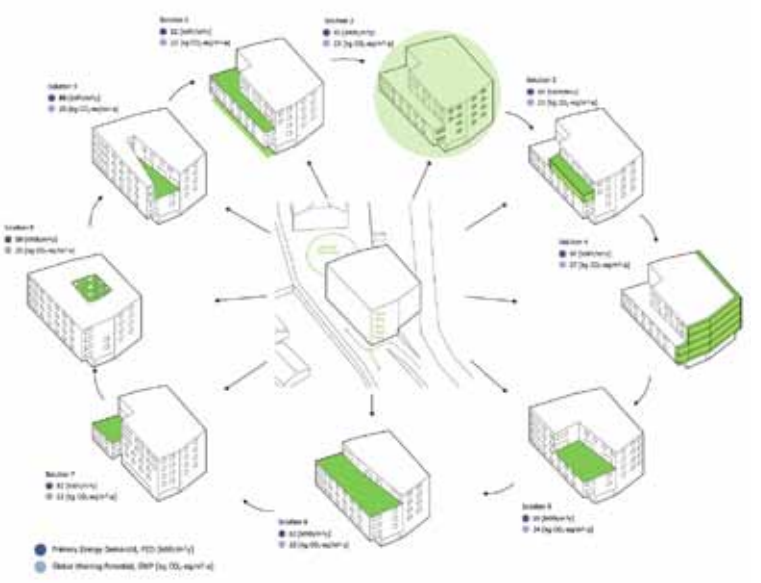


Figure 14: Comparison of the environmental performance of different geometries.

design. For example, they compared their alternative material choice to the same geometry made of concrete and conventional materials.

There were only minor difficulties in modelling and the application of CAALA in the concept design phase worked well. Nevertheless, only one group (Group 2) did a variant-based improvement process as intended by the teachers. Some groups started with an initial design with low environmental impact, based on their general knowledge or intuition. Group 1 for example chose a compact geometry, well-oriented windows and a combination of timber and earth construction material. Clearly, in this case the optimization potential using an LCA tool is smaller than for other groups that chose conventional materials, such as group 3. Figure 10 summarizes this aspect. Group 2 evaluated many design variants and reduced their impact compared to their initial variant. They even achieved slightly better environmental results than Group 1 that did not improve their initial variant based on the results of the tool. However, the design Group 1 showed the highest architectural quality. Both designs fulfilled the goals of the assignment.

4. REFLECTION ON THE CASE STUDIES

All four project show the aspects for the potentials and limits of the application of LCA tools in the architectural design process. In this section, these will be discussed regarding the following aspects:

- Integration of tools in the architectural design workflow and
- Relation of environmental performance and architectural quality.

4.1 Integration of tools in the architectural design workflow

The results from the courses presented here show that the quality of decisions based on LCA tools depends on the time of application in the design process. In conventional LCA calculation, the assessed object (the so called functional unit) is defined by its function which remains the same throughout the evaluation process. This is different in architectural design; the

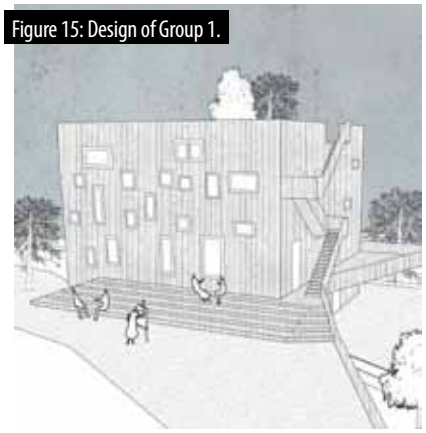


Figure 15: Design of Group 1.

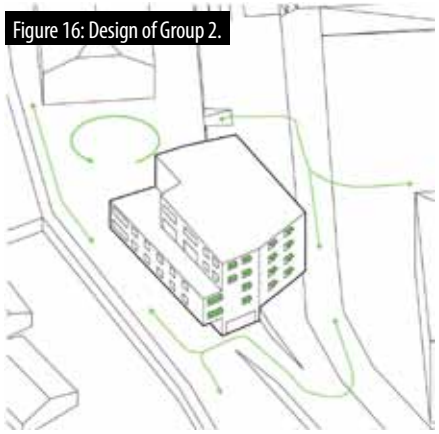


Figure 16: Design of Group 2.


Figure 17: Design of Group 3.

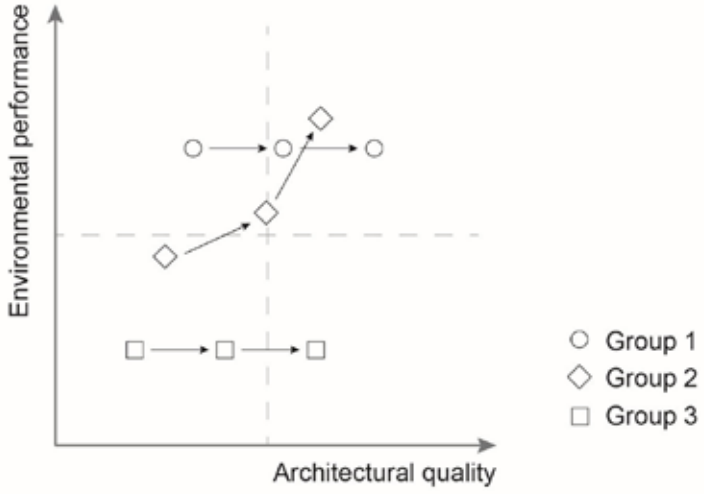


Figure 18: Development of environmental performance and architectural elaboration of the different designs from initial concept to developed design with defined materials.

function develops over the planning phase and the evaluation needs to be repeated in an iterative process. Integrating environmental aspects into the design phase requires an evaluation of the geometry, type of construction, materials or joints according to the design stages.

In general, integration in the early concept design stage allows for more design changes based on the LCA results and therefore for higher improvement of the environmental performance. However, the results of the course *Sustainable Construction* show that very accurate but complex data can result in too much time spent on the assessment. The information required for the tool needs to develop along with the design process. Managing complex data blocks the design process, if very detailed data are required too early. If the assessment is carried out late, changes cannot be integrated, because the iteration cycle would take too much time (for example see Group 2 of the course *Sustainable Construction*).

While during *Link-in-Energy*, the main issues resulted from the tool, the main question during *Environmental Design Strategies* was the design approach. Most students were interested in LCA results to use them as an argument for the supposed benefits of their design solution, but they did not seem interested in using the results to improve their solution. One reason might be that the assignment was to abstract. The supervisors asked to environmentally optimize the designs as far as possible. The results might have been different, if a limit on the global warming potential would have been fixed the same way a client fixes a financial budget for any design project. Furthermore, benchmarks showing how many kg of CO_2-eq/m^2 is "good" or "bad" might have helped to question solutions with low environmental performance.

The course *Link-in-Energy* showed that real-time results are very important in concept design to compare different variants. This is also true for the developed and technical design stage as shown in *Cycle-oriented construction* for defining the type of construction and materials, when the improvement is indicated without export and in real-time multiple alternatives can be tested.

The variety of LCA tools is increasing and the choice for one needs to reflect the design phase it will be integrated in. With the growing number of tools, it becomes even more important to employ the suitable tool at the right time. CAALA proved to be applicable in the very early design stages to compare geometric variants, while more detailed assessment using rb-Tool or spreadsheet-based tool such as Lixcel should be carried out in later stages to define constructions and materials.

4.2 Relation of environmental performance and architectural quality

The design strategies employed are of significance as two examples from the course *Environmental Design Strategies* show. Most students used a top-down approach moving from the building volume, to the detailed geometry and then to defining types of constructions and materials. They employed CAALA first, then moved to rb-tool and finally looked into detailed material databases. The advantage of this approach is that the

overall design concepts exists before any tool is used. As such, it will be unlikely that the tool compromises the design concept. Students do not put aspects of architectural design aside as observed in the course *Sustainable Construction* when they focussed mainly on the quantitative LCA results. The pure optimization towards the highest environmental performance, which means least embodied primary energy demand, in this case, leads to solutions that are not satisfying from an architectural point of view. The environmental performance and the design concept can only be improved through iteration cycles of generation of a variant, assessment, and adaption of parameters. This requires the willingness to integrate the results for the assessment and to re-evaluate decisions previously taken. If this willingness is lacking, no improvement will be possible.

One group of *Environmental Design Strategies* applied a bottom-up approach starting from the materials. They looked at regional available materials and focussed on combining these to building elements meanwhile evaluating the recyclability. Based on these environmentally optimized building elements they developed a design concept. They started their research using material databases, then moved to the rb-tool and finally to CAALA to evaluate the whole building. This approach showed the advantage that the environmental aspects of the material choice are well integrated into the design concept. A potential issue arises if too much time is spent on the material assessment and the architectural design concept is weakened.

5. POTENTIAL AND LIMITATIONS - CONCLUSION

This paper compares the results from four different academic courses using four different LCA tools during the architectural design process. The results show that the potential of using these tools to improve the environmental impact is very high, but keeping the balance between architectural design and environmental aspects is still difficult. Both dimensions require the other one as there is no architectural quality without the consideration of environmental aspects and there is no sustainable building without architectural quality. Ideally, both architectural and environmental dimensions benefit each other. Conflicts can occur, for example, a big glass area can provide a great view to the outside and benefit the architectural design but decrease the environmental performance due to a high embodied impact. Both sides need to be evaluated and the negotiation process requires a strong architectural concept, which protects the key characteristics and is flexible for optimisation.

The LCA tools can support this negotiation process. However, if the point in time during the design process does not match the tool, the dimensions of environmental performance and architectural quality compete against each other. This highlights the relevance of the choice of tool and time of application. The user needs to be aware about the tools capabilities and balance it to the time when it is employed for optimisation. As in conventional LCA for products, the architectural characteristics and requirements need to be defined first. In the concept stage of the design phase, a geometric optimisation needs to reflect this and show potential within this framework. In the developed stage, different types of construction are compared, followed by an evaluation of materials and joints in the technical stage. All case studies show, that the comparison of different alternatives is key to argue for the best solution. The course results showed that the success of employing LCA tools in the design process highly depends on the point in time and the design strategy followed.

In general, the integration of LCA into architectural design shows a high potential to optimise the environmental performance of buildings. The number of LCA tools is growing, the computation power of PCs is increasing and cloud computing opens new possibilities. The current students are used to work with computers. Furthermore, the application of 3D tools in early design is growing (Köhler, 2016) even if they all have their advantages and disadvantages. This leads to the conclusion that the issue of environmental design now shifted from a lack of adequate tools to the responsibility to develop a design approach that integrates architectural and environmental quality. The use of iteration cycles in designing, analysis, and adaption apparently is not common to many students. This requires the willingness and openness to question and revise decisions already taken. The method of iteration needs to be integrated into the design studios.

Currently, assessment tools in the design phase evaluate only one aspect, e.g. environmental or economic properties. This leads to the emphasis on a single parameter. Even if the environmental aspect is of particular relevance, a sustainable effectiveness develops only, if also functional aspects are integrated. In the future, the software competences will grow and more functions can be integrated in one tool. This stresses the relevance of two main findings and recommendations of this research: A strong design concept is needed that reacts throughout the planning process with flexibility while carving out its key characteristics; and awareness about the tool's capabilities reflects in the choice of a suitable tool in the specific planning stage.

The software market develops continuously and with high pace making it impossible to teach students all available tools. More important is to educate them to understand the scope of a specific tool and the relevance of a design strategy. This will support the next generation of architects to do both, develop buildings with architectural quality and contribute to a more positive environmental footprint.

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Boštjan Bugarič: KOMUNICIRANJE GRAJENEGA OKOLJA
COMMUNICATION OF THE BUILT ENVIRONMENT

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IZVLEČEK

Prispevek obravnava načine komuniciranja grajenega okolja. Poskuša opredeliti kako različne komunikacijske oblike, poddaja (zvok), dokumentarec (podoba) ali socialna omrežja dosegajo različne publike. Vsi ti različni načini, ki znatno vplivajo pri aktualizaciji urbanističnih in arhitekturnih vsebin, so predstavljeni na primerih poddaje, dokumentarnega filma ter online kataloga; sprehajali se bomo po tržnicah Londona, raziskovali nedokončane objekte v Kopru in se na koncu prepustili Architectuulovi spletni digitalizaciji. Komuniciranje grajenega okolja vključuje različne fokusne skupine in metode doseganja ter vključevanja javnosti. Katera komunikacijska orodja omogočajo oblikovanje kritičnega diskurza o urbanističnih tematikah je odvisno od načina dostopa do ciljnih javnosti.

KLJUČNE BESEDE

komuniciranje, virtualni prostor, komunikacijske tehnike, grajeno okolje, globalno mesto, digitalizacija

ABSTRACT

How do we react to different ways of communicating built environment? How do podcasts (sounds), documentaries (images) and social media communicate ideas and concepts often reaching diverse audiences? Drawing on examples of how different knowledge can be communicated through sound (podcast), images (documentary film) and catalogues (social media) we will reflect on how to create spaces that cater for different audiences and the meaning of disseminating built environment research in formats other than design. We will walk through the markets of London, explore unfinished buildings in Koper and look at digitized Architectuul's online catalogue. Different ways of communication involve different focus groups and methods of public involvement. Which communication enables the creation of a critical urban discourse depends on the access to the target public.

KEY-WORDS

Communication, Virtual Space, Communication Techniques, Built Environment, Global City, Digitization

1. UVOD

Razvoj novih tehnologij spreminja fokus medijskim reprezentacijam komuniciranja grajenega okolja. Sprememba reprezentacije je usmerjena v iskanje novih tehnologij in načinov komunikacije, ki se odvija tudi na nematerialnem nivoju. Globalno mesto je sestavljeno iz materialne in nematerialne infrastrukture, ki je s sodobnimi tehnologijami vse bolj izražena v kontekstu medmrežnih tokov. Pred tridesetimi leti je namesto spleta pri prezentaciji mest prihodnosti za vir navdiha služila filmska produkcija1. Danes se fokus prenaša na medije oddaj in podaj2 ter nove sodobne tehnologije kot sta virtualna in povečana (augmentirana) realnost3.

Fizični dejavniki, ki vplivajo na razvoj globalnega mesta so povečani migracijski tokovi zaradi klimatskih sprememb, distribucija dobrin, diferenciacija dela (robotizacija) in razslojevanje med peščico bogatih in množico revnih. Vzroki, ki povečujejo njihove vplive, se kažejo v disperziji kapitala v obliki investitorskega urbanizma ter večanju negativnih ekoloških učinkov in s tem povezanim povečevanjem klimatskih sprememb. Slednje prispevajo k večanju migracijskih tokov ljudi iz predelov, ki so pogojeni s pomanjkanjem osnovnih resursov kot sta hrana in voda. Na drugi strani najdemo vplive investitorskega urbanizma, ko investitor implemetira prostorske interese s pomočjo politike in kapitala. Obravnavano območje definira, pripravi in prodaja izključno za razvoj dobičkonosnih investicij; ko se resursi območja izčrpajo, se kapital seli v iskanje novih lokacij eksploatacije. Pri tem poteka izrazito enosmerna komunikacija brez vključevanja vseh deležnikov. Zato je komuniciranje grajenega okolja pomembno, saj omogoča oblikovanje neodvisnih skupin uporabnikov, ki se hitreje povezujejo, podajajo objektivne informacije ter snujejo neodvisne oblike bivanja na nivoju mikrolokacij. Gre za razvoj samostojnih oblik bivaja in organizacije, ki vključujejo kooperativno povezovanje bivalnih oblik, reciklažo sistemov in materialov, oblikovanje lastne mikroklime in uvajanje samooskrbnih sistemov pridobivanja in ohranjanja resursov. Kot primer kako lahko komuniciranje preko spletnih medmrežij vpliva na širjenje informacij o izvoru in namenu kapitalskih investicij v mestu obravnavamo civilno iniciativo Ne da(vi)mo Beograd. Projekt urbane revitalizacije Beograd na vodi zajema območje desnega brega Save med sejmom in glavno železniško postajo v obsegu dveh milijonov kvadratnih metrov. Leta 2014 je vlada republike Srbije sklenila dogovor s podjetjem Eagle Hills iz Združenih Arabskih Emiratov za katerim stoji 3.5 biliona evrov vredna investicija z največjim nakupovalnim centrom na Balkanu, prestižnimi stanovanji in hoteli. Po rušenju stanovanjskega dela Savamale, ki se nahaja na bodočem območju projekta, je iniciativa Ne da(vi)mo Beograd organizirala protest, katerega se je udeležilo 20 000 ljudi. Na tiskovni konferenci je premier Vučić priznal, da za rušitvijo Savamale stoji več mestnih uradnikov. S podporo so se prebivalci odzvali na investitorski urbanizem in netransparentnost politike z zahtevo po solidarenem in bolj humanem razvoju mesta (Baničević, 2016).

Pojavlja se vse več primerov aktivne zlorabe spletnih medijev. Velja izpostaviti Twitter profil Jenne Abrams, državljanke ZDA, ki je s svojimi neoliberalnimi in desničarskimi komentarji uspela pridobiti 70.000 sledilcev v 3 letih (The Guardian, 2017). Njena prava identiteta se je razkrila pred kratkim, za lažnim profilom se skriva ruska obveščevalna služba. Primer postaja vse bolj prisoten v spletni javnosti in je problematičen, ker je postal eden izmed glavnih citiranih Twittov s strani Guardiana, New York Timesa in ostalih pomembnih mednarodnih medijev. Vse večji vpliv na družbeno realnost in mesto ima tudi umetna intelligenca. Nedavni primer podelitve državljanstva humanoidni robotki Sophii v Združenih Arabskih Emiratih, odpira polje nenavadne selekcije, ki se skriva za humanoidno podobo Sophie. Njenja aktivna participacija sledi izbiri umetne inteligence, kar pomeni, da nima ničesar skupnega z humanostjo4.

Na podlagi opisanega se v nadaljevanju prispevka odpira vprašanje komuniciranja grajenega okolja; katera komunikacija predstavlja idealen model oblikovanja objektivne medijske reprezentacije. Preko treh različnih predstavljenih primerov se bo preverjalo osnovna izhodišča objektivnosti metode komuniciranja grajenega okolja.

2. AKTIVNA PARTICIPACIJA V FIZIČNEM IN VIRTUALNEM PROSTORU

2.1 Virtualna aktivna participacija v globalnem mestu

Deregulacija, privatizacija, nove oblike monetarnih politik so korporativni načini, ki so prevzeli oblikovanje mest, kot pravi Sassen (2017) "do te mere, da podjetja vdirajo v mesto na način podoben izgradnji srednjeveškega obzidja z zgodovinskim območjem – tako poslovna območja postajajo zaščiteni zasebni prostori teh mest. To se dogaja od poznih 1980ih po vsem svetu, da kooperacije obvladujejo operativni prostor, ki ustreza njihovim interesom." Urbana območja 21. stoletja bodo zastopana z javnimi prostori srečevanje med virtualnim in fizičnim svetom. Marifield (2014) je prepričan, da bo to izbrisalo razliko med javnim in zasebnim prostorom ter prineslo novo opredelitev pasivnih ali aktivnih prostorov. Sassen (2017) govori o novi obliki globalnega mesta, ki mora na strateškem obmejnem območju dati moč tistim, ki je nimajo - prikrajšanim, diskriminiranim, manjšinam. Izključeni lahko tako dobijo boljši način vključenosti kot v homogenih provincialnih mestih. V globalnem mestu so prisotni v horizontalni smeri. Takšna organizacija razvija skupnosti, povezane s podobnimi interesi. Hakiranje globalnega mesta pomeni oblikovanje robnega območja, kjer kooperativni prostori zgubljajo moč zaradi tega, ker nimajo več dostopa. Območje ustvarja močna zavest o skupnosti. Danes so skupnosti soočene z odsotnostjo vsebin v javnem prostoru, zaradi česar se pripadniki v fizičnem svetu ne srečujejo več tako zlahka. Soočeni so z dejstvom, da je edini prostor srečevanja virtualni prostor z novim fokusom komuniciranja. Socialna omrežja prevzemajo glavno vlogo informatorjev in se tako objektivnost informacij popolnoma razvrednoti.

Oblikovanje objektivne skupnosti, ki bo razvijala fokus na novih načinih bivanja, proizvodnji hrane in rekuperaciji vode, je podvrženo pospešenemu in hitremu razvoju multinacionalk z drugačnimi interesi. Primer je Alphabet,

1 V obdobju med 1980 in 2000 so bili na temo prihodnosti mest in družbe posneti uspešni primeri Hollywoodske filmske produkcije kot naprimer Iztrebljevalec/ Blade Runner (1982) Ridleya Scotta, Čudni dnevi/ Strange Days (1995) Kathryn Bigelow, trilogija Matrica/ The Matrix (1999) Lane in Lily Wachowski, Trumanov šov/ The Truman Show (1998) Petra Weira, Peti element/ The Fofth Element (1997) Luca Bessona.

2 V prevodu je podaja poznana v angleščini kot podcast.

3 V angleškem prevodu Virtual Reality (VR) in Augmented Reality (VR).

4 Hipotetično bi lahko umetna inteligenca odločila, da so ljudje za planet škodljivi in jih iz planeta "odstranila".

podružnica podjetja Google, ki razvija nove tehnologije, povezave z industrijo ter raziskovanjem na področju naravoslovnih znanosti. Google ima pod nadzorom pretok informacij in podatkov, gradi povsem nov virtualni imperij, virtualno mesto. S pridobivanjem podatkov je možna pretvorba vseh teh informacij v ponudbo kaj lahko virtualne trgovine oglašujejo in prodajajo. Ta primer je s strani Googla tudi fizično prisoten v bivšem industrijskem delu Toronta. Alphabet razvija plan za novo tehnološko skupnost Quayside s senzorji, ki bodo uravnavali in beležili rabo energije, potovalne čase uporabnikov, pretok prometa, kvaliteto zraka in količino odpadkov. S sistemom CCTV kamer bo zabeležena zadovoljnost uporabnikov. Alphabet se z idejo pridružuje različnim idejam iz preteklosti: postaviti celoten koncept mesta iz ničesar. Primer je EPCOT (Barthe, 2002)5, eksperimentalno načrtovana skupnost prihodnosti, ki jo je Walt Disney zasnoval kot simulaker realnega mesta, ki naj bi generiralo sodoben način urbanega življenja. Za Disneyevo filozofijo stoji načrt oblikovanja korporativnega mesta, ki se je po njegovi smrti 1966 leta namesto tega spremenil v zabaviščni tematski park blizu Orlanda na Foridi v ZDA. Drugi primer je mednarodni poslovni center Songdo na severozahu Seoula v Južni Koreji. Songdo predstavlja pametno mesto prihodnosti, ki bo do leta 2020 zgrajeno na 600 hektarjih. Navkljub prizadevanjem ostaja umetno zgrajeno mesto brez prebivalcev in tako predstavlja ogromno nenaseljeno puščavo. Tretji primer umetno zasnovanega mesta je Niemeyerjeva Brazilija. Modernistični estetski ideal popolnega merila prav tako ne daje zavetja kot kraj za prebivalce. Sociolog Richard Burdett poudarja, da Brazilija, zaradi odsotonsti socialnega faktorja in neustrezne naseljenosti, ni pravo mesto (Marshall, 2017). Virtualno mesto, ki ga Alphabet aplicira na primer Toronta, bo z aplikacijo zabeležilo in mapiralo vse dogodke javnih prostorov v realnem času. Znanstevniki podjetja bodo oblikovali različne potencialne scenarije z zbiranjem podatkov in oblikovali recipročni sistem, ki bo v zameno prodajal nove produkte. Kako pa bo sistem služil starejšim, depriviligiranim in revnim ni jasno, najbrž bodo prisiljeni zapustiti te popolne javne prostore nadzora. Primeri so izjemno diskutabilni, saj postavljajo v ospredje posameznika in ne skupnosti. Skupnost lahko z ustrezno povezavo in komunikacijo omogoča oblikovanje drugačnih razvojnih scenarijev.

3. MEDIJSKE REPREZENTACIJE

Model objektivnosti medijske reprezentacije temelji na treh izhodiščih, ki podajajo informacije grajenega okolja in so preverljivi na podlagi strokovnih podatkov; ta so kvantitativna preveritev ustreznosti objavljenih oziroma predstavljenih informacij in podatkov, izbira distribucijskih kanalov in donos sporočila in primerjava reprezentacije modela. V nadaljevanju prispevka so izhodišča vrednotenja objektivnosti posameznih primerov medijske reprezentacije in s tem komuniciranja grajenega okolja predstavljena na treh primerih: dokumentarni film, podcast in socialna omrežja.

3.1 Dokumentarni film kot edukativno orodje

Pomanjkanje komunikacije med mestnimi akterji povzročajo kopičenje nedokončanih ruševin v mestu, ki nimajo ustreznih vsebin. Primer take ruševine se nahaja tik ob historičnem mestnem jedru Kopra. Od leta 2008 se tam nahaja nedokočan objekt Solis, ki se je začel graditi v kombinaciji javno zasebnega partnerstva za nelogično povezane programe občinske uprave, hotela in olimpijskega bazena. Zaradi krize gradbenega sektorja, stečaja gradbenega podjetja Primorje, ki je kompleks gradil, se v obdobju zadnjih deset let z ruševino ni zgodilo nič.

Kot kontrapunkt temu je tekom študijskega procesa na oddelku Komuniciranje in mediji Fakultete za humanistične študuje nastal eksperiment v obliki kratkega eksperimentalnega filma Nedokončano: Olimpijsko mesto (Bugarič et al., 2017). Slednji postavlja v ospredje posledice investitorskega urbanizma in z drugačno komunikacijo nagovarja široko javnost. Iz terenskega dela se komentarji, kritike in predlogi intervjuvancev iz koprskih ulic pretvorijo v vsebinsko zasnovo začasnih rab za nedokončan Solis. Kot prototip začasne rabe6 bi lahko za objekt ponudili nove vsebine s preprostimi arhitekturnimi rešitvami. Funkcionalnost rešitve, kjer začasna raba ščiti betonsko konstrukcijo pred zunanjimi vplivi, se kaže v minimalnih posegih in maksimalnem izkoristku. Predlog začasne rabe se lahko izvede, kot navaja Bugarič (2017), na način da se betonsko konstrukcijo zaščiti s hidroizolacijo, na kateri se ustvari podlaga za urbane vrtove. Zbiralniki za vodo po notranjosti objekta služijo kot zbiralni in namakalni sistem zbiranja deževnice. Solis bi lahko na ta način postal edinstven prostor, prizorišče ekoloških vsebin, in bi s tako začasno rabo osmislil objekt za določeno obdobje z zmerno in pragmatično investicijo.

Meščani zaradi neustrezne informiranosti sprejemajo propadle investicije kot nekaj samoumevnega, različni investitorji pa iščejo potencialne v prostorih, kjer bodo razvijali nove zgodbe o uspehu. Film je bil pred javno predstavitvijo omejen s strani administrativnih postopkov. Navkljub temu so se urbane tematike predstavile s projekcijo na fasado Univerze na dvorišču Fakultete za humanistične študije in na javni televiziji Koper Capodistria. Širjenje tematike se nadaljuje po spletu s pomočjo socialnih medijev.

Pri preveritvi izhodišč se glede objektivnosti opaža neskladje podatkov pri kvantitativni preveritvi podatkov in podajanja različnih informacij. Opaža se vprašanje ustrezne distribucije informacij, dvojna reprezentacija informacij pomeni pomanjkanje ustrezne objektivnosti.

3.2 Socialni mediji in virtualna skupnost

Deljenje vsebin preko socialnih medijev je posebej pomembno pri skupnostih, ki nimajo izrazite moči in se lahko preko spleta informirajo ter dodatno izobrazijo o določenih temah. Kot izrazit primer največje odprtokodne skupnosti na spletu je spletna platforma Architectuul (2017). S kombinacijo deljenja arhitekturnih vsebin na spletnem katalogu in preko socialnih omrežij, je Architectuul ena izmed večjih spletnih skupnosti, saj obsega približno 500.000 sledilcev na socialnih omrežjih. Skupnost se poleg socialnih omrežij organizira s komunikacijo preko različnih komunikacijskih kanalih, odvisno v kakšnem kontekstu je posamezen pripadnik do skupnosti. Obstajajo trije tipi uporabnikov: osnovni uporabnik je prisoten na nivoju komunikacije z uredniškim odborom preko socialnih omrežij7 in kataloga, strokovnjak pripravlja zahtevnejše tekste, ki se kot posebne rubrike objavijo

5 V prevodu Experimental Prototype Community of Tomorrow pomeni Eksperimentali prototip skupnosti za jutri.

6 Začasna raba je urbanistična praksa, katere namen je oživeti zapuščene prazne prostore mesta z začasnimi vsebinami.

7 Facebook, Twitter, Instagram, Pinterest, Google+

na blogu kot je naprimer rubrika Forgotten Masterpieces (Architektuul, the blog, 2017) in pridruženi urednik oblikuje konceptualni del in vsebinsko zasnovo, predvsem pomaga pri razvoju novega formata Dossier. Pridruženi uredniki komunicirajo preko organizacijskih orodji kot sta Asana[8], Slack[9]. Pri rubrikah in katalogu samem se skupnost povezuje z namenom digitalizacije svetovne arhitekture in tako oblikuje spletni katalog, ki je povezan z mednarodnimi institucijami, založbami in festivali, ta izvor pa generira določene vsebine spletnih skupnosti.

Primer objektivnosti izhodišč na odprtokodni skupnostni platformi se pokaže šele po daljšem obdobju, ko oblikovana skupnost s podajanjem informacij pokaže ustreznost podanih podatkov, ki se začnejo podvajati. Navkljub hitri distribuciji, je zaradi doseganja objektivnosti pomembna kontinuiranost podajanja informacij, ki omogoča preveritev objektivnosti čez daljše časovno obdobje. Primerjava reprezentacije modela z drugimi spletnimi občili dosega zaradi hitre distribucije tudi hitro preverljivost podatkov.

3.3 Podajanje specifičnih vsebine za različne interesne skupine

Pri generiranju vsebin za njihovo distribucijo je bistvenega pomena izbor ustreznega formata in medija prezentacije. Najboljši način je kombinacija formatov, ki so prirejeni za določen tip publike. Poleg predstavljenega medija podobe in virtualnih mrež, vključuje zadnji primer zvočno predstavitev. Včasih kot radio, danes to podaja oziroma je podcast. Njihova distribucija je večja, v kolikor so povezani v različna socialna omrežja ali skupnostne konglomerate različnih interesnih skupin. Primer je podcast 99% Invisible (Mars, 2017), neodvisna produkcija Romana Marsa, ki se fokusira na oblikovanje in arhitekturo. Leta 2010 je začel Mars vsebine pripravljati v sodelovanju javnega radia in Ameriškega inštituta arhitektov v San Franciscu. Danes je glavni distributer podcasta mreža Radiotopia (https://www.radiotopia.fm/), ki distribuira v eter 20 različnih podcastov, slednji pa so poslušani okvirno v višini 13 milijonov mesečno.

Za zaključek še primer podaje, ki je vezan na raziskovanje sodobnih mest in skupnosti. Gre za uporabo formata podaje, ki bo služil ko orodje za opazovanje različnih urbanih nivojev. V prvi epizodi je predstavljen primer Londona (Bugarič, Carabelli, 2016) preko sprehodov po značilnih londonskih tržnicah. Ena izmed je tržnica latino skupnosti Seven Sisters, ki jo želijo investitorji porušiti z namenom izgradnje za prodajo. Primer prikazuje kako pomembno vlogo igra ohranjanje skupnosti, saj v mikro nivojih mesta tržnice definirajo odnose, ki omogočajo raznovrstnost, urbanost in pravico do mesta. To je kontrapunkt strašljivemu megapolisu.

Pri preveritvi objektivnosti so podatki zaradi velikega nabora mrež in platform spletnih podcastov na visokem nivoju. Distribucija je hitra, primerjava reprezentacije modela, ki zahteva primerno produkcijo pa kaže na visoko objektivnost modela.

6. ZAKLJUČEK

Neoliberalni pretok kapitala vpliva na razvoj investitorskega urbanizma, pri katerem investitorji in politiki odločajo o urbanem razvoju mesta brez vključevanja vseh deležnikov. Posledica je pomanjkanje vsebinske raznolikosti in razvoj enosmerne komunikacije interesnih skupin. Potrebno je ustvarjati ustrezno komunikacijo v lokalni skupnosti od spodaj navzgor in s tem krepiti samozadostni mikrourbanizem. Organizacije civilne družbe s tem dobivajo moč skupnosti. Florida (2003) trdi, da lahko kreativni ljudje v mestu pripomorejo k okrepitvi gospodarske učinkovitosti, toda, kot ugotavlja Riegler (2013), je gentrifikacija le obliž za neuresničene akcije kot so mestna prenova in urbana regeneracija. Za Floridovo teorijo se skrivajo urbani developerji, ki spodbujajo urbano okolje s soseskami, ki favorizirajo mlado, urbano, ustvarjalno elito in popolnoma ignorirajo potrebe sedanjih prebivalcev. Kot odgovor na to, Florida v nedavnem intervjuju (Chamberlain, 2017) obravnava novo urbano krizo revščine v predmestju in izginjanje srednjega razreda kot posledičen rezultat večanja cen nepremičnin in dobrin v predelih novega kreativnega razreda. Razvoj novih oblik distribucije dobrin in kapitala kot so to Airbnb, Uber bo v prihodnosti še bolj poglobilo socialne razlike med prebivalci, robotizacija delovne sile pa bo povzročila spremembe v delovnih potrebah in ovrednotenju človeškega dela. Virtualizacija mest, ki se postopoma začenja simbolično s procesom pametnih mest, pa bo z zbiranjem podatkov pospeševala prodajo novih produktov. Depriviligiranim in marginaliziranim ostaja bodisi možnost preseljevanja na rob družbe bodisi aktivna participacija v virtualnem prostoru.

Komunikacija grajenega okolja je primerljiva preko modelov, ki omogočajo objektivne medijske reprezentacije. Preveritev metode objektivnosti komunikacije grajenega okolja je podana skozi izhodišča vrednotenja objektivnosti posameznih primerov. Prvi model odpira vprašanje ustrezne distribucije informacij in neskladje podajanja informacij. Drugi model lahko svojo objektivnost upraviči samo skozi daljše časovno obdobje, ko oblikovana skupnost generira ustreznost in objektivnost informacij. Tretji model kaže visoko objektivnosti s primerjavo reprezentacije modela na zahtevni produkciji in hitri distribuciji. Glede na primerjalno analizo se pokaže tudi pomembnost vloge kontinuitete podajanja informacij skozi različne modele. Objektivnost komuniciranja grajenega okolja je izpolnjena, v kolikor izpolnjuje vse tri izhodišča, kvantitativno preveritev ustreznosti objavljenih oziroma predstavljenih informacij in podatkov, izbiro in kontinuiteto distribucijskih kanalov in ustreznost modela pri reprezentaciji modela. S tem se na podlagi primerjalne analize lahko izlušči, da je podcast metoda z največjo objektivnostjo modela.

