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INTEGRITET I VEK KONSTRUKCIJA U HERITOLOGIJI

STRUCTURAL INTEGRITY AND LIFE IN HERITOLOGY

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Ključne reči
- integritet konstrukcija
- heritologija
- Entoni Gormli

Izvod

Fenomen integriteta konstrukcija u heritologiji povezan je sa teorijom prostora, teorijom restauracije, kao i zahtevima održivog razvoja, pa heritološki pogled na integritet konstrukcija monumentalnih dela savremene umetničke produkcije, podrazumeva integrisani tehnološko – kulturološki pristup. U ovom radu prikazano je istraživanje ovih aspekata u radovima britanskog autora Entonija Gormlija, čije monumentalne skulpture na različitim meridijanima kao umetničko-tehnološko-ekološki koncepti, potvrđuju višeslojnost problema integriteta i veka konstrukcija u postindustrijskom društvu.

Keywords
- structural integrity
- heritology
- Antony Gormley

Abstract

The phenomenon of structural integrity in heritology associated with the theory of space, the theory of restoration, as well as the requirements of sustainable development and heritological view of the structural integrity of monumental works in contemporary art production includes an integrated technology - a cultural approach. In this paper, the study of these aspects in the works of British author Antony Gormley, whose monumental sculptures in different meridians, as well as artistic and technological, ecological concepts, confirm the multifaceted nature of the structural integrity and life problem in post-industrial society.

UVOD

Uloga novih tehnologija u realizaciji monumentalnih dela savremene umetničke produkcije, uobičajeno se, usled nedostatka multidisciplinarnog utemeljenja u valorizaciji, vrednuje tautegorijski. Heritologija, međutim, ulogu novih tehnologija smatra presudnom za uvođenje umetnosti u epohu visokog kvaliteta monumentalnosti, utvrđujući parametre koji se u domenu integriteta i veka konstrukcija izvode iz tehnološke i konceptualne prirode autorskog dela, /1/.

To je utoliko značajnije, ukoliko se ima uvid u razloge zapostavljenosti monumentalnih projekata u svetu, tokom poslednjih decenija, koji su se pre svega odnosili na nerazumevanje novih tehnologija i njihove uloge u umetnosti 21. veka: vreme modernizma u kojem se pokazalo da nominacija formi monumenata izvire iz šireg problemskog sklopa, koji obuhvata i pitanja estetike tehnoloških rešenja, /2/, kao i probleme antropologije, /3/, nagovestilo je na koji način nauka treba da korespondira sa umetnošću, generišući nove stvaralačke modele, služeći se savremenim tehnološkim rešenjima u realizacijama formi.

Postmoderna potom donosi problematizovanje suštine originalnosti, kao svojstva objekta po sebi, zatim pitanja autentičnosti dela, kao kategorije koja se naučno dokazuje /4/, kao i svojstva autentičnosti umetničkog stvaranja, kao prakse zasnovane na manuelnoj veštini. Razvoj digitalnih tehnologija, CAD/CAM i CNC tehnologija, omogućava materijalizaciju i masovnu proizvodnju kopija i replika umetničkih objekata i artefakata, što bitno utiče na promenu

INTRODUCTION

The role of new technologies in the realisation of monumental works of modern art production is commonly tautegoricaly valued due to the lack of a multidisciplinary foundation in the valorisation,. Heritology, however, considers the role of new technology as crucial for the introduction of art in the epoch of high quality monumentality, identifying parameters that are in the domain of structural integrity and life derived from technological and conceptual nature of the copyrighted work, /1/.

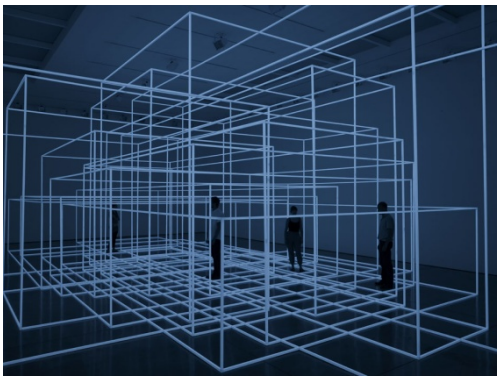
This is even more important, having insight into the reasons for the worldwide monumental projects neglected in recent decades, which have been primarily related to the lack of understanding of new technologies and their role in the art of 21st century. Modernism time has shown that the nomination of monumental forms originates from a broader problem-assembly which involves questions of aesthetics of technological solutions, /2/, as well as the problems of anthropology, /3/, and suggested the way science should correspond with the arts, generating new creative models, using modern technological solutions in the form of realizations.

