Retractable Kinetic Towers Against Rocket

A Deployable Active Device to Monitor and React to Threats at Borders

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Resumo: Como alternativa aos drones, uma torre ativa movel pode ser facilmente içada, sendo capaz de operar de maneira equivalente a uma torre estática de vários quilômetros de altura, porém, com muito menos vulnerabilidades. Esta é uma aplicação do antigravitador de Bolonkin, um *framework* com dispositivos que fornecem uma força repulsiva (oposta à gravidade) entre determinados corpos. O conceito básico se resume em que um cabo forte e pesado é projetado para cima usando uma roda motorizada no chão. O impulso ascendente do cabo é transferido para o aparelho por meio de um mecanismo de polia/roldana, o qual leva o cabo de volta para o motor. O momento transferido do cabo para o aparelho produz uma força de empuxo que pode suspender o aparelho no ar, ou, simplesmente, levantá-lo. Há uma força igual e oposta na roda motorizada no chão. Este dispositivo é chamado de antigravitador cinético (repulsor cinético) porque a gravidade atrai quaisquer dois corpos, enquanto o dispositivo oferecido repele quaisquer dois corpos. Com a articulação correta, um estágio mais pesado pode suportar o mecanismo enquanto outro estágio mais leve se estende lateralmente como um braço dispondo uma ferramenta para realizar alguma tarefa. Essa torre é útil para comunicações, vigilância e ataque (incluindo lançamento de foguetes e disparos de canhão para alcance estendido em altitude), e pode ser rapidamente retraída e realocada. As "pipas de fogo" de Gaza e outras ameaças menos letais podem ser prontamente detectadas, antes mesmo de cruzarem a fronteira.

Palavras-chave: torre ativa, antigravitador, força repulsiva, transferência de momento.

Abstract: As an alternative to drones, a deployable active tower technology which appears to be an Indian rope trick, can suddenly place at height – the equivalent of a multi-kilometer tall tower with far fewer vulnerabilities than a static tower. This is one application of Bolonkin's antigravitator, a method and devices that provides a repulsive (repel, push, opposed to gravity) force between two given bodies. The basic concept is that a strong, heavy cable is projected upwards using a motorized wheel on the ground. The upward momentum of the cable is transferred to the apparatus by means of a pulley/roller mechanism, which sends the cable back down to the motor. The momentum transferred from the cable to the apparatus produces a push force which can suspend the apparatus in the air or lift it. There is an equal and opposite force on the motorized wheel on the ground. This device is called a kinetic (mechanical) antigravitator (kinetic repulsator) because gravitation attracts any two bodies, whereas the offered device repels any two bodies. With correct linkage one heavier stage can support the mechanism while another lighter stage reaches sideways like an arm to extend a tool to do a task. Such a tower is useful for communications, surveillance and strike (including rocket launch and cannon firing for extended range at altitude) and can be suddenly retracted and relocated. The "fire kites" of Gaza and other less lethal threats can be promptly detected and targeted in seconds at ignition before they ever cross the border. Similarly, rockets in boost phase of trajectory can be detonated from a distance of a few kilometers of a rocket launch. In addition, using this technology soldiers can "leap frog" to locations needed quickly and the "long arm" can extract those who pose a danger without endangering border control police or soldiers. Especially at night this would terrify those targeted.

Keywords: active tower, antigravitator, repulsive force, momentum transfer.

1 Introduction

Threats against the integrity of borders, such as the Gaza-Israel border, demand new technologies. Extant high-tech drones or low-tech walls have proven ineffective. To prevent border breaches or to react to impeding threats, a border must be continuously monitored. Currently, using conventional methods like satellite imaging and aerial photographs or videos has proven ineffective. Rather observation posts at a height are necessary: the higher you are, the farther you can see… but the farther they can see you.

Table 1: Distance to the Horizon

Height *h* (m)	**d_c (m)**	**Notes**
1	3,571.59	
1.5	4,374.29	Average eye-level
100	35,716.07	
1,000	112,948.13	
9,144	341,653.39	Aircraft cruising at 30,000 feet
100,000	1,133,855.37	The Kármán Line, or "edge of space"

Passive towers for observation usually take very long to construct, give warning a new observing post is coming into existence (and the enemy time to take countermeasures) and are increasingly vulnerable with the very height increase that make them useful. Collapses of TV towers, for example, can be sudden and dramatic. And while in theory a transporter/erector analogous to a missile launch vehicle could move and rapidly erect a very tall tower suddenly, it would be very difficult to engineer one with a reasonable mass fraction of payload.

Instead of using compressive tower engineering, this paper proposes a kinetic tower design of tensile tower engineering—tensioning fibers to support a load. Our invention is adapting the Kinetic Tower to an observe and attack instrument, a device just as a snake coils to a height before striking and launches the attack from its maximum height (Illustrated in Fig. 1) . The higher you are, the farther you can shoot…

The Kinetic Tower does not need to be raised until needed. When needed it:

- Rises like a periscope just above crest level
- Dips down, and computes a fire solution
- Up, confirm and correct for movement, fire for massively extended range (extra seconds of flight before hitting ground)
- down, and evasive action against counter-battery

- up, and counterstrike
- down, coil up, and hide in prepared hard site like a coiled snake

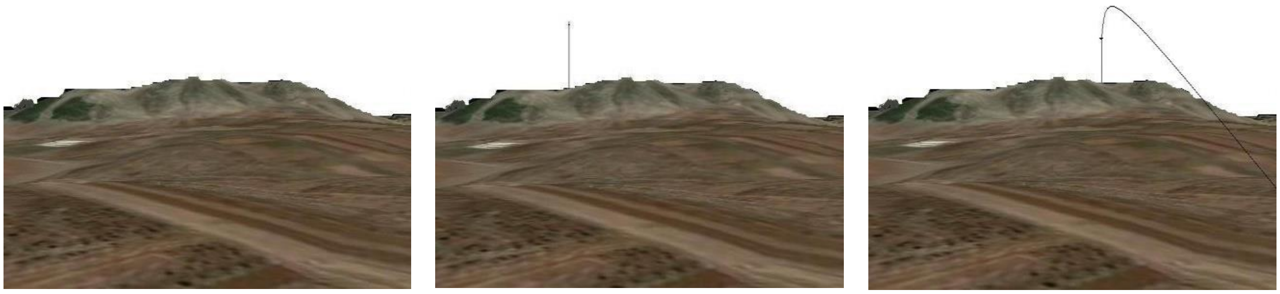

Fig. 1: Illustration of Kinetic Tower observe and strike capability.

Alexander Bolonkin has designed a kinetic tower [1- 8] capable of reaching height so great that you can literally have an elevator to space. [9 - 12] It is based upon the physics behind the uplift force of a pulley. It rises quickly and can be controlled. This method produces a push (repulsive, repel, opposed to gravitation) force between given bodies. The basic concept is that a strong, heavy cable is projected upwards using a motorized wheel on the ground. The upward momentum of the cable is transferred to the vehicle by means of a pulley/roller mechanism. This mechanism creates a push force and that also sends the cable back down to the motor. The momentum (push force) transferred from the cable to the vehicle can suspend it in the air or lift it. This force is equal and opposite to the force on the motorized wheel on the ground. The push (mechanical) force opposes the gravitational force between these bodies (for example, the ground and a flying vehicle). This force is created by a linear thin cable moved between the given bodies. If there is no roller and air friction and the distance between the given bodies is not changed, the suggested pusher does not require energy (except for the initial start and wheel friction). When the distance is increased, the energy is spent, when the distance is decreased, we gain energy. For some people this push force may be surprising because the bodies are connected only by the flexible thin long cable. But there are no violations of the laws of physics – we transfer a momentum between the bodies through the moving cable. When this momentum in a unit of time (force) is more than the gravity force, the bodies will move away from one other; when the momentum is less than the gravity force, the bodies will be drawn together.

In numerous papers and books Bolonkin demonstrated the feasibility of using a static fiber line to hold up a tower of taut lines. The dynamic forces to force a fiber structure is strong enough to rise erect into the sky, like an Indian rope trick. A practical truck mounted unit with its own deployable and rapidly relocatable tower with modular mounting points on top for payloads that can sense, strike, and defend is proposed in this paper.

This is ideal to observe enemy missile launches from a distance — and strike to prevent them, without expensive dedicated orbiting counter-strike aircraft. As such, this is a practical alternative to the Iron Dome which shoots down missiles before they hit the target: this can destroy the missiles before they are launched.

The whole point of a retractable tower is instant response capability. 5 km sideways strike range (2.5 km in each direction) is near optimum because then 20 towers can cover the Gaza border in real time. A different weapon head can be fitted to the kinetic tower to burn up fire kites. There are several approaches, but an infrared seeker head can detect the flames and guide a strike head to literally snatch the kite out of midair like a falcon. (Probably an easier approach to actually engineer is just to spray it with high pressure oxygen to make it burn itself out of the air over the Gaza Strip before it ever crosses the border, or to maneuver a small flamethrower using a Stihl liquid fuel pump within meters and burn the plastic up over the Gaza Strip from our side of the border and let *them* worry about putting out the fires, for a kinetic tower with the correct strike head can be based on our side of the border yet strike like a snake head.

Another possibility is using this device to levitate a soldier rapidly over the border to manually snatch a kite igniter or burn the kite itself up in the air with a flame thrower, or for other such rapid interventions. Especially at night, this would demoralize the enemy, because our soldiers would literally never set foot in Gaza yet be able to intervene at will. Positioning the baseline kinetic tower when and where it is needed is accomplished by a practical truck mounted unit with its own deployable and rapidly relocatable tower with modular mounting points on top for payloads that can sense, strike, and defend.

2 Method

Some variants of the installation are shown in Fig. 2. The installation includes (see notations in Fig. 2 and others): a linear closed-loop cable, top and bottom rollers, any conventional engine, and a load. Details of the top roller are shown in Fig. 3, the bottom (lower) driver roller is shown in Fig. 4. The small rollers (Fig. 4) press on the cable and together with the large roller and engine move the cable. The possible cable cross- section areas are shown in Fig. 4(c). Fig. 5 shows the anti-gravitator in a slope position. The installation includes (see notations in Fig. 2 (a), (b) and others): strong closed-loop cable, two rollers, any conventional engine, loop-top station, load elevator, and support stabilization ropes.

