Dancing with Gravity

In life I have found great joy created by those who have mastered an art, those who have distilled their practice to a profound purity. When I was in high school, I worked for a master blacksmith, Tom Joyce, now considered a living treasure and a recipient of the prestigious MacArthur genius award. I remember watching him strike the hot iron with grace and ease. Each blow moved the steel father towards its final shape. Rarely did a blow land wrong, requiring his next effort to correct errors of his previous. There was an economy in the way he used his muscular effort. The way he moved his body around the forge and anvil and the way he reached for and returned tools to their place, were all part of a larger dance of creation. He moved quickly but without haste and strain, with the movements only a man who has touched the same tools tens of thousands of times can produce. Each movement had its place in the process collaborating with the others, none could be taken away, none was a waste. When I took the hammer and tongs into my own hands, I realized the difficulty in the art of shaping glowing iron with blows. I struggled with the most basic parts of the process, the manipulation of the glowing steel in the tongs, and controlling the relationship of the anvil and hammer necessary to make the simplest of shapes, a point on a rod. Knowing the challenge of the art with my own hands only added to the joy I felt watching Joyce create. I tell this story not because I have since mastered the forge, nor shall this paper be an investigation into the art of black smithing. Rather I share this memory because it is experiences like these which are integral to my inspiration.

I have for the last year found a tremendous passion and joy for balancing my body on ropes and cables. I dream of building aerial sculptures upon which others and I will perform. There is a rigor to this art. There is an art to the rigging and there is an art to movements upon rope. Both are necessary for this performance and both are difficult and complex endeavors. Theater is not just created by actors, but it is also built of edifices of wood, metal, cloth, and light. Yet usually the creation of these require different practices, the work of many people. However with the work I do, I must wear the engineer's ring as well as the suede soled shoes of the funambulist. Inspired by the movements of Joyce's hammer, I am working to find the essentials in rigging and rope walking.

In this paper I primarily will look at the work of two masters resisting gravity by the use of structures including wire rope. By studying and connecting the work of Philippe Petit and Frei Otto, I hope to discover insights into why those who seek stillness of body and lightness in building create work which to me is inspirational. Philippe Petit as a wire walker has used rope anchored to towers, bridges and mountains as a stage for extraordinary performances, which exist in flirtation with gravity and mortality. Frei Otto builds great structures using wire ropes, steel tubes and plastic to create the lightest most efficient structures that he can which still stand in the force of the elements and gravity. Each has used the rope as a tool on a path to distill his art to the essential. As Robert Le Ricolais, a prominent engineer and artist said, "Who knows a

better structure than a rope?"[1] Rope has a long history of being a central character in the resistance of gravity and the ascension of the body and spirit.[2]

I will investigate the notion of reduction and economy in the creation of lightweight structures and in the physical movements of the wire walker. I will compare the energy consumed in the wire walker's performance to the mass used in a lightweight structure, showing the parallels. In both of these endeavors there is an interest in reducing the energy or mass which is used to keep erect the structure or body. In the lightweight structures of Frei Otto and in the movements of Philippe Petit, very different practices, I will argue how joy and splendor is reached tangentially, created in a search for simplicity, a symbiosis with space and gravity. I will share what I have come to mean when I say structural or physical economy. And hopefully I can begin to understand how the process of developing such economies yields majestic movements and forms whose suspension in the sky create lightness and grace operating in harmony with natural laws.[3] While under a grand roof of Otto's, the volume of an enormous anticlastic surface built of cable and plexiglass tiles, a deep touch of body and spirit arises. When we see the high wire artist gliding his foot along his wire with such effortlessness, in such silence, it exalts our perceptions of time and space. But also essential to these arts is the existence of the idea of the potential for a fall, a release of potential energy, a terrifying projection—snapped cables, twisted and buckled steel tubes and a fallen performer in great pain or worse.[4]

For action or product to be sublimely touching there must be more than just grace and prettiness. It must take our imagination beyond the tangible and describable aspects of the objective form to a boundary between chaos and order, between support and collapse—a place which stirs our being. I will argue a direct approach to this can be when the creator forgets his notions of beauty and aesthetics and instead delves with body and mind into the reduction and simplification of his work.

