HRVATSKA KOMORA INŽENJERA GRAĐEVINARSTVA
Dani Hrvatske komore inženjera građevinarstva 2020.

Čelik u rekonstrukciji povijesne građevine

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Ključne riječi: čelik, rekonstrukcija, povijesne zgrade

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Sadržaj:

1.1. UVOD

Trenutno je u Europi udio radova na popravcima, zaštitama i rekonstrukcijama veći od novogradnje, s time da se taj omjer svake godine mijenja u korist popravaka, zaštite i rekonstrukcija.

Zahtjevi koji su nam zadani prema današnjim potrebama odnose se na funkcionalnu upotrebu, arhitektonsko oblikovanje i normom propisano granično stanje nosivosti i uporabljivosti.

Čelik kao osnovni građevinski materijal nosive konstrukcije svojim se karakteristikama pokazao kao optimalan izbor pri rekonstrukciji.

U projektu rekonstrukcije povijesne zgrade, koji je prikazan u ovome radu, osim prije navedenih zahtjeva bili su propisani i posebni uvjeti od strane konzervatora u vidu očuvanja povijesne baštine te su se čelikom uspijeli riješiti i najsloženiji detalji.

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1.2. PRIMJER IZ PRAKSE

Rekonstrukcija ciglene zgrade u Dječju kuću Rijeka

.

PROJEKTNI ZADATAK

Kako bi se mogao realizirati projektni zadatak odabran je čelik kao osnovni materijal te je kroz navedena poglavlja prikazana njegova upotreba

A TEŠKA SKELA

B VERTIKALNI ELEMENTI - STUPOVI

C HORIZONTALNI ELEMENTI - MEĐUKATNA KONSTRUKCIJA

D DETALJI SPOJEVA.

