periodica polytechnica

Architecture
41/1 (2010) 35–41
doi: 10.3311/pp.ar.2010-1.05
web: http://www.pp.bme.hu/ar

RESEARCH ARTICLE

For the centenary of Hungary's first reinforced concrete church in Rárósmulyad

Dániel Vető

Received 2010-09-29

Abstract
This year is the centenary of the first reinforced concrete church of Hungary. The Saint Elisabeth Church in Rárósmulyad was designed by the architect István Medgyaszay and is both a technical and historical monument. The special structure of the dome of the church is made of prefabricated elements. The construction of the building and its static behaviour is also discussed.

Keywords
Dome · shell · reinforced concrete · prefabrication · Medgyaszay · Rárósmulyad

Acknowledgement
I am grateful to the granddaughter of István Medgyaszay, Gabriella Ládonyiné Bartha, for admitting me into the family museum of the architect, and allowing me to search for documents, plans and photos. I am grateful to Ferenc Potzner, for letting me use the scanned images of the plans and some original photos of Medgyaszay. I am also grateful to the residents of Rárósmulyad, who recounted their stories about the building.

Dániel Vető
Department of Mechanics, Materials and Structures, BME, H-1521 Budapest Műegyetem rkp. 1-3., Hungary
e-mail: veto@szt.bme.hu

Introduction

The application of reinforced concrete in the architecture of Hungary began in the years following the turn of the century. The role of the architect István Medgyaszay was of great importance in the use and the spread of this new technology. Reinforced concrete in his buildings was designed with a refined artistic sense, often with fascinating meticulousness. The material appeared even in his earlier buildings, but his first one, completely made of reinforced concrete, is the Saint Elisabeth Church in Rárósmulyad. This is, at the same time, the first reinforced concrete church of Hungary [12]. The opportunity to write this article has arisen as the church was built exactly 100 years ago.

The architect, the location and the commissioners

István Medgyaszay (Budapest, 23-*rd* August, 1877 – 29-*th* April, 1959) was born as István Benkó, he only took the name Medgyaszay, the surname of his maternal grandmother later. His mother was Kornélia Kolbenheyer, the daughter of Mór Kolbenheyer, the illustrious Lutheran pastor of Sopron. His father, Károly Benkó started work as a bricklayer, later becoming a master builder. He established the first cement factory in Hungary in Nyergesújfalu [13]. After his death in 1893, István Medgyaszay had to take on the role of breadwinner. He worked as apprentice mason, in architectural offices and studied at the Budapest State Industrial School, the State Grammar School, the Academy of Fine Arts in Vienna, the architectural master class of Otto Wagner, the Technical College of Vienna, then as student of architecture at the Technical University of Budapest. He entered design competitions repeatedly, studied the folk art of Hungary on field trips, and travelled to Egypt and India. He regularly gave lectures at the Technical University of Budapest, summarising his architectural thoughts in his studies. After the communist takeover he was slighted, in his workplace he was only commissioned with the design of buildings of minor importance. Three weeks after his retirement he died at the age of 82 [13].

Rárósmulyad belonged to the county of Nógrád of historical Hungary, today it is in the region of Slovakia under the name of

Mul'a. It is situated on the right hand side of the river Ipoly, 20 kilometres from Balassagyarmat. The church was planned by Medgyaszay as a private commission. According to the request of the clients, the church had the dual purpose of parish church and family burial vault [6]. The building originally stood alone at the edge of the village of 400 inhabitants. Today, the number of population is under 300 [17], and a house has been built close to the church.

Fig. 1. The Saint Elisabeth Church in Rárósmulyad

The building (Fig. 1) was built from a bequest of 100,000 crowns from the will of the testator, the late Rudolf Körfy, the former landlord of the region. The commissioners – the executors of Körfy: János and József Rittinger by name – charged the architect to start the construction works in January, 1910 [6]. Among others, the contract contained the proviso that the construction works should be started in the spring of 1910, and finished on 15^{th} September, 1910. Medgyaszay had to guarantee the building for a period of one year. He personally led the construction works, and it is respectable standard even today that he could meet the deadline of half a year. The local inhabitants of the village speak about an 18-month construction, probably with the planning included. The date of the consecration of the church was 20^{th} November, 1910 [7] [15], although the inhabitants claim that it was 19^{th} November. The patron saint of the church is Saint Elisabeth of Hungary, whose feast day is 19^{th} November.