Postmodernism then brings problematized essence of originality, as properties of the object itself, then questionable authenticity of works, as a category scientifically proven, /4/, and properties of the authenticity of artistic creation as well as practice-based manual skill. The development of digital technology, CAD/CAM and CNC technology, allows the materialization and mass production of

odnosa prema autentičnosti u postindustrijskom okruženju /5/: zahvaljujući novim tehnologijama, u isto vreme moguće je na različitim krajevima sveta, primenom istih parametara, proizvesti identične kopije i replike svakog umetničkog objekta za koji je napravljen 3D model.

Odnos materijala i tehnologije u savremenoj umetničkoj praksi menja se uvođenjem novih materijala koji imaju visoku čvrstoću i plastičnost, otpornost prema puzanju, zamoru i površinskoj degradaciji. Usavršavanje načina fabrikacije konstrukcijskih delova velikih dimenzija, koje je omogućilo dobijanje homogene mikrostrukture, posebno kada se primenjuje postupak dobijanja superlegura metalurgijom praha, /6/, omogućilo je i napredak u dizajnu prostornih instalacija u urbanom okruženju. Otuda i umetničko-inženjerska performativna aktivnost, kao pojam koji se vezuje za više vidova savremenog stvaralaštva.

U kontekstu prelaza sa fordističkog modela proizvodnje, kao dihotomije materijalnog (manuelnog) i nematerijalnog rada, na postfordistički model proizvodnje u kojem se javljaju specifične kombinacije intelektualnog i kreativnog rada i umetničke i tehnološke imaginacije, dolazi do fleksibilnih interakcija između naučnih, umetničkih i tehnoloških rešenja (sl. 1 i 2).



Slika 1. Entoni Gormli: SOBA ZA DISANJE, 2006-2010 , /7/
Figure 1. Antony Gormley: BREATHING ROOM, 2006-2010, /7/

INTEGRITET I META-PROSTOR

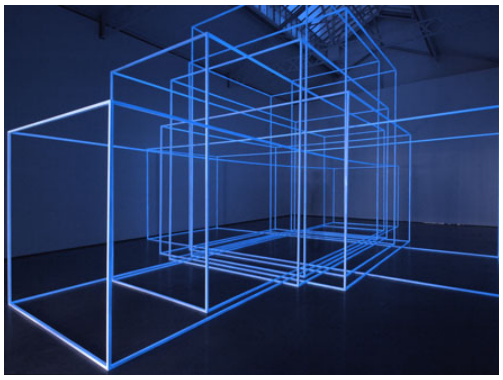
Da i sam autor može biti inicijator stvaranja brojnih kopija dela radi njihovog sukcesivnog izlaganja u ekološki definisanom prostoru, pokazuje projekat profesora Univerziteta u Kembridžu, Entonija Gormlija, pod nazivom *Horizon Field*, realizovan u Alpima (sl. 3 i 4), gde je postavljeno 100 identičnih skulptura (svaka težine 630 kg), raspoređenih u rasponu od 150 km^2 na visini od 2039 m. Promovišući stav da skulpturama nisu potrebni prostori pod krovovima galerija, te i nalepnice sa nazivima, Gormli ističe da delo izloženo kiši i suncu, leti i zimi, na dnevnom svetlu i mesečini, počinje da živi emanirajući moćan beg u vremenu i prostoru. Po rečima umetnika, *Horizon Field* posvećen je savremenom čoveku koji svoje životno vreme provodi u meta-svetu, tumačeći iskustva koja mu prenosi *i-phone* i njegov prenosni računar, posmatrajući svet kroz prostore visokih građevina.