2. TEŠKA SKELA

PROJEKT TEŠKE SKELE I
TEHNIČKO RJEŠENJE FAZNOG IZVOĐENJA I UKLANJANJA DIJELA KONSTRUKCIJE CIGLENE ZGRADE

Razupiranje profili

Cijevna skela

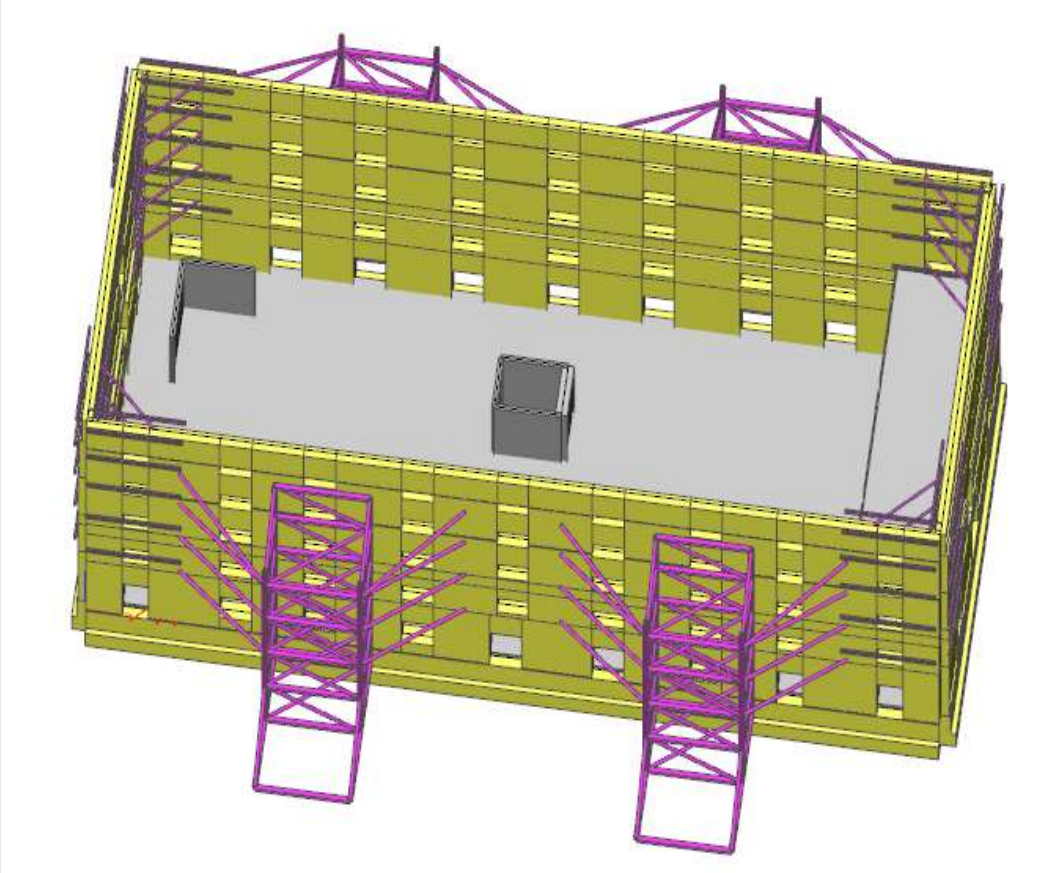
Linijski okviri

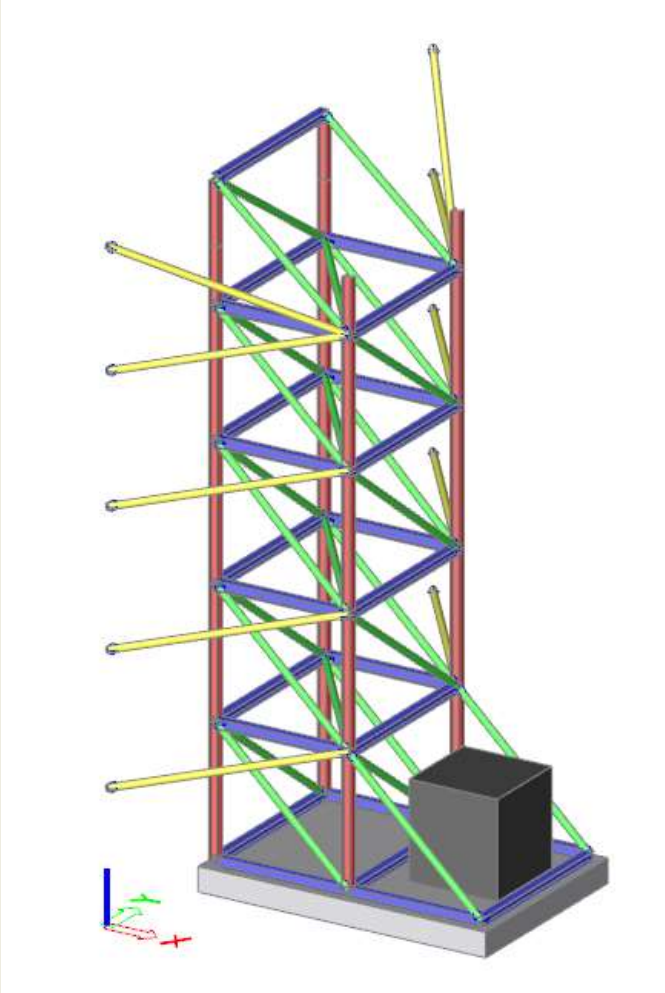
Razupiranje rešetkom

Podupiranje okvir

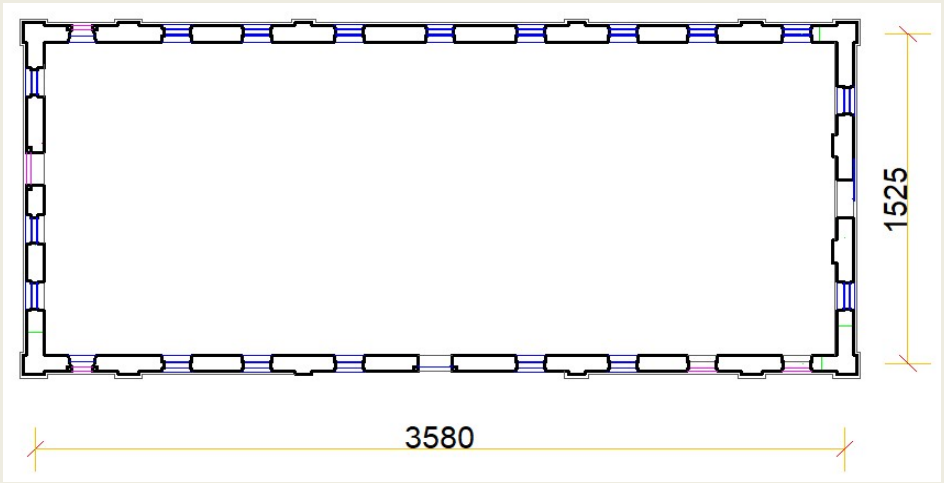
Toranjska

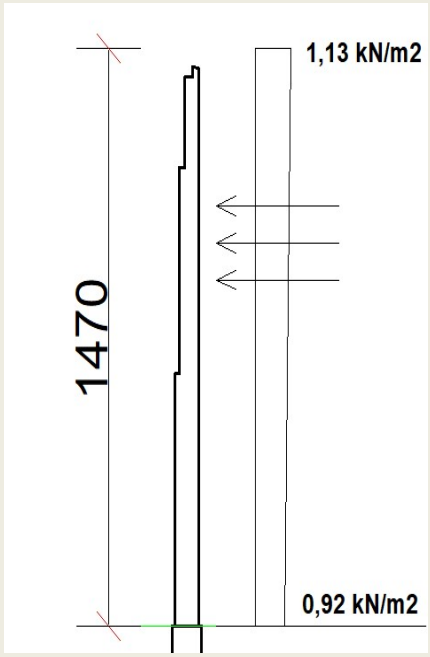
ODABRANA TORANJSKA TEŠKA SKELA

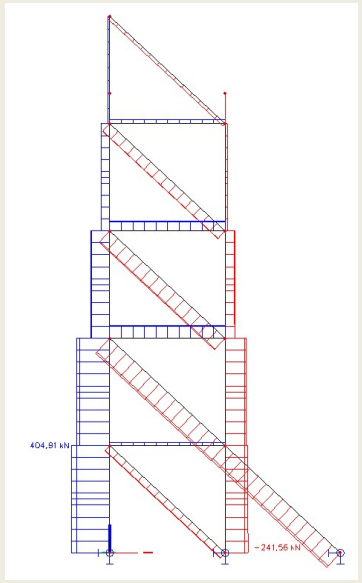


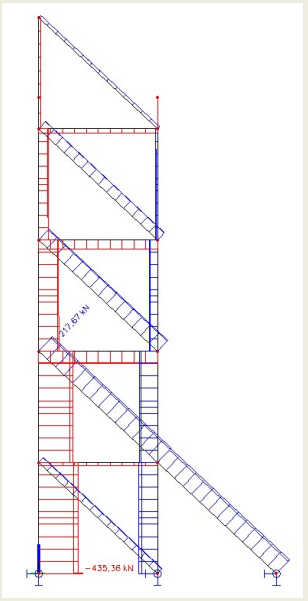


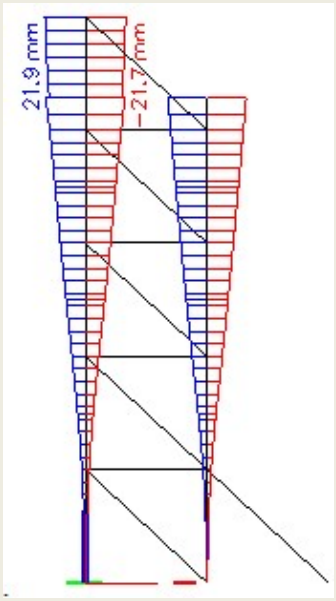
PRORAČUN
TEŠKE SKELE

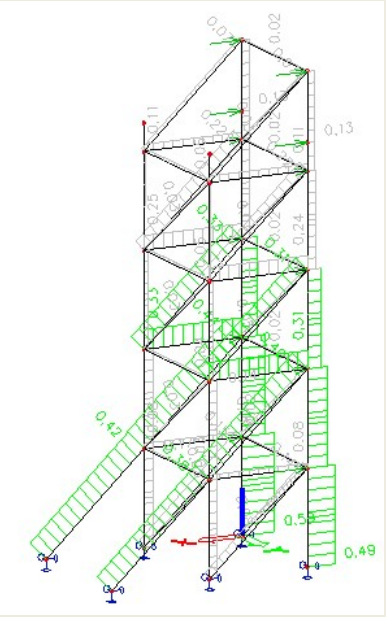




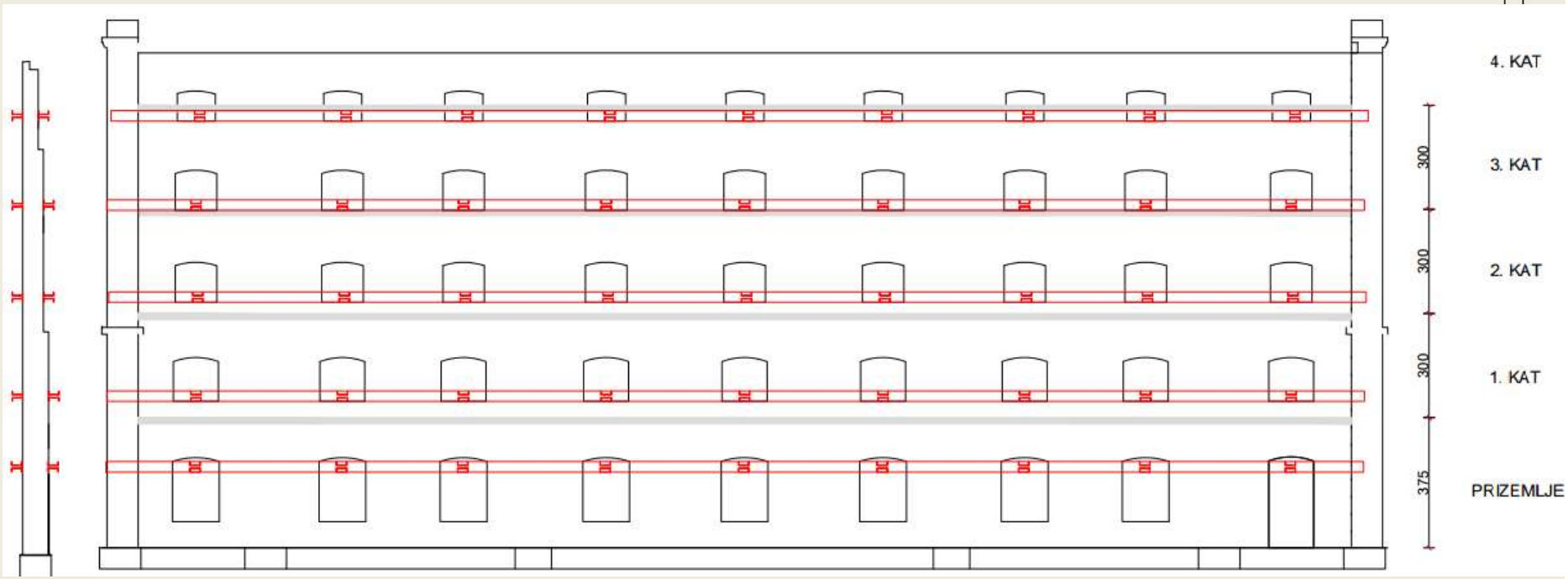


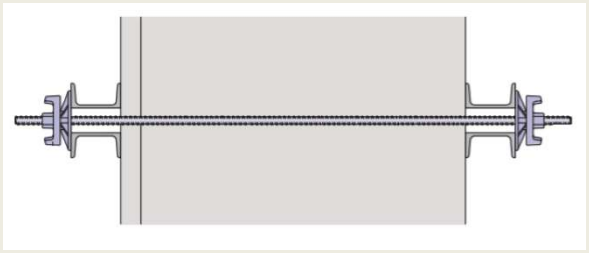


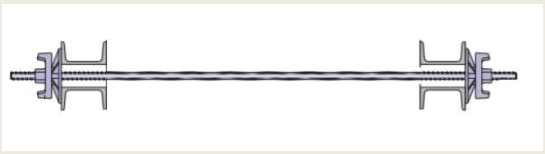


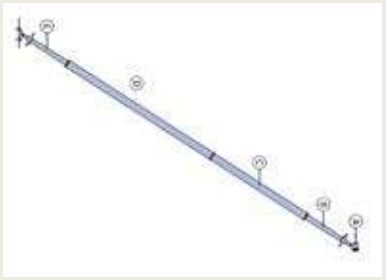


Prihvaćanje na zid
Standardni višenamjenski pojasa i zatezač (Variokit SRU ili slično)