The installation works in the following way: the engine rotates the lower driver roller and continuously sends the closed-loop cable upwards at high speed. The cable reaches a top roller (which may be at high altitude), turns back and moves to the lower driver roller. When the cable turns back, it creates a push (repulsive, repel, reflective, centrifugal, momentum) force. This repulsive force can easily be calculated using centrifugal theory (see the theoretical section of this paper).

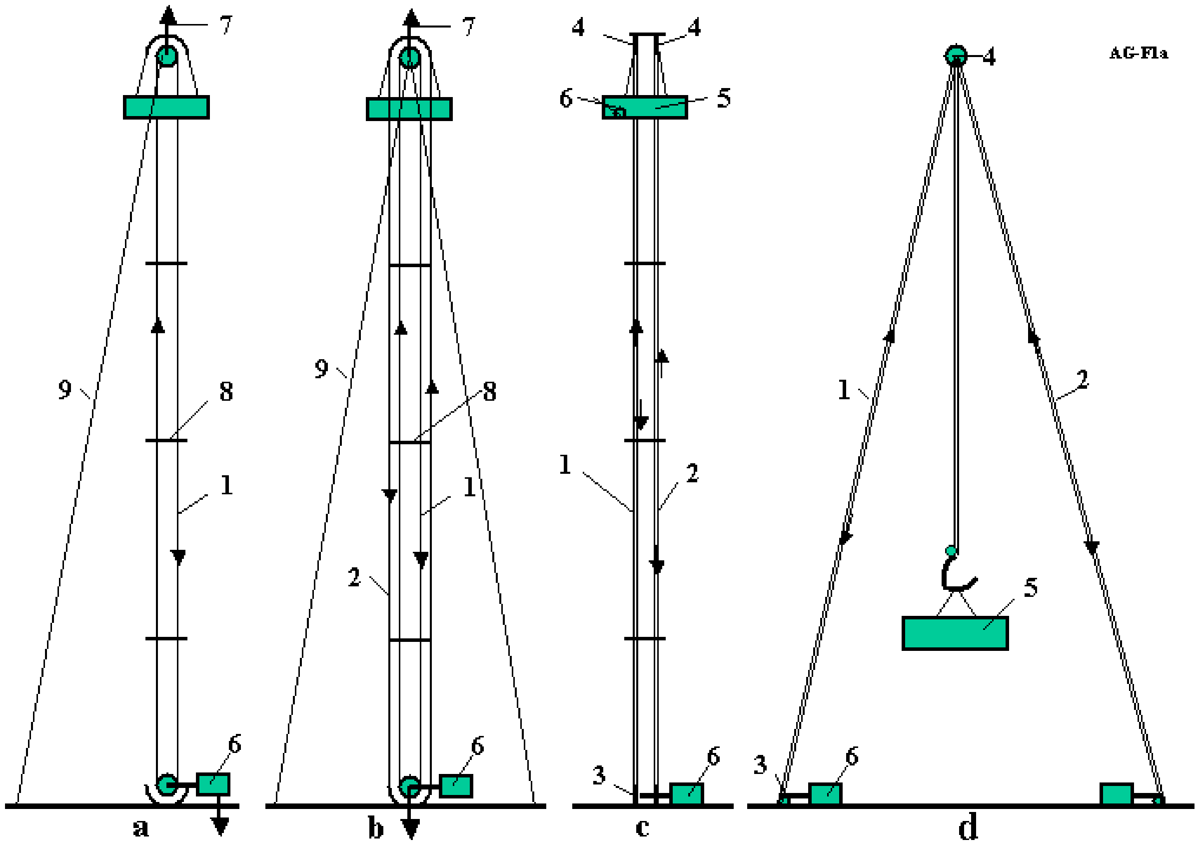

Fig 2: Push devices (kinetic anti-gravitators) with closed-loop cables. *a* – single cable with brace, *b* - double cables are moved in opposite directions and located in one plane, *c* – installation having four closed-loop cables in different plates and without braces, *d* – load crank having minimum three cables. Notation are: 1- one closed-loop cable; 2 – the second closed-loop cable; 3 – lower rollers; 4 – top rollers; 5 – suspended object; 6 – engine; 7 – push (lift) force; 8 – spreader, 9 - braces.

The push force can also be calculated against the mobile cable mass using momentum or reflection theories (see the theoretical section). The cable turns 180 degrees around pulleys. That turn produces a centrifugal force which supports or moves the load. However, Newton's laws say that for every action there is an equal and opposite reaction. In this case, the action comes from the wheel as this is what is pushing the cable and producing the net negative gravity field direction force on the cable. To do that, the wheel moves (is pressed) by the positive gravity direction. This means the cable will push the wheel back toward the source of the gravity (in this case to the ground).

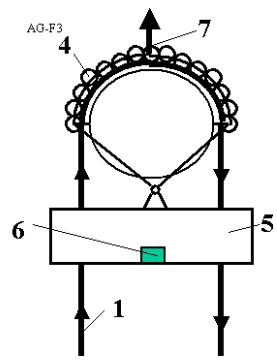

Fig. 3: Top roller of kinetic anti-gravitator (Notation: Same as in Fig. 2).

A top roller (Fig. 3) (which may be at high altitude), turns back and moves to the lower driver roller (Fig. 4). When the cable turns back, it creates a push (repulsive, repel, reflective, centrifugal, momentum) force. This repulsive force can easily be calculated using centrifugal theory. The push force can also be calculated against the mobile cable mass using momentum or reflection theories.

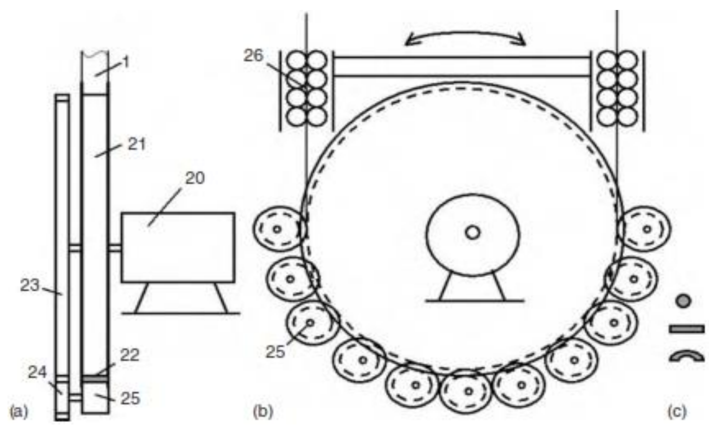

Fig. 4: Drive roller of kinetic anti-gravitator. Notations: (20) Engine; (21) drive roller; (22) (1) flexible cable; (23) large gear wheel; (24) small gear wheels; and (25, 26) directive rollers. (a) side view; (b) front view; and (c) cable cross-section.

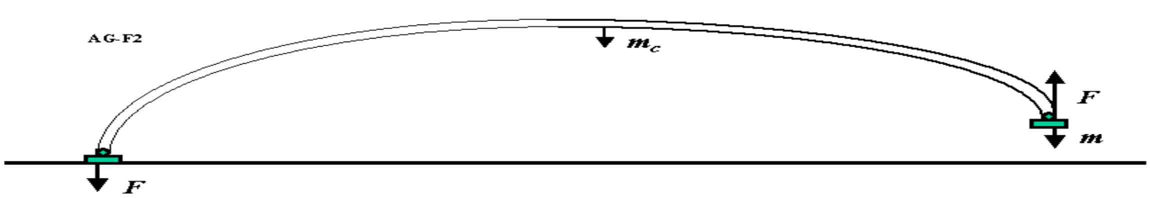

Fig. 5: Kinetic anti-gravitator in slope position.

The repulsive force points in a vertical direction and it must be more than the gravitational force of the cable and load. This anti-gravity force keeps the load or cable top station suspended on the top roller; and the load cable (or special elevator) allows the delivery of a load to the cable top station. The rollers and cable may have high speed and stress. They must be made from a strong (for example, composite) material. In this case, the rollers have the same permitted stress (and permitted rotary speed) as the cable. The permitted (safety assurance) speed (of the cable or roller) is the speed permitted (admitted, safety) by the maximum material strength divided by an assurance factor.

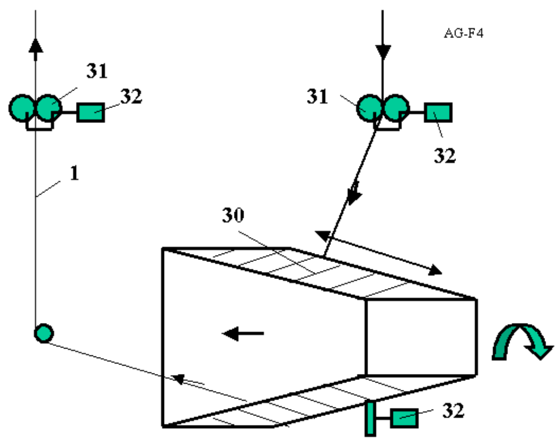

Fig. 6a: Revolving spool. Notations: (30) Cable spool; (31) directive rollers; and (32) spool engine. The left and right cables can have different speeds.

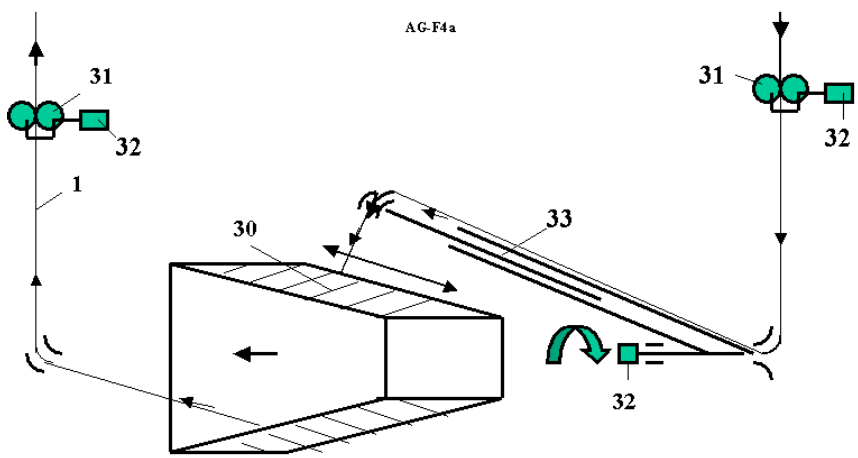

Fig. 6b: Motionless spool (the lever rotates around the spool). Notations: (30) Cable spool; (31) directive rollers; (32) motor; and (33) revolving lever. The left and right cables can have different linear speeds.