The building: its construction 100 years ago and its state today

The main hall of the church is octagonal (Fig. 2), and is indicated as being 15 m x 15 m on the ground-plan, and roofed with a dome. Between that and the tower with a tall spire there is a connecting part with additional rooms. The testator and his family lie under the sanctuary in their burial vault (Fig. 3). Looking at the church, one immediately notices the statues referred to as the "Angels of Death" standing on the upper corners of the octagonal hall [6]. Prefabricated from artificial stone, during the construction works, one of the eight angels fell down killing one (or two?) person(s) – according to the recollections of the local inhabitants. It can also be observed that the heads of the statues are masculine in appearance, but their bodies have female characteristics. The plinth of the building is relatively high, its upper boundary is at about 2-2.5 metres. This endows the building with a feeling of strength. The walls of the church at the edges are made blunt with planes leaning inwards. It is noticeable in other buildings of Medgyaszay, which is in connection with the architect's idea about the behaviour of the building material. In ancient Greek architecture, the slight leaning of the side columns of a building had also been in general use, to produce a harmonic architectural effect. On the top of the church tower, there is a tall spire with a balcony built with meticulous care beneath it. The windows of the church are designed with very fine divisions.

The artistic prefiguration of the building was the well-known church of Körösfő [11]. The church of Rárósmulyad is strange and attractive at the same time, dreamlike and fabulous [6]. It unites the European Gothic art, the fascinating architecture of the Orient, the serenity of the Italian early Renaissance and the noble charm of Transylvanian church architecture, the branch of Hungarian folk architecture that had risen to classicality. The atmosphere of the interior (Fig. 4) can only be compared to the chapels of Italian early Renaissance. The soft forms without sharp edges only suggest the boundaries of the hall; the walls do not appear to be made of an impermeable medium [6]. The inner painting also contributes to the overall view. The complete external and internal painting in 1968 is recognisable immediately, the local inhabitants of the village indicated that there was also further external painting later, and the church got its present-day light blue colour around 1993. Hopefully this colour will be changed in the renovation works of this year, and the church can regain its original colour.

The building – excluding the pulpit, organ, doors and the seating – is completely made of reinforced concrete [12]. In this respect, this is the first one in the territory of Hungary at that time. It is interesting how the new material was received in the age. There was a letter from the priest to the office of the bishop. The priest, Miklós Lepsényi asked among other things, whether concrete is allowed for a church [16].