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Violeta Nushi, Arta Basha-Jakupi: VKLJUČEVANJE "INFORMACIJSKEGA MODELIRANJA ZGRADB" (BIM) V TRAJNOSTNO ARHITEKTURO IN GRADBENIŠTVO: ŠTUDIJA PRIMERA NA UNIVERZI V PRIŠTINI

THE INTEGRATION OF BIM IN SUSTAINABLE ARCHITECTURE AND CONSTRUCTION EDUCATION: CASE STUDY IN PRISTINA UNIVERSITY

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IZVLEČEK

Glede na poglobljeni in primerjalni pregled člankov, objavljenih za uporabljene vrste programske opreme za "Inforamcijsko modeliranje zgradb" (BIM), študija omogoča širši razumevanje in kritičen razmislek o vključevanju in sintezi razvoja BIM v izobraževalni sistem na Kosovu z namenom podajanja smernic akademskim raziskovalcem, študentom in strokovnim delavcem. Ker je učinkovitost BIM široko sprejeta v svetovni industriji "Arhitekrue, Inženiringa, Konstruiranja" (AEC), je potrebno vzpostaviti sinergijo med izobraženimi BIM kadri in tistimi, ki se v praksi ukvarjajo z aplikacijo BIM programske opreme na Kosovu. To vodi k iskanju intenzivnejših in primernejših pristopov ter orodij z namenom vzpostavljanja integralnih rešitev preko izobraževalnega sistema; zlasti z namenom, da bi ponudili znanje svetovne prakse BIM v izobraževalne programme, ki so usmerjeni v trajnsotni razvoj ter AEC, učne načrte in / ali tečaje.

Večina Tehničnih fakultet Univerz na Kosovu predpostavlja preživetje BIM-a kot strategija poučevanja in načrtuje premagovanje ovir za integracijo BIM-a v kurikulum. Z izvedenim vprašalnikom za študente smo raziskali trenutno stanje integracije BIM na programih visokošolskega izobraževanja "Sustainable Architecture and Construction" (SAC). Na podlagi pridobljenih odgovorov smo ugotovili, da jepriporočljivo povečanje znanja ocenjevalca za evalvacijo vključitve BIM v učne načrte ter novi trajnostni didaktični koncepti in zavedanje, kar bo spodbudilo uporabo in prenos znanja v BIM v programe SAC, kar bi omogočilo diplomantom pridobitev znanj o BIM programski opremi pred vključitvijo v profesionalno kariero.

KLJUČNE BESEDE

"Informacijsko modeliranje zgradb" (BIM), izobraževalni proces, učni načrt, vprašalnik.

ABSTRACT

After a comparative review of articles published for used types of "Building Information Modeling" (BIM) software, this study provides a wider understanding and critical reflection on integration and synthesis of BIM developments into Kosovo education system in order to provide important guidance to academic researchers, students, and practitioners. As the effectiveness of BIM has been widely accepted in the worldwide "Architecture, Engineering, Construction" (AEC) industry, there is an urgent need to establish a synergy between BIM educated and practitioners in Kosovo likewise. This necessarily leads towards finding more intensive and suitable approaches and tools, for an integrated solution through the education system; in particular, to offer worldwide BIM's practices into sustainable AEC education programs, curricula and/or courses.

Virtually, the most of the Technical Faculties within universities of Kosovo pretermit viability of BIM in teaching strategy and plan to overcome the barriers to integration of BIM into the curriculum. Through conducted questionnaire to students was surveyed the current state of BIM integration at higher education curricula of Sustainable Architecture and Construction (SAC) programs. Based upon their answers, came out the recommendation to increase the appraiser's knowledge for BIM in curricula, followed up by new sustainable didactical concepts and awareness, which will energize the commencement of BIM into SAC programs and establish graduates, equipped with the necessary knowledge and skills for BIM software before they get promoted in professional calling.

KEY-WORDS

"Building Information Modeling" (BIM), education process, curricula, questionnaire.

1. INTRODUCTION

In despite an extensive number of studies regarding the methods for integration on Building Information Modeling (BIM) in process of education for Architecture, Engineering and Construction (AEC), a lack of consensus remains among researchers and practitioners regarding the applications of BIM in context of education in Kosovo (Nushi and Jakupi, 2017).

One of the essentials of sustainable architecture and construction education like the other technical education is to remain up to date and follow current trends. In this sense is it important to see the needs of an increased population, followed by the increased clamour for a better lifestyle. Thus, the great demand for the natural resources, such as sunlight, atmosphere, water, land (includes all minerals) along with all vegetation has the oblique report with the Architectural, Engineering, and Construction (AEC) industry demands.

A tendency of meeting such demands and their reports are also appearing in the capital of Kosovo, Pristina, due to rapid expansion and growth, in 1910 with 18,000 habitats to nearly more than 550,000 residents recently (Nushi et al., 2011). Particularly the social-political changes within the last two decades have influenced the demands for the achievement of architecture and sustainable construction. Thus, the nexus between AEC industry and political power, in fact, habitats, areas-contexts, and costs are not proportional developed.

Furthermore, misuse of sustainable building assessment in Kosovo by environmental and building state management or/and other institutions, during entire life-cycle of buildings, creates an e effect that regardless of some comparable alternatives of buildings assessment management methods, so in default of appropriate BIM system. In this regard, the sustainable development in KS needs a holistic approach and integrated establishment. In this direction, learning methods in higher education of architecture and construction should follow changes as though worldwide contemporary education systems.

Thus, the knowledge or skill acquired by instruction or to study architecture and construction requires today also the activity or process of studying, practicing, being taught for the achievements in BIM or/and other digital tools. Today is crucial for the universities to introduce BIM as education promising tool since in general, it helps to create opportunities for advanced collaboration and project coordination in a triangle, client: designer: builder; and develop building design documentation and construction processes.

To satisfy the building technology demands for AEC industry with BIM, many educative institutions around the world have integrated BIM into their academic programs of AEC (Pikas et al., 2013). The problem of identifying and solving social, environmental, cultural and economic prosperity must be supported. From the educative and academic point of view, the quality of life of habitats, education needs, unemployment, environmental degradation and increased needs for natural resources makes important transformations to the way of long-term planning, learning and justifying decisions in AEC industry. In this context, the educational system in Kosovo can be exploited in developing bringing sustainable AEC industry, e.g. through the educational process of using BIM tool implementation into new concepts for design and construction issues.

The BIM tool in education processes is measured by research questionnaire. The overview of questionnaire outcome leads to the conclusion that the design of sustainable built environment curriculum in relation to current and future needs of the Kosovo AEC industry and BIM implementation is pending. Thus, its quantitative and qualitative data provide an exploratory look at the views of a group of 30 students. Their personal interest is to foresee, plan and actively promote the implementation of BIM skills into SAC high education processes.

2. LITERATURE REVIEW AND CONTEXTUAL COMPARISON

The approbation of BIM in educational programs is relatively a new effort. BIM teaching programs are being offered in many universities; nevertheless, they are usually narrowed to software training, gained in different education/training manner, illuminated or taught by professional associations, universities or commercial companies. Recruitment for BIM specific role directly from education also varies. In a lot of cases, there are no – suitably qualified and/or skilled candidates available to be considered as have relevant experience. In general in Kosovo, the education systems clearly do not produce BIM skilled candidates needed by AEC industry now. Skills training is not the sole concern of the AEC industry itself but should be approached at e.g. secondary and higher education levels, to develop and promote the training, learning and research aspects of BIM knowledge.

Researchers (Ghosh and Parfitt, 2015) have identified the need to incorporate BIM into university teaching to equip engineering graduates with an adequate understanding of BIM concepts and they identified engineers' BIM skills as a means to help achieve the successful uptake of BIM within the AEC industry. BIM can be incorporated into university education in four different ways. The options could be as follows: (1) introducing a BIM elective or organizing a workshop, (2) introducing an advanced BIM focused degree program, (3) restructuring the existing curriculum to include BIM, and (4) integrating BIM into the existing SAC curriculum (Ghosh and Parfitt, 2015).

Researchers (Gier, 2007) have concluded that BIM is a helpful teaching tool for construction estimation and quantity take-off skills and highly contribute to design comprehension skills and understanding of construction materials, methods, and processes. In Australia, many Technical and Further Education (TAFE) institutions are providing BIM courses within AEC programs. However, this education is inclined towards the use of particular BIM software packages with little consideration to BIM management topic or the procedures for working in a collaborative environment (NATSPEC, 2015). The findings of the studies (Wu and Issa, 2013; Liu and Hatipkarasulu, 2014) from the members of Associated Schools of Construction (ASC) in the US indicates that 54% of the programs had dedicated and fully developed

Table 1: Typical BIM courses offered in CM programs in the US universities.

Course names	Institutions	Credit Hours	Description/Purpose of course
Construction Information system	Auburn University	3	To explore, create and implement BIM that exists in mobile and/or cloud application forms.
CNMG 2318, BIM	The University of Arkansas at Little	3	To focus on utilizing basic functions of BIM for residential and commercial construction and examine geometry, spatial relationships, geographic information, quantities and properties of building components. To ease quantity takes off by virtual models of buildings.
MCM-602, Construction Information Modeling	Philadelphia University	3	Integrated practice and BIM are given comprehensive coverage, about the application of the software to the actualization of the built form.
CM 414, Virtual Construction	University of Washington	3	To examine the use of BIM for managing the construction process and facilitating collaboration among project participants.
CE 570, BIM Collaborative CM	University of Southern California	3	To provide some hands-on experience with advanced BIM solution and to provide some knowledge about how to work in BIM teams and learn to different aspects of BIM-based scheduling, estimating and collaborative modeling.
ECIV 309, BIM in Construction	Montana State University	2	To develop working knowledge of BIM and its software applications and to understand BIM role in AEC industry.
CGT 46000, BIM for commercial construction	Purdue University	3	Study of commercial job site planning and coordination. Trade coordination, visualiza tion, and communication are also emphasized.

BIM classes in their curriculum. To learn more, the authors studied BIM education status in the US, i.e. BIM courses in Construction Engineering and Management programs (CE&M), as shown in Table 1.

The research study (Hoang and Bedrick, 2015) also highlighted that some countries have already prepared to deal with the integration while others have yet to start this integration process into AEC programs. However, in Kosovo, studies on the status of BIM implementation in universities and in the AEC industry are not very common. The BIM skilled and educated members are lacking in formal and informal settings. Universities across Kosovo are facing a serious lack of focus on overall construction engineering and management skills and education. It believed that 60-70% of Architectural Engineers and Civil Engineering graduates join construction firms and rest to the other domains such as design and consulting firms. Therefore, there is a need to introduce and teach BIM into education process at the university level in order to prepare skilled students to apply BIM on projects when they join AEC industry, enterprise or elsewhere in SAC framework issues.

2.1 Objectives

The aim of this research is that through the conducted questionnaire to students to survey the current state of BIM integration at higher education curricula of Sustainable Architecture and Construction (SAC) programs at the University of Pristina. Based upon their answers, this research tent to outcome with the recommendation to increase the appraiser's knowledge for BIM in curricula, followed up by new sustainable didactical concepts and awareness, which will energize the commencement of BIM into SAC programs and establish graduates, equipped with the necessary knowledge and skills for BIM software before they get promoted in professional calling during their performance into AEC industry.

The following research questions to achieve this aim are: what are students' knowledge and understandings in range of terms and concepts related to BIM tool? Why do they arise the needs for BIM skills? What are practical needs stated of the students are for BIM to be used in SAC field? Where do the students look for BIM education/training? Are they sufficiently aware of a BIM education/training benefits? Do they understand future processes of BIM?

The findings and arguments of this research will have a pedagogical impact since generally the recommendation to implement BIM into the curriculum for design, building construction, and urban planning will potentially increase AEC industry performance in Kosovo. Particularly in relation to current and future needs of AEC industry in Kosovo will influence versus to educators and professional bodies seeking to respond to the fast-technological, thus to legitimate for systematically embedding long-term design and construction curricula.

3. RESEARCH METHODOLOGY

The research was done by distributing the questionnaire to 30 architecture students within the University of Pristina. They have been told that the trend of the questionnaire is to get information on whether or not to use BIM for the needs of the AEC industry. The analysis and evaluation of the 30 responses collected were presented as summarized in the tables and

graphs shown below. Overview of basic information about architectural students' views on the definitions and practices of BIM, the use of BIM in the field of design, engineering and construction, the use of BIM for the sustainable development of AEC industry; the type of guidelines, programs or syllabuses to be more effective in encouraging more educational institutions to adopt the BIM usage practices, etc.

The questionnaire consists of the following subsection: 1) Personal Information, 2) University Information, 3) Evaluation of current state of BIM integration in the SAC curriculum, and 4) the barriers to integrating BIM into SAC curriculum., 12 questions and 9 sub-question, such are some of them: what are their main sources of information on BIM practices? Is there any connection between the knowledge that students have with the needs of the AEC industry for sustainable development? What ideas, people or events have influenced the most in developing their interests in the skills they would gain with BIM? In general, they are encouraged to comment and/or clarify about sources of educational strategies or new curricula and programs that would make it easier for them to engage in sustainable design, engineering, and construction in Kosovo.

4. ANALYSIS AND DISCUSSION

BIM's knowledge and skills that can be accumulated through the education process, measured by a questionnaire realized for students, suggest that integrating BIM's knowledge into compulsory education within the syllabuses, since BIM's technology awareness was provided energy and derives immediate activity for effective action in the AEC field; professionals with the skills acquired by BIM contribute directly to the AEC filed, consequently in the sustainable development of the country; and other issues that help the population's awareness of the impact of AEC's industry on their environmental, social, economic and cultural values. In order to be able to perform fully in their communities and at work, students generally welcome the growing knowledge and skills that BIM will provide. Moreover, the skills gained with BIM will increase their chances of finding jobs. Meanwhile, employers can expect vice versa, so young people can be able to contribute effectively and effectively to the AEC industry.

The respondents – students were asked about the sources of information they collected about BIM. The majority of respondents, 57% (17 respondents), had collected it from personal research; 34% (10 respondents) had collected the information from literature and/or media; whereas remained 3 respondents collected from workshops, cooperators, and courses. None of the respondents had a chance to collect the information about BIM from any investors during their on-job training, as shown in Figure 1.

The respondents answered on how much of BIM levels incorporated in projects as shown in Figure 2. It is clearly seen that majority of them, 43% (13 respondents) did not had or not used BIM into their projects during their studies or elsewhere; 33% (10 respondents|) incorporated BIM into few of projects; whereas, 17% (5 respondents) had experience of using BIM application both in professional and amateur settings.

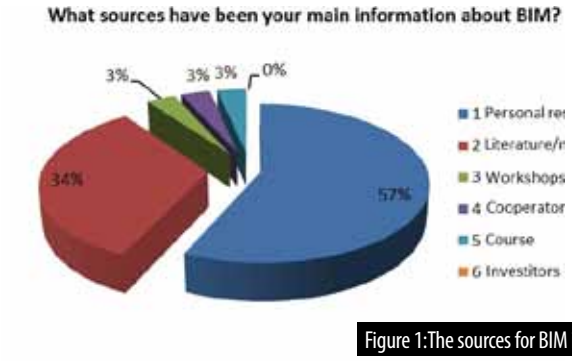

Figure 1:The sources for BIM information.

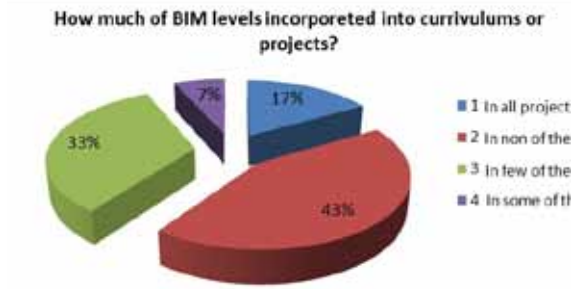

Figure 2: The BIM levels incorporated into curriculum or projects during studies.

During this research, it was very important to define whether respondents' taken additional professional education about BIM has been applied during their studies. The majority, 37% (11 respondents) have applied occasionally gathered education about BIM; whereas 27% (8 respondents) used it very often; hence almost the same, 23% (7 respondents) never used or/had a knowledge to applied BIM during their studies (Figure 3).

Furthermore, in the Figure 4 is shown the relation of respondents' answer about if is BIM included into their projects, and if so is it incorporated more into individual building or public, or are those invested privately or by the government?

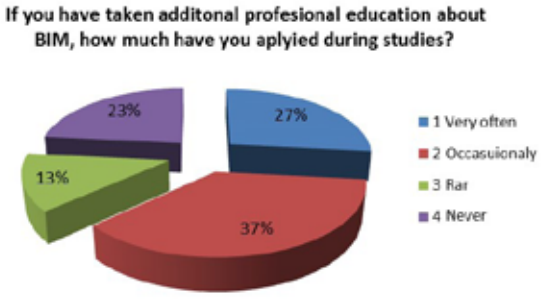

Figure 3: The respondents' usage of BIM professional education.

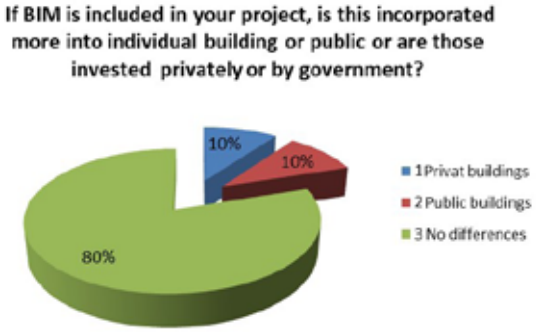

Figure 4: The usage of BIM in building categories.

In response to multiple choice questions about what strategy should be used to integrate codes into BIM programs for AEC, or to what extent are the following types of considerations in BIM strategies to expedite processes in the AEC industry, were found that most, 80% of respondents answered that energy and water; for material selection, 90% of respondents; etc., as shown in Table 2.

Table 2: Summary of Responses - types of considerations at BIM strategies.

Land use		Land impact		Energy and water		Selection of materials		Well-being		Respondents
4	12%	3	9%	2	6%	0	0%	0	0%	Best practice
6	18%	4	12%	3	9%	3	9%	7	21%	Improved practice
20	60%	23	79%	25	85%	27	91%	23	79%	There are no measures about codes/standards includes

To what extent are the following factors that could be hampering the recognition of your profession or the incorporation of BIM strategies for sustainable construction in your professional work, questions such as (1) Lack of education; (2) Lack of expression of student interest; (3) Lack of teamwork; (4) Lack of understanding of recognition; (5) Sustainable construction is expensive; (6) Sustainable design support; (7) Lack of »green« materials; (8) Legal problems that offer material guarantees or non-standardized methods, (9) not safe from getting information about AEC, the respondent's answers are as shown in the Table 3.

The questioner consisted a final part of multiple choice questions, such as: what strategy should be used to integrate BIM into AEC program; was found that respondent suggested teaching standalone BIM course, and/or to incorporate BIM topics/contents into conventional AEC courses; or/and suggested organizing BIM workshops in AEC program; to restructure the existing AEC curriculum to include BIM; or/and to student learn BIM skills by themselves. Also, in response to the question on the current status of BIM education within the AEC curricula in their universities, 67% believed that it was at very low level. Furthermore, 57 % considered high level that use of BIM could improve AEC industry in near future.

5. CONCLUSIONS

It overtakes that the implantation of BIM skills might be taken through education establishments lies across organizations, government departments, and professional institutions and in this case through the education processes within Universities. BIM education could motivate usage of inventive technologies such as BIM, that society and environment demand contemporary construction. But, the current practice of BIM skills and knowledge is fragmented in University of Pristina's curricula. It is important that BIM implementation within curricula is just a step towards sustainable social development in general in regards to requirements for professionals at AEC industry.

6. RECOMMENDATIONS

At the educational national level, the University of Pristina should build student's capacities, young skilled BIM people for their future SAC field career choices. The future graduates of the architectural and building construction will face easily increased level of social and environmental needs for SAC conscience and thinking; in such a foundation, students of architecture within University of Pristina should be better placed to stimulate their professional studies within a broader context and assisted by certain technologies, such as BIM skills building industry experience and future planning and designing, meanwhile fulfilling the needs of building AEC industry in Kosovo.

Table 3: The factors could hamper BIM integration into respondents' professional work.

1		2		3		4		5		6		7		8		9		Respo.
11	33%	9	27%	10	30%	13	39%	11	33%	8	24%	10	30%	8	24%	13	39%	small obstacles
15	45%	16	48%	15	45%	11	33%	14	42%	22	66%	19	67%	20	60%	11	33%	big obstacles
4	12%	5	15%	5	15%	6	18%	5	15%	0	0%	1	3%	2	6%	6	18%	none of the obstacles

Therefore, it should be a plan to create awareness for BIM integration into AEC curricula and to look forward to increasing BIM skilled teaching capacities too. In that regards, besides teaching methodologies, the workshops, training, and conferences should be arranged in order to share the knowledge among SAC students, teachers and international practices. Also, traditional SAC curriculum structure needs to be revised, hence it is extremely important for the university to develop new and comprehensive BIM course or to develop the other best strategy for integrating BIM into SAC programs, based on current national and international AEC industry needs.

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Gregor Čok: PLANIRANJE IN NAČRTOVANJE ODPRTEGA JAVNEGA PROSTORA V OBALNEM PASU

PLANNING AND DESIGN OF OPEN PUBLIC SPACE IN THE COASTAL ZONE

DOI: http://dx.doi.org/10.15292/IU-CG.2017.05.058-067 ▮ UDK: 711.4(497.4) ▮ 1.02 Pregledni znanstveni članek / Review Article ▮ SUBMITTED: August 2017 / REVISED: September 2017 / PUBLISHED: November 2017

IZVLEČEK

S spremembo politike urejanja prostora po letu 1991 se je tudi na slovenski obali pričela oblikovati nova praksa načrtovanja posegov v prostoru. V ta okvir sodi tudi planiranje in načrtovanje odprtega javnega prostora v ožjem obalnem pasu. Raziskava je usmerjena v opredelitev stanja na področju pojavnosti teh prostorov, njihove tipologije, projektne prakse pri načrtovanju in stopnje dejanske realiziranosti. Za območje obravnave smo izbrali Strunjanski zaliv kot posebna krajinska in kulturološka entiteta, ki je podvržena številnim razvojnim in varstvenim interesom. Za to območje smo z deskriptivno raziskovalno metodo analizirali deset obstoječih projektov, ki vsebujejo podrobne zasnove odprtih javnih prostorov. Z medsebojno primerjavo posameznih parametrov smo ugotovili, da gre za različne avtorske pristope, prilagojena merila obdelave in različne interpretacije atraktivnih vizualnih elementov, ki so sestavni del celotne scenografije tradicionalnih dejavnosti, povezanih z morskim okoljem. Za večino obravnavanih primerov smo ugotovili, da gre za kvalitetne prostorske rešitve, čeprav je stopnja njihove realiziranosti zaradi številnih, težko opredeljivih razlogov relativno nizka. Ključne medsebojne razlike obstajajo predvsem zaradi različnih razlogov nastanka in virov financiranja teh projektov. Rešitve so zato zelo raziskovalno ali, nasprotno, zelo investicijsko utemeljene. V vseh primerih pa je evidentna prisotnost ustrezne prostorske stroke. Obalni pas mora s svojim, vsem dostopnim odprtim javnim prostorom tudi v bodoče ostati predmet javnega interesa. Prav kvalitetno oblikovane prostorske rešitve v tem okolju lahko bistveno prispevajo k trajnemu zagotavljanju demokratične rabe javnega dobra.

KLJUČNE BESEDE

Obalni pas, odprt javni prostor, tipologija, planiranje in načrtovanje, strokovni pristop

ABSTRACT

By changing the spatial planning policy after 1991, a new practice of spatial development planning was introduced for the Slovenian coastal zone as well. This framework also involves the planning and design of open public space in the narrow coastal zone. The focus of this study was to define the situation concerning the manifestations of these spaces, their typology, design project practices, and the actual implementation level. The Strunjan Bay was selected as the study area, i.e. as a special landscape and cultural entity subject to a multitude of development and conservation interests. Using a descriptive research method, 10 existing projects were analysed for the area, which contain detailed designs of open public spaces. By comparing the individual parameters we found that the projects used a variety of authorial approaches, adapted processing criteria, and various interpretations of attractive visual elements, which are a component of the overall set design of traditional activities related to the marine environment. For most of the cases we found that they provided high-quality spatial solutions, but the level of their implementation was low – due to many complex reasons. The key differences are due to the different reasons of introducing these projects and their sources of financing. The solutions are therefore either highly research-oriented or, on the contrary, investment-oriented. In all cases the presence of the relevant spatial profession is evident. With all its accessible open public space, the coastal zone must remain in the public domain. A high-quality design of the spatial solutions in the zone can significantly contribute to a sustainable provision of democratic use of a public good.

KEY-WORDS

Coastal zone, open public space, typology, planning and design, professional approach

1. UVOD

Obalni pas je v Sloveniji posebna prostorska entiteta v kateri se srečujejo različni interesi. V njen kontekst sodi tudi odprti javni prostor, kot osnovna oblika *javnega dobra* širokih funkcionalnih in simbolnih dimenzij, predvsem pa kot lokacija fizične in percepcijske konfrontacije človeka in morskega okolja. Zaradi turistične atraktivnosti, gospodarskega potencialna in posebnih varstvenih režimov je to območje izpostavljeno tudi posebnemu projektnemu pristopu. Retrospektiva urbanističnega in arhitekturnega načrtovanja na slovenski obali opozarja na velik strokovni interes pri obravnavi tega prostora tako z vidika protekcionizma kot konzumacije obstoječih potencialov (Gabrijelčič, 2007). Kljub evidentnemu sodelovanju stroke v postopkih planiranja in načrtovanja javnega prostora pa so dejanske realizacije posameznih projektov v obdobju po letu 1991 relativno maloštevilne (Čepar, 2017).

Pojavnost in oblika odprtega javnega prostora je danes posledica dolgoletnih interesov in različnih upravno-političnih pristopov v zasnovi namenske rabe priobalnih zemljišč. V Sloveniji so se ključni strukturni koraki izoblikovali v procesu intenzivne urbanizacije po 2. svetovni vojni. Takratni vizionarji socialističnega družbenega in prostorskega razvoja (Balažič, 2006) so začrtali temeljne cilje pri načrtovanju posegov na obalni liniji, ki so poleg razvojnih sekvenc (t.i. turistični obalni pas na območju Kopra, Izole in Portoroža) vključevali tudi režime varovanih območij in uvedbo statusa javnega dobra. Med njimi prosperira Edo Mihevc, ki je z razvojno-planskim pristopom (Regionalni načrt slovenske obale iz l. 1959) in obsežnim opusom realiziranih obalnih ureditev uveljavil ključne smernice za bodoči urbanistični in arhitekturni ustroj tega prostora (Čebron Lipovec, 2012).

Urejanje obalnega pasu je tudi kasneje zaznamoval poseben strokovni interes (Gabrijelči 2007) v obliki številnih študijskih projektov (Dalla Valle et al, 2014), natečajev, arhitekturnih delavnic (Ažman Momirski, 2013), javnih tribun in drugih dogodkov, ki izkazujejo temu prostoru širši nacionalni pomen.

Posebno obdobje *razvoja metodoloških praks* za planiranje in načrtovanje v obalnem pasu predstavlja minulo desetletje v katerem so vse tri obalne občine pristopile k pripravi novih planskih dokumentov. V procesu, ki še traja, so bile izdelane tudi številne kvalitetne strokovne podlage za planiranje in načrtovanje javnega prostora v obalnem pasu. Stanje na področju dejanske izvedljivosti posameznih projektov (za urejanje odrtih javnih površin) pa je vsemu navkljub danes precej neperspektivno. Temu dejstvu botruje predvsem dihotomija pristojnosti za urejanje kopnih in vodnih zemljišč (domena občin in države), permanentno spreminjajoča se prostorska zakonodaja, investicijski pritiski na obalna zemljišča, izzvana in hkrati prizadeta javnost z odklonilno participacijo v javnih razpravah (Bolčič, 2016) in posledično vedno bolj zapleteni postopki sprejemanja prostorskih izvedbenih aktov.

V splošnem smislu je odprt javni prostor v teoriji in strokovni praksi obsežno obravnavan. Posamezne strokovne discipline ga preučujejo iz različnih vidikov. Področje planiranja in načrtovanja izpostavlja predvsem njegovo socialno funkcijo (Lehrer, 1998), oblikovne in fizične karakteristike (Lynch, 1972) pomen pri oblikovanju identitete v prostoru (Dešman, 2008) in druge semantične dimenzije, ki jih javni prostor kot generator antropogenih interakcij vzpostavlja v določenem fizičnem kontekstu (Carr, et al, 1992).

Na odprt javni prostor v obalnem pasu pa bistveno vpliva predvsem morsko okolje. Neposredna bližina naravnih prvin kot so morska gladina, naravni habitati, atraktivni mikro ambienti, lokalni hidrološki pojavi in spekter tradicionalnih dejavnosti povezanih z rabo morskih zemljišč predstavljajo v tem okolju poseben javni interes (Čok, 2017). Atraktivnost vodnih zemljišč v kontekstu oblikovanja javnega prostora oziroma vzajemnost povezave vode in kopnega pri ustvarjanju privlačnih pejsažov dokazujejo tudi študije, ki obravnavajo obrečni prostor v urbanem okolju (Lečnik, 2007). Rečni koridorji predstavljajo s svojo javno funkcijo velik generični potencial za socialno integracijo, vzpostavljanje urbane identitete in strukturne prepoznavnosti javnega značaja v mestnem organizmu (Olaj et al, 2012).

Večina držav sredozemskega bazena se pri planiranju in načrtovanju posegov v obalnem pasu morja, vključno z javnim prostorom kot javnim dobrim, danes sooča s podobnimi izzivi. V teh okoljih so prisotni številni interesi, ki so čedalje bolj vezani na eksploatacijo naravnih virov vodnih zemljišč kot so: energenti (vodna vetrna polja, podvodna naftna in plinska nahajališča, ekspanzijski plinski terminali), ribištvo in marikultura, navtika (transport, logistika), turizem in druge dejavnosti, ki na kopenskih zemljiščih potrebujejo določeno oskrbno infrastrukturo (Ažman Momirski, 2015). Kot odziv na vse večje upravne probleme pri usklajevanju varstvenih in razvojnih interesov se je pričelo na področju planiranja in načrtovanja v okviru meddržavnih asociacij (Maes, 2008) vzpostavljati dva sistemska ukrepa v smeri izboljšanja obstoječega stanja:

1. razvoj t.i. pomorskega prostorskega načrtovanja (Marine Spatial Planning), s katerim se bo določala namenska raba vodnih zemljišč, gre za podoben ekvivalent prostorskemu planu namenske rabe zemljišč, kot velja za kopni del (Pell, Lloyd 2004),
2. razvoj t.i. integralnega prostorskega načrtovanja na stiku kopnih in vodnih zemljišč (ICZM protokol, 2008), kjer se bo podrobno usklajevalo varstvene režime in razvojne interese ter načrtovalo podrobnejše prostorske ureditve v soglasju z vsemi referenčnimi deležniki (Marsič, 2016; Bolčič 2016).

Prav slednje, ki je trenutno v fazi implementacije v nacionalno zakonodajo tudi v Sloveniji (analiza praks ICZM, 2012), bo imelo v prihodnje ključno vlogo pri obravnavi javnega prostora na stiku kopnega in morja. Članek je usmerjen v pregled obstoječega stanja na slovenski obali, natančneje v prakso planiranja in načrtovanja javnega prostora po obstoječi zakonodaji. V razpravi je predstavljena primerjava posameznih projektov, ki obsegajo načrtovanje javnega prostora na območju Strunjana. Izpostavljena so vprašanja vezana na tipologiji javnih prostorov, njihovo zasnovo in realiziranost.

1.1 Opredelitev problema

Na območju Strunjanskega zaliva je preteklem obdobju prevladovala izrazito varstveno usmerjena politika prostorskega razvoja. Ta je botrovala njegovi sedanji, relativno ohranjeni fizični podobi. Na območju krajinskega parka Strunjan, ki obsega soline in laguno Stjuža, obalno linij ter akvatorij samega zaliva, se so kljub ostrim pogojem vseeno realizirali določeni

posegi v prostor (turistični nastanitveni kompleksi, plažne ureditve, ribiško pristanišče, šolǰišče itd.) tako v obliki zasebnih kot javnih investicij. Med vsemi ureditvami pa je iz vidika urbanističnega in arhitekturnega oblikovanja najbolj zapostavljen prav odprt javni prostor (lungomare, plaža, center naselja), ki ga v mnogih situacijah zaznamuje degradacija, skromno oblikovanje, neprepoznavnost in druge karakteristike zatečenega stanja, ki omejujejo njegov prostorski in ambientalni potencial. V tem okviru sta pomembni naslednji raziskovalni vprašanji:

1. Kakšne oblike odprtega javnega prostora obstajajo v obalnem pasu Strunjanskega zaliva in kakšno je njihovo fizično stanje?
2. Ali za odprt javni prostor sploh obstaja ustrezna prostorska dokumentacija, ki določa njegovo podrobno urbanistično in arhitekturno oblikovanje?

1.2 Delovna hipoteza

Obalni javni prostor je kljub intenzivni rabi in atraktivni legi v mnogih sekvencah relativno nerazpoznaven. Temu botrujejo različni razlogi od neustreznega pristopa pri njegovi obravnavi do pomanjkanja idejnih prostorskih rešitev.

1.3 Metodologija

Raziskava je poteka v treh fazah. V prvi fazi smo opredelili območje obravnave in izvedli valorizacijo stanja v prostoru. Uporabljena je bila metoda opazovanja fizičnih dejstev t.j. grajenih posegov v prostoru ter posameznih entitet naravne in kulturne krajine. Valorizacija je obsegala terensko delo, foto dokumentiranje, obdelavo podatkov in opredelitev ključnih ugotovitev.