The moment of friction in the top roller can be compensated by guy lines as in Fig. 2(a), or by the second closed-loop cable rotating in an opposed direction to the first cable (Fig.2(b)–(d)) and located in one plane (Fig. 2(a)). A pusher may have its cable made from conventional steel wire (or steel fiber). This cable has a smaller permitted maximum speed and air drag. It requires less power for rotation than a light cable made from artificial fibers. As shown in the theoretical section, the current widely produced artificial fibers allow reaching altitudes of up to 100 km [2]. The closed-loop cable can be of variable length. This allows starting from zero altitude, increasing the load (station) altitude to a required value, and spooling the cable for repair. The devices for this action are shown in Figs. 6. The offered spools allow reeling and unreeling the left and right branches of the cable with different speeds to change the length of the cable.

3 Multi-stage kinetic tower.

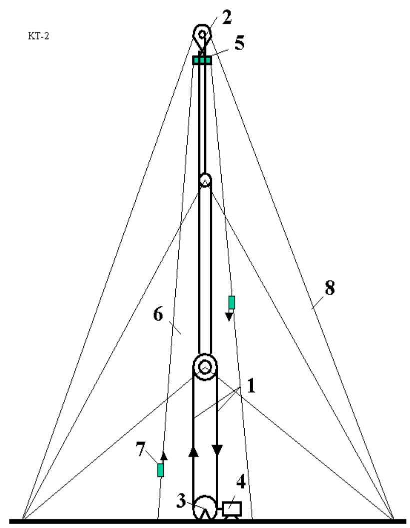

Fig.7: Multi-stage kinetic tower.

The offered tower may be used for a horizon parallel launch of cheap weapons like ballistic concrete or even rocks (Fig. 7). The vertical kinetic towers support horizontal closed-loop cables rotated by the first-stage vertical cables. The weapons apparatus is lifted by the vertical cable, then connected to the horizontal cable and accelerated to the required velocity — with a later model taller tower, even — above much of the atmosphere. This would enable a small missile to do the work of a huge missile because most of the fuel would not be wasted in the first and second stages. A cost factor of fifty times cheaper is possible. A horizontal device similarly can be used for launch aircraft or missiles. (Fig. 8)

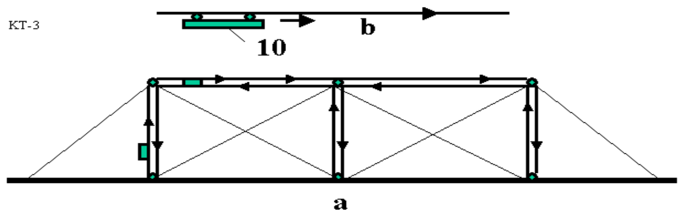

Fig.8: Kinetic space installation with horizon accelerate parts. *b.* 10 **-** Accelerated missile.

Advantages

The suggested towers and launch system have big advantages by comparison to the current solid towers and missile launch systems:

- They allow reaching a very high altitude impossible for solid towers. No expensive missiles or drones or fighter jets.
- They are cheaper by some thousand times than the current low towers. The kinetic towers may be used for tourism, power TV and radio transmission over a very large and profitable area, radio rf tag locator, as a space launcher.
- The offered kinetic tower launcher can be made in a few years. Other competing technologies may require some decades for development, design, and building.
- The offered cable towers and space launcher does not require high technology and can be made by any non-industrial country from current artificial fibers. Cables. Bolonkin details the parameters of cable characteristics in previous publications, for example, reference [13].
- Missile fuel brought to altitude is expensive just as jet fuel from an aerial tanker is more expensive than the same fuel on the ground. But the stationary loop-top station would allow economizing of the expense of pre-positioning this fuel, making possible refueling of drones at patrol altitude, and in fact replace drones because the engine is located on the Earth's surface and very powerful cameras and telescopes could be brought to an altitude of interest.
- Even expensive and delicate astronomical telescopes could be elevated above atmosphere and retrieved and maintained on the ground. For example, NASA's Kuiper Airborne Observatory (KAO) operates at 41,000 feet with powerful infrared telescopes.
- The fare for high altitude tourists would be affordable enough to open a massive new market.
- No pollution of the atmosphere from toxic rocket fuel. Conservation of drone engine flying hours.
- We can launch thousands of tons of useful loads annually.

- The capability of reaching vertical heights rapidly could be useful in skyscraper rescue and defensive works in mountain areas.

Mobility of the tower means rapid construction of defensive works is possible in an unprecedented way. For example, by means detailed [14, 15] Border communities, such as Sederot, could be given total ballistic protection against nearly any level of assault without needing to be on alert for incoming weapons. Kinetic towers could enable construction of standoff barriers (essentially nets with bags of small rocks that incoming missiles would have to hit) which would be impractical to build now but could be suspended in the air if kinetic towers could be used to wire cables above existing city geometry without using impractical conventional cranes. A conventional crane can take a good part of an hour to emplace but in theory a kinetic tower should be movable in real-time under computer control over a wider area of operation.

4 Theory of the kinetic anti-gravitator

Push force for immobile object

a) Repulsive (repel, push) force in space without gravitation**.** We can find the push force of the kinetic anti-gravitator from centrifugal theory (Fig. 9)

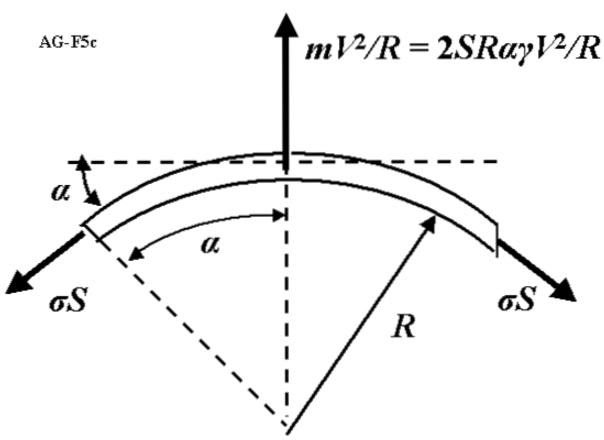

Fig. **9:** Forces of the rotary circle cable.

We first take a small part of the rotary circle cable and write the equilibrium rotation for centrifugal force and tensile stress:

$$\frac{2SR\alpha\gamma V^2}{R} = 2S\sigma \sin\alpha \ , \qquad (1)$$

where α = angle of the circle part (in rad). When $\alpha \to 0$ the relationship between maximum rotary speed V and tensile strength σ of a closed-loop (curved) cable is

$$V = \sqrt{\frac{\sigma}{\gamma}} = \sqrt{k}\ , \quad F = 2\sigma S \ , \qquad (2)$$

where F is the repulsive (lift) force (N), $k = \sigma/\gamma$ is to relative cable stress (m^2/s^2), S is the area of one branch of the cable cross section (m^2). The more convenient value of $K = 10^{-7}k$ is used for graphs. For example, the cable has the cross-section area S = 1 mm^2, stress σ = 100 kg/mm^2. Two cables can keep a load of 200 kg at altitude. We can find the lift force using reflection theory (see textbooks on theoretical mechanics). Writing the momentum of the reflected mass in one second gives

$$F=mV-(-mV)=2mV,\ m=\gamma SV, \text{ or } \ F=2\gamma SV^2. \qquad (3)$$

Here, m is the cable mass reflected in one second (kg/s). If equation (2) is substituted into (3), the expression for the repulsive (lift) force $F = 2\sigma S$ will be the same.

b) Lift force in constant gravity field. In constant gravity field without air drag, the list force of the offered device equals the centrifugal force F minus the cable weight W

$$F_g = F - W = F - 2\gamma gSH = 2\gamma S(V^2 - gH) = 2S(\sigma - \gamma gH) = 2S\gamma\left(k - gH\right) \ , \qquad (4)$$

where H is the height of the kinetic device (top end of the cable) (m).

c) Repulsive force for a mobile object. For a mobile object the repulsive force is

$$F = 2\gamma S\,(V \pm v)^2\ , \qquad (5)$$

where v is the objective speed [m/s]. The minus sign is taken when the cable length is increased, the plus sign is taken when the cable length is decreased. From equation (5) it follows that the maximum object speed obtained from the cable cannot exceed the cable speed. Equation (5) is used for launching and landing of flight apparatus.

d) Restore force**.** When the cable is deviated from a vertical position in the gravity field, the restore force is

$$F_r = F - g\,m_c/2\ . \qquad (6)$$

5. Air drag of the cable

The computation of cable drag is not developed. No experimental data are available for air drag of a very long cable.

a) The air drag of a double subsonic cable can be estimated using the drag equations for plates (the Reynolds number is included) [16]

$$D_L = 0.5 \cdot 0.664 \rho^{0.5} \mu^{0.5} V^{1.5} L^{0.8} s, \; D_T = 0.5 \cdot 0.0592 \rho^{0.8} \mu^{0.2} V^{1.8} L^{0.8} s, \quad D = 0.5(D_L + D_T) \qquad (7)$$

The cable has only one side, as opposed to a plate which has two sides, that way the multiplier 0.5 is inserted (Fig. 10 and 11).

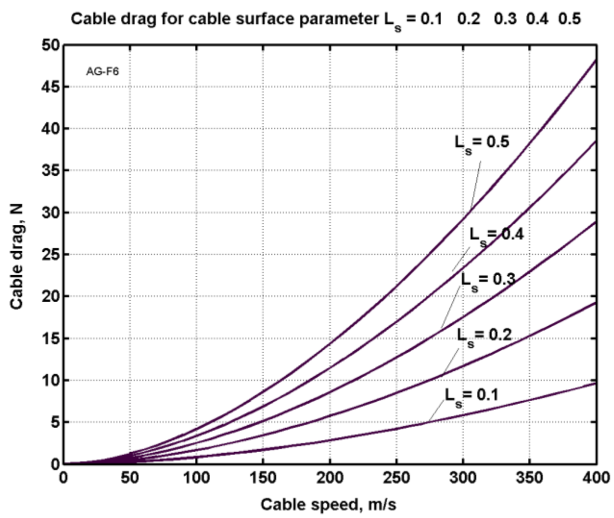

Fig. 10: Air cable drag versus cable speed for the cable surface parameter $L_S = L^{0.8}\, s = 0.1 – 0.5$.