It would be invaluable to know how the church was built, un-

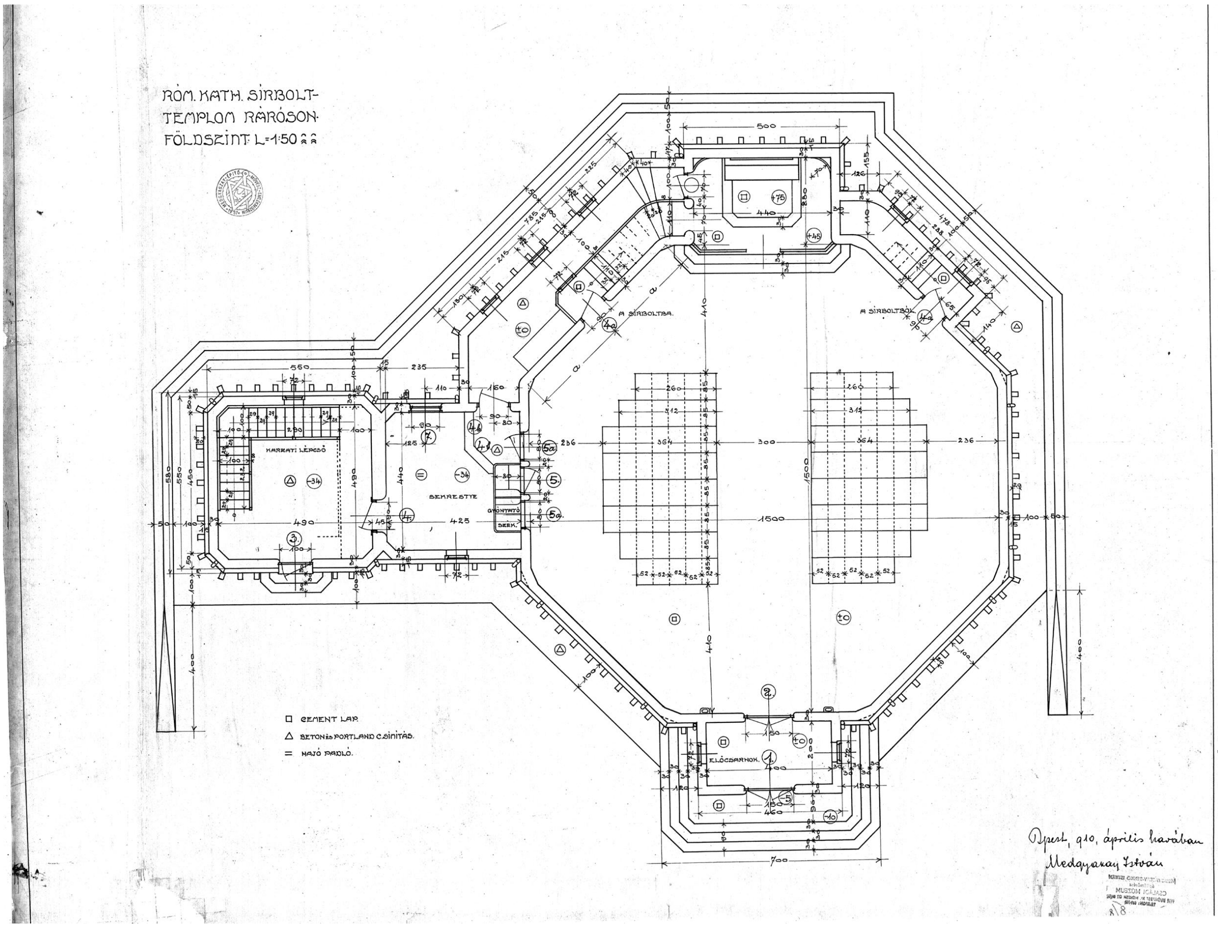

Fig. 2. The ground plan of the church (by kind permission of Potzner, F.)

