Riddle of the Dome - Transcript

The Renaissance Secrets Team (The Open University) (2005)

MASSIMO RICCI:
It's terrific! It's a terrific mystery that I've managed to unravel! I really believe it was my love for Brunelleschi, my love for my city, Florence, and for this monument.

NARRATOR:
Florence, Italy.
Crowds of tourists besiege the doors of its cathedral.
Millions of people come from all over the world to stand beneath a Renaissance dome and marvel.

STELLA GAMBLING:
It was very important for each city to show its strength its power its wealth. And they were very keen to have something which everybody else would look at with awe, and wonder how on earth it was ever constructed.

CECIL BALMOND:
These are still dimensions that are big and serious for any engineering enterprise. I mean any engineer today would still have to seriously think, how would he go up fifty metres in the air ...that's a feat anyway.

NARRATOR:
The dome of the Cathedral was built nearly 600 years ago. It was one of the first great works of the Renaissance. It's an engineering masterpiece - bigger than any dome built before, and completely new in its design. It's one of the most studied buildings on the planet, but still no one knows quite how it was built.

CAROLINE ELAM:
An enormous building like this is quite difficult to analyse. You can't dissect it as though it were a corpse because a lot of its structure is actually buried inside. Nobody's going to demolish the dome in order to discover how it was constructed and so there are some things we'll probably never know.

NARRATOR:
Its builder, Fillipo Brunelleschi was a shadowy figure, so secretive that no one has been able to discover the inventions that made his dome possible, until now. A local architect believes he's cracked one of the great secrets of the Renaissance.

MASSIMO RICCI:
I truly love this monument. From being a child I have always loved it because, for a real Florentine, it is the symbol of our city! Coming to know the mystery in which it is shrouded, which resisted the investigations of Leonardo, Michelangelo, Ximelis, I have allowed myself to be seduced. I've now been studying it for twenty-seven years!

NARRATOR:
Massimo has worked for decades on a solitary obsession. Now he thinks he's found the answer. And he's ready to prove it. In a Florence park, half a mile from the real thing, Massimo is building his own dome. It's an exact scale model of Brunelleschi's original - an experiment in Renaissance engineering. Massimo believes that this will finally reveal the inventions of the greatest architect of the Renaissance.

MASSIMO RICCI:
Brunelleschi can be described in a few words - he is one of the greatest geniuses that humanity has ever had. He is one of the greatest geniuses of all time. He can't simply be defined as an architect, or an engineer, or even an artist because in all fields he has touched the principal

apexes of art and technology. Defining Brunelleschi and the Renaissance seems very easy for me because the truth is that Brunelleschi is the Renaissance.

NARRATOR:
When work on the dome began in 1420 Brunelleschi was virtually unknown. Sixteen years later the dome was built, and its architect was a superstar.

SIMON PEPPER:
Brunelleschi's career as an architect was in a very real sense launched by his high profile involvement in this project and consolidated by its success.

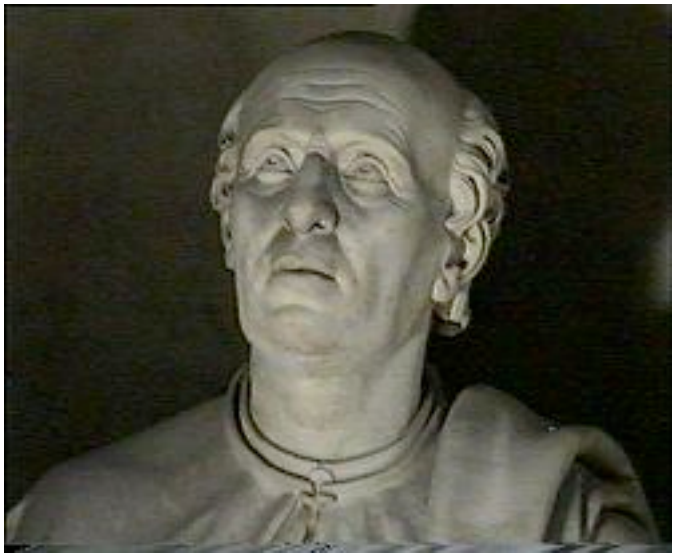
CAROLINE ELAM:
And this was a project which took up really the major part of his career as an architect and it undoubtedly made him the most famous and celebrated architect in Italy.