ODABRANA TORANJSKA TEŠKA SKELA

ODABRANA TORANJSKA TEŠKA SKELA

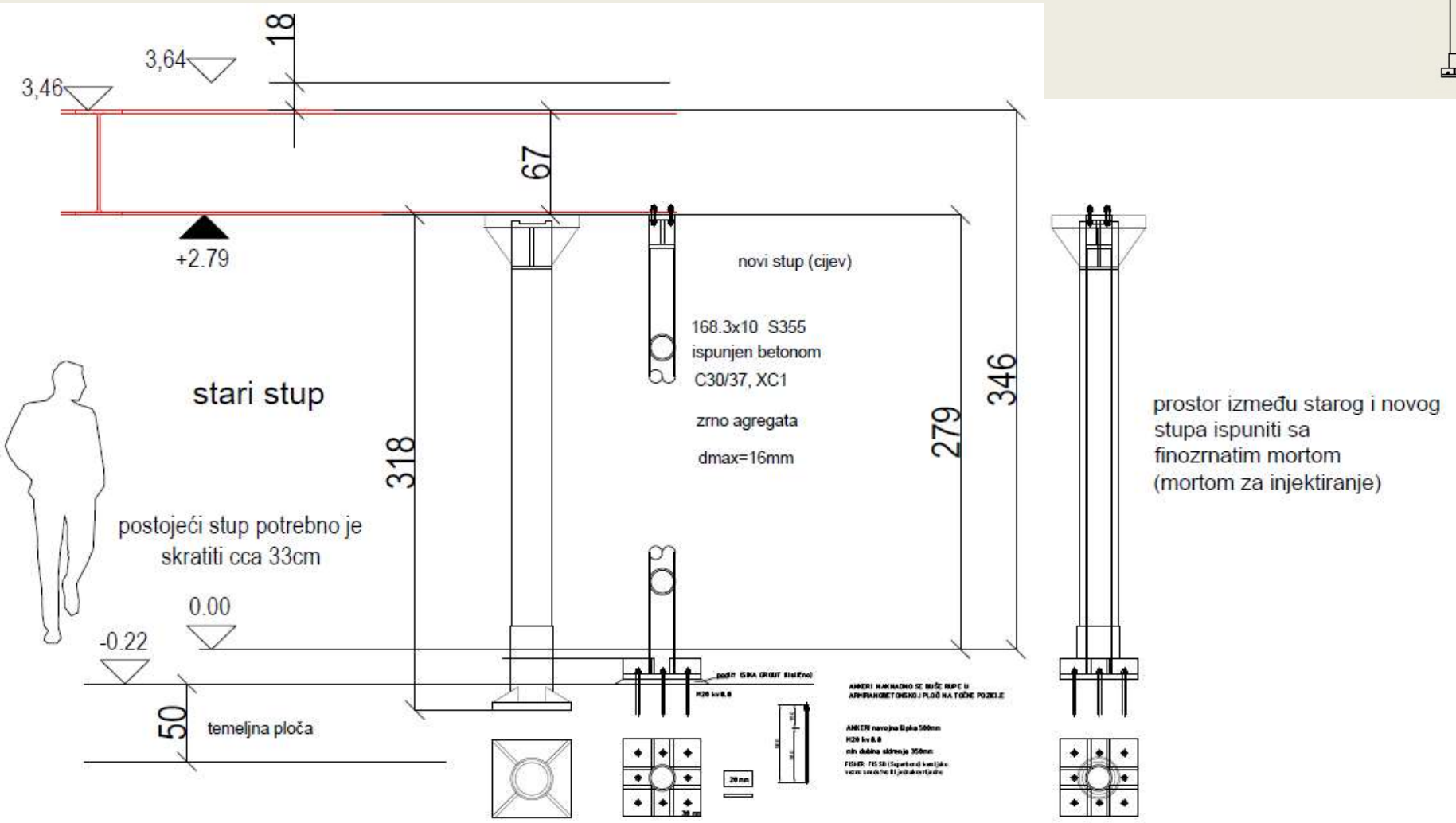
3. VERTIKALNI ELEMENTI – STUPOVI

UGRADNJA POSTOJEEĆIH STUPOVA U OSNOVNU KONSTRUKCIJU

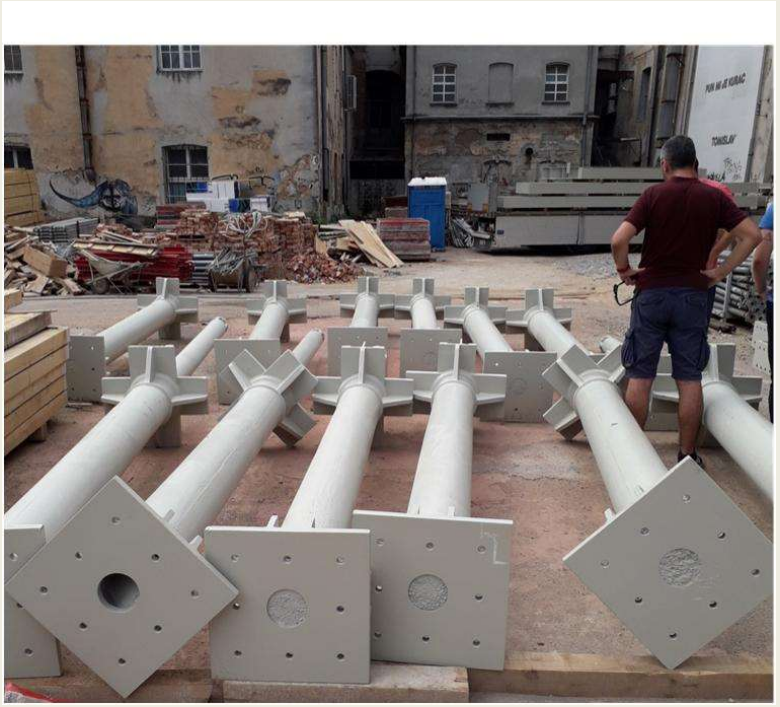
Ljevano željeznih stupova iz 1899. zbog svoje unikatnosti pod zaštitom su konzervatota.

Nakon što su uklonjeni, dio stupova saniran je na način da im je ugrađena nova unutarnja ispuna i spojevi te su vraćeni u zgradu da sudjeluju u nosivosti.

STUPOVI


18
3,64
3,46
67
+2.79
novi stup (cijev)
168.3x10 S355
ispunjen betonom
C30/37, XC1
zrno agregata
dmax=16mm
346
279
318
stari stup
postojeći stup potrebno je
skratiti cca 33cm
0.00
-0.22
50
temeljna ploča
prostor između starog i novog
stupa ispuniti sa
finozrnatim mortom
(mortom za injektiranje)

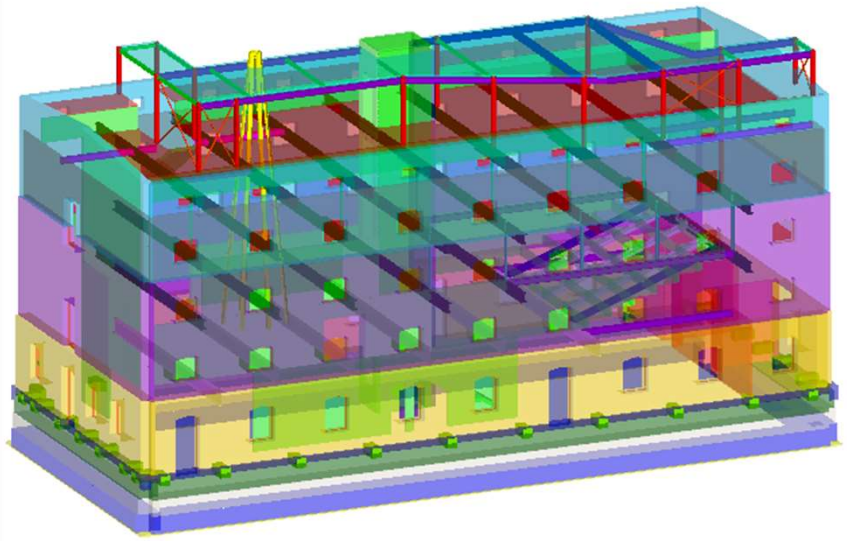
STUPOVI



Donacija dijela preostalih unikatnih stupova Građevinskom fakultetu u Rijeci temelj su za daljnja znanstvena istraživanja, otkrivanje novih spoznaja te objavljivanje istih u svrhu doprinosa cijeloj zajednici

