

# Warangal Fort is an Impact Crater? Discussions and Hypothesis

Deepak Bhattacharya and Pradeep Ramancharala\*

Department of Earthquake Engineering and Registrar Indian Institute of Information Technology, Hyderabad, India  
At/ Sri Radha Krishna, Kedar Gouri Road, Bhubaneswar – 751002, India. 0-8658248606

## Abstract

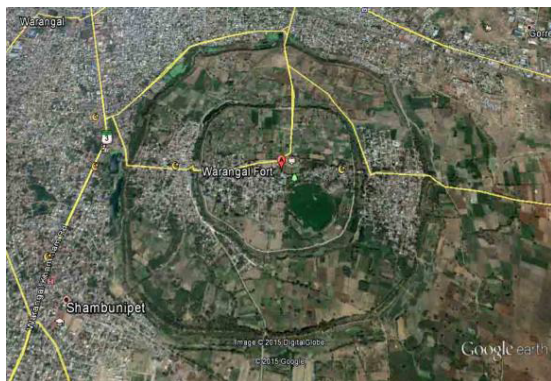
Warangal fort, India is the case study. Impact craters are catastrophic natural events. Circular rings are associated. Some have mono others have dual. Principles and mechanics of ring formation are discussed and a unique 'Cone Concept' is hypothesized. Anecdotal evidences are factored in multidisciplinary method. A shock wave diverter is designed based on 'cone concept' and gem formation. Gem formation is also discussed. Impact preceded evolution of Homosapiens who may have occupied it as most, best, safe, preferred habitat. Useful in civil engineering, heritage studies and Smart Cities. A first time, original report.

**Keywords:** Impact crater; Dual rings; Cone concept; Shock wave diverter; Civil engineering; Smart cities

## Introduction

In the literature pertaining to impact craters, the Lonar crater (Dist. Aurangabad-Maharastra) is the sole from India [1]. We have earlier reported two 'impact crater' type geomorphic members [2]. In these presents we focus on the Warangal fort site, Telengana, India. The imperial Kakatiyas had their capital here and have also left behind extensive grandiose archaeological remains, with deft use of granite (as done nowhere else in India [3]). The Kohinoor diamond belonged to the Kaktiyas! Historians and archaeologists have indicated the pre-existence of a wall like earth-and-rubble make ring datable to pre 13<sup>th</sup> AD, (undetermined) [4]. It posits to be a unique site (apart a possible new find) and as a possible interesting case wherein civilisation arose out of natural hazard and adopted it in continuum.

Figure 1a is the satellite image of the Warangal fort, Telengana, India (downloaded from Google-Earth, with Thanks). Figure 1b is the site map hoisted by the Archaeological Survey of India. We can see that it comprises of 2 rings and a water spot. Total radii is roughly of the order 1.8 Kms which works out to 36 sq kms. All this clearly proves the dual ring circular format (as recorded by satellite in the visible spectrum). The ring duo is typically circular. There seems to be a natural symmetry. This also suggests a complex architecture (not simple crater). We identify it as a possible 'impact crater'. Such identification and interpretation makes the caption a first time matter and posits the geomorphologic candidate as a possible new find (geologic). Thus arise the opportunities.



**Figure 1a:** Google Earth Sat pix., visible range. Warangal Fort complex; Dual rings.

The mechanics of ring formation has scantily been discussed in literature. They have been assumed as products of mere (simple) surface waves. In this 'Technical Note' (theoretical) we focus on such scholastic area based on field observations and experience based ideas as 'hypotheses. We do more so to draw the attention of the young, the enterprising and the more enabled minds, early in the day.

In Figure 1c only mono ring is indicated (only inner and the water spot are indicated). This is possibly the earliest on-foot official survey based geo-space record [5].

## Mechanics of Ring Formation

Figure 2a and 2b graphically state our hypothesis of the dual ring mechanics. There are 3 inverted cones, namely (i) core cone (ii) inner ring (iii) outer ring.