NARRATOR:
To think like Brunelleschi, Massimo had to forget the twentieth century and become an engineer of the Renaissance. Brunelleschi had never revealed his methods. Massimo had to reinvent them from scratch. Apart from Brunelleschi's buildings the past has left few clues to follow.

MASSIMO RICCI:
I have indirectly walked the road trodden by the great maestro who unlike many illustrious men of the time was a very reserved person, he himself has left us nothing, not even a signature.

NARRATOR:
In a Florence church, a side chapel is covered with Renaissance frescoes. The scenes tell the story of St. Peter. Among groups of identifiable, fifteenth century celebrities we have the only contemporary portrait of Brunelleschi.
Who was he? Why was he so secretive? And how did he come to build the dome?

SIMON PEPPER:
His family background were well to do well placed Florentine family. But although very bright, he wasn't particularly interested in book learning and went instead to learn the craft of goldsmithing. He came relatively late to architecture. He was 40 when he began his major involvement in the dome.



NARRATOR:
The story of the dome began nearly a century before Brunelleschi was born. In 1296 the medieval city of Florence began to build a new cathedral. It was intended to become the grandest gothic building in Europe. Florence was becoming a power to be reckoned with and it wanted all the world to know it.

SIMON PEPPER:
The city had come from one of many important town to be one of the biggest and most prosperous towns in Italy. There was a lot of money around.

NARRATOR:
The wealthy Florentine guilds spent huge amounts of money on buildings and works of art.

Soon Florence would no longer be Medieval. It would be pioneering a new age - the Renaissance.
This would be the city of Leonardo and Donatello, Michelangelo and Boticelli. Painting, sculpture, architecture, and literature were all being reinvented. Florence was at the heart of a revolution that was felt right across Europe.
The Renaissance wasn't only a movement in art. It changed everything. From religion and politics, to technology and engineering.

NARRATOR:
Massimo was exploring the Renaissance engineering in one way - but what about the original dome? What could the cathedral reveal about the building methods of the past?
Timothy Verdon, once a professional art historian, is now a priest. He's Canon of Florence Cathedral and has studied the ways in which Christianity expressed itself in a piece of monumental engineering.

TIMOTHY VERDON:
The vast vaulted bays of the nave of the Florence cathedral, expressed not only their love of gothic forms, but above all their capacity to manipulate the technology of gothic construction, to create in this case eighteen metre square vaulted spaces, larger than those in any other European gothic.

TIMOTHY VERDON:
As they reached the end of the nave however, their dream grew larger. What they imagined was a space that could compete with the greatest spaces the history of world architecture knew. They dreamed of a domed space that would be like the dome of heaven itself, a vast

space beneath which, the human being could feel at one and the same time, the smallness of his proportional relationship to god the creator, and the greatness of his own capacity to recreate in human terms, a heaven like god's own heaven.

SIMON PEPPER:
What strikes one is the huge confidence that the entire project represents. They began it probably without knowing how they were going to finish it. They knew what they wanted to achieve but not how they were going to achieve it.

NARRATOR:
The shape and size of the planned dome was known. It was even imagined in a painting. But no one seems to have given a thought to how this fantasy was going to be built. After a hundred years of construction, Florentine confidence turned to horror and then resignation. The grandest cathedral in all of Europe was impossible to finish.

STELLA GAMBLING:
The problem was that they had set themselves a task which at the time that the Duomo was originally built, erm they had no way of solving, and for a long time it it was just a hole, there was no dome there at all.

NARRATOR:
Timothy Verdon knows every nook and cranny of the cathedral, from the narrow stairwell which runs between the walls of the dome, to secret passages which lead to the very heart of the building - to places that the tourists never see.
Hidden above the nave, a timber roof spans the towering arches of the gothic church. Here the dust lies just as it fell centuries ago, when the medieval masons constructed the vaults. But the

dome would be twice as tall as the nave, enclosing a space that seemed impossible to span. Brunelleschi knew that the tried and tested methods of the middle ages had to change. But how?