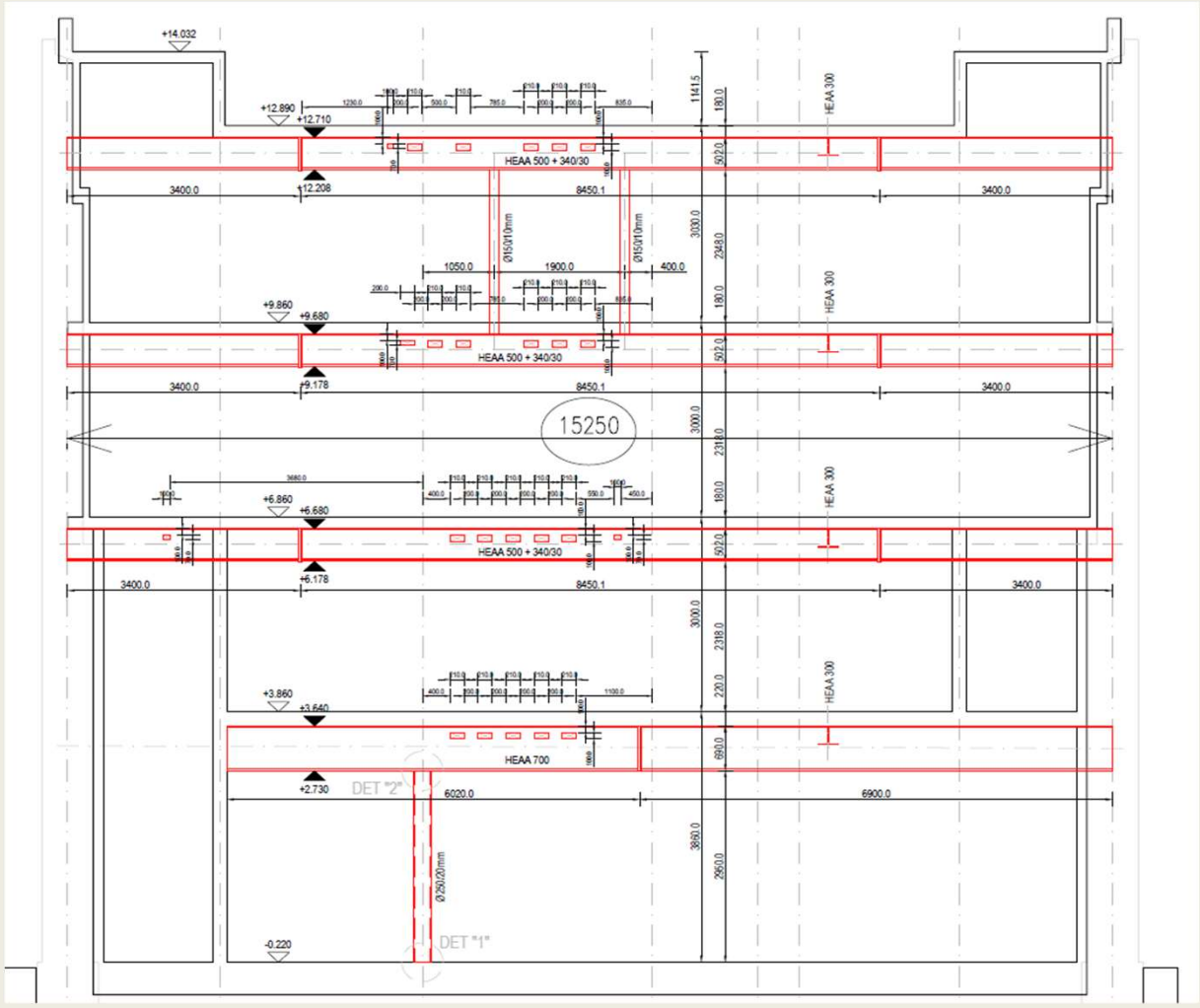
4. HORIZONTALNI ELEMENTI - MEĐUKATNA KONSTRUKCIJA

Model Scia



Model Tower

Zbog novog rasporeda i potrebe za otvorenim prostorom, međukatna spregnuta konstrukcija doseže raspon i do 15,25m. Relativno veliko opterecenje knjižnice i veliki rasponi proizašli iz geometrije razlog su za odabirom visokih i masivnih metalnih profila. Karakteristični presjek:



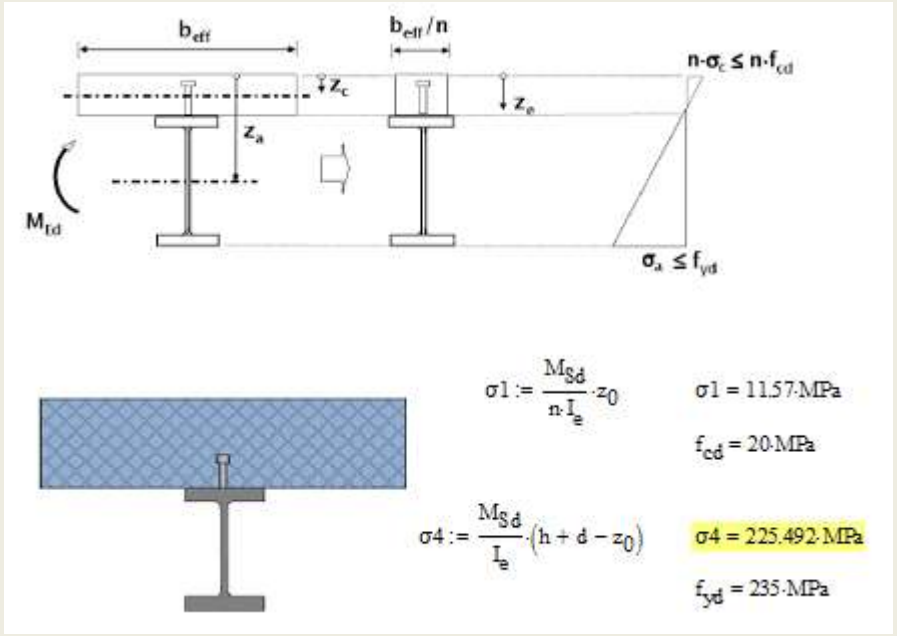
Dijagram momenata za ULS

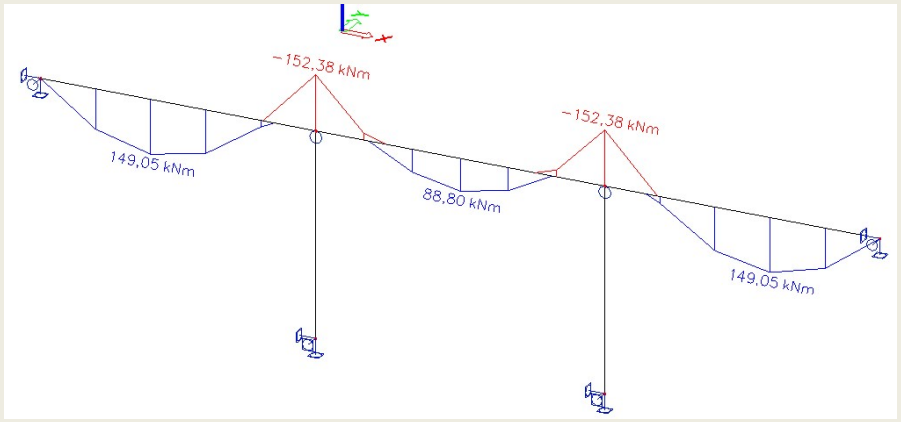
Dijagram vlačnih naprezanja u čeliku za ULS