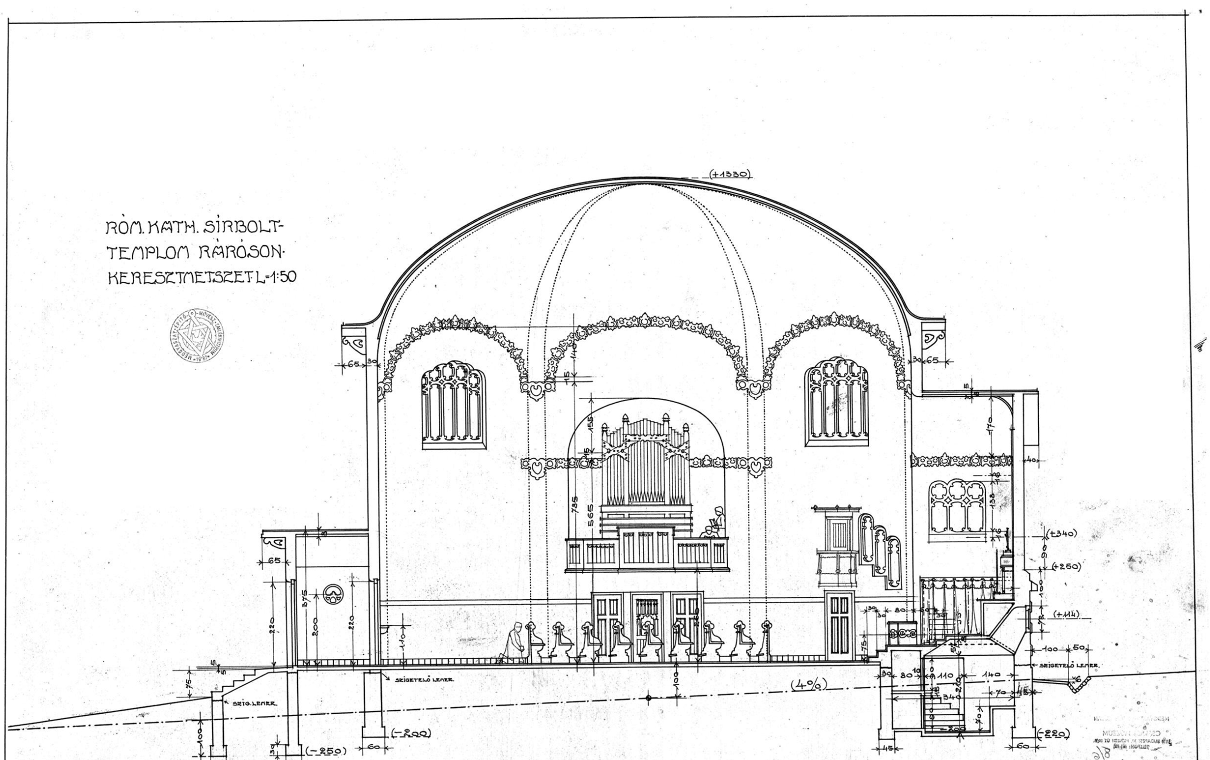

Fig. 3. The section of the church (by kind permission of Potzner, F.)

Fig. 4. The interior of the church (by kind permission of Potzner, F., photo: Medgyaszay, I.)

fortunately, we have very little information about it. It is known that the reinforced concrete works were made by the company of A. Pittel, Budapest [13]. Local memory suggests that the church was built by Italian workers. When viewing the church, it can be seen that the walls were not made of prefabricated elements, they were actually cast in place with the help of formwork on both sides. At the corners there are no separated pillars, the whole walling acts as one single surface structure. The walling is also plastered inside and out.

The dome above the octagonal hall is a different structure. According to some sources [6] it can only be supposed, others [10] [17] disclose as fact that the roof was assembled of prefabricated elements. From examining it on site, it is probable that the structure is really prefabricated. The eight sections of the octagonal dome shell may well have been made separately. Local knowledge suggests that these elements had been prefabricated on the building site itself. The elements were concreted together after they had been placed in their final positions. According to Moravánszky [10], the segments were pressed together with a visible steel band. How the elements could have been lifted into place is an important question, as the weight of one section of the dome could exceed 7 tons. It is reasonable to assume that the sections were gradually pushed (thus not lifted) upwards into their positions, with the help of scaffolding. In their final positions, there were probably gaps between the elements which were concreted afterwards. To the outer circular edge a tension ring was needed, made possibly of either steel or reinforced concrete. Because of its shape, vertical loads were necessary; it is one possible reason for the existence of the angel statues (2 tons each). Originally, there was no metal sheet cover on the roof. The water insulation on the outer surface of the dome could have been – although it is not included in the plans – ”Siderosthen”, an insulation technology preferred at that time. It was a technology using tar and sulphur, and was also used on the rim of the spire.

Interesting questions arise about the construction of the tower and especially of the spire. Beneath the spire, the traces of the flow of concrete could be studied. It can be seen that the four edge pillars of the spire and their horizontal connecting beams were constructed first, as a frame, and the sides of the spire were made afterwards. These sides are in a relatively steep plane, therefore they were probably made with formwork on both sides. The outer surface received a cement coating to cover up any unevenness. If a cement coating is applied to a relatively new (few days old) concrete surface, right after the formwork is removed, it will strongly bond to the initial concrete.

Under the spire, there is a spherical concrete shell to reflect the sounds of the church bells. As pigeons can fly into the spire of the tower, a considerable amount of excrement could be found on the top of the spherical surface. The additional weight negatively affects the sound of the bells. It has been re-concreted in the past; probably the concrete material had deteriorated.

After visiting the site, it can be stated that there is no damage to the building that could cause a threat to its load-bearing capacity. Only at one single place can a relatively large crack be seen, but this is thought to be a result of the corrosion of the steel reinforcement. There are many small cracks, lack of plaster, and other minor damage which show that the church needs thorough and proper renovation work. The fence (designed by Medgyaszay and built shortly after the church) also suffers from various types of damage. If all this could be repaired the church would be a worthy example of the architecture of Hungary at the turn of the century.

Static behaviour

The dome above the octagonal hall is being analysed statically. The geometry of the dome has been taken from the plans of the architect, thus – in the lack of a survey – it is supposed that the shell has been built as it was planned. It can be seen that the dome is close to a rotationally symmetric shape, nevertheless, first the rotationally symmetric shells are considered.