TIMOTHY VERDON:
Brunelleschi was virtually obsessed with the dome, and really believed that only he could build it.
At one point he says (IN ITALIAN) I see it already covered with its dome. When they asked him how he would build it, he refused to tell them. At one point the famous story is told, that he invited everyone to bring an egg, and he said anyone who could make the egg stand up straight on the marble table, will understand my system.
They all tried it fell over. Brunelleschi finally took the egg, 'broke the arse of the egg on the edge of the table' (IN ITALIAN) The egg stood up straight, but the others said we could have done that too. and Brunelleschi said yes, and if I tell you my system, you'll be able to build the dome.

STELLA GAMBLING:
People don't believe him; they poke fun of him. They ask him to explain and when he does they don't understand the explanation, they demand models. But Brunelleschi wants to keep control of the whole situation. And so when he does present models they very often have bits missing, or he leaves bits out so that he keeps the secret of exactly how the thing is going to be constructed, and nobody else can copy him.

NARRATOR:
But that didn't stop people from trying.

A century after Brunelleschi, Michelangelo studied Florence Cathedral as he planned St. Peter's in Rome.
A century later still and Christopher Wren studied engravings of Brunelleschi's dome when he was building St. Paul's in London.
Architects and engineers are still inspired by Brunelleschi.

Daniel Libeskind is one of today's most radical architects and Cecil Balmond, one of the world's top engineers. They're planning a new extension to the Victoria and Albert museum in London. It's called "The Spiral". If they can build its apparently impossible walls, it will be one of the most extraordinary buildings in the world.

CECIL BALMOND:
I think the Spiral project is a whole new leap forward in taking what is traditional materials, but in a wholly new way - very much like Brunelleschi's dome did.

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DANIEL LIBESKIND
You have to enter a realm when you become naïve - where you don't know how to do something.
That's exactly what Brunelleschi did. He didn't enter a transparent space in which constructions of that sort were already made. He entered as I do. I think all creative architects, artists, enter a space of forgetting, of er, unlearning.

CHAT - BALMOND & LIBESKIND:
And then it rises all through here, this entire space here is actually traversed by the building without any support. Now that will give some sleepless nights. If you think that it's actually - the point is just over this... this ridge, into the void...into the void, up from here, spiralling off into the void.

DANIEL LIBESKIND:
When I came to see the dome I had studied it in books, I had looked at pictures of the dome. I had looked at drawings of the dome, and I was interested in how it was made as a young architect - a student of architecture. But nothing was there to prepare me for the actual presence of the dome.
It is the shock of the new in some senses. It is the shock of something that has never existed and that no drawing and no device could actually prepare us for its existence. I think that's the shock which it had then and it still has for us today.

SIMON PEPPER:
I think one has to take a leap back into time and put yourself in the position of people who didn't really know what the end of the story was going to be. This was a very similar experience to a lot of medieval builders when they were pushing the limits of gothic construction.

NARRATOR:
The massive vaults of Florence Cathedral had pushed the tried and tested methods of the middle ages to the limit. Each vault had been built using wooden templates called centring elements which supported the stone work during construction and also guided the overall shape of the arches. But the vast dome needed a creative step - a leap of the imagination that the fifteenth century masons found impossible to take.

TIMOTHY VERDON:
Their notion that they could do the same thing for the dome, derived from the belief that they could in fact construct the same kind of wooden centring, shoring it up from below, scaffolding from sixty metres below, scaffolding forty three metres wide, a forest of scaffolding supporting a mountain of centring elements, on which then hundreds and thousands of tons of brick and

stone masonry would have to be laid. When they actually faced the real problems they would have to solve, they understood instinctively that the same system would not work.

NARRATOR:
But Brunelleschi was convinced he could do it - that somehow the massive, curving walls could be made to rise without any support.

TIMOTHY VERDON:
Brunelleschi had a kind of remarkable confidence. He says at one point for the er commissioners of the cathedral, that even as he begins the work he knows he doesn't know everything he'll need to know to build it, he has certain ideas but he'll have to work the others out as he goes. He is confident, though - he says that since the church is dedicated to God and His Holy Mother, they will help him.