V drugi fazi smo za predmetno območje s pomočjo deskriptivne metode izvedli pregled obstoječe prostorske dokumentacije in drugih projektov, ki vsebujejo prostorske rešitve z opredeljenim javnim prostorom. Obravnavali smo pet skupin dokumentov: obstoječe prostorsko planske akte občine Piran, prostorske izvedbene akte, diplomske naloge, natečajne rešitve in raziskovalne prostorsko razvojne projekte. Analiza je obsegala ugotavljanje pristopa pri njihovem načrtovanju, tipologijo in podrobnejše elemente zasnove. V tretji fazi smo sintetizirali rezultate in podali sklepne ugotovitve.

2. REZULTATI

V nadaljevanju so prikazane ključne ugotovitve posameznih faz. Območje raziskave je obsegalo zahodni del Strunjanskega zaliva in sicer: obalno sekvenco od vile Tartini do kompleksa Salinera ter celotno območje naselja Strunjan severno od regionalne ceste Koper - Piran vključno z laguno Stjuža in strunjanskimi solinami.

2.1 Valorizacija stanja v prostoru

V okviru valorizacije stanja v prostoru smo izvedli terenski ogled in opredelili posamezne prostorske elemente. Ugotovili smo, da se javni prostor na območju Strunjana v principu deli v tri skupine:

1. javni prostor neposredno ob vodni liniji: javna pešpot od kompleksa Salinere do kompleksa Krke z vmesnimi razširitvami. Gre za izrazito linijsko obliko sprehajališča oz. *Lungomare-a,* ki preči zahodni rob solin, umetni nasip Stjuže, območje kopališča in se nadaljuje v odsek naravne obale v smeri proti Mesečevem zalivu pod Belim križem. Značilnosti tega prostora so: izrazita ambientalna atraktivnost, preplet naravnih in ustvarjenih krajinskih entitet, na posameznih lokacijah pa tudi zatečeno degradirano stanje neurejene obale, neregulirana deponija ribiške infrastrukture (slika 1), erodirane brežine (slika 2) ipd.
2. javni prostor v priobalnem območju: sekvence javnega prostora na območje solin in priobalnih zemljišč lagune Stjuža med morjem in naseljem. Območje predstavlja ohranjeno t.j. izvorno, tradicionalno in še vedno aktivno rabo solinarske dejavnosti. Pretežni del ima regulativni status *naravnega rezervata Stjuža* z izrazito protekcionističnimi omejitvami pri njegovem upravljanju in (pre)oblikovanju. V njem se prepletajo prečne sprehajalne poti, značilni napajalni kanali, gnezdišča, mokrišča in številni drugi atraktivni mikroambienti. Kompleks solin je vključno z internimi potmi dobro vzdrževan, parcialne probleme predstavlja erozija brežin in zamuljanost plovnih kanalov.
3. javni prostor na kopnem delu oz. v notranjosti zaliva, ki obsega posamezne pešpoti in platoje na južnem in vzhodnem obrobju Stjuže, ter javni prostor na območju naselja. Percepcijsko središče javnega prostora predstavlja razširitev osrednje lokalne ulice (Strunjan) na območju med gostilno »Pod trto« in spomenikom NOB. V tem predelu je javni prostor relativno neprepoznaven, čeprav obstoječe odprte površine služijo različnim namenom (parkiranje, prireditve itd.). Neprivlačno vizualno stanje predstavljajo tudi posamezni začasni servisni objekti (lope) umeščeni na obrobje odprtih javnih površin.

Na podlagi valorizacije smo ugotovili, da obstajajo številne lokacije in pojavne oblike javnega prostora, vendar gre v večini primerov le za zametke oz. (ne)prepoznavno izoblikovane površine, ki bi sicer morale v prostoru zagotavljati ustrezno programsko in oblikovno kvaliteto. Ugotovil smo, da je njihova tipologija (funkcija in oblika) bistveno odvisna od same lokacije oziroma od oddaljenosti ali bližine vodne linije, kot temeljne ločnice morskega okolja in kopnega zaledja (Tabela 1).

2.2 Pregled obstoječe prostorske dokumentacije in ostalih referenčnih strokovnih gradiv

V okviru druge faze smo izvedli pregled referenčne prostorske dokumentacije in projektov izdelanih za predmetno območje. Usmerjeni smo bili v obravnavo javnega prostora kot javnega dobra. Na podlagi nabora in selekcije gradiva smo ugotovili, da obstaja 10 relevantnih primerov izvedbenih in idejnih projektov, ki na različne načine določajo umestitev in oblikovanje javnega prostora (npr. diplomska naloga za ureditev kopališča, natečaj za ureditev centra Strunjana, razvojno raziskovalni projekt za ureditev ribiškega pristanišča in servisnega platoja itd.). S primerjalno analizo smo ugotovili, da med njimi obstajajo različne okoliščine njihovega nastanka, vsebinsko in strukturno pa se razlikujejo po namenu, naročniku in merilu obdelave (Tabela 2).

Lokacija

kot izhodišče za razvoj tipologije javnih prostorov
(obstoječih in tistih v razvoju)

STRNJENO NASELJE	OBALNI PAS	VMESNI PROSTOR
- trg (jedro naselja)	- plažne ureditve	- oprti javni prostor solin
- območje spomenika	- plato in obod mandrača	- sprehajališča in drevoredi
- parcialne površine (piazzete)	- lungomare sprehajališče	- prireditveni plato pred Krko
- javna parkirišča	- platoji pomolov	- utrjene pohodne brežine

Tabela 1: Pojavne oblike javnega prostora na območji Strunjana glede na mikrolokacijo.

Glede na namen se delijo na:

a. konceptne prostorske rešitve, ki so izdelane na načelnem nivoju in relativno neobremenjene z izvedbeno dimenzijo (finančno, časovno in lastniško-pravno). Rešitve so izdelane z veliko mero razumevanja pomena javnega prostora, v njih je mogoče prepoznati suveren strokovni pristop,
b. izvedbene prostorske rešitve v obliki ZN, OPPN in PGD-PZI, ki jih v veliki meri zaznamuje finančni, materialni in izvedbeni vidik. V njih je mogoče prepoznati značilen investicijski pristop, ki ga spremljajo določene modifikacije v procesu realizacije.

Glede na poreklo investitorja se delijo na:

a. financirane iz javnih sredstev: občina, regionalna razvojna agencija, različni EU skladi, državni proračun RS oz. posamezne javne institucije,
b. financirane iz zasebnih sredstev: s strani gospodarskih družb oziroma posameznih investitorjev t.j. lastnikov zemljišč.

Evidentno je, da je naročnik, ne glede na poreklo, prepustil *določeno svobodo* kreativnega oblikovanja pri urejanja javnih površin izdelovalcu projekta.

Glede na merilo obdelave se delijo na:

a. idejne rešitve izdelane v merilu, ki prikazuje ključne, vendar načelno opredeljene programske in oblikovne karakteristike (avtorski pristopi se medsebojno zelo razlikujejo: tradicionalni ali sodobni kreativni nazori),
b. podrobnejše rešitve, ki prikazujejo materialnost obdelave javnih površin, tipologijo urbane opreme, konkretne dimenzije, itd.
c. izvedbeno merilo (PZI), ki opredeljuje vse potrebne podatke za realizacijo prostorske rešitve skladno z avtorjevo kreativno predstavo in namero.

2.3 Specifični elementi pri načrtovanju javnega prostora v obalnem pasu

S primerjavo posameznih prostorskih rešitev smo ugotovili, da se v zaledjnem območju pojavljajo konvencionalne tipološke oblike odprtega javnega prostora, kot so: trg, piazzeta, ulica, park itd., kot se tudi sicer pojavljajo na ostalih zaledjnih lokacijah ne-priobalnega prostora. Pri njihovi opredelitvi pa nekateri avtorji vseeno poskušajo uveljaviti značilen mediteranski značaj (*npr. poimenovanja prostorov in elementov: mediteranski park, lokalni kamen, lokalna iglasta vegetacija, drevored pinj, pogledi proti morju iz osrednjega trga, prostor kjer se sliši zvok morja in vetra, prostor od koder se v daljavi vidi silhueto Piranske punte in morskega horizonta, oblikovanje urbane opreme po vzoru navtične arhitekture itd.*), ki naj bi poudarjal identiteto kraja in posledično opozarjal na bližino morja kot posebne prostorske entitete.

Ureditve v priobalnem območju pa vsebujejo določeno posebno obravnavo javnega odprtega prostora. Ugotovili smo pet specifičnih posebnosti pri načrtovanju na obali liniji:

1. Zagotavljanje vzdolžne prehodnosti oziroma zagotavljaje prostega prehoda ob obalni liniji (zasnova *lungomare*). Praktično v vseh projektih je mogoče prepoznati namen vzpostavitve linearno zasnovanega zaznavnega prostora, ki sprehajalcu omogoča permanentno opazovanje morskega horizonta oz. neprekinjen pogled na morje v dinamični fazi hoje. Posamezne vmesne razširitve so namenjene začasnemu postanku in so izrazito enostransko t.j. ciljno orientirane. Tako se zagotovi obiskovalcu sekvenčni postanek in opazovanje horizonta v mirovanju na izbrani lokaciji.
2. Zagotavljanje prečne prehodnosti v smeri zaledje - obala, oziroma zagotavljanje parcialnega pristopa do obale kot javnega dobra. Gre za strukturni ukrep s katerim se v prostorskih rešitvah na čim več mestih (tam kjer je to mogoče) napaja obalna linija, plaža, pristajalni pomoli in ribiški mandrač. Prečne povezave imajo večinoma funkcionalno dimenzijo, le redke rešitve vključujejo tudi ambientalno komponento z uporabo urbane preme pri oblikovanju javnih površin.
3. Zagotavljanje vizualne transparentnosti (pogledi v smeri proti morju in obratno) z namenom opazovanja morskega okolja kot posebne ambientalne entitete (vodnega horizonta, površine morja, morskih pojavov, plovil in posameznih elementov navtične infrastrukture/arhitekture). Projekti v tem smislu načrtno ne vsebujejo vizualnih preprek (gosta vegetacija, eksponati, javna razsvetljava, info oprema itd.), ki bi preprečevali ali omejevali željeno transparentnost.
4. Javne površine v prepletu z dejavnostmi vezanimi na morsko okolje (ribiška infrastruktura, navtični privezi in pristajalni pomoli). Posamezni projekti v svojih kreativnih rešitvah načrtno prepletajo javne in tehnološke površine. S tem je dosežena posebna interakcija lokalnih tematskih elementov z opazovalcem. Tipičen primer je plato ribiškega mandrača,

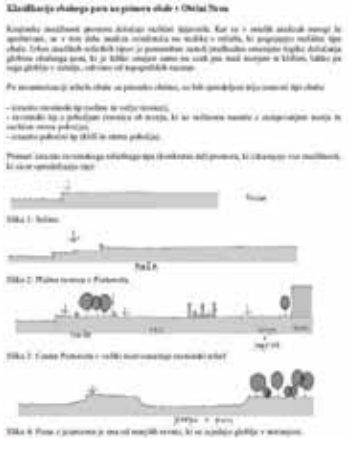
Tabela 2: Primerjava obravnavanih projektov.

Št.	Naziv, leto, avtorji	Status projekta, namen	Opis prostorske ureditve	Tipologija javnih površin (JP) in njihov pomen, prostorski elementi, strokovni pristop
1	**CAMP** - Podrobnejša zasnova prostorskih ureditev obalnega pasu, (2004), Gabrijelčič et al. (Slika 2)	- Aplikativno raziskovalni projekt: CAMP (*Coastal Area Management Programme* /Program upravljanja z obalnim območjem) - Uvajanje trajnostnih načel v proces načrtovanja v obalnem pasu, poudarek na upoštevanju širokega spektra in ciljev	Projekt uvaja tipologijo obalnih sekvenc (pet kategorij: od grajene do naravne) iz vidika urejanja podrobnejših prostorskih elementov. Projekt podje usmeritve za: varovanje cezur v prostoru, ohranjanje vedute iz morja na kopno in obratno, urejanje posameznih prostorski entitet, dostopa do obale linije kot javnega dobra itd.	- opredeljena tipologija: da - pomen JP: širši in lokalni - posamezni elementi JP: ne - raziskovalni pristop
2	**SHAPE** - Idejna zasnova krajinsko urbanistične ureditve za Strunjan in idejne rešitve posameznih prostorskih ureditev, (2014) Skupina 1: Gregor Čok, Andrej Mlakar, Mateja Segulin, Andreja Skubic (Slika 3)	- Aplikativno raziskovalni projekt SHAPE (*Shaping an Holistic Approach to Protect the Adriatic Environment between coast and sea / Oblikovanje celostnega pristopa k zaščiti morskega okolja in obal Jadrana)* - Usklajevanje režimov v 100m obalnem pasu skladno z določbami protokola ICZM - Skupina 1: pilotni projekt: izvajanja ICZM v praksi - simulacija postopka OPPN za obalne ureditve med kompleksoma Krka in Salinera - Skupina 2: prostorske ureditve v centru naselja Strunjan in parcialne arhitekturne intervencije v širši okolici	Skupina 1: Projekt uvaja načelo integralnega načrtovanja. Območje obravnave je členjeno na pet lokacij za katere so izdelane podrobne prostorske rešitve (plato pred hotelom Krka, dve ureditvi plažnih površin, ribiški mandrač in informacijski plato na vhodu v soline). Javni prostor je ključni predmet urejanja, zasnovane so mikro ureditve, tlakovanja itd. Rešitve temeljijo na predhodni analizi interesnih skupin uporabnikov. Predlagana je sprememba namenske rabe površin, ki bi omogočala realizacijo posameznih projektov.	- opredeljena tipologija: da - pomen JP: širši in lokalni - posamezni elementi JP: da - raziskovalni in projektni pristop
3	Skupina 2: Janko Rožič, Matjaž Suhadolc, Gašper Drašler (Slika 4)		Skupina 2: Projekt je usmerjen v urejanje javnega prostora v zgodovinskem jedru Strunjana in posameznih manjših arhitekturnih intervencija v širši okolici. Rešitve temeljijo na premisleku o programski nadgradnji, prenovi in širitvi naselja, sonaravnem načrtovanju, omejevanju negativnih vplivov prometa, turizma in stihijske gradnje itd. Posebej je izpostavljena doživljajska komponenta javnih površin, usmerjenost pogledov in sonaravno oblikovanje urbane opreme.	- opredeljena tipologija: da - pomen JP: širši in lokalni - posamezni elementi JP: da - raziskovalni in projektni pristop
4	**Urbanistična in oblikovna zasnova centra Strunjan**, (2013), različni avtorji, zmagovalna rešitev: Styria Arhitektura d.o.o. (Slika 5)	- Vabljeni natečaj - Zbiranje variantnih strokovnih urbanističnih in oblikovnih rešitev za ureditev območja centra Strunjana	V natečaju so sodelovale štiri avtorske skupine. Predmet obravnave je center naselja vključno z neizkoriščenimi zemljišči vzhodno in zahodno od obstoječe pozidave ter območje spomenika NOB. Rešitve obsegajo podrobne programske in oblikovne zasnove, javni prostor je posebej izpostavljena tema, čeprav se ne nahaja neposredno ob obalni liniji.	- opredeljena tipologija: da - pomen JP: lokalni - posamezni elementi JP: da - kreativni in projektni pristop
5	**Ureditev Plaže v Strunjanu**, (2005), Neda Besničar Suhadolnik (Slika 6)	- Diplomska naloga - Ureditev plaže in ureditev širšega obalnega območja Stjuže	Diplomska naloga obsega urbanistično in arhitekturno ureditev plaže, kot najbolj obremenjenega območja v Strunjanskem zalivu. Naloga analitično preučuje prostorske entitete v širšem prostorskem merilu (vedute, akcente, smeri dostopa itd.) in opredeljuje tezo, da mora plaža, kot javni prostor postati težišče interakcij različni interesnih skupin.	- opredeljena tipologija: da - pomen JP: širši in lokalni - posamezni elementi JP: da - raziskovalni, študijsko kreativni
6	**Ureditev Kopališča Strunjan**, (2008), Alenka Kenda	- Diplomska naloga - Ureditev območja kopališča, preoblikovanje (ne)urejene obale v kvalitetno kopališče in sprehajališče	Zasnova celovite rešitve preoblikovanja kopališča in sprehajališča na sekvenci od vhoda v območje plaže pri Krki do mandrača. Projekt opredeljuje prostorske rešitve, ki temeljijo na elementih regionalne arhitekturne tipike.	- opredeljena tipologija: delno - pomen JP: širši in lokalni - posamezni elementi JP: da - študijsko kreativni
7	**Ureditveni načrt Zdravilišče Strunjan**, (1997), Urbanistika d.o.o. (Slika 7)	- Izvedbeni projekt (PIA) - Ureditveni načrt za kompleks zdravilišča in vplivnega območja	Ureditveni načrt ureja širši prostor zdravilišča, vključno z plažo in obalo ob laguni Stjuža. Akt določa pogoje za urbanistično oblikovanje objektov, naprav in odprtega prostora, pogoje za urejanje komunalnega omrežja in za druge posege v prostor ter določa dovoljene tolerance. Območje je zaradi specifičnih lastnosti členjeno na pet funkcionalnih celot (zdravilišče Krka, teniška igrišča, vila Tartini, kopališče, obala ob laguni Stjuža).	- opredeljena tipologija: da - pomen JP: lokalni - posamezni elementi JP: da - formano projektni, investicijski pristop
8	**Ureditev središča Strunjana**, PGD-PZI, (2013), PIA studio d.o.o.	- Izvedbeni projekt (PGD-PZI) - ureditev območja ob spomeniku NOB in parkirišča	Projekt obsega: ureditev parka on spomeniku NOB, rekonstrukcija lokalne ceste LC 177 116 v središču naselja in ureditev meteorne kanalizacije na širšem območju Strunjana. Opredeljene so parcialne ureditve zunanjih površin, način tlakovanja, materiali itd.	- opredeljena tipologija: ne - pomen JP: lokalni - posamezni elementi JP: ne - formano projektni, investicijski pristop
9	**Ureditev dostopne poti v Strunjanu o križišča Krka do gostišča Salina**, (2015), ISAN 12 d.o.o.	- Izvedbeni projekt (PGD-PZI) - Prometna ureditev v ožjem vplivnem območju obalne linije	Projekt je izrazito tehnološko usmerjen, obsega ureditev parkirnega platoja pred hotelskim kompleksom in dostopne poti v smeri Stjuže.	- opredeljena tipologija: ne - pomen JP: lokalni - posamezni elementi JP: ne - tehnološki, investicijski pristop
10	**OPPN Strunjan**, (2008), Studio Mediterana d.o.o.	- Izvedbeni projekt (OPPN) - Ureditev območja ob cesti Strunjan-Beli Križ od kampa Strunjan do vile Jadranka	Projekt uvaja celovito prostorsko rešitev za parcialne posege na območju, ki je izrazito izpostavljeno vedutam v smeri pogledov proti morju in obratno. Rešitev obsega gradnjo štirih novih objektov in urejanje zelenih površin. Predlagane rešitve imajo v kontekstu urejanja javnega prostora v Strunjanskem zalivu predvsem percepcijski pomen.	- opredeljena tipologija: delno - pomen JP: lokalni - posamezni elementi JP: ne - formano projektni, investicijski pristop, arhitekturno oblikovanje - kreativni pristop

Tabela 3: Elementi, ki so predmet urejanja in dejanska realiziranost projekta.

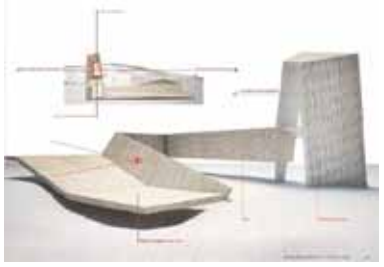
Projekt št.		1	2	3	4	5	6	7	8	9	10
oblika in tipologija odprte javne površine	oblikovana geometrija, gabariti	da	da	da	da	da	da	da	da	ne	delno
	opredeljena funkcija, namen	da	da	da	da	da	da	da	delno	delno	delno
tlakovanje	opredeljen material	ne	da	ne	da	delno	delno	delno	da	da	da
	oblikovan raster	ne	ne	delno	da	delno	delno	da	da	ne	ne
vegetacija	vertikalna	da	da	ne	da	da	da	da	da	da	delno
	površinska	da	da	da	da	da	da	da	da	da	da
urbana oprema	počivališča, klopi	delno	da	da	da	da	ne	ne	da	ne	ne
	razsvetljava	ne	da	ne	da	ne	ne	ne	da	delno	ne
	informacijske table	ne	ne	da	da	ne	ne	ne	ne	ne	ne
	drugi elementi zunanjih ureditev	ne	da	da	da	da	ne	da	ne	ne	ne
orientacija	izpostavljena veduta proti morju	da	da	da	delno	da	da	da	ne	ne	da
percepcija	izpostavljena doživljajska komponenta	da	da	da	da	da	ne	ne	ne	ne	ne
uporabniki	opredeljene Interesne skupine	da	da	ne	delno	delno	delno	delno	ne	ne	ne
realizacija	delež: del ali celota	0%	20%	0%	0%	0%	0%	15%	100%	80%	20%

Slika 1: Zatečeno stanje; na območju obravnave obstajajo številni zametki odprtega javnega prostora vendar je njihovo fizično stanje neurejeno.



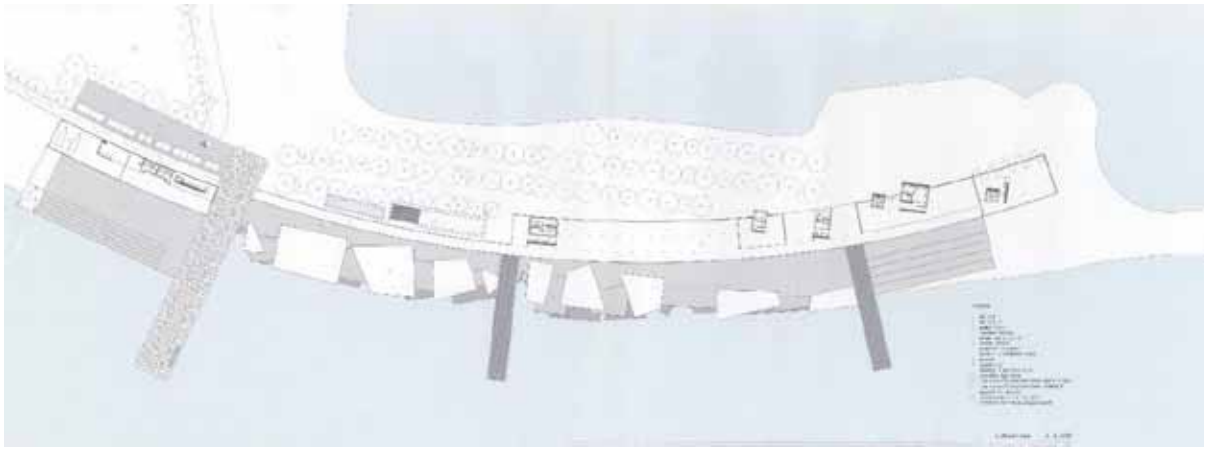
Slika 2: CAMP (projekt 1); projekt uvaja analitično klasifikacijo obalnih sekvenc in usmeritve za njihov trajnostni razvoj (Gabrijelčič et al, 2004).

Slika 3: SHAPE (projekt 2, skupina 1); projekt uvaja načela integralnega načrtovanja posegov v obalnem pasu. Slike (zgoraj) prikazujejo idejne prostorske rešitve za zasnovo odprtega javnega prostora (ureditev plaže in ribiškega mandrača) in posledično dejansko realizacijo (spodaj) (Čok et al, 2014; avtor fotografij: Viktor Žigon).

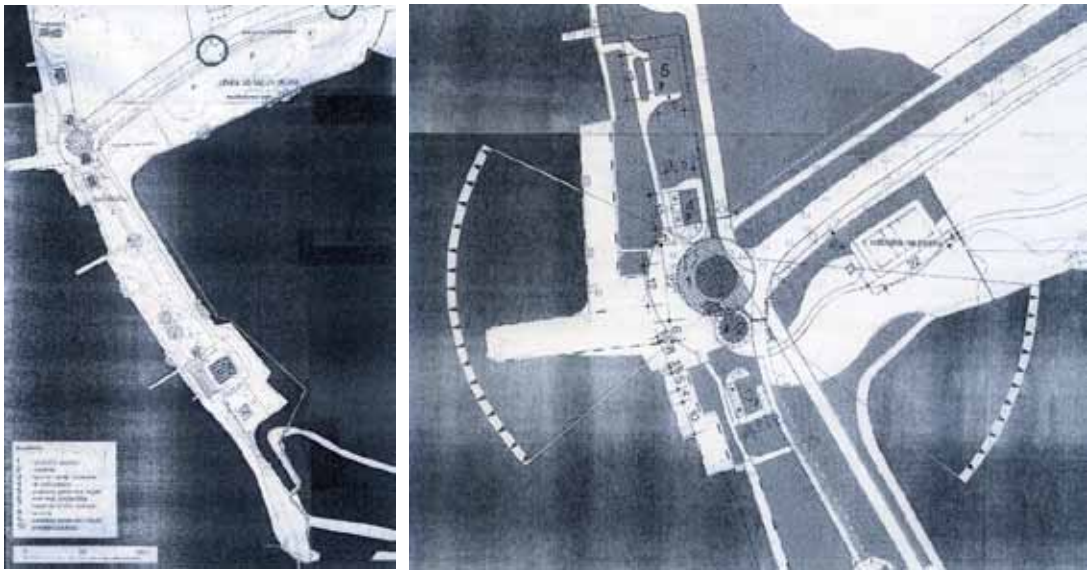


Slika 4: SHAPE (projekt 3, skupina 2); projekt obsega posebne ureditve javnega prostora na celotnem območju naselja, posebej je izpostavljeno historično jedro in oddaljene lokacije, od koder je mogoče celostno opazovati morsko okolje Strunjanskega zaliva (Rožič et al, 2014).

Slika 5: Natečajna rešitev za ureditev centra Strunjana (projekt 4); projekt obsega posamezne mikrokredite z natančno opredeljenimi elementi odprtega javnega prostora (Styria Arhitektura d.o.o., 2013).



Slika 6: Diplomska naloga (projekt 5); Ureditev plaže v Strunjanu, zasnova uvaja inovativne urbanistične in arhitekturne elemente za oblikovanje odprtega javnega prostora neposredno na obalni liniji (Besničar Suhadolnik, 2005).



Slika 7: Ureditveni načrt Zdravilišče Strunjan (projekt 7), predstavlja enega prvih regulativnih instrumentov v tem okolju, projekt uvaja celostno zasnovo plažnih ureditev in turističnega kompleksa v širši okolici (Urbanistika d.o.o., 1997).

ki ga načrtno preči javni *lungomare*. Na stičišču interesov se srečujejo obiskovalci, ribiči s svojo infrastrukturo, dejavnosti marikulture, kopalci in obiskovalci parka solin. Na ta način postane javni prostor stičišče interesnih skupin, katerih spekter je zelo širok in zagotavlja prisotnost posameznih uporabnikov tega prostora v celoletnem časovnem ciklu.

5. Percepcija celote: javne površine v zaledju do koder sega percepcijski vpliv morskega okolja. Gre za lokacije, ki so fizično sicer oddaljene od obalne linije vendar omogočajo posredno doživljanje morskega okolja. Večino gre za lokacije na sprehajalni poti pod (severno od vile Tartini) ali nad klifom (Beli križ), ki nudijo atraktivne poglede proti morju in hkrati poglede na značilno krajino zalednega amfiteatra, ki ga v vzhodnem delu predstavlja zelena dolina Strunjana. V projektu SHAPE (*skupina 2*) gre za premišljene rešitve izkoriščanja vedutnih točk ali daljših doživljajskih sekvenc iz katerih je mogoče opazovati celostno podobo Strunjanskega zaliva in oddaljenih atraktivnosti obalne krajine (pogled na celoten tržaški zaliv).

3. DISKUSIJA: Avtorski pristop pri načrtovanju javnega prostora v obalnem pasu

Poleg naštetega pa se projekti medsebojno bistveno razlikujejo tudi po kreativnem pristopu avtorja oz. avtorske skupine. S kvalitativno primerjavo prostorskih rešitev, ki je obsega ugotavljanje obstoja in izvirnosti (kvalitete) oblikovnih karakteristik pri načrtovanju javnih prostorov (Tabela 3) smo ugotovili tri osnovne oblike avtorskega pristopa:

1. *izrazito raziskovalni, študijski pristop;* ki izraža poglobitev avtorske skupine v predmet obravnave. V okviru takšnih projektov je bila predhodno izdelana raziskava prostora, ciljnih skupin uporabnikov, prisotnih

interesov v prostoru v širšem smislu in drugih dejstev, ki so predstavljala kvalitetna projektna izhodišča za oblikovanje končne prostorske rešitve. Tak pristop načeloma ni obremenjen z upravno formalnimi in investicijskimi omejitvami, zato so rešitve lahko zelo konceptne in inovativne (diplomske naloge, razvojno raziskovalni projekti),

2. *izrazito oblikovni, kreativni pristop;* prisoten predvsem pri natečajnih rešitvah. V okviru projektne natečajne naloge je naročnik natančno opredelil fokus, obseg in potrebe v prostoru. Tudi v tem primeru avtorji načeloma niso bistveno obremenjeni s pogoji izvedljivosti in so zato lahko usmerjeni v oblikovanje rešitve v domeni lastnih kreativnih nazorov. Omejitev v teh projektih predstavlja časovni okvir in omejeno prostorsko območje obravnave - rešitve lokalnega pomena (natečajne rešitve). Evidentna je prisotnost izkušene stroke, ki poskuša v prostoru uveljaviti presežno vrednost v odnosu do obstoječega stanja.
3. *izrazito formalni, projektni pristop*; prisoten pri izdelavi izvedbenih aktov. Avtorji načeloma izhajajo iz številnih robnih pogojev (pogoji investitorja in obstoječih planskih aktov) zato so, kljub izraženemu strukturnemu in programskemu razmisleku, končne prostorske rešitve v določenih elementih oblikovno omejene. Vseeno je v tudi v teh projektih evidentno prisoten element strokovnosti in želja po zasnovi čim boljše zasnove javnega prostora v danih pogojih (PGD-PZI, OPPN).

Ne glede na pristop pa je med projekti mogoče opaziti različne oblikovne trende, ki so poleg oblikovalskih tendenc in nazorov posameznih avtorjev, tudi logična posledica kronologija njihovega nastanka. Gre za cca. dvajset letno obdobje v katerem se prepletajo zametki postmoderne, regionalizma, dekonstruktivizma, high-tech arhitekture in sodobnega minimalizma.

V novejših projektih je v oblikovnih rešitvah mogoče zaznati čedalje bilj subtilno obravnavo morskega okolja kot trajnostne prostorske kvalitete. To se zrcali *v individualnost usmerjeni* opredelitvi funkcije javnega prostora (konzumacija tišine, karakterističnih vedut in naravnih elementov atmosfere), naboru materialov (interpretacija lokalnih/tradicionalnih gradiv) in tipologiji urbane opreme (njena pojavnost, minimalizem, orientacija, oblika). Prisotna je težnja po celostnem dojemanju prostora oziroma po povezavi naselja, lagune in obale v javno dostopen preplet atraktivnih ambientov. V tem okviru imajo javne površine vlogo mehanizma, ki to omogoča.

4. ZAKLJUČEK

V obalnem pasu Strunjanskega zaliva obstaja velik obsega odprtega javnega prostora različnih oblik. S pregledom referenčnih projektov smo ugotovili, da obstaja tudi veliko idejnih in izvedbenih projektov, ki kvalitetno definirajo njegovo programsko in oblikovno dimenzijo. Projektni pristop posameznih avtorjev je v večini primerov izrazito kreativen, žal pa so vsi ti projekti realizirani le v manjšem obsegu. Povprečna stopnja realizacije je kljub ustrezno opredeljeni namenski rabi zemljišč manjša od 20% (vseh 10 skupaj). Med ključne razloge za takšno stanje tako gotovo ne sodi pomanjkanje ustreznih strokovno utemeljenih idej ampak drugi zadržki, kot so investicijske omejitve, neformalne upravno-politične blokade in druge, težko opredeljive okoliščine, katerih ugotavljanje presega vsebino te raziskave. Smatramo, da se bo z razvojem integralnega načrtovanja, kot ga uvaja protokol ICZM, ter z vse večjo participacijo javnosti v razpravah o javnem prostoru kot javnem dobu, stanje v prihodnje izboljšalo. K temu bo pripomoglo tudi vse večje splošno družbeno zavedanje, da je morsko okolje ekološko omejena nacionalna dobrina v katero je potrebno posegati preudarno in z veliko stopnjo previdnosti. Obalni pas mora ostati območje javnega interesa v katerem ni prostora za selektivne investicije zasebnega značaja. Prav kvalitetno oblikovan in vsem dostopen odprt javni prostor mora biti referenca za trajno zagotavljanje demokratične konzumacije vseh potencialov obalnega pasu.

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Alen Mangafić, Mitja Košir, Alma Zavodnik Lamovšek: DOLOČITEV SONČNEGA OBSEVANJA URBANIH OBMOČIJ S POMOČJO ODPRTOKODNEGA GIS MODELA: APLIKACIJA NA PRIMERU ROŽNE DOLINE V LJUBLJANI

DETERMINATION OF SOLAR IRRADIATION IN URBAN AREAS WITH AN OPEN SOURCE GIS MODEL: APPLICATION ON THE EXAMPLE OF THE ROŽNA DOLINA IN LJUBLJANA

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IZVLEČEK

Določanje sončnega obsevanja je ključno za načrtovanje solarnih sistemov. Obstajajo različni GIS modeli za določitev sončnega obsevanja, ki se medsebojno razlikujejo po vhodnih podatkih, strojnih zahtevah, zanesljivosti in primernosti glede na posebnosti obravnavanega območja in narave študije. Urbana območja zaradi razgibanosti in raznolikosti predstavljajo večji izziv pri množičnem vrednotenju potenciala prejete sončne energije. V članku je predstavljena metodologija za določitev obsevanja streh urbanih območij s pomočjo GRASS GIS modela *r.sun*, ki ponuja izračun na podlagi visoko ločljivih prostorskih, atmosferičnih in meteoroloških podatkov. Uporabljeni vhodni podatki so prosto dostopni za celotno območje Slovenije. Predlagan metodološki pristop smo preizkusili na območju mestne četrti Rožna dolina s severnim delom Viča v Ljubljani. Območje je namreč zelo pestro po tipologiji zgrajenih objektov, pokrovnosti tal in višinskih razlikah.