In membrane shells the internal forces in each point are acting solely in the tangent plane of that point. Let us suppose a rotationally symmetric, elliptic (centres of curvature downwards) membrane shell with vertical symmetry axis. Also let us suppose a uniform vertical distributed load (pointing downwards) on the whole surface which is supported with membrane supports. If one chooses a point on the shell, two directions can be distinguished in its tangent plane that are perpendicular to each other. The one that can be achieved by an intersection between the tangent plane and a plane perpendicular to the symmetry axis is called the circumferential direction; that which is created by an intersection between the tangent plane and a plane containing the symmetry axis is called the meridional direction. It can be stated that in this described case there is no shear force in the tangent plane, so the only internal forces are circumferential and meridional normal forces [5].

If a rotationally symmetric shell is cut by a plane which contains the symmetry axis, a section line called a meridional curve is created. If this curve is the catenary, then there will be no internal forces in the circumferential direction in the whole shell. Naturally the forces in the meridional direction do not disappear; there will be a compression force in this direction. The shape of the catenary is quite special: even in the planar case, a vault with the shape of the catenary has no bending moment and shear, only normal forces. Returning to the spatial case, the internal forces of our membrane shell of revolution depend highly on the shape of the meridional curve. If the meridional curve of the shell is above the catenary, then there will be tension forces in the circumferential direction. If the meridional curve is under the catenary, we will see compression forces in the circumferential direction. This latter case is usual for dome shells made of prefabricated segments, as there is no need to make connections that resist tension [9].

In the following, the section curve taken from the plans of the architect is being considered and it is compared with other curves (Fig. 5). It is noticeable that all the curves have the same starting and endpoints, and the starting tangent at the top is also the same. If these curves were meridional curves of a shell of revolution, one could estimate the internal forces in the dome – at least their signs. It can be seen that the curve of the plans of the architect is above the catenary, so tension forces should appear in the circumferential direction. Thus, if a rotationally symmetric shell is made of prefabricated elements with this meridional curve, it has to be made with connections that resist tension.

The dome of the church is not rotationally symmetric, but it is close to one. To analyse the static behaviour of the dome, the finite element method is used by means of Axis 10. In the model, the thickness of the shell is 8 cm, the modulus of elasticity of the concrete is 710 kN/cm^2, the Poisson-ratio is 0.16 and the density is 2400 kg/m^3. In the calculations only the dead load is considered, so the shell is loaded with a uniformly distributed load over its surface. The results show that in the circumferential direction there is compression in the upper part, and tension in the lower part of the shell (Fig. 6). Naturally there is compression in the meridional direction (Fig. 7). The static behaviour of this shell is similar to a rotationally symmetric one, but probably the safety against buckling is higher in our case, because of the stiffening effect of the ribs.

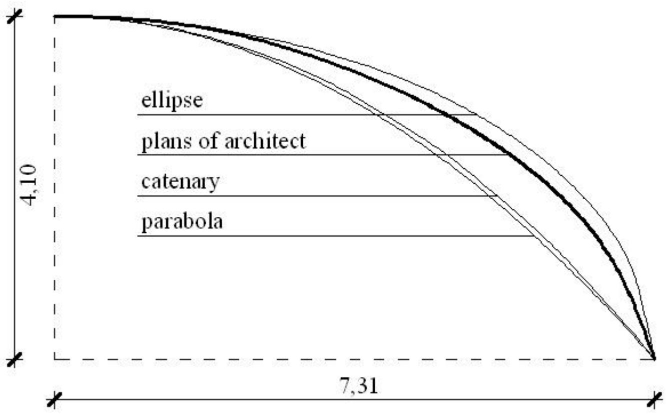

Fig. 5. Section curves of shells

It would be interesting to see the original static calculations and plans which were presumably made by the building company of A. Pittel, Budapest. Today, there is a large building company, with the head office in Vienna, which could be connected to the one that built the church in Rárósmulyad, but the attempt to find any information was unsuccessful. However, complementary works of the reconstruction of the theatre of Sopron (planned by Medgyaszay) were also made by this company in the same year [2, 3].

In other works of Medgyaszay there were civil engineers engaged in planning. At the reconstruction of the Opera in 1913, the engineer was Károly Uy [4], in other cases Szilárd Zielinski, who introduced the technology of reinforced concrete in Hungary [8]. There is also some chance that Medgyaszay adopted the plans of an existing shell system, which was known in that time.