Dijagram tlačnih naprezanja u betonu za ULS

Progib elastični za SLS

Progib dugotrajni za SLS

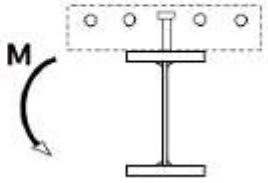


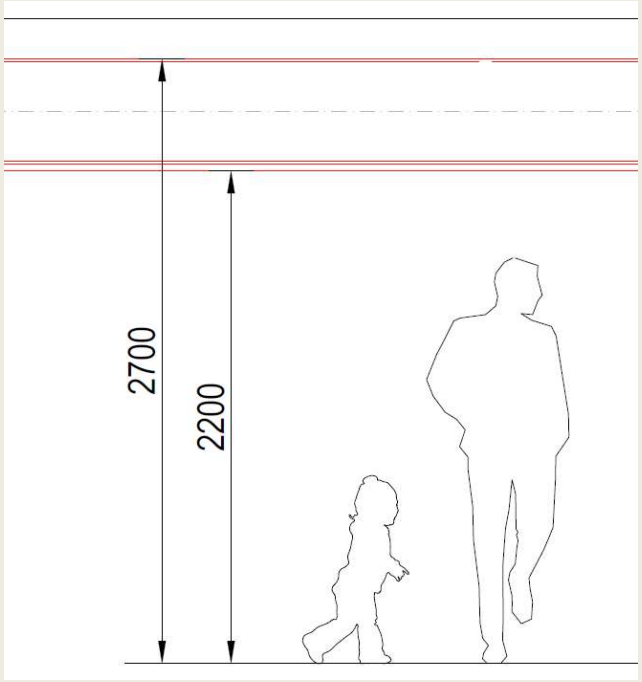


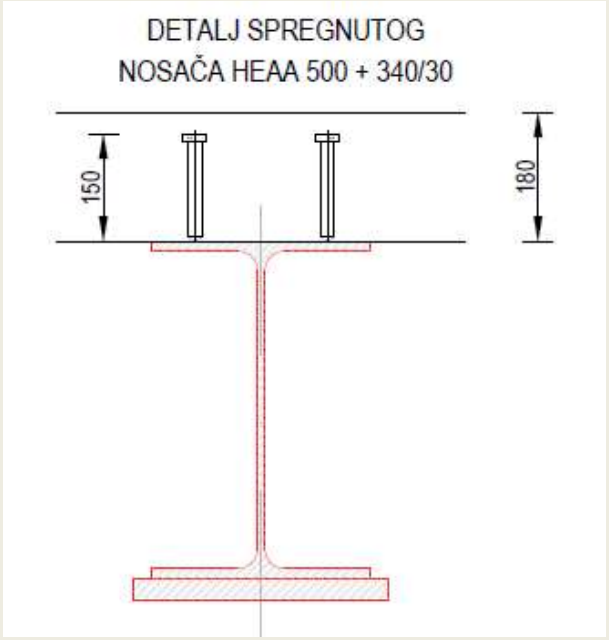
$f_{yk} := 500\frac{N}{mm^2}$ $f_{yd} := \frac{f_{yk}}{1.15}$ $f_{yd} = 43.478\cdot\frac{kN}{cm^2}$

$d_p := H_0 - 0.5\cdot c_b + d - 3cm$

$A_{S1REQ} := \frac{M_{Sd.}}{d_p\cdot f_{yd}}$

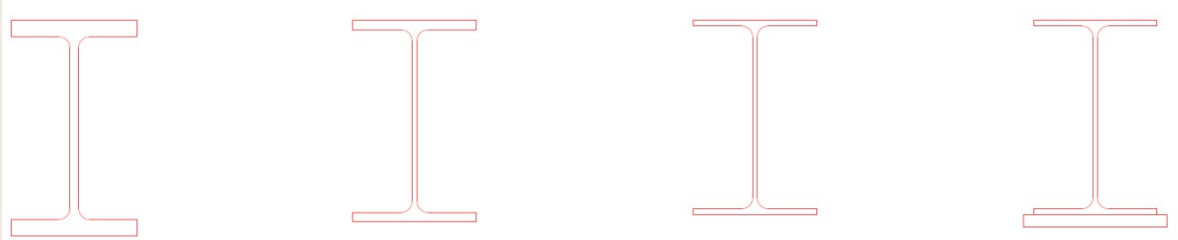






HEA 500A:
cca 40.000,00kg

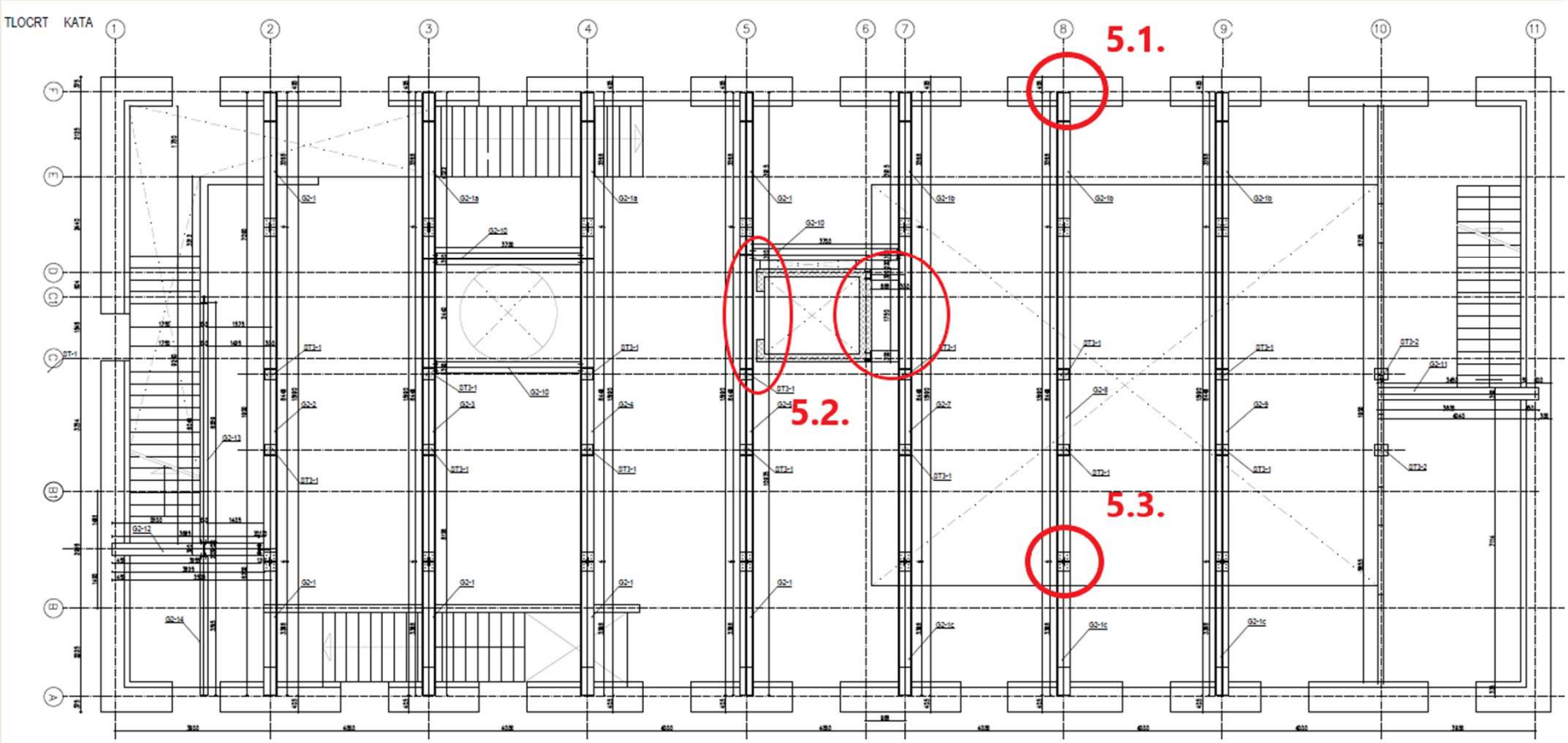
UGRAĐENO ČELIKA
cca 120.000,00 kg



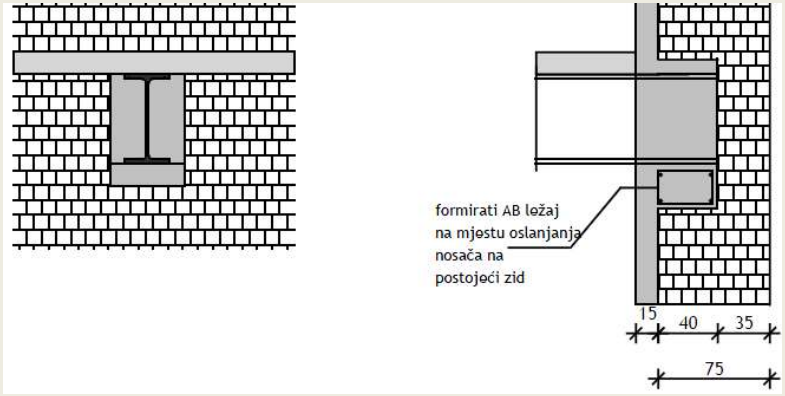
HEM 500 270 kg/m	HEA 500 155 kg/m	HEA 500A 107 kg/m	HEA 500A+340/30 107 kg/m + 79kg/m =186 kg/m