The core cone is created by the vertical component of the potential at impact. It dives down (alike bullet) and rebounds from the dense strata below. Impact (large meteorite crash) happens at absolute velocity. The



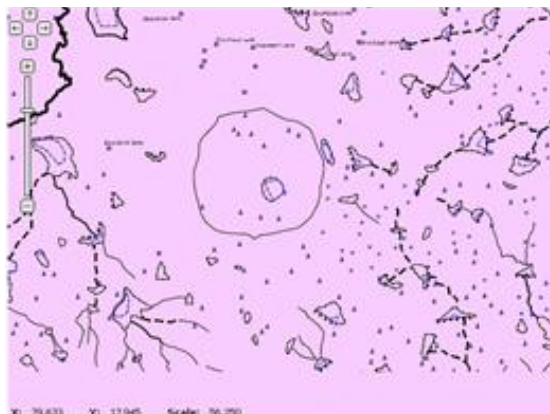
**Figure 1b:** Site map give the dual rings as 'ramparts' and mud fortification.

\*Corresponding author: Pradeep Ramancharala, Department of Earthquake Engineering, and Registrar Indian Institute of Information Technology, Hyderabad, India, Tel: 09391131199, 08658248606; E-mail: [ramancharla@iiit.ac.in](mailto:ramancharla@iiit.ac.in)

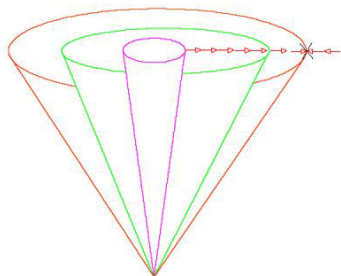
Received May 29, 2017; Accepted June 14, 2017; Published June 16, 2017

Citation: Bhattacharya D, Ramancharala P (2017) Warangal Fort is an Impact Crater? Discussions and Hypothesis. J Geogr Nat Disast 7: 203. doi: 10.4172/2167-0587.1000203

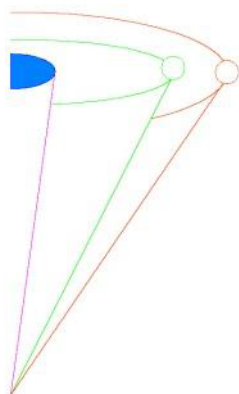
Copyright: © 2017 Bhattacharya D, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.



**Figure 1c:** NSDI, Web Map Service, Topo Sheet, Hydrographic No. E44N5 and No.E44N9 as per Railway Top Sheet Declaration, Govt. of India.



**Figure 2a:** Graphical presentation of the Cone Hypothesis. Lines of conjectured forcings. Rebound. Horizontal cancellation.



**Figure 2b:** Location of the rings and impact region (small rings).

core cone therefore represents the zone of entropy (narrow angled). This because a large depth dimension of the Y-axis (compared to the X). Simultaneous energy depletion with increasing crustal density and counter thrust (from around) a uniform constriction (tapering) of the energized area happens. Thus the inverted cone comes into being. It may have high compaction.

Momentum is work done potential per second/per second. And, momentum dissipates laterally efficiently in a radial form in homogenous media (boundary less conditions). Large meteorite impact energy (of near seismic scale) are pile drivers. Have a circular field (of disturbance) at surface (X-axis). As such potential dives

inward it experiences efficiency of conservation due to enhancing homogeneity of the plastic along the vertical column (Newton's 1<sup>st</sup> Law. The sole). However, spinning globular mass with hyper dense core (earth) experiences least cancellation and hence rebounds the impacted shock, efficiently. Such rebound is also alike a cone. Identical path of the rebound potential fails due energy depletion and also due to compaction (relative higher) that has happened in the incident\core cone=wider angled rebound.