NARRATOR:
Brunelleschi began to build, not knowing whether his ideas would work or not. It was the gamble of his life - and he knew it. Brunelleschi had to be single-minded. To have any chance of success he needed to invent new tools, new measurement systems, and radical working practices. Here was a man at odds with his workforce, telling experienced bricklayers how to mix their mortar, showing master masons how to cut their stone.
Still unwilling or unable to explain his plans, Brunelleschi remained passionately focussed. He knew that he had to do one thing - keep his newly built walls from falling down.

TIMOTHY VERDON:
We know that at a certain point, when the walls of his dome began to curve inward, when therefore the workmen's confidence that the normal structural stability was undermined by the curve toward the centre, they refused to go out on the scaffolding, they felt it was certain to fall. Brunelleschi himself had to go out on the scaffolding, pull great weights behind him, walk up and down, jump to show them, that the walls would in fact stay in place.

NARRATOR:
So just what did Brunelleschi do? In the stairwell of the dome one piece of evidence remains visible. The bricks are laid in an unusual pattern.

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CECIL BALMOND:
If you normally put brick upon brick, and if you just go up vertically, you er we all know that works, but if you start going on the slope that's that's very difficult and Brunelleschi came up with the brilliant idea of a herringbone pattern, that it it's, it's common sense in a way, but it's the intuition of an engineer at work definitely.

NARRATOR:
Many investigations had used the herringbone brickwork to explain Brunelleschi's achievement. But for Massimo it wasn't enough. How had the bricks been laid in such a complex pattern? And how had the shape of the dome been preserved without any scaffold to guide it?
The maverick architect had struggled for years to arrive at a solution.

MASSIMO RICCI:
Actually studying a problem, such a difficult and complex question, will bring a person to the point where he is confronted by night after night of studies which seem to pass in a few minutes.
Brunelleschi too, faced with the same problem, would certainly have done the same thing.

NARRATOR:
Did Massimo's obsession really bring him any closer to Brunelleschi? Faced with academic sceptics Massimo pressed on with his experiments. How had his hero actually built the dome?

SIMON PEPPER:
The fact that Brunelleschi was able to do this without using centring was what seems to have struck his contemporaries as the greatest part of the achievement.

NARRATOR:
Like the original, Massimo's dome has a light scaffold around its edge for the builders work from - but there's no forest of supporting timber propping up the walls from the ground, and no template to give it its shape.

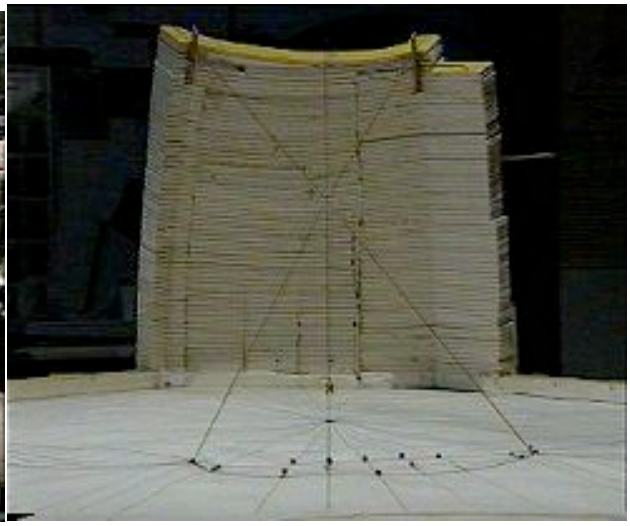
Brunelleschi was a genius. He knew enough geometry to describe the shape of the dome, but how could he build it? He needed a trick simple enough to be used by ordinary bricklayers working at perilous heights. The minute positioning of every single brick was vital.

The first important system invented by Brunelleschi was for the substitution of the large centrings, total centrings, with small ones, like these.

Obviously there had to be a trick to do this.

Well, the trick is this simple plumb-line that I have here, and these two ropes which in fact are for making this centering vertical which in turn is held in place with these hooks that you can see.

These hooks were also found in the real dome.