Economy in Structure and Movement

I shall start with my definition of economy in relation to gravity in building and in action. There are physical realities dictated by the ever present force of gravity and the laws of mass and energy which confront the engineer and the wire walker, challenging him to engage in a constant dance. The work of a designer and aerialist is not to defy gravity for this is impossible—only a fool thinks he is soaring when he is falling—but to learn to work within its laws finding the simplest solution to problems of weight, strength, balance, and movement.[5]

A bridge is made of materials which have mass. First, before a bridge can support passage it must be able to support itself. Some of the structure's strength is needed for its own support. Now if the bridge is built "economically," its materials will be placed where the stresses in the structure most concentrate. Its weight will only be a fraction of its total strength. If on the other hand, material is spread uniformly, as for example in a solid rod, only a small span or load is

1. Robert Le Ricolais (1973), *Things Themselves Are Lying And So Are Their Image*. Graduate School of Fine Arts University of Pennsylvania, PA. p. 96
2. Marcel Eliade (1962), *The Two And The One*. Harper & Row, Published, Inc. New York, NY. p. 165
3. Le Corbusier (1985), *Towards a New Architecture*. Dover Publications, London. p. 1
4. Emmanuel Kant (1914), *Critique Of Judgement*. Macmillan and Co.: London. p. 120
5. Hovey Burgess, (1983). *Circus Techniques,* Brian Dubé, Inc. New York, NY. p. 2

possible. The following idea of Le Ricolais gives us some insight into how removing material from a structure will make it stronger. He tells us that the art of making a efficient structure lies in understanding the placement of its cavities, in using the absences of material, and then in orienting and connecting as best as possible the structural members around these voids.[6]

If we look at the action of a man squatting then standing again we can see a similar principle at play. If the body's muscles are bound by tensions, the movement will be stiff, jerky and require much effort. The man's balance and alignment will be thrown off by his struggles and the muscular corrections to remain in balance will be unsteady. He will tire quickly and may even find movement unpleasant and discouraging. Now if we watch a man whose practice has engaged him in his body, a dancer for instance, the same movement now looks effortless and fluid. The muscles engage in ways that hold the skeleton in alignment using the elegant mechanical advantages which natural evolution has given us,[7] but our sedentary life so often hides these from us. Muscles which are not needed relax and do not act as "brakes" against the movement.[8] Quickness in balance is achieved and one's relation to gravity is felt. Subtle movements are all that are needed to stay upright and poised. In great athletes or performance artists one quality of effortlessness we often see is the stillness an individual is able to achieve in positions of great stress. In fact, it is more a distillation of tension and effort than a engaging which makes physical actions economic and effortless. I am reminded of one of the great martial artists of modern times, Bruce Lee with his advice in regards to developing physical skills when he says,

> "It's (one's practices) not daily increase but daily decrease—hack away the unessentials"[9]

In the absence of unnecessary material or strain, a structure or a body will have greater capacity to resist gravity.

Light Weight Structure and the Funambulist

Frei Otto was born in 1925, the son and grandson of a sculptor. He took interest in flight at an early age and as a fifteen year old he took up glider flying. Later he joined the German Air Force as a pilot. After the Second World War in Germany, Frei Otto, as a young engineer, faced a compound problem in the creation of structures, the severe shortage of materials, and a great need for housing.[10] Perhaps this and his exposure to flying machines early on played a critical part in directing his focus towards economy and efficiency while approaching a structural problem. As Philip Drew, the author of *Form and Structure*, a book on the works of Otto says of Otto's process,

> "In the absence of conventional architectural habits and routine fishing in the ocean of old forms, the dissection of his work for stylistic influences—indeed the

6. Le Ricolais, *Things Themselves Are Lying And So Are Their Image,* p. 103
7. D'arcy Thompson, (1961). *On Growth and Form*. Cambridge University Press.: New York, NY. p. 127
8. Bruce Lee (1975). *The Tao of Jeet Kune Do*. Ohara Publications Inc.: Burbank California. p. 43
9. Bruce Lee, *The Tao of Jeet Kune Do*, p. 42
10. Philip Drew (1976). *Form and Structure*. Westview Press: Boulder, Colorado.