Depletion of the impacted energy occurs due to dispersion which is simultaneous along X and Y axis. The horizontal component of the energy i.e., the X axis energy and the rebound energy i.e., the Y axis converge in near surface depths at a relative distance from the midpoint of the core cone (strata and moisture content dependant). Confluence of the forces results in upwelling which is signature of entropy (i.e., forthing liquefaction, and escape into the atmosphere). In order to conserve, mass has to increase (state change). Such liquefied mass piles up and builds up (incrementally) as the ring. While impact is instantaneous, the rebound and ring formation is a process (time scale phenomena). At such point in time the atmosphere is highly turbulent with down-turned barometric thrust of the atmospheric column. This provides more space. Pyroglastic conditions further delay quenching. All this results in sustained forthing and piling; prima facie a natural load structure. The inner ring is also the on-surface signature of a sub-surface cone. In space, meteorites are in a state of dynamic inertia. The earth is in static inertia (relative). The ground at impact site is of heterogeneous composition. Earth's gravity plays significantly on the meteorites that have large cross sections cum high specific gravity (large mass). Meteorite's velocity is distance traversed dependant. This because acceleration at hyper velocity and absolute momentum. On impact insults the static strata so much that the (heterogeneous) ground plastics within a given radii heave into a homogenous state. Unable to conserve the instantaneous injection of energy the surface and immediate sub-surface plastics liquefy (turbulent-hot-fluid media i.e., state change). The depth of the point of the rebound (cone vertices) is the factor for the radii of the inner ring and not the angle of incidence of the impact and or the architecture of the impactor (albeit cross section and mass matters more). The inner ring is a case of '(direct) rebound'. It is also the transverse wave/shock wave cum liquefaction region. The at-surface radial form and the sub-surface inverted conical architecture arises as natural selections alias preferred shapes due vertical/tangential flash injection of excess energy into solids. The circular inner ring region also represents the required area for neutralisation of the momentum (imparted radially most into the surrounding plastic and partially into the space). Apart, pulverization, atomization, fission, fusion, new compound formation with or without re-granulation becomes a distinct possibility (subsequent submission). At surface (inner ring region) the opposing lines of the forces initially cancel, finally balk and break the plastic(s) even the heterogeneous. Thence, chaos is in situ (explosion, subduction). The rebound forcings are closely angled to the vertical. This brings Newton's 2<sup>nd</sup> Law of Motion into play as the dominant and longitudinal wave failure (between the inner ring and the central vertical). Interestingly, the inner rings are marked by shearing, trenching, alternating throw of the debris, and in mixed size composition (typical seismic T wave left behind at surface signature).

The outer ring forms whence and where at surface horizontal component of the impact about to be neutralized by the strata that is in static inertia (instead) gets up-regulated due co-fluxing with the reflex energy (slanted forcings), as the magma resets its own {dented} interior architecture. Such confluence of the energy lines results in another upwelling (outer ring). It is a good case of delayed action mechanism.

The dual ring architecture is created when the soil contains moisture (bulking property). Else, mono ring is formed. And whereas, the impact crater rings are uniform circular upwelling(s). Such (complex and timed phenomena) occur primarily because (a) the lines of the forces are oblique i.e., slanted (b) homogenous behavior of the plastics involved (c) uniform rebound(s). All this supports the 'cone concept'. The at-surface rings, the (hypothesised) sub-surface cones are 'response architectures'.

Furthermore, the magma's convective currents vortically up well at certain location and sink at others as gravity waves. An impact coincident with upwelling region shall have the possibility of creating the delayed action 2<sup>nd</sup> rebound that makes the outer ring. An impact coincident with region of sinking magma shall then fail to have the outer ring. Such ideas have not been considered pre to these presents.

The Warangal dual rings indicate that during the time of the impact the soil plastic of the region had good moisture (as compared to present). If such from space impact hypothesis holds good, then the inner circle should be marked by fault and fissures and the inner region with marginal upheaval (geological and geographical survey due). At site Warangal, all these (geologic and geomorphic signatures) are quietly apparent to the informed eye (when we conducted foot survey).