Remek dela monumentalne skulpture ovog autora, pokazuju kako inovativnost Entonija Gormlija utiče na tehnološke zahteve u pogledu integriteta i veka konstrukcija. Zbog toga, svoje autorstvo umetnik doživljava kao deo kolektivnog rada

copies and replicas of art objects and artefacts which significantly affects the attitude towards authenticity in the post-industrial environment, /5/: thanks to new technologies, at the same time it is possible in different parts of the world using the same parameters to produce identical copies and replicas of art objects for which a 3D model is designed.

The relationship of materials and technology in modern art practice is changed by the introduction of new materials with high strength and ductility, resistance to creep, fatigue and surface degradation. Improved methods of fabrication of large-sized structural parts that allowed obtaining a homogeneous microstructure, especially if applied to processes in superalloy powder metallurgy, /6/, has enabled progress in the design of spatial installations in the urban environment. Hence, the art engineering performative activity - a term associated with many forms of contemporary art.

In the context of the transition from the Fordist model of production, as a dichotomy of material (manual) and non-material labour, to the postfordist production model in which specific combinations of intellectual and creative work and artistic and technological imagination occur, there is a flexible interaction between solutions in science, art and technology (Figs. 1 and 2).



Slika 2. Entoni Gormli: SOBA ZA DISANJE I, 2006, /8/
Figure 2. Antony Gormley: BREATHING ROOM I, 2006, /8/.

INTEGRITY AND META-SPACE

The project of the author Anthony Gormley, University of Cambridge professor, called *Horizon Field* implemented in the Alps (Figs. 3 and 4), set to 100 identical statues (each weighing 630 kg), placed in the range of 150 km^2 at an altitude of 2039 m, demonstrates that the author himself may be the initiator of a number of copies for their successive exposure to a ecologically defined space. Promoting the view that sculptures do not require to be placed under roofs in gallery spaces, neither having labels with names, Gormley emphasizes that the work exposed to rain and sun, summer and winter, daylight and moonlight, begins to live emanating the powerful escape in time and space. According to the artist, *Horizon Field* is dedicated to the modern man who spends his life-time in the meta-world, interpreting the experience passed by his i-phone and laptop, looking at the world through windows of tall buildings.

Masterpieces of monumental sculptures by this author, present how Anthony Gormley's innovation affects the technological requirements for structural integrity and life. Therefore, the artist sees his authorship as a part of a collective

u kojem realizacija u prostoru traži najbolje inženjere i proizvodne kompanije koje mogu da realizuju umetničke ideje (sl. 5 i 6).

Slika 3. 3D model skulpture u okviru projekta *Horizon Field*, /9/
Figure 3. 3D model sculpture within the project *Horizon Field*, /9/.

Slika 5. *Svemirska stanica* i *Drugi instrumenti*, /11/
Figure 5. *Space Station* and *Other Instruments*, /11/.

UMETNIČKI KONCEPT, INTEGRITET I VEK KONSTRUKCIJA

Analiza stepena harmonizacije umetničke ideje sa zahtevima održivog razvoja, u stvaralaštvu Gormlija, pokazuje refleksije različitih umetničkih, inženjerskih i ekoloških ideja u oblasti strukturne morfologije, u tradiciji autora kao što su Otto i Le Ricolais, kao i istraživanja značajnih autora iz oblasti kulturne ekologije /13, 14/ i ekološke antropologije /15, 16/.

Skulpture *Anđeo Severa* (sl. 7 i 8) i *Izloženost* (sl. 9 i 10), kao i serije radova *Firnanment* (sl. 11 i 12) i *Horizon Field* (sl. 13 i 14), predstavljaju projekte čiji se vek konstrukcije određuje prema tehnološkim principima uz uvažavanje zahteva održivog razvoja, tamo gde su promene u okruženju deo umetničkog koncepta.