NARRATOR:
By making sure that the small wooden centrings were correctly aligned, the profile of the dome could be traced in stages. Some experts had suggested similar devices before, but Massimo knew he was still only just beginning to understand Brunelleschi's system. The wooden centring didn't explain how the complicated pattern of bricks could fill the spaces between the corners of the dome.
And the angle of these bricks was critical. Too flat, and the geometry wouldn't work - too steep and the bricks would fall before the mortar had set. There had to be something more. At last Massimo discovered Brunelleschi's secret. The most important invention of the dome.

MASSIMO RICCI:
After about fifteen years, I managed to build the flower and from that moment on it was all a… well, a continuous discovery.

NARRATOR:
A flower! Massimo believes that Brunelleschi drew a pattern of petals where the dome was to spring from the tops of the cathedral walls base of the dome. This precise mathematical form then became a key to position every single brick in the construction.
Its brilliant in its simplicity.

MASSIMO RICCI:
It has taken twenty years of my life to discover this simple metal flower which solves the dome's construction problems. This is the real secret of the dome of Santa Maria del Fiore.
This simple metal flower, which allows such perfect orientation, as you can see, of all these difficult bricks we have here.
This simple wire enables the bricklayers to place them so perfectly.
There would have been no other way of doing it.

NARRATOR:
Once the flower pattern is fixed all you need are ropes leading from the pattern at one end, to the top of the wall on the opposite side.
A line is adjusted along the flower until it passes through the centre point of the dome.
This allows a bricklayer, holding the other end of the rope, to line up each brick at a slightly different angle preserving the dome's overall shape.
The curve of the walls demonstrates that the flower pattern works. But how could historians be sure that Brunelleschi used the same technique? The search was on for a piece of historical evidence.
Was there anything that linked Massimo's flower theory to Brunelleschi's dome?
A document in the Florence archives, for centuries thought to be a casual sketch of the dome, was brought to the centre of a historical debate.

CAROLINE ELAM:
There are very few bits of visual evidence about the cupola. We know that many many drawings were produced but we only have one drawing surviving and that's 's beautiful coloured drawing on parchment by Giovanni di Gerrado da Prato. And what it seems to be is a criticism of what Brunelleschi had done.

MASSIMO RICCI:
Giovanni di Gerardo accused him of constructing a flawed dome and he was the person who came closer than anyone else to uncovering the method of its construction. In fact, he drew it in its entirety despite the fact that this manuscript had been known for two centuries, people did not understand the meaning either of the drawings or of the text.
Once again I was the first to decipher both the drawings and the textual content because, practically speaking, I had previously found the right path.

NARRATOR:
Massimo thinks that this finally proves his theory. The trouble is that the Gerrado document is such a rough sketch it can be made to fit almost any idea. So historians remain sceptical and the mystery of the dome is set to continue.

SIMON PEPPER:
We've got a happy hunting ground for all kinds of theories, among them the kind of theory that can rise out of attempting to replicate what they were doing by building large scale models of the project itself.

CAROLINE ELAM:
I think a huge amount of progress has been made in understanding it in the last 25 years and it's still going on.
And Massimo Ricci's recent work is enormously interesting, but probably there'll always be question marks. This is something people are going to go on discussing and worrying about for a very long time.

NARRATOR:
Like the original, Massimo's model will become another Florence tourist site. But it's flimsy evidence for historians. Many people think his ideas are crazy. But Massimo remains convinced that he has truly revealed Brunelleschi's greatest secret.

MASSIMO RICCI:
It's terrific! It's a terrific mystery that I've managed to unravel!
I really believe it was my love for Brunelleschi, my love for my city, Florence, and for this monument which is really, truly universal. It's of universal value.
The greatest expression of rationality in architecture that man has ever produced.

NARRATOR:
But the dome means even more than this to the people of Florence. However Brunelleschi did it, the dome rises above rational engineering. It represents Renaissance invention, but also a Renaissance passion - the ambition of man, confident in the faith of God.

TIMOTHY VERDON:
To see the liturgy to see this octagon full of people who lift songs of praise to God in whom the transcendence of the human spirit is legible in their faces - that is finally to understand in modern terms what Brunelleschi conceived in the fifteenth century.

CAROLINE ELAM:
I think it's difficult to overestimate Brunelleschi's achievement because, by transforming the appearance of Florentine architecture in the 15th century, he really transformed the appearance of the whole of Western architecture in the centuries afterwards.