### Numerical aspects

In the case of the Warangal impact crater the radius is determinable. The circular base area of the hypothetical inverted cone(s) as in Figure 2a shall be the products of  $\pi r^2$ .

Thereafter, we shall have to determine the depth (via geo engineering-sounding methods) at which may be located the vertices of such an (conjectured) cone. It will be the height (h) dimension. Alternatively, the depth of the base rock strata can also be assumed as the height (h) and results compared and corroborated with (evidence based data).

Using the base area and the height value we can arrive at the Volume (v) of such a cone by the formula  $v=(1/3) \pi r^2 h$ .

Thereafter, we can re-verify such conical architecture by calculating the slant heights (s) by using the formula  $s=\sqrt{(r^2 + h^2)}$ .

Further, the angle of the slant auto transpires on CAD platform.

This shall provide symmetry between the observed, the investigated and the numeric models.

The cone theory can possibly with easy be verified for each and every impact sites?

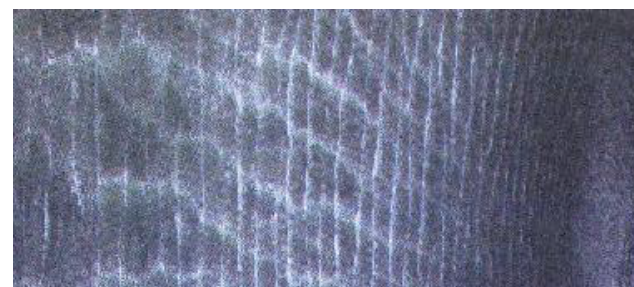
### Alternate concepts

Impact crater rings on every planet indicate (near) perfect circles. And, perfect circles arise out of tangential projectiles. The mechanics is of surface longitudinal waves of simple harmonic motion even with bottom friction; are not associated with jarring motion; are non-shearing; non-trenching; throw debris to the outer, uniformly.

In fluids (Newtonian and Non) longitudinal mechanics failure results in spirals and vortex. Fluids are non rigid and non-shearing. Therefore, in fluids (homogenous or non; compressible or non) energy conservation is associated with vortex and coils (long path). At impact, the ground material behaves as relative fluid of high friction. They may also be marked by the typical T wave left behind at surface signatures. This throws up the possibility of vortex\crew type sub-surface upwelling being associated with impact craters. The dry and



**Figure 3a:** Effect of compressible fluid's velocity (sustained tangent injection alike earth quake; inverted) on frictionless, boundary less non-compressible fluid, unlimited vol. large core centre; non circular and non longitudinal; non spiral (contrasts with Figure 4).



**Figure 3b:** Enlarged section. Transverse wave predominance; tangent injection energy expends at surface as forth crested waves conserving in equal area grid; frothing is enstrophy; T waves type surface signature as in monotonous-homogenous wet pedology. If an inverted cone is placed in such field it gets surrounded (surround effect; efficient attraction) without any build up at any locus. Here compressible fluid is acting on non compressible fluid. In seismic events non-compressible magma (fluid) acts on relatively compressible crustal matter. In impact craters the injection is a mono event (herein it is a continuous event); moreover, the impacting mass disintegrates assisting dissipation. To our mind the crater rings are creations of longitudinal waves. Further, for T wave generation sustained energy injection (input) posits as a requisite. Furthermore, at surface buildings attract T waves and thus exhibit the Vibrating Table phenomena (correlate with Figure 5).

hard land impact sites have mono-rings. Wet and moist have dual. Vortex is independent and mono structures. Two vortexes do not sheath. They suffer 'Karnam vortex street' effect (alternating spirals and serial). Furthermore, vortex is spirals and also not near perfect circles. And whereas, two cones can sheath and or follow each other unidirectionally (well noted in plasma physics and around high voltage bare conductor transmission insulators). Therefore, uniform conical rebound(s) as discussed under Figure 2 posits as candidate.