5. DETALJI SPOJEVA

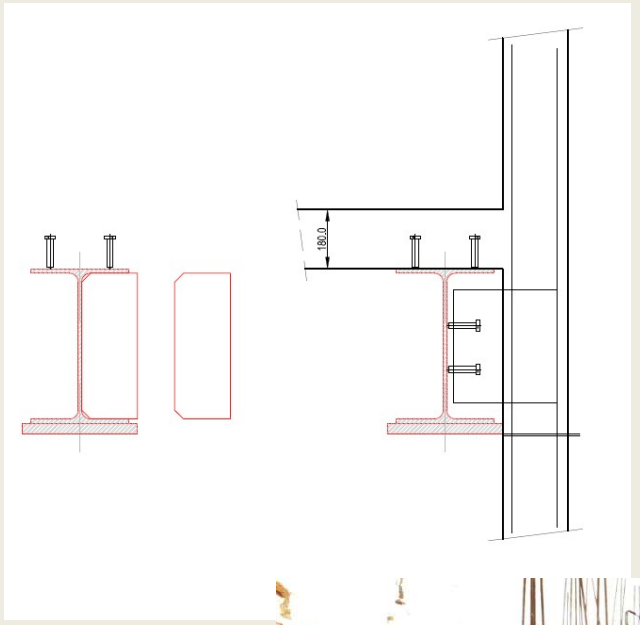
5.1 OSLONCI NA VANJSKIM ZIDOVIMA
5.2. OSLONCI NA JEZGRU LIFTA
5.3. NASTAVLJANJE NOSAČA