> very notion of style—is alien. His denial of architectural product in deference to structural process enthrones concept and method over self conscious aesthetic manipulation as the determinant of form."[11]

Engineers such as Frei Otto and Robert Le Ricolais looked into using high strength materials in new ways to create structures whose goals were to use a minimum of material to create a maximum of structure. The core concept was to remove material which was not under stress, material that was a hinderance to the structure because it added weight and cost, but did not add strength. By doing so, the structure's members would exist in either pure tension or pure compression which would lead to a great reduction in the mass of a structure itself. The unachievable desire of the lightweight engineer was most simply articulated by poet engineer Robert Le Ricolais when he asked a structure to be:

> "Zero weight infinite span."[12]

In the Munich Olympic Stadium, designed by Frei Otto and built for the 1972 Summer Olympics, great masts rise up high into the sky. Anchored to the masts' heads enormous roofs of cable nets supporting plexiglas tiles swoop down and over the stadium seats, creating an awesome topography. In places large masts float high above the spectators, held in space by tensegrities. In all cases the forms of the architecture, the shapes the material articulate in space, are creations of structural solutions whose design it is to carry the forces of the architecture in the most slender and lightest way. These immense roofs are the giant descendants of little soap films clinging to wire models which Otto dipped into and raised out of soap baths, photographed and measured. It has long been known that soap films have a uniform tension on all parts of their surface.[13] In this way they can only take the shape of what engineers call "minimum surface."[14] The beauty in a minimum surface is that it can be a pure tension and compression structure. All areas are in equal tension, equilibrium, and restrained by the inherent double curvature of the surface. The compressive forces can be isolated in the supporting structures. In this way, one arrives at a roof, which is both strong, light and rigid.

The shapes created by this enormous architecture are the results of Otto's measuring and translating natural physical dynamics to the modern materials of steel and plastic. In this, the words of Le Corbusier, the architect and modernist ring true.

> "The Engineer, inspired by laws of Economy and governed by mathematical calculation, puts us in accord with universal law. He achieves harmony."[15]

In his quest to find the simplest, lightest solution to structure, Frei Otto has reduced each part to only what is absolutely needed to carry out its essential purpose as part of the whole system. As he says,

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11. ibid,. p. 6
12. Robert Le Ricolais, *Things Themselves Are Lying And So Are Their Image*, p. 81
13. ibid,. p 14
14. C. V. Boys (1959), *Soap Bubbles, their colors and the forces which mold them.* dover Publications, New York, NY. p. 48
15. Le Corbusier, *Towards a New Architecture*, p. 1

> "We are looking for those constructions that show with particular clarity the natural processes that create objects. We are looking for the essential. We even speak of the "classical" when something that cannot be improved becomes visible"[16]

His process shares much in common with the athlete who over years of dedicated training rids his actions of superfluous motion and dissolves wasted effort. Like the trained muscles of an athlete, the beams of the roof have been reduced in stature to slender cables allowing great spans between columns. Strength does not fight itself by adding unnecessary bulk and mass.

> "The Munich roofs convey the sense of effortless grace which is so much a feature of a great athlete's performance."[17]

Philippe Petit was born in Nemours France in 1949. A rebellious and spirited boy he was expelled from five schools for honing the art of pick pocketing on his teachers.[18] His athletic and physical passions are numerous. He is an excellent juggler, magician, and performer, but he is most famous for his 1974 clandestine high wire performance between the towers of the World Trade Center in downtown Manhattan. Those minutes of subtle movements alone on a wire, Petit, watched by thousands to whom he appeared as nothing more than a black dot, a hole in the sky, a flirtation with such proximity to death, burned his performance into the collective memory of the world. In the simple act of walking without embellishment on an ephemeral path joining two towers, an immortal inspiration swelled in thousands.[19]

> "the essential, this is to etch movements in the sky, movements so still they leave no trace. The essential thing is simplicity. [20]

At the age of 17, he discovered the wire and practiced walking on it fiercely. He describes the wire as a great teacher. For Petit, the lesson of the rope dance is to find the essential and to discard everything else.