KLJUČNE BESEDE

sončno obsevanje, GIS, r.sun, lidar, Copernicus, Molusce

ABSTRACT

The determination of solar irradiation is crucial when planning the installation of solar systems. There are different GIS models for determining solar irradiation, which differ from each other in terms of input data, hardware requirements, performance, reliability and suitability, depending on the specificity of the study area and the nature of the study. Because of their diversity, urban areas pose a greater challenge for the estimation of the potential of the received solar energy. In the article we present a methodology for determining the irradiation of roofs in urban areas using the GRASS GIS model *r.sun*, which executes the computation with high resolution spatial, atmospheric and meteorological data. The used input data is freely available for the entire territory of Slovenia. The proposed methodological approach was tested on the area of the town quarter Rožna dolina in Ljubljana city with the northern part of Vič. The area is very diverse according to the typology of the built objects, the land cover and altitude differences.

KEY-WORDS

Solar irradiation, GIS, r.sun, lidar, Copernicus, Molusce

1. Uvod

Eden večjih izzivov trajnostnega razvoja sta načrtovanje energetske učinkovitosti in energetske samozadostnosti tako na ravni lokalnih skupnosti, kot sosesk in stavb. Nenehni tehnološki napredek terja poglobljeno analizo lastnosti proučevanega prostora in iskanje lokalnega energetskega potenciala. Z analizo je treba prepoznati tudi pomanjkljivosti dosedanjega energetskega sistema ter načine, na katere posegi v prostor vplivajo na spremembe energetskega potenciala. S kombiniranjem dosedanje energetske infrastrukture (npr. elektrovodi, plinovodi, itd.) in obnovljivih virov (npr. sončna, vetrna, geotermalna in biomasna energija) lahko izboljšamo energetsko učinkovitost tudi v urbanem okolju in zmanjšamo ogljični odtis dosedanje energetske proizvodnje (Kammen in Sunter, 2016).

V tem članku je predlagan metodološki pristop za izvajanje množičnega ovrednotenja sončnega obsevanja streh v Sloveniji s pomočjo odprtokodnih modelov, ki temeljijo na simulacijah sprememb pokrovnosti tal in prosto dostopnih atmosferskih podatkov.

Pri prostorskem načrtovanju solarnih sistemov je treba izvesti študijo o sončni obsevanosti proučevanega območja. Na sončno obsevanost vplivajo različni geografski in atmosferski parametri, na katere ne moremo direktno vplivati. Vplivamo lahko na lokalne fizične lastnosti pri načrtovanju solarnih sistemov, kot so upoštevanje geomorfoloških značilnosti okolja, grajenih objektov, vegetacije in obnašanje solarnih sistemov v različnih pozicijah. Najbolj natančne meritve sončne obsevanosti so terenske, vendar je celoten proces dolgotrajen (več let za pridobivanje ustreznega statističnega vzorca) in neustrezen za primere, v katerih želimo izvesti množično ovrednotenje potenciala. Zaradi močnega vpliva tako medsebojnega kot nebesnega senčenja v urbanih okoljih, le-ta predstavljajo večji izziv pri množičnem vrednotenju potenciala prejete sončne energije, s tem simuliranje količine obsevanja postaja zahtevnejše. Pri prostorskem načrtovanju večjih grajenih objektov (npr. stolpnice), je treba oceniti tudi vpliv takega posega na podlagi dosedanjega lokalnega potenciala sončnega obsevanja. S simuliranjem spremembe sončne obsevanosti v okolici lahko ocenimo tudi potencialno »energetsko škodo«, s katero novozgrajeni objekt indirektno deluje na okolico. Karte, izdelane na podlagi ocene potenciala prejete sončne energije kot tudi ostali rezultati ocene sončnega obsevanja, so lahko zelo pomembna podlaga pri izvajanju prostorske politike, tako na regionalni, kot na lokalni ravni.

2. Dejavniki in modeli za izračun sončnega obsevanja

Dejavnike, ki vplivajo na sončno obsevanost Hofierka in Šúri (2002) delita na tri skupine:

1. Zemljina geometrija, revolucija, rotacija in deklinacija Zemlje, zemljepisna širina analizirane lokacije,
2. geomorfološke značilnosti površja (višina, nakloni, usmerjenost, osončenost, pokrovnost),
3. atmosferski parametri kot so (a) plinske plasti, (b) trdne in kapljevinske snovi (npr. aerosoli, nekondenzirana para) in (c) oblaki (kondenzirana para) vplivajo na to, v kakšni obliki (direktno, difuzno) in koliko sončnega sevanja preide skozi Zemljino atmosfero.

Pri izračunu potenciala solarnih (fotonapetostnih kot tudi solarno-termičnih) sistemov ocenjujemo globalno, oz. celotno sončno obsevanost. »Globalno obsevanje je vsota direktnega sončnega sevanja in difuznega sevanja neba, ki jo prejme element horizontalne ploskve in se izrazi v W/m^2. Cirkumglobalno obsevanje je vsota direktnega sončnega sevanja, difuznega sevanja neba ter od tal odbitega dela teh komponent, ki pade na kroglo, ki je dvignjena od tal« (Hočevar in Rakovec, 1975).

Obstajajo različni računalniški modeli za izračun sončnega obsevanja in se razlikujejo po metodologiji in parametrih, katere upoštevajo. Podjetje *ESRI* npr. ponuja orodje *Area Solar Radiation*, ki izvaja izračun sončnega obsevanja na podlagi vhodnega digitalnega modela višin in za izračun zahteva različne topografske in obsevalne parametre, kot so ekspozicija površja in koeficient difuznosti. Za razliko od nekaterih modelov, kot so *Solargis* in *r.sun*, *Area Solar Radiation* za izračun ne ponuja integracije množic atmosferičnih podatkov (ESRI, Solargis, 2017). Zaloge vrednosti, kot so npr. rastrski podatki, boljše opisujejo atmosferične lastnosti v prostoru kot posamezni koeficienti, ki posplošuje celoten analiziran prostor z enotno vrednostjo. Nehomogenost je lastnost prostora tako v geometrijskem kot fizičnem pomenu. Fizične lastnosti vezane na pokrovnost tal in prevetrenost (korelirano z vlažnostjo) so še bolj razgibane in nehomogene v urbanih območjih kot v odprtem prostoru. To pomeni, da za pridobitev ustreznejšega rezultata sončnega obsevanja v urbanem okolju potrebujemo model, ki upošteva množice atmosferičnih parametrov kot tudi podatke meteoroloških postaj. Odprtokodni GRASS GIS ponuja model *r.sun*, ki izvaja izračun sončnega obsevanja z upoštevanjem vseh treh že navedenih dejavnikov po Hofierka in Šúri (2002). Zaradi tega smo se odločili, da bomo študijo našega primera izvedli s pomočjo *r.sun* modela, ki je predstavljen v nadaljevanju.

2.1 Predstavitev r.sun modela za izračun sončnega obsevanja

GRASS GIS ponuja veliko orodij za preračun rastrskih in vektorskih podatkov. Gre za odprtokodni program, ki poleg vseh klasičnih geoinformacijskih analiz, izvaja tudi preračune trirazsežnih vektorskih in rastrskih podatkov (sestavljenih iz vokslov). Izvaja tudi kompleksnejše geostatistične izračune, kot so trirazsežno krigiranje in ostale volumenske interpolacije. Njegov grafični uporabniški vmesnik in način delovanja nista najprijaznejše narave, ampak je velik delež GRASS GIS orodij integriran v uporabniku veliko bolj prijazen QGIS. QGIS v različici 2.18 Las Palmas ponuja 314 GRASS GIS 7.2.1. orodij. Med njimi je tudi model *r.sun*, ki sta ga razvila Jaroslav Hofierka in Marcel Šúri z Oddelka za Geografijo in Geoekologijo Univerze v Prešovu (2002). Model ponuja dva načina uporabe: (1) izračun globalnega sončnega obsevanja na določenem območju z upoštevanjem od tal odbite komponente sončnega sevanja v pogojih brez upoštevanja oblakov in (2) z določanjem koeficientov jasnosti neba, določenih na podlagi meteoroloških podatkov.

V našem primeru smo najprej izračunali koeficiente jasnosti neba (*clear sky index*) in potem še globalno obsevanje z njihovim upoštevanjem.

Vhodni podatki *r.sun* modela so:

- digitalni model višin,
- usmerjenost (površja ali solarnega sistema),
- naklon (površja ali solarnega sistema),
- Linkeov faktor motnosti (angl.: *Linke turbidity factor*, v nadaljevanju: TL),
- površinski albedo oziroma koeficient odbojnosti,
- geografska širina in dolžina analizirane lokacije,
- število obravnavanih dni v letu,
- deklinacija sonca,
- indeks jasnosti neba za direktno komponento sončnega obsevanja (angl.: *clear sky index - beam*),
- indeks jasnega neba za difuzno komponento sončnega obsevanja (angl.: *clear sky index - diffuse*),
- časovni korak pri seštevanju obsevanosti,
- gostota vzorčenja pri preračunu vpliva senčenja.

Model *r.sun* upošteva atmosferske parametre, ki jih izračuna s pomočjo Linkeovega faktorja motnosti zraka, površinskega albeda in indeksov direktne in difuzne komponente sončnega obsevanja oz. obsevanja pri upoštevanju oblačnosti (Hofierka in Šúri, 2002).

3. Metodološki pristop

Po analizi različnih študijskih primerov (Nguyen in Pearce, 2007; Hofierka in Šuri, 2002; Lucca in Valentini, 2017) smo predlagali lasten metodološki pristop, ki ima izhodišča v dveh študijskih primerih:

1. Razporeditev sončne obsevanosti za ekološke namene na Slovaškem (Hofierka in Šúri, 2002).
2. Solar Lab GIS, Politecnico Di Milano (Lucca in Valentini, 2017).

V prvem študijskem primeru Hofierka in Šúri, avtorja *r.sun* modela, določita obsevanost z upoštevanjem površinskega albeda konstantne vrednosti. Linkeove faktorje motnosti pridobita iz meteoroloških postaj. V drugem primeru, avtorja Lucca in Valentini izvajata izračun albeda na podlagi pokrovnosti tal, vendar določita Linkeove faktorje motnosti na podlagi predlaganih koeficientov v navodilih modula *r.sun* (preglednica 1). Pokrovnost je bila izvedena na podlagi CORINE Land Cover podatkovnih slojev (v nadaljevanju CLC).

V metodološkem pristopu, ki ga predlagamo, smo uporabili kombinacijo korakov iz prvega študijskega primera (Hofierka in Šúri, 2002) z upoštevanjem vrednosti albeda tal na podlagi pokrovnosti (Lucca in Valentini, 2017) in upoštevanjem meteoroloških podatkov v obdobju 2010 – 2017 za določitev Linkeovih faktorjev motnosti neba (CAMS). Iz drugega študijskega primera smo prevzeli način izračuna vrednosti albeda tal, ker je preračun albeda z obdelavo satelitskih posnetkov (npr. MODIS) časovno bolj zahteven in ne ponuja rezultatov, ki bi znatno vplivali na boljši izračun sončnega obsevanja za območje naše velikosti. (Nguyen in Pearce, 2010).

Linkeove faktorje motnosti in meteorološko zaznane količine globalne, direktne in difuzne obsevanost smo pridobili iz baze podatkov Copernicus (CAMS, 2010 - 2017), programa Evropske komisije za spremljanje Zemlje. Zaradi izračuna sončnega obsevanja streh v urbanem okolju, je vpliv senčenja upoštevan z izračunom globalnega obsevanja na osnovi digitalnega modela površja in ne digitalnega modela reliefa. Zaradi zastarelosti podatkov CLC, smo izvedli simulacijo spremembe talne pokrovnosti CLC 2018 v odnosu na izhodiščna podatka CLC 2006 in CLC 2012 z orodjem Molusce. Izvedli smo izračun za solarne sisteme z usmerjenostjo proti jugu (usmerjenost 270°) za naklone med 30° in 45°.

Predlagan metodološki pristop smo preizkusili na območju mestne četrti Rožna dolina s severnim delom Viča v Ljubljani. Območje je namreč zelo pestro po tipologiji zgrajenih objektov, pokrovnosti tal in višinskih razlik (teren pada od Rožnika proti jugu), železniškega omrežja ter zaradi različnih lastninskih struktur (izvedba morebitnih investicij v solarne sisteme se razlikuje za zasebne in javne stavbe).

Podrobnejša metodološka pojasnila so dodana v poglavju priprave vhodnih podatkov.

4. Priprava vhodnih podatkov

Pred izračunom globalnega obsevanja smo določili meje študijskega območja. Na podlagi tega smo pridobili in izdelali podatkovno bazo za nadaljnji preračun.

4.1 Izdelava digitalnega modela površja

Pri preračunavanju sončnega obsevanja streh je treba izvajati preračune na čimbolj natančnem digitalnem modelu površja. Trenutno najbolj natančni javno dostopni podatki v Sloveniji so georeferencirani in klasificirani oblaki točk GKOT na ARSO-vem portalu ARSO Lidar. V njem so točke klasificirane na tla, stavbe in tri različne tipe vegetacij (ARSO, 2017). Podatke v LAZ formatu smo obdelali s pomočjo GRASS GIS orodji *r.in.lidar* in *r.resamp.rst* ter izdelali digitalni model površja prostorske ločljivosti 1 m^2.

4.2 Linkeov faktor motnosti

Linkeov faktor motnosti posplošuje modele atmosferske absorpcije in sipanja (difuzije) sončnega sevanja v vremenskih pogojih z jasnim nebom. »Njegova količina opisuje optično globino atmosfere zaradi absorpcije zaradi vodne pare in absorpcije in sipanja zaradi aerosolnih delcev v primerjavi s popolnoma čisto in suho atmosfero« (SoDa, 2010). Faktor ima vrednosti med 1 in 7, kjer najnižja vrednost predstavlja suho in čisto atmosfero, vse vrednosti med 6 in 7 pa opisujejo zelo onesnažena urbana območja.

Modul *r.sun* ponuja izračun z vpisom enega konstantnega faktorja ali z uvozom rastrskega podatka z različnimi vrednostmi. Predlagani koeficienti v navodilih modula *r.sun* so predstavljeni v preglednici 1. Vhodni rastrski sloji so rezultat interpolacije povprečnih mesečnih vrednosti 45 točk v obdobju 2010 - 2017. Primer interpoliranih povprečnih januarskih vrednosti lahko vidimo na sliki 1 in primerjavo ponujenih TL vrednosti in izračunaninih v grafikonu 2.

Preglednica 1: Predlagani koeficienti v navodilih modula *r.sun*.

	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Avg	Sep	Okt
Gore	1,5	1,6	1,8	1,9	2,0	2,3	2,3	2,3	2,1	1,8
Podeželje	2,1	2,2	2,5	2,9	3,2	3,4	3,5	3,3	2,9	2,6
Mesto	3,1	3,2	3,5	4,0	4,2	4,3	4,4	4,3	4,0	3,6
Industrija	4,1	4,3	4,7	5,3	5,5	5,7	5,8	5,7	5,3	4,9

Vir: GRASS GIS (2017)

4.3 Površinski albedo

»Albedo je mera za svetlobno odbojnost površine telesa. Poznamo več vrst površinskega albeda. Površinski albedo ima razpon od 0.0 do 1.0. Z večanjem količine vode na površju se vrednost albeda znižuje« (Percival in Clesceri, 2003). Obstaja več metod za izračun površinskega albeda in vse so vezane na analizo pokrovnosti tal in obdelavo teh podatkov. Natančne meritve izvaja NASA s pomočjo inštrumenta MODIS z lastnimi sateliti. Podatke o pokrovnosti tal izdeluje tudi Copernicus program s podatkovno bazo CORINE CLC, ki vsebuje podatke o pokrovnosti za leta 1990, 2000, 2006 in 2012. Podatki so pridobljeni s pomočjo podatkov satelitov Landsat-5 in -7, SPOT-4/5m IRS P6 LISS III in RapidEye. V študijskem primeru Solar Lab (Lucca in Valentini, 2017) so vsaki CLC vrednosti dodelili tudi ocenjeno količino površinskega albeda, kar smo aplicirali tudi na našem proučevanem območju. Ostale podatke o površinskem albedu drugih tipov pokrovnosti smo prevzeli iz izračunov, ki sta izvedla Percival in Miller (2003). Vrednosti površinskega albeda na podlagi CLC so prikazane v preglednici 2.

Pri obravnavanju vpliva podatkovnega sloja moramo upoštevati vsa ostala realna stanja na območju, saj imajo s snegom pokrita tla drugačen albedo (od 0.40 do 0.90). V tem primeru bi to lahko teoretično pomenilo, da bi v primeru snega bila večja količina od tal odbitega dela sončnega sevanja in izračunani parametri ne bi prikazali manjše količine obsevanja. Enako velja za pokritost solarnih sistemov s snegom, zato smo nadaljevali ocenjevanje brez upoštevanja teh vplivov.

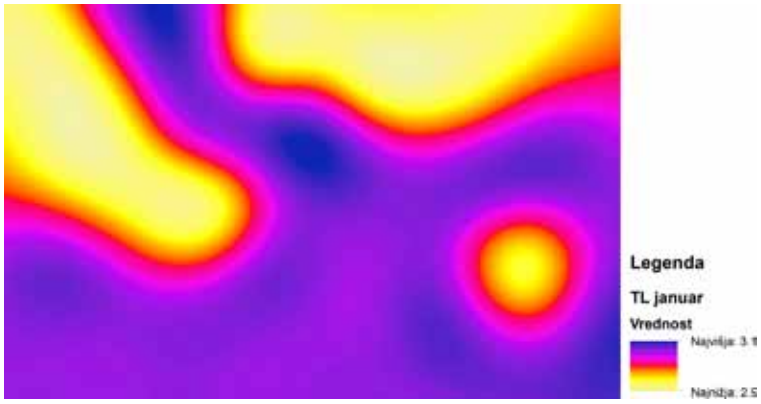
4.3.1 Simulacija sprememb pokrovnosti tal z orodjem MOLUSCE

V primeru, da bi imeli sodobne podatke o pokrovnosti (npr. CLC 2018) bi izvajali izračun na podlagi rastra z vrednostmi reklasificiranimi po načelu preglednice 2. Simulacijo smo izvedli z orodjem MOLUSCE v programu QGIS kot eksperiment. Vhodni podatki so bili CLC 2006 in 2012 (ARSO, 2017) kot reference pokrovnosti tal. Parametri, pri katerih je orodje iskalo razloge za spremembo so bili:

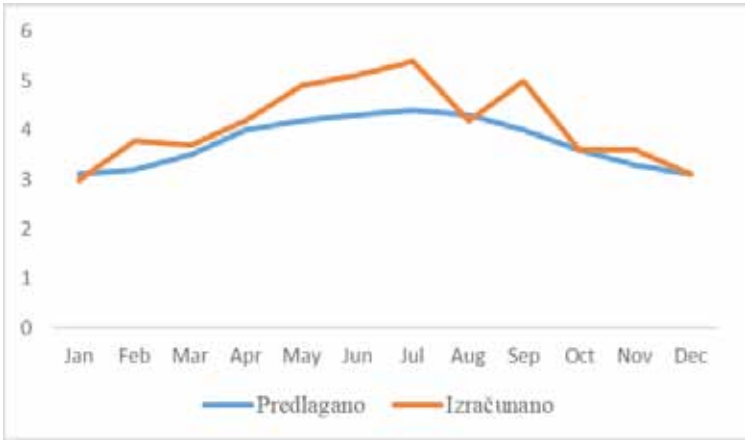
- razdalje od cestnega omrežja (GURS, 2017)
- število prebivalcev iz »mreže 100 m x 100 m« (SURS, 2017)
- razdalje od stavb, zajetih v Katastru stavb (GURS, 2017)

MOLUSCE je preračunal razlike dveh slojev pokrovnosti, poiskal korelacije

Slika 1: Primer interpoliranih količin TL, januar.



Grafikon 1 : Primerjava ponujenih vrednosti TL in izračunanih.

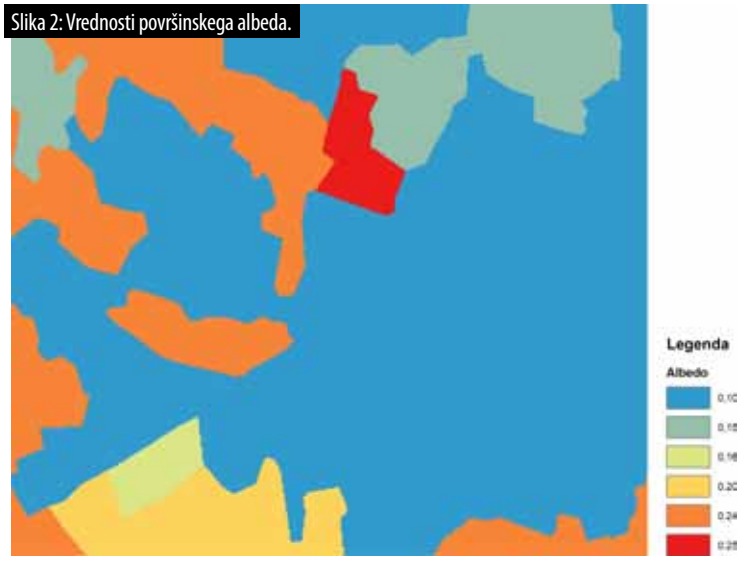


Preglednica 2: Reklasifikacija vrednosti površinskega albeda na podlagi CLC.

CLC KODA	Opis	Albedo
112	Nesklenjene urbane površine	0,10
121	Industrija, trgovina	0,10
122	Cestno in železniško omrežje in pridružene površine	0,10
132	Odlagališča	0,10
142	Površine za šport in prosti čas	0,25
211	Nenamakane njivske površine	0,16
231	Pašniki	0,24
242	Kmetijske površine drobnoposestniške strukture	0,20
311	Listnati gozd	0,10
313	Mešani gozd	0,15

Vir: Percival in Miller (2003) in Solar Lab (2017)

Slika 2: Vrednosti površinskega albeda.



med parametri in spremembami in zgradil model za napoved sprememb v pokrovnosti tal. Iteracijo spremembe smo določili na 1, oz. korak za 6 let, kar pomeni da smo simulirali sloj CLC 2018, ki je prikazan v sliki 2. Spremembe so bile minimalne.

4.4 Indeks jasnosti neba za globalno, direktno in difuzno obsevanje

Meteorološke meritve mesečnih vsot globalnega (GHI), direktnega (BHI) in difuznega (DHI) obsevanja smo pridobili iz baze podatkov CAMS *Radiation Service* in jih dodali v trirazsežni vektorski sloj, enako kot smo to naredili pri preračunu TL. Baza podatkov je vsebovala tudi podatke o količinah GHI, BHI in DHI v pogojih odsotnosti oblakov. Indeksa jasnosti neba direktnega in difuznega sevanja (*clear-sky index*) sta razmerje med izračunanim in meteorološkim podatkom. Za pridobitev indeksov jasnosti neba direktnega in difuznega obsevanja na nagnjeni površini smo upoštevali navodila, katera sta po korakih opisala Hofierka in Šúri (2002). Koeficienti imajo vrednosti med 0 in 1 ter opisujejo oblačnost. Količine bližje 0 opisujejo bolj oblačno, tiste bližje 1 pa manj oblačno hemisfero (grafikon 2).

Statistični vzorec, ki smo ga sestavili, vsebuje vse podatke mesečnih vsot obsevanja za obdobje od 1. januarja 2010 do 1. januarja 2017 za vseh 45 točk, ki smo jih interpolirali s pomočjo trirazsežne interpolacije orodja *v.vol.idw* in pridobljene 3-R rastre pretvorili v vrednosti na dvodimenzionalni površini. Koeficienti variacije indeksov jasnosti neba za globalno obsevanje vseh točk v enem mesecu (KV_{KCi}) imajo vrednosti med 0.004 in 0.022 (preglednica 3).

Glede na pridobljene podatke lahko trdimo, da je na tako majhnem območju s tolikšno višinsko razliko (Δh = 83 m) ustrezno tudi izvajanje interpolacije z veliko manjšim številom točk predlagamo uporabo vzorca do 10 točk za interpoliranje indeksov jasnosti neba. V primeru preizkusa modela *r.sun* na obravnavanem območju, smo predlagali uporabo povprečnih količin koeficientov za izdelavo rastrov konstantnih vrednosti za posamezne mesečne vrednosti.

4.5 Določitev referenčnega dneva v letu in deklinacija sonca

Ker uporabljeni model preračunava vsote vrednosti GHI, BHI in DHI za določene dni v letu, je bilo treba izvajati izračun za dneve, ki najbolj zanesljivo kažejo na mesečno povprečje. Aplicirali smo metodo izračuna povprečnih vrednosti, ki ga predlaga ESRA (2000) in določili izhodiščni dan *i* kot vrednost 17. Model *r.sun* lahko avtomatsko določa vrednosti deklinacije sonca in tudi zemljepisne širine in dolžine, v kolikor so podatki georeferencirani. Vnaprej definirani podatki znatno pospešijo čas izračuna. Za našo ločljivost ($1m^2$) je model potreboval več kot 1 uro za izračun rezultatov za en mesec. Izračunanih je bilo 2 krat po 12 scenarijev in sicer za sončne panele z naklonom 30° in 45°. Zahtevane podatke o sončni deklinaciji smo pridobili na portalu Wolfram Alpha (Wolfram Alpha, 2017).

5. Rezultati in njihovo ovrednotenje

Zagnali smo izračun s korakom seštevanja vrednosti 0,25 ure in z gostoto vzorčenja ob preračunu senčenja od 0,7, kot je predlagala ESRA pri ovrednotenju izračuna z iskanjem kompromisa natančnosti in hitrosti izračuna. Rezultati so predstavljali 24 rastrov mesečnih vrednosti sončnega obsevanja ter dva rastra s povprečnimi letnimi vrednosti za obravnavana naklona. Povprečne letne vrednosti dnevnega globalnega obsevanja z naklonom

Grafikon 2 : Sprememba indeksov ob jasnemu dnevu globalnega obsevanja.

Preglednica 3: Koeficienti variacije indeksov jasnosti neba za globalno, direktno in difuzno obsevanje.

	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Avg	Sep	Okt	Nov	Dec
KV_{KCGHI}	0.022	0.015	0.012	0.011	0.006	0.005	0.006	0.004	0.007	0.007	0.019	0.020
KV_{KCBHI}	0.022	0.015	0.012	0.011	0.006	0.005	0.006	0.004	0.007	0.007	0.019	0.020
KV_{KCDHI}	0.002	0.004	0.002	0.001	0.000	0.002	0.002	0.001	0.003	0.001	0.003	0.005

Preglednica 4: Konverzija dni pri oblikovanju vzorca (i = izhodiščni dan).

Mesec	Konverzija dni	Prestopno leto	Deklinacija sonca [rad]
Januar	i		-0.36220
Februar	31 + i		-0,20950
Marec	59 + i	(+1)	-0,02396
April	90 + i	(+1)	0,18220
Maj	120 + i	(+1)	0,33690
Junij	151 + i	(+1)	0,40800
Julij	181 + i	(+1)	0,37020
Avgust	212 + i	(+1)	0,23470
September	243+ i	(+1)	0,04005
Oktober	273 + i	(+1)	-0,16080
November	304 + i	(+1)	-0,33100
December	334 + i	(+1)	0,40750

Vir: ESRA (2000)

kolektorja 30° so na sliki 3. Rastrske vrednosti smo dodelili stavbam iz vektorskega sloja Katastra stavb (GURS, 2016) s pomočjo orodja *Zonal Statistics v* QGIS-u. Povprečne letne vrednosti dnevnega globalnega obsevanja z naklonom kolektorja 30° so na sliki 4.

Optimalen naklon se spreminja skozi celotno leto, ter na obravnavnem območju znaša 34° (PVGIS, 2017; grafikon 4). Po preračunih lahko vidimo, da je na obravnavanem območju naklon solarnega sistema 30° boljši v primerjavi s tistim pod 45° v večini leta, razen v obdobju od oktobra do februarja.

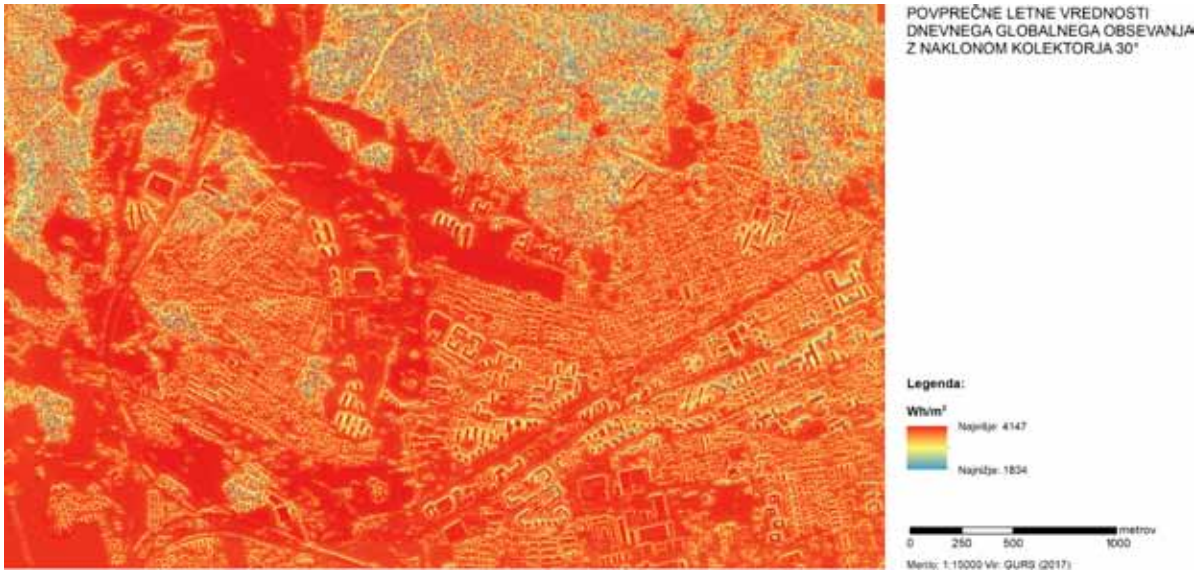
Pridobljene rezultate smo primerjali z rezultati, ki jih za Ljubljano preračunava spletni kalkulator Slovenskega portala za fotovoltaiko (2017). Ta

Grafikon 3: Količina dnevnega globalnega sončnega obsevanja po mesecih.

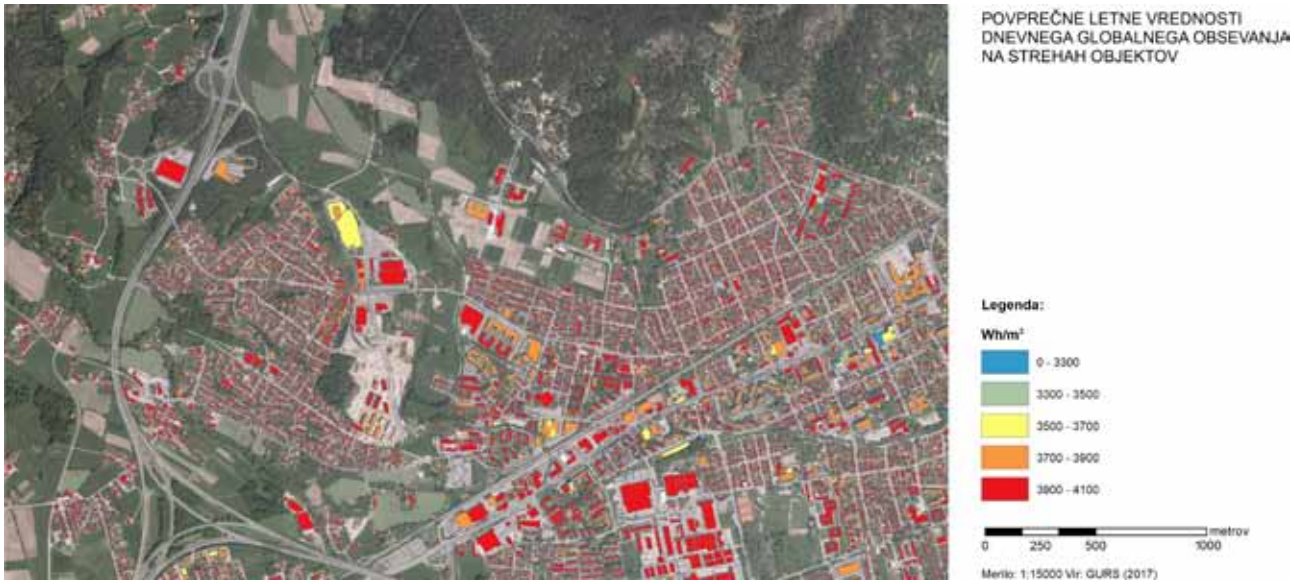
za podana naklona z enako usmerjenostjo izračuna količine sončnega obsevanja na horizontalni površini med 1304 kWh/m² in 1346 kWh/m². Odstopanje srednjih vrednosti med našimi in vrednostmi Slovenskega portala za fotovoltaiko je 5,87 % in 5,53 %, kar je sprejemljivo, glede na to da smo pridobili rastrske in vektorske podatke z vpogledom sončne obsevanosti za 7516 gradbenih objektov vpisanih v Kataster stavb.

V primeru, da bi razpolagali z večjim vzorcem vhodnih podatkov za pripravo indeksov jasnosti neba za globalno obsevanje (na podlagi meteorološki meritev in vrednosti TL), bi vrednosti rezultatov bile nižje, saj se je po podatkih, zbirke podatkov avtomatskih meritev državne ekološko-meteorološke mreže za spremljanje kakovosti zunanjega zraka, količina izpustov onesnaževal iz industrije, prometa in energetike v obdobju 2003 – 2013

Slika 3: Povprečne letne vrednosti dnevnega globalnega obsevanja z naklonom kolektorja 30°.



Slika 4: Povprečne letne vrednosti dnevnega globalnega obsevanja na strehah objektov z naklonom kolektorja 30°.