Reinforced concrete churches in Hungary

The first reinforced concrete church was followed by many others. The list is mainly based on [1] [17]:

1910, Rárósmulyad, Saint Elisabeth Church, R. Cath., architect: István Medgyaszay

1913, Kerekegyháza, Saint Stephen Church, R. Cath., architect: Dénes Györgyi

1932, Balatonboglár, Exaltation of the Holy Cross Church, R. Cath., architect: Iván Kotsis

1933, Városmajor, Budapest, Sacred Heart of Jesus Church, R. Cath., architects: Aladár and Bertalan Árkay

1933, Pasarét, Budapest, Anthony of Padua Church, R. Cath., architect: Gyula Rimanóczy, the structure is reinforced concrete frame

1943-45, Balatonlelle, Holy Trinity Church, R. Cath., architect: Bertalan Árkay

1948, Rózsadomb, Budapest, John of Capistrano Chapel, R. Cath., architect: Antal Say-Halász

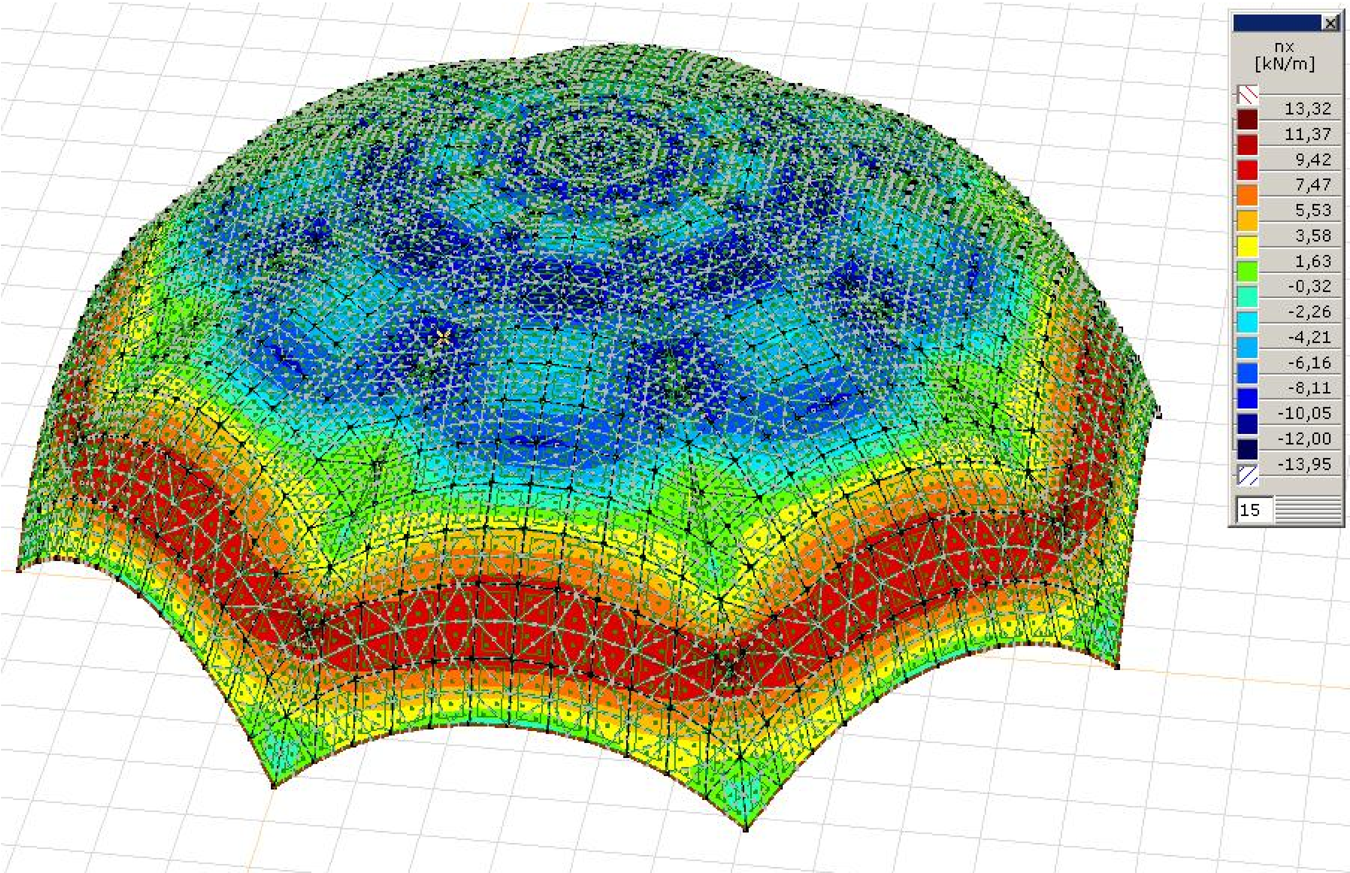

Fig. 6. Internal forces of the dome shell in a circumferential direction

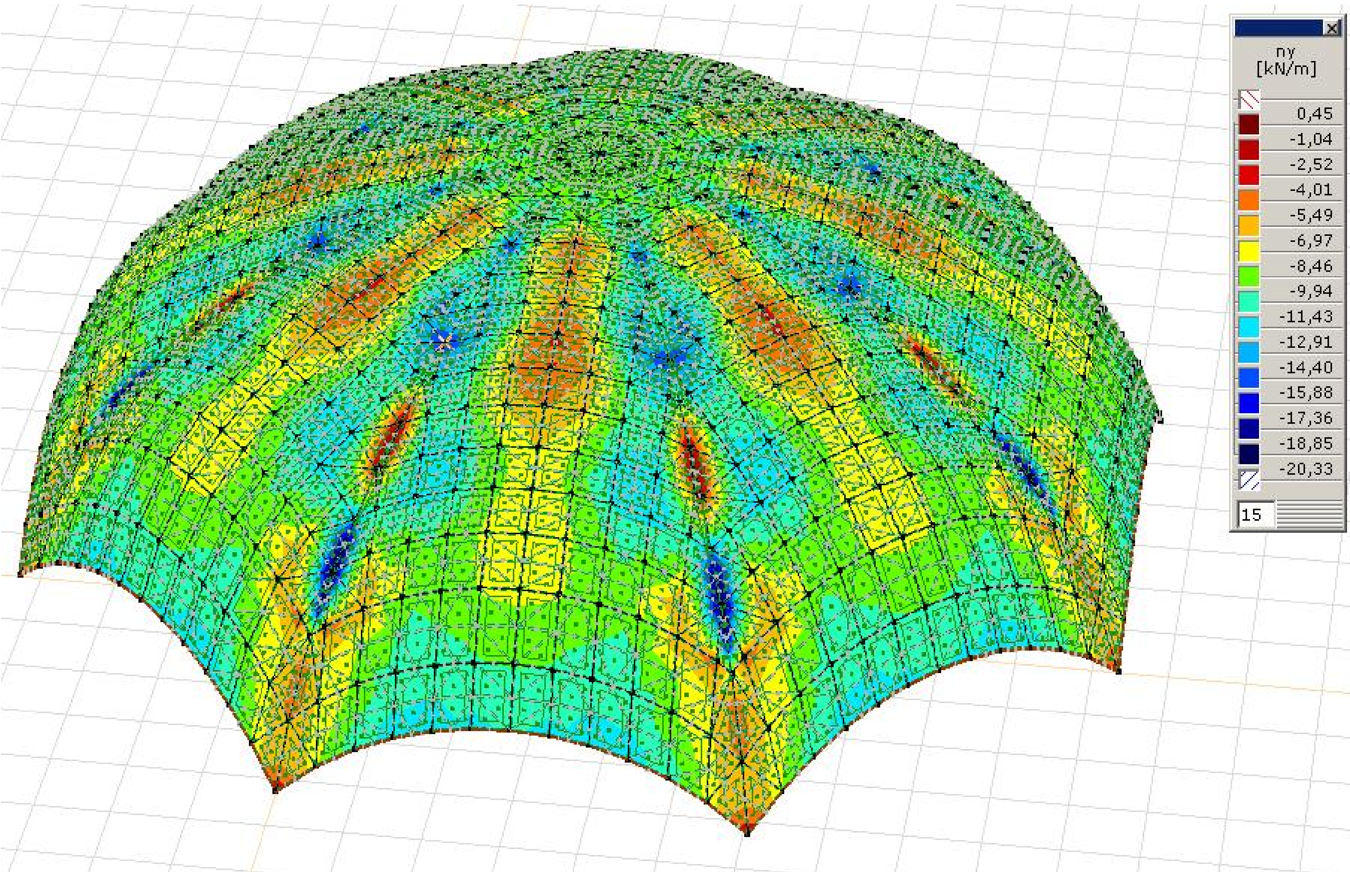

Fig. 7. Internal forces of the dome shell in a meridional direction

1958, Taksony, Saint Anne Church, R. Cath., architect: Bertalan Árkay, the church has been roofed with a reinforced concrete dome designed by Pál Csonka