The difficulty of the rope dance lies in the combination of the equilibrist's center of gravity being high above his narrow perch or pivot. This center of gravity has a tendency to constantly displace itself as gravity pulls it into rotation about the rope. The talent of the equilibrist lies is never allowing these forces of rotation to exceed those which he is able to generate for their destruction. These motions must be quick for gravity acts fast and, if the equilibrist is slow, he soon finds himself far out of balance and must throw his whole body into motion in the hope that he will "land" atop his perch again. When a person first begins balancing upon a rope, we notice this type of gross movement. He thrashes, falling one way then the other, introducing twisting motions which further his inevitable failure and he soon knocks himself down. In its beginnings,

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16. Frei Otto, Bodo Rasch, (2006), *Finding Form*. Translated from German by Michael Robinson, Duetscher Werkbund Bayern, Munich, Germany. p.15

17. Philip Drew, *Form and Structure*, p. 39

18. Philippe Petit (2008). *MAN ON WIRE*. Sky Horse Publishing, New York, NY. p. 3

19. Based on the statements of Dean Snyder in conversation with me who witnessed Petit's walk. He remembers being on the streets with thousands and everyone was transported by the enormity of the event. He said it was the most beautiful and extraordinary sight he had ever seen and would ever see.

20. Petit, *On The High Wire,* p. 102

the motion of falling from a state of equilibrium is subtle and it is at this point that the master rope walker is able to detect the imbalance and destroy it before it gains momentum and greater effort is needed to stay upon the rope. Just as the lightweight engineer looks for a minimal solution to structure, the master of the rope seeks the slightest movement to maintain his balance. With minimum tension and stress, he is most aware of his senses, senses so vital to balance. The great rope dancers and wire walkers, who in order to stroll in the sky upon a wire strung between mountains, reduce their motions of balance towards an allusive but intangible stillness.[21] The funambulist still is bound to the dance of balance which gravity and his narrow perch mandate, and to avoid falling he must move, but the smaller his movements become the more he finds comfort and perhaps even joy in his delicate situation.

Tangential Beauty/Psychic Impact

In both the work of Petit and Otto, through their rigorous practices spanning their lifetimes, the focus is and has been on the essential needs of the endeavor. Through optimization of movements and structures, an elemental connection to the world is created. In is not in the quest of beauty which they toil, but in the creation of a thing from which nothing else can be taken. It is in this that beauty is found. To see the silence of Petit's balancing or the transparency of Otto's roof leaves the mind to measure how close failure has been approached. As I imagine Philippe Petit's performance between the towers I feel a wonder, a joy—an exaltation of human spirit, what wondrous skill, what a deafening silence. How still he has to be to walk on so little so far from solid ground. As I watched *Man on Wire*, I saw the New York police commander struggling to describe the experience of witnessing Petit's performance on a wire rigged between the World Trade Center. He could not measure or compare the power of what he had felt in seeing Petit dance upon a wire. Although Petit broke the law with his performance it also expanded the limits we associate with being human.

> "The theater must give us everything that is in crime, love, war, or madness, if it wants to recover its necessity"[22]

Frei Otto's works are similar. They do not defy law in their creation or existence, but they expand our sense of the possible something love, war, and madness do although not always beneficially. Otto's finesse in structure allows him to erect his materials, connecting them like great tents rising from ground to sky. Everything is slender in relation to the space created. It is thus that the structure melds into the air, soaring skyward, almost becoming an apparition where flying columns float over the heads of thousands.[23] The Olympic Stadium's transparent roof of plexiglas and wire rope nets has a transparency and delicacy which juxtaposes the great mass intrinsic to such a monumental space. The structure evokes a physical paradox. It is solid and carefully built so it does not endanger the 80,000 guest it hosts during events. All of the forces have been carefully examined and the members which support these forces have necessary

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21. Philippe Petit (1985), *On The High Wire*. Random House: New York, NY. p. 20

22. Antonin Artaud (1958), *The Theater and Its Double*. Grove Press Inc.: New York, NY. p. 85

23. A reference to the flying masts of the Munich Olympic Stadium, which have been employed to increase the free spans between column in the stadium's grand seating and thus provide unobstructed view to the spectators.

strength. Nothing has been left to chance. For it is in cases such as these, with so many lives on the line, that the structure cannot fail.