Atmospheric column thrust is tangential (1000-1100hPa i.e., fair weather) and because the sea waves which are smooth, long and unidirectional, even in boundary less and frictionless condition. Only due astronomical gravity and surface winds (slanted pull and push) sea waves gain in amplitude and even become hetero-directional (roaring forties-to-screaming sixties). Figure 3a is a case of high tangential forcings inflicted onto the surface of the homogenous liquid at deep sea in atmospheric fair weather (iso) condition.

Figure 3b provides an enlarged cross section. The waves are not smooth, neither longitudinal, though circular, with prominent transverse waves; although the source (copter's rotor) is a perfect circle. Unlike the bullet action of impact crater, herein, in spite of the potential being continuous and circular there are no smooth harmonious waves.



**Figure 4:** Sea bed subduction (bottom injection; sustained), giant tsunami generation, dual waves (viewer's left), vortical structure; spiral bands; anti-clock (Coriolis effect); no transverse; no longitudinal waves; raised core centre (boiling); boundary-less, frictionless, unlimited vol., conditions; Japan 03-2011. Radians as in Figure 3a and 3b are absent in Figures 1 and 4. Not noted in any impact crater.

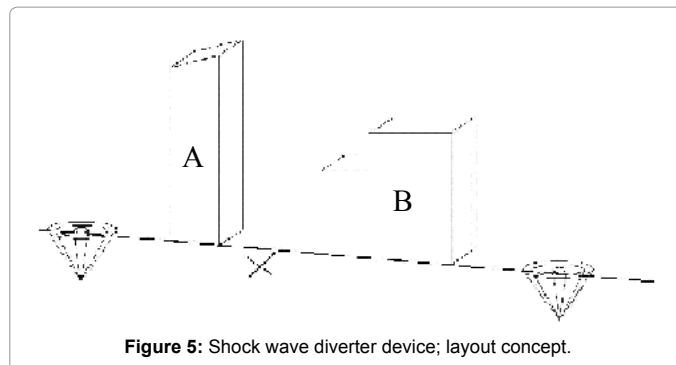
Transverse waves dissipate energy efficiently. Longitudinal waves conserve efficiently. If either be present it then portends a superficial phenomenon (insignificant depth dimension). Impact craters are large depth dimension members. Thus, the conical rebound concept is attracted as a hypothesis.

A casual geographic study indicates that meteorites seem to enter the earthian environment at any location and then swerve towards shores and plateaus – preference for lithosphere. Thus the eastern shore board of India may be more prone than the west (geostrophic rotation effect). It is also prime for dual (Figure 4).

### Shock wave diverter (cone)

The young fold mountains are marked by seismic activity, which is ever present (severe natural hazard). And, the regions extending afar normally have hills of elevations ranging between 1000-3000mts from the MSL. These hills act as vibrating platforms and the shock waves prefer the hills, dales [6] neighbouring valleys, moist/high water table lands in particular [7]. On the other hand, such geomorphologies offer idyllic living conditions and are fast being urbanized. High rise constructions are coming up. More lives are being exposed to the natural hazard.

Herein above we have discussed as to how inverted cone type natural architecture is associated with pile driving shock waves of (near) seismic potential, oriented towards the earth's interior. Seismic waves of the 'T' type have reverse direction of propagation (interior to the supra). We may consider any possible use of such geometric form (Figure 2), and the understandings thereof. Figure 5 is the schematic presentation of one such idea. The angled line represents the inclined ground in the hill-valley earthquake prone region. A and B are two high rise man made tenements. We have placed 6 clusters of inverted cones in a hexagonal plan away from the buildings (which are at mid). These cones are filled with materials that are light (than the soil around); have large cross section; have contrasting liquefaction and burning points; and are porous (trap water and sound). Few choice candidates are charcoal; silica granules; globular resins; mica pellets; fly ash (all long lasting). Each layer being loaded with a mono material of identical



**Figure 5:** Shock wave diverter device; layout concept.

composition. They are separated with layers of polythene sheets (layers being loaded simultaneously, maintaining level).