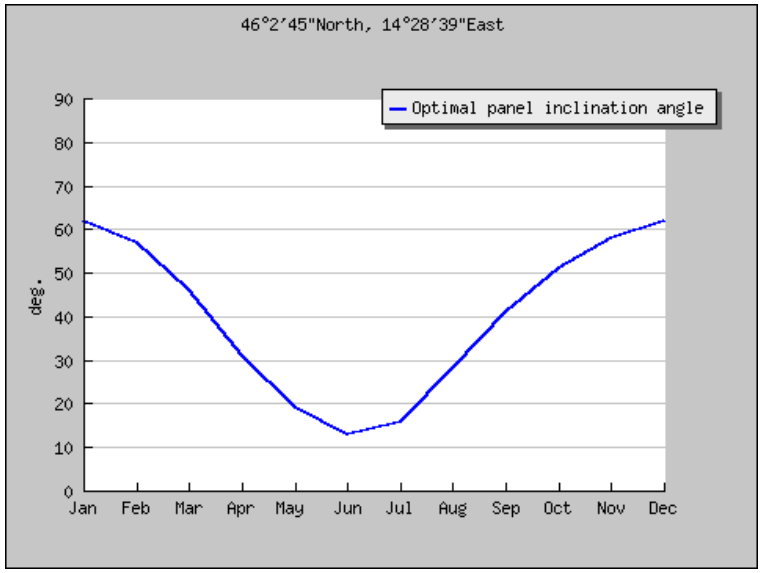


na območju močno zmanjšala od leta 2009 (Ogrin M., Vintar Mally K. et.al., 2014; Glojek K. in Ogrin M., 2015). To dejansko pomeni, da je najbolj primerno izvajati preračun obsevanja na podlagi vzorca sestavljenega od leta 2009 naprej. Povprečne letne vrednosti dnevnega globalnega obsevanja in letna količina prejetega sevanja so izračunane v preglednici 5.

V primeru, da bi 15 % površin obravnavanih streh pokrili s sončnimi sistemi z učinkovitostjo 20 %, bi v enem letu pridelali enako količino električne energije, zaradi katere se v Sloveniji postransko proizvede 7985 ton ogljikovega dioksida, kot je razvidno iz preglednice 6 (240 g CO_2eq/kWh v letu, Electricity Map, 2017).

Trenutno obstaja več aplikacij, ki izvajajo izračun prejetega sončnega obsevanja, kot so PVGIS, PVWatts ter razvijajoči se projekt Google Project Sunroof (PVGIS, 2017; PVWATTS, 2017; Google Project Sunroof, 2017). Prednost naših rezultatov v primerjavi s PVGIS je ta, da PVGIS izračuna obsevanje na podlagi digitalnega modela površja ločljivosti 100 m in ne upošteva vseh vplivov senčenja podrobnega urbanega okolja, kot to upošteva uporabljeni digitalni model površja ločljivosti 1 m (PVGIS, 2017). Aplikacija PVWatts se navezuje na SolarAnywhere® podatke 10 kilometerske mreže (NREL, 2017). Google-ov Project Sunroof je še vedno v razvoju ter ponuja podatke le za ZDA. Izračun izvajajo

Grafikon 4: Optimalni nakloni solarnega sistema po mesecih.



Vir: PVGIS-CMSAF 2017

Preglednica 5: Povprečne letne vrednosti dnevnega globalnega obsevanja in letna količina prejetega sevanja.

	Dnevno povprečje [Wh/m²]	Vsota celotnega letnega obsevanja [kWh/m²]
Naklon 30°	3,905	1425
Naklon 45°	3,770	1376

Preglednica 6: Energetski in ekonomski potencial ter razlike v emisiji CO2.

Potencial v primeru da bi izkoristili 15 % strešnih površin [kWh/m2] letno	Učinkovitost 20 % [kWh/m2]	Zmanjšanje CO2 [t/leto]
166.360.577	33.272.115	7985

Vir: Electricity Map, 2017

tudi z vhodnimi podatki digitalnega modela površja iz aerosnemanja, katerega lastnost so v dokumentaciji opisali le kot visoko ločljivo (Google Project Sunroof, 2017). Najvišjo ločljivost lidarskih posnetkov v ZDA imajo podatki 3DEP ter so ločljivosti 1 m (Nationalmap, 2017)

6. Sklep

Izračun sončnega obsevanja streh s pomočjo modela *r.sun* s predlagano metodologijo je v kratkem času izvedlo preračun potenciala sončnega obsevanja za veliko število stavb. Končni rezultati so lahko uporabni tako pri projektiranju lastnih solarnih sistemov in preračunu potenciala v okolici, kot za simulacije načrtovanja novega objekta (npr. visoke stolpnice), za katere bi morali podatke le prirediti digitalnemu modelu površja. S to metodologijo lahko v hitrem času pridobimo celotno bazo podatkov za Ljubljano in ostala območja v Sloveniji. Pridobljene podatke bi lahko predstavili javnosti v obliki spletnega pregledovalnika. Rezultati so visoke ločljivosti ter zelo primerni za urbana okolja.

Fizične in ostale podatke lahko uporabimo za različne preračune, kot so npr. energetski in ekonomski potenciali ter spremembe okoljskega odtisa. Upravljalci stavb bi na podlagi teh podatkov lahko začeli načrtovati uporabo skupnih stanovanjskih fondov za izgradnjo sončnih kolektorjev in fotonapetostnih sistemov s čimer bi v nekaj letih znatno znižali skupne stroške električne oskrbe stanovanjskega bloka. Enako velja za objekte v lasti države in lokalnih skupnosti, ki lahko predstavljajo vzorčni primer za sprejemanje sodobnih trajnostnih rešitev. S tem bi prebivalcem lahko pokazali, da je energetska učinkovitost dejansko v javnem interesu.

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Andreja Troha: SPREMINJANJE POSELITVENIH VZORCEV NA OBMOČJIH AVTOHTONE RAZPRŠENE POSELITVE

CHANGING SETTLEMENT PATTERNS IN AREAS OF AUTOCHTONOUS DISPERSED SETTLEMENT

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IZVLEČEK

Razpršeno poselitev razumemo kot avtohtono lastnost določenih območij, ki je v preteklosti poleg samega preživetja prebivalcev prispevala tudi k vzpostavljanju in ohranjanju kulturne krajine, medtem ko razpršeno gradnjo razumemo kot negativen pojav v prostoru. Ta v osnovi pomeni degradacijo kulturne krajine zlasti v povezavi s suburbanizacijo ter z njo povezanimi družbenimi stroški, ki so posledica porasta prometa ter z njim povezanim vzdrževanjem in gradnjo infrastrukture. Na urbanih oziroma urbaniziranih območjih je pojavnost obeh oblik poselitve bistveno lažje opazovati in tudi opredeliti, tako s pomočjo matematičnih metod kot s pomočjo posameznih kazalnikov. Na območjih, kjer prevladuje razpršen vzorec poselitve, pa je te opredelitve težko kvantitativno in kvalitativno ovrednotiti. S pomočjo različnih pristopov (vsebinskih in matematičnih) k vrednotenju posameznih lastnosti prostora smo skušali potegniti ločnico med razpršeno poselitvijo in razpršeno gradnjo.

KLJUČNE BESEDE

urbanizacija, suburbanizacija, razpršena gradnja, razpršena poselitev, razpršena urbanizacija, kazalniki

ABSTRACT

Dispersed settlement is understood as an autochthonous characteristic of certain areas, which in the past, along with securing livelihood of the population, contributed to the establishment and preservation of the cultural landscape, while dispersed building is understood as a negative phenomenon in space. The latter basically means the deterioration of the cultural landscape, particularly tied to suburbanisation and related social costs, which are a consequence of traffic growth and the related maintenance and building of infrastructure. In urban or urbanised areas, the occurrence of both forms of settlement is much easier to observe and identify, both using mathematical methods or applying individual indicators. However, in areas with a prevalence of the dispersed settlement pattern it is difficult to quantitively or qualitatively evaluate these definitions. Using various approaches (both substantive and mathematical) to evaluating the individual characteristics of space we wanted to draw a divided between dispersed settlement and dispersed building.

KEY-WORDS

urbanisation, suburbanisation, dispersed building, dispersed settlement, dispersed urbanisation, indicators

1. INTRODUCTION

From the very beginnings, ever since humans have started to transform space, their actions in space have been affected by its use. Throughout history land use changed and transformed along with the development of settlement forms: from existential land uses as a means of survival at the very beginning, through economic and, finally, existentialist land uses. Settlement forms have changed throughout history in dependence of production means. With agricultural revolution, patterns and forms of permanent settlement started to emerge; with urbanisation revolution, as a consequence of division of labour, villages developed into towns and cities; and industrial revolution set off globalisation and urbanisation and, most recently, information revolution that conditions new types of social relationships and related social processes.

The image or formation of urban structures is determined by five generically autonomous spatial elements: *the location of a city* (*situs/locus*) is specified by the *edge* or *perimeter* around the urban tissue, which can be divided into anonymous, *housing tissue, tissue of architectural accents of special significance,* and *free areas of the communication network*. In terms of their emergence, urban structures are either designs (compositions) or formations (agglomerations). Here, formations are understood as unplanned built form, while designs are understood as planned built form (Košir, 1993).

Nowadays urbanisation is understood as expansion of cities and the urban way of life, which causes demographic, social, economic, and morphological changes (Mihelčič et al., 2015).

The phenomena of urban sprawl and suburbanisation led to the collapse of one of the generic spatial elements that in the past defined the settlement structure of urban form, i.e. the edge or perimeter, which restricted and defined this structure within space. The sprawl of (sub)urban areas also reflects the transition from urban structures, from distinctly compositional, planned, and organised structures into an archetype of formations – agglomerations.

In this sense we talk about disintegration of cities as developed spatial structures, which are changing into their opposite. The expansion of urban structures in space based on analytical findings and their application is replacing the wasteful building of land in the suburbs. Such expansion is directly related to uncontrolled growth of settlement and economic activities from urban areas towards rural areas.

In the 1920s, the term "suburbanisation" was first used in the literature concerned with American cities, at a time when the cities mostly expanded along railway lines. Later new terminological classifications were developed on this basis. Owing to the intensification of the research concerning this phenomenon whose manifestations were becoming increasingly problematic, the literature in principle agrees that the terms "suburbanisation" or "suburban areas" stand for "development and expansion of emerging transitional zones, which are the result of dynamic processes of dispersion taking place from densely populated city centres to scarcely populated rural areas" (Ravbar, 2005, p. 31). The manner of expansion of urban areas, their manifestations in space, and the reasons underlying the expansion defined new forms and classifications of urbanisation.

2. DEFINITION OF THE TERM AND THEORETICAL STARTING-POINTS

2.1 Urbanisation

Urbanisation is the process of formation of urbanity, population growth, and transformation of rural areas into settlements with urban character, i.e. expansion of the urban way of life to rural areas.

According to the main characteristics, we distinguish between three development periods of urbanisation (Rebernik, 2008, p. 51–60): primary urbanisation or preindustrial phase, secondary urbanisation or industrial phase, and tertiary urbanisation or post-industrial or metropolitan phase of urbanisation, characteristic of highly developed countries.

The prevailing opinion in the literature is that, in principle, suburban areas are characterised by the development of emerging transitional zones that are the result of dynamic processes of dispersion, directed from densely populated city centres towards rural areas. Most authors agree that the phenomenon of suburbanisation is understood as a spatial manifestation of all social changes in the society. These changes are not manifested only in the increase or expansion of areas with stand-alone single-family houses on city outskirts, but also in the changed structures of workplaces in cities and their outskirts. Nowhere in the world was it possible to prevent or at least mitigate this process, despite the urban planning efforts in various social environments and at various levels (Ravbar, 2005: str. 31).

According to development stages and geographic manifestation characteristics, Ravbar (2005) divided suburbanisation into three stages, i.e. *demographic suburbanisation* (first, migration of population occurs), *industrial suburbanisation* (dispersal of jobs in production activities), and *tertiary suburbanisation* (dispersal of jobs in service activities).

Rebernik (2008) identifies four types of suburbanisation according to their spatial and locational characteristics:

- *Periurbanisation* – urbanisation of the wider rural environment of a city (periphery), often in the form of scarce or discontinued settlement. Periurbanisation areas have three basic characteristics: recent settlement, large share of commuters, and functional links with the city (Brunet, 1992 in Rebernik, 2008).
- *Exurbanisation* – a phenomenon of extended suburbanisation or urbanisation of the wider rural surroundings of metropolitan areas. It is related with the phenomenon of holiday houses in rural areas, emigration of retirees and the middle class to rural areas (Rebernik, 2008).
- *De-urbanisation (counterurbanisation)* – describes the emigration of population from metropolitan areas to rural areas. Some authors refer to it as emigration outside the reach of commuting (Rebernik, 2008). The most common factors contributing to suburbanisation are

(Pacione, 2001 in Rebernik, 2008): improved road transport network, improved accessibility to rural settlements, more long-distance commuting, lower cost of living in rural areas, decentralisation of employment, development of non-agricultural activities in rural areas, possibility of employment in rural areas, higher income and higher standard of living of inhabitants, higher share of retirement-age people coupled with higher retirement incomes, preference for single-family rural living, suburbs as rural nostalgia, growth of anti-urbanism.

- *Urban sprawl* – according to Ravbar (2005: p. 32) it is understood as the physical sprawl of cities (where built-up areas of lower density, which along with housing also include production and commercial facilities, grow faster than the population) and thus studies only a part of the highly complex process related to the much more complex term of suburbanisation. In fact, this relates to wasteful occupation of land in the suburbs. It is linked with uncontrolled growth of settlement and economic activities from urban areas towards rural areas.

Rebernik (2004) further states that two basic concepts of understanding urbanisation have been established: on the one hand, urbanisation as population growth and spatial expansion of cities and urban areas and, on the other hand, urbanisation as a social, economic, functional, and physiognomic transformation of rural areas in the sense of reducing the differences between the city and rural areas.

2.1.1. Dispersed settlement of major scale (urban sprawl)

The terms 'sprawl'[1] and later the phrase 'urban sprawl'[2] were first used in professional papers by American researchers, while in the 1990s the term was taken over by other scientific fields; similarly, the term was first commonly established among the professional and general communities in the United States, and later also worldwide.

Despite some common characteristics it should be underlined that the notion of "sprawl" means different things to different people (Chaltrope & Fulton, 2002). Also, the term "urban sprawl" is used differently in Europe and the US. Even though normative starting-points are mostly the same or similar, the causes of urban sprawl and its occurrence differ (Pattachini & Zenou, 2009).

Dispersed urbanisation, as a manifestation of suburbanisation, occurs in space as uncontrolled sprawling of both urban and rural areas. In the literature, the term is a set phrase describing unplanned sprawling of low population density on the outskirts of major urban centres or metropolitan areas. The ongoing research of the phenomenon has provided various definitions to describe it, nevertheless, there are some common characteristics pervading the literature (Brody, 2013): low-density, single family dwellings, automobile dependency, where residents rely on cars rather than on walking for their everyday supply, spiraling (dispersed) growth outward from existing urban centres, 'ribbon' or strip development along roads, and undefined edge between urban and rural areas.

The focus of the international project Urban Sprawl: European Patterns, Environmental Degradation and Sustainable Development (URBS PANDENS) (Couch et al., 2006) was to comprehensively assess the various 'patterns', 'cause and effect' relationships, and the impacts of regulations and measures on the process of unplanned growth of urban areas at the (trans) national, regional, and local levels. The project provides the assessment of environmental, economic, social and political aspects related to urban growth in selected EU Member States and case studies of city areas[3].

In the project some relevant 'archetype patterns' were identified, which occurred in the process of (non)sustainable expansion of European cities:

- "top-down" supply by building and upgrading major infrastructure systems and structures (airports, motorways, by-passes, high-speed railways, subways, etc.) in order to improve global accessibility, recognisability, and transnational competitiveness of the city (e.g. Athens and 2004 Olympics);
- the "bottom-up" demand influenced by the "new" lifestyle, "traditional" values, greater purchasing power of urban residents in order to improve the quality of life (changing holiday homes or other secondary housing to permanent housing and construction of new housing in the wider urban area, e.g. in Vienna, Stockholm, also Ljubljana and Athens);
- "specific" phenomena occurring in various combinations of infrastructure (non)supply and (new) lifestyle in the 1990s: influenced by new state and/or local governments in post-socialist cities (e.g. Leipzig, Ljubljana, Warszawa) and in post-industrial cities with a decline in the number of population in the inner city and wider urban areas (e.g. Liverpool, Leipzig).

In Slovenian scholarly literature, this phenomenon was not appropriately addressed until the international project URBS PANDENS (Couch et al., 2006).

The reason is probably the unique settlement structure that has its roots in natural and historical conditions, but also because Slovenian territory has not seen the grand-scale design of entirely new settlements in the periphery as those typical for the areas where this phenomenon was first identified, i.e. in the United States. In the literature, the term "suburbanisation" is most commonly used.

2.2 Urbanisation in Europe

Urbanisation of rural areas in Europe started with the industrial revolution. In the time following the industrial revolution, Europe shifted from mostly agricultural to mostly urban. European cities witnessed the greatest growth

1 The term "sprawl" in the context relating to expansion forms of urbanisation was first used in 1937 by Earle Draper in a national (US) conference of planners. Earle Draper used the term to characterise both an unaesthetic and uneconomic manner of settlement (cited in Wassmer, 2002).

2 The phrase "urban sprawl" was first used in the article "Urban Sprawl" published by the sociologist William Whyte in Fortune magazine in January 1958 (Wassmer, 2002).

3 As part of URBS PANDENS (Couch et al., 2006) the phenomenon of urban sprawl in Slovenian territory was also studied, i.e. in the metropolitan area of the Ljubljana Urban Region.

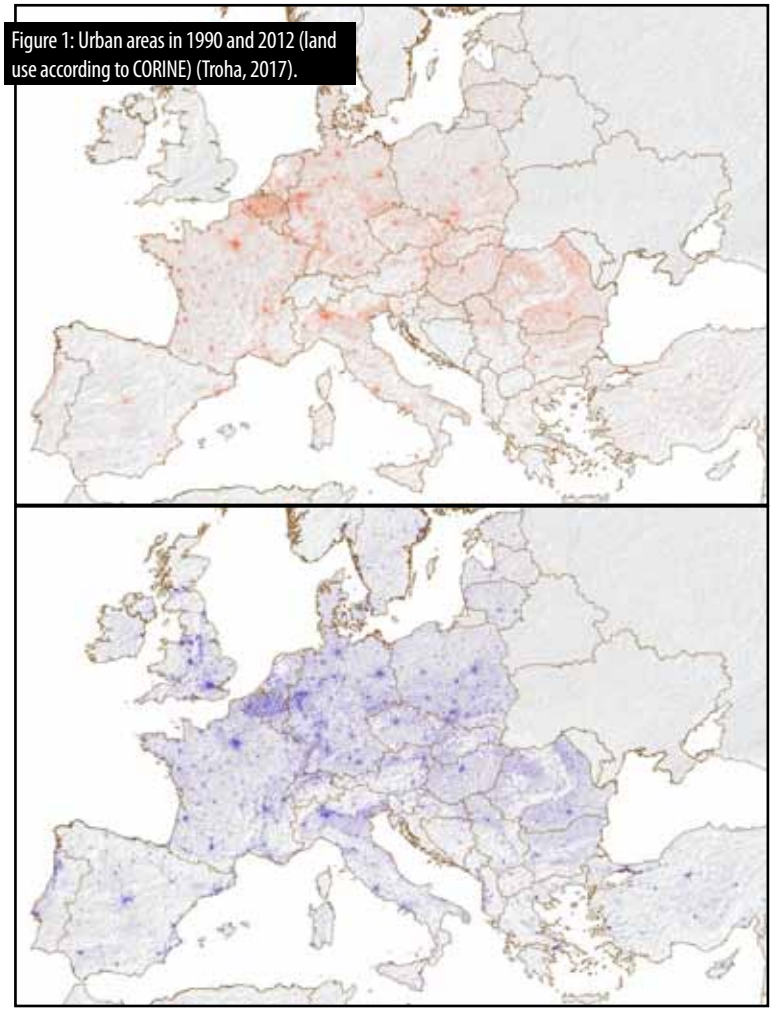


Figure 1: Urban areas in 1990 and 2012 (land use according to CORINE) (Troha, 2017).

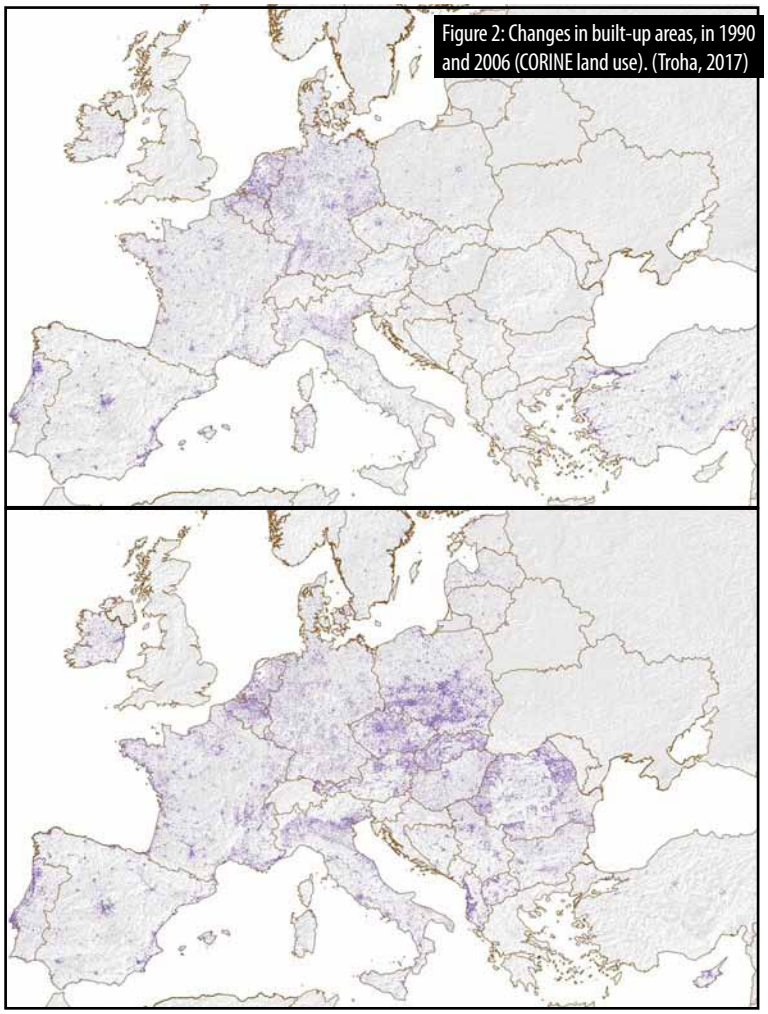


Figure 2: Changes in built-up areas, in 1990 and 2006 (CORINE land use). (Troha, 2017)

between 1950 and 1960 (EEA, 2006), a time characterised by the emigration from rural regions to cities.

In the following period the main settlement wave moved from the cities to their periphery and into agricultural hinterland. The expansion of cities towards their hinterland accelerated the development of public transport and accessibility by car, which enabled commuting. With population came other activities, e.g. production and service activities and, finally, commercial, financial, and research activities located in business centres with good accessibility and lower costs (e.g. the City of London). In some areas we see a decline in population in city centres, however, the surface area of built-up land is not increasing. The emigration of population and growth of cities is no longer tied to population density, as people emigrate both from regions with high population density and those with low population density (EEA, 2006). The rate of population growth in some European countries on urban outskirts has become higher than in cities (Rebernik, 2008).

The reasons underlying urbanisation are various; generally, several groups of reasons for urbanisation to occur have been identified[4]:

economic (economic growth, globalisation, European integrations, raising of the standard of living, price of land, both for building and agricultural, etc.)

social (population growth, higher household income, housing conditions, problems of city centres with inferior quality of residential and natural environments, transport with the growth in the use of cars and poor public transport, legislative framework with deficient spatial planning, lack of vertical and horizontal coordination in implementing land policies, etc.).

4 Extensive studies that were systematically concerned with the phenomenon of "sprawling" in Europe, were commissioned by the European Commission; the study was completed in 2005 (Couch et al., 2005); and by the European Environment Agency); the study was completed in 2006 (EEA Report, 2006).

Figure 3: Degree of urbanisation in 2001 and 2014 (land use according to CORINE). (Troha, 2017)

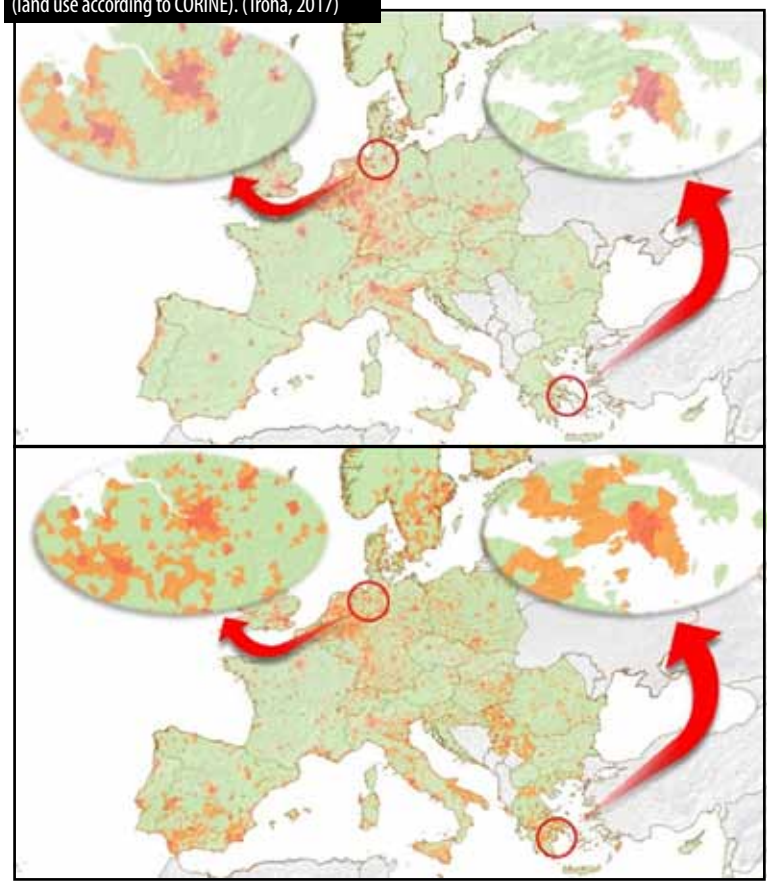
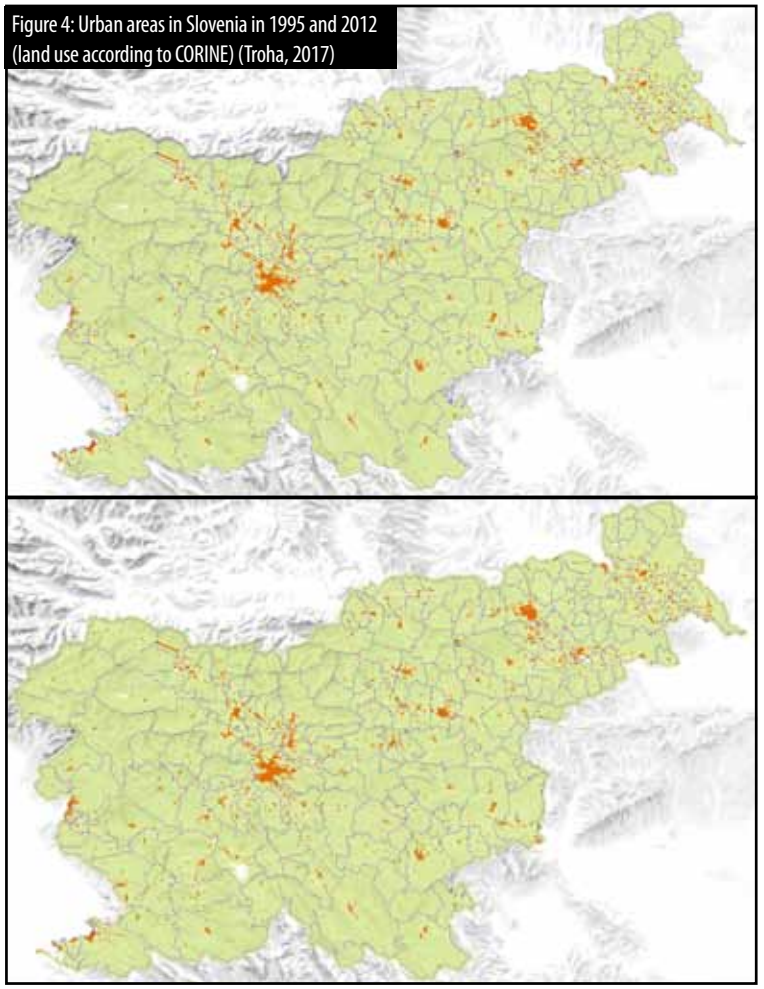


Figure 4: Urban areas in Slovenia in 1995 and 2012 (land use according to CORINE) (Troha, 2017)



These studies report that urbanisation in Europe is the most evident in areas with high settlement density and strong economic activities on the one hand and in areas with fast economic growth on the other hand. Settlement pressures on smaller towns in rural regions, along transport corridors, and in waterfront (coastline) areas are also evident.

Both studies revealed that the urbanisation process in South European cities is slower, cities remained more compact, but nowadays this difference is shrinking.

2.3 Urbanisation in Slovenia

Slovenia's settlement is distinctly dispersed, and its settlements are historically unequally distributed, while in the decades following World War II, under the influence of socio-economic change, the settlement non-uniformity increased even further.

In Slovenia, intensive economic development after World War II (particularly by developing secondary economic activities) set off intensive urbanisation of regional and subregional centres, while urbanisation also reached rural areas. Due to favourable social conditions (possibility of solving the housing problem, jobs, transport proximity, etc.) concentration of the population started to increase in small urban centres as well, particularly at the expanse of depopulation of the rural hinterland. At the time of favourable economic and social conditions the depopulation trend continued, as in rural areas at higher elevations mostly the elderly and less educated inhabitants remained, while educated labour force migrated to urban centres with better work and living conditions. In the 1970s the trend of mass emigration to employment centres settled down which was mostly because of the better standard of living and lower transport costs and thus better transport options to employment centres. At the time, until the 1990s, in the areas of dispersed settlement, new-build developments started to emerge as a solution to the housing problem of the inhabitants. New builds were typically randomly placed, unplanned, and often illegal.

Compared to other European countries, Slovenia is characterised by a relatively low degree of urbanisation, which is the result of intensive commut-

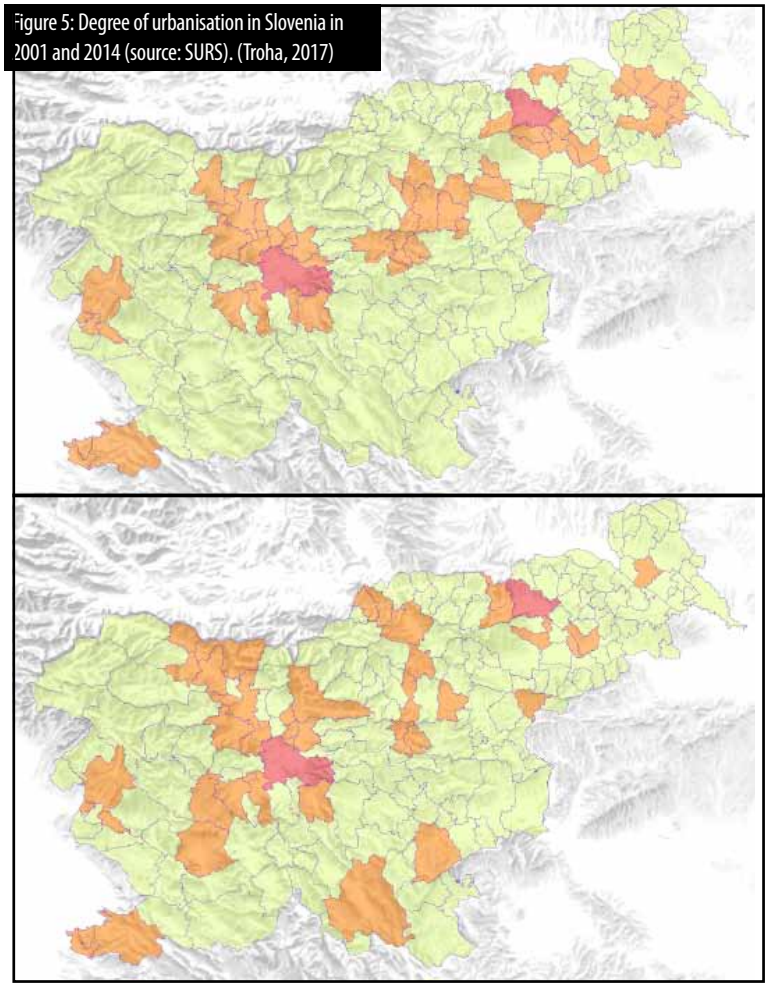


Figure 5: Degree of urbanisation in Slovenia in 2001 and 2014 (source: SURS). (Troha, 2017)

ing, and the start of implementing polycentric development that became the main starting point of the Republic of Slovenia's development. Accessibility to employment and supply functions in rural regions slowed down migration flows. The first signs of suburbanisation around major urban centres were observed in the early 1980s and later these processes strengthened further. According to both Rebernik (2004) and Pichler - Milanovič (2005), urbanisation around major towns and cities strengthened in the first half of the 1990s, while at the turn of the millennium small rural settlements with good accessibility to major urban centres began to strengthen.

2.4 Dispersed building, dispersed settlement, and dispersed urbanisation

In official documents, dispersed settlement and dispersed building occur as a pair, where dispersed settlement is defined as the autochthonous characteristic of certain areas and, as such, presents a spatial quality, while dispersed building is understood as a distinctly negative spatial phenomenon. Basically, this means the deterioration of the cultural landscape, particularly tied to suburbanisation and related social costs that are a consequence of traffic growth and the related maintenance and building of infrastructure. In terms of siting the building tissue we can understand that dispersed building concerns the dispersal of individual structures in a concrete location or an immediate settlement area. Dispersed settlement, on the other hand, can be understood as a characteristic of a certain wider area, where unlike the placement of structures in a concrete area, it is a system of small settlement units that are not hierarchically structured.

In the Slovenian legislative framework. the terms "dispersed building" and "dispersed settlement" were introduced by the Spatial Management Act (hereinafter ZUreP-1) [5] the Spatial Development Strategy of Slovenia (SPRS) arising therefrom, and the Spatial order of Slovenia (PRS)[6].