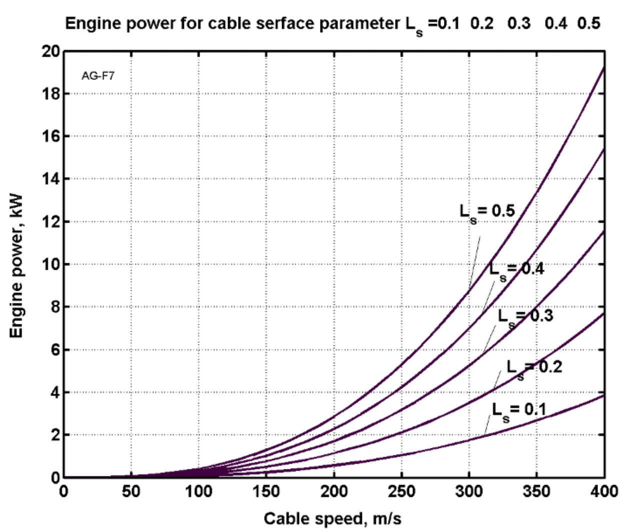

Fig. 11: Engine power versus cable speed for the cable surface parameter $L_S = L^{0.8}\, s = 0.1 – 0.5$.

The power P of cable air drag D is

$$P = DV = 0.5(D_T V + D_L V) = 0.5(P_T + P_L), \quad V = \sqrt{\sigma/\gamma} \ . \qquad (8)$$

The power of turbulent drag P_T and of laminar drag P_L, respectively is

$$P_L = 0.5 \cdot 0.664 \rho^{0.5} \mu^{0.5} \left(\frac{\sigma}{\gamma}\right)^{1.25} L^{0.8} s, \quad P_T = 0.5 \cdot 0.0592 \rho^{0.8} \mu^{0.2} \left(\frac{\sigma}{\gamma}\right)^{1.4} L^{0.8} s, \qquad (9)$$

where the total cable perimeter s of the round cables is

$$s = 2\sqrt{\frac{\pi n F}{\sigma - \gamma g H}} \ . \qquad (10)$$

Most of the engine power (80– 90%) takes the turbulent cable drag. In space there is no air, thus no air drag and we can use a very long cable. If the altitude H is small (up to 5 – 6 km), we can ignore the factor $\gamma g H$. In this case, the cable depends on the relation ($\sigma^{0.9}/\gamma^{1.4}$). As you see, a cable with low tensile stress σ and high density γ (for example, conventional steel cable) requires less power because the safe maximum cable speed is small ($V \approx 250$ – 350 m/s). However, the required cable weight increases 10 – 15 times. The round and single closed-loop cable (n = 2) requires minimum power. The plate and semi-circle cables require more power, but they may be more suitable for a drive mechanism.

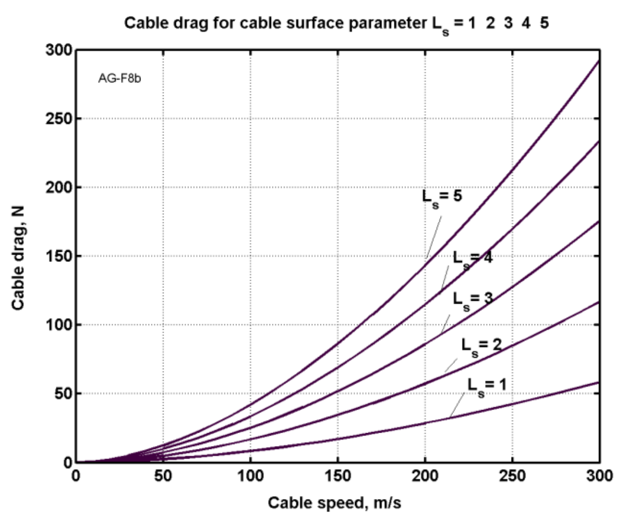

Fig. 12a: Cable drag versus cable speed for the cable surface parameter $L_s = L^{0.8} s$ = 1– 5.

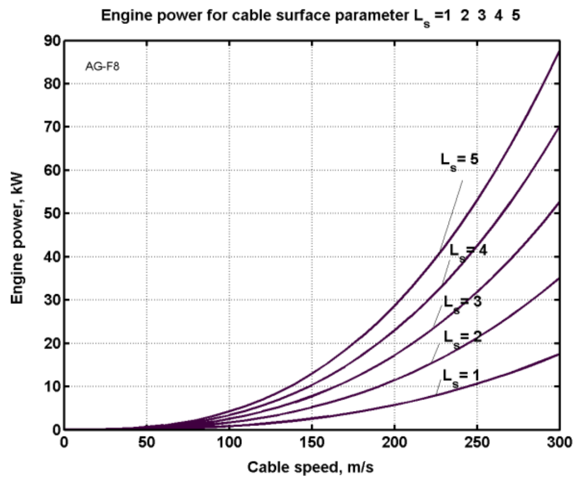

Fig. 12b: Engine power versus cable speed for the cable surface parameter $L_s = L^{0.8}\, s = 1\text{–}5$.

b) Air drag of supersonic and hypersonic double cable. Below, the equation from Anderson[6] for the computation of local air friction for a two-sided plate is given.

$$\frac{T^*}{T} = 1 + 0.032M^2 + 0.58\left(\frac{T_w}{T} - 1\right), \quad M = \frac{V}{a}, \quad \mu^* = 1.458\times 10^6 \frac{T^{*1.5}}{T^* + 110.4},$$

$$\rho^* = \frac{\rho T}{T^*}, \quad R_e^* = \frac{\rho^* V x}{T^*}, \quad C_{f,L} = \frac{0.664}{(R_e^*)^{0.5}}, \quad C_{f,T} = \frac{0.0592}{(R_e^*)^{0.2}},$$

$$D_L = 0.5C_{f.l}\rho^* V^2 S, \quad D_T = 0.5C_{f.t}\rho^* V^2 S, \quad D = 0.5D_T + 0.5D_L, . \qquad (11)$$

Where[6]: T^*, Re^*, ρ^*, μ^* are the reference (evaluated) temperature, Reynolds number, air density, and air viscosity respectively. $M = V/a$ is the Mach number, a is the speed of sound (m/s), V is cable speed (m/s), x is the length of the plate (distance from the beginning of the cable) (m), T is flow temperature (°K), T_w is body temperature (°K), $C_{f.l}$ is a local skin friction coefficient for laminar flow, $C_{f,t}$ is a local skin friction coefficient for turbulent flow. As S is the area of skin (m^2) of both plate sides, it means for the cable we must take $0.5S$; D is the general air drag (friction) (N). It may be shown that the general air drag for the cable is $D = 0.5D_T + 0.5D_L$, where D_T is the turbulent drag and D_L is the laminar drag. For a **horizontal** cable, the friction drag can be computed using equation (8) where $\rho = \rho^*$, $\mu = \mu^*$. From equation (11) we can derive the following equations for turbulent and laminar boundary flows of a **vertical** cable

$$D_T = \frac{0.0592s}{4}\rho_0^{0.8}\left(\frac{T}{T^*}\right)^{0.8}\mu^{0.2}V^{1.8}\int_{H_0}^{H} h^{-0.2}e^{0.8bh}dh = 0.0547d\left(\frac{T}{T^*}\right)^{0.8}\mu^{0.2}V^{1.8}\int_{H_0}^{H} h^{-0.2}e^{0.8bh}dh,$$

$$D_L = \frac{0.664s}{4}\rho_0^{0.5}\left(\frac{T}{T^*}\right)^{0..5}\mu^{0.5}V^{1.5}\int_{H_0}^{H} h^{-0.5}e^{0.5bh}dh = 0.5766d\left(\frac{T}{T^*}\right)^{0.5}\mu^{0.5}V^{1.5}\int_{H_0}^{H} h^{-0.5}e^{0.5bh}dh, \qquad (12)$$

where s is the cable perimeter. The laminar drag for high speed is 50–300 times less than the turbulent drag and we can ignore it. Engine power and additional cable stress can be computed using conventional equations:

$$P = 2DV, \quad \sigma = \pm\frac{D}{S} = \pm\frac{4D}{\pi d}, \tag{13}$$

The factor 2 is needed because we have two branches of the cable: one moves up and the other moves down. The drag does not decrease the repulsive (lift) force because in the different branches the drag is in the opposite directions. Computations of equation (6) are presented in Figs. 10 to 12 for low cable speeds and in Fig. 13 and 14 for high cable speeds for different value $L_s = L^{0.8}\,s$.

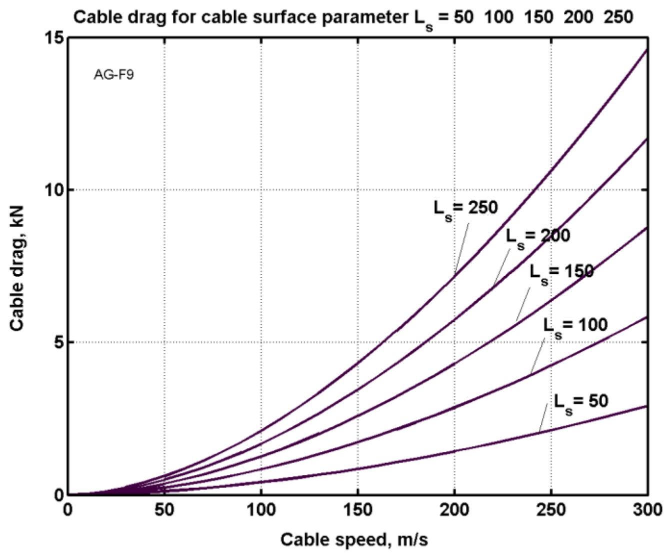

Fig. 13: Air cable drag versus cable speed for the cable surface parameter $L_s = L^{0.8}\,s$ = 50–200.