Monumentalna skulptura *Anđeo Severa* (*Angel of the North*) visine 20 m, čiji je raspon krila od 54 m veći od raspona aviona Boing 727, napravljena je od 200 tona čelika i 500 tona betonskog temelja, na mestu nekadašnjeg rudnika Tajn, čijim je zatvaranjem obeležen kraj značajne ere rudarstva u Velikoj Britaniji. Delo je omaž životu i radu hiljada rudara koji su tokom poslednjih tri stotine godina radili na podzemnoj eksploataciji uglja. Impozantna krila ove skulpture pomerena su unapred za 3.5° da bi u posmatraču izazvala efekat namere zagrljaja.

work in which realization in space demands the best engineering and manufacturing companies that can implement artistic ideas (Figs. 5 and 6).

Slika 4. Postavljanje skulpture u Alpima, na visini 2039 m, /10/
Figure 4. Setting sculpture in the Alps, at an altitude 2039 m, /10/.

Slika 6. *Horizon Field Hamburg*, 2012, /12/
Figure 6. *Horizon Field Hamburg*, 2012, /12/.

THE CONCEPT OF ART, STRUCTURAL INTEGRITY AND LIFE

Analysing the level of artistic ideas harmonization with the sustainable development requirements, in the Gormley creation, shows reflection of different art, engineering and environmental ideas in the field of structural morphology in the tradition of authors such as Otto and Le Ricolais as well as by significant research in the field of cultural ecology /13, 14/ and ecological anthropology /15, 16/.

Sculptures *Angel of the North* (Figs. 7 and 8) and *Exposure* (Figs. 9 and 10) and a series of papers *Firnanment* (Figs. 11 and 12) and *Horizon Field* (Figs. 13 and 14) are projects where structural life is determined by engineering principles with respect to sustainable development, where changes in the environment are part of the artistic concept.

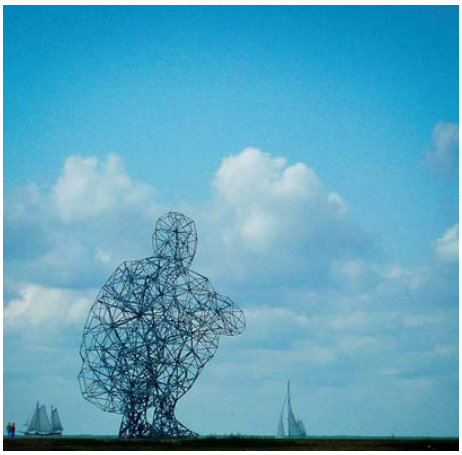
The monumental sculpture *Angel of the North*, 20 m in height, with wingspan of 54 feet is larger than that of the Boeing 727, and is made of 200 tons of steel and 500 tons of concrete foundation at Tyne, a former mine whose closing marked the end of a significant mining era in UK. The work is a tribute to the life and work of thousands of miners who had worked underground coal mining during the last three hundred years. The imposing wings of the sculpture are moved forward by 3.5°, causing an effect of embrace intentions in the observers eyes.

Slika 7. *Andjeo sa severa*, /17/
Figure 7. *Angel of the North*, /17/.

Slika 8. Radovi na skulpturi *Andjeo sa severa*, /18/
Figure 8. Works on the sculpture Angel of the North, /18/.

Slika 9. *Firnanment*, White Cube Masons's Yard, London, 2008
Figure 9. *Firnanment*, White Cube Masons's Yard, London, 2008.

Slika 10. Zavarivanje poligonalne konstrukcije *Firnanment*, /19/
Figure 10. Welding the polygonal structure of *Firnanment*, /19/.



Slika 11. *Exposure*, 2010, /1/
Figure 11. *Exposure*, 2010, /1/.

Slika 12. Izgradnja *Exposure*, /20, 21/
Figure 12. Installation of *Exposure*, /20, 21/.