The jarring shock waves ('T' type) shall prefer these sub-surface inverted cones (move away from the at-surface structures). This is because of preferred material composition, while the slant of the inverted cone would offer more surfaces for shock wave (energy) to play upon and get diverted towards the expanding base of the inverted cone. The shock waves shall experience alteration in these contrasting material layers. The shock waves shall get embroiled, embedded and absorbed variedly from layer to layer, and the potential shall make the material(s) aerodynamic, variably. As a result the whole load will get gouged (fly out) as admixed semi-solid, with intent forthing (ignited resins). Such phenomena would continue for few minutes as preferred pathway. In solids energy prefers shortest path to conservation. Thus, there shall be diversion.

Seismic wave borne energy (T or S) builds up around the foundations (stilts and piles). The near-bouts thence behave alike locations of 'entropy'. This catalyses a cascade resulting in structural disaster. The locations of such (hypothetical) 'shock wave diverting devices' would also act as manmade 'entropy points'. These would additionally because significant cancelation (micro area). Thereby the structure's outers and the appendages shall also be less affected. There shall then be less injury and fatality from 'falling debris'. These devices may also down turn the associated (spine chilling) rumbling noise that is intently psychosomatic (may eventually enable body balance and run). The space between the 2 buildings is marked by an 'X'. This is the unsuitable place for such type of 'shock wave diverting device'.

### Impact caused gem formation?

Impact crater are found in all continents and even in littoral regions. However it is only the Deccan and Africa that are also known for at surface gems. Either are tropical climes. Now, a meteorite is a burning missile having ultra high temperature and speed. When it hits earth surface oxygen in the neighbouring region gets depleted and before the vacuum can be replenished by fresh flow-ins the impact sends surface matter flying into great elevations, entropy is created over very wide domain with pyroglastic conditions. Some of the debris remain within the oxygen less regions. If such matters be very high content minerals they would be hot (none burning), dry and highly energized (reactive). They thence acquire the property of isotope. The envira is thence also highly dense while the energized debris are aerodynamic and hence downward descent gets slow (column floatation phenomena). Quenching is sustained- and -delayed. If such hot, dry, critically energized mineral debris remains suspended in reactive gases viz., Neon, Freon, etc., they may react resulting in chromogenic changes along with crystalization (or vice-versa). Inert gases inflict translucence

i.e., crystals alias diamonds. If the temperature and the fluid thrust be at critical thresholds it results in mono crystals of high refractive index. Thus a raw gem stone and or a diamond is formed which eventually becomes a surface item. The processes may continue and or may terminate on surface touch. The geographical spread of the gem spew may be dependent upon the pyroglastic blast dynamics (plume direction also). Gems can possibly be generated via column flotation in dense compressible fluid media with threshold and critical conditions.

## Discussions

Our considered view is that the imperial Kakatiyas had a penchant for gems also presently noted in all Deccan shrines. The Persian-Arabicphone 'nizam' (bejewelled) too conjures such ethos. It seems the Kakatiyas have had celebrated the anicon of Siva (fact\joy) in a bejewelled form and manner which is a paradigm shift (His choice being aviseka i.e., fluid wash), as alike the Savara pratha (tribal ritual) vis-à-vis Lord Sri Jagannath. Now, gems and granite(s) are hard plastics. Thus, the Kakatiyas seems to have had technical lead in gem gathering (stockpiling), polishing i.e., working on hard plastics. Our view is that the phone 'kakatiya' is a trigonic Sanskrit jargon and denotes (i) 'cleaver + capable' (ii) dark intelligence (iii) kalinga relatives.

Jurassic age was the geological period whence meteorite impacts had also occurred elsewhere around the globe. The pyroglastic blast (following the impact at Warangal) should have obliterated the animals having large airways, if there were any around. Even the atmosphere pollution and its effect may have lasted for long. This could have made the domain (geographical scale) sterile for re-germination of giant predators (geological scale period). All these in turn along with the dual rings (natural fortification) and a perennial water spot posited as most, best, safe, self sustaining, preferred habitat, by and by. Save and except the impact, the crater and the dual rings, nothing happened overnight. Hence, evolution and historical process looms large. Therefore, related type of surveys in such directions are warranted apart gravity and magnetic anomalies [8]. This study is nascent.