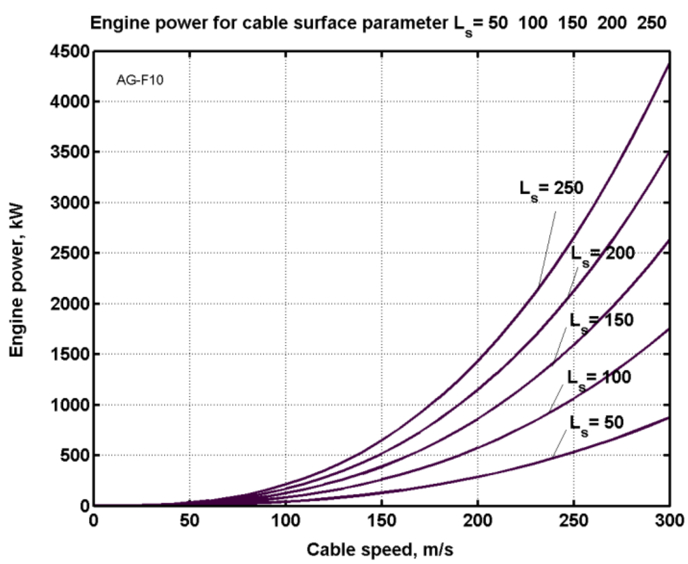

Fig. 14: Engine power versus cable speed for the cable surface parameter $L_s = L^{0.8}\,s$ = 50–200.

6. Limitations Contingent Upon Wind

Wind: speed, duration, altitude distribution, speed distribution

Wind is important element of the offered method. The wind vortexes from buildings and trees are located at near Earth surface. We can calculate the minimum and maximum admissible wind for the kinetic tower.

$$\frac{dH}{dV}=-V,\quad \frac{dV}{dt}=g-\frac{D}{m},\quad \frac{D}{m}=C_D\frac{\rho aV}{2p},\quad p=\frac{0.5C_D\rho aV}{gN},\quad p\geq 0,\quad \frac{D}{mg}\leq N,$$
$$for\quad H=0-10km\quad \rho=1.225e^{-H/9218},\quad for\quad H=10-\infty\quad \rho=0.414e^{-(H-10000)/6719}, \tag{14}$$

where H – altitude (m), V – speed (m/s), t – time (sec), m – mass (kg), D – drag (n), g =9.81 m/sec^2 – gravity, C_D – drag coefficient, ρ - air density (kg/m^3), a – sound speed (m/sec), p – parachute specific load (kg/m^2), N – overload (g).

Wind speed increases with height. The speed may be computed by equation

$$\frac{V}{V_0}=\left(\frac{H}{H_0}\right)^{\alpha}, \tag{15}$$

where V_0 is the wind speed at the original height, V the speed at the new height, H_0 the original height, H the new height, and 〈 the surface roughness exponent (Table 2).

Table 2: Typical surface roughness exponents for power law method of estimating changes in wind speed with height [17]

Terrain	Surface Roughness Exponent, α
Water or ice	0.10
Low grass or steppe	0.14
Rural with obstacles	0.20
Suburb and woodlands	0.25

The result of computation of equation (15) for different heights is presented in Fig.15. The wind speed increases on 20-50% with height.

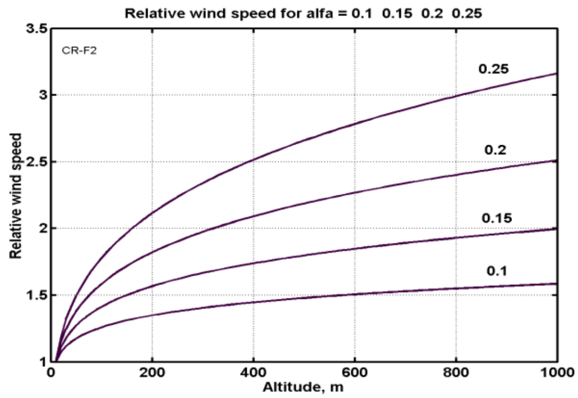

Fig.15: Relative wind speed via altitude and Earth surface. For sea and ice α = 0.1**.**

Annual Wind speed distribution

Annual speed distributions vary widely from one site to another, reflecting climatic and geographic conditions. Meteorologists have found that the Weibull probability function best approximates the distribution of wind speeds over time at sites around the world where actual distributions of wind speeds are unavailable. The Rayleigh distribution is a special case of the Weibull function, requiring only the average speed to define the shape of the distribution.

Equation of Rayleigh distribution is

$$f_x(x) = \frac{x}{\alpha^2}\exp\left[-\frac{1}{2}\left(\frac{x}{\alpha}\right)^2\right], \quad x \ge 0, \quad E(X) = \sqrt{\frac{\pi}{2}}\alpha, \quad Var(X) = \left(2 - \frac{\pi}{2}\right)\alpha^2, \qquad (16)$$

where α is parameter, is illustrated in Figs. 16 and 17.

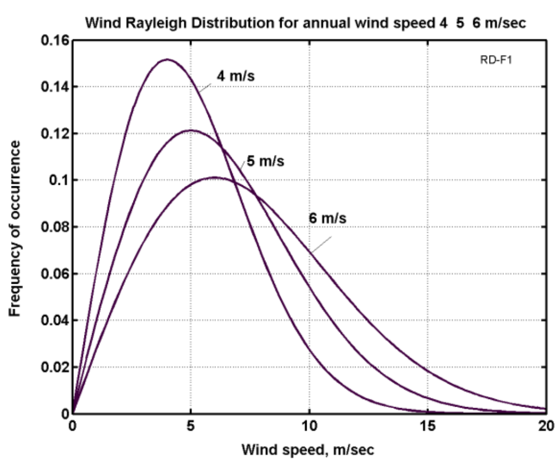

Fig. 16: presents the annual wind distribution of average speeds 4, 5, and 6 m/s.

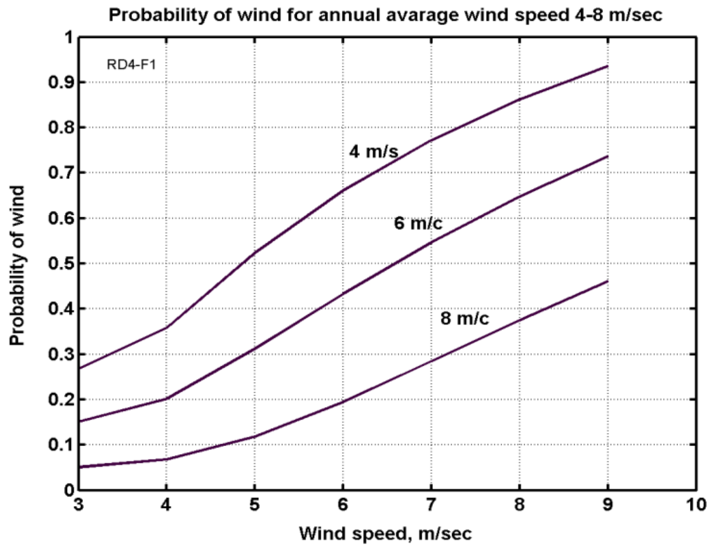

Fig. 17: Wind speed distribution**.**

7. Viewing Distance (distance of video signal)

The distance L which can be viewed of the Earth from a high altitude (antenna) is given by

$$L = \sqrt{2R_e H + H^2}\,, \tag{17}$$

where R_e = 6378 km is the Earth radius, H is an antenna altitude. The results of computation show that video signal in distance of hundreds of times more than current MAV, which has range only 0.3 – 1 km).

8. Mass and Admissible Current of Wire

The admissible current in wire depends from relation a gross-section area to a cooled wire surface. That why it linearly depends upon diameter of wire. For aluminum and copper wire these ratios are following respectively:

$$J_1=8d, \quad J_2=10d\,, \tag{18}$$

where J_1, J_2 are admissible current (ampere), d is wire diameter (mm). Result of computation is in Fig.18.

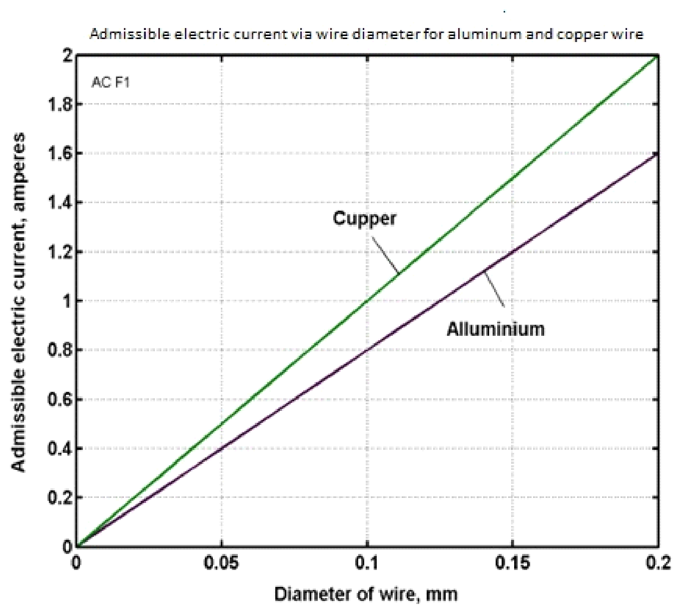

Fig. 18: Safe electric current via wire diameter for aluminum and copper wire.

The weight, W (g) of wire is respectively

$$W_1 = \frac{\pi}{4} d^2 \gamma_1 L , \quad W_2 = \frac{\pi}{4} d^2 \gamma_2 L , \tag{19}$$

where d is wire diameter (cm), γ - density (g/cm^3), L is a wire length (cm). For aluminum γ = 2.7 g/cm^3, for copper γ = 8.93 g/cm^3. The result of computation for L = 100m is presented in Fig. 19.

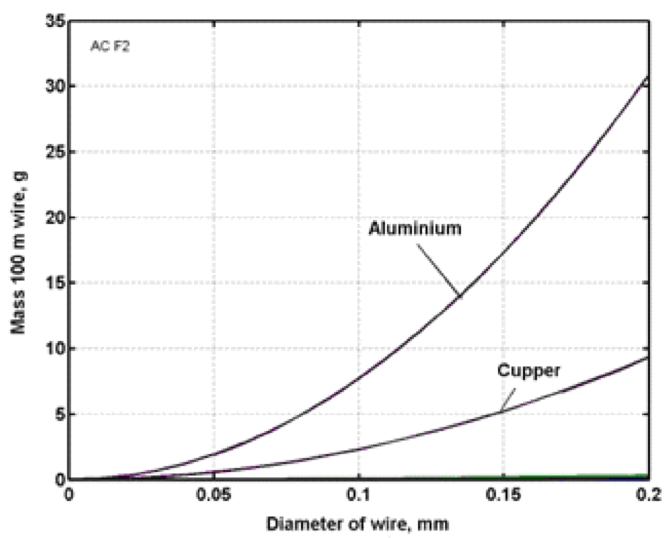

Fig. 19: Mass of 100 m aluminum and copper wire + 10% of wire cover (isolator), g.