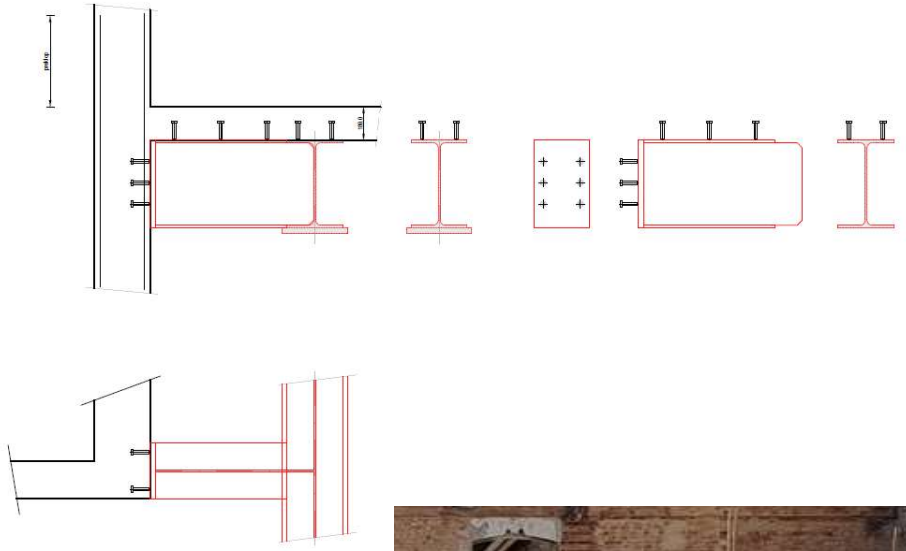
5.1 OSLONCI NA VANJSKIM ZIDOVIMA



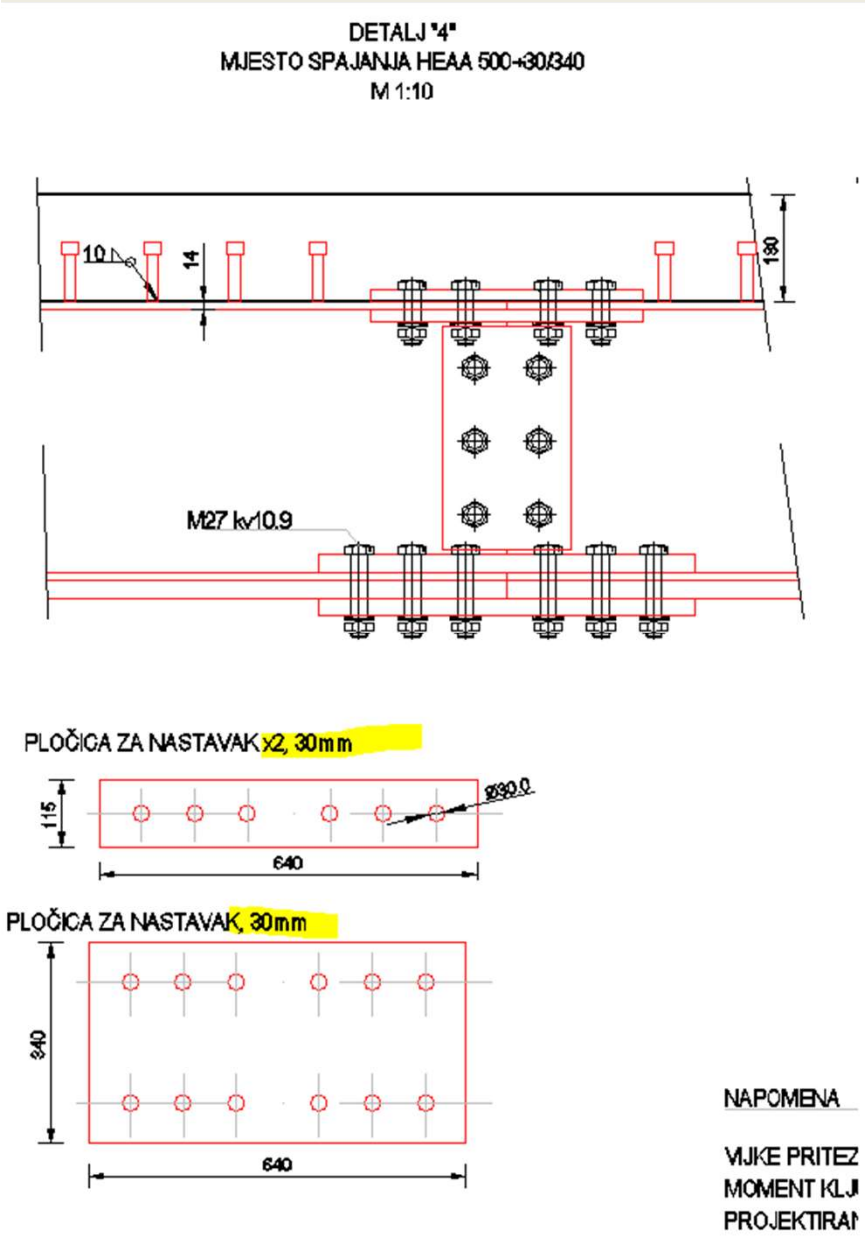
5.2.1. OSLONCI NA JEZGRU LIFTA

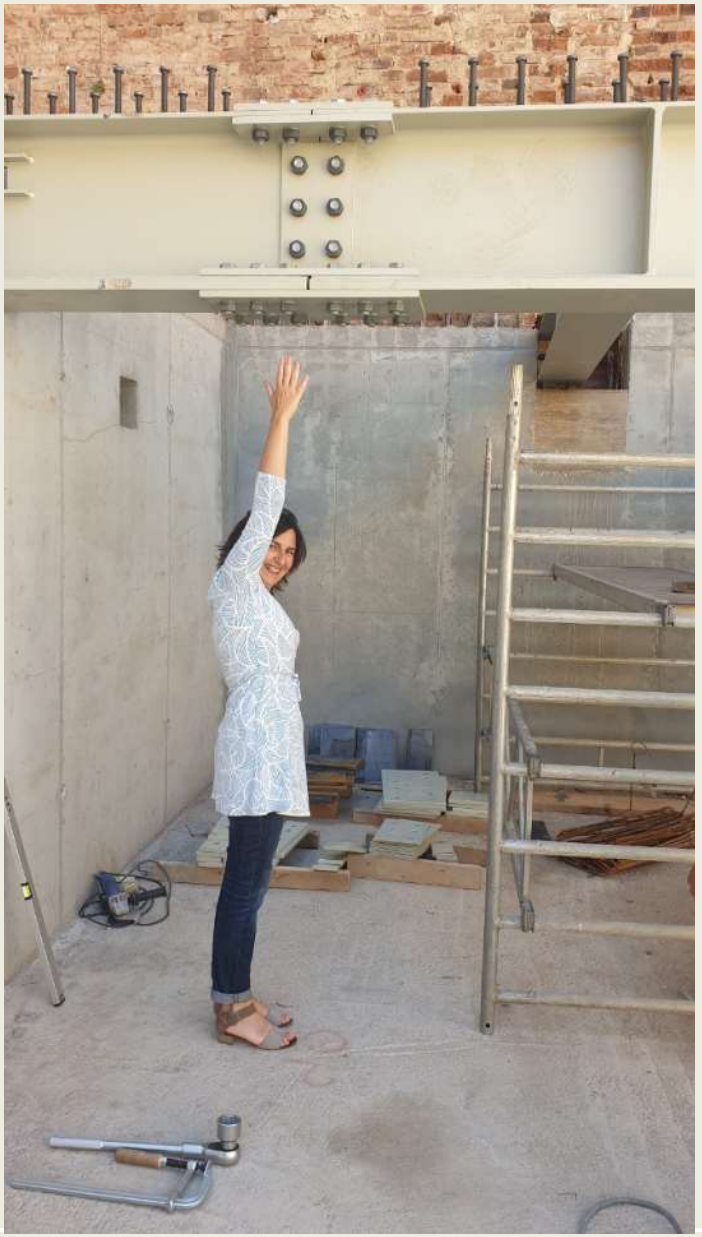


5.2.1. OSLONCI NA JEZGRU LIFTA



5.3. NASTAVAK


DETALJ "4"
MJESTO SPAJANJA HEAA 500+30/340
M 1:10
10
14
180
M27 kv10.9
PLOČICA ZA NASTAVAK x2, 30mm
115
640
PLOČICA ZA NASTAVAK, 30mm
340
640
NAPOMENA
VIJKE PRITEZ
MOMENT KLJ
PROJEKTIRAN

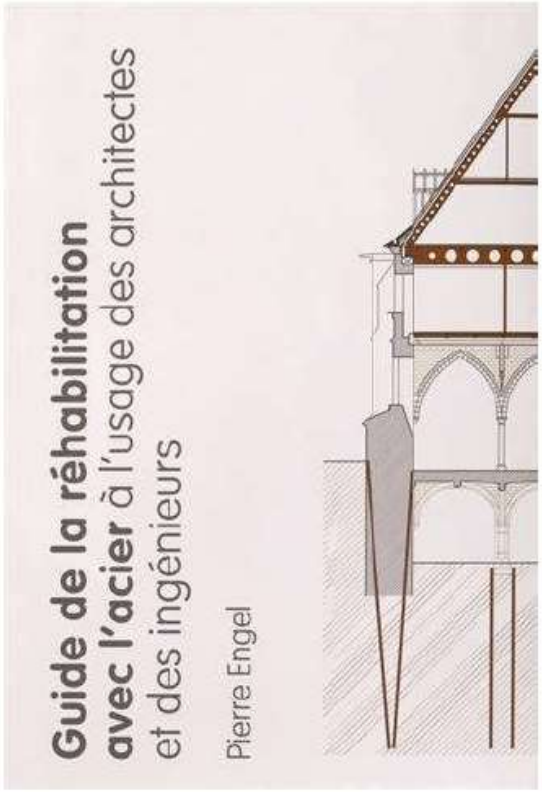


6. LITERATURA

LITERATURA

Pierre Engel

Guide de la réhabilitation avec l'acier à l'usage des architectes et des ingénieurs



Pierre Engel

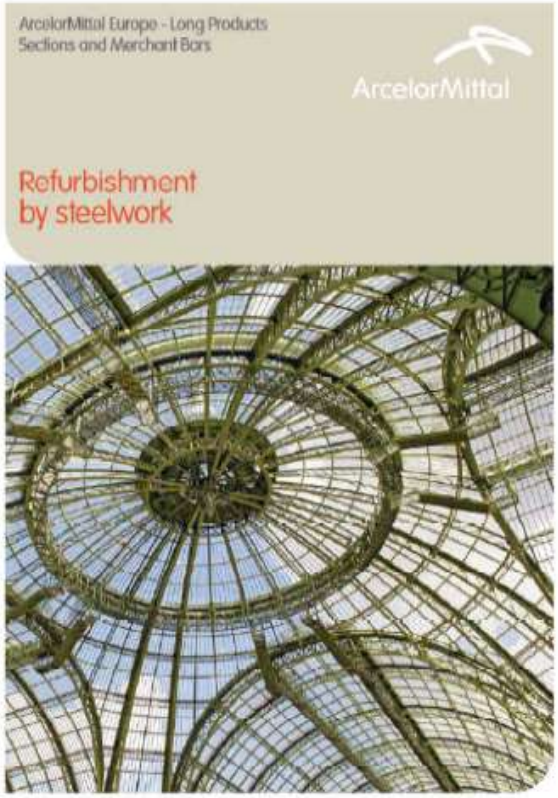
Manuel de réhabilitation avec l'acier

Pierre Engel

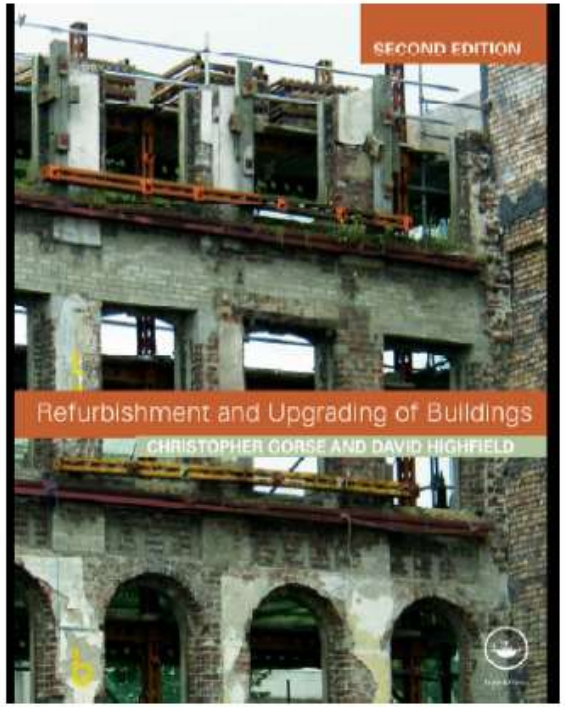
Guide de la réhabilitation des enveloppes et des planchers

6. LITERATURA

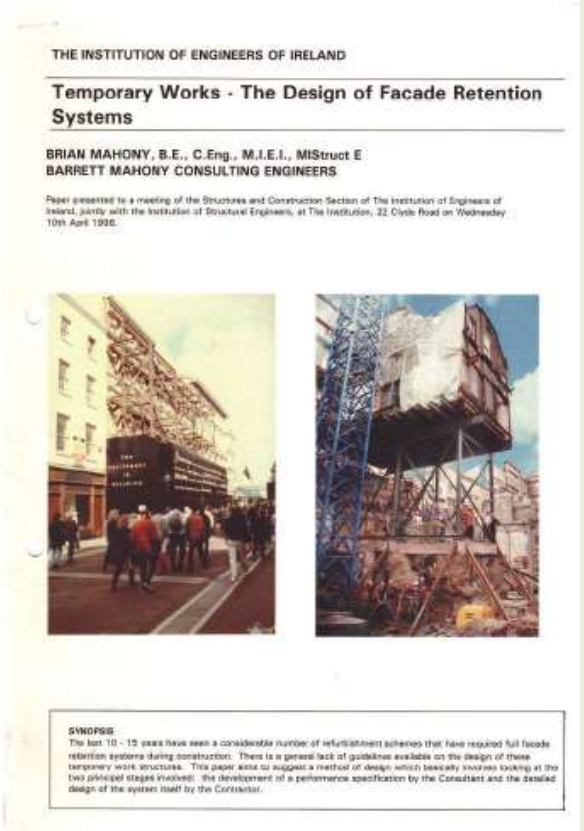
Refurbishment by steelwork, ArcelorMittal, , LUXEMBOURG, Version 2014-1



Refurbishment and Upgrading of Buildings, Second edition Christopher Gorse and David Highfield Taylr & Francis e-Library, 2009.



Temporary works the design of facade retention system Brian Mahony Barrett Mahony Ireland 1996


THE INSTITUTION OF ENGINEERS OF IRELAND

Temporary Works - The Design of Facade Retention Systems

BRIAN MAHONY, B.E., C.Eng., M.I.E.I., MIStruct E
BARRETT MAHONY CONSULTING ENGINEERS

Paper presented to a meeting of the Structures and Construction Section of The Institution of Engineers of Ireland, jointly with the Institution of Structural Engineers, at The Institution, 22 Clyde Road on Wednesday 10th April 1996.