> "Leave nothing to chance. Chance is a thief who never gets caught."[24]

Yet when I page through pictures of the Munich Olympic Stadium, it feels like the whole roof is ephemeral, spontaneously formed and then quick to disintegrate. Like a giant paper kite flying at the moment, but in all its buoyancy it is fragile. In the presence of its soaring grace and elegance, it also appears fragile, invoking notions of a possible collapse. It is this duality that also makes a great wire walker's performance so transporting. In Petit's movements lie great stillness and calm, yet his perch is insubstantial. It barely exists, disappearing from the eye at a distance. The wire itself rolls and sways underfoot, not for a moment still. The situation has a profound uncertainty and transience about it. If in this balance there lies a moment of reposes, it is brief and transient. Roland Bathes in *Camera Lucida* describes in photographs the elements which transport us, holding power for the spirit.

> "it is this element which rises from the scene, shoots out of it like an arrow and pierces me."[25]

These great works shock us, dismissing our expectations of convention, waking us from a slumber. Artaud tell us great works will be,

> "like the plague...there is something both victorious and vengeful: we are aware that the spontaneous conflagration which the plague lights wherever it passes is nothing else than an immense liquidation."[26]

In the practices which enthrone the search for economy, a careful reduction to the structure and in movement creates a power that is felt in the product. When the creator does not feel beauty is guiding his work, but rather when a passion for conservation and simplification takes hold of his desire, a freedom is created. Bruce Lee speaks of this freedom in *Toa of Jeet Kune Du*.

> "Art reaches its greatest peak when devoid of self-consciousness. Freedom discovers man the moment he loses concern over what impression he is making or about to make."[27]

He tells us what unleashes a man's greatest potential is when the attention is held within the creative act itself, rather than on the projection of a product. For me an important discovery in research during the writing of this paper has been an increased awareness that individuals who follow processes of simplification to guide their work often have great success in touching others with the power of the work. There is something about the nature of these works which is less dependent on taste to enjoy than when the act of creation is motivated by aesthetic meditations. For the intention of creating something beautiful is to me comparable to seeking old Buddha which is described in the following parable.

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24. Petit, *On The High Wire,* p. 20
25. Roland Barthes (1980) *Camera Lucida*. Hill and Wang.: New York, NY. p. 26
26. Artuad, *The Theater and Its Double,* p. 27
27. Bruce Lee (1975), *The Tao of Jeet Kune Do*. Ohara Publications Inc.: Burbank California. p. 8

> "Were you talking about old Buddha? Why old Buddha is no Buddha. Real Buddha is a fish just netted leaping and jumping"[28]

Our profoundest experience

> "is in reality untranslatable. To express it is to betray it. But to translate it is *to dissimulate it*. True expression hides what makes it manifest."[29]

I think the work that Petit and Otto—and the aspiration I have of my own work—give us a window to reflect upon potentials within human experience and its connection to nature. Like the engineer looking to better his design by ridding it of unnecessary material, or like the wire walker practicing on his wire to find a minimum effort in balance, the meditations on reduction channeled into creation reflect to the audience, pointing them towards an essential self where illusions manifested in fears and misery are converted, their energy used to fuel compassion and generosity. Because the distillation and clarification is embodied not just concepts, "old Buddha," the real cultivations of these works ultimately act upon the human spirit.

> "Listen to the man who works with his hands he may be able to show you a better way to do it"[30]

It is through this embodied intelligence, through searches of economy and simplicity that I will find a creativity which is not based on agenda or desire to create something of importance and beauty by which I am still bound to a limited sphere of social power and its corresponding misery, but to harness within myself and in the world around me, the energy for continual growth and compassion.

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28. Korean Zen Master Ko Un

29. Artaud, *The Theater and Its Double,* p. 71

30. Louis Kahn (1975), *Light is the theme : Louis I. Kahn And The Kimbell Art Museum.* Kimbell Art Foundation: Fort Worth, Texas. p. 54

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