9. Kinetic tower of height 4 km and variants for security applications

Take a conventional artificial fiber widely produced by industry with cable performances as follow: admissible stress is σ =180 kg/mm^2 (maximum σ = 600 kg/mm^2, safety coefficient n = 600/180 = 3.33), density is γ = 1800 kg/m^3, cable diameter d =10 mm.

The special stress is $k = \sigma/\gamma = 10^6$ N/m^2 ($K = k/10^7 = 0.1$), admissible cable speed is $V = k^{0.5}$ =1000 m/sec., the cable cross-section area is $S = \pi d^2/4$ = 78.5 mm^2, useful lift force is $F = 2S\gamma(k\text{-}gH)$ = 27.13 tons; requested engine power is P = 16 MW (Eq.(10)), cable mass is $M = 2S\gamma H = 2\cdot 78.5\cdot 10^{-6}\cdot 1800\cdot 4000$ = 1130 kg.

The variants

a) Flying "superman" (Fig. 20a). Taking on altitude H = 100 m, the maximum load is M = 200 kg (this is enough for superman, his equipment, an engine and a parachute for safety). The steel cable has cables is $S = Mg/\sigma$ = 2 mm^2, cable diameter is d = 1.6 mm, the perimeter of the four cables is s = 10 mm. The cable mass is $m = SL\gamma$ = $2\times10^{-6}\times100\times7800$ = 1.56 kg, and cable speed is $V = \sigma/\gamma = 10^9$ 7900 = 356 m/s. Area parameter is $L_S = L^{0.8}s$ = $100^{0.8}$ 0.01 = 0.4 . The cable drag is D = 31 N (Fig. 10 or equations (9) – (10)), and the required engine power is P = 11 kW (Fig. 11). The cable can be made from transparent fibers and in any case it will be invisible from a long distance.

b) Walking "superman" or vehicle (Fig. 20b). The lower rollers can be made separately and have separate controls. This allows the supermen to walk, run, and move with high speed. For example, if the previous flying superman described above takes one step (length 100 m) in 2 seconds, he will have a speed of 180 km/hour.

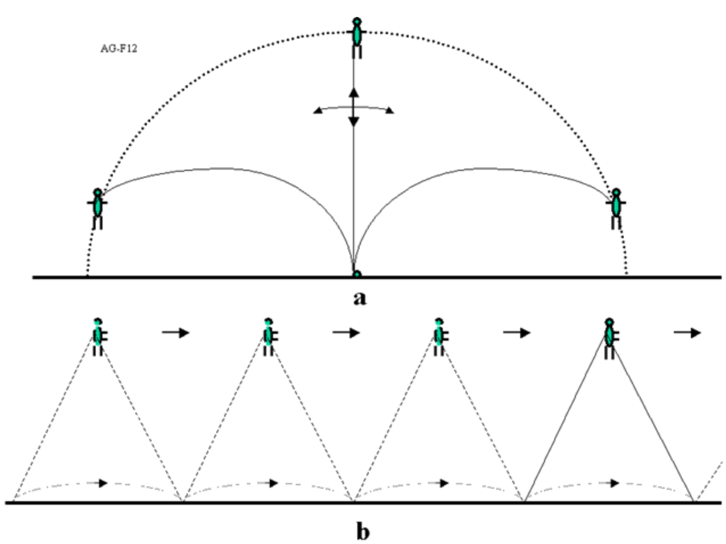

Fig. 20a: Flying superman using the kinetic anti-gravitator. b) Legged (walking) superman using two kinetic anti-gravitators.

c) Jumping (pogo-stick) "superman" (Fig. 21a). Assume the short kinetic anti-gravitator gives a man of mass M = 100 kg the speed V = 70 m/s with acceleration $a = 3g = 30$ m/s^2. The cable length is $L = V^2/2a = 70^2/2\times30$ = 82 m. The time of acceleration $t = V/a = 70/30 = 2.33$ seconds. The total cross- section areas of all cables is $S = Ma/\sigma = 100\times30/200\times10^7 = 1.5$ mm^2, and the cable mass is $m = SL\gamma = 1.5\times10^{-6}\times 82 \times 1800 = 230$ g. The jump distance at an angle $\alpha = 45^o$ without air drag (it is small at this speed) is $J = V^2/g = 70^2/10 = 490$ m, the altitude is $H = V^2\sin\alpha/2g = 70^2 \sin 45^o/20 = 173$ m, jump time is about 10 seconds. The required starting thrust is 300 kg, and the start (jump) power is about $P = E/t = mV^2/2t = 100 \times 70^2/2 \times 2.33 = 105$ kW, but the start energy will be restored in landing except for the air drag loss of 10–20%. If we have an energy accumulator, a permanent power of 5 –10 kW will be enough for this device.

d) Jumping vehicle. Assume the kinetic anti-gravitator gives a vehicle of mass $M = 1000$ kg the speed of $V = 200$ m/s with acceleration $a = 8g = 80$ m/s^2 (which is acceptable for military soldiers). The cable length is $L = V^2/2a = 200^2/2/80 = 250$ m. The time of acceleration $t = V/a = 2.5$ seconds. The jump distance at an angle of 45° without air drag (it is not very much for a streamlined body) is about 4 km, the altitude is 1.4 km, and the jump time is about 20 seconds. The cross-section area of all the cables is $S = Ma/\sigma = 1000\times80/200/10^2 = 40$ mm^2 . Cable mass is $m = SL\gamma = 40\times10^{-6} \times 250\times1800 = 18$ kg. The restored in landing except for the air drag loss of 10–20%. If we have an energy accumulator, an engine with 500–800 kW power will be enough for this device. The vehicle can have a small wing (area 2 m^2) and glide from an altitude of 1.4 km for a distance of 14–17 km to the selected place for the next jump.

e) Long arm (long hand) (Fig. 25b). The proposed method allows us to create a "long arm" which suspends a video camera or weapon aloft. Assume the load mass of the long hand is M = 2 kg and the hand has a length of 1 km. The hand uses a steel cable with σ = 100 kg/mm^2 and γ = 7.9 g/cc. Maximum speed is

$$V = \sqrt{\sigma/\gamma} = \sqrt{10^9/7900} = 356 \text{ m/s.} \qquad (21)$$

The cross-section area is $S = M/\sigma = 2/100 = 0.02$ mm^2, $d = 0.08$, $s = 1$ mm, and the cable mass is $m = SL\gamma = 0.02\times10^{-6}\times1000\times7900 = 158$ g. The cross-section area parameter is $L_s = L^{0.8} s = 1000^{0.8} \times 0.001 = 0.25$. The cable drag is $D = 20$ N (Fig. 10 or equations (9) – (10)), and the required engine power $P = 6.8$ kW (Fig. 11). The operator (e.g. a soldier) can observe regions within a 1 km radius and immediately apply the weapon if necessary. The radius may be increased up to 10 km. If using a more powerful kinetic anti-gravitator that can hold a load of 200 kg with a net and catcher installed at the end of the cable, the operator can catch the soldier and deliver him or her to another place. This may be very useful for rescue and anti-terrorist operations.

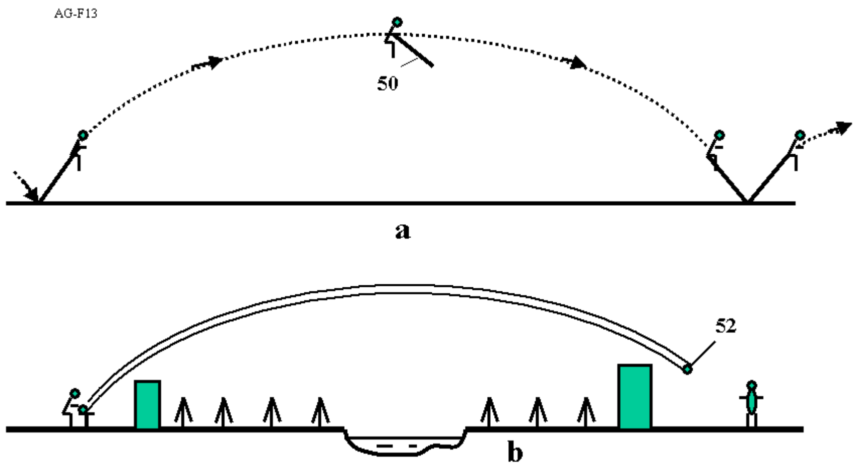

Fig. 21a: "Superman" using the jump kinetic anti-gravitator (50). **b**) The super-hand (52), which allows operation at long distances of 1–10 km.

10. High altitude crane

The construction of skyscrapers needs high cranes. Consider the design of a crane of $L = H = 500$ m height using the offered method. Take the useful load as 1 ton and the steel cable as having safe tensile stress of $\sigma = 50$ kg/mm^2 and cable density of $\gamma = 7.9$ g/cc. The total cross-section cable area is (equation (8)) $S = F/(\sigma - \gamma g H) = 22$ mm^2. The cable mass is $m = S\gamma H = 2\times10^{-6}\times500\times7900 = 87$ kg, and safe cable speed is $V = (\sigma/\gamma)^{0.5} = 250$ m/s. If the installation has four cables of diameter $d = 2.6$ mm each, the total perimeter of the four cable is $s = 4\pi d = 33.2$ mm, the parameter $L_s = L^{0.8} s = 500^{0.8}\, 0.0332 = 4.8$, the cable air drag is $D = 200$ N (Fig. 10, equation (9-10)), and the required power to support cable rotation is $P = 50$ kW (Fig. 11, equation (10)). This is the highest (500 m) and the lightest (87 kg) crane in the world having a load capability of 1 ton.