SYNOPSIS
The last 10 - 15 years have seen a considerable number of refurbishment schemes that have required full facade retention systems during construction. There is a general lack of guidelines available on the design of these temporary work structures. This paper aims to suggest a method of design which basically involves looking at the two principal stages involved: the development of a performance specification by the Consultant and the detailed design of the system itself by the Contractor.

6. LITERATURA

Retention of major facades

Goodchild Kaminski London 1989

Retention of major facades

S. L. Goodchild, BSc, CEng, MICE
Campbell, Reith & Hill

M. P. Kaminski, BSc, CEng, MIStructE, MICE
Campbell, Reith & Hill

This paper was presented at a colloquium on refurbishment held at the Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1X 8BH, on 9 February 1989.

Synopsis

The authors have been responsible for several major facade retention projects in the City of London. Experience gained from these projects has enabled a carefully planned approach to be developed for the investigation, design and construction of such projects, in particular the temporary works requirements and their integration with the new building design. The paper describes the various stages of the design development and provides detailed information on the key factors to be considered, from the preliminary investigations stage through to the onsite installation of the temporary works and the construction of the new building behind the retained facade.

Introduction

The redevelopment of sites where the existing buildings have facades of architectural importance, but where the interiors no longer meet the requirements of modern-day users, is increasingly being considered, not only for refurbishment but for major reconstruction while retaining the historic and familiar appearance of the original buildings. Over the last 10 years or so there have been several developments which have adopted the facade retention solution, particularly those in city centre sites, where the commercial buildings of the late 19th and early 20th centuries no longer provide the necessary space and environmental conditions now demanded by office and retail occupiers.

Fig 1. New Bread Street House, City of London

To the engineer, a major facade retention scheme requires careful consideration of the design and construction criteria at a number of special stages, from the commencement of the demolition of the existing building, through to the final integration of the retained facade with the new structure.

Our experiences with a variety of retention schemes in recent years has enabled us to formulate a design approach which we believe can be applied to most developments of this type. While every project will have its own unique constraints, there are common considerations which will always apply, the purpose of this paper is to describe these, at specific design stages, with explanations and illustrations taken from actual projects.

Preliminary considerations

(i) Identification of building type and suitability for facade retention

Most of the buildings which lend themselves to facade retention redevelopment were originally constructed around the turn of the century, using loadbearing brick and/or stonework for the external walls. The internal structure may be entirely loadbearing walls or a partially framed structure using steel and/or timber construction. Concrete floors may be present in some cases. Buildings with fully loadbearing skeletal steel frames were not introduced until the latter part of the 19th century but, until 1908, it was still a requirement of the London Building Act 1894 that external walls were of full loadbearing thickness.

More recent steel framed or reinforced concrete framed structures with relatively thin external brick or masonry cladding do not lend themselves to facade retention redevelopment. Very few of such buildings have important or listed facades. Internal alterations and refurbishment, in conjunction with external renovation or recladding, is likely to be a more viable method of extending the useful life of modern buildings than partial demolition and redevelopment.

(ii)Initial site research

One of the major problems associated with trying to establish the precise details, and loadbearing characteristics, of older buildings in town and city centres is the lack of a fully recorded history. A history of previous development on the site may be fundamental to assessing potential foundation problems for the new development. Details of the original construction and new alterations would help assessments of loading and stress on the existing walls and foundations.

The initial research and investigations in general terms will embrace some or all of the following:

(a) Research site history, via local authority and public archives, historical societies, previous owners, etc.

(b) Research availability of construction drawings and details of existing building, including any recent alterations. Obtain copies of relevant available details.

(c) Conduct visual inspections of the existing building internally and externally to identify the general nature of its construction and the likely nature of support afforded to the facade wall. This will include identifying lateral support from flank walls, party walls, internal walls and floors and also any vertical support where self-weight accumulates over.

(d) Research likely subsoil conditions and assess whether foundation problems are probable in relation to the new development proposals. Problems often arise if the construction of more floors of heavier construction than those being demolished is envisaged, if obstructions are found, or underpinning is required.

Appraisal of Existing Iron

and Steel Structures

1997 The Steel Construction Institute

The Steel Construction Institute

Appraisal of Existing Iron and Steel Structures

On the Strength of Cast Iron Columns

Jacques Rondal CivEng PhD

Kim JR Rasmussen MScEng PhD

The University of Sydney May 2003

The University of Sydney
Department of Civil Engineering
Sydney NSW 2006
AUSTRALIA

http://www.civil.usyd.edu.au/

Centre for Advanced Structural Engineering

On the Strength of Cast Iron Columns

Research Report No R829

By

Jacques Rondal CivEng PhD
Kim JR Rasmussen MSeEng PhD

May 2003

6. LITERATURA

Design of Composite Joints for buildings

European Convention for Constructional Steelwork

1999

Design of Steel-to-Concrete Joints Design Manual I

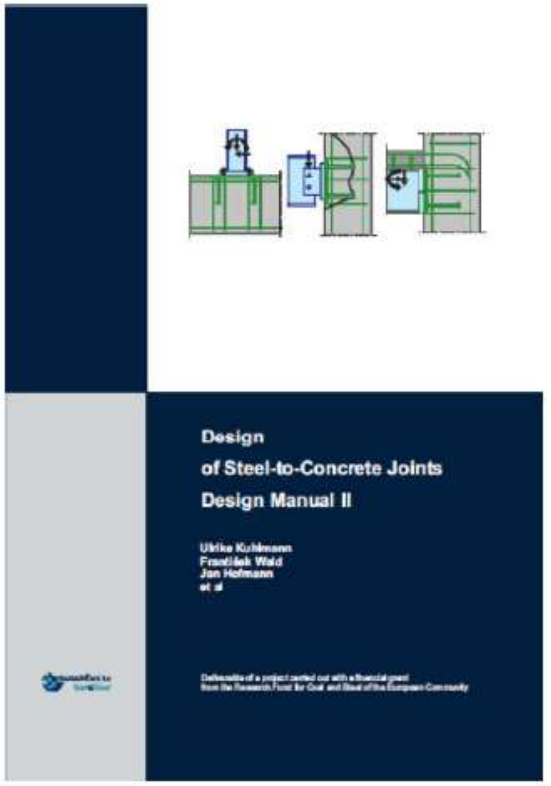
European Convention for Constructional Steelwork

2014

Design of Steel-to-Concrete Joints Design Manual II

European Convention for Constructional Steelwork

2014

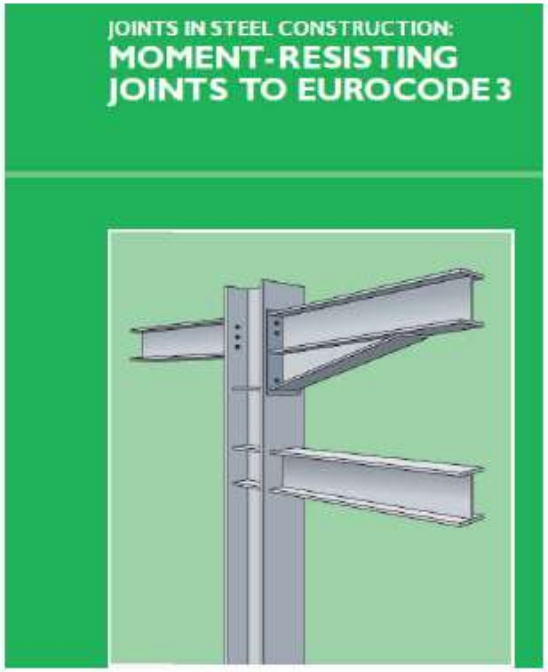


6. LITERATURA

Typisierte Anschlüsse im Stahlhochbau nach DIN EN 1993-1-8

Simple joints to Eurocode 3
Joints in steel construction 2013

Moment resisting joints to Eurocode 3
Joints in steel construction 2013



6. LITERATURA

Eurocode 3-1-8 Proračun spojeva – Komentar s primjerima – Mr. sc. Vjenceslav Leko dipl. ing. građ.

Primjeri proračuna spregnutih konstrukcija prema Eurocode 4 - Darko Dujmović, Boris Androić, Ivan Lukačević 2014.

Projektiranje spregnutih konstrukcija prema Eurocode 4
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