## Concluding

Not all natural disasters (viz., micro twisters/land tornados) redefine geography\orography. Meteorite impacts (irrespective of size) are natural disasters. However, it is only the large meteors that have the potential to redefine geography. The Warangal fort site represents a case of geography being made and well defined by such natural disaster (large impact). It posits as a (meteorite impact site) having complex structure, that was adopted by the primitive man (continuing till date) as choice site for settlement. The rings acting as natural fortification, this is possibly the sole impact structure that is also associated with a deep and rich human-cultural heritage. Thus, is also a case of geography and history being shaped by natural disaster.

The at-surface mono or dual rings of the impact craters are not mere/simple surface waves stilled due depletion of the impact potential. The rings and the sub-surface conical forms are 'natural response architecture' is our hypothesis No.1. Ring type or conical rebound is our hypothesis No.2. The supporting hypothesis are as follows:- (i) may have some nexus with magma upwelling or gravity sink regions (ii)

complex wave flow patterns (surface and sub-surface) are associated with large meteorite impact (iii) material behavior alters when injected with seismic quanta of energy (iv) preference for shores and plateaus (v) the Warangal site is now part of the land locked central India peninsula of Gondwana. This was not the case at event moment (vi) modern structural engineering thus far is known not to have taken into account the possible benefits of the inverted cones in diverting and down-regulating seismic shocks (vii) shock wave diverting devices are necessary in Smart City Schemes. Our understanding is nascent. This is an exploratory work. It is necessary to go beyond such hypothesis. Long period-large scale investments are involved. Therefore, multi-lateral and multi-disciplinary initiatives are warranted.

## Acknowledgements

Thanks to the engineers of M/s Rhythm Architect, BBSR for making the CAD based drawings. Mr. Anilshwar, Mr. I Raghu, and Mr. K Useniah civil engineering scholars of NIT Warangal had participated in field visits and at site photography. Prof. D. Venkat Reddy, Geology, NIT Suratkal for yeoman inspiration. Department of Civil engineering, NIT-Warangal had assisted with valuable logistics. Students of IIT-H for hearing and participating 'long period talk' on such hypothesis. But for such valuable help this work would not have been possible now.

## References

1. Fudali RF, Milton DJ, Fredriksson K, Dube A (1980) Morphology of Lonar Crater, India: Comparisons and implications, *The Moon and the Planets* 23: 493-515.
2. Deepak B (2015) Two Impact Crater Type Geomorphologies: India. *International Journal of Earth Sciences and Engineering* 8: 234-235.
3. Cousens H (1900) Lists Of Antiquarian Remains In His Highness The Nizam's Territories. Volume 31 of Archaeological Survey of India [Reports], office of the Superintendent of Government Printing, Calcutta.
4. Yajnik, Birad R (2013) Kakatiya Dynasty: The Golden Age of Telugu Civilisation, Srinivasa C Raju.
5. NSDI-National Spatial Data Infrastructure, web map service, AP, Hydrographic, Survey of India, Scale 1:56200, <https://nsdiindia.gov.in/nsdi-portal/index.jsp> on screen GPS (approx).
6. Bhattacharya D (2014) Geography; Geomorphology and Geology as coupled factors in Shillong and Sikkim Plateau hydrological cycles. *International Journal of Earth Sciences and Engineering* 7: 1686-1688.
7. Bhattacharya D, Five Resent Asian Earthquakes – Data Set, Research Gate.
8. Rajasekhar RP, Mishra DC (2005) Analysis of gravity and magnetic anomalies over Lonar lake, India: An impact crater in a basalt province, *Research Communications. Current Science* 88: 1836-1840.