11. High tower

Consider the design of a high tower of $L = H = 4$ km using the offered method. Take the useful load as 30 tons and the steel cable as having a safe tensile stress of $\sigma = 50$ kg/mm^2 and cable density of $\gamma = 7.9$ g/cc. The total cross-section (all branches) of the cable area is (equation (9.4)) $S = F/(\sigma - \gamma g H) = 1630$ mm^2. Cable mass is $m = S\gamma H = 51.5$ tons, and safe cable speed is $V = (\sigma/\gamma)^{0.5} = 250$ m/s. If the installation has four cables, the diameter of one cable is $d = 23$ mm, the total perimeter of the four cable is $s = 4\pi d = 0.289$ m, the parameter $L_s = L^{0.8}s = 4000^{0.8}\cdot 0.289 = 220$, the cable air drag is $D = 9500$ N, and the required power to support cable rotation is $P = 2.3$ MW. This is highest (4 km) and the lightest (52 tons) tower in the world, which has a load capability of 30 tons at the top.

Conventional steel cable has a maximum tensile stress of $\sigma = 300$ kg/mm^2 and density of $\gamma = 7900$ kg/m^3, and fiber steel cable has a tensile strength of about $\sigma = 2000$ kg/mm^2. At present, industry widely produces cheap artificial fibers with a maximum tensile stress of $\sigma = 500$–620 kg/mm^2 and density[10.11] $\gamma = 800$–1800 kg/m^3. Whiskers have $\sigma = 2000$–8000 kg/mm^2 and density[10] $\gamma = 2000$–4000 kg/m^3, and–1800 kg/m^3. Theory[11] predicts that nanotubes can have $\sigma = 100{,}000$ kg/mm^2 and density $\gamma = 800$ –1800 kg/m^3. We will consider a double closed-loop cable in projects below. We will also use the conventional steel cable that has confirmed (safety, permitted) tensile stress of $\sigma = 50$–100 kg/mm^2 or the conventional fibers with a maximum confirmed strength of $\sigma = 200$ kg/mm^2 and density $\gamma = 1800$ kg/m^3. This means the safety factor is 3–6 or 2.5–3.1. The use of whiskers or nanotubes dramatically improves the parameters of the kinetic anti-gravitator for long distances.

12. Discussion

According to Eli Yishai, one of four Deputy Prime Ministers, and Minister of Internal Affairs in 2011 revealed that at that time, Israel faced over 100,000 missiles

“In a speech to Shas activists in the north on Monday Yishai said "this is a complicated time and it's better not to talk about how complicated it is. This possible action is keeping me awake at night. Imagine we're [attacked] from the north, south and center. They have short-range and long-range missiles - we believe they have about 100,000 rockets and missiles." [18].

"It's difficult to sleep at night when you know what is going on," said the minister, in an uncharacteristically dramatic statement. "Remember the Second Lebanon War, how many missiles there were – the entire North ran away. Imagine the North, Center and South… I do not want to scare anyone, but the missile array of Hamas, Hizballah and the Syrians, the approximate number of long and short-range missiles approaches 100,000 missiles. Try to calculate G-d forbid what that can do." [19].

In an updated estimate of what missiles are in Gaza alone, at the start of the summer 2014 conflict, Hamas had approximately 12,000 rockets of various ranges, including long-range rockets. It fired approximately 4,600 rockets during the 50-day war, and roughly 4,000 more were hit from the air in Israeli bombardments. That left the terror group with about one-third of its original arsenal. [20] Every estimate before a war has been wrong as to quantity: It is implausible they have fewer than 50,000 rounds and more than 500,000. Until a war starts, the extent of their arsenal is unverifiable, and then it is too late.

Projectiles and Mortar Shells

Composed of inexpensive materials, the short range Kassem missiles have bombarded Israel mainly from Gaza but at times from the Sinai Peninsula. These projectiles are strong enough to penetrate buildings and kill and maim by shrapnel. The effects include:

- Horror of sudden death wears down morale.
- Even dud Qassams can cause slow erosion of a city.
- Forces people to flee city en masse.
- Fleeing cities can greatly complicate defense mobilization.

If Israel can't mobilize, it can lose a war!

Israel's various opponents are developing an ability to salvo 100 missiles an hour for weeks**.** Routine alerts that destroy normal life, are eventually ignored. Ignoring enemy fire– even duds– also discourages Israelis believing that their government cares. Israel must also be prepared for escalation.

Window Breaking Distance

Danger is not just from direct hits, but sizeable explosions can blow out all glass in a city. It is impossible to replace windows in a whole city in less than a half year– imagine this happening during a cold rainy winter! There is a significant danger of horrible injuries from glass blowout. The computations are as followed:

- 1 PSI—11 miles = 17.702784 kilometers from 1 megaton
- ~ 4 km from 20 kilotons
- ~ 170 meters from 1-ton warhead

Spread of Bombardment

In 1991, Saddam Hussein bombed Tel Aviv. For a month and a half, long-range missiles landed on the city. In 2006, every major city in northern Israel was hit, including Haifa, Nazareth, Tiberius, Nahariya, Safed, Afula, Kiryat Shmona, Karmiel, and Maalot, along with dozens of kibbutzim, moshavim, and Druze and Arab villages. During the 2006 war, a total of 1012 Katyusha missiles hit Kiryat Shmona. Approximately half of the city's residents had left the area, and the other half who remained stayed in bomb shelters.

Effect of Bombardment

- Kiryat Shemona 2006: evacuation of more than 350,000
- 2001-2008 Missile bombardment of Sderot and Western Negev -Israel managed to attack 7,000 targets in 34 days from the air, the result of Israel's ability to combine real-time intelligence with air force power. Out of the 7,000 targets, about 1,000 were pre-planned.

Israel is often bombarded from Gaza, over 15,000 missiles since the 2005 withdrawal, putting nearly one million Israeli citizen citizens under direct threat every day. [21] Over 6,000 have hit Sderot since the evacuation from Gaza. What the residents of Sderot, Ashkelon, and environ, are qassam missile. Range of missiles launched from Gaza is illustrated in Fig. 22.

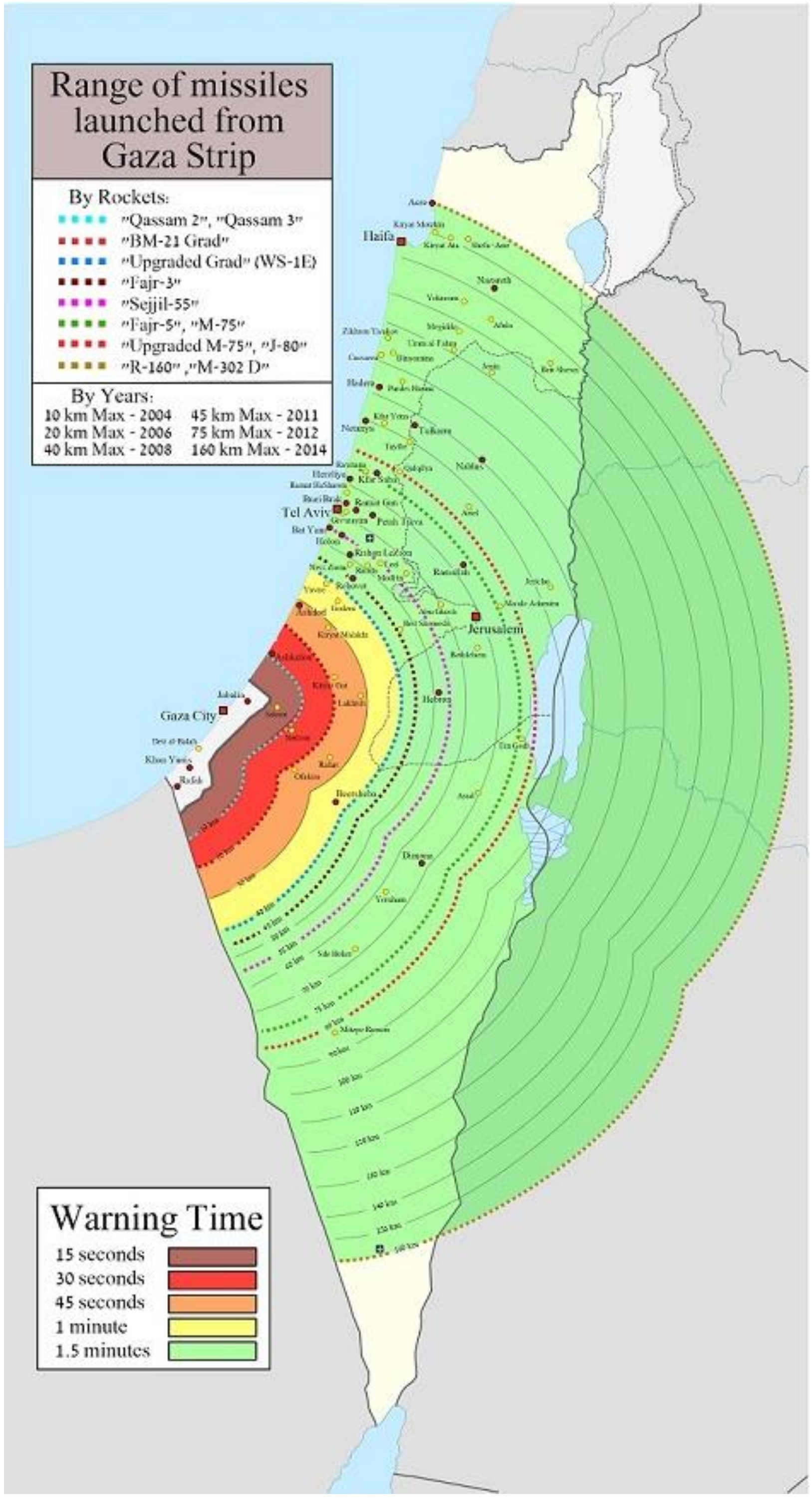

Fig. 22: Hamas Missile Ranges. Although some of their medium range missiles reached Tel Aviv and Jerusalem, which by and large are downed by Iron Dome, the closest targets are less protected. These are the locations frequently targeted.

Iron Dome is effective if they never run out of interceptors, but reality is within a week (even with the trick of only intercepting the ones that would do damage), it is expected that it will start having to conserve defenses to vital targets like Dimona or Ben Gurion. Lebanon (Fig. 23) and Gaza are now launching pads.

