

AGAINST THE GRAIN: REDEFINING THE LIVING UNIT – Advanced slotting strategies for multi-storey timber buildings

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ABSTRACT: Using Charles and Ray Eames's famous 1950s House of Cards slotting toy as both design metaphor and structural precedent provides the starting point for a novel building logic (utilising three existing Swedish timber systems) that allows volumetrically slotted units to stack inside of and support each other. Contemporary computer-aided fabrication techniques based on evolutionary algorithms and CNC manufacturing strategies are used to produce a methodology for designing a kit-of-parts system at the scale of the skyscraper, based on the slotting together of cross-laminated timber (CLT) panels. A catalogue of novel slotting methods is produced, and a number of alternative slotted joint treatments identified that hold promising potential for further development, parametrically design and control volumes, understand the fabrication workflow and constructional sequence on site, and build prototypes of the chosen slotting configurations at scales ranging between 1:50 and 1:1.

KEYWORDS: Wood architecture, multi-storey timber buildings, slotting, living units, cnc, evolutionary solvers, evolutionary algorithms, prototype, Charles and Ray Eames, House of Cards, porosity, volumetric slotting, retrofitting, gas holder, Moelven, Trä8, Martinsons, Byggma Masonite

1 INTRODUCTION

This project is about slotting two-dimensional massive timber panels into three-dimensional volumes, then slotting those volumes into each other, a formal move that creates countless opportunities for alternative and compelling layouts of living units, based on organisational principles that are directly derived from the internal logic of the system of slotted timber panels. We are also interested in finding ways of broadening this concept of slotting to internalise within the scheme other congruent ideas at different scales: not just the slotting together of the laminate boards that make up the CLT panels, or the slotted joints prevalent within traditional timber construction, but the slotting of entire programmatic functions: a kitchen slotting into a bathroom, a terrace slotting into a bedroom, and so on.

2 SCALAR SLOTTING

This novel architectural concept of slotting two- and three-dimensional elements together at varying scales is used to investigate the slotting of an entire building into an existing site, the slotting of living units into the building's structural framework and grid, as well as the slotting of panels to construct those units. Merging conceptual ideas with practical knowledge of different types of slotted joints (that is, how they work and fit inside each other), a highly consistent project is created, whereby the different notions of slotting feed back into and reinforce each other.

Projecting from large to small, beginning at the scale of the building, our first slot is the entire building slotting into another site and structure. At the scale of the living units, our second move is to slot these volumetrically into and around each other. At the scale of the single unit, our third

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move is to slot panels together in a two-dimensional fashion. The bespoke wall panels of each unit are prefabricated on site, and then slotted together before being craned into place and volumetrically slotted together as described above.

3 SITE AND EXISTING BUILDING

Ever since the Victorian era, gasholders – occasionally referred to as gasometers – have cast their iconic long shadows across the pavements of almost every British town. This project was born out of a fascination with a particular gasholder site, located just five minutes from our east London studio. The Bethnal Green gasholders are an industrial feature, intact and unlisted, surviving from the late-19th century and through the Blitz. The decommissioned site is a forgotten space within the city. Owned by the National Grid, no gas is now stored on site. Through the retrofitting scheme we propose here, it could deliver new public and open space, as well as an enhanced public realm and activated waterspace, while connecting two significant networks: the Regent's Canal waterway and the Cambridge Heath Road main high street. It would breathe new life into an abandoned space. Furthermore, the significance of the canal site as a public amenity could be secured: ecologically important to the borough, it is already recognised as a Site of Metropolitan Importance for Nature Conservation.¹ The gasholders are large structures with a sizeable boundary that makes them open and flexible. Their cylindrical skeletons of columns and girders enable us to work with a guide frame and a point of reference for structural and formal design features.

4 HODOLOGICAL INTERNAL ORGANISATION

Big buildings are boring. That is to say, many tall buildings tend to be tedious – the obvious importance of optimal structural design comes at the price of variation and diversification. The end result is more often than not a vast expanse of repetition at a vast expense of difference. Planimetrically constrained organisations (monotonous series of unvarying spaces unimaginatively positioned one after another inside a perfectly symmetrical grid) makes for mind-numbingly characterless floor layouts and dulled architectural experiences.

The traditional aim of the designer to use the same structural frame for all functions was sustained by what we believe is a valid principle of economy. The unimaginative aspect only enters the picture when this grid is utilised in an oversimplified fashion, often in two dimensions, rather than as the open-ended indicative lattice it could be. The strategy we have here adopted adds variety within a structurally uncompromised, repetitious (radial) grid: our hodological spaces² are created as the result of a series of pathways through different spatial units within this three-dimensional framework; pathways that are in turn the

results of productive compromises between conflicting objectives.

Rather than merely being a formal exercise, due to the conflict/compromise relationship underpinning the parameters fed to the evolutionary solver, the resulting spaces can be tuned to provide certain programmatic relationships and functional features – providing views, multiple egress routes, and access to outdoor space from all living units, for example, while creating dynamic interior spatial relationships, allowing daylight to enter even the smallest of apartments, and so on. The process also makes it possible to adjust the ratio and relative floor area of smaller to larger living units (which in the current example has been set to be between 50 and 400m²).

5 ARCHITECTURAL ANALYSIS

Our building is a mixed-use scheme combining residential housing and commercial units. It offers a new hybrid and retrofitted typology organised around a central core courtyard. Conceived conceptually as a slotted building, it presents itself as an open, permeable and re-invigorated addition to the local east London regeneration process. This is a building that is utterly site-specific: its strategic location connecting two main urban arteries, the watercourse, Regents Canal, and high street, Cambridge Heath Road, demands the built form to reflect and communicate its industrial past, sustainable future, radical form, mix of old and new materials, and commanding silhouette – complementing those of Hawksmoor, Wren, Foster, Rogers, and Piano in the city's skyline.

The slotted building traces the gasholder's cylindrical skeleton without touching it (the two are in fact set apart by 500mm. The contrast between the harsh existing steel structure and the soft new timber frame addition celebrates their material and phenomenological differences. The existing gasholder's proportions and apertures provide an important framing device for the inserted tower (within a single band of horizontal members we have slotted three storeys of new structure). This logic is carried throughout the building, although extending for an additional six storeys above the gasholder's current height.

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