In line with ZPNačrt, ***dispersed building*** is a negative phenomenon that occurs in space, characterised by irrational land use and insufficient municipal infrastructure and is, as such, in need of rehabilitation. It is thus seen as a low-density, non-contiguous distribution of structures in space, with low population density and without a recognisable settlement pattern. As early as 1980s the term was introduced in the legislative framework, but more in terms of content than terminologically. Thus already the Act on Urban Planning and Other Forms of Land Use[7] specified that outside settlement development areas, settlement areas can be determined only when they are directly intended for agricultural production, forestry, tourism, etc.

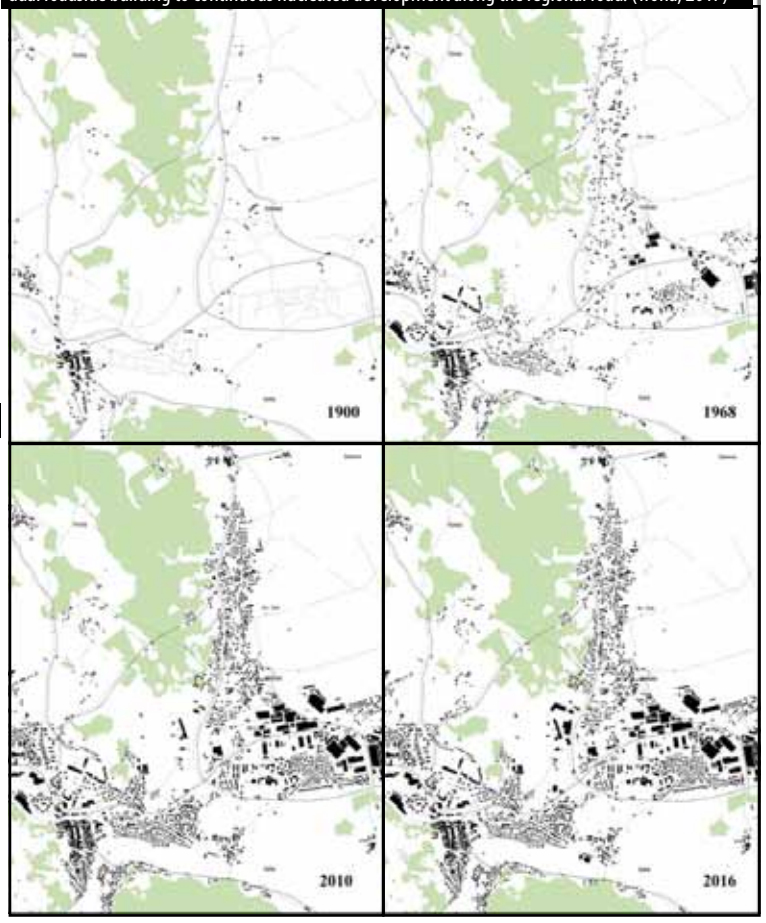
On the other hand, ***dispersed settlement*** is a type of settlement with low population density, which presents an autochthonous settlement pattern and is preserved as such. Dispersed settlement means a type of settlement which is characterised by a large number of scattered small settlementa and parts of settlements with low population density, without a clear organisation and without clear hierarchical relations between them. Typologically they are classified as fragmented, dispersed, scattered, detached settlements as part of autochthonous settlement.

The term ***dispersed urbanisation*** was first used in the paper by D. Rebernik entitled Recent Urbanisation Trends: From Suburbanisation to Reurbanisation, published in 2004 in Geographical Bulletin (Geografski vestnik, 76-2, 2004, p. 53–63). The term used in this paper comes closest to the English term "urban sprawl" in the context of studying the changes in settlement patterns in dispersed settlement areas.

5 Zakon o urejanju prostora [Spatial Management Act] (Official Gazette of the RS, No. 110/02, 8/03 – corr., 58/03 – ZZK-1, 33/07 – ZPNačrt, 108/09 – ZGO-1C, and 80/10 – ZUPUDPP).
6 Odlok o strategiji prostorskega razvoja Slovenije [Ordinance on Spatial Planning Strategy of Slovenia] (Official Gazette of the RS, No. 76/04 and 33/07 – ZPNačrt), Uredba o prostorskem redu Slovenije [Decree on Spatial Order of Slovenia] (Official Gazette of the RS, No. 122/04, 33/07 – ZPNačrt and 61/17 – ZUreP-2).
7 Zakon o urejanju naselij in drugih posegov v prostor [Act on Urban Planning and Other Forms of Land Use] (Official Gazette of the SRS, No. 18/84, 37/85, 29/86, Official Gazette of the RS, No. 26/90, 18/93, 47/93, 71/93, 29/95 – ZPDF, 44/97, 9/01 – ZPPreb, 23/02 – odl. US and 110/02 – ZUreP-1).

Figure 6: Škofja Loka with urbanised hinterland. Intensive suburbanisation led to merging of adjoining agglomerations (photo: Matevž Lenarčič, 2010)

Figure 7: Urbanisation of the villages from Škofja Loka towards Kranj from 1900 to 2016, from individual roadside building to continuous nucleated development along the regional road. (Troha, 2017)



By adopting new, current, spatial legislation in 2007 and 2009 the previous focus of the spatial policy of preventing dispersed building surpassed the framework of mere prevention and was thus directed into evaluating the existing dispersed settlement patterns. In line with the provisions of the act, in preparation of municipal spatial plans the qualitative characteristics of such settlement patterns should be determined (dispersed settlement vs. dispersed building). In the areas identified as areas of dispersed settlement building plots are determined within the areas of dispersed settlement. In the areas identified as areas of dispersed building, unlike the building *fundus* (the area of land under a building), building plots are not shown in implementing spatial planning documents. By preventing the expansion, development is, in fact, obstructed, while the preservation of the existing structures is ensured.

According to Furman Oman (2002), provisions of Slovenian spatial legislation do not ensure unambiguousness of the basic notions concerning dispersed building. The terminological definition of disperse forms is insufficient, as outside of agglomerations, only two types of built form are recognised, i.e. autochthonous dispersed settlement and dispersed building, without clear and objective definitions of these structures.

Gabrijelčič (1997) finds that dispersed building is a recent phenomenon rather than an autochthonous settlement trend developed across a longer period of time. He further explains that between 1970 and 1996 as much as 50% of the housing stock was built; in fact, between 1970 and 1980 housing construction shifted from central areas of urban agglomerations to open space, characterised by the previously characteristic forms of dispersed settlement.

Settlement, as a factor of changing the essential elements of Slovenian landscapes, has mostly adverse affects that are reflected in urbanisation of rural areas. Rather than areas intended for agriculture, rural areas are increasingly becoming residential areas (Hudoklin et al., 2005).

Figure 8: Dispersed construction in exposed areas (photo: Andreja Troha, 2017)

Figure 9: Martinj Vrh with isolated (individual) farmsteads – enclosures (photo: Andreja Troha, 2007)

Figure 10: A homestead with land as an enclosure, detached from other homesteads with large areas of land not built on (forest, pasture, arable land). Bregar, Municipality of Železniki (Photo: Andreja Troha, 2007)

In the Ljubljana Urban Region and in Slovenia in general, this phenomenon is manifested in the growth of built-up land, as a consequence of changing zoned land use from agricultural to developed and undeveloped building land intended for construction of transport infrastructure and utilities, housing, industry, business, and commercial activities. The reasons for this phenomenon can be economic, social, and environmental or a consequence of the statutory scheme (Pichler-Milanović et al., 2007). The various types and manifestations are to a great extent conditioned by the very reasons underlying the phenomenon and originate mostly from the social environment; by understanding the reasons for its occurrence we can develop the measures to control it.

Figure 11: Residential space – exclusively non-agricultural land use (photo: Andreja Troha, 2017)

3. METHODOLOGICAL APPROACH

The literature describes various methods for identifying the causes, characteristics, and the scope of dispersed building, dispersed settlement, and dispersed urbanisation.

For observing and identifying the reasons, characteristics, and the scope of the phenomenon, we usually use individual indicators that describe the characteristics of the phenomenon and which are quantifiable. The most commonly used methods for observing the phenomenon of dispersion of built-up areas are: historical method, method by observation – how the structure changed over time (temporal metamorphosis), observing changes in the phenomenon using various indicators that are characteristic for and define the phenomenon.

Selected indicators allow for assessment of urban settlements in dispersed building areas. The choice of indicators is based on the characteristics of urban sprawl, but they need to be evaluated based on the characteristics of autochthonous dispersed settlement. The selected indicators need to he compared and assessed. The criteria for each indicator need to be accurately defined, while the correlations between the individual indicators and groups of indicators are determined based on statistical analyses.

Characteristics of dispersed urbanisation and the underlying indicators:

1. *Low-density, single family dwellings*
   - median lot size
   - number of dwelling units per spatial unit
   - net floor space of residential buildings
2. *Large automobile dependency*
   - travel times to the city centre
   - distance to the city centre

- travel times to basic supply functions
- distance to basic supply functions

3. *Spiraling growth outward from existing urban centres to the periphery*
   - changing of zoned land use
   - building the infrastructure
4. *Leapfrogging, dispersed patterns of settlement development*
   - changing of zoned land use
5. *Ribbon settlement, strip settlement development*
   - changing of zoned land use
   - building the infrastructure
6. *Blurred, undefined boundary between urban and rural areas*
   - changing of zoned land use
   - building the infrastructure

The factors and reasons underlying the expansion of urbanisation in rural areas were divided into three basic aspects, wherein we wanted to find such a set of indicators that would allow for a detailed analysis and derivation of the appropriate set of indicators to define construction developments from the aspect of preserving the cultural landscape and to assess the expansion of settlement in this respect.

Table 1: Set of indicators concerning dispersed urbanisation development.

ECONOMIC INDICATORS	SOCIAL INDICATORS	ENVIRONMENTAL INDICATORS
■ level of services with supply functions (school, shop, post office, bus stop, etc.) ■ infrastructure services in settlements (municipal utilities, telecommunications, etc.) ■ dynamics in residential buildings construction (period/year of construction) ■ building status (obtained building permit) ■ distance from the municipality centre	■ dynamics in the number of population (natural population growth, immigration, etc.) ■ commuting (daily mobility) ■ age structure	■ degree of urbanisation ■ actual and zone land use ■ share of protected areas ■ intensively cultivated agricultural land ■ forest and other wooded land area ■ degree of motorization

The use of the individual indicators was tested by observing the expansion of built-up areas in Europe and Slovenia (see Figures 1–7), where we observed the actual land use in 1990 in 2012, and the changes in land use between 1990 and 2000 and between 2000 and 2006. The degree of urbanisation (see Figure 3), which is one of the key indicators of urbanisation expansion, was observed for 2001 and 2014. The same indicators for comparable years were observed for Slovenia as well (see Figure 5).

The most commonly used method for measuring urban sprawl dynamics is the Qualitative-Attractivity Migration Model – **QUAM method**. The method was, as a mathematical tool for describing the phenomenon, used in the international study URBPANDENS. The second method is the **space–access model**, a model of choosing between accessibility and space, which explores the relationships between the individual spatial characteristics and describes their mutual interactions, based on stakeholder (actor) decision-making. For identifying the reasons, characteristics, and the scope of the phenomenon, we can also use **individual indicators** to describe and quantify the characteristics of the phenomenon.

The QUAM model deals with net migration flows of actor classes; some actors of the class may well move into the other direction, but the model describes the direction of the net fluxes under mean preference assumptions. The main idea is to deduce as many consequences as possible about the dynamic behaviour of the system if only the direction and the kind of the interactions between the actor classes are known. This approach allows for considering the interactions that are not quantifiable, while defining adequate parameters depends on the individual's perspective and is difficult to operationalize (Meyer-Veden and Eisenack, 2006).

The space–access model is based on systematic treatment of housing structures in urban settlements, which it tries to explain by the impact of the dwelling size and access to the city centre on decision-making of households concerning the use of housing services. Households, based on their income, are faced with the choice between accessibility and housing space. By considering the various incomes and preferences of various social and economic groups this model allows for establishment of a structure of rings of settlement around the city centre.

The phenomena of dispersed building, dispersed settlement, and dispersed urbanisation will be observed in the area of Škofjeloško-cerkljansko hribovje (Škofja Loka and Cerkno Hills).

3.1 Checking the method in the area of Škofjeloško-Cerkljansko hribovje (municipalities of Škofja Loka and Železniki)

The study area comprises the area of the municipalities of Škofja Loka and Železniki. A geographically larger part of Škofja Loka and Železniki territories is part of pre-alpine hills, only the plain around Škofja Loka is part of the Ljubljana Basin. The central part of Škofjeloško-cerkljansko hribovje lies between the valleys of the Poljanska Sora River and the Selška Sora River, while the central ridge extending from Škofja Loka to Lubnik and onwards to Stari vrh and Mladi vrh draws a divide between both Sora rivers.

The territories of Selška dolina (Selca Valley) and Poljanska dolina (Poljane Valley) and Škofja Loka were, according to the records available, settled back

in the Hallstatt Period, while during migration of nations this area had an important geostrategic position as the Selca Valley provided a gateway to the Soča Valley and further to Furlanija (Friuli). Until 1291 these lands were colonised, starting with colonisation of the plain Sorško polje and later with colonisation of both valleys and the surrounding hills. At the time the colonists were Slovenian, while the settlers from Carinthia and Bavaria came later. In the 14th century, the Selca Valley saw expansion of iron-making. The second wave of colonisation in the secluded, hilly region between Škofja Loka and Tolmin, i.e. the Rovte colonisation, started in the 16th century. Until the 19th century, the main economic activity in the Selca Valley was iron-making, while the conditions in the area drastically changed with the revolution in 1848, which officially marked the end of Feudalism. This region saw an economic revival only after 1950, with the development and expansion of wood and metal industries, which are still present nowadays. During its biggest economic heyday, architectural building industry and craft industry developed, which is reflected both in bourgeois buildings in Škofja Loka as well as various buildings in Železniki and the countryside. In this time both urban structures took shape, i.e. both of Škofja Loka and Železniki, while the basic settlement pattern in the hinterland developed already during colonisation. The siting of the built form was adjusted to natural conditions and, at the same time, to the rigid social structure of the time.

Based on the provisions of valid spatial documents in the area of Škofjeloško-Cerkljansko hribovje the methodology involving field work and statistical data analysis helped us to identify the various types of settlements and rural areas, including their function in the settlement system and the level of infrastructure services[8].

Škofja Loka and Železniki are municipal centres that play very different roles in the wider settlement system; Škofja Loka is a centre of regional significance with all supply functions, while Železniki is a municipal centre. Significant local centres are Reteče and Gorenja vas – Reteče, while supply centres or rural settlements are Brode – Gabrk, Sv. Lenart, Bukovica, Bukovščica, Dolenja vas, Selca, Davča, and Spodnja Sorica. Other settlements have no supply functions or distinctly developed activities characteristic of urban settlements.

In Sorško polje nucleated settlements and partially roadside settlements prevail. Due to suburbanisation, the former village settlements between Škofja Loka and Kranj merged into a continuous built-up area (see Figure 7). The settlements are situated along the outer edges of fields, while the middle of the field mostly remained unoccupied. In the main valleys there is a prevalence of nucleated settlements, while in the Poljane Valley there is a prevalence of detached dispersed settlements mostly located along valley edges on alluvial fans of lateral streams rather than on the frequently flooded valley bottom. In the hills, settlements assume the form of isolated farmsteads and small hamlets, as well as detached dispersed settlements (ridges, rounded hills; in-between gullies and valleys are scarcely populated).

The geographical position and geomorphological characteristics make up the characteristic image of the landscape. Sorško polje and the valleys of Selška Sora and Poljanska Sora form a natural boundary of Škofjeloško-Cerkljansko hribovje. In the valley there are the main communication lines, which, pursuant to spatial documents, make up the potential regional perimeter link between central Slovenia and Primorska region. Road connections in the area branch out to individual farmsteads, as compared to the valley, the individual farms were not connected into continuous settlements but rather they were separately distributed across the entire area. Thus dispersed settlement is strongly manifested in the area. In line with spatial documents, this area can be defined as less urbanized countryside comprising less accessible rural and mountainous areas with smaller settlements and a sparse population (SPRS, 2004).

3.1.1. Identifying the characteristics of urban tissue and landscape structures

Based on the analysis of settlement areas of autochthonous dispersed settlement within the individual areas, which have common built form and landscape characteristics, micro locations were selected where the individual characteristics of the built form and the efficiency using the selected indicators to identify dispersed urbanisation were tested.

Several methods were used to check the characteristics and applicability of the individual indicators.

Using the historical method, we checked the occurrence of dispersed settlement and the growth of built form across different periods. The Franciscan Cadastre, the Josephinian Cadastre as well as analogue and digitised military survey maps were used for checking. Partially, we could also apply GIS spatial data.

The method of spatial data processing and analysis was used also for checking the selected indicators in relation to the settlement and dispersed urbanisation systems. ACAD MAP 3D 9 and AGIS 2.18.1310 software was used for spatial data processing in GIS technology, allowing for the use of spatial data in GIS systems. Furthermore, various surveying and other spatial data were used, involving both geopositioned spatial data and other spatial data in digital format. By comparing spatial data we qualitatively and quantitatively checked the selected indicators.

3.1.2. A GIS data application example

Spatial data analysis was done using all three types of spatial data, both digital and analogue; digital geopositioned (georeferenced) data, tabular and information data, both in digital and analogue format.

On the illustrated example we aim to compare, using the historical method, the development of the settlement pattern in the study area as a function of time.

8 Troha, A., Krajner, P. (2007). Strokovne podlage za poselitev. Železniki: Občina Železniki. Valenčak J. et el. (2005). Izhodišča za pripravo strategije prostorskega razvoja in prostorskega reda Občine Železniki. Železniki: Občina Železniki.

9 Autodesk® AutoCAD® Map 3D 2017 © 2016 Autodesk, Inc.

10 QGIS version 2.18.13© 1989, 1991 Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.

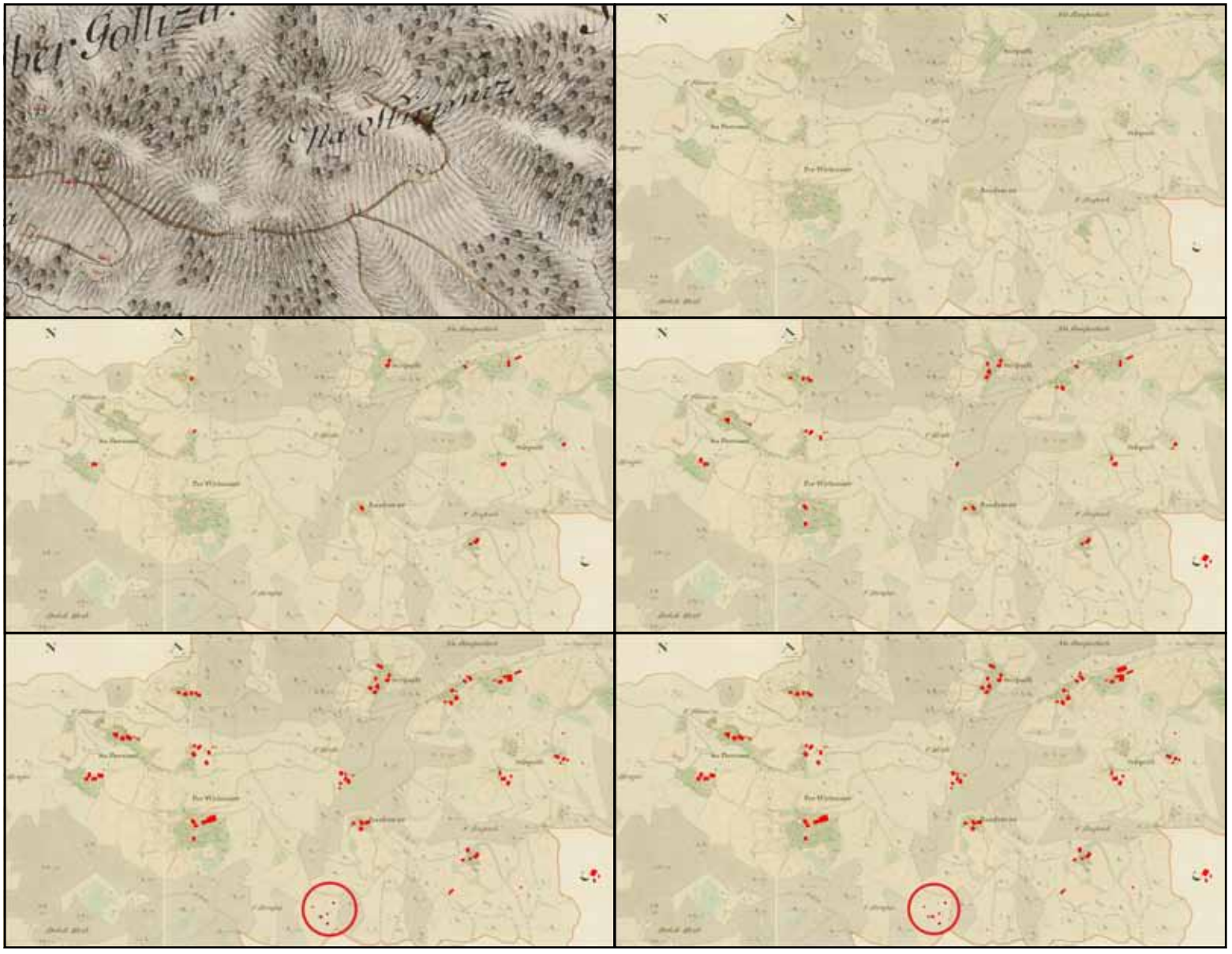


Figure 12: Historical background of settlement development in areas of a dispersed settlement pattern. From left to right: military survey map from 1763–1787 (source: Rajšp, Ficko, 1995), Franciscan Cadastre for Carniola 1823–1863 (source: RS Archive), Franciscan Cadastre and the Buildings Cadastre, buildings built before 1900, buildings built before 1968, buildings built before 2010, and buildings built before 2016 (source: RS and GURS archives). (Troha, 2017)

The digitised data of the military map (1763–1787), the Franciscan Cadastre (1823–1863), and the georeferenced data from the Buildings Cadastre suggest that the settlement pattern until 1968 was preserved in its original form by expanding and densifying the original locations of settlement in dispersed farmsteads and enclosures. After 1968 we have seen a more intensive expansion of settlement outside the original settlement areas (Figures 14 and 15).

Along with surveying data and records maintained by the Surveying and Mapping Authority of the Republic of Slovenia (GURS), other spatial data were used in the analysis, which are kept by other public authorities as part of their original tasks.

The following data are also essential for analysing the selected indicators: records on actual land kept, for agricultural policy needs, by the Ministry of

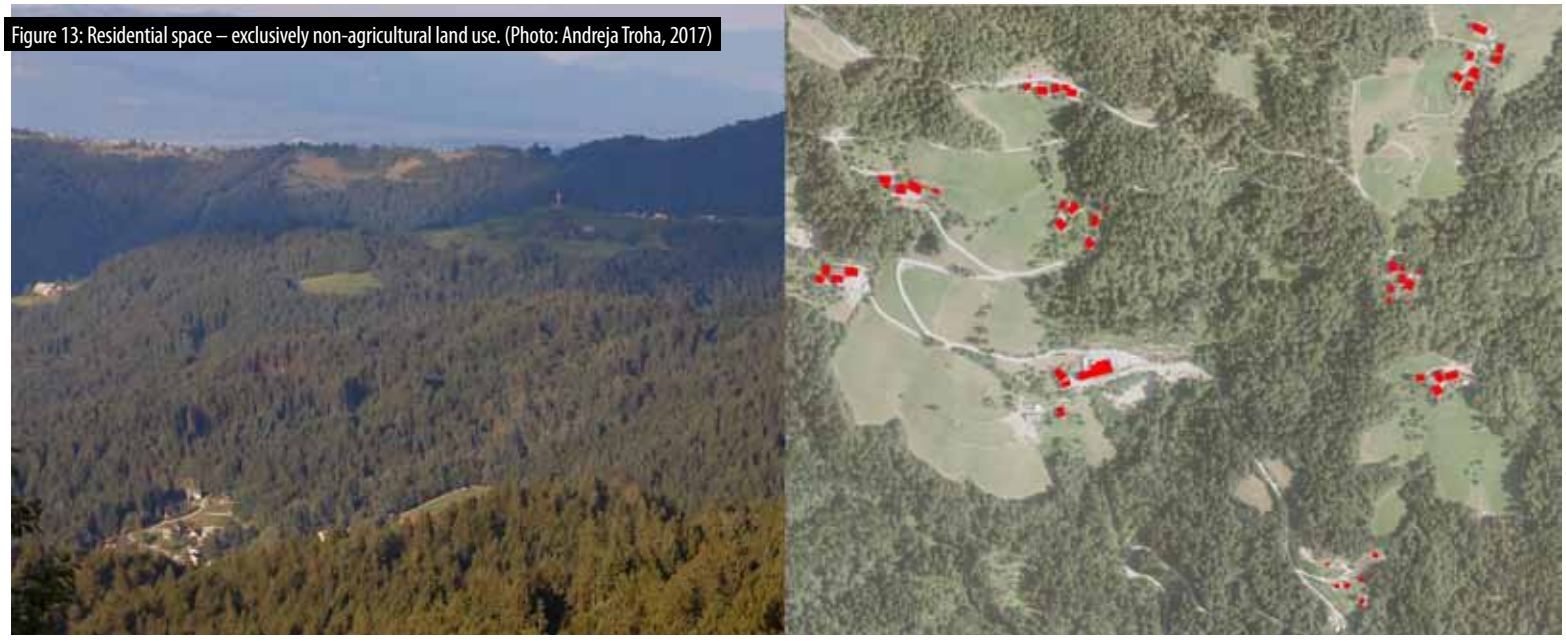


Figure 13: Residential space – exclusively non-agricultural land use. (Photo: Andreja Troha, 2017)

Agriculture, Forestry and Food (MKGP), data by the Statistical Office of the RS (SURS), spatial data kept by the Ministry of the Environment and Spatial Planning (MOP) and the Ministry of Culture (MK) and, finally, the spatial data kept by local communities for their own needs or to pass them on to public authorities.

GURS data provide information about the level of services of individual settlements in terms of utilities, supply functions, transport connections, distance to areas of supply functions as well as the previously mentioned dynamics of constructing buildings. Statistical data, both georeferenced and other data from SURS databases, are necessary to determine the social

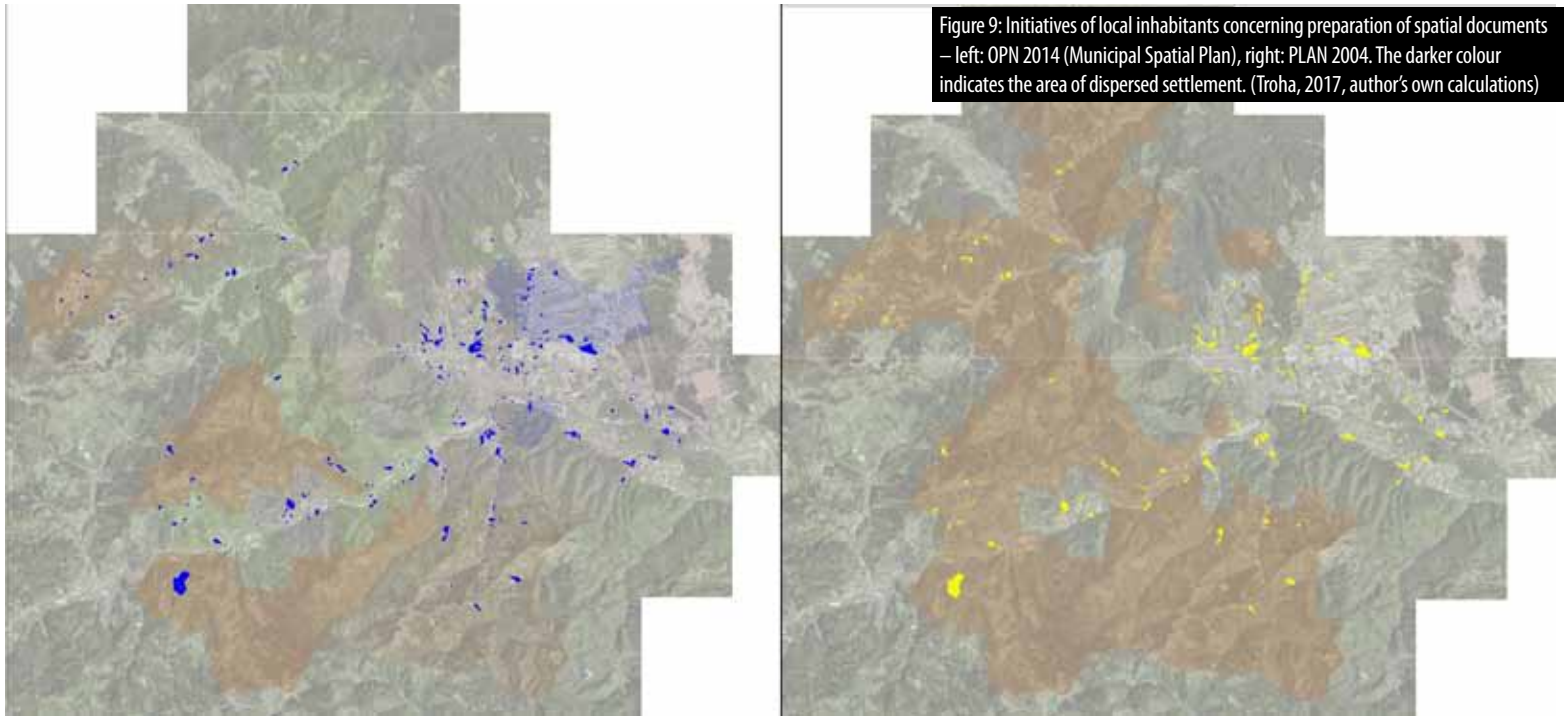


Figure 9: Initiatives of local inhabitants concerning preparation of spatial documents – left: OPN 2014 (Municipal Spatial Plan), right: PLAN 2004. The darker colour indicates the area of dispersed settlement. (Troha, 2017, author's own calculations)

indicators defining dispersed urbanisation. For checking environmental indicators, the databases kept by GURS, ministries, and local communities are crucial, particularly the data on zoned land use, along with the data on actual land use.

4. CONCLUSIONS

The sprawl of settlement in areas where the dispersed settlement is an autochthonous settlement pattern is increasingly intensive, which is, upon initiatives of residents for changing zoned land use reflected in the adoption of spatial documents and through illegal construction and its (subsequent) legalisation. If the expansion of such settlement involves growth and traditional, existing settlement patterns, this, indeed, helps to preserve the cultural landscape and the quality of natural and architectural landscape. The latter is demonstrated through the preservation of zoned land use as well as preservation of agricultural and cultivated land in the areas concerned. On the other hand, in the case of dispersed urbanisation or the so-called "urban sprawl", such settlement expansion does not contribute to preserving landscape patterns, but rather accelerates the deterioration or shrinking of agricultural and cultivated land in these areas.

So far, the discussion revealed that *the growth of settlements in areas of autochthonous dispersed settlement is to a large extent dispersed building that does not contribute to greater preservation and recognisability of rural areas, while it does increase social costs for ensuring adequate supply of these areas.*

The hypothesis will be tested by using the individual indicators of urbanisation (social, economic, environmental, according to Vintar Mally, 2006) and determine the most appropriate areas for a detailed analysis. In the selected areas, using a set of indicators that define dispersed urbanisation, we will check whether this is, indeed, this type of settlement or the so-called organic expansion of settlement. The method for checking the individual indicators will be selected based on the spatial characteristics and the type of indicators used to check the spatial characteristics. Each of the previously presented methods can help us to determine the level of urbanisation (only to a certain extent), but each also has some deficiencies related to identification of physical characteristics of space, as the subject of their treatment is exclusively urban areas along major city centres, i.e. metropolitan regions. When choosing and developing the methodology for quantifying such phenomena in, exclusively, sparsely populated rural areas we will need to overcome the large-scale framework and observe the phenomenon in settlement structures at micro scale.

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Mojca Furman Oman: ENAJSTA ŠOLA POD MOSTOM: (NE)OGRAJEVANJE JAVNIH PROSTOROV – ZLATA KOCKA 2017

THE SCHOOL UNDER THE BRIDGE: (NON-)FENCING OFF PUBLIC SPACES

DOI: UDK: 711.1 : 37 ▮1.04 Strokovni članek / Professional Article ▮SUBMITTED: May 2017 / PUBLISHED: November 2017

IZVLEČEK

Enajsta šola pod mostom je izposojena Cankarjeva metafora, ki smo jo uporabili za pristop k ozaveščanju in izobraževanju mladih o pomenu skupnega javnega prostora in sicer na neformalen način, zunaj učilnice, v praksi na izbranem javnem prostoru. Projekt je naslavljal temo »(ne)ograjevanje javnih prostorov«, ki je v Sloveniji, predvsem pa v mestu Celje, izredno aktualna. Poleg tega smo s projektom načeli še eno aktualno problematiko - zakaj in pred čim se danes ograjujemo. Torej, ali niso ograje okrog naših javnih prostorov v mestih le odraz ravnanja na ravni države in Evrope, ki se prav v tem času pospešeno ograjuje. Projekt je na provokativno vprašanje odgovoril z elementi arhitekture: material, s katerim se ograjujemo, smo transformirali v elemente urbane opreme javnega prostora, ki spodbujajo k druženju in socialnim stikom med različnimi uporabniki javnih prostorov.

KLJUČNE BESEDE

ograjevanje, javni prostor, mesto, urbanizem, izobraževanje mladine

ABSTRACT

The School Under the Bridge, a metaphor taken from Ivan Cankar, was used as a way to raise awareness and inform the youth about the importance of shared public space. This was done in an informal way, outside the classroom in the chosen public space. The project addressed the topic of (non-) fencing off public spaces, a current problem in Slovenia and particularly in Celje. In addition, the project discussed the question of another current topic – why and what do we fence ourselves from? Aren't fences the reflection of political situation in Slovenia and in Europe that is currently putting up its fences? The project responded to this provocative question through incorporation of architecture: the material, normally used to construct fences, was transformed into urban furniture that encourages socialising and social contacts among public space users.