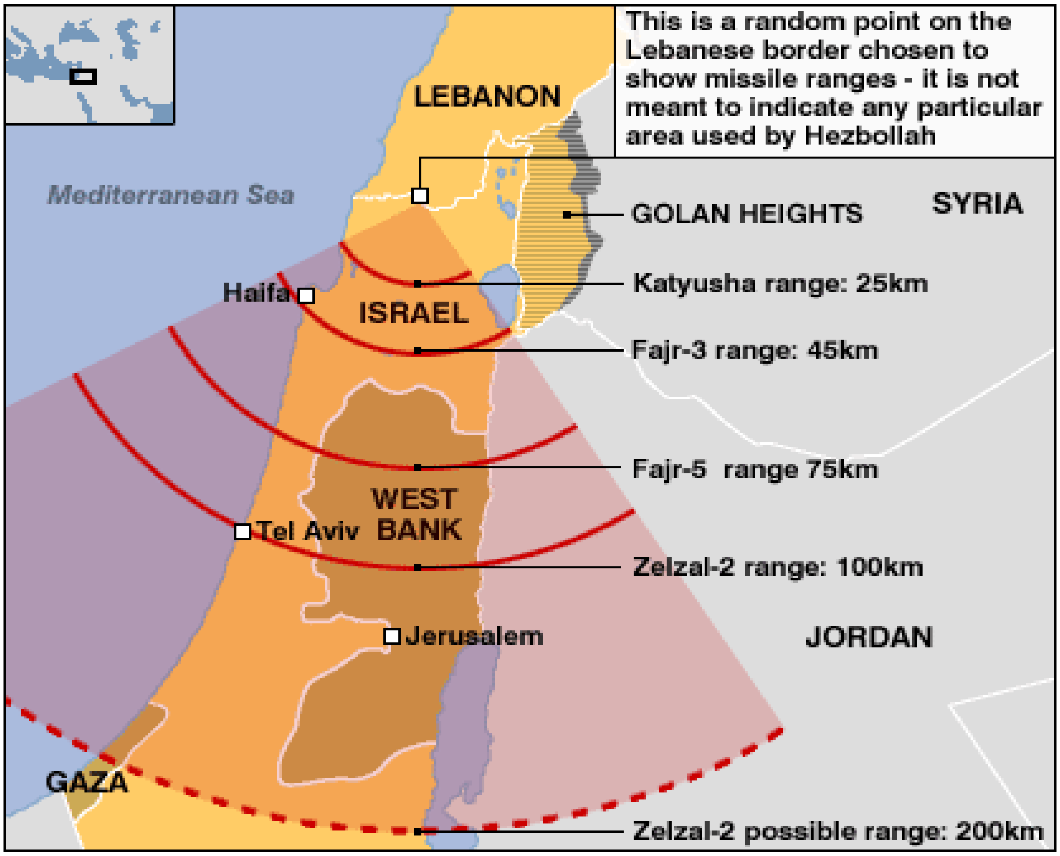

Fig. 23: Range of Missiles Launched from Lebanon

Right now, the infrastructure for simultaneous multi-front launches are being put in place by Iranian proxies. Hezbollah in Lebanon and Syria and Hamas in Gaza, and from Iran itself.

Applications of Retractable Kinetic Tower for National Defense

General positive trends in security should not obscure the erosion of security: The gradual buildup of enemy strike capability, in the hundreds of thousands of rounds and the erosion of deterrence so nearly every day some new provocation occurs. Government spokesmen say they will not tolerate strikes from Gaza but of course they do. Negligence toward border defense will destroy the State’s relation with border communities. As such, Israel is in dire need of a technology that can comprehensively protect civilian and governmental centers from missiles, fire kites, fence approaches and other increasing threats. Patriot, Iron Dome and other anti-missile missiles are prohibitively expensive and do not effectively stop all but the most hittable short-range missiles. The proposed kinetic tower fills this unique position in this situation. Three such kinetic towers could throw up a point anti-missile barrier on demand over a vulnerable target. If 5-kilometer range can be established for each kinetic tower, 20 could provide real time protection for the entire Gaza border (with appropriate weapons heads fitted)

Application of Kinetic Tower to Stop Border Infiltrations, Fire Kites and Snipers

More recently, the Gaza demonstrations and infiltrations by way of under the wall tunnels or over the wall incendiary kites which destroyed more than 17,000 dunam of crops (a dunam is 1/1000th square kilometer) and nature reserve highlight the impotence of a purportedly strong army which sparingly used live ammunition where there was clear and present danger to the lives of Israelis, but the diplomatic backlash was relentless.

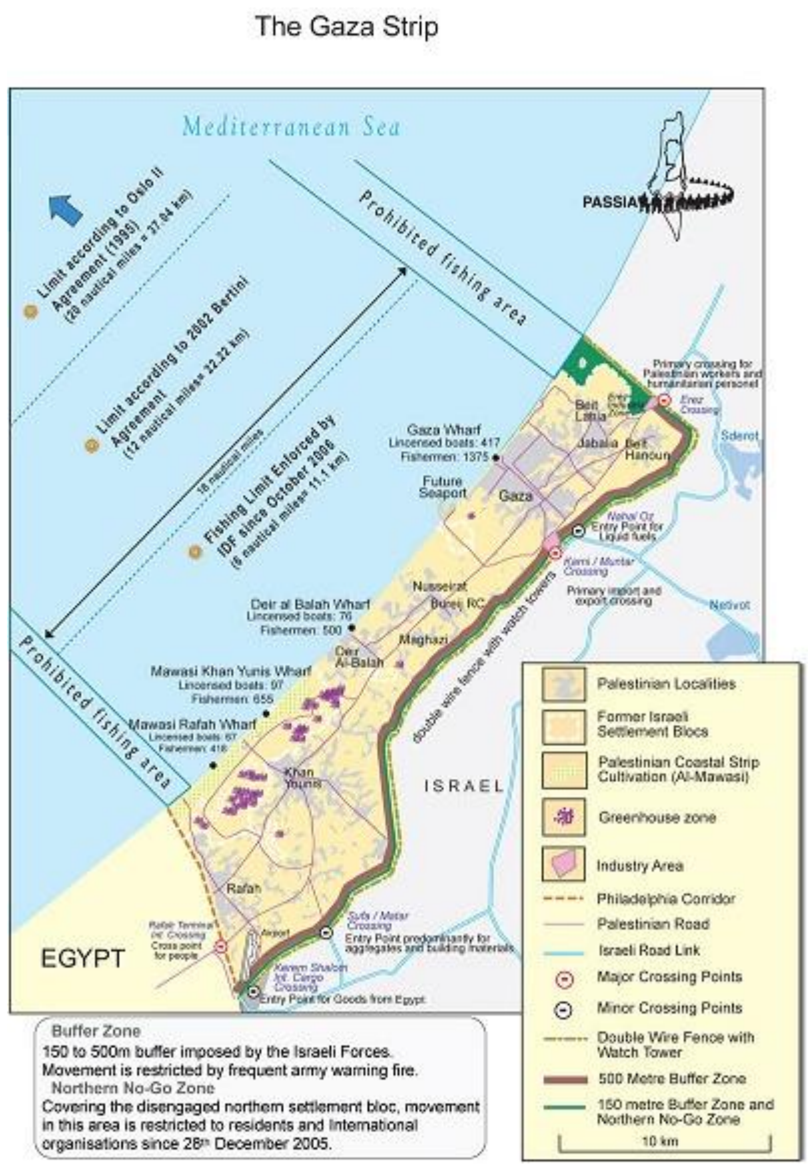

Fig 24: Map [22] by The Palestinian Academic Society for the Study of International Affairs [23].

Several kinetic towers rising up to meet the challenge of enemy combatants using women, children and medics as shields, could employ technologies at heights to repel groups from approaching the border. It is even possible to snatch an individual from the surface and capture him to a height with the right equipment, in seconds. It would take about twenty kinetic towers to fully cover Gaza's border, (Fig. 24) and about 30-40 to provide a full range of useful capabilities including intercepting flyby missiles.

For example, one Active Denial System, [24] a US nonlethal crowd-control device firing a beam of 94-Ghz microwaves (known as millimeter waves) could have a horizon and range sufficient to cover almost half a kilometer of the border, certainly the most troublesome and densest areas, all at once. It is certain that a dozen such devices rearing up at unpredictable places and times, could give the most determined group of people pause, certainly after the first painful exposure. The problem is the actual US ADS is not terribly practical in terms of its power supply logistic train or anything else. But there are other designs of crowd repellent that would be practical to deploy, though not as safe.

And in another configuration, this can act as a "long arm" to extract someone from up to 10 km. This would enable interventions anywhere in Gaza from our side of the border without using drones. The key is constant variable height surveillance of the border and instant reaction without needing to trigger a drone launch which can give pre-warning to enemies and blind spots of coverage during sortie rotation.

Empirical Validation and Proof of Concept

At the end of the day this is an empirical question. If this device is built and is operational, then it is a question of scalability. A cowboy can trill a lasso in either horizontal or vertical position Fig. 25 (for video illustration, references [25, 26]). These same forces that enable the lasso to maintain its shape if force is exerted are the same ones underlying the kinetic tower. However, proof of concept requires a working small-scale model of kinetic tower functions. Such a small-scale device has been constructed and proved to be functional as shown in Fig. 26.

Experiments requested by author and performed by Mr. Gregory Lishanski in 2002– 2003 show the revolving straight closed-loop cable is stable in the vertical and horizontal positions. (Fig. 26) Lishanski's experiments provide empirical evidence that kinetic anti-gravitator creates a permanent controlled force. If the distance between bodies does not change, the kinetic anti-gravitator requires only a small amount of energy to compensate for the friction in the rollers and air. This is certainly true below sonic velocity.

Fig. 25: Lasso trilled in vertical position.

Fig. 26: Rotated closed-loop cable-vertical position.

Summary

While Israel possesses early warning systems after the launch, it needs a mechanism to view actions before the launch not just to make its reprisals accurate, but more importantly to prevent the launch. Kinetic Towers on the bed of trucks which are hidden from view by the security wall, can be driven to driven to locations which intelligence reports make suspect, and the antenna like kinetic tower rises to heights to see suspected locations and strike before the launch. Alternatively, the kinetic tower can be used to launch aircraft such as inexpensive and motor less gliders to observe and deliver a payload at the site of the launch. As these gliders are inexpensive and low tech compared to hi-tech gliders currently in use.

References

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