1967, Hollóháza, Saint Ladislaus Church, R. Cath., architect: László Csaba

1973, Farkasrét, Budapest, All Saints' Church, R. Cath., architect: István Szabó, the walls of the church are made of unplastered hollow concrete blocks

1976, Nemeshetés, Holy Spirit Church, R. Cath., architect: Ferenc Török, built mainly by the residents of the village

1977, Hodász, Conversion of Saint Paul Church, R. Cath., architect: László Csaba, the structure is reinforced concrete frame, the walls are made of brick

1983, Gyál, Saint Stephen Church, R. Cath., architect: Dénes Perczel, the structure is made of steel and reinforced concrete, the walls are made of brick

1983, Borbánya, Nyíregyháza, Saint Ladislaus Church, R. Cath., architect: Ferenc Bán, the structure is made of reinforced concrete, the walls are made of brick

1985-91, 149 Béla Bartók Street, Budapest, Saint Gerard Church, R. Cath., architect: András Kiss, structural engineer: József Keszthelyi, constructor: Mélyépítő Company, the structure of the church is made of prefabricated reinforced concrete

The list is not complete. There are also churches covered with reinforced concrete domes that are important to mention. The dome of the chapel of the old people's home in Székesfehérvár is made of reinforced concrete, the architects are Jenő Bory and László Kreybig, the structural plans were made by Kálmán Balogh [14]. The Calvinist church of districts VI.-VII., Budapest and the Roman Catholic Church of Muraszombat have also domes made of reinforced concrete. The Blue Church in Pozsony has parts made of reinforced concrete.

Summary

Neither Medgyaszay, nor other architects have planned churches like the one built in Rárósmulyad since its construction. It is a unique technical and historical monument. Therefore it would be necessary to become acquainted with this church and to appreciate it better. Restoring the building to its original state is also an important objective – so restored, it could really become a proud reminder of Hungarian reinforced concrete architecture.

References

1 **Balázs Gy**, *Beton és vasbeton, III. kötet, Magasépítési beton- és vasbeton szerkezetek története*, Akadémiai Kiadó, Budapest, 1996.

2 **Berecz D**, *A soproni színészet sorsa az első világháború előtti évtizedben*, Soproni Szemle **32/3** (1978), 61-71.

3 **Boronkai P**, *A soproni Petőfi Sándor Színház építésének története*, Soproni Szemle **20/2** (1966), 86-92.

4 **Déry A**, *Történeti szerkezettan*, Terc Kiadó, Budapest, 2002.

5 **Hegedűs I**, *Héjszerkezetek*, Műegyetemi Kiadó, Budapest, 1998.

6 **Kathy I**, *Medgyaszay István*, Akadémiai Kiadó, Budapest, 1979.

7 **Lepsényi M**, *A magyar stílusú templom*, Élet (25^{th} December, 1910).

8 **Mihailich Gy, Haviár Gy**, *A vasbetonépítés kezdete és első létesítményei Magyarországon*, Akadémiai Kiadó, Budapest, 1966.

9 **Mokk L**, *Helyszíni előregyártás*, Műszaki Könyvkiadó, Budapest, 1961.

10 **Moravánszky Á**, *Versengő látomások – Esztétikai újítás és társadalmi program az Osztrák Magyar Monarchia építészetében 1867-1918*, Vince Kiadó, Budapest, 1998.

11 **Nagy G**, *Magyar építészek*, Kossuth Kiadó, Budapest, 2004.

12 **Názer Á**, *Az első vasbeton templom Magyarországon – Rárósmulyad*, Várak, kastélyok, templomok **4/5** (2008), 32-33.

13 **Potzner F**, *Medgyaszay István*, Holnap Kiadó, Budapest, 2004.

14 **Uy K**, *A vasbéton újabb alkalmazásai a templomépítésben, II. rész*, Építő Ipar **35/8** (1911), 71-73.

15 *Ecclesiastical visitation of Rárósmulyad, 1911*, Esztergom. Primatical Archives.

16 *Letter of Lepsényi, M. to the office of the Bishop, 17^{th} October, 1910*, Esztergom. Primatical Archives.

17 available at `www.wikipedia.org`.