KEY-WORDS

fencing, public space, city, urban planning, education

Enajsta šola pod mostom je izposojena Cankarjeva metafora, ki smo jo uporabili za pristop k ozaveščanju in izobraževanju mladih o pomenu skupnega javnega prostora in sicer na neformalen način, zunaj učilnice, v praksi na izbranem javnem prostoru. Projekt je naslavljal temo »(ne)ograjevanje javnih prostorov«, ki je v Sloveniji, predvsem pa v mestu Celje, izredno aktualna. Tu se namreč v zadnjem desetletju mnoge javne ustanove odločajo za ograjevanje (skupnih) javnih prostorov, tako se npr. ograjujejo otroška igrišča, šole, načrtuje se ograjevanje mestnega parka in podobno. K ograjevanju teh prostorov ustanove pristopajo zaradi težav z vandalizmom, slabim odnosom do javnih prostorov ali neodgovorno rabo le-teh. Menimo, da je tak pristop napačen, saj družbo vodi v še večjo individualizacijo, odtujenost, zmanjšanje socialnih stikov, vse manj možnosti srečevanja in kvalitetnega preživljanja časa na javnih prostorih, v omejenost in nadzor. Menimo tudi, da je potrebno težavo rešiti v izvoru - potrebno se je vprašati, kam je zašla naša družba, da smo v času od osamosvojitve dalje (in kvalitetno urejenih ter uporabljanih javnih prostorov) zašli na polje popolne individualizacije in brezbrižnosti do skupnega javnega dobra. Zato smo sistematično pristopili k promociji, izobraževanju in ozaveščanju že najmlajših generacij ter jim

The School Under the Bridge, a metaphor taken from Ivan Cankar, was used as a way to raise awareness and inform the youth about the importance of shared public space. This was done in an informal way, outside the classroom in the chosen public space. The project addressed the topic of (non-) fencing off public spaces, a current problem in Slovenia and particularly in Celje. In the last decade, many public institutions have been opting to fence off public spaces, such as playgrounds and urban parks. These steps are taken due to the problem of vandalism, bad attitude towards public spaces and the irresponsible use of these places. We believe such approach is inappropriate, as it results in greater individualisation, alienation, weaker social contacts, fewer options for good-quality socialising in public places paired with choice limitation and control. We further believe the problem should be resolved at its source – we should ask ourselves where our society has come since it became independent and what has caused the complete shift to individualisation and indifference in regard to the welfare of our society. We have decided to systematically educate the younger generations, promote awareness and present the endless opportunities offered by quality public space , while indirectly attempting



predstavili neskončne možnosti, ki jih ponuja kvaliteten javni prostor in s tem posredno skušali vzgojiti odgovorne uporabnike teh prostorov.

Projekt je ozaveščal o pomenu kvalitetno grajenih in oblikovanih javnih prostorov kot skupni vrednoti ter aktivno vključil mlade pri njihovem snovanju. Javni prostor in njihova ponovna revitalizacija so namreč eden od večjih izzivov celotne države, ki bo terjala veliko strokovnega znanja, angažiranja civilne družbe ter političnega aktivizma.

Poleg tega smo s projektom načeli še eno aktualno problematiko - zakaj in pred čim se danes ograjujemo. Torej, ali niso ograje okrog naših javnih prostorov v mestih le odraz ravnanja na ravni države in Evrope, ki se prav v tem času pospešeno ograjuje. Projekt je na provokativno vprašanje odgovoril z elementi arhitekture: material, s katerim se ograjujemo, smo transformirali v elemente urbane opreme javnega prostora, ki spodbujajo k druženju in socialnim stikom med različnimi uporabniki javnih prostorov.

Projekt je imel širše učinke tako v smeri prostorskega ozaveščanja, kot iskanja alternativnih bivanjskih oblik in osveščanja glede pomena javnih prostorov, prispeval je k višji stopnji zavedanja o pomenu kvalitetno urejenih javnih prostorov in o primernem odnosu do le-teh; mladi so se seznanili s prepoznavanjem problemov v skupnem javnem prostoru in aktivno sodelovali pri iskanju rešitev. Dosegli smo tudi konkretni cilj: dejansko smo opremili izbrano območje - javni prostor v Celju - z elementi, ki vabijo k srečevanju in druženju v javnem prostoru in ki pokažejo, da je ograjevanje

to educate responsible users of public space. The project raised awareness about the significance of well-built and well-designed public space and encouraged the youth to actively participate in its creation. The revitalisation of public space is one of the major challenges for the entire country and will take much expertise, engagement of civil society, and political activism. In addition, the project discussed the question of another current topic – why and what do we fence ourselves from? Aren't fences the reflection of political situation in Slovenia and in Europe that is currently putting up its fences? The project responded to this provocative question through incorporation of architecture: the material, normally used to construct fences, was transformed into urban furniture that encourages socialising and social contacts among public space users.

The project was effective in terms of space awareness as well as in seeking out different housing alternatives. It contributed to greater awareness about the meaning of well- maintained public spaces and the appropriate attitude towards them; the youth was introduced to recognising problems and played an active role in finding solutions. We achieved a solid goal: we actually furnished the chosen area – a public space in Celje – with pieces that invite people to meet and socialise and that prove that fencing off public spaces is a wrong approach. The material used was the material typically used for fences – panels, wires, tape, slats. And finally, we posed a question: (why) is fencing off ... truly necessary?

The project was sponsored by the Ministry of environment and spatial plan-

javnih prostorov napačen pristop k njihovi rabi. Kot material smo uporabili gradiva iz katerih sicer izdelujemo ograje - panele, žice, trakove, letvice. Poleg tega smo postavili aktualno vprašanje: ali (in zakaj) je ograjevanje javnih prostorov, držav, regij, ... res potrebno?

Projekt je v okviru Meseca prostora 2016 financiralo Ministrstvo za okolje in prostor. Zavod Metro SR je projekt izvedel z dijaki 4. letnika Gimnazije Celje - Center, likovne smeri na Umetniški gimnaziji.

Za projekt smo prejeli nacionalno nagrado Zlata kocka 2017, ki jo za prispevek k izobraževanju otrok in mladine o pomenu kvalitetno grajenega okolja, arhitekture, urbanizma in trajnostnega razvoja podeljuje Zbornica za arhitekturo in prostor Slovenije.

ning as part of the project entitled Month of Space. The project was conducted in cooperation between Zavod Metro SR and the students of the fourth year at Painting and Fine Arts Department at Gimnazija Celje – Center.

The project won The Golden Cube Award 2017.

III.

PROJEKTI

PROJECTS

POZABLJENE MOJSTROVINE

FORGOTTEN MASTERPIECES

2017/2018

TIP PROJEKTA *TYPE OF PROJECT*
raziskovalna spletna rubrika

DELOVNA SKUPINA
vodja delovne skupine: dr. Boštjan Bugarič

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GRADIVO PRIPRAVIL *MATERIALS PREPARED BY*
dr. Boštjan Bugarič

COBISS
Spletna povezava: http://blog.architectuul.com/tagged/foma.

VSEBINA

Pozabljene mojstrovine *angl. Forgotten Masterpieces* je raziskovalna rubrika, ki jo na spletu soustvarja skupnost spletnega kataloga Architectuul. Katalog je eden izmed največjih svetovnih mednarodnih baz podatkov za odprtokodno arhiviranje z več kot 100.000 registriranimi uporabniki in 500.000 sledilci na socialnih medijih (Facebook, Twitter, Pinterest). Od ustanovitve leta 2010, se Architectuul ukvarja s predstavitvijo raziskovalnih arhitekturnih projektov. V okviru rubrike Pozabljene mojstrovine se uredniki soočajo s predstavitvijo pozabljenih arhitekturnih del. Z akcijo se dokumentira, zbira in predstavipozabljene ter propadajoče arhitekturne stvaritve. V sodelovanju z Docomomo International spletna rubrika predstavlja dela od leta 1918 do leta 2018 v kontekstu varstva, ohranjanja in obnove arhitekturne dediščine, s posebnim poudarkom na modernizmu. Skupnost tako osredotoča na akcije ponovnega odkrivanja pozabljenih mojstrovin s sodelovanjem članov iz vsega sveta. Architectuul pri kampaniji sodeluje tudi z arhitekturnimi institucijami, nevladnimi organizacijami in univerzami, ki pripomorejo pri zbiraju in digitalizaciji informacij ter organizaciji predavanj, pogovorov ali seminarjev. Pozabljene mojstrovine so dokumentirane in širši skupnosti dostopne na http://blog.architectuul.com/tagged/foma.

Slika 1: Spletna rubrika Pozabljene mojstrovine.

ABSTRACT

There are many forgotten architectures, which can enrich the discourse about architecture and the city development. These buildings can be a means to trigger discussions on important contemporary issues with the benefit of hindsight and allow us to take a fresh look at materials, functions and use, style or urban context. Therefore the Architectuul community starts to concentrate its efforts on rediscovering and documenting forgotten buildings all over the world. Working with architecture institutions, NGOs and universities brings in the forefront the capacity of collecting and documenting information, giving lectures, talks or conduct seminars. Forgotten Masterpieces aims to expose architectural treasures and thus encourage the wider community to engage with the project.

V6-1510 (B): CELOVITA METODOLOGIJA ZA POPIS IN ANALIZO DEGRADIRANIH OBMOČIJ, IZVEDBA PILOTNEGA POPISA IN VZPOSTAVITEV AŽURNEGA REGISTRA

V6-1510 (B): COMPREHENSIVE METHODOLOGY FOR INVENTORY AND ANALYSIS OF DERELICT LAND, IMPLEMENTATION OF THE PILOT CENSUS AND ... (CRP)

Ljubljana, Slovenia

2015-2017

PROJEKT FINANCIRAN S STRANI *PROJECT CO-FUNDED BY*

Projekt CRP V6-1510 je sofinanciral Javna agencija za raziskovalno dejavnost Republike Slovenije iz državnega proračuna.

TIP PROJEKTA *TYPE OF PROJECT*
Raziskovalni projekt CRP V6-1510 v okviru Ciljnega raziskovalnega programa »CRP 2015« v letu 2015 »6 Regionalni razvoj: povezovanje ukrepov za doseganje trajnostnega razvoja«.

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COBISS
LAMPIČ, Barbara, FOŠKI, Mojca, ZAVODNIK LAMOVŠEK, Alma, BARBORIČ, Blaž, CIGALE, Dejan, KUŠAR, Simon, MRAK, Gašper, POTOČNIK SLAVIČ, Irma, RADOVAN, Dalibor. Evidentiranje in analiza funkcionalno degradiranih območij v izbranih statističnih regijah Slovenije. Urbani izziv, Posebna izdaja, ISSN 2232-481X, 28. Sedlarjevo srečanje, Ljubljana, 2. 6. 2017, 2017, št. 7, str. 10-18, ilustr. [COBISS.SI-ID 65386850]

VSEBINA

Uvod

Zaradi prestrukturiranja gospodarstva in aktualnih družbenih procesov v zadnjem desetletju postajajo degradirana območja v Sloveniji vse akutnejši prostorski, okoljski in tudi zdravstveni problem. Sanacija in prenova degradiranih območij sta dve od prednostnih usmeritev razvoja poselitve, še posebej s skupnim ciljem EU do leta 2020, da do leta 2050 preidemo na ničelno stopnjo izkoriščanja zemljišč (Evropska komisija, 2011:17). Dejansko stanje v prostorskem razvoju Slovenije kaže na slab izkoristek degradiranih območij za potrebe razvoja gospodarstva, se je na degradiranih območjih izvedlo le 9 % (18 ha od skupaj 191 ha) načrtovanih gospodarskih investicij.

Degradirana območja nastajajo iz različnih vzrokov, oziroma kot rezultanta součinkovanja prostorskih, okoljskih, socialnih in ekonomskih procesov. Sanacija in prenova sta tako učinkoviti le z interdisciplinarnim in usklajenim pristopom različnih resorjev, zato je v letu 2015 v okviru Ciljnega raziskovalnega programa Ministrstvo za gospodarski razvoj in tehnologijo razpisalo raziskovalno nalogo z namenom ugotovitve stanja degradiranega prostora in njihovega prostorskega potenciala za gospodarski razvoj.

V sklopu projekta smo opredelili razumevanje FDO in njihovo tipologijo, izvedli popis FDO najprej v sedmih statističnih regijah, nato pa na območju celotne Slovenije, v nadaljevanju pa pripravili nabor možnih ukrepov za sanacijo in prenovo FDO.

Opredelitev funkcionalni degradiranih območij

Z namenom identifikacije in zajema podatkov o degradiranih območjih v izbranih statističnih regijah smo opredelili funkcionalno degradirano območje (FDO) kot nezadostno izkoriščeno ali zapuščeno območje z vidnim vplivom predhodne rabe in zmanjšano uporabno vrednostjo, ki lahko predstavlja potencial za razvoj.

Metoda dela

Projekt je bil razdeljen v šest vsebinskih delovnih paketov oz. faz, pri čemer je bila vsebinsko in časovno najzahtevnejši popis FDO na terenu:

Faza 1: Pregled relevantne literature in virov ter primerov dobrih praks reaktivirani FDO
Faza 2: Oblikovanje nabora meril in kriterijev za opredelitev FDO, oblikovanje nove tipologije FDO (preglednica 1) in vzpostavitev modela – možnosti za reaktiviranje FDO
Faza 3: Izvedba pilotnega popisa DO
Faza 4: Vzpostavitev evidence degradiranih območij in izdelava aplikacije za vodenje evidence
Faza 5: Analiza podatkov o FDO ter njihova primerjava z drugimi relevantnimi prostorskimi zbirkami podatkov
Faza 6: Določitev razvojne faze za reaktiviranje posameznega FDO, ukrepi za reaktivacijo FDO ter predlog akcijskega načrta za njihovo rekativacijo

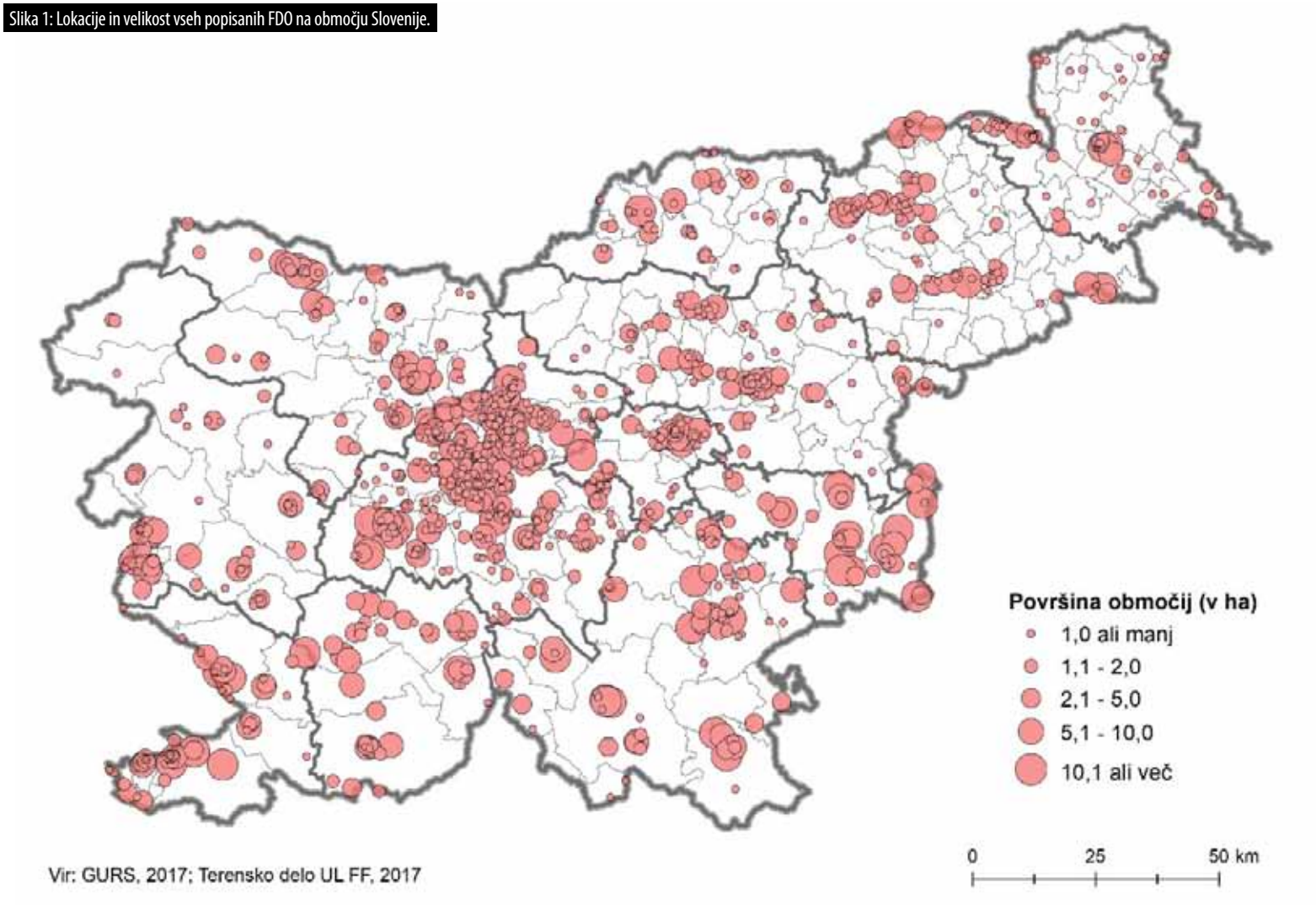
Rezultati

V postopku evidentiranja smo prepoznali in v celoti popisali 1081 FDO s

ID	Tip FDO	Podtip
1	**FDO kmetijske dejavnosti**	
2	**FDO storitvenih dejavnosti**	2.1 FDO javnih storitev
		2.2 FDO poslovnih, trgovskih in drugih storitvenih dejavnosti
		2.3 FDO starega mestnega ali vaškega jedra
3	**FDO turistične, športno-rekreacijske in športne dejavnosti**	
4	**FDO industrijskih in obrtnih dejavnosti**	
5	**FDO obrambe, zaščite in reševanja**	
6	**FDO pridobivanja mineralnih surovin**	6.1 FDO rudnika
		6.2 FDO kamnoloma, peskokopa
		6.3 FDO gramozne jame
		6.4 FDO ostala območja pridobivanja mineralnih surovin
7	**FDO infrastrukture**	7.1 FDO prometne infrastrukture
		7.2 FDO okoljske infrastrukture
		7.3 FDO ostale gospodarske javne infrastrukture
		7.4 FDO zelene infrastrukture
8	**FDO prehodne rabe**	8.1 FDO opuščenega gradbišča
		8.2 FDO značilne prehodne rabe
9	**FDO za bivanje**	9.1 FDO za bivanje - nedograjena stanovanjska območja
		9.2 FDO za bivanje - stara dotrajana območja

Preglednica1: Opredelitev tipov in podtipov FDO.

Slika 1: Lokacije in velikost vseh popisanih FDO na območju Slovenije.



skupno površino 3422,7 ha. Od 212 slovenskih občin smo FDO zabeležili v 170-ih. Po številu so prevladovala FDO industrijskih in obrtnih dejavnosti, FDO pridobivanja mineralnih surovin in FDO storitvenih dejavnosti. Po površini so prav tako prevladovala FDO industrijskih in obrtnih dejavnosti (1196,9 ha), FDO pridobivanja mineralnih surovin (649,9 ha) in FDO infrastrukture (418,4 ha). Povprečna velikost FDO znaša 3,2 ha; v povprečju so največja FDO industrijskih in obrtnih dejavnosti (5,1 ha), najmanjša pa FDO za bivanje, ki obsegajo le 1,1 ha.

Prostorska razporeditev FDO pokaže dejansko razsežnost pojava funkcionalno razvrednotenega prostora v Sloveniji (slika 1). Prav tako prihaja do velikih razlik med območji FDO glede stopnje opuščenosti. Podatki kažejo, da je največ (535 od skupaj 1081) povsem opuščenih območij, sledijo pa jim pretežno opuščena (347) in delno opuščena območja (192).

Zaključek

Z vidika umeščanja novih razvojnih projektov v prostor pa je pomembna predvsem velikost FDO, vendar obstoječa kapaciteta ne omogoča umeščanja velikopoteznih investicij. Vendar pa je treba upoštevati tudi dejstvo, da z razvojem tehnologije in preusmeritvijo gospodarstva v razvojno in inovacijsko intenzivne dejavnosti takšnih območij v evropskem prostoru potrebujemo vedno manj.

ABSTRACT

Due to the restructuring of the economy and social processes, functional degraded areas (FDAs) in Slovenia are becoming increasingly acute spatial, environmental and health problems. Within the project, we defined FDAs and their typology, made a field inventory of FDAs and prepared a set of possible measures for the reactivation and renewal of FDAs. There were recorded 1081 FDAs with a total area of 3422.7 ha, which differed according to typology, degree of abandonment, spatial distribution and size. The latter is important in terms of placing new development projects in the space, but with the development of technology and the reorientation of the economy in development and innovation intensive activities, the size is no longer playing the most important role.

V2-1513 : IZDELAVA MODELA POVEZANOSTI CELOTNE SLOVENIJE S KOLESARSKIMI POTMI

V2-1513: MODEL OF THE INTEGRATION OF SLOVENIAN BICYCLE NETWORK (CRP)

Ljubljana, Slovenia

2015-2017

TIP PROJEKTA *TYPE OF PROJECT*
Raziskovalni projekt CRP V2-1513 v okviru Ciljnega raziskovalnega programa »CRP 2015« v letu 2015 »7 Spodbujanje povečanja konkurenčnosti slovenskega turizma«.

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JAVNA AGENCIJA ZA RAZISKOVALNO DEJAVNOST REPUBLIKE SLOVENIJE

Projekt CRP V6-1510 je sofinancirala Javna agencija za raziskovalno dejavnost Republike Slovenije iz državnega proračuna.

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA GOSPODARSKI RAZVOJ IN TEHNOLOGIJO

Univerza v Ljubljani
Fakulteta za gradbeništvo in geodezijo

IPOP

VSEBINA

Uvod

V Sloveniji so se prizadevanja za infrastrukturno urejanje kolesarskih povezav začela z jasno izraženo potrebo po celovitem umeščanju in načrtovanju kolesarskih poti in povezav v strateških dokumentih. Navkljub trudu, ki se vlaga v izgradnjo kolesarsko infrastrukturo, pa ostaja umeščanje in načrtovanje kolesarskega omrežja nepovezano in v večji meri prepuščeno iniciativi regionalnim oziroma lokalnim institucijam. Glavni vzrok za trenutno stanje je predvsem v razdrobljenih pristojnostih različnih ministrstev, lokalnih skupnosti in razvojnih agencij, ki do sedaj praviloma niso mogli doseči skupnih vizij in tovrstnega operativnega sodelovanja, predvsem pa v nerazumevanju kolesarjenja kot izrazito interdisciplinarne aktivnosti s številnimi multiplikativnimi učinki.

Cilji projekta

V projektu so bili na podlagi projektne naloge ter problemskih izhodišč oblikovani naslednji cilj:

1. Opredeliti vrste in oblike kolesarskih povezav ter njihovih uporabnikov po ciljnih skupinah.
2. Ustvariti enotno podatkovno bazo kolesarskih poti in povezav.
3. Prikaz dejanskega stanja kolesarskih poti in povezav v Sloveniji ter njihovo navezanost na evropske kolesarske smeri ter omrežja ter razvrstitev kolesarskih poti na ustrezne kategorije.
4. Oblikovanje modela celovitega državnega kolesarskega omrežja.
5. Opredelitev kriterijev in kazalnikov za določanje prioritetnih kolesarskih povezav
6. Oblikovati predlog delitve pristojnosti na državno in regionalno raven.
7. Oblikovati predlog smernic in ukrepov za vzpostavitev predlaganega kolesarskega omrežja z opredelitvijo pristojnosti in nalog po posameznih resorjih na državni in regionalni ravni.
8. Izdelati oceno potrebnih finančnih sredstev za vzpostavitev celostnega kolesarskega omrežja.

Metoda

Projekt je obsegal več faz:

1. Podroben pregled relevantne literature in virov ter nabor primerov dobre prakse doma in v tujini
2. Pregled obstoječih podatkov in vzpostavitev enotne baze obstoječih kolesarskih poti in povezav
3. Oblikovanje modela celovitega kolesarskega omrežja s kriteriji za vzpostavitev celovitega državnega kolesarskega omrežja (DKO):
   - prometna varnost
   - povezovanje nacionalnih in regionalnih središč
   - navezava turističnih središč i n območij
   - navezava državnega kolesarskega omrežja na mednarodne kolesarske povezave
   - potek kolesarskih poti ob rekah, kjer je to le mogoče
   - upoštevanje razgibanosti terena
   - navezava državnega kolesarskega omrežja z gorsko kolesarskimi potmi
   - navezava državnega kolesarskega omrežja na slovensko železniško omrežje
4. Predlog zasnove državnega kolesarskega omrežja
5. Predlog smernic in ukrepov za realizacijo DKO po predlaganem modelu
6. Ocena stroškov

Rezultati

Predlog zasnove DKO je izdelan v dveh variantah:

1. s takojšnjo vzpostavitvijo povezanega sistema DKO, pretežno po obstoječih maloprometnih cestah z vključitvijo že izgrajenih kolesarskih poti,
2. končni predlog povezanega DKO, ki bo v večji meri temeljil na novo izgrajeni kolesarski infrastrukturi (slika 1).

V zaključni fazi je bil oblikovan predlog smernic in ukrepov za realizacijo DKO, vključno z oceno stroškov predlagane zasnove DKO za predlagane novogradnje kolesarskih poti, premostitvenih objektov ipd. Prav tako so predlagane pristojnosti in naloge na državni in regionalni ravni, kar je povezano tudi z upoštevanjem obstoječe zakonodaje v RS (ki ločuje kolesarske povezave glede na povezovalni pomen v prostoru na daljinske, glavne, regionalne in lokalne).

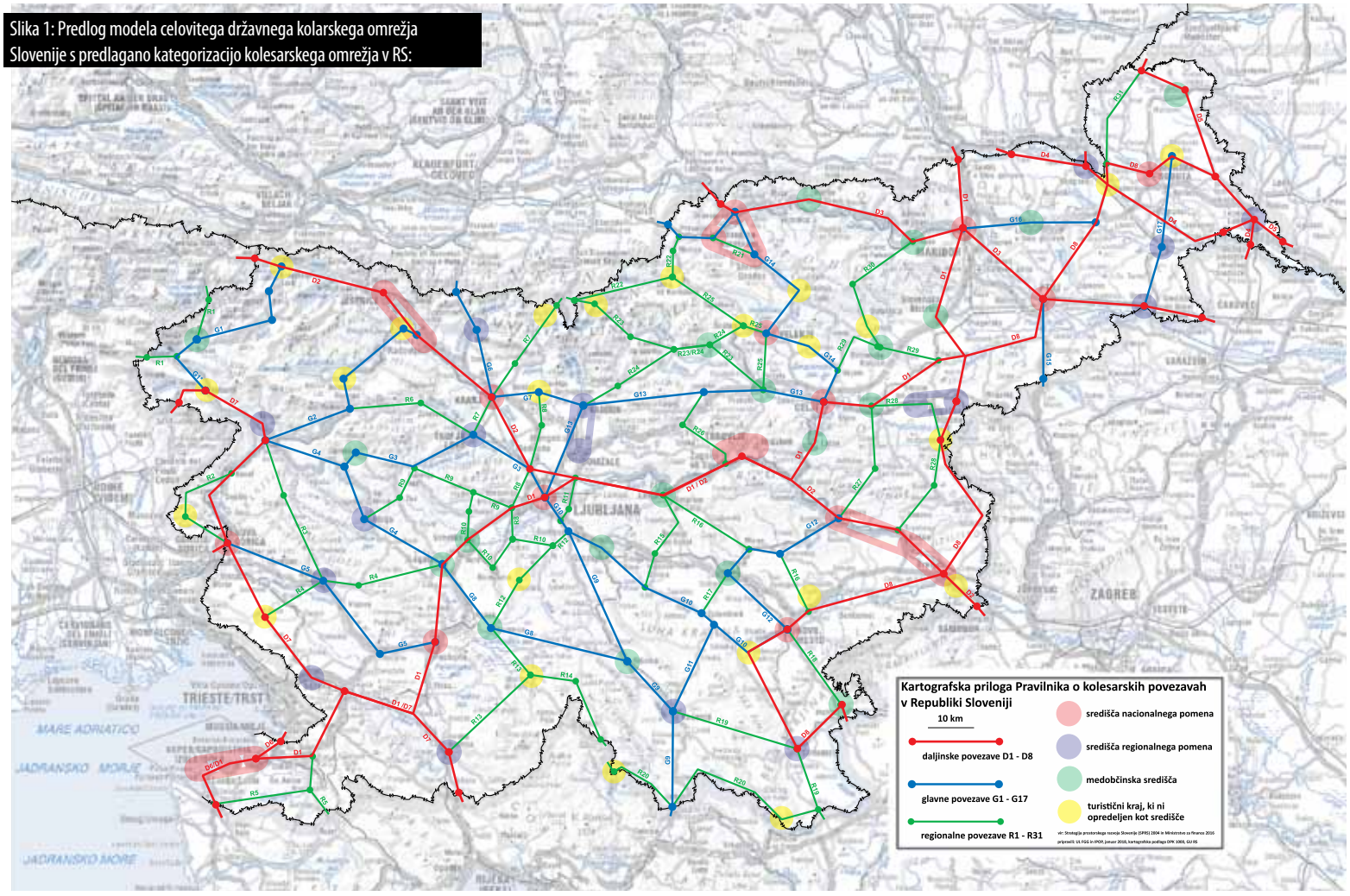
Zaključek

V zaključku je treba poudariti, da je v času projekta na Ministrstvu za infrastrukturo nastal osnutek Pravilnika o kolesarskih povezavah v Republiki Sloveniji (september 2017, Ministrstvo za infrastrukturo), v katerem je vključena predlagana zasnova DKO. Poleg tega je bil izvede tudi n prenos baze podatkov obstoječih kolarskih poti in povezav ter zasnove DKO na Ministrstvo za infrastrukturo. v v prostor pa je pomembna predvsem velikost FDO, vendar obstoječa kapaciteta ne omogoča umeščanja velikopoteznih investicij. Vendar pa je treba upoštevati tudi dejstvo, da z razvojem tehnologije in preusmeritvijo gospodarstva v razvojno in inovacijsko intenzivne dejavnosti takšnih območij v evropskem prostoru potrebujemo vedno manj.

ABSTRACT

The main reason for the presently unregulated situation concerning cycling networks lies in the jurisdictional fragmentation between various ministries, local communities, and development agencies, which were until now unable to reach a common vision and operational cooperation in this field, particularly failing to look at cycling as a distinctly interdisciplinary activity with multiplicative effects. The project's goal was to overcome the existing situation and develop a comprehensive design of a country-wide cycling network, which will be based on relevant criteria for its establishment. The proposed design of the country-wide cycling network was in the final project stage included in the proposal of the Rules on Cycling Connections in the Republic of Slovenia.

Slika 1: Predlog modela celovitega državnega kolarskega omrežja Slovenije s predlagano kategorizacijo kolesarskega omrežja v RS:



Kategorije predlaganega kolesarskega omrežja v RS

- daljinsko kolesarsko omrežje (D): povezava nacionalnih in regionalnih središč; omogočajo povezavo na mednarodne kolesarske povezave;
- glavno kolesarsko omrežje (G): omogočajo povezavo med središči regionalnega pomena;
- regionalno kolesarsko omrežje (R): omogočajo povezavo medobčinski središč, pomembnejših središč lokalnega pomena, turističnih območij in območij izjemnih naravnih znamenitosti;
- lokalno kolesarsko omrežje.

ANALIZA MOŽNOSTI ZA IZVAJANJE URBANIH PROJEKTOV Z UPORABO JAVNO ZASEBNEGA PARTNERSTVA
ANALYSIS OF OPTIONS FOR IMPLEMENTING OF URBAN PROJECTS USING PUBLIC-PRIVATE PARTNERSHIP

Slovenija / *Slovenia*

2016/2017

TIP PROJEKTA *TYPE OF PROJECT*
nacionalni raziskovalni projekt - Ciljno raziskovalni program CRP 2016
National Research Project - Target research programmes CRP 2016

DELOVNA SKUPINA *WORKING GROUP*
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PROJEKT FINANCIRAN S STRANI *PROJECT CO-FUNDED BY*
Javna agencija za raziskovalno dejavnost Republike Slovenije (ARRS) in Ministrstvo za okolje in prostor (MOP)

INTERNET STRAN WEB PAGE
http://www.fa.uni-lj.si/default.asp?id=3056

GRADIVO PRIPRAVILA *MATERIALS PREPARED BY*
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PROJEKT FINANCIRAN S STRANI *PROJECT CO-FUNDED BY*

JAVNA AGENCIJA ZA RAZISKOVALNO DEJAVNOST REPUBLIKE SLOVENIJE

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA OKOLJE IN PROSTOR

PROJEKTNI PARTNERJI PROJECT PARTNERS

Univerza v Ljubljani Fakulteta za arhitekturo

Urbanistični inštitut Republike Slovenije
Urban Planning Institute of the Republic of Slovenia

VSEBINA

Razvoj slovenskega prostora je ob javno-finančnih omejitvah v večji meri odvisen od drugih, nejavnih virov financiranja. Njihova odsotnost lahko predstavlja resno oviro za doseganje strateških ciljev prostorskega razvoja, kar vodi v zmanjševanje konkurenčnih prednosti slovenskih mest in naselij, dolgoročno pa tudi v zmanjšanje kvalitete bivanja. Mehanizem javno-zasebnega partnerstva (JZP) je eno od orodij, ki omogoča kombiniranje javnih in zasebnih finančnih virov, in je v Evropi in svetu pogosto uveljavljen inštrument urbanega razvoja predvsem pri zagotavljanju infrastrukturne opremljenosti prostora in razvoju mesto služnih dejavnosti. V Sloveniji leta 2006 sprejeti Zakon o javno-zasebnem partnerstvu je bil med drugim sprejet s ciljem omogočiti in razširiti uporabo zasebnih virov pri izvajanju projektov v javnem interesu. Mehanizem javno-zasebnega partnerstva (JZP) v praksi ni polno zaživel oz. ni prinesel željenih rezultatov pri razvoju urbanega prostora. Predstavljeni projekt analizira vzroke in predlaga možne rešitve za večji razmah JZP. Poleg finančnih, projekt identificira, še druge glavne ovire kot so npr. slaba podoba JZP v javnosti, sorazmerno nizka upravljavska usposobljenost in strokovna podkovanost občinskih uprav za izvajanje JZP ter odsotnost podpornih mehanizmov, ki bi partnerjem JZP omogočali podporo pri odločanju in izvajanju projektov. Podanih je več možnih rešitev od vzpostavitve nacionalne projektne pisarne za JZP, vzpostavitve enotne podatkovne baze za promocijo in spodbujanje JZP, do izvajanja izobraževalnih in drugih dejavnosti. Izdelan pa je bil tudi koncept nacionalnega priročnika na temo JZP za urbani razvoj, katerega namen je predstaviti osnovne značilnosti JZP in prikazati, kako z uspešno uporabo tega mehanizma mesta lahko tudi v pogojih omejenih lastnih finančnih virov udejanjajo kvaliteten urbani razvoj.