Konstrukcija skulpture, vredna 800.000 funti, projektovana za vek od 100 godina, izrađena je od COR-TEN čelika sa projektovanom izdržljivošću na udare vetra od 100 milja na čas. Ispod metalne strukture *Angel of the North* su betonski piloni dubine 20 m. Unutrašnju strukturu čine rešetkasti čelični nosači 1016 × 305 × 272 mm. Svaka od 325 tetraedarskih jedinica sastoji se od čeličnih zavarenih delova za čije je spajanje korišćen metod čelične igle koja je uklanjana

The sculpture structure, worth 800,000 pounds, designed for a life of 100 years, is made of COR-TEN steel with a resistance to winds of 100 miles per hour. Under the metal structure *Angel of the North*, there are concrete piers to a depth of 20 m. The internal structure of the sculpture is made of steel trusses 1016 × 305 × 272 mm. Each of the 325 tetrahedral units consists of welded steel parts that are connected using the steel needle method and removed after

nakon zavarivanja. Za generisanje pozicija unutrašnjeg rasporeda u strukturi *Angel of the North*, napisan je softver FEA, koji raspoređuje tetraedarske jedinice u cilju popunjavanja širine unutrašnjeg područja ove specifične strukture, koja ima sedamnaest unutrašnjih slojeva tetraedarskih jedinica.

Slika 13. Izgradnja *Exposure*, /20, 21/
Figure 13. Installation of *Exposure*, /20, 21/.

Instalacija *Firnanment IV* sastoji se od 1030 čeličnih kugli prečnika 150 mm i 1849 čeličnih prizmatičnih elemenata zavarenih u poligonalnu strukturu čiji je oblik prilagođen galeriji. Serija radova koji su zahtevali proračune radi prilagođavanja različitim prostorima u svetu, rađena je u saradnji sa inženjerom Tristanom Simonsom.

INTEGRITET U HIBRIDNI PROSTOR

Skulptura *Exposure* od nerđajućeg čelika, visine 25 m, čija proizvodnja je trajala šest godina, projektovana je kao objekat čiji je očekivani vek trajanja 120 godina. Struktura se sastoji od 2.000 ručno proizvedenih komponenti koje se vezuju u 547 čvorova putem takozvane slučajne matrice koja podrazumeva odsustvo ortogonalnih modela spajanja elemenata. Skulptura sadrži i 14.000 vijaka, što sve zajedno teži preko 60 tona. Kada bi se figura od metala ispravila u stojeći stav, imala bi visinu preko sto metara.

Autor Gormli ističe da je ideja *Exposure*, skulptura ukorenjena u tlo, vremenom reaguje na promene okoline, na podizanje nivoa mora kao posledice globalnog otopljavanja. U tom smislu, umetniku je veoma važna reakcija gledaoca koji ima mogućnost da ovom umetničko-inženjersko-ekološkom delu, pristupa u ravni same skulpture, zbog čega vajar nije želeo da projektuje postolje. Gormli očekuje da će tokom vremena podizanje nivoa mora zahtevati i podizanje nasipa, što bi značilo progresivno ukopavanje skulpture. Promena okruženja u ovom slučaju znači i direktnu promenu konteksta umetničkog dela, te umetničko delo trpljenjem posledica u realnom prostoru, odražava trpljenje ljudskog bića u njegovom fizičkom i duhovnom habitusu. Ovaj hibridni prostor prevazilazi teorijski utemeljen naziv *Der gestimmte Raum*, ali nosi sve odlike njegove suštine. Istovremeno, ovako kreirana prostornost ne odstupa od definicije koju je dao Giedion: prostor kao beskonačni potencijal unutrašnjih odnosa u kojem pojedinac mora da se projektuje, ako želi da doživi njegovu pravu prirodu.

welding. To generate the internal layout configuration of the structure of *Angel of the North*, a custom software FEA is written that distributes tetrahedral units that fill the width of the internal structure of specific areas, with seventeen inner layers of tetrahedral units.

Slika 14. Izgradnja *Exposure*, /20, 21/
Figure 14. Installation of *Exposure*, /20, 21/.

Installation of Firnanment IV consists of 1030 steel balls with a diameter of 150 mm and 1849 steel prismatic elements, welded into a polygonal structure, a shape corresponding to the gallery. The series of works required calculations to suit different venues in the world are developed in cooperation with an engineer Tristan Simmonds.

INTEGRITY AND HYBRID SPACE

The sculpture *Exposure* is of stainless steel, with a height of 25 m, whose production lasted six years, is designed as an object with an expected life of 120 years. The structure consists of 2,000 hand-made components connected to 547 nodes via a so-called random matrix, meaning the absence of orthogonal merge model elements. It contains 14,000 bolts, all of which weigh over 60 tons. If the metallic figure would spring to a standing position, it would stand over one hundred meters tall.

