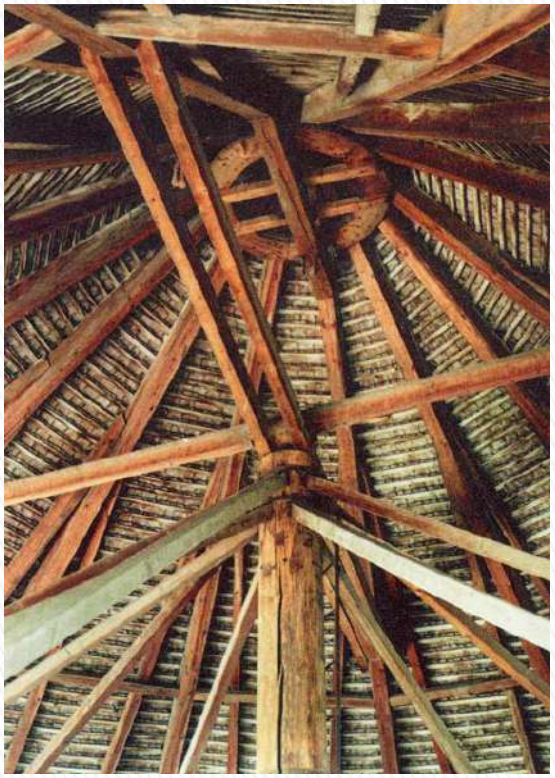


# ASSESSMENT OF THE CONDITION AND REPAIR OF SUVACA IN KIKINDA

**Nenad Krstivojević dipl.ing.građ.**

-Kikinda Suvaca is a dry grain grinder that uses horse work and one of the two remaining in the whole of Pannonia. It has been proclaimed an immovable cultural property of exceptional importance to the Republic of Serbia. It was built in 1899, and stopped operating in 1945. It consists of three connected parts: drive space, mill space and miller's room. The main building is a drive space with a pyramidal roof and there is a device for moving the mill stone. In a constructive sense, it is a multi-sided pyramid housing a large wheel, spanning about 15 m1, measuring about 45m1 in height and 8.50 m1 in height, and secured with 12 spacers for a central cylindrical shaft mounted vertically called a "popa". The roof structure is wooden covered with pepper tile.







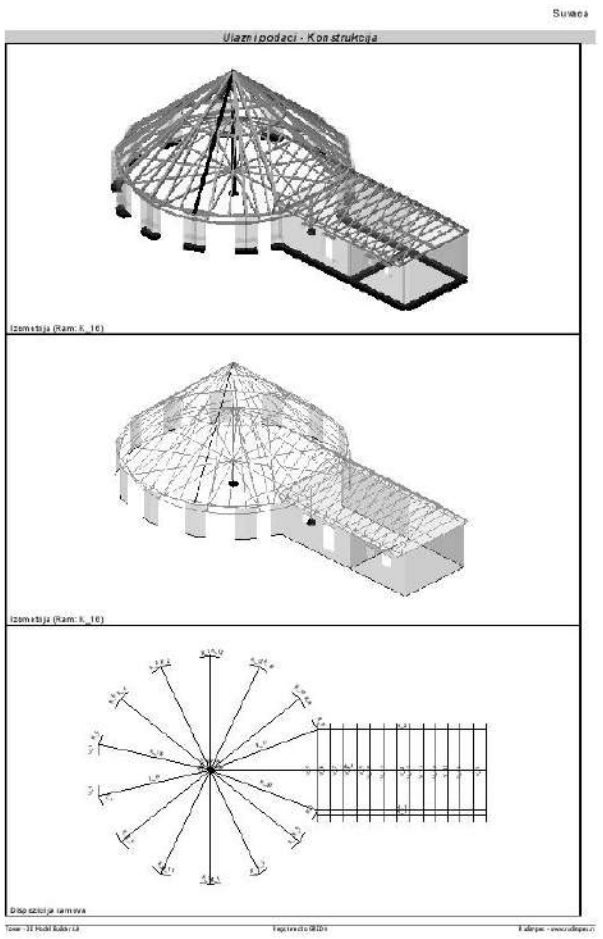
-Roof rests on 14 low pillars of baked brick exterior and interior plastered with lime mortar, 60 cm wide 1.85 m1, with wedding dresses and clamps at the top of timber, which carry ridges and horns of roof over wooden columns and horizontal. The walls of the rest are of charge and of unbaked brick, "brick," plastered with clay and weed mortar. An inspection of the structure of the building and a static check of all elements of the wooden structure of the roof and of the rotating structure, brick walls and foundations revealed that it was in relatively good condition. All these damages do not jeopardize the basic safety and stability of the building, but repair work is required as soon as possible to prevent the building from further deterioration.