Metoda in program dela na raziskavi

V raziskovalni projekt, ki je bil zastavljen interdisciplinarno, so bili vključeni strokovnjaki s področja urbanizma, arhitekture, krajinske arhitekture, prostorskega načrtovanja, upravljanja in prava. Projekt je razdeljen v štiri delovne svežnje:

R_1: Analiza Strategije pametne specializacije Slovenije (SPS S4), potreb občin ter mestnih občin (MO), trajnostnih urbanih strategij (TUS) in uporabe mehanizma javno zasebnih partnerstev (JPZ). Raziskava temeljil na študiju relevantne domače ter tuje literature in pregledu zakonskega okvira v Sloveniji za področje projektov izgradnje po modelu JZP. Opravljena je bil pregled razvojnih potreb ter analiza uporabe mehanizma JZP v lokalnih skupnostih, s poudarkom na MO, ki imajo opredeljene TUS. Analiza je bila podkrepljena s izvedbo pol strukturiranih intervjujev z relevantnimi oddelki enajstih MO ter predstavniki investitorjev. Opravljena je bila analiza vsebin ter lokacij v TUS-ih opredeljenih kot razvojni potenciali mest in analiza uspešnih ter neizvedenih projektov JPZ, v tujini in Sloveniji.

R_2: Opredelitev urbanih projektov, primernih za JZP. Drugi del je obsegal opredelitev ključnih tipov urbanih projektov, ki so primerni za JZP in analizo ter možnosti upravljanja procesov načrtovanja in izvedbe projektov s pomočjo mehanizma JZP v slovenskem poslovnem prostoru. Preučene so bile možnosti uporabe finančnih instrumentov in razpoložljivih virov financiranja v RS in pregled možnih spodbud in oblik soudeležbe zasebnega kapitala za večjo soudeležbo le tega v javnih investicijah.

R_3: Predlog za pripravo in vodenje JZP. V sklopu tretjega svežnja je bila opravljena revizija oblik JPZ ter postopka sklenitve JZP, ki jo določa Zakon o javno-zasebnem partnerstvu (ZJZP, Ur. l. RS. št. 127/06.) iz leta 2006. Podan je bil predlog za vzpostavitev podlage za izboljšanje prakse JZP na osnovi analize uspešnih in neizvedenih projektov in predloga za izboljšavo upravljavske zmogljivosti občin za pripravo ter vodenje projektov JZP v sklopu urbanih projektov.

R_4: Koncept podatkovne baze JZP in priporočila za lokalne skupnosti za upravljanje z JPZ. Zadnji, zaključni sveženj projekta je obsegal razvoj koncepta za opredelitev urbanih projektov primernih za JZP, izvedbo urbanističnih delavnic na temo uporabe JZP v urbanih projektih. Izdelan je bil koncept svetovalne pisarne na nacionalni ravni ter koncept priročnika s priporočil za lokalne skupnosti pri upravljanju z JZP.

Zaključek

Rezultati projekta kažejo, da javno-zasebno partnerstvo (JZP) kot oblika izvajanja urbanih projektov v Sloveniji še ni široko razširjena. Za večji razmah JZP na področju prostorskega razvoja je potrebno razviti dodatne podporne mehanizme za opredelitev, zasnovo in izvajanje projektov JZP v praksi. Izkoristiti je potrebno možnosti, ki jih ponujajo skupna vlaganja javnih in zasebnih partnerjev, saj lahko tovrstna sodelovanja v prihodnje predstavljajo pomemben mehanizem razvoja slovenskega urbanega in širšega prostora. V luči javno-finančnih omejitev je to verjeten scenarij za udejanjanje deklarativno zapisanih razvojnih ciljev prostorskega razvoja v praksi in doseganje konkurenčnih pogojev za bivanje in razvoj dejavnosti ter aktivnosti slovenskih mest.

Slika 1: Tveganja glede na oblike javno-zasebnega partnerstva (zaključno poročilo projekta, 2017).
Figure 1: Risks connected to the forms of public-private partnership (project final report, 2017).

ABSTRACT

The Public Private Partnership (PPP) plays an important role as an instrument of urban development, especially in the provision of public infrastructural projects, including urban projects that affect the dynamics of urban development. With the declining levels of public resources, the collaboration between public and private investors seems necessary. Not rarely only the involvement of a private partner into a project which is in a public interest makes the investment possible. In 2006 Slovenia adopted the Public Private Partnership Act with the aim of enabling and extending the use of private resources within projects in the public interest. Despite that, the PPP sector in Slovenia remains underdeveloped. The project Analysis of options for implementing of urban projects using public-private partnership shows, that PPP as a form, has not been fully implemented in practice and so it did not produce the desired results in the development of urban space. In order to increase the use of PPP in spatial development, additional support mechanisms need to be developed for the definition, design and implementation of PPP projects in practice. Several possible solutions such as the establishment of a national PPP project office and the establishment of a single PPP database for the promotion and promotion of PPPs have been suggested. At the same time management and professional competences of municipal administrations for the implementation of PPPs have to be improved. Additionally, to the suggested education and training of municipal administration for the use of PPP in urban projects, a concept of a national manual on PPP for urban development was developed. The manual presents the basic characteristics of PPPs and demonstrates how can cities, despite the public financial constraints, achieve the desired urban development through the use of PPP.

IV.

DELAVNICE

WORKSHOPS

UREDITEV OBMOČJA STAREGA MESTNEGA JEDRA LENDAVE

DEVELOPING THE OLD TOWN AREA OF LENDAVA

Lendava, Slovenija

2017

TIP DELAVNICE *TYPE OF WORKSHOP*
urbanistična delavnica/Urban Design Workshop

MENTORJI *MENTORS*
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SZ Arhitektonski fakultet Zagreb: Grgur Butigan, Jakov Matas, Marin Mišan, Krešimir Petric

ORGANIZATOR *ORGANISER*
Občina Lendava

NAROČNIK
Občina Lendava

DATUM IN KRAJ RAZSTAVE
Občinska stavba, Lendava, 27.06.2017

GRADIVO PRIPRAVIL *MATERIALS PREPARED BY*
doc. dr. Gregor Čok

COBISS *Slovene Co-operative Online Bibliographic System and Services*
STRMEČKI, Anja, VIDA, Gregor, AMBROŽIČ, Andreja, MILAŠINOVIĆ, Mirjana, RIJAVEC, Bernarda, MAJCAN, Polona, FRELIH, Katja, MERVIČ, Urša, DIMEC, Maša, TUFEGDŽIĆ, Andraž, OMERZEL, Tjaša, BLAJ, Gregor, KROŠELJ, Simona, NOVAK, Kaja, SÜČ, Mitja, BUTIGAN, Grgur, MATAS, Jakov, MIŠAN, Marin, PETRIC, Krešimir. Lendava 2017-2025 : mednarodna urbanistična delavnica za ureditev območja starega mestnega jedra Lendave. Ljubljana: Fakulteta za arhitekturo, 2017. 87 f., ilustr. [COBISS.SI-ID 3539588]

VSEBINA

Občina Lendava je pristopila k organizaciji mednarodne urbanistične delavnice s katero želi pridobiti ustrezne strokovne rešitve za svoj dolgoročni prostorski razvoj. Dodaten motiv za organizacijo delavnice predstavlja odločitev za kandidaturo mesta na javnem razpisu za Evropsko kulturno prestolnico za leto 2025. Obstoječo gospodarsko in družbeno situacijo v občini danes zaznamuje predvsem atraktivna geostrateška lega na stičišču štirih držav (SLO, AU, HU, HR), pestra demografska slika oz. mešana struktura nacionalnih entitet, velika zapuščina gospodarske infrastrukture iz obdobja SFRJ, na kateri nastajajo uspešna nova podjetja ter pestra krajinska slika zalednega teritorija z velikim potencialom za turistični razvoj.

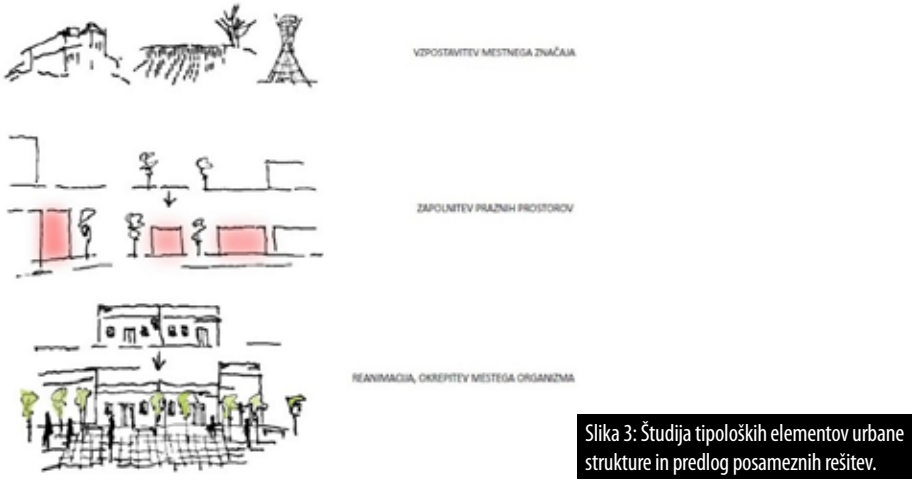
Delavnica je potekala na dveh nivojih in sicer: 1) na nivoju širšega merila celotne občine je podala razvojno prostorsko vizijo za reanimacijo gospodarske in turistične infrastrukture, 2) na nivoju mesta pa podrobnejše smernice in konkretne prostorske rešitve za: a) reorganizacijo interne prometne sheme, b) oživljanje starega mestnega jedra, c) obnovo nekdanje židovske četrti, c) razvoj novega upravnega, izobraževalnega in poslovnega središča na južnem robu mesta, e) predloge za vzpodbujanje medgeneracijske sinergije v obliki inovativnih programskih in arhitekturnih intervencij na posameznih lokacijah mesta. V okviru posameznih študijskih projektov so bili izdelani številni prostorski prikazi urbanističnih in arhitekturnih rešitev, makete in vizualizacije. Delavnica je s predstavljenim gradivom podala zunanji pogled na bodoči razvoj kraja in konstruktivno diskusijo z lokalnimi prebivalci in decisionmakerji.

ABSTRACT

The focus of the workshop was to design a development vision for the town of Lendava, which wants to boost its economic, spatial, and cultural development. A further motive for organising the workshop was the town's decision to apply, in response to the public call for applications, for the title of European Capital of Culture of 2025. The workshop provided conceptual design solutions for: reorganisation of the town's traffic scheme, regeneration of the old city centre, regeneration of the former Jewish quarter, development of a new administrative, education, and business generator at the southern edge of the city, proposals for encouraging inter-generational synergies, revival of tourist attractions, and other business measures for creating new jobs in the municipality's hinterland. The workshop provided an external view of the future development of the town and a constructive discussion with its inhabitants and decision-makers.

Slika 1: Razvoj novega upravnega, izobraževalnega in poslovnega generatorja na južnem robu mesta.

Slika 2: Vizija razvoja poslovne cone.



Slika 3: Študija tipoloških elementov urbane strukture in predlog posameznih rešitev.

V SOJU BETONSKIH LUČI
SPOTLIGHT OF THE CONCRETE LIGHT

Ljubljana

2017

TIP DELAVNICE *TYPE OF WORKSHOP*
oblikovalska delavnica

MENTORJI *MENTORS*
izr. prof. dr. Alenka Fikfak, asist. Janez P. Grom, Urška Kalčič

ŠTUDENTJE *STUDENTS*
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ORGANIZATORJI
UL, Fakulteta za arhitekturo

PARTNERJI *PARTNERS*
Salon ID:doma, Andrej Kovačič, Matevž Frančič
Lafarge cement, d.o.o, mag. Andrej Sopotnik

AVTOR FOTOGRAFIJ *PHOTOGRAPHS BY*
Jure Pučnik

GRADIVO PRIPRAVIL *MATERIALS PREPARED BY*
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VSEBINA

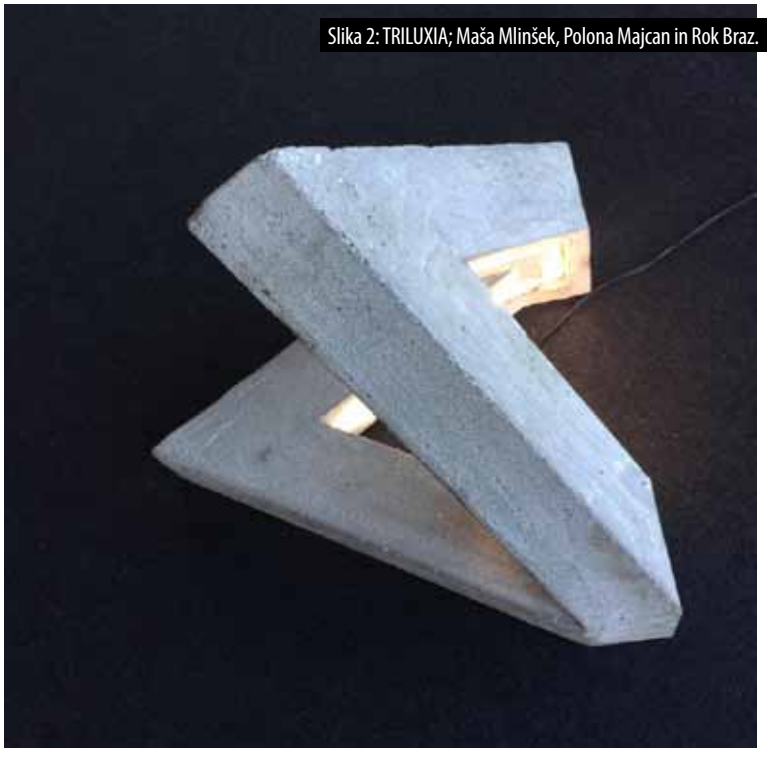
V pedagoškem procesu približati študente k materializaciji lastnih idej v otipljive produkte je nedvomno izziv. Razvoj od ideje, do črte in preko črte v realen produkt je izjemen učen pripomoček in posebna izkušnja, s katero se je ravno v delavnici »Betonska Luč« marsikateri študent prvič spopadel. Izkušnja kako se vzpostavi stik med projetnim delom in otipljivostjo materiala je bila tako svojstvena in je botrovala celo večim, sprva nepredvidenim pozitivnim rezultatom.

Delavnica, ki je presegala meje seminarske selekcije, saj je bila razpisana kot odprta delavnica namenjena vsem študentom Fakultete za arhitekturo je bila koncipirana v želji po sodelovaju med študenti arhitekturne in urbanistične smeri skozi oblikovanje mešanih delovnih skupin. Organizacija predavanj zunanjih predavateljev je bila osnova za razširitev programa delavnice v smislu vzpostavitve sodelovanja s salonom ID:doma in podjetjem lafarge cement, d.o.o.. istočasno pa je bil preko teh sodelovanj omogočen dostop do širokega nabora aktualnih informacij iz področja oblikovalskih trendov in pa tehnologije betona.

Širok spekter študentov in dialogi znotraj skupin so bili osnova za širok spekter različnih konceptov. Luči, ki so nastajale sprva v konceptni obliki, nato skozi tehnično preverjanje konceptov ter vse do fizičnega mešanja različnih betonskih agregatov in vlivanja mas v kalupe, so tako odgovarjale na potrebe interierov, ahitekturnih aplikacij in na potrebe urbanih javnih prostorov. Rešitve so postregle z inovacijami pri ustvarjanju kalupov s CNC stroji, inovacijami pri izrabi optičnih vodnikov za prenos in usmerjanje svetlove, inventivnostjo pri interpretiranju obstoječih betonskih prefabrikatov za zunanjo, infrastrukturno uporabo ter igrivo interpretacijo ambientalne svetlobe v povezavi s fizično taktinostnjo in interakcijo s svetlobnim telesom.

Končni rezultat delavnice je bilo devet projektnih rešitev, devet izvirnih svetil in devet javnih avtorskih predstavitev v prostorih salona ID:doma. Kjer so se avtorji svetil v zaključku spopadli z določevanjem realnih vrednosti svojih svetil. Visok nivo tehnične izdelave, obdelave materiala in kvalitetnega oblikovanja je bil odražen tudi v konkretnih odkupih izdelkov. Študentje so se tako srečali tudi s pragmatičnim delom iz realnega poslovnega sveta – kako iz koncepta in ideje fizično izdelati predmet in ga nato znati tudi uspešno tržno opredeliti.

Slika 1: ENERGIJA V ČASU; Urh Wiegele in Andraž Hrovat.



Slika 2: TRILUXIA; Maša Mlinšek, Polona Majcan in Rok Braz.

ABSTRACT

The main goal of the workshop was to allow students to discover the possibilities of materialisation of theoretical thought processes. As the result of an architects work should be to strive for a physical result it is inherently important to give students the possibilities and tools to interpret the projects in a material form to achieve a self-contemplation on the decisions taken in the projectual stages. Understanding physical processes and material attributes can be done best when the research is empirical. These goals were achieved with the workshop and students were given a real possibility to understand design, architecture and details and transform theoretical knowledge with a direct process of learning outside the classroom.

"RADNIČKA V NE/NASTAJANJU" – NAČRTOVANJE JUGOVZHODNEGA VHODA V ZAGREB

RADNIČKA STREET IN THE DIS/APPEARING: PLANNING OF THE SOUTHEAST ENTRANCE TO ZAGREB

Zagreb, Hrvaška

2017

TIP DELAVNICE *TYPE OF WORKSHOP*
mednarodna urbanistična delavnica

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DATUM IN KRAJ RAZSTAVE
avla UL FGG, 26. 10. 2017

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UL Fakulteta za gradbeništvo in geodezijo: David Krepej, Tanja Elsner, Domen Ovčar, Marko Jalovec, Ambrož Ložar, Maja Jezernik, Ana Potočnik, Maja Jordan, Maja Mauko, Ajda Kafol Stojanović, Simona Vraničar, Jasna Munda, Žan Pavlin, Karin Rkman, Miha Trstenjak, Stefan Borovčanin, Alicja Csarnomska

COBISS *Slovene Co-operative Online Bibliographic System and Services*
Radnička u ne/nastajanju : planiranje jugoistočnog ulaza u Zagreb. Sveučilište u Zagrebu, Arhitektonski fakultet, Katedra za urbanizam, prostorno planiranje i pejsažnu arhitekturu in Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, Katedra za prostorsko planiranj. 2017. ISBN 978-953-8042-31-7. [1COBISS.SI-ID: 8194657]

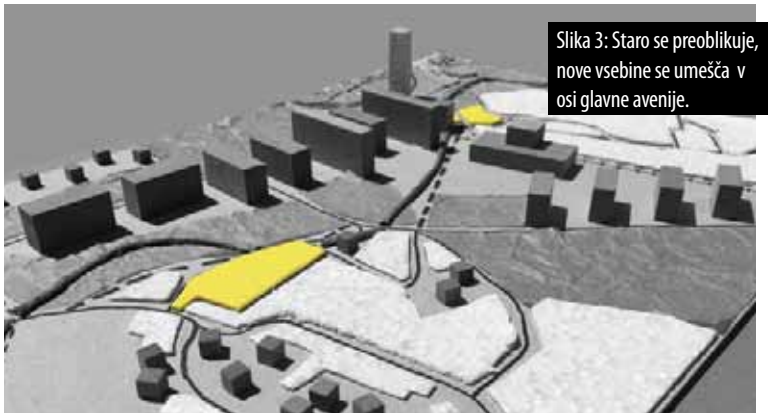

Slika 1: Prostori opuščene proizvodnje papirja.

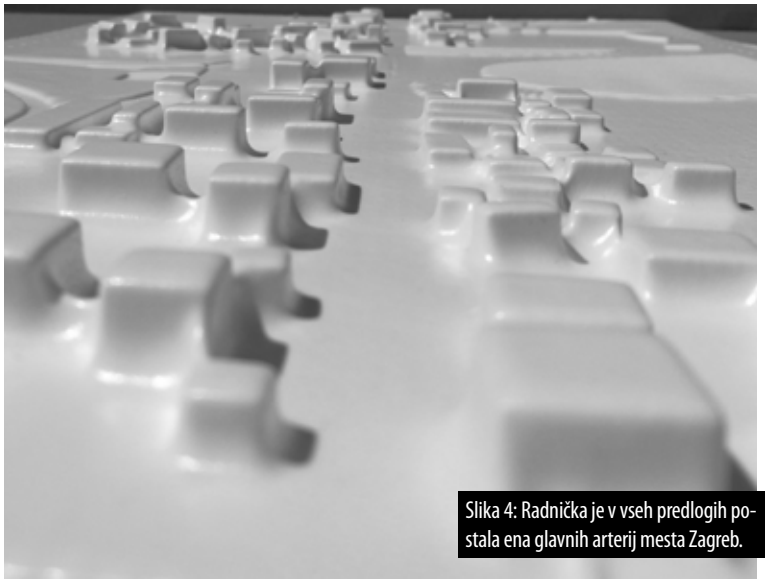

Slika 2: Skupna dvodnevna delavvnica v prostorih osnovne šole Žitnjak, v katerem sedaj domujejo zagrebški umetniki.

VSEBINA

Delavnica Radnička v nesnastajanju je potekala v organizaciji Fakultete za arhitekturo, Univerze v Zagrebu, in Fakultete za gradbeništvo in geodezijo, Univerze v Ljubljani. Študenti so obravnavali prostor jugovzhodnega dela Zagreba. Območje ob Radnički cesti je bilo nekdaj namenjeno industriji in komunalnim dejavnostim mesta Zagreb. Tako je bilo že na začetku jasno, da je slika tega območja zelo nejasna in da prostorski načrti ne dohajajo sedanjega razvoja v tem delu mesta. Samo območje je izredno heterogeno po vsebinah, funkcijah, morfologiji in tipologiji objektov. Z izgradnjo domovinskega mosta, izgradnjo novega letališkega terminala na letališči Pleso in preoblikovanjem nekdanje mestne dvopasovnice v široko sodobno štiripasovno avenijo je tako nekdaj pozabljeni prostor postal zanimivo center dogajanja in razvoja v tem delu mestu. Hkrati je postal glavni vhod v mesto za vse tiste, ki prihajajo preko letališča.

V začetku je bila naloga študentov osredotočena na spoznavanje prostora, analizo obstoječga stanja in vrednotenju obstoječega prostorskega načrta. Kasneje je bil glavni izziv prikazati različne scenarije razvoja za tega dela mesta. Veliko predlogov je planersko nalogo pristopilo kot na celjenja rane v mestu, z uporabo obstoječih grajenih struktur in z umeščanjem sodobnih posamičnih gradenj v obliki poudarkov v prostoru in nizanju ekementov ob horizontalnosti celotnega poteka Radničke ulice. Veliko poudarka je bilo tudi na izgradnji sodobne infrastrukture: podaljševanju tramvajskih prog do letališča kot trajnostno naravnavnih sistemih pešpoti in kolesarskih poti z vkomponiranjem zelenega sistema v ozadju objektov ob Radnički.


Slika 3: Staro se preoblikuje, nove vsebine se umešča v osi glavne avenije.


Slika 4: Radnička je v vseh predlogih postala ena glavnih arterij mesta Zagreb.

ABSTRACT

The workshop was conducted in south-east entrance to Zagreb city. The area was in past predominantly industrial with several city utility services located there. The Radnička road itself is in a process of major urban transformation. The new airport terminal on one end and the newly built 'Domovinski' bridge across the Sava river have started transformation of this almost abandoned industrial area to a major city entrance with four lane avenue. The students were tasked to present ideas and scenarios to enhance this transformation and to vision the path of this transformation.

V SODELOVANJU Z JAVNOSTJO DO URBANIH PROSTOROV

WITH PUBLIC PARTICIPATION TO URBAN SPACES

Ljubljana

2017

TIP DELAVNICE *TYPE OF WORKSHOP*
izvedbena delavnica – participativni urbanizem

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Slika 1: Končan paviljon.

VSEBINA

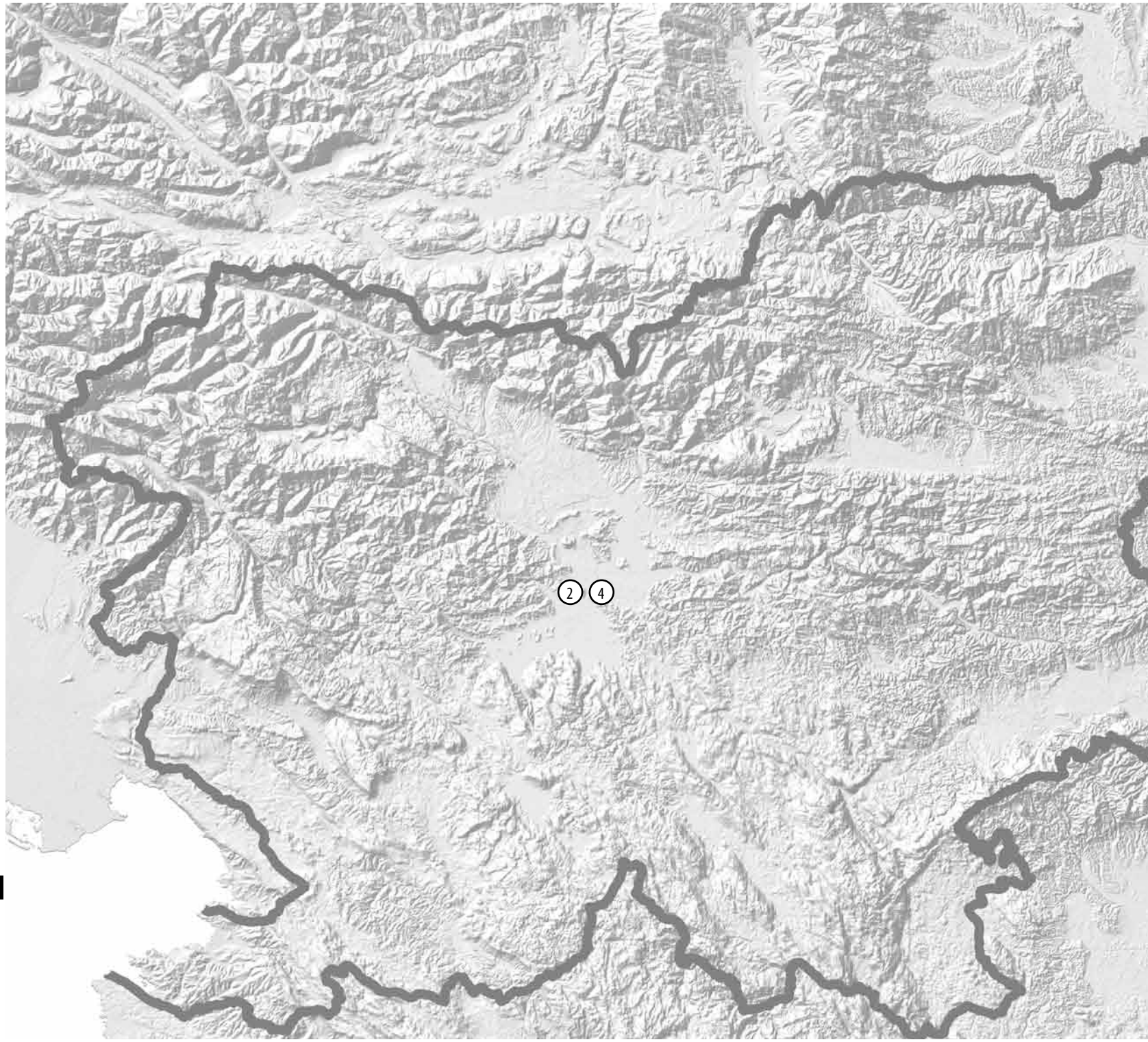
Neizogiben element poseganja v prostor je predočitev predvidenih posegov javnosti in soočanje z odzivi. Raznoliki strukturi javnosti primerno so ti odzivi kompleksni in večkrat tudi nekompatibilni med seboj ali pa z idejami, ki jih imajo namen strokovnjaki vnesti v demokratičnost javnega prostora. Prodorno razumevanje teorije izraženo v dobronamerni oblikovni igrivosti in optimistično vizionarstvo tako samo po sebi ni dovolj. Umetnost mobilizacije interesa javnosti in vzpostvitev skupnih ciljev in vizij je tako med pomembnejšimi veščinami sodobnega urbanista, vkolikor je pričakovati dosledne realizacije v prostoru.

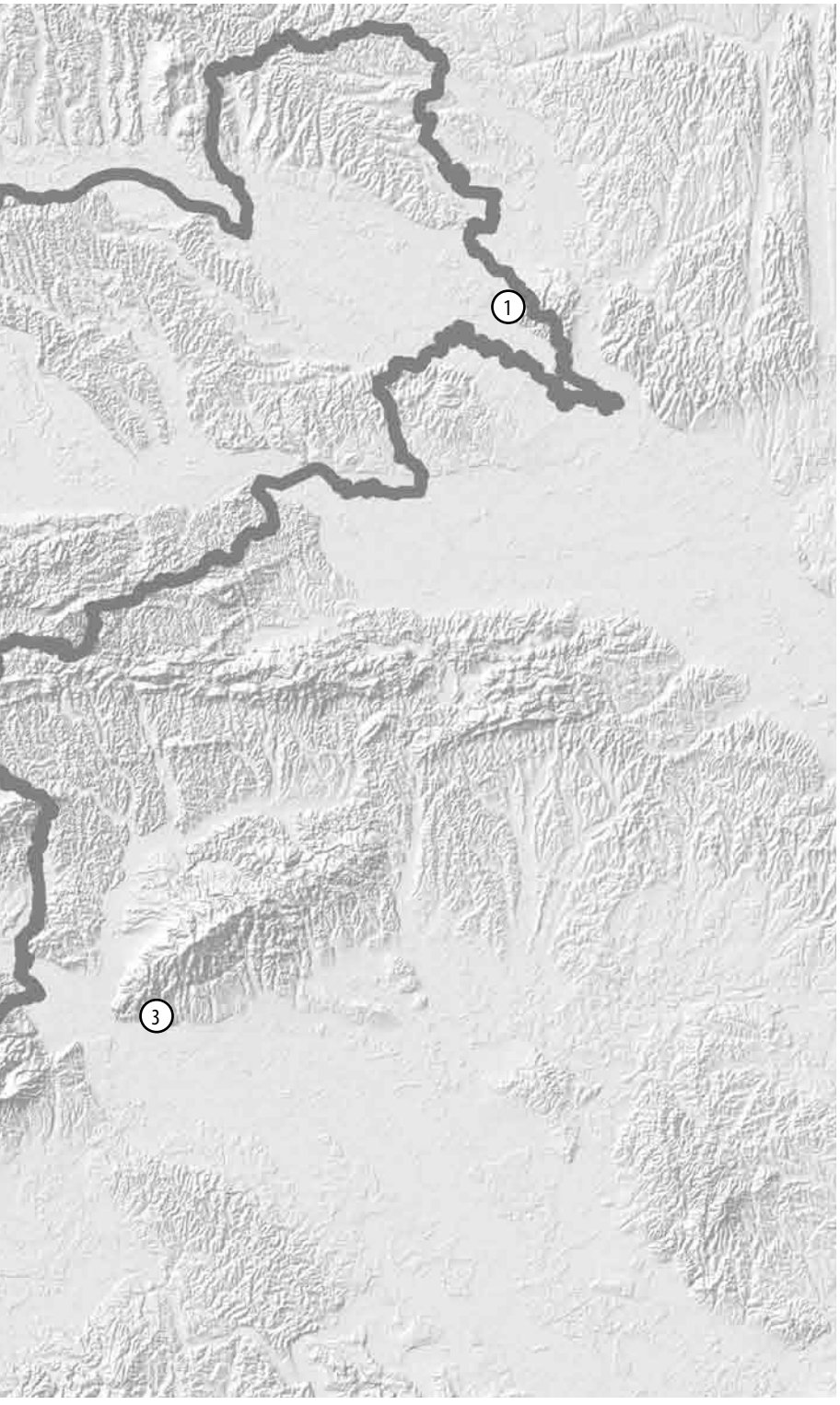
Izbrana lokacija za projekno obdelavo je bila Bratovževa ploščad v Ruskem Carju za Bežigradom v Ljubljani, delo arhitektov Marjana Bežana, Braco Mušiča in Nives Starc. Nekoč prizorišče odmevnega filma »Sreča na Vrvici« režiserja Janija Kavčiča, danes pa spomenik in v tem primeru tudi arhitekturno urbanistična relikvija modernizma je danes nosilec kopice problemov, ki segajo vse od tehničnih težav pri vzdrževanju obsežne betonske ploščadi med večstanovanjskimi stolpnicami, do odprtih lastniških vprašanj in splošne prostorske osmislitve monumentalno zasnovanega prostora.

Študentje arhitekture iz smeri urbanizem so v želji po izkustvu realnega stika z javnostjo, razdeljeni po skupinah, osnovali svoje rešitve ter jih predali v komisijsko obravnavo. Sama delavnica je bila organizirana v obliki internega natečaja. Komisija je bila v sestavi treh partnerjev, ki so sodelovali pri projektu Humana mesta (Urbanističnega inštituta RS, Fakultete za arhitekturo in civilne iniciative Skupaj na ploščad!). Predložene rešitve so bile med seboj različne in so obravnavale urejanje prostora na svojstvene načine: nekatere rešitve so bile zasnovane bolj konceptualno nekatere pa so v prostor postavljale nove urbane elemente oziroma novo urbano pohištvo ter se ukvarjale bolj z rešitvami ozelenitve že obstoječih zelenih korit. Rezultat delavnice je bila postavitev začasne lesene paviljonske strukture. Namen paviljona je ustvarjanje atraktivnega skupnega prostora za vse uporabnike. Istočasno pa je paviljonu bila namenjena vloga razstavnega prostora, kjer naj bi vsi akterji in deležniki v prostoru objavljali svoje projektne predloge.


Slika 2: Delo je potekalo v vseh vremenskih razmerah .


Slika 3: Postavljanje gradbenega odra





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