The author Gormley points out the idea of *Exposure*, that the sculpture rooted in soil, eventually responds to environmental changes, to rising sea levels as a result of global warming. In this sense, the reaction of the viewer who has the opportunity to access this artistic-engineering-environmentalistic work in the plane of the sculpture itself, which is why the sculptor did not want to design the stand. Gormley expects that over time, the rising sea level would require raising of the embankment, which would mean progressive sinking of the sculpture. Environmental changes in this case, are a direct change in the context of the artwork, and so the artwork suffers the consequences in real space, and reflects the endurance of humans in their physical and spiritual habit. This hybrid space exceeds the theoretically based name *Der gestimmte Raum*, but it bears all hallmarks of its essence. At the same time, thus created spatiality does not deviate from the definition given by Giedion: Space as the infinite potential of Interior relations to which the individual has to be projected, if one wants to experience its true nature.

Skulptura *Izloženost* čije je planiranje sa realizacijom trajalo devet godina, jer zbog neophodnosti složenih softverskih rešenja iz tehnoloških razloga ne bi ni moglo biti realizovano pre deset godina, zahtevala je ekspertska znanja: razvoj softvera pomoću kojeg je izvršena digitalizacija modela skulpture, kreiranje algoritama koji omogućavaju projektovanje elemenata koji mogu da ostvare predviđeni integritet konstrukcije; razvoj oblika koji bi mogao da ostvari proizvođač Hab-Fab koji je, uz sopstvene subvencije od 120.000 funti u realizaciji, zatražio pomoć od svetskih proizvođača iz Kanade, Turske, Ukrajine i Finske. Testiranje modela urađeno je u *East Lothian*, pre nego što je izvršena isporuka skulpture u Holandiju.

ZAKLJUČAK

Integritet i vek konstrukcija, značajne su oblasti heritološkog istraživanja u zaštiti monumentalnih dela. Kada implozija estetskog kvaliteta sa margina materijalne proizvodnje u njeno središte, korespondira sa implozijom tehnološkog principa sa margina umetnosti u njenu konceptualnost, dolazi do zastoja u razvoju monumentalnog kvaliteta. Zbog toga, kako pokazuju radovi britanskog autora Entonija Gormlija, savremeno monumentalno umetničko delo mora biti inovativno u oba aspekta, kao dijaloška kreacija u kojoj umetnička inovacija inspiriše tehnološku, a tehnološka umetničku. Kontekstualizovanje ovakvih odnosa u domene ekologije održivog razvoja, otvara u oblasti istraživanja integriteta i veka konstrukcija novo polje inovativnog delovanja.

ZAHVALNOST

Ovo istraživanje obavljeno je zahvaljujući podršci Ministarstva prosvete, nauke i tehnološkog razvoja u okviru projekata TR-34028 i TR-35040, kao i podršci Ministarstva kulture, informisanja i informacionog društva u okviru projekta br. 633-00-373.

The planning and implementation of the sculpture *Exposure* lasted nine years, since because of the necessity of complex software solutions for technological reasons it could not be implemented ten years ago. *Exposure* has required expert knowledge: the development of software for a digitization model of the sculpture, creating algorithms that allow design elements that can be envisaged to achieve structural integrity; development of forms that could have accomplished the producer Hab-Fab who, besides its own subsidy of 120,000 pounds, requested assistance from international manufacturers from Canada, Turkey, Ukraine and Finland for the realisation. Model testing was done in East Lothian, before delivering the sculpture to the Netherlands.

CONCLUSION

Structural integrity and life is an important area of heritologic research in protecting monumental works. When the implosion of aesthetic quality from the margins of material production to the centre corresponds with the implosion of technological principles from the margins of art in its conceptuality, it results in a delay of development in monumental quality. Therefore, as British author Anthony Gormley's works present, the modern monumental work of art has to be innovative in both aspects, as a dialogue creation in which artistic innovation inspires technological innovation, and technology inspires the art. Contextualisation of these relations in the field of ecology and sustainable development opens a new field of innovative action in the research of structural integrity and life.

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