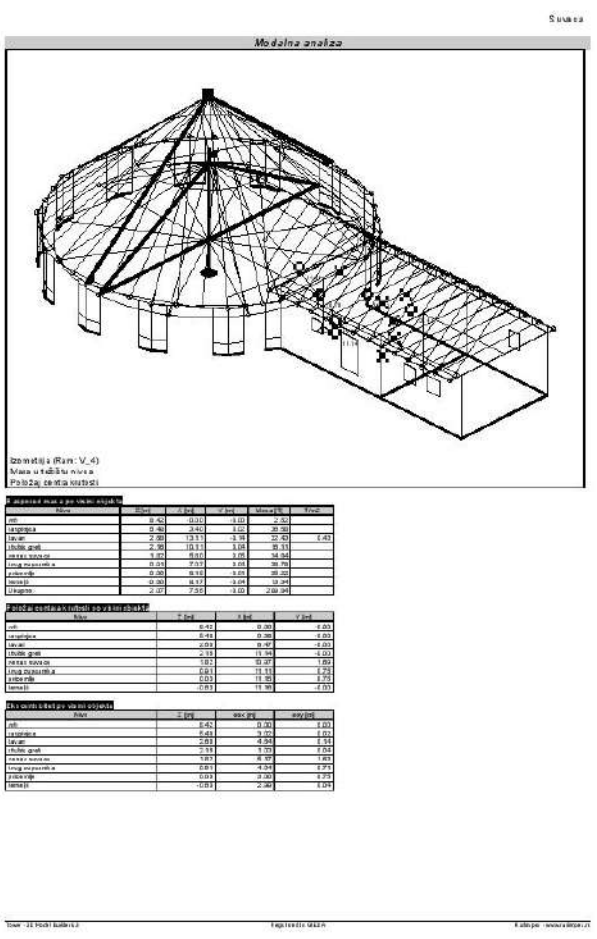




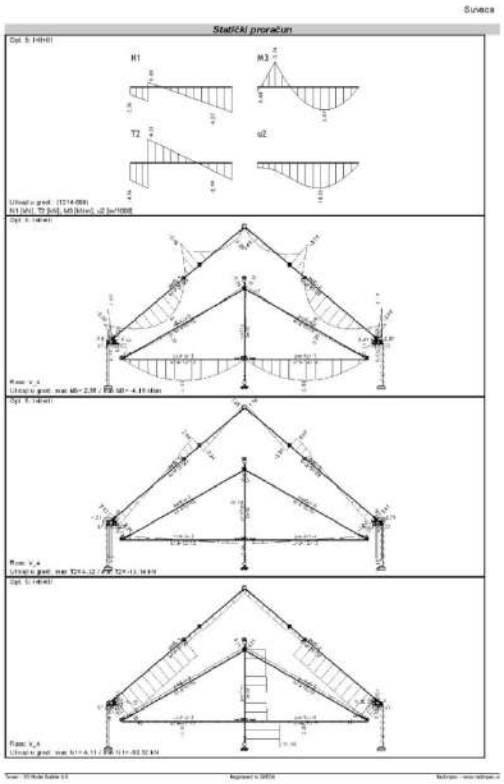
- CONDITION AND DESCRIPTION OF DAMAGE TO THE OBJECT

- The first model of the tower construction in Tower6 program was made for easier loading of loads and to see the influence on the structure, easier to see the forces in the elements of the roof, attic, and the wooden drive of the circular mechanism, forces and stresses in the walls and basic joints. The loads entered are: constant from the roof covering and the structure itself, occasional from snow and wind loads and extremely seismic.



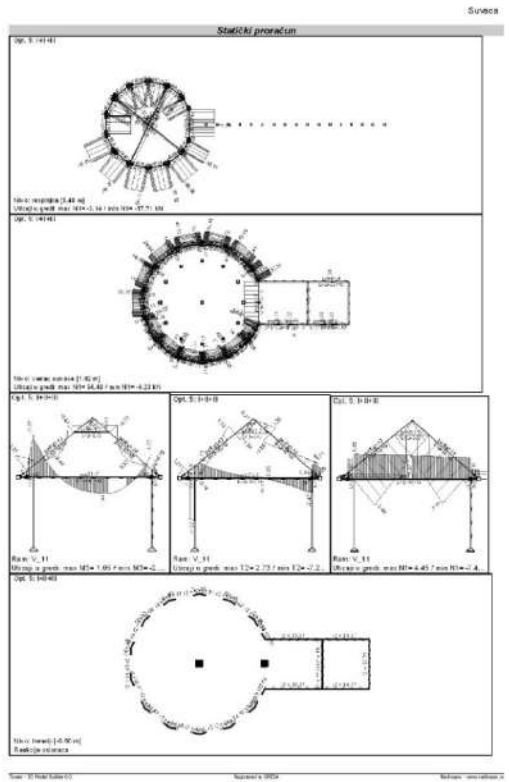



-Roof and roof structure: The wooden roof structure by inspection seems to be in good condition. Some of the replaced elements show that some of the worn out elements of the roof structure were made in due time. By static check all the elements of the roof: ridge posG, drive horns posRg, wedding dresses posVc, taut wedding dress posZc, horizontal posHs, stagger posRs, corneas posRg, small horns - mill horns posRg1, small stapler - mill posRs1 satisfy the detailed static check. The peaks and tiles are partially damaged and the damaged tiles and tiles need to be replaced as soon as possible to prevent damage to the wooden structure of the roof.






- Attic construction: The inspection seems to be in good condition as no significant cracks or dents are visible in the ceiling. The static elements of the ceiling satisfy the static check: posT1 and posT2 looms, the beam of the posGr room for constant and occasional attic loads. Rotary drive structure: The inspection seems to be in good condition, except for the main pole ,, pope ,, which with a large vertical crack that needs to be repaired – to be filled. The static check satisfies all wooden elements of the rotary drive part: paços or horizontal posHor, beams posKos, main pole posPop, for constant and occasional vertical loads of the rotary mechanism. The metal mill mechanism itself was not subject to this static check.






-Walls: There are no pronounced cracks in the walls. Mostly there are parts with cracked or fired mortar, both mortar as lining and dropped mortar, mostly at the top of the brick pillars in the pyramidal drive section. In the masonry and masonry walls, the clay and weed mortar, mostly from the outside, fell away in the mill and mill rooms. Static walls satisfy their thickness for vertical and seismic loads, which is confirmed by a budget check. It is not necessary to introduce new walls or masonry columns. Basic construction: the assumed foundation depth of the foundation is min Df = 0.60m1 in the dust clay layer. The assumed allowable voltage is Gmah = 100KN / m². The foundations are of baked brick and the assumption is that they are the same width as the walls themselves. The inspection shows that the walls are waterproofed to the foundations so that moisture does not climb along the walls.





# Ground level lowering control and seismic stability control

## КОНТРОЛА НОСИВОСТИ ТЛА ИСПОД ТЕМЕЉА

Претпостављен допуштен напон на претпостављеној минималној дубини фундирања Дф=0.60м је Гдоп=100 кН/м²

**а)Реакције на темеље зидова погонског дела суваче од сталног, повременог оптерећења и оптерећења ветром:**

P= 55.00 кН/м¹

Претпостављена ширина тракастог темеља од печене опеке (као и зид) : Б= 0.60 м¹

Просечни напон у темељној спојници зида од г+п+в:

Гу=Р/Б= 55.00кН/м¹/0.60м¹= 91.67 кН/м² < Гдоп=100 кН/м²

**б)Реакције на зидове млинског простора и зидове млинаревог стана од сталног, повременог и оптерећења ветром:**

P= 35.00 кН/м¹

Претпостављена ширина тракастих темеља од опеке (као и зидови) : Б= 0.50 м¹

Просечни напон у темељној спојници зида од г+п+в:

Гу=Р/Б= 35.00кН/м¹/0.50м¹= 70.00 кН/м² < Гдоп=100 кН/м²

**ц)Реакције на Поп главни стуб погонског дела суваче од сталног и повременог оптерећења:**

P= 50.52 кН

Претпостављене димензије темеља од камена: Б= 0.90 м¹ Л= 0.90 м¹

Просечни напон у темељној спојници стуба од г+п:

Гу=Р/БхЛ= 50.52кН/м¹/0.90м¹/0.90м¹= 62.37 кН/м² < Гдоп=100 кН/м²

**Све ширине темеља објекта задовољавају на дозвољену носивост терена испод њих за све комбинације оптерећења. Није потребна никаква додатна интервенција на постојећим темељима.**



## КОНТРОЛА ЗА СЕИЗМИЧКУ СТАБИЛНОСТ ОБЈЕКТА

### УКУПНО ОПТЕРЕЋЕЊЕ ОБЈЕКТА НА НИВОУ ТЕМЕЉА

Добијено из Tower6 прорачуна за стално+повремено оптерећење

– Стално+повремено оптерећење према резултатима програма Tower6

62.00x12+87.00x2+50.57+8.80+204.78+183.50+94.31+39.46+178.15+175.99+175.34 =

= 2029.10 кН

(сабране све силе нормалне на нивоу темеља)

Укупно оптерећење: Ру= 2029.10 кН

### УКУПНА СЕИЗМИЧКА СИЛА ОБЈЕКТА НА НИВОУ ТЕМЕЉА

Добијено из Tower6 прорачуна за сеизмичко оптерећење

– Сеизмичко оптерећење програма Tower6

врх.....2.92 кН
распињача.....36.58 кН
таван.....32.43 кН
стубић гребена.....16.11 кН
венац суваче.....34.84 кН
круг зупчаника.....38.78 кН
приземље.....35.22 кН
темељ.....13.34 кН

Укупно сеизмичко оптерећење на нивоу темеља: Сс= 209.84 кН

Укупна ширина зидова објекта на нивоу приземља са одбијеним отворима

Б= 0.60м¹ x((0.7x2)x12+0.7x2))м¹+0.50м¹ x(11.55x2+5.50x2)м¹= 27.97м²

(сабране све површине зидова на нивоу темеља)

Просечни нормални напон у зидовима објекта на нивоу темеља

Гу=Рп/Б= 2029.10кН/27.97м²= 72.55 кН/м²= 0.07255 МПа

Просечни напон смицања у зидовима објекта на нивоу темеља

Ту=Сс/Б= 209.84кН/27.97м²= 7.50 кН/м²= 0.0075 МПа

Главни напон затезања

Го=(Гу²/4+(1.5*Ту)²)^(1/2) – Гу/2==(0.07255²/4+(1.5*0.0075)²)^(1/2) – 0.07255/2=
0.03798 МПа –0.036275МПа = 0.0017 МПа < 0.009 МПа

Објекат је по прорачуну стабилан за сеизмичка дејства.

- STRUCTURAL REPAIR AND RECONSTRUCTION MEASURES

On the roof structure: No intervention is required on the elements of the roof structure. All you have to do is replace the worn lath and damaged pepper tile. In the attic structure: No intervention is required on the attic structure, except for the introduction of a wooden pillar along the wall between the mill rooms and the beam support room that goes across the room and carries those atticers above the room. The inner wall is abruptly reduced from 50 cm wide to 12 cm wide at the point where the beam rests. Therefore, a 14/14 cm pillar should be placed under the beam to support a beam that has visibly crossed that narrowed wall. On the underside, find a foundation of a wall that remained as wide as the previous wall and support a wooden pole.



-On rotary propulsion system: No intervention is required on the elements of the propulsion structure except the main pole ,, pope ,, which has a large vertical crack up to 2 cm wide that needs to be repaired - filled with a mixture of epoxy resin (such as Sikadur 31 CF Normal ). The restoration must be a reparable, two-component, non-leakable, epoxy resin adhesive suitable for use on overhead surfaces. not to leak. It is also important that it hardens without shrinkage, that it does not need a primer and that it has good mechanical strength, and that it can have a viscosity to fill such a narrow crack. Fill the crack from the bottom of the crack upwards and when it hardens the epoxy fill,





-On the walls: An object model in Tower6 has been created to facilitate total vertical load and total seismic load at the foundation level as easily as possible. The calculation of the main tensile stress at ground level gives a much lower value than allowed since the walls are massive enough, although the roof is quite high. Since all cracks are up to 10mm, no reinforcement or reinforcement of cracks is required. The rendered mortar should be cleaned and repainted with the same, lime or clay. It is not allowed to clean all cracks at the same time without being successively repaired in order to avoid subsequent damage.







-Foundation: No intervention is required on the underlying structure.Conclusion: The construction of the coffin is in relatively good condition. It is necessary to fill the longitudinal crack in the main pillar ,, popi ,,; remove worn-out mortar on the walls and replace it with new ones; add a new wooden pole.





-The building was rehabilitated according to the project at the end of 2015 and the beginning of 2016 with the contractor PD “Koto” from Belgrade with the supervision of the Institute for the